Norsk institutt for luftforskning
Norwegian Institute for Air Research

Norwegian Institute for Nature Research

Norwegian Institute for Water Research

Environmental pollutants in the terrestrial and urban environment 2021

Revised report

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ABSTRACT

Samples from the urban terrestrial environment in the Oslo area were analysed for metals and a large number of organic environmental pollutants. The selected samples that were analysed were soil, earthworm, fieldfare egg and liver, brown rat liver, roe deer liver, vegetation, insects and red fox liver. Biomagnification-potential was estimated based on detected data for relevant predator-prey pairs.

NORWEGIAN TITLE

Miljøgifter i terrestrisk og bynært miljø 2021

KEYWORDS

Urban terrestrial monitoring | POPs, PFAS, metals | Bioaccumulation

ABSTRACT (in Norwegian)

Prøver fra det urbane terrestriske miljøet i Oslo-området ble analysert for metaller og et stort antall av kjente og nye organiske miljøgifter. De utvalgte prøvene som ble analysert var jord, meitemark, egg og lever fra gråtrost, lever fra brunrotte, lever fra rådyr, vegetasjon, insekter og lever fra rødrev. Biomagnifiseringspotensial ble estimert basert på detekterbare data for relevante rov og byttedyr par.

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Contents

Summary

On behalf of the Norwegian Environment Agency, NILU- Norwegian Institute for Air Research, in collaboration with the Norwegian Institute for Nature Research (NINA) and the Norwegian Institute for Water Research (NIVA), analysed air, soil and biological samples from the terrestrial and urban environment for various inorganic and organic environmental pollutants.

In the third period (2021-2025) of the urban terrestrial monitoring programme, several new species, new pollutants in some of the contaminant classes, and new contaminant groups were included. In 2021, the new species included were roe deer liver, vegetation (rowan tree leaves), bees, spiders and Spanish slugs. Liver-samples were analysed in addition to egg-samples of fieldfare. New pollutant class was phthalates in soil.

Key goals of the programme:

- Report concentrations of selected environmental pollutants at different trophic levels of a terrestrial food web in an urban area.
- Estimate bioaccumulation and biomagnification potential of the different pollutants in food chains.
- Contribute with information about potential sources to pollutants for terrestrial organisms.

A broad range of environmental pollutants, consisting of metals, polychlorinated biphenyls (PCB), brominated flame retardants (BFR), organic phenolic pollutants, ultraviolet (UV) stabilizing substances, per- and polyfluorinated alkylated substances (PFAS), siloxanes, chlorinated paraffins (CP), organic phosphorous flame retardants (OPFR) and dechloranes were measured in the following samples:

- one pooled sample of soil
- one pooled sample of earthworm
- one pooled sample of fieldfare egg
- one pooled sample of brown rat liver
- three pooled samples of fieldfare liver
- three individual samples of roe deer liver
- three pooled samples of vegetation (leaves from rowan tree)
- three pooled samples of honey bee
- three pooled samples of bumble bee
- three pooled samples of spiders
- one pooled sample of Spanish slugs

In addition, biocides were analysed in liver from red fox and brown rat, and phthalates were analysed in soil.

In general, measured concentrations of metals and PCBs were in agreement with results from the previous program periods. Lead (Pb) and cadmium (Cd) and many other metals were highest in soil living organisms such as earthworm and Spanish slug, followed by bees. The new metals included in 2021, gadolinium (Gd), antimony (Sb) and tin (Sn), had highest concentrations in soil and rowan followed by Spanish slug and earthworm. The PCBs and the dominating congener PCB-153, had highest concentrations in the pooled fieldfare egg-sample followed by fieldfare liver and brown rat liver. The other samples had relatively low concentrations of PCBs and below the level of detection (LOD).

Some of the detected concentrations indicate risk for secondary poisoning. Cd- and Pb-concentrations in earthworms exceeded the PNECoral value for predators of earthworms. The pooled sample of brown rat liver exceeded the PNECoral value for arsenic (As) for predators.

Brominated flame retardants (BFRs) were hardly detected in the various matrices. The highest concentration was detected for α-HBCD in the pooled brown rat liver-sample of 1.4 ng/g ww.

For PFAS, PFOS was, as expected, the dominating compound in some samples. However, the ultra-short-chain perfluoroalkyl acid, trifluoro acetic acid (TFA), dominated in rowan, roe deer liver, bees and Spanish slug. The highest concentration of TFA in rowan was 278 ng/g ww. The highest concentration of PFOS of 120 ng/g ww was detected in the pooled fieldfare egg sample, which exceeded the PNECoral of 37 ng/g ww for secondary poisoning of predators. PFOA in fieldfare egg slightly exceeded QSbiota of 0.9 ng/g for secondary poisoning of predators. In the new species, rowan, insects and Spanish slug, PFOS and other sulfonates were below LOD with some exceptions. PFCA-compounds were detected in more samples than PFSA. The highest concentrations of the carboxylates, excluding TFA that dominated in some samples, were detected for PFDoDA and PFTeDA of 15 and 12 ng/g ww, respectively, in fieldfare egg. Of neutral and new PFAS-compounds, only FTS was detected; 10:2 FTS had highest concentration (3.65 ng/g ww found in fieldfare egg).

Chlorinated paraffins (CP) were detected in some of the samples. A very high concentration of medium chain CPs (MCCPs) was detected in brown rat liver (1013 ng/g ww). The second highest MCCP-concentration was detected in Spanish slug (97.7 ng/g ww). CPs were not detected in soil, bees and spider. In short chain CPs (SCCPs), the isomer classes 10,6 and 11,6 were the dominating classes in many of the samples, except the rat liver and Spanish slug. In MCCP, the isomer classes 14,6, 14,7 and 14,8 dominated in most samples, except in rat liver and Spanish slug.

Cyclic siloxanes were mainly detected in liver samples of brown rat, fieldfare, roe deer and spider. The highest concentrations were detected of D5 (53 ng/g ww), D4 (9.3 ng/g ww) and D6 (7.8 ng/g ww) in rat liver. D4 was the dominating compound in liver of fieldfare and roe deer and spider.

Organophosphorus flame retardant (OPFR) were detected in some samples with highest detection rate in rowan, bees and slug. Highest concentration was detected for TCPP in honey and bumble bee of 21 and 11 ng/g ww, respectively.

Among the UV-compounds, homosalate was detected in the highest number of samples, and the highest concentrations were measured in the three rowan leave samples, 55-125 ng/g ww. In bees and Spanish slug, only homosalate and octocrylene (OC) were detected. UV-327 and UV-328 were detected in soil, fieldfare, brown rat and rowan.

Dechloranes were only detectable in soil, fieldfare egg and liver, and brown rat liver. Anti-DP dominated with 2.42 ng/g ww in brown rat liver.

For phenols and bisphenols, many compounds were not detectable. 4,4 Bis-A was the compound found in highest number of samples, followed by 4,4, Bis-F and 2,4 Bis-F. The highest concentrations were detected of 4,4 Bis-A in fieldfare egg (71 ng/g ww) and earthworm (41 ng/g ww).

Biocides were analysed in five red fox liver samples and one pooled liver sample of brown rat. As expected from previous results in the programme, bromadiolone dominated in red fox liver samples. One red fox liver sample (268 ng/g) exceeded the assumed threshold for liver poisoning in field foxes of 0.2 mg/kg. In brown rat liver, permethrin dominated with 144 ng/g ww.

Phthalates were only analysed in the one pooled soil sample across three locations. DEHP was the dominating compound with 40.6 ng/g dw followed by DnBP (13.9 ng/g dw) and DPHP+DiDP of 6.5 ng/g dw, all below PNECsoil values.

Calculated biota-soil accumulation factor (BSAF or BAF) and biomagnification factor (BMF) confirmed earlier findings and indicated that several PCBs and PFAS compounds bioaccumulate and biomagnify with BSAF and BMF>1.

Revision December 2022, updated with results of the component class phenols and bisphenols.

Sammendrag

På oppdrag fra Miljødirektoratet, analyserte NILU - Norsk institutt for luftforskning, i samarbeid med Norsk institutt for naturforskning (NINA) og Norsk institutt for vannforskning (NIVA), en lang rekke uorganiske og organiske miljøgifter i luft, jord og dyrearter fra bynært og terrestrisk miljø.

Prosjektet har følgende prioriterte mål:

- Rapportere konsentrasjon av utvalgte miljøgifter i flere nivåer i næringskjeder på land
- Estimere opptak og grad av opphoping av miljøgifter i utvalgte næringskjeder
- Bidra til å skaffe informasjon om kilder til eksponering i landlevende dyr for ulike typer miljøgifter

Et stort antall miljøgifter som metaller, polyklorterte bifenyler (PCB), bromerte flammehemmere, UV stabiliserende stoffer, per- og polyfluorerte stoffer (PFAS), siloksaner, klorerte parafiner (CP), organiske fosforflammehemmere (OPFR) og dekloraner ble analysert i følgende prøver:

- en samleprøve av jord
- en samleprøve av meitemark
- en samleprøve av gråtrostegg
- en samleprøve av lever fra brunrotte
- tre samleprøver av gråtrostlever
- tre individuelle prøver av rådyrlever
- tre samleprøver av vegetasjon (blad fra rogn)
- tre samleprøver av honningbie
- tre samleprøver av humle
- tre samleprøver av edderkopp
- en samleprøve av brunskogsnegle

I tillegg ble biocider analysert i fem leverprøver fra rødrev og en samleprøve av rottelever, og ftalater ble analysert i den ene jordprøven.

Nivåene av metaller og PCB var generelt i samsvar med tidligere resultater i de to foregående programperiodene. Konsentrasjonene av bly (Pb) og kadmium (Cd) og mange andre metaller var høyest i jordlevende organismer som meitemark og brunskogsnegl, etterfulgt av bier. De nye metallene som ble inkludert i programmet i 2021, gadolinium (Gd), antimon (Sb) og tinn (Sn), hadde høyeste konsentrasjoner i jord og rogn etterfulgt av brunskogsnegl og meitemark. De høyeste konsentrasjonene av PCB-ene og den dominerende kongeneren PCB-153, ble funnet i den ene sammenslåtte eggprøven etterfulgt av gråtrostlever og brunrottelever. De andre prøvene hadde relativt lave konsentrasjoner av PCB i tillegg til konsentrasjoner under deteksjonsgrensen (LOD).

Noen konsentrasjoner indikerte risiko for sekundær forgiftning. Cd- og Pb-konsentrasjonene i meitemark oversteg PNECoral-verdien for predatorer av meitemark som byttedyr. Den ene sammenslåtte prøven av brunrottelever overskred PNECoral-verdien for arsen (As) for rovdyr.

Bromerte flammehemmere (BFR) ble knapt påvist i de ulike prøvene. Høyeste konsentrasjon ble påvist for α-HBCD i den ene sammenslåtte leverprøven av brunrotte på 1.4 ng/g vv.

For PFAS var PFOS som forventet den dominerende forbindelsen i flere prøver, men den ultrakortkjedete perfluoralkylsyren, trifluoreddiksyre (TFA), dominerte i rogn, rådyrlever, bier og

brunskogssnegl. Den høyeste konsentrasjon av TFA i rogneblad var 272 ng/g vv. Høyeste konsentrasjon av PFOS ble påvist i det samleprøven av gråtrostegg på 120 ng/g vv, som oversteg PNECoral på 37 ng/g vv for sekundær forgiftning av rovdyr. PFOA i gråtrost overskred så vidt QSbiota på 0.9 ng/g vv for sekundær forgiftning av rovdyr. I de nye artene som rogneblad, insekter og brunskosnegl, var PFOS og andre sulfonater for det de fleste prøvene under LOD. PFCA-forbindelser ble påvist i flere prøver enn PFSA. Høyeste konsentrasjoner av karboksylatene ble påvist for PFDoDA og PFTeDA på 15 og 12 ng/g vv, henholdsvis, i gråtrostegg. Av nøytrale og nye PFAS-forbindelser ble bare FTS påvist; og 10:2FTS hadde høyeste konsentrasjon (3.65 ng/g vv, detektert i gråtrostegg).

Klorparafiner, CP, ble påvist i noen av prøvene. En svært høy konsentrasjon av mellomkjedete klorparafiner (MCCPs) ble påvist i rottelever (1013 ng/g vv). Den nest høyeste MCCP konsentrasjonen ble påvist i brunskogsnegl (97.7 ng/g vv). CP ble ikke påvist i jord, bier og edderkopper. For kortkjedete klorparafiner (SCCPs) var isomerklassene 10,6 og 11,6 de dominerende klassene i mange av prøvene, bortsett fra rottelever og brunskogsnegl. For MCCP-ene dominerte isomerklassene 14,6, 14,7 og 14,8 i mange prøver, bortsett fra rotte og brunskogsnegl.

Sykliske siloksaner ble først og fremst påvist i rottelever, gråtrostlever og rådyrlever samt edderkopp. Høyeste konsentrasjoner ble detektert av D5 (53 ng/g vv), D4 (9.3 ng/g vv) og D4 (7.8 ng/g vv) i i rottelever. D4 var dominerende komponent i lever fra gråtrost og rådyr, og i edderkopp.

Organofosfor flammehemmere (OPFR) ble påvist i noen prøver med flest detekterte i rogn, bier og brunskogsnegl. Høyeste konsentrasjon ble påvist for TCPP i honningbie og humle på henholdsvis 21 og 11 ng/g vv.

Blant UV-forbindelsene ble homosalate detektert i flest prøver, og høyeste konsentrasjoner ble målt i de tre prøvene av rogneblad, 55-125 ng/g vv. I honningbier, humler og brunsnegle ble kun homosalate og octocrylene detektert. UV-327 og UV-328 ble detektert i jord, gråtrost, brunrotte og rogneblad

Dekloraner kunne kun påvises i jord, egg og lever fra gråtrost og rottelever. Anti-DP dominerte med 2.42 ng/g vv i rottelever.

For fenoler og bisfenoler var mange forbindelser under deteksjonsgrensen. 4,4 Bis-A ble funnet i høyest antall prøver, etterfulgt av 4,4, Bis-F og 2,4 Bis-F. De høyeste konsentrasjonene ble detektert for 4,4 Bis-A i gråtrostegg (71 ng/g ww) og meitemark (41 ng/g ww).

Biocider ble analysert i fem leverprøver av rødrev og en samleprøve av rottelever. Som forventet fra tidligere resultater i programmet, dominerte bromadiolon i leverprøver av rødrev. Én rødrevleverprøve (268 ng/g vv) overskred nivåene for antatt forgiftning i rødrev med feltbasert terskelverdi på 0.2 mg/kg. I rottelever dominerte permetrin med 144 ng/g vv.

Ftalater ble kun analysert i den ene samleprøven av jord fra tre lokaliteter. DEHP var den dominerende forbindelsen med 40.6 ng/g tv etterfulgt av DnBP (13.9 ng/g tv) og DPHP+DiDP på 6.5 ng/g tv, alt under PNECjord for jordlevende organismer.

Biota-soil akkumuleringsfaktor (BSAF eller BAF) og biomagnifisering faktor (BMF) beregninger bekreftet tidligere funn og indikerer at flere PCB-er og PFAS-forbindelser bioakkumulerer og biomagnifiserer med BSAF og BMF>1.

Revidert desember 2022, oppdatert med resultater av komponentgruppen fenoler og bisfenoler.

Abbreviations

BAF	bioaccumulation factor
BFR	brominated flame retardants
BMF	biomagnification factor
BSAF	biota soil accumulation factor
CI	confidence interval
CP	chlorinated paraffins
cVMS	cyclic volatile methyl siloxanes
dw	dry weight
EI	electron impact ionization
ESI	electrospray ionization
fv	Fettvekt
GC-MS	gas chromatography – mass spectrometry
GC-HRMS	gas chromatography – high resolution mass spectrometry
GPC	gel permeation chromatography
ICP MS	inductive coupled plasma – mass spectrometry
LC-MS	liquid chromatography – mass spectrometry
LOD	limit of detection
LOEL	lowest observed effect level
MEC	measured environmental concentration
lw	lipid weight
MCCPs	medium-chain chlorinated paraffins
M-W U	Mann–Whitney *U* test
N	detected/measured samples
n.a.	not analysed
NCI	negative chemical ionization
NOEC	no observed effect concentration
NOAEL	no observed adverse effect level
NOEL	no observed effect level
n-PFAS	neutral polyfluorinated compounds
newPFAS	new polyfluorinated compounds
NP-detector	nitrogen-phosphorous detector
OPFR	organophosphorus compounds
PBDE	polybrominated diphenylethers
PCA	principal component analysis
PCB	polychlorinated biphenyls
PCI	positive chemical ionization
PEC	predicted environmental concentration
PFAS	per- and polyfluorinated alkylated substances
PNEC	predicted no effect concentration
PSA	primary/secondary amine phase
SCCPs	short-chain chlorinated paraffins
SSD	species sensitivity distribution
SIR	selective ion reaction
SPE	solid phase extraction
TL	trophic level
TMF	trophic magnification factor
UHPLC	ultra high pressure liquid chromatography
vv	Våtvekt
ww	wet weight

1 Background

Terrestrial ecosystem covers food chains of organisms that live and grow on land. The main objective of this monitoring programme "MILBY" is to assess the presence and bioaccumulation potential of certain environmental pollutants in a terrestrial urban ecosystem. The monitoring is conducted in Oslo, the capital of Norway and Norway's largest city. The programme is led by NILU- Norwegian Institute for Air Research, The Norwegian Institute for Nature Research (NINA), The Norwegian Institute for Water Research (NIVA) and IFE, Institute for Energy Technology. Together with the monitoring programme "Environmental pollutants in an urban fjord" which monitors environmental pollutants in the inner Oslofjord, MILBY seeks to assess the presence and environmental uptake of environmental pollutants from sources in an urban environment.

The sampling in 2021 includes several new species and fewer samples per species compared to the previous two program periods from the years 2013-2015 to 2015-2020. New samples and species in year 2021 were vegetation (rowan), insects, Spanish slug, liver from roe deer and fieldfare chicks. In addition, new contaminants were added to several of the contaminant groups.

A description of the various species, pollutants, and how the samples were handled and prepared, is provided in the Material and Methods, Appendix 1, as is the chemical analysis and the quality assurance measures taken.

Due to the different physicochemical properties of the pollutants of interest, several different sample preparations methods were applied. Lipophilic compounds such as PCB, BFR and CP were analysed together. PFAS, metals, phenols, siloxanes, UV compounds, phthalates and biocides required each a dedicated sample preparation. Briefly, samples were homogenized and extracted with appropriate solvent. After extraction solvents were aliquoted out and reduced, followed by a clean-up procedure to remove lipids and other interferences prior to analysis.

GPS coordinates of the samples are given in Appendix 2. Concentrations of pollutants and isotope values in the samples are given in Appendix 3.

2 Plan for sampling and analysis in 2021

An overview over the analysed species and samples is given in Table 1, and locations are given in Figure 1 and Table 2. All samples were sampled and handled according to the guidelines given in CEMP (OSPAR)[1]. The samples and procedures collected for year 2021 are described in Appendix 1. Analytical endpoint in the various samples is shown in Table 3.

The sampling sites at Alna and Alnabru are located in an area with industrial activity and is close to one of Oslo's main highways, and the sampling site in Svartdalsparken is at a former landfill which has been converted and restored to a recreational area. Grønmo is a former landfill site in Oslo (the largest in the city) which was shut down in 2007. The area around Grønmo is now regulated for sports- and recreational activities. The area also contains a reuse and recycling station for waste. Steinbruvannet is located in a recreational and forest area in the northern part of Oslo called Nordmarka. The other locations reflect where one was able to find nests and the species, and locations for where animals were taken/shot by others (such as roe deer and red fox).

[1] https://www.ospar.org/work-areas/cross-cutting-issues/cemp

2.1 Sampling plan in 2021

Table 1: Type of samples, sampling strategy showing whether and how samples where pooled before analysis, number of samples analysed and locations, (Coordinates can be found in the Appendix 2). Locations corresponds to locations shown in Fig. 1. Bærum X and Oslo X refer to unknown sample location in Bærum and Oslo, respectively.

Sample type	Sampling strategy	No. of samples	Locations	Year
Soil	Pool of 3 soil samples from 3 locations	1	Alnabru, Steinbruvannet, Svartdalsparken	2021
Earthworms *Lumbricidae*	Pool of samples from 3 locations consisting of 20 individuals	1	Alnabru, Steinbruvannet, Svartdalsparken	2021
Fieldfare *Turdus pilaris*	Pool of 2 eggs from 3 nests/locations	1	Alnabru, Steinbruvannet, Grønmo	2021
Brown rat liver *Rattus norvegicus*	Pool of 2 individual livers, same gender	1	Romerike recycling, Lillestrøm (ROAF)	2021
Fieldfare chick *Turdus pilaris*	Pool of 2 individual livers from the same nest	3	Alna, Ekeberg, Svartdalsparken	2021
Roe deer *Capreolus capreolus*	Individual liver samples	3	Bærums Verk, Nesoddtangen, Oslo X	2021
Rowan *Sorbus aucuparia*	Pooled samples from each location	3	Alna, Ekeberg, Jar	2021
Honey bee *Apis mellifera*	Pooled samples from each location	3	Nøklevann, Bygdøy, Maridalen	2021
Bumble bee *Bombus ssp*	Pooled samples from each location	3	Nøklevann, Bygdøy, Maridalen	2021
Spider *Pisauridae; Dolomedes fimbriatus / Pisaura mirabilis, Lycosidae; Pardosa*	Pooled samples from each location	3	Nøklevann, Bygdøy, Maridalen	2021
Spanish slug *Arion vulgaris*	One pooled sample from one location	1	Nordstrand	2021
Red fox *Vulpes vulpes*	Individual liver samples	5	Hellerudmyra, Bærum X, Oslo X	2021

Figure 1: Locations of samples collected and analysed in 2021. See below for corresponding table of sample types and locations, and Appendix 2 for coordinates of the sites. Fieldfare and fieldfare liver refer to eggs and chicks respectively. One fieldfare (egg) symbol is hidden behind multiple symbols at Svartdalsparken. Note that more samples were collected but not analysed in 2021, and these are not shown here.

Table 2: Locations of all samples collected and analysed in 2021. Locations are shown in the map in Figure 1.

Municipality	Sampling-sites	Soil	Earth-worm	Brown Rat	FF* Egg	FF* Liver	Roe deer	Rowan	Honey bee	Bumble bee	Spider	Spanish slug	Red fox
Oslo	**Alnabru/Alna**	X	X		X	X		X					
Oslo	**Ekeberg**					X		X					
Oslo	**Svartdalsparken**	X	X		X	X							
Oslo	**Steinbruvannet**	X	X										
Bærum	**Hellerudmyra**												X
Oslo	**Grønmo**				x								
Oslo	**Bygdøy**								X	X	X		
Oslo	**Maridalen**								X	X	X		
Oslo	**Nøklevann**								X	X	X		
Oslo	**Nordstrand**											X	
Nesodden	**Nesoddtangen**						X						
Bærum	**Jar**							X					
Bærum	**Bærums Verk**						X						
Lillestrøm	**ROAF**			X									
Oslo	**Oslo X[1]**						X						X
Bærum	**Bærum X[1]**												X

*FF: fieldfare

1) Bærum X and Oslo X refer to unknown sample location in Bærum and Oslo, respectively.

2.2 Pollutants and other analytical endpoints in 2021 matrices

The various contaminant classes and other analytical endpoints are given in Table 3. Phthalates were only analysed in the one pooled soil sample. Metals, UV compounds and Phenols were not analysed in spiders due to lack of material. Biocides were only analysed in red fox liver samples. Lipid content was not analysed in vegetation, bees, spiders and red fox livers. The detection rates of the analytical endpoints are given in

Table 3: Type of matrices and analytical endpoints in 2021

Type of sample	Contaminant classes analysed in the samples
Soil	Metals, PCB, PFCA, PFSA, nPFAS, new PFAS, Other BFR, Dechloranes, Siloxanes, CP, OPFR, UV-compounds, Phenols, Phthalates, stable isotopes $\delta^{15}N$ and $\delta^{13}C$, TOC and pH
Earthworm	Metals, PCB, PFCA, PFSA, nPFAS, new PFAS, Other BFR, Dechloranes, Siloxanes, CP, OPFR, UV-compounds, Phenols, stable isotopes $\delta^{15}N$ and $\delta^{13}C$, lipid content
Brown rat liver	Metals, PCB, PFCA, PFSA, nPFAS, new PFAS, Other BFR, Dechloranes, Siloxanes, CP, OPFR, UV-compounds, Phenols, Biocides, stable isotopes $\delta^{15}N$ and $\delta^{13}C$, lipid content
Fieldfare egg	Metals, PCB, PFCA, PFSA, nPFAS, new PFAS, Other BFR, Dechloranes, Siloxanes, CP, OPFR, UV-compounds, Phenols, stable isotopes $\delta^{15}N$ and $\delta^{13}C$, lipid content
Fieldfare chick liver	Metals, PCB, PFCA, PFSA, nPFAS, new PFAS, Other BFR, Dechloranes, Siloxanes, CP, OPFR, UV-compounds, Phenols, stable isotopes $\delta^{15}N$ and $\delta^{13}C$, lipid content
Roe deer liver	Metals, PCB, PFCA, PFSA, nPFAS, new PFAS, Other BFR, Dechloranes, Siloxanes, CP, OPFR, UV-compounds, Phenols, stable isotopes $\delta^{15}N$ and $\delta^{13}C$, lipid content
Rowan	Metals, PCB, PFCA, PFSA, nPFAS, new PFAS, Other BFR, Dechloranes, Siloxanes, CP, OPFR, UV-compounds, Phenols, stable isotopes $\delta^{15}N$ and $\delta^{13}C$
Honey bee	Metals, PCB, PFCA, PFSA, nPFAS, new PFAS, Other BFR, Dechloranes, Siloxanes, CP, OPFR, UV-compounds, Phenols, stable isotopes $\delta^{15}N$ and $\delta^{13}C$
Bumble bee	Metals, PCB, PFCA, PFSA, nPFAS, new PFAS, Other BFR, Dechloranes, Siloxanes, CP, OPFR, UV-compounds, Phenols, stable isotopes $\delta^{15}N$ and $\delta^{13}C$
Spider	PCB, PFCA, PFSA, nPFAS, new PFAS, Other BFR, Dechloranes, Siloxanes, CP, OPFR, stable isotopes $\delta^{15}N$ and $\delta^{13}C$
Spanish slug	Metals, PCB, PFCA, PFSA, nPFAS, new PFAS, Other BFR, Dechloranes, Siloxanes, CP, OPFR, UV-compounds, Phenols, stable isotopes $\delta^{15}N$ and $\delta^{13}C$, lipid content
Red fox liver	Biocides

2.3 Key findings

A list of the selected environmental pollutants with abbreviations and CAS no. can be found in Appendix 1, Table 25. In addition, Appendix 1 gives background information on sampling strategies, compound classes, analytical and statistical methods. Concentrations and isotope data for the single samples are available in Appendix 3.

In total, 129 selected environmental pollutants were analysed. In addition, other important parameters were analysed such as isotopes $\delta^{13}C$ and $\delta^{15}N$, lipid content in biological samples, dry matter in soil and rowan leaves, pH and TOC in soil.

In the chapters below, tables with median, minimum and maximum concentrations are given for each component where number of samples equals three. For soil, earthworm, brown rat and fieldfare egg, only one concentration is available for the one pooled sample.

Table 4 shows the percentage detection of the components in the different sample types. For environmental pollutants not analysed in the samples, these are denoted n.a. in the table. As can be seen, metals were detected in almost all samples which is also the case with PCB, and many of the perfluorinated sulfonates (PFSA) and carboxylates (PFCA). Biocides were only analysed in livers from red fox and rat, and phthalates were only analysed in soil.

Table 4: Percentage detection of components in various sample types. n.a.: not analysed. White cell without text is zero detection. The colour scale is from navy blue (100 % detection) through lighter blue to white (zero detection)

Class	Components	Soil	Earthworm	Fieldfare egg	Fieldfare liver	Rat liver	Deer liver	Rowan	S-Slug	Honey bee	Bumble bee	Spider	Fox liver
Metals	Cr	100	100	100	100	100	100	100	100	100	100	n.a.	n.a.
	Ni	100	100	100	100	100	100	100	100	100	100	n.a.	n.a.
	Cu	100	100	100	100	100	100	100	100	100	100	n.a.	n.a.
	Zn	100	100	100	100	100	100	100	100	100	100	n.a.	n.a.
	As	100	100	100	100	100	100	100	100	100	100	n.a.	n.a.
	Ag	100	100		100	100	67	100	100		67	n.a.	n.a.
	Cd	100	100	100	100	100	100	100	100	100	100	n.a.	n.a.
	Pb	100	100	100	100	100	100	100	100	100	100	n.a.	n.a.
	Hg	100	100	100	100	100	100	100	100	100	67	n.a.	n.a.
	Gd	100	100		100	100	100	100	100	100	100	n.a.	n.a.
	Sb	100	100	100	100	100	100	100	100	100	100	n.a.	n.a.
	Sn	100	100	100	100	100	67	100	100	100	100	n.a.	n.a.
PCB	PCB28	100	100			100	67	100	100		33		n.a.
	PCB52	100	100	100	67			100					n.a.
	PCB101	100	100	100	100	100		100	100			100	n.a.
	PCB118	100		100	100	100	67	100				100	n.a.
	PCB138	100	100	100	100	100	33	100				100	n.a.
	PCB153	100	100	100	100	100	67	100				100	n.a.
	PCB180	100	100	100	100	100	100	100				100	n.a.
BFR	ATE (TBP-AE)	100										33	n.a.
	α-TBECH										33		n.a.
	β-TBECH										67		n.a.
	γ/δ-TBECH	100											n.a.
	BATE	100								33	33		n.a.
	PBT	100						100			67		n.a.
	PBEB	100			33		33						n.a.
	PBBZ												n.a.
	HBB				33			67					n.a.
	DPTE	100	100		33		67	67	100	33			n.a.
	EHTBB	100											n.a.
	BTBPE	100											n.a.
	TBPH (BEH/TBP)					100							n.a.
	DBDPE												n.a.
	α-HBCD			100		100							n.a.
	β-HBCD												n.a.
	γ-HBCD												n.a.
PFCA	TFA						100	100	100	67	67		n.a.
	PFPrA							33	100				n.a.
	PFBA												n.a.
	PFPA			100	67	100							n.a.
	PFHxA								100				n.a.
	PFHpA		100						100				n.a.
	PFOA	100	100	100	100	100	100	100	100	100	33		n.a.
	PFNA	100	100	100	100	100	100	67	100	67			n.a.
	PFDcA	100	100	100	100	100	100	33	100	67			n.a.
	PFUnDA		100	100	100	100	33		100	33			n.a.
	PFDoDA		100	100	100	100	33		100	33			n.a.
	PFTriDA		100	100	100	100		100	100				n.a.
	PFTeDA		100	100	100	100			100				n.a.
	PFHxDA		100	100	67				100				n.a.
	PFOcDA								100				n.a.
PFSA	PFEtS												n.a.
	PFPrS												n.a.
	PFBS							100		33			n.a.
	PFPS												n.a.
	PFHxS			100	100	100							n.a.
	PFHpS		100	100	100	100		33		33			n.a.
	PFOS	100	100	100	100	100	100						n.a.
	SUM PFOS	100	100	100	100	100	100						n.a.
	PFNS			100									n.a.
	PFDcS												n.a.
	PFUnS												n.a.
	PFDoS												n.a.
	PFTrS												n.a.
	PFTS												n.a.
nPFAS	N-MeFBSA												n.a.
	N-EtFBSA												n.a.
	PFBSA												n.a.
	meFOSA												n.a.
	etFOSA												n.a.
	meFOSEA												n.a.
	PFOSA												n.a.
	meFOSE												n.a.
	etFOSE												n.a.
	FOSAA												n.a.
	Me-FOSAA												n.a.
	Et-FOSAA												n.a.
newPFAS	6:2 FTS		100			100							n.a.
	8:2 FTS		100	100	100	100							n.a.
	10:2 FTS			100	100	100							n.a.
	12:2 FTS												n.a.
	4:2 FTS												n.a.
	PFECHS												n.a.

Table 4 cont.: Percentage detection of components in various sample types. n.a.: not analysed. White cell without text is zero detection. The colour scale is from navy blue (100 % detection) through lighter blue to white (zero detection).

Class	Components	Soil	Earthworm	Fieldfare egg	Fieldfare liver	Rat liver	Deer liver	Rowan	S-Slug	Honey bee	Bumble bee	Spider	Fox liver
CP	SCCP		100	100	33	100	33	100	100				n.a.
	MCCP		100	100	67	100	33	100	100				n.a.
Cyclic siloxanes	D4				67	100	100		100	33		100	n.a.
	D5				67	100	100					100	n.a.
	D6				100	100	100					33	n.a.
	M3T(Ph)				67	100	33						n.a.
OPFR	TCEP												n.a.
	TCPP/TCIPP	100	100		33	100	33	67	100	100	100	100	n.a.
	TDCPP/TDCIPP							100	100	100			n.a.
	TBEP/TBOEP	100				100	33	100	100	100			n.a.
	EHDP/EHDPP							67	100				n.a.
	TCP	100						67					n.a.
	TBP/ TnBP						33	67		67	100		n.a.
	TBP/TiBP									100	100		n.a.
	TEP		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	100	n.a.
	TPrP/TPP												n.a.
	TiBP	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.		n.a.
	BdPhP												n.a.
	TPP/TPhP							100	100	33			n.a.
	DBPhP												n.a.
	TXP										67		n.a.
	TIPPP/T4IPP								100				n.a.
	TTBPP												n.a.
	TEHP	100							100				n.a.
Dibromoaldrin & Dechloranes	DBA												n.a.
	Dec-602	100		100	33								n.a.
	Dec-603			100									n.a.
	Dec-604												n.a.
	Dec-601												n.a.
	syn-DP				33	100							n.a.
	anti-DP	100		100	33	100		33					n.a.
UV protecting compounds	OC							100	100	33	67	n.a.	n.a.
	BP3							100				n.a.	n.a.
	EHMC-Z											n.a.	n.a.
	EHMC-E											n.a.	n.a.
	UV-327	100		100	100	100		100				n.a.	n.a.
	UV-328	100		100		100		100				n.a.	n.a.
	UV-329					100						n.a.	n.a.
	Homosalate	100	100	100	100	n.a.	100	100	100	100	100	n.a.	n.a.
	M1-UV328											n.a.	n.a.
Biocides	Bromadiolon	n.a.	n.a.	n.a.	n.a.	100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	80
	Brodifacoum	n.a.	n.a.	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	80
	Flocumafen	n.a.	n.a.	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
	Difenacoum	n.a.	n.a.	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	80
	Difethialone	n.a.	n.a.	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
	Permethrin	n.a.	n.a.	n.a.	n.a.	100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	20
Phthalates	DEHP	100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	DPHP+ DiDP	100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	DiNP		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	DiBP		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	DnBP	100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Phenols	TBBPA		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.			n.a.	n.a.
	4,4 Bis-A		100	100	67	100	67	n.a.				n.a.	
	2,4- Bis-A							n.a.				n.a.	
	2,4 Bis-S											n.a.	
	4,4 Bis-F	100	100	100				n.a.				n.a.	100
	2,4 Bis-F		100	100				n.a.				n.a.	100
	Bis- G							n.a.				n.a.	
	Bis-FL							n.a.				n.a.	
	Bis-AP							n.a.				n.a.	
	Bis-Z							n.a.				n.a.	
	Bis-E							n.a.				n.a.	
	Bis-B							n.a.				n.a.	
	Bis-M							n.a.				n.a.	
	AO-MB1											n.a.	
	4-Dodecylphenol											n.a.	
	4-n-Nonylphenol											n.a.	
	4-n-Octylphenol							33				n.a.	
	4-t-Octylphenol							67				n.a.	

2.3.1 Metals

Metals were analysed in all samples except spiders due to lack of material, see Table 5. The concentrations of metals in the various samples are in agreement with data from previous years in the urban terrestrial monitoring program (Heimstad et al., 2021) where Zn was the dominating metal in all samples. In agreement with previous years, in soil and earthworm, second highest concentrations were detected for Pb followed by Cr and Cu. In the other samples, Cu had the second highest concentration after Zn.

None of the metals in soil exceeded the threshold value in Chapter 2, Appendix 1 of the Regulations Relating to Pollution Control for when soil legally is considered to be contaminated[2]. Cd and Pb concentration in earthworms exceeded the PNECoral value of 160 ng/g food and 3600 ng/g food, respectively for predators of earthworms. The concentration of As in the pooled sample of brown rat exceeded the PNECoral value for predators of 1000 ng/g ww, and one deer liver sample had a high Ag concentration of 253 ng/g ww, but effect threshold is not known.

Table 5: Metal concentrations in Soil), Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Vegetation (Rowan), Honey bee, Bumble bee and Spanish slug (Slug). Where the number of samples equal three, median concentrations and and min-max interval are given otherwise single concentrations are reported. All concentrations, except in soil (ng/g dw), are given in ng/g ww. Concentrations exceeding PNEC or orther thresholds are shown in bold.

	Soil n=1	EW n=1	FF egg n=1	BR liver n=1	FF liver n=3	Deer liver n=3	Rowan n=3	Honey Bee n-=2	Bumble Bee n=3	Slug n=1
Cr	44601	2735	8.43	153	561 380-3129	57.2 49.0-238	570 515-783	677 86.9-1267	136 78.6-152	20882
Ni	31389	1783	3.60	106	322 181-1835	6.06 4.42-17.0	3385 2646-4072	468 159-778	104 95.0-128	11859
Cu	40075	1936	382	4480	10013 9559-10309	3506 3225-82437	8036 7476-8141	9256 8957-9555	10920 10261-14343	18746
Zn	147063	127058	5682	25724	31283 27455-40720	28129 27401-28601	25235 14171-35405	47316 41071-53561	39225 38898-43421	196668
As	6793	452	5.88	**10495**	76.0 57.3-91.9	1.24 0.36-2.61	55.8 51.9-67.7	8.58 8.37-8.79	11.6 8.36-40.5	569
Ag	209	11.7	<1.0	2.38	16.7 15.2-52.4	1.08 <1.0-253	2.19 1.27-8.27	<1.0	1.02 <1.0-1.78	94.0
Cd	469	**1966**	0.41	13.3	67.7 63.7-197	140 104-169	108 30.3-248	158 122-194	26.8 18.8-43.5	781
Pb	53402	**7401**	8.00	159	149 112-296	17.4 10.9-55.3	282 248-656	56.7 32.5-80.8	51.4 39.9-67.5	537
Hg	143	52.4	11.3	29.4	23.6 21.7-36.5	1.06 0.30-7.32	30.9 25.8-31.0	0.30	0.21 <0.16-0.24	23.0
Gd	3837	16.3	<0.01	0.18	0.12 0.4-0.21	0.05 0.01-0.08	63.5 62.6-68.0	0.79 0.77-0.81	1.02 0.50-1.78	25.1
Sb	155	13.5	0.34	6.48	0.65 0.61-1.41	0.27 0.20-0.62	112 86.5-140	1.92 1.78-2.06	2.14 2.08-3.81	12.9
Sn	13081	22.6	67.8	19.6	69.8 47.6-176	2.02 <1.0-5.28	220 216-224	3.85 2.99-4.72	8.98 3.60-47.3	37.3

[2] https://lovdata.no/dokument/SF/forskrift/2004-06-01-931/KAPITTEL_1-2#KAPITTEL_1-2

Although one should be careful to compare across species and different organs, below is listed the species with highest concentrations of the various elements.

Matrices with highest concentrations of the various elements:

Cr: S-slug>>EW> H-bee>FF-liver
Ni: S-slug>> Rowan>EW>H-bee
Cu: S-slug> B-bee~FFliver>H-bee>Rowan
Zn: EW>S-slug>>H-bees-B-bees
As: BRliver>>S-slug>EW>FFliver
Ag: S-slug>FFliver>EW>Rowan
Cd: EW>>S-slug>H-bee >RDliver
Pb: EW>>S-slug> Rowan> FFliver
Hg: EW>Rowan>BRliver>FFliver~S-slug
Gd: Rowan>S-slug>EW>>other species
Sb: Rowan>>EW~S-slug>BRliver
Sn: Rowan>FFliver~FFegg>S-slug

2.3.2 PCB

Seven PCB congeners were analysed in all samples, see Table 6. PCB-153 was the dominating congener in most of the samples. On a wet weight basis, the lowest PCB concentrations were detected in insects, deer liver and vegetation, and the highest concentrations were detected in fieldfare egg.
None of the concentration were exceeding known threshold effect levels.

Table 6: PCB concentrations in Soil, Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Rowan leaves, Honey bee, Bumble bee (Bu-Bee), Spider and Spanish slug (Slug). Where the number of samples equal three, median concentrations and min-max interval are given otherwise single concentrations are reported. All concentrations are given in ng/g ww except for spider (ng/sample) and soil (ng/g dw).

	Soil n=1	EW n=1	FF egg n=1	BR liver n=1	FF liver n=3	Deer liver n=3	Rowan n=3	Honey Bee n-=2	Bumble Bee n=3	Spider n=1	Slug n=1
PCB-28	0.38	0.10	< 0.02	0.22	<0.03	<0.01	0.06 0.06-0.07	<0.01	<0.02	<0.01	0.01
PCB-52	0.37	0.06	0.62	<0.03	0.08 <0.07-0.24	<0.17	0.07	<0.03	<0.03	<0.01	< 0.02
PCB-101	0.32	0.13	4.16	0.23	0.74 0.24-0.85	<0.03	0.13 0.12-0.15	<0.06	<0.06	0.05 0.03- 0.06	0.03
PCB-118	0.35	<0.07	1.43	0.51	0.26 0.16-0.30	0.07 <0.04-0.1	0.10 0.09-0.10	<0.07	<0.07	0.01 0.01- 0.07	< 0.04
PCB-138	1.13	0.38	15.6	2.65	1.80 0.68-3.17	<0.12 <0.12- 0.15	0.14 0.13-0.16	<0.23	<0.23	0.01 0.01- 0.02	< 0.11
PCB-153	1.03	0.51	28.3	2.90	2.57 1.0-6.20	0.18 <0.17- 0.44	0.15 0.15-0.19	<0.33	<0.33	0.04 0.04- 0.32	< 0.17
PCB-180	0.78	0.15	11.3	2.39	1.43 0.38-2.78	0.06 0.05-0.08	0.06 0.04-0.06	<0.08	<0.08	0.06 0.04- 0.06	< 0.04

2.3.3 BFR

Many BFR compounds were not detected in the various samples. Highest number of BFR compounds were detected in the one pooled soil sample, and the compound DPTE was detected in highest number of samples, Table 7.

Table 7: BFR concentrations in Soil, Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Vegetation (Rowan), Honey bee, Bumble bee, Spider and Spanish slug (Slug). Where the number of samples equal three, median concentrations and and min-max interval are given otherwise single concentrations are reported. All concentrations, except in soil (ng/g dw) and spider (ng/sample), are given in ng/g ww.

	Soil n=1	EW n=1	FF egg n=1	BR liver n=1	FF liver n=3	Deer liver n=3	Rowan n=3	Honey Bee n-=2	Bumble Bee n=3	Spider n=1	Slug n=1
ATE (TBP-AE)	0.03	<0.01	<0.01	<0.01	<0.03	<0.007	<0.003	<0.028	<0.056	<0.013 <0.013-0.015	<0.007
α-TBECH	<0.20	<0.10	<0.1	<0.10	<0.21	<0.052	<0.020	<0.150	<0.34 <0.34-0.53	<0.104	<0.052
β-TBECH	<0.15	<0.08	<0.08	<0.08	<0.15	<0.038	<0.015	<0.107	<0.27 <0.27-0.51	<0.077	<0.038
γ/δ-TBECH	0.11	<0.04	<0.04	<0.04	<0.09	<0.021	<0.008	<0.063	<0.016	<0.043	<0.021
BATE	0.05	<0.01	<0.01	<0.01	<0.03	<0.007	<0.003	<0.022	<0.028 <0.024-0.036	<0.015	<0.007
PBT	0.06	<0.03	<0.03	<0.03	<0.06	<0.015	0.02 0.01-0.02	<0.029	<0.03 <0.03-0.04	<0.030	<0.015
PBEB	0.05	<0.02	<0.02	<0.02	<0.03 <0.03-0.04	<0.008 <0.008-0.009	<0.003	<0.016	<0.016	<0.016	<0.008
PBBZ	<0.48	<0.25	<0.25	<0.25	<0.49	<0.123	<0.005	<0.244	<0.24	<0.246	<0.123
HBB	<0.19	<0.10	<0.10	<0.10	<0.19 <0.19-0.20	<0.048	0.022 <0.019-0.024	<0.095	<0.095	<0.096	<0.048
DPTE	0.05	0.01	<0.01	<0.01	<0.025 <0.025-0.034	0.007 <0.006-0.008	0.008 <0.002-0.011	<0.017 <0.017-0.035	<0.018	<0.013	0.009
EHTBB	0.04	<0.03	<0.03	<0.10	<0.20	<0.028	<0.04	<0.059	<0.107	<0.018	<0.011
BTBPE	0.09	<0.03	<0.03	<0.03	<0.06	<0.015	<0.006	<0.029	<0.030	<0.029	<0.015
TBPH (BEH/TBP)	<0.14	<0.07	<0.07	1.28	<0.14	<0.035	<0.04	<0.016	<0.12	<0.071	<0.035
DBDPE	<26.9	<13.7	<13.7	<13.7	<27.5	<6.87	<2.67	<13.6	<13.6	<13.7	<6.87
α-HBCD	<0.21	<0.02	0.158	1.3	<0.05	<0.02	<0.005	<0.024	<0.026	<0.024	<0.012
β-HBCD	<0.06	<0.02	<0.02	<0.02	<0.04	<0.01	<0.004	<0.019	<0.018	<0.019	<0.009
γ-HBCD	<0.08	<0.02	<0.02	<0.02	<0.05	<0.02	<0.005	<0.024	<0.024	<0.024	<0.012

2.3.4 PFAS

The PFAS group consists of numerous per- and polyfluorinated compounds. We have chosen to separate this large class of compounds into four subgroups dependent on functional groups and properties: The perfluorinated sulfonates (PFSA), the perfluorinated carboxylates (PFCA), the neutral polyfluorinated compounds (nPFAS) with the compounds PFOSA, meFOSA, etFOSA, meFOSE, etFOSE, 6:2 FTOH, 8:2 FTOH, 10:2 FTOH and 12:2 FTOH; and the relatively new fluorotelomer sulfonates (newPFAS) with the compounds 4:2 FTS, 6:2 FTS, 8:2 FTS and 10:2 FTS. In this chapter and in the summary, SumPFAS is the sum of all sub-groups. While sumPFOS is the sum of branched and linear PFOS., the term PFOS, denotes the linear isomer. PFOS had highest concentration across all PFAS groups for all type of samples.

As previous years' results from this monitoring program, highest PFOS concentration was detected in the one pooled fieldfare egg sample of 120 ng/g ww (linear PFOS of 115 ng/g ww). This PFOS concentration exceeded the PNECoral of 37 ng/g ww (see Appendix) and QSbiota of 33 ng/g ww for secondary poisoning of predators, set by the European Commission (Ankley et al., 2021). For comparison, EFSA assessed the risks to human health related to the presence of perfluoroalkyl substances (PFASs) in food based on sum of the four PFASs PFOS, PFOA, PFNA and PFHxS and established a tolerable weekly intake (TWI) of 4.4 ng/ kg body weight per week[3]

PFOA in fieldfare eggs slightly exceeded QSbiota of 0.9 ng/g for secondary poisoning of predators set by Valsecchi et al., 2017 (Ankley et al., 2021).

[3] https://www.efsa.europa.eu/en/news/pfas-food-efsa-assesses-risks-and-sets-tolerable-intake

Table 8: PFSA concentrations in Soil, Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Rowan leaves, Honey bee, Bumble bee (Bu-Bee), Spider and Spanish slug (Slug). Where the number of samples equal three, median concentrations and min-max interval are given otherwise single concentrations are reported. All concentrations are given in ng/g ww except for spider (ng/sample) and soil (ng/g dw). <S/N 3: the concentratins were below 3 times the signal to noice. Concentration exceeding PNEC or orther thresholds are shown in bold.

	Soil n=1	EW n=1	FF egg n=1	BR liver n=1	FF liver n=3	Deer liver n=3	Rowan n=3	Honey Bee n=3	Bumble Bee n=3	Spider n=3	Slug n=1
TMFS	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3
PFEtS	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3
PFPrS	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3
PFBS	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	<0.05 <0.05-0.21	<0.05	<0.05	<0.05
PFPS	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
PFHxS	<0.05	<0.05	0.82	0.08	0.12 0.11-0.27	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
PFHpS	<0.05	3.30	0.61	0.66	0.54 0.44-0.65	<0.05	<0.05 <0.05-0.20	<0.05 <0.05-0.06	<0.05	<0.05	<0.05
PFOS	0.57	14.7	**115**	13.8	26.4 25.9-46.6	1.88 0.60-2.13	<0.05	<0.05	<0.05	<0.05	<0.05
SumPFOS	0.61	15.3	**120**	20.1	28.4 27.2-48.9	3.30 1.08-4.15	<0.05	<0.05	<0.05	<0.05	<0.05
PFNS	<0.10	<0.10	0.19	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PFDcS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PFUnS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PFDoS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PFTrS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PFTS*	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

*no standard available. Identification based on similar compound with respect to m/z, MS settings and retention time.

PFAS compounds could be detected in all investigated matrices where PFOS was the dominating compound in many samples except for roe deer liver, rowan, bees and Spanish slug, were perfluorinated carboxylates had highest concentrations, due to relatively high concentration of the ultra-short chain carboxylate compound TFA (*Table 9*). Especially rowan leaf samples had high concentration ranging from 106 to 278 ng/g ww.

A recent study analysed TFA in archived leaf samples from various tree species (Freeling et al., 2022). Freeling et al concluded that the increasing levels of TFA in the studied plants over time were likely due to increasing anthropogenic emissions of gaseous TFA precursors over the last three decades.

Table 9: PFCA concentrations in Soil, Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Rowan leaves, Honey bee, Bumble bee (Bu-Bee), Spider and Spanish slug (Slug). Where the number of samples equal three, median concentrations and min-max interval are given otherwise single concentrations are reported. All concentrations are given in ng/g ww except for spider (ng/sample) and soil (ng/g dw). <S/N 3: the concentratins were below 3 times the signal to noice. <S/N 10: the concentratins were below 10 times the signal to noice. Concentration exceeding PNEC or other thresholds are shown in bold.

	Soil n=1	EW n=1	FF egg n=1	BR liver n=1	FF liver n=3	Deer liver n=3	Rowan n=3	Honey Bee n=3	Bumble Bee n=3	Spider n=3	Slug n=1
TFA	<S/N 3	<S/N 3	<S/N 3	<S/N 3	<S/N 3	8.5 8.4-12.9	222 106-278	16.9 <S/N10 - 25.9	7.7 <S/N10 - 11.6	n.a.	76.4
PFPrA	<S/N 3	<S/N3	<S/N3	<S/N3	<S/N 3	<S/N 3	<S/N10 <S/N10 -0.99	<S/N 10	<S/N 10	n.a.	0.72
PFBA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PFPA	<0.04	<0.04	0.05	0.34	0.13 <0.04-0.19	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
PFHxA	<0.05	<0.05	<0.04	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.21
PFHpA	<0.05	0.573	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.29
PFOA	0.19	0.81	**0.99**	0.84	0.50 0.33-0.61	0.10 0.06-0.11	0.08 0.11-0.11	0.09 0.09-0.11	<0.05 <0.05-0.08	<0.05	0.36
PFNA	0.14	0.37	1.26	0.83	0.50 0.40-0.71	0.27 0.22-0.53	<0.05	0.15 <0.05-0.29	<0.05	<0.05	0.44
PFDA	0.09	0.31	3.40	1.32	1.13 1.12-2.45	0.41 0.07-1.20	<0.05 <0.05-0.13	<0.05 <0.05-0.09	<0.05	<0.05	0.41
PFUnDA	<0.05	0.56	3.10	0.39	0.95 0.95-1.42	0.17 <0.05-0.44	<0.05	<0.05	<0.05	<0.05	0.41
PFDoDA	<0.05	1.27	15.0	0.42	4.80 3.12-7.07	0.09 <0.05-0.53	<0.05	<0.05	<0.05	<0.05	0.53
PFTrDA	<0.10	<0.10	8.58	0.25	2.68 2.65-5.08	<0.10	0.22 0.12-0.26	<0.10	<0.10	<0.10	0.52
PFTeDA	<0.05	2.15	12.43	0.19	5.64 2.62-5.86	<0.05	<0.05	<0.05	<0.05	<0.05	0.36
PFHxDA	<0.10	<0.10	0.37	<0.1	0.14 <0.1-0.16	<0.10	<0.10	<0.10	<0.10	<0.10	0.16
PFOcDA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.16

Table 10: nPFAS and newPFAS concentrations in Soil, Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Rowan leaves, Honey bee, Bumble bee (Bu-Bee), Spider and Spanish slug (Slug). Where the number of samples equal three, median concentrations and min-max interval are given otherwise single concentrations are reported. All concentrations are given in ng/g ww except for spider (ng/sample) and soil (ng/g dw).

	Soil n=1	EW n=1	FF egg n=1	BR liver n=1	FF liver n=3	Deer liver n=3	Rowan n=3	Honey Bee n=3	Bumble Bee n=3	Spider n=3	Slug n=1
PFOSA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
N-MeFBSA	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
N-EtFBSA*	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
PFBSA	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
MeFOSA	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
EtFOSA	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
MeFOSE	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
EtFOSE	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
FOSAA	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Me-FOSAA	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Et-FOSAA	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
6:2 FTS	<0.10	0.59	<0.10	0.54	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
8:2 FTS	<0.10	0.31	1.50	0.69	0.31 0.20-3.86	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
10:2 FTS	<0.10	<0.10	3.65	0.23	0.45 0.35-2.55	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
12:2 FTS*	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
4:2 FTS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PFECHS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

*no standard available. Identification based on similar compound with respect to m/z, MS settings and retention time.

2.3.5 Chlorinated paraffins, CP

SCCPs and MCCPs were detected in most samples, see *Table 11*, except soil, bees and spiders. The highest detected concentration for MCCPs was detected in the one pooled sample of rat liver where the concentration was 1013 ng/g ww. The concentration in this sample was also highest when the samples were compared on a lipid weight basis. SCCPs were on a lipid weight basis highest in one fieldfare chick liver. None of the samples exceeded the PNECoral values of 5500 ng/g food and 10 000 ng/g food (wet weight) for SCCPs and MCCPs, respectively.

Table 11: CP concentrations in Soil, Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Rowan leaves, Honey bee, Bumble bee (Bu-Bee), Spider and Spanish slug (Slug). Where the number of samples equal three, median concentrations and min-max interval are given otherwise single concentrations are reported. All concentrations are given in ng/g ww except for spider (ng/sample) and soil (ng/g dw).

	Soil n=1	EW n=1	FF egg n=1	BR liver n=1	FF liver n=3	Deer liver n=3	Rowan n=3	Honey Bee n=3	Bumble Bee n=3	Spider n=3	Slug n=1
SCCPs	<15.4	12.7	10.5	27.6	<15.7 <15.7-18.1	<3.9 <3.9-4.59	13.2 12.3-43.2	<7.8	<7.9	<7.9	8.9
MCCPs	<50.6	51.0	26.5	1013	55.4 <51.6-57.5	<12.9 <12.9-21.4	36.5 34.7-75.0	<25.6	<26.1	<25.8	97.7

The fractional contribution from each congener group to the relative total abundance is multiplied by the total SCCPs or MCCPs amount to provide the contribution of each congener group expressed as concentration. The most dominating isomer groups (highest % contribution) in the various samples, are shown in Table 12 and Table 13 for SCCPs and MCCPs, respectively. The isomer groups are given as, number of C-atoms, number of Cl- atoms.

Table 12: The most dominating isomer classes in the various samples with detected concentrations, expressed as % of the total concentration in SCCPs: Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Vegetation (Rowan) (ng/g ww), and (Spanish) slug (n=1).

Dominating isomer classes *	EW n=1	FF egg n=1	BR liver n=1	FF liver3	Deer liver 2	Veg. 1	Veg. 2	Veg. 3	Slug n=1
10 C, 6 Cl	16 %	7 %		18 %	21 %	8 %		6 %	
10 C, 8 Cl									23 %
10 C, 9 Cl									34 %
11 C, 5 Cl	8 %			11 %	14 %				
11 C, 6 Cl	14 %	8 %		25 %	26 %	8 %	13 %	10 %	
11 C, 7 Cl						9 %	9 %	9 %	
11 C, 10 Cl		14 %							
12 C, 6 Cl	7 %			10 %			13 %		
12 C, 9 Cl			14 %						
12 C, 10 Cl		18 %	11 %						
13 C, 9 Cl			10 %						

* first number before comma represents the number of carbons and second number after comma denotes the number of chlorine atoms.

Table 13: The most dominating isomer classes in the various samples with detected concentratrions, expressed as % of the total concentration in MCCPs: Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Vegetation (Rowan) (ng/g ww), and (Spanish) slug (n=1).

Dominating isomer classes*	EW n=1	FF egg n=1	BR liver n=1	FF liver2	FF liver3	Veg. 1	Veg. 2	Veg. 3	Deer liver 2	Slug n=1
14 C, 5 Cl			8 %					9 %	13 %	
14 C, 6 Cl	17 %	24 %		21 %	26 %	13 %	8 %	19 %	29 %	
14 C, 7 Cl	13 %	17 %		15 %	14 %	13 %	13 %	11 %	15 %	
14 C, 8 Cl	10 %	17 %	8 %			14 %	25 %	11 %		
15 C, 6 Cl	9 %			12 %	13 %				15 %	
15 C, 8 Cl			8 %			7 %	9 %	7 %		
16 C, 8 Cl			7 %							
17 C, 5 Cl										20 %
17 C, 6 Cl										42 %

* first number before comma represents the number of carbons and second number after comma denotes the number of chlorine atoms.

In SCCPs, the isomer classes 10,6 and 11,6 were one of the dominating classes in many of the samples, except the rat liver and slug. In MCCPs, 14,6, 14,7 and 14,8 dominated in many samples, except rat and slug.

Among the samples, slug had two distinct dominating isomer groups in both SCCPs and MCCPs, while others, and especially rowan, was characterized by many isomer groups with low percentage contribution.

2.3.6 Cyclic siloxanes (cVMS)

Cyclic siloxanes were mainly detected in liver samples from brown rat, fieldfare and deer in addition to spider samples, see *Table 14*. Highest concentrations were detected in brown rat liver followed by deer liver and fieldfare liver samples. D4, D6 andTris(trimethylsiloxy)phenylsilane, (M3T(Ph)) were on a lipid weight basis highest in one of the three roe deer livers, D5 was highest in rat liver. The compound M3T(Ph) was found in much lower concentrations than D4, D5, D6. D4 had slightly higher concentrations than D5 and D6 lowest of these three, see *Table 14*.

None of the biological samples exceeded the available PNEC values for secondary poisoning, available at the ECHA chemical information web site[4] (see also Appendix 1).

Table 14: Cyclic siloxane concentrations in Soil, Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Rowan leaves, Honey bee, Bumble bee (Bu-Bee), Spider and Spanish slug (Slug). Where the number of samples equal three, median concentrations and min-max interval are given otherwise single concentrations are reported. All concentrations are given in ng/g ww except for spider (ng/sample) and soil (ng/g dw).

	Soil n=1	EW n=1	FF egg n=1	BR liver n=1	FF liver n=3	Deer liver n=3	Rowan n=3	Honey Bee n=3	Bu-Bee n=3	Spider n=3	Slug n=1
D4	<2.00	<2.00	<2.00	9.32	5.39 <1.08-5.65	7.12 6.55-7.24	<0.42	<0.42 <0.42-0.46	<0.42	1.65 0.65-5.23	0.58
D5	<2.04	<2.04	<2.04	53.1	3.39 <0.63-3.41	5.38 5.34-5.79	<1.07	<1.07	<1.07	1.13 0.80-2.86	<1.07
D6	<1.26	<1.26	<1.26	7.84	1.86 0.87-1.89	3.09 2.77-3.92	<1.07	<1.07	<1.07	<1.82 <1.82-2.13	<1.07
M3T(Ph)	<0.02	<0.02	<0.02	0.73	0.11 <0.08-0.17	<0.08 <0.08-0.38	<0.11	<0.11	<0.11	<1.82	<0.11

[4] https://echa.europa.eu/da/search-for-chemicals

2.3.7 OPFR

TCPP was the dominating OPFR compound in the samples, except for rowan where TPP dominated in one rowan sample, and EHDPP, slightly higher than TCPP, in another rowan sample. None of the OPFR compounds were detected in the one fieldfare egg sample, and TCPP was the only one detected in one fieldfare liver sample.

Highest TCPP concentrations were detected in honey bee and bumble bee samples followed by spider, slug and vegetation and highest number of OPFR compounds were detected in rowan, Spanish slug and bees.

None of the OPFR concentrations in soil exceeded known PNECsoil values or PNECoral in biota[3].

Table 15: OPFR concentrations in Soil, Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Rowan leaves, Honey bee, Bumble bee (Bu-Bee), Spider and Spanish slug (Slug). Where the number of samples equal three, median concentrations and min-max interval are given otherwise single concentrations are reported. All concentrations are given in ng/g ww except for spider (ng/sample) and soil (ng/g dw).

	Soil n=1	EW n=1	FF egg n=1	BR liver n=1	FF liver n=3	Deer liver n=3	Rowan n=3	Honey Bee n=3	Bumble Bee n=3	Spider n=3	Slug n=1
TCEP	<0.06	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<0.2	<1.4
TCPP/ TCIPP	0.51	1.17	< 0.9	1.23	< 0.9 <0.9-1.18	<0.9 <0.9-1.28	2.48 <0.9-4.61	13.8 13.1-20.7	9.29 8.85-11.0	2.17 2.15-5.47	3.47
TDCPP/ TDCIPP	<0.16	<0.2	<0.2	< 0.2	<0.2	<0.2	0.65 0.58-0.81	0.59 0.28-0.60	<0.2	<0.2	0.79
TBEP/ TBOEP	0.2	< 0.1	< 0.1	0.29	< 0.1	<0.2 <0.2-0.31	0.29 0.27-0.34	0.62 0.28-0.85	<0.1	<0.2	2.48
EHDP/ EHDPP	<0.03	<0.2	<0.2	<0.2	<0.2	<0.2	2.23 <0.2-5.34	<0.2	<0.2	<0.2	0.4
TCP	0.14	< 0.1	< 0.1	< 0.1	< 0.1	<0.1	0.25 <0.1-0.31	<0.1	<0.1	<0.2	<0.1
TBP/ TnBP	<0.18	<0.2	<0.2	<0.2	<0.2	<0.2 <0.2-0.32	0.29 <0.2-0.33	1.39 <0.2-2.33	1.23 1.12-2.46	<0.4	<0.2
TBP/TiBP	<0.18	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.15 0.94-2.33	0.66 0.61-0.67	<0.2	<0.2
TEP*	<0.03	-	-	-	-	-	-	-	-	0.85 0.76-1.04	-
TPrP/TPP	<0.02	< 0.06	< 0.06	< 0.06	< 0.06	<0.06	<0.06	<0.06	<0.06	<0.2	<0.06
TiBP*	-	-	-	-	-	-	-	-	-	<13	-
BdPhP	<0.03	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
TPP/TPhP	<0.03	<0.2	<0.2	<0.2	<0.2	< 0.2 < 0.2-0.6	2.90 2.15-5.49	<0.2 <0.2-0.41	<0.2	<0.2	0.58
DBPhP	<0.03	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
TXP	< 0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.54 <0.2-0.60	<0.2	<0.2
TIPPP/ T4IPP	< 0.04	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	2.42
TTBPP	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1
TEHP	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.72

*Not detected in some samples due to matrix effects

2.3.8 UV compounds

Homosalate was detected in all investigated samples and was also the UV substance that was detected in highest number of samples. The highest concentration for homosalate was reported in rowan, see *Table 16*. UV-327 and UV-328 were detected in soil, fieldfare, brown rat and rowan Except from homosalate, none of the UV compounds were detected in earthworm and deer liver. Highest number of UV compounds and highest concentrations were detected in rowan, and EHMC-Z and -E were not detected in any samples. BP3 and UV-329 were only detected in one sample of rowan and brown rat liver, respectively. On a lipid weight basis, UV-327 was highest in fieldfare chick liver and UV-328 was highest in rat liver.

Table 16: UV compound concentrations in Soil, Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Rowan leaves, Honey bee, Bumble bee (Bu-Bee), Spider and Spanish slug (Slug). Where the number of samples equal three, median concentrations and min-max interval are given otherwise single concentrations are reported. All concentrations are given in ng/g ww except for soil (ng/g dw).

	Soil n=1	EW n=1	FF egg n=1	BR liver n=1	FF liver n=3	Deer liver n=3	Rowan n=3	Honey Bee n=3	Bumble Bee n=3	Spider n=3	Slug n=1
OC	<3.4	<3.4	<6	<2	<9	<3.4	29.0 19.2-50.0	<11 <11-31.4	11.3 <9-24.2	n.a.	3.70
BP3	<0.8	<0.8	<1.2	<1	<2	<0.8	18.7 10.3-27.7	<2.4	<2	n.a.	<0.8
EHMC-Z	<0.2	<0.2	<0.4	I	<0.6	<0.2	<0.2	<0.8	<0.7	n.a.	<0.2
EHMC-E	<0.9	<0.9	<1.4	<0.3	<2.3	<0.9	<1.4	<2.8	<2.3	n.a.	<0.9
UV-327	0.20	<0.5	1.13	1.40	1.44 1.21-1.60	<0.1	1.18 0.91-1.25	<0.2	<0.1	n.a.	<0.7
UV-328	1.80	<0.4	0.57	5.60	<1	<0.4	1.53 1.02-2.29	<1.3	<1	n.a.	<0.4
UV-329	<0.6	<0.6	<1.1	3.10	<1.7	<0.6	<1.1	<2.1	<1.7	n.a.	<0.6
M1-UV328	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	n.a.	<0.5
Homo-salate	4.6	4.2	1.4	n.a.	2.6 1.8-3.8	0.86 0.86-0.87	71 55-125	13 10-21	15 14-23	n.a.	7.4

2.3.9 Dibromoaldrin and dechloranes

Dibromoaldrin (DBA) and dechloranes were detected in few samples. Anti-DP were detected in four samples and had highest concentration (wet weight basis) in the one sample of brown rat liver, see Table 17. Highest amount of dechlorane compounds were detected in the fieldfare egg where dec-602, dec-603 and anti-DP were detected.

Table 17: Dibromoaldrine and dechlorane concentrations in Soil, Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Rowan leaves, Honey bee, Bumble bee (Bu-Bee), Spider and Spanish slug (Slug). Where the number of samples equal three, median concentrations and min-max interval are given otherwise single concentrations are reported. All concentrations are given in ng/g ww except for spider (ng/sample) and soil (ng/g dw).

	Soil n=1	EW n=1	FF egg n=1	BR liver n=1	FF liver n=3	Deer liver n=3	Rowan n=3	Honey Bee n=3	Bumble Bee n=3	Spider n=3	Slug n=1
DBA	<0.15	<0.07	<0.07	<0.07	<0.15	<0.06	<0.02	<0.07	<0.07	<0.07	<0.04
Dec-602	0.04	<0.02	0.58	<0.02	<0.03 <0.03-0.04	<0.01	<0.003	<0.01	<0.01	<0.01	<0.01
Dec-603	<0.04	<0.02	0.11	<0.02	<0.04	<0.02	<0.004	<0.02	<0.02	<0.02	<0.01
Dec-604	<0.72	<0.37	<0.37	<0.37	<0.73	<0.25	<0.07	<0.36	<0.36	<0.36	<0.18
Dec-601	<0.07	<0.03	<0.03	<0.03	<0.07	<0.03	<0.007	<0.03	<0.03	<0.03	<0.02
syn-DP	<0.15	<0.08	<0.08	0.90	<0.16	<0.05	<0.02	<0.06	<0.08	<0.08	<0.04
anti-DP	0.56	<0.06	0.14	2.42	<0.19 <0.19-0.27	<0.05	<0.02	<0.05	<0.06	<0.06	<0.03

2.3.10 Phenols and bisphenols

Of the phenol and bisphenol compounds, 4,4 Bis-A was the compound found in highest number of samples, followed by 4,4, Bis-F and 2,4 Bis-F. 4,4 Bis-A had the highest concentrations with 71 and 41 ng/g ww measured in fieldfare egg and earthworm, respectively. All the other phenols were below LOD or not possible to analyse (see 3.6 QA/QC), except 4-n-octyl-phenol and 4-t-octyl-phenol which were detected in rowan leaves. Due to lack of sample material, phenols were not analysed in spider samples.

Table 18: Concentrations of phenols in Soil, Earthworm (EW), Fieldfare (FF) egg and liver, Brown rat (BR liver), Deer liver, Rowan leaves, Honey bee, Bumble bee (Bu-Bee), and Spanish slug (Slug). Where the number of samples equal three, median concentrations and min-max interval are given otherwise single concentrations are reported. All concentrations are given in ng/g ww except for soil (ng/g dw).

	Soil n=1	EW n=1	FF egg n=1	BR liver n=1	FF liver n=3	Deer liver n=3	Rowan n=3	Honey Bee n=3	Bumble Bee n=3	Slug n=1
TBBPA	< 5.5	n.a..	n.a.	n.a.	n.a..	n.a.	n.a.	< 50	< 8.3	n.a.
4,4 Bis-A	< 4.4	41	71	12	7.4 <3.8-7.9	5.4 <3.8-6.9	n.a.	< 40	< 6.7	< 3.5
2,4- Bis-A	< 2.5	< 2.3	< 6	< 2.1	< 2.2	< 2.2	n.a.	< 22	< 3.4	< 3.8
2,4 Bis-S	< 0.4	< 0.3	< 1.3	< 0.3	< 0.3	< 0.3	n.a.	< 3	< 0.5	< 0.3
4,4 Bis-F	0.8	8.5	15	< 0.7	< 1.5	< 1.3	< 0.07	< 6.8	< 1.1	7.8
2,4 Bis-F	< 2	17	17	< 1.7	< 1.8	< 1.8	n.a.	< 17	< 2.3	7.7
Bis-G	< 1.1	< 1	< 2.6	< 0.9	< 0.9	< 1	n.a.	< 9.6	< 1.6	< 1.6
Bis-FL	< 1.2	< 1.1	< 4.2	< 01	< 1	< 1	n.a.	< 10	< 1.7	< 2.7
Bis-AP	< 0.9	< 0.8	< 2.9	< 0.7	< 0.7	< 0.8	n.a.	< 7.8	< 1.3	< 1.8
Bis-Z	< 1.7	< 2.2	< 5.2	< 1.4	< 1.5	< 1.5	n.a.	< 15	< 2.5	< 1.3
Bis-E	< 0.8	< 0.7	< 4	< 0.7	< 0.7	< 0.7	n.a.	< 7	< 1.2	< 2.5
Bis-B	< 1	< 1	< 4	< 0.9	< 0.9	< 0.9	n.a.	< 9.3	< 1.6	< 0.8
Bis-M	< 0.04	< 1.8	< 1.8	< 0.7	n.a.	< 0.9	n.a.	< 1.5	< 0.4	< 6.6
AO-MB1	< 2.4	< 2.4	< 3	< 2.1	<2.2	< 2.2	<1.7	< 22	< 3.7	< 1.9
4-dodecyl-phenol	< 0.9	n.a.	< 4.4	< 1.5	n.a.	< 2.5	<12	< 35	< 22	< 0.9
4-n-nonyl-phenol	< 2.8	n.a.	< 7.5	< 2.7	n.a.	< 3.8	<17	< 25	< 8	< 2.2
4-n-octyl-phenol	< 2.2	< 5.3	n.a.	< 1.7	< 1.7	< 1.8	<2.8 <0.5- 4	< 18	< 3	< 1.6
4-t-octyl-phenol	< 1.4	< 4.5	n.a.	< 1.2	< 1.2	< 1.3	2 <0.4-14	< 13	< 2.2	< 1.1

2.3.11 Biocides (rodenticides) in red fox and brown rat liver

Biocides (rodenticides) were analysed for in five red fox liver samples and one pooled rat liver sample. Six biocides (bromadiolone, brodifacoum, flocumafen, difenacoum, difethialone and primethrin) were selected for analyses in these samples.

Bromadiolone, brodifacoum and difenacoum and permethrin, but not flocumafen and difethialone were detected in the red fox liver samples. Bromadiolone was detected in highest concentrations, see *Table 18*. In contrast, the dominating compound in the one brown rat liver samples was permethrin at 144 ng/g ww. In red fox liver on the other hand permethrin was only detected in one sample (65 ng/g ww). The other biocides were below limit of detection in rat liver, except bromadiolone of 3.2 ng/g ww.

Bromadiolone is acutely toxic to mammals with acute oral rat LD50 of 0.56-1.31 mg/kg bw.[5] The concentration in brown rat is well below this acute toxicity. PNECoral (concentration in food) for bromadiolone has been set to 0.00019 mg/kg-0.00044 mg/kg for mammals; i.e. 0.19-0.44 ng/g[5], see also chapter 3.3. in Appendix. The concentration in brown rat (liver), as potential prey for red fox, exceeded this threshold.

One red fox liver sample (268 ng/g) exceeded the assumed threshold for liver poisoning in field foxes of 0.2 mg/kg (Sage et al., 2010). Permethrin[6] did not have concentrations above known toxicity thresholds.

Table 19: Mean (median) concentrations with min-max interval below of biocides in red fox liver and brown rat liver. All concentrations are given in ng/g ww.

Compounds	Red fox n=5	Brown rat n=1
Bromadiolone	91.6 (48.8) <1-268	3.1
Brodifacoum	20.5 (1.8) 0.95-197	<1
Flocumafen	<1	<1
Difenacoum	11.9 (3.6) <1-46.0	<1
Difethialone	<1	<1
Permethrin	14.2 (<3) <3-65	144

[5] https://circabc.europa.eu/sd/a/861933f1-29f7-4758-8d69-7d9eafea4ca5/Assessment%20Report%20revised%2016122011.pdf

[6] http://dissemination.echa.europa.eu/Biocides/ActiveSubstances/1342-18/1342-18_Assessment_Report.pdf

2.3.12 Phthalates in soil

Phthalates were only analysed in the one pooled soil samples across three locations. DEHP was the dominating compound with a measured concentration of 40.6 ng/g dw followed by DnBP (13.9 ng/g dw) and DPHP+DiDP of 6.5 ng/g dw.

The concentration of DEHP is well below the PNECsoil value of 13 mg/g dw, and DnBP is also below the PNECsoil value of 50 ng/g dw (ECHA chemical information, see Appendix).

Table 20: Concentrations of phthalate compounds in the one pooled soil sample

Compounds	Soil ng/g dw
DEHP	40.6
DPHP+ Diisodecyl phthalate (DiDP)	6.5
DiNP	<0.6
DiBP Diisobutyl phthalate	<0.4
DnBP di-n-butyl phthalate	13.9

2.3.13 Dominating pollutant groups in the species

Dominating pollutant groups on a wet weight basis were evaluated in the various samples. In principle hydrophobic pollutants should be normalised with respect to lipid weight in order to be compared. This is not done here since PFAS and most OPFR compounds are water soluble and/or associated to proteins. Concentrations below LOD were not included in the sum concentrations. For matrices with three individual samples, the median sum value was used. Ultrashort chain PFCA compounds such as TFA dominated in several samples and is part of the PFCA sum which is relatively high in roe deer liver, rowan, insects and Spanish-slug.

On a wet weight basis for biota and rowan and dry weight for soil:

Soil*:	Metals>> Phthalates> UV> PCB
Earthworm:	Metals>> Phenols~CP> PFSA
Fieldfare egg:	PFSA>Phenols> PCB>PFCA
Brown rat liver:	Metals>> CP> Siloxanes> PFSA
Fieldfare liver:	Metals>> CP> PFSA> PFCA
Roe deer liver:	Metals>> CP> Siloxanes> PFCA
Rowan:	Metals> PFCA> UV> CP
Honey bee:	Metals>> UV> OPFR> PFCA
Bumble bee:	Metals>> UV> OPFR> PFCA
Spider*:	OPFR~ Siloxanes> PCB
Spanish-Slug:	Metals>> CP> PFCA>Phenols

**Phthalates only analysed in soil, metals and phenols not anlysed in spider samples*

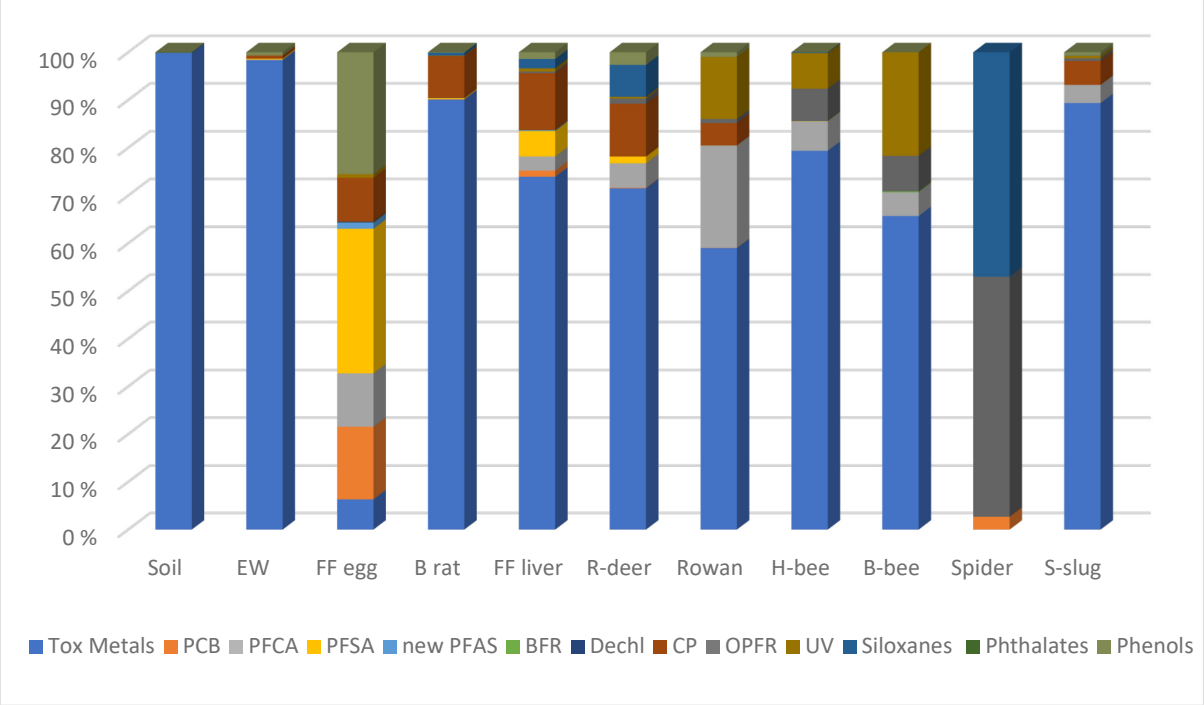

Figure 2: Percentage distribution of sum concentrations of compond classes in matrices: Soil, earth worm (EW),fieldfare egg (FF egg), brown rat (B rat), fieldfare liver (FF liver), roe deer (R-deer), Rowan, honey bee (H-bee), bumble bee (B-bee), spider and Spanish slug (S-slug). Biota and rowan samples in ng/g ww, soil in ng/g dw and spider as ng/sample. Note that metals and phenols were not analysed in spider samples.

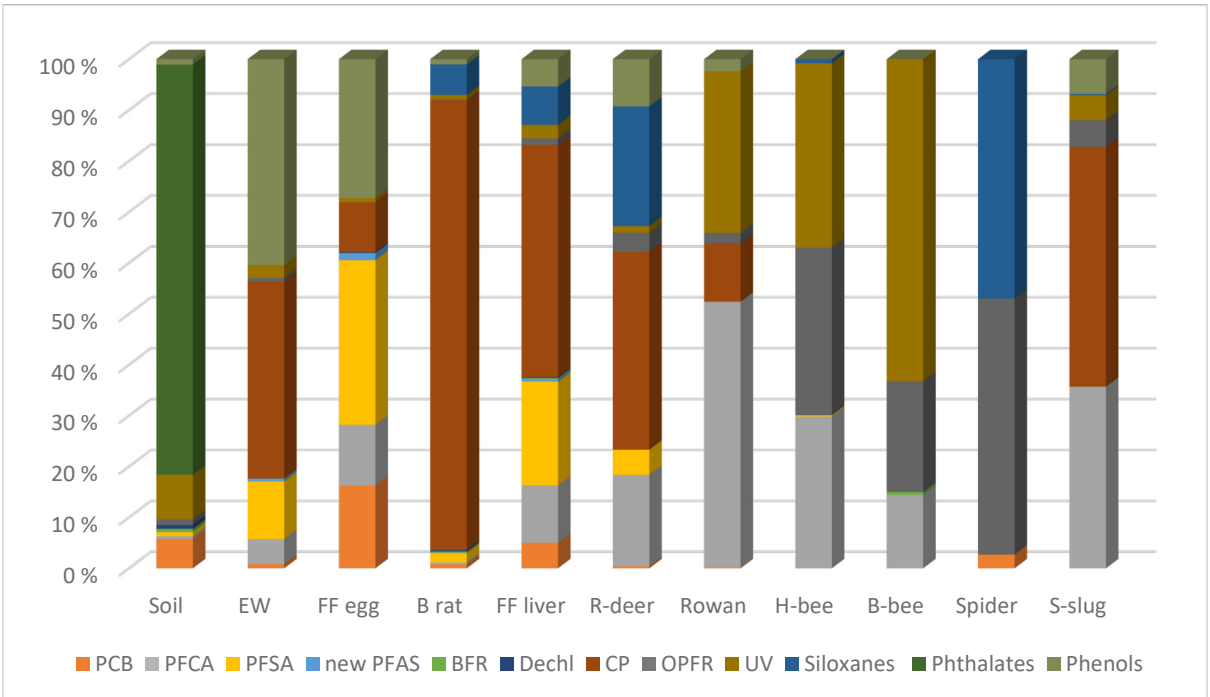

Figure 3: Percentage distribution of sum concentrations of organic pollutant classes in matrices: Soil, earth worm (EW),fieldfare egg (FF egg), brown rat (B rat), fieldfare liver (FF liver), roe deer (R-deer), Rowan, honey bee (H-bee), bumble bee (B-bee), spider and Spanish slug (S-slug). Biota and rowan samples in ng/g ww, soil in ng/g dw and spider as (ng/sample). Note that metals and phenols were not analysed in spider samples.

Dominated hydrophobic organic pollutants on a lipid weight (organic carbon for soil) basis for the hydrophobic groups in various samples are shown below. Concentrations were normalised to TOC for soil and lipids for organisms. In the list below, PFAS (PFSA, PFCA and new PFAS), OPFR and phenols were included in the comparison on a wet weight basis. TCPP, the dominating OPFR compound, has a relatively low $LogK_{ow}$ (2.6) and high water solubility (1200 mg/l). Lipid content was not analysed in insects and vegetation and are therefore not included.

On a lipid weight (and TOC for soil) basis for all organic compounds except PFAS and OPFR:

Soil:	Phthalates>>UV> PCB>Dechloranes
Earthworm:	CP> UV> PCB>PFSA
Fieldfare egg:	PCB>CP>PFSA > Phenols
Brown rat liver:	CP>>Siloxanes>>UV>PCB
Fieldfare liver:	CP>>Siloxanes>PCB> UV
Roe deer liver:	CP>Siloxanes>>UV> PFCA
Spanish slug:	CP >UV>PFCA>Siloxanes

Bisphenol A which was the dominating bisphenols compound detected in some samples has a $LogK_{ow}$ of approximately 3.6. If phenols were included on a lipid weight basis, phenols becomes one of the two groups with highest sum concentrations in earthworm, fieldfare eggs and Spanish slug.

2.3.14 Trophic relationship and potential biomagnification

$\delta^{15}N$ values were used to estimate the relative trophic positions of the different organisms. Terrestrial food chains are in general short, and biomagnification is generally assumed to be positively linked to food chain length such that the longer the food chain is, the higher the pollutant concentrations will be at the top of the food chain. Thus, despite bioaccumulation capabilities of some pollutants, top predators in the terrestrial food webs may be at lower risk for experiencing secondary poisoning than top predators in pelagic food webs, which often are longer (McGarvey et al., 2016). The strength of the relationship between tissue concentrations and trophic position is however also influenced by the properties of the chemicals, the types of tissue analysed, sampling period and location, and feeding habits of the species. In general, more lipophilic chemicals show stronger relationships between measured tissue concentrations and trophic position.

$\delta^{13}C$ values provide information regarding the source of dietary carbon, e.g. whether and to what extent an organism feeds on marine or freshwater organisms or aquatic or terrestrial organisms. For example, samples from marine locations are expected to show a less negative $\delta^{13}C$ value than samples from terrestrial locations. However, direct comparison of the data presented in this report should be done with care, since different tissues were analysed for the different species in the study (egg, liver, whole individuals). Different tissues may have different $\delta^{13}C$ turnover rates and may reflect the dietary exposure differently and in an optimal study design only data from the same tissue type should be compared (optimally muscle tissue due to slow turnover rates).

When relating all samples in 2021 against $\delta^{13}C$ and $\delta^{15}N$, the graph in Figure 4 is achieved

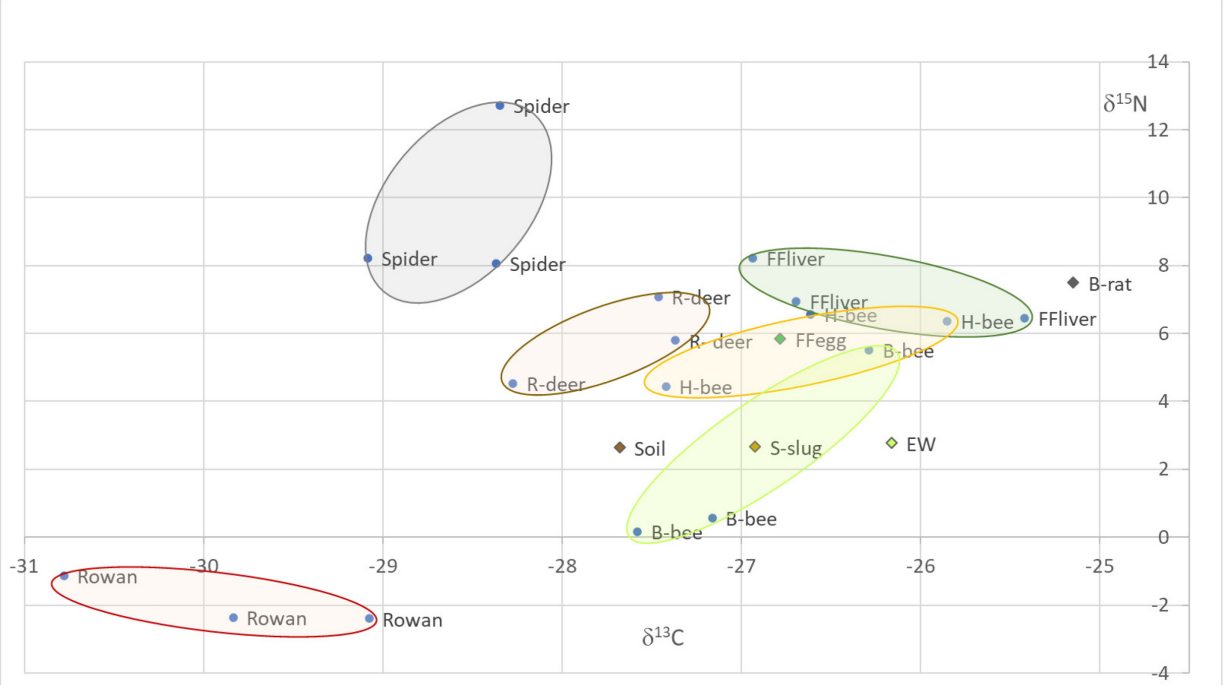

Figure 4: Relationship between the dietary descriptors δ15N and δ13C in soil and biota samples from urban terrestrial environment in Oslo, 2021; soil (S), earthworm (EW), brown rat (Rat), slug (S-slug), fieldfare egg (FF egg), fieldfare liver (FFliver), Roe deer liver (Roe deer),spider, rowan, honey bee (H-bee) and bumble bee (B-bee). Note that only one sample exist for soil, earthworm, fielfare egg and rat ans slug. These are marked with various colours and diamond symbol.

As can been seen from the $\delta^{15}N$ and $\delta^{13}C$ plot, the vegetation rowan blades are distinct different with lowest $\delta^{15}N$ and $\delta^{13}C$ values in the plot. Low $\delta^{13}C$ values are associated with a terrestrial signal. The one sample of soil, slug and earthworm show comparable $\delta^{15}N$ values, an indication to similar trophic level, and soil revealed lower $\delta^{13}C$ values than slug and earthworm. Roe deer (liver), where rowan is assumed to be important part of diet, show comparable $\delta^{15}N$ values to honey bees and the one pooled sample of fieldfare egg, but on average lower $\delta^{13}C$ values. Brown rat samples have comparable $\delta^{15}N$ values to some samples of fieldfare liver, one roe deer liver and two spider samples, but higher $\delta^{13}C$ signal which associate to less terrestrial food diet. Brown rat is known to be an omnivore and will consume almost anything in their environment. They will scavenge through trash or eat any food that is left unprotected. Spider samples have stronger terrestrial signal with much lower $\delta^{13}C$ values. One spider sample has the highest $\delta^{15}N$ value, which may indicate a stronger predator signal. This pooled sample from Bygdøy and one of the two other pooled sample consisted of the spider species Lycosidae (Pardosa sp1) which does not explain the difference, but different prey at different locations (Bygdøy and Maridalen) might be an explanation.

Trophic magnification factors were not calculated in 2021 due to several factors: i) low sample number of several species for the analysis (n=1, n=3), liver samples instead of muscle as recommended (Kidd et al., 2019; van den Brink et al, 2016) ii) uncertainty related to if organisms were linked by diet through the food web (Kidd et al., 2019) and ii) recommendation of at least 3 trophic levels (Borgå et al, 2012, Kidd et al, 2019). Instead, we chose to assess if bioaccumulation and biomagnification factors could be calculated for those compounds with detected concentrations.

Bioaccumulation and biomagnification factors, BSAF and BAF

Biota soil accumulation factor (BSAF) was calculated for some compounds at specific locations where contaminant data was detected for both soil and earthworm (EW) in the same year.
Soil and earthworm samples were both pooled samples consisting of samples from three locations, and most important for BSAF calculations, the locations and time of sampling were exactly the same for soil and earthworm. Spanish-slug concentrations were not included in the calculation of BSAF since it was sampled at a different location than soil samples.

BMF was calculated for the most relevant prey-predator pair such as earthworm-fieldfare where only earthworm (EW) has whole body concentrations. Egg and liver concentrations were used for fieldfare (FF).

Be aware that the number of samples are very small with only pooled sample of soil, earthworm, fieldfare egg and three samples for fieldfare liver. Ideally, when calculating BMF values for for fieldfare, the concentration in the total body ormuscle concentrations should have been used. This was not possible in our study base as concentrations were measured in liver and egg samples only.

Table 21: % TOC in the one pooled soil sample

	TOC ug/mg dw	TOC % dw (2016)
soil	**41.5**	**4.15**

Table 22: BSAF ($EW_{lw}/Soil_{TOC}$)) and BMF on a lipid weight basis for fieldfare egg and fieldfare liver for PCB congeners

Compounds	BSAF($EW_{lw}/Soil_{TOC}$)	BMF($FFegg_{lw}/EW_{lw}$)	*BMF($FFliver_{lw}/EW_{lw}$)
PCB-28	0.79	-	-
PCB-52	0.49	3.24	2.57
PCB-101	1.27	9.95	4.74
PCB-118	-	-	-
PCB-138	1.01	13.1	5.37
PCB-153	1.50	17.6	7.00
PCB-180	0.57	24.3	11.3

*Average concentration of three FF liver samples was used

Unfortunately, very few other hydrophobic compounds were detected above LOD in both soil and earthworm, and the prey-predator pair earthworm and fieldfare. In addition to PCB congeners, only SCCP and MCCP had detectable concentrations.

Table 23: BMF (FF/EW) for SCCP and MCCP

Compounds	BMF($FFegg_{lw}/EW_{lw}$)	*BMF($FFliver_{lw}/EW_{lw}$)
SCCP	0.26	0.89
MCCP	0.16	0.89

**Average concentration of three liver samples were used where LOD values were multiplied by ½.*

Only one sample of fieldfare liver had detectable concentrations of both SCCP and MCCP. If only this location is used the BMF becomes slightly above 1 with 1.4 and 1.1 for SCCP and MCCP, respectively.

None of the other hydrophobic compounds had detectable concentrations for calculation of BSAF and BMF.

PFAS compounds

Some previous studies have revealed correlation between organic content in soil and PFAS concentrations, and BSAF (or BAF) has in some cases been calculated with wet weight concentration for earthworm divided by soil concentration normalized to TOC (Rich et al. 2015; Conder et al. 2020). The BAF calculations in the present study were done on a wet weight basis for both soil and earthworm.

BAF= C_{EW} (ng/g ww) / C_{soil} (ng/g ww)

BMF was also calculated on a wet weight basis for fieldfare (FF) as predator and earthworm (EW) as prey. The one sample of fieldfare egg and the three fieldfare liver samples divided by the one earthworm sample for detected concentrations.

BMF= C_{FF} (ng/g ww) / C_{EW} (ng/g ww)

Table 24: BAF(C_{EW} / C_{soil} l) and BMF(C_{FF} / C_{EW}) values for PFAS compounds with detected concentrations on a wet weight basis.

Compounds	n=1 for Soil and EW *BAF $(EW/soil)_{ww}$	n=1 for EW and FF_{egg} BMF $(FF_{egg}/EW)_{ww}$	n=3 for FF_{liver}, n=1 for EW BMF_{mean} $(FF_{liver}/EW)_{ww}$
PFOA	4.23	1.23	0.59
PFNA	2.67	3.41	1.44
PFDA	3.38	11.0	5.06
PFUnDA	-	5.58	1.99
PFDoDA	-	11.7	3.92
PFTrDA	-	4.90	1.98
PFTeDA	-	5.79	2.19
PFHxDA	-	1.11	0.35
PFHpS	-	0.18	0.17
PFOS (sum)	25.1	7.85	2.27
8:2FTS	-	4.80	4.65

*Concentrations in soil for PFUnDA-PFHxDA, PFHpS and 8:2 FTS were below LOD

The general conclusion is that these bioaccumulation calculations first and foremost can indicate which compounds that are more likely to bioaccumulate with BSAF/BAF and BMF well above 1, and others that are more uncertain with lower values below and near 1. Further, using egg from fieldfare give higher magnification (BMF) for most compounds compared to BMF based on liver concentration of fieldfare.

2.4 Conclusion and recommendations

The third period (2021-2025) of the urban terrestrial monitoring programme included several new species, new pollutants in some of the contaminant classes, and some new contaminant groups. In 2021, the new species monitored were roe deer (liver), vegetation (rowan tree leaves), bees, spiders and Spanish slug. In addition, liver samples were analysed in addition to egg samples of fieldfare. New pollutant class was phthalates in the one pooled soil sample.

The most important findings were:

- Possible risk of secondary poisoning in predators due to elevated Cd, Pb and As levels in some of the investigated species;
    - Cd and Pb concentration in earthworms exceeded the PNECoral value for predators of earthworms.
    - The one pooled sample of brown rat liver exceeded the PNECoral value for As for predators.
- High levels of Trifluoro acetic acid (TFA) in some samples
    - TFA had higher concentration than PFOS in rowan, roe deer liver, bees and Spanish slug.
- Possible risk of secondary poisoning in predators of fieldfare eggs due to elevated PFOS levels
    - Highest concentration of PFOS was 120 ng/g ww and detected in the one pooled fieldfare egg which exceeded the PNECoral of 37 ng/g ww for secondary poisoning of predators.
- MCCPs were the dominating CP class in all samples
    - MCCPs had higher concentration than SCCPs in the samples, and highest concentration of MCCPs were detected in brown rat liver and Spanish slug.
- The UV protecting compound homosalate detected in all analysed samples
    - Highest number of UV compounds and highest concentrations were detected in rowan leaves. Homosalate dominated with a median relatively high concentration of 40 ng/g ww in rowan.
- Bromadiolone in one red fox liver sample (268 ng/g) exceeded the assumed threshold for liver poisoning in field foxes with a liver threshold of 0.2 mg/kg.
- Phthalates in soil was dominated by DEHP
    - DEHP (40.6 ng/g dw) was the dominated phthalate compound measured in the one pooled soil sample
- Bioaccumulation
    - Bioaccumulation was investigated with the use of field based calculations of BSAF and BMF, where several PCBs and PFAS compounds revealed values >1, i.e. indicating biomagnification.

Recommendations

- The use of only one pooled sample across three locations reduces the possibility of evaluating potential pollution sources, in addition excluding the possibility to compare to previous results from the two program periods. However, as a screening for new compounds, one pooled sample may be an appropriate compromise.
- In order to use TMF calculations it is recommended to have similar number of samples at lower and higher trophic levels, at least three trophic levels, rather muscle than liver samples, and organism related by diet through the food web.

- It is recommended, if possible, to collect Spanish slug samples at the same locations as soil and earthworm in order to assess biota-soil accumulation (BSAF) factor and for comparison of concentrations between earthworm and Spanish slug.

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3 Appendix 1: Material & Methods

3.1 Sampling and matrices

Soil and earthworms

Soil and earthworm samples were collected at the same three locations (Table 24, Figure 5). The upper layer of 0-20 cm of soil was sampled and at three locations at each site, combining the three subsamples to one pooled sample per location. In cases where the site was connected to a transition between forest and open field, samples were taken in the forest, in the field and between. For earthworms, pooled samples at each site consisted of 15-20 individuals. To purge their guts, earthworms were kept in aluminium covered plastic containers, and lined with moist paper sheets for three days before being frozen at -20°C.

Table 25: Locations for soil and earthworm sampling.

Location for soil and earthworms	Date	Soil depth	Site description
Alnabru	August 4	12-13 cm	The samples were collected in the green corridor along the river Alna.
Svartdalsparken	August 4	10-16 cm	Park area for recreation and playground. Samples taken in birch forest near park and river.
Steinbruvannet	August 4	14-16 cm	Forest near freshwater lake, samples taken near track

Figure 5: Soil and earthworm sampling near Steinbruvannet

Fieldfare eggs

Two fieldfare eggs were collected 11th of May 2021 from each of three nest locations at Alnabru, Svartdalsparken and Grønmo, 6 eggs in total, under permission from the Norwegian Environment Agency. The laying order of the eggs was not taken into account when collecting the eggs to avoid disturbing the nest more than necessary. The eggs were kept individually in polyethylene bags in a refrigerator (+4°C), before being shipped by express mail to NINA for measurements and emptying. When emptying, the whole content of the eggs was removed from the shell, homogenized and stored in a clean glass before storage at – 20°C. The weight of the eggs varied from 6.2 to 6.9 grams.

Fieldfare chicks

The goal was to collect fieldfare chicks from the same nest as eggs were collected, if the eggs had hatched and the chicks survived. This was successfully obtained for 3 of the nests, while 2 nests disappeared along the way due to predation or other reasons. An extra nest was found with chicks at Ekeberg, and we therefore collected 8 fieldfare chicks from 4 nests in total, during the period 19th of May to 7th June 2021. The body mass ranged from 66 to 76 grams, and they were approximately 8-12 days old. Fieldfare chicks leave the nest at the age of 12-16 days. Chicks were sacrificed with a fast blow to the head followed by cervical dislocation. They were put in zip lock plastic bags and stored at -20°C before being shipped by express mail to NINA for measurements and dissection. The livers of siblings were stored together in a clean glass at – 20°C, before being sent frozen by express mail to NILU. Liver samples were analysed from the following three locations, Svartdalsparken, Alnabru II and Ekeberg.

Brown rat

Two male individual brown rats were caught during wintertime (15th of March 2021) using clap-traps (avoiding rat poison) at the ROAF recycle station near Lillestrøm. The rats were placed in the freezer as fast as possible on the day of collection and stored at -20°C before being shipped by express mail to NINA for measurements and dissection. The bodyweight of the two rats making the one pooled sample was 83 and 266 g. The rat livers were sent frozen packed in aluminium foil in zip locked bags by express mail to NILU for analyses.

Roe deer

Liver samples were collected from three individual roe deers. One roe deer was collected by wildlife managers from Oslo Kommune, after being killed by road traffic. The specific location and date for this were unknown, and we refer to this location as Oslo X. The roe deer was stored at -20°C before being transported frozen by car to NINA for measurements and dissection. Another roe deer was killed by road traffic and collected 23rd of May 2021 at Bærums Verk. The third roe deer was shot, because of a broken leg, and collected 20th of April 2021 by a wildlife manager at Nesoddtangen. The roe deers from Bærums Verk and Nesoddtangen were dissected by a wildlife manager. The entire liver was removed, wrapped in aluminum foil and stored in zip-lock bags at -20°C before being shipped by express mail to NINA. The two deers from Bærums Verk and Nesoddtangen weighted 25 kg, while body mass could not be obtained from the one from Oslo due to body damage from the traffic incident. All three were adult female roe deers.

Rowan

We collected and analysed leaves included stem from rowan trees (Figure 6). The rowan samples (more than 200 gram fresh weight per sample) were collected in mixed forests at three locations, Alna, Ekeberg and Kjelsås. At each location, rowan samples were collected from 2-4 rowan tress within 100 m circumference. Sampling took place the 13th of August and 31st of August 2021. Samples were put in aluminium foil and plastic zip-lock bags and by standard mail to NILU on the same dates as collected.

Figure 6 Rowan was collected at Alna in a mixed forest near road. The inlet picture at the top rigth shows the sampling unit; Leaves with stem.

Figure 7: Mixed forest, Ekeberg (outerpart of Ekebergsletta

Figure 8: Kjelsås, mixed forest at a park near residencial area

Honeybee, bumble bee and spiders

We aimed at collecting Honeybees (*Apis mellifera*), Pisauridae spiders (*Dolomedes fimbriatus* / *Pisaura mirabilis*) and bumble bees (*Bombus* ssp) from Oslo. After discussion with the Norwegian Environment Agency and in the project group, it was decided that minimum 50 individuals from each group from the three localities / areas, a total of 450 individuals, would be collected during the summer of 2021. We selected three areas where we assumed that all groups could be collected; Bygdøy, Maridalen and Nøklevann. The sites were surveyed 2-3 times each, a total of 6 days of survey; 15th of June (Maridalen), 23rd of June (Nøklevann), 11th of August (Bygdøy), 12th of August (Maridalen), 17th of August (Bygdøy, Nøklevann), and 26th of August (Nøklevann).

All individuals were collected with standard insect nets. The individuals were collected live directly from the net to 2 or 8 ml polypropylene tubes with screw cap 8 ml. The individuals were thus not affected or touched by anything else then the net and the tube. The tubes with the collected material were transferred at the end of the field day to a -20°C freezer for euthanasia and preservation. Bumble bees and spiders were inspected using a magnifying glass through the tubes and without taking the material out of the tubes.
Honeybees: Three relevant honeybee farms were found in the three areas, Nøklevann, Maridalen and Bygdøy. All the bees collected were workers (drones were avoided), probably Krainer breed. The bees were collected from different hives at the different honeybee farms.

Spiders: Several sites within the three focal areas were searched for relevant spiders. It proved difficult to find enough species within the family Pisauridae, and therefore individuals from the family Lycosidae were also collected. Only at the site at Nøklevann, 49 *Dolomedes* were found. At Bygdøy only Lycosidae (*Pardosa* sp1) were collected, while at Maridalen 1 *Dolomedes*, 4 *Pisaura* and 47 *Pardosa* sp1 were collected. It is highly probable that all the individuals of *Pardosa* sp1 belong to the same species.

Bumble bees: In order to limit the extent of the surveys, it was decided to collect all bumble bees regardless of species. It is challenging to inspect and determine species through the tubes., and the species determination is somewhat rough. The main part of the material consisted of the *Bombus lucorum* species complex, common carder bee (*Bombus pascuorum*) and red-tailed bumblebee (*B. lapidarius*) and/or *B. wurflenii*.

Figure 9: By-Bi bee farm at Bygdøy

Figure 10: Nøklevann site at Sørli farm/Bøler

Spanish slug

Spanish slugs (at least 20 gram per sample) were collected at Nordstrand in the period 06.09-12.09.21; i.e. park and pond with birch forest near residential area at Nordstrand. Park surrounded by residences and roads. The samples were put in aluminium foil and plastic zip-lock bags and stored at -20°C, before being sent frozen to NILU by express mail.

Figure 11: Sampling location for Spanish slug, Nordstrand.

Red fox

Five red foxes were collected in 2021 for the analyses of biocides. Two individuals were shot by a local hunter at Hellerudmyra. Three red foxes were killed by road traffic and collected by wildlife managers. Two of these foxes came from Bærum and one from Oslo, but the exact locations and dates were unknown, and we refer to these locations as Bærum X and Oslo X. All the foxes were stored at -20°C, before being transported frozen to NINA by car or express mail for measurements and dissection. Among the collected foxes, there were three females and two males. Their sex was determined by inspection of the gonads (Morris, 1972). The weight of the five animals varied from 2.6 to 8.2 kg. The complete livers were removed and put in aluminium foil and plastic zip-lock bags, and subsequently sent frozen by express mail to NILU for chemical analyses.

3.2 Investigated environmental pollutants

In this study a total of 137 environmental pollutants were investigated. These included metals, seven PCB, PFAS, other BFR, three siloxanes (D4, D5 and D6), chlorinated paraffins (SCCP and MCCP), organic phosphorous compounds (OPFR), UV compounds, phthalates (soil), biocides (fox and rat samples). In addition the stable isotopes $\delta^{15}N$ and$\delta^{13}C$ were monitored. An overview over the analysed compounds is given in *Table 25*.

Table 26: Overview over analysed compounds.

Compounds	Abbreviation	CAS
Metals		
Chromium	Cr	7440-47-3
Nickel	Ni	7440-02-0
Copper	Cu	7440-50-8
Zink	Zn	7440-66-6
Arsenic	As	7440-38-2
Silver	Ag	7440-22-4
Cadmium	Cd	7440-43-9
Lead	Pb	7439-92-1
Mercury	Hg	7439-97-6
Gadolinium	Gd	7440-54-2
Antimony	Sb	7440-36-0
Tin	Sn	7440-31-5
Polychlorinated biphenyls (PCB)		
2,4,4'-Trichlorobiphenyl	PCB-28	7012-37-5
2,2',5,5'-Tetrachlorobiphenyl	PCB-52	35693-99-3
2,2',4,5,5'-Pentachlorobiphenyl	PCB-101	37680-73-2
2,3',4,4',5-Pentachlorobiphenyl	PCB-118	31508-00-6
2,2',3,4,4',5'-Hexachlorobiphenyl	PCB-138	35065-28-2
2,2',4,4',5,5'-Hexachlorobiphenyl	PCB-153	35065-27-1
2,2',3,4,4',5,5'-Heptachlorobiphenyl	PCB-180	35065-29-3
Per- and polyfluorinated alkyl substances (PFAS)		
PFCA (perfluorinated carboxylate acids)		
Trifluoro acetic acid	TFA	76-05-1
Perfluoro propanoic acid	PFPrA	422-64-0
Perfluorinated butanoic acid	PFBA	375-22-4
Perfluorinated pentanoic acid	PFPA	422-64-0
Perfluorinated hexanoic acid	PFHxA	307-24-4
Perfluorinated heptanoic acid	PFHpA	335-67-1
Perfluorinated octanoic acid	PFOA	375-95-1
Perfluorinated nonanoic acid	PFNA	335-76-2
Perfluorinated decanoic acid	PFDA	2058-94-8
Perfluorinated undecanoic acid	PFUnDA	307-55-1
Perfluorinated dodecanoic acid	PFDoDA	72629-94-8
Perfluorinated tridecanoic acid	PFTrDA	376-06-7
Perfluorinated tetradecanoic acid	PFTeDA	67905-19-5
Perfluorinated hexadecanoic acid	PFHxDA	16517-11-6

Compounds	Abbreviation	CAS
Perfluorinated octadecanoic acid	PFOcDA	16517-11-6
PFSA (Perfluorinated sulfonates)		
Perfluoro ethanoic sulphonate	PFEtS	354-88-1
Perfluoro propanoic sulphonate	PFPrS	423-41-6
Perfluorinated butane sulfonate	PFBS	375-73-5
Perfluorinated pentane sulfonate	PFPS	2706-91-4
Perfluorinated hexane sulfonate	PFHxS	108427-53-8
Perfluorinated heptane sulfonate	PFHpS	375-92-8
Perfluorinated octane sulfonate (linear)	PFOS	1763-23-1
Perfluorinated octane sulfonate (branched)	brPFOS	n/a
Perfluorinated nonane sulfonate	PFNS	17202-41-4
Perfluorinated decane sulfonate	PFDcS	67906-42-7
Perfluoroundecane sulfonate	PFUnS	441296-91-9
Perfluorododecane sulfonate	PFDoS	79780-39-5
Perfluorotridecane sulfonate	PFTrS	749786-16-1
Perfluorotetradecane sulfonate	PFTS	n/a
nPFAS (polyfluorinated neutral compounds)		
Perfluorooctane sulfonamide	PFOSA	754-91-6
N-(methyl)nonafluorobutanesulfonamide	N-MeFBSA	68298-12-4
N-ethyl-perfluorobutane-1-sulfonamide	N-EtFBSA	40630-67-9
Perfluorobutylsulphonamide	PFBSA	30334-69-1
N-Methyl perfluorooctane sulphonamide	MeFOSA	31506-32-8
N-Ethyl perfluorooctane sulfonamide	EtFOSA	4151-50-2
N-Methylperfluorooctanesulfonamidoethyl acrylate	MeFOSEA	25268-77-3
N-Methyl perfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7
N-Ethyl perfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2
Perfluorooctane sulfonamidoacetic acid	FOSAA	2806-24-8
N-Methylperfluoro-1-octanesulfonamidoacetic Acid	Me-FOSAA	2355-31-9
N-Ethyl perfluorooctanesulfonamidoacetic acid	Et-FOSAA	2991-50-6
newPFAS		
6:2 Fluorotelomersulfonate	6:2 FTS	27619-97-2
8:2 Fluorotelomersulfonate	8:2 FTS	481071-78-7
10:2 Fluorotelomersulfonate	10:2 FTS	120226-60-0
12:2 Fluorotelomersulfonate	12:2 FTS	149246-64-0
4:2 Fluorotelomersulfonate	4:2 FTS	757124-72-4
Cyclohexanesulfonic acid, decafluoro(pentafluoroethyl)	PFECHS	67584-42-3
BFR		
Decabromodiphenyl ethane	DBDPE	84852-53-9
2,4,6-tribromophenyl ether)	ATE (TBP-AE)	3278-89-5
α-1,2-Dibromo-4-(1,2-di-bromo-ethyl)cyclohexane	α-TBECH	3322-93-8
β-1,2-Dibromo-4-(1,2-di-bromo-ethyl)cyclohexane	β-TBECH	3322-93-8
γ/δ- 1,2-Dibromo-4-(1,2-di-bromo-ethyl)cyclohexane	γ/δ-TBECH	3322-93-8
2-bromoallyl 2,4,6-tribromophenyl ether	BATE	99717-56-3
1,2,3,4,5 Pentabromobenzene	PBBZ	608-90-2
Pentabromotoluene	PBT	87-83-2

Compounds	Abbreviation	CAS
Pentabromoethylbenzene	PBEB	85-22-3
Hexabromobenzene	HBB	87-82-1
2,3-dibromopropyl 2,4,6-tribromophenyl ether	DPTE	35109-60-5
2-Ethylhexyl 2,3,4,5-tetrabromobenzoate	EHTBB	183658-27-7
1,2-Bis(2,4,6-tribromophenoxy)ethane	BTBPE	37853-59-1
Bis(2-ethylhexyl) tetrabromophthalate	TBPH (BEH/TBP)	26040-51-7
α-Hexabromocyclododecane	α-HBCD	25637-99-4
β-Hexabromocyclododecane	β-HBCD	25637-99-4
γ-Hexabromocyclododecane	γ-HBCD	25637-99-4
Dechloranes and dibromo-aldrin		
Dechlorane plus syn	syn-DP	135821-03-3
Dechlorane plus anti	anti-DP	135821-74-8
Dechlorane 601	Dec-601	3560-90-2
Dechlorane 602	Dec-602	31107-44-5
Dechlorane 603	Dec-603	13560-92-4
Dechlorane 604	Dec-604	34571-16-9
Dibromoaldrin	DBA	20389-65-5
Cyclic volatile methyl siloxanes		
D4 - octamethylcyclotetrasiloxane	D4	556-67-2
D5 - decamethylcyclopentasiloxane	D5	541-02-6
D6 - dodecamethylcyclohexasiloxane	D6	540-97-6
Tris(trimethylsiloxy)phenylsilane	M3T (Ph)	2116-84-9
Chlorinated paraffins (CP)		
Short-chain chlorinated paraffins (C10-C13)	SCCP	85535-84-8
Medium-chain chlorinated paraffins (C14-C17)	MCCP	85535-85-9
Organic phosphorous flame retardants (OPFR)		
Tri(2-chloroethyl)phosphate	TCEP	115-96-8
Tris(2-chloroisopropyl) phosphate	TCPP/TClPP	13674-84-5
Tris(1,3-dichloro-2-propyl)phosphate	TDCPP/TDClPP	13674-87-8
Tris(2-butoxyethyl) phosphate	TBEP/TBOEP	78-51-3
2-etylhexyldiphenyl phosphate	EHDP/EHDPP	1241-94-7
Tricresyl phosphate	TCP	1330-78-5
Tri-n-butylphosphate	TBP/ TnBP	126-73-8
Tri-iso-butylphosphate	TBP/TiBP	126-71-6
Triethyl phosphate	TEP	78-40-0
Tripropyl phosphate	TPrP/TPP	513-08-6
Triisobutyl phosphate	TiBP	126-71-6
Butyl diphenyl phosphate	BdPhP	2752-95-6
Triphenyl phosphate	TPP/TPhP	115-86-6
Dibutylphenyl phosphate	DBPhP	2528-36-1
Trixylylphosphate	TXP	25155-23-1
Tris(4-isopropylphenyl)phosphate	TIPPP/T4IPP	26967-76-0
Tris(4-Tert-butylphenyl)phosphate	TTBPP	78-33-1
Tris(2-ethylhexyl)phosphate	TEHP	78-42-2

Compounds	Abbreviation	CAS
UV compounds		
Octocrylene	OC	6197-30-4
Benzophenone-3	BP3	131-57-7
Ethylhexylmethoxycinnamate	EHMC	5466-77-3
2-(5-Chloro-2H-benzotriazol-2-yl)-4,6-di-tert-butylphenol	UV-327	3864-99-1
2-(2H-Benzotriazol-2-yl)-4,6-di-tert-pentylphenol	UV-328	25973-55-1
Octrizole	UV-329	3147-75-9
Homomenthyl salicylate	Homosalate	118-56-9
Benzenepropanoic acid, 3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-hydroxy-	M1-UV328	84268-36-0
Phenols		
Tetrabromobisphenol A	TBBPA	79-94-7
4,4 Bisphenol A	4,4 Bis-A	80-05-7
2,4- Bisphenol A	2,4- Bis-A	837-08-1
2,4 Bisphenol S	2,4 Bis-S	5397-34-2
4,4 Bisphenol F	4,4 Bis-F	620-92-8
2,4 Bisphenol F	2,4 Bis-F	2467-03-0
Bisphenol G	Bis- G	127-54-8
Bisphenol FL	Bis-FL	3236-71-3
Bisphenol AP	Bis-AP	1571-75-1
Bisphenol Z	Bis-Z	843-55-0
Bisphenol E	Bis-E	2081-08-5
Bisphenol B	Bis-B	77-40-7
Bisphenol M	Bis-M	13595-25-0
AO-MB1	AO-MB1	118-82-1
4-Dodecylphenol	4-Dodecylphenol	104-43-8
4-n-Nonylphenol	4-n-Nonylphenol	104-40-5
4-n-Octylphenol	4-n-Octylphenol	1806-26-4
4-t-Octylphenol	4-t-Octylphenol	140-66-9
Biocides (rodenticides)		
Bromadiolon		28772-56-7
Brodifacoum		56073-10-0
Flocumafen		90035-08-8
Difenacoum		56073-07-5
Difethialone		104653-34-1
Permethrin		52645-53-1
Phthalates		
Di (2-ethylhexyl)phthalate	DEHP	117-81-7
Di(2-propylheptyl) + Di-isodecyl phthalate	DPHP+DiDP	53306-54-0 +68515-49-1
Di-isononyl phthalate	DiNP	28553-12-0
Di-isobutyl phthalate	DiBP	84-69-5
Di-n-butyl phthalate	DnBP	84-74-2

3.3 PNEC values

*Table 27: PNEC values for **Soil ecosystem** with references. Most data adopted from Andersen et al 2012[7], EU risk assessment reports (EU RAR), Environment Agency risk evaluation reports (EA ERAR) and European Chemicals Agency, http://echa.europe.eu. Entries with font coloured in grey are second priority due to assumed less reliability.*

Compound	$PNEC_{Soil}$	Unit in soil	Reference	Safety factor	Endpoint
BPA (4,4 Bis-A)	3.2	mg/kg dw	EU RAR BPA	10	Calculated from PNECaquatic –D. magna
TBBPA	0.012	mg/kg dw	EU draft RAR TBBPA	10	Earthworm reproduction
PentaBDE	0.38	mg/kg dw	TA-2625	50	
OctaBDE	20.9	mg/kg ww	EU RAR 2003	50	Phytotoxicity
DecaBDE	98	mg/kg ww	EU RAR 2002	50	
HexBDE	1.2	mg/kg ww	EU RAR 2003	50	Phytotoxicity
TriBDE	20.9	mg/kg ww	Using Octa BDE value	50	Phytotoxicity
TetraBDE	20.9	mg/kg ww	Using Octa BDE value*	50	Phytotoxicity
HeptaBDE	20.9	mg/kg ww	Using Octa BDE value	50	Phytotoxicity
NonaBDE	20.9	mg/kg ww	Using Octa BDE value	50	Phytotoxicity
Cyclic siloxane (D4)	0.16	mg/kg ww	EA ERA 2009 Octamethylcyclotetra-siloxane		PNEC for water, equilibrium partitioning method
Cyclic siloxane (D4)	0.15	mg/kg dw	European Chemicals Agency,		partition coefficient
Cyclic siloxane (D5)	4.8	mg/kg ww	EA ERA 2009 Decamethylcyclo-pentasiloxane		PNEC for water, equilibrium partitioning method
Cyclic siloxane (D5)	3.77	mg/kg dw	European Chemicals Agency	100	
Nonylphenols	0.3	mg/kg dw	European Chemicals Bureau, 2002	10	Earthworm reproduction
Octylphenols	0.0067	mg/kg dw	Environmental Agency (UK) 2005	10	Calculated from PNECaquatic-mysid M. bahia
4-tert-octylphenol	0.0059	*mg/kg ww*	EA RER 2005 4-tert-octylphenol	Large uncertainty	PNEC surface water and equilibrium partitioning
4-tert-octylphenol	2.3	mg/kg dw	European Chemicals Agency,	10	
MCCP	11.9	mg/kg dw	European Chemicals Agency,	10	
SCCP	5.95	mg/kg dw	European Chemicals Agency,	20	
MCCP	10.6	mg/kg ww	EU RAR addendum 2007	**10**	Earthworm reproduction
SCCP	1.76	mg/kg ww	EU RAR addendum 2008	**0**	LogKow estimation- no safety factor
TFA	4.7	**ng/g dw**	ECHA Chemical information (Scientific Properties)		Secondary poisoning: No potential for bioaccumulation (1)
PFOA	0.16	mg/kg dw	TA-2444/2008	100	Worm reproductivity
PFOS	0.373	mg/kg dw	pfos.uk.risk.eval.report.2004	1000	Worm toxicity

[7] Andersen, S., Gudbrandsen, M., Haugstad, K., Hartnik, T. (2012) Some environmentally harmful substances in sewage sludge - occurrence and environmental risk. Oslo, Norwegian Climateand Pollution Agency (TA-3005/2012). (In Norwegian).

Compound	$PNEC_{Soil}$	Unit in soil	Reference	Safety factor	Endpoint
$SumPCB_7$	0.01	mg/kg dw	Aquateam rapport nr 06-039	50	Calculated from aquatic data
TCEP	0.386	mg/kg dw	EURAS, 2009	50	Folsomia candida 28 d exposure
TCPP	1.7	mg/kg dw	EU RAR TCPP	10	Spiring Lactuca sativa
TCPP	1.33-1.7	mg/kg dw	Echa Chemical Information		
TDCP/TDCPP	0.33	mg/kg dw	EU RAR 2008	10	57d NOEC reproduction toxicity E.foetida
TBEP	0.81	mg/kg dw	TA-2784	EqP	Calculated
EHDPP	0.302	mg/kg ww	Environmental Agency (UK), 2009	10	Estimated from aquatic data
TCP	0.0027	mg/kg dw	EU-RER	10	Spiring Lactuca sativa
TBP/TnBP	5.3	mg/kg dw	TA-2784	EqP	Based on LogKow
TBP/TnBP	0.64	mg/kg dw	ECHA-Registration dossier		
TIBP	0.64	mg/kg dw	TA-2784	EqP	Based on LogKow
DEHP	13	mg/kg dw	ECHA Chemical information (Scientific Properties)		
DiNP	30	mg/kg dw	ECHA Chemical information (Scientific Properties)		No potential for bioaccumulation
DPHP	26.5	mg/kg dw	ECHA Chemical information (Scientific Properties)		No potential for bioaccumulation
DnBP	50	**ng/g dw**	ECHA Chemical information (Scientific Properties)		
DiBP	23.1	**ng/g dw**	ECHA Chemical information (Scientific Properties)		No potential for bioaccumulation
UV-328 (25973-55-1)	90	mg/kg dw	ECHA Chemical information (Scientific Properties		
UV-329 (3147-75-9)	10	mg/kg dw	ECHA Chemical information (Scientific Properties		No potential to cause toxic effects if accumulated (in higher organisms) via the food chain
OC (6197-30-4)	1.25	mg/kg dw	ECHA Chemical information (Scientific Properties		No potential to cause toxic effects if accumulated (in higher organisms) via the food chain
Homosalate	54.11	mg/kg dw	ECHA Chemical information (Scientific Properties		No potential to cause toxic effects if accumulated (in higher organisms) via the food chain
BP3 (131-57-7)	13	**ng/g dw**	ECHA Chemical information (Scientific Properties		Additional info: No potential for bioaccumulation
Cd	1.15	mg/kg dw	European chemicals Bureau, 2007	2	*SSD: species sensitivity distribution*

Compound	$PNEC_{Soil}$	Unit in soil	Reference	Safety factor	Endpoint
Cd	0.9	mg/kg dw	European Chemicals Agency,		
Cr	62	mg/kg dw	European chemicals Bureau, 2005	3	Estimated from aquatic data
Cu	89.6	mg/kg dw	European chemicals Bureau, 2008	2	SSD
Cu	65	mg/kg dw	European Chemicals Agency		
Hg	0.3	mg/kg dw	Euro-chlor, Voluntary risk assessment, Mercury, 2004	1000	Background value Soil
Hg	0.022	mg/kg dw	European Chemicals Agency,		
Ni	50	mg/kg dw	VKM report 2009	2	SSD
Pb	166	mg/kg dw	EURAS, 2008	2	SSD
Pb	147-212	mg/kg dw	European Chemicals Agency,		
Zn	26	mg/kg dw	VROM, 2008	2	SSD
Zn	35.6	mg/kg dw	European Chemicals Agency,		
As	0.7	mg/kg dw	Reimann et al. (2017)[8]		

*Table 28: **$PNEC_{oral}$ values (mg/kg in food)** for secondary poisoning with references. Most data adopted from Andersen et al 2012, EU risk assessment reports (EU RAR), Environment Agency risk evaluation reports (EA ERAR) and European Chemicals Agency, http://echa.europe.eu. Entries with font coloured in grey have second priority.*

Compound	$PNEC_{oral}$ mg/kg food	Reference	Safety factor	Endpoint
PCBs	0.001	INERIS: Annex VII PNEC values and hazard information for candidate substances, 2009. *Uncertainty to the value since not based on EU Risk Assessment report*		based on TDI of 0.02 µg/kg bw/day for total PCBs via diet (WHO, 2003 & ATSDR, 2000) and TDI of 0.01 µg/kgbw/day for total PCBs, via diet (RIVM, 2001)
PCB153	0.67	TemaNord 2011: 506. ISBN 978-92.893-2194-5 Using Sludge on Arable Land (Table 7)	20	RIVM (1995) Risk assessment of bioaccumulation in the food webs of two marine AMOEBE species: common tern and harbor seal. RIVM Report 719102040.
BPA	2.67	EU RAR BPA add	30	Three generation feeding study of rats
TBBPA	667	(mammalian) EU RAR TBBPA	30	2-generation rat reproduction study
PentaBDE	1	EU Risk assessment-Diphenyl Ether, Pentabromo derivative Final Report, August 2000	10	30 day oral rat study-liver effects
OctaBDE	6.7	EU Risk assessment-Diphenyl Ether, Octabromo derivative Final Report, August 2003	10	Rabbit phetotoxicity
DecaBDE	833	DecaBDE, EA-ENvRA-2009	30	Rat, two years carcinogenicity study
PFOS	0.067	Brooke et al. 2004	30	Rat liver effects, chronic study NOEC 2mg/kg

[8] Reimann et al. (2017). GEMAS: Establishing geochemical background and threshold for 53 chemical elements in European agricultural soil. Applied Geochemistry

Compound	$PNEC_{oral}$ mg/kg food	Reference	Safety factor	Endpoint
		http://www.environment-agency.gov.uk/		
PFOS	0.017	Brooke et al. 2004	30	Rat liver effects, chronic study Lowest no effect 0.5 ppm
PFOS	0.037	RIVM 2010 http://www.rivm.nl/dsresource?objectid=rivmp:15878&type=org&disposition=inline&ns_nc=1	90	NOAEL of 0.1 mg/kgbw/d for maternal weight gain from a teratogenicity study
PFOS	0.033	European Commission. 2011. Perfluorooctane sulfonate. PFOS Environmental Quality Standard (EQS) dossier. Brussels, Belgium.		QSbiota (secondary poisoning: predators)
PFOS	0.33	Newsted et al 2007, in Appendix 3, RIVM 2010	30	21 weeks, bodyweight, reproduction, NOEC, northern bobwhite quail
PFOA	0.9E-03	Valsecchia et al 2016 doi:10.1016/j.jhazmat.2016.04.055	90	Developmental abnormalities in mice
HCB	0.0167	Science Dossier http://www.eurochlor.org/media/90477/sd16-hcbaquaticra-final.pdf	30	NOEC mink 0.5 mg/kg
DEHP	3.3	ECHA Chemical Information		
DnBP	1.33	ECHA Chemical Information		https://echa.europa.eu/brief-profile/-/briefprofile/100.001.416
Cyclic Siloxane (D4)	1.7	EA ERAR 2009 Octamethylcyclotetra-siloxane	300	Rat liver effects
Cyclic Siloxane (D4)	41	Source: European Chemicals Agency, http://echa.europa.eu/	90	
Cyclic Siloxane (D5)	13	EA ERAR 2009 Decamethylcyclopenta-Siloxane,	30	Repeated exposure, liver effects
Cyclic Siloxane (D5)	16	Source: European Chemicals Agency, http://echa.europa.eu/	90	
Cyclic Siloxane (D6)	66.7	Source: European Chemicals Agency, http://echa.europa.eu/	300	
Cyclic Siloxane (D6)	50-100	EA ERAR 2009	300	Reproduction NOAEL rat
Nonylphenols	10	EU RAR nonylphenol	10	Rat multi-generation study, reproduction effect
Octylphenols	10	Environmental Agency (UK) 2005	30	Rat, two-generation study, systemic and postnatal toxicity
4-tert-octylphenol	10	EA RER 2005 4-tert-octylphenol	30	
4-tert-octylphenol	2.36	Source: European Chemicals Agency, http://echa.europa.eu/	30	

Compound	$PNEC_{oral}$ mg/kg food	Reference	Safety factor	Endpoint
MCCP	10	EU RAR addendum 2007	30	Rat, 90 days study, kidney effects
SCCP	5.5	EU RAR addendum 2008	30	Reproduction effects on wild duck
TDCP	3.3	EU RAR 2008	30	Two-years carcinogenicity rat study
EHDPP	1.1	Environmental Agency (UK) 2009	90	Rat 90 d oral exposure
TCP	1.7	EA RER 2009 (1330-78-5)	30	Two-years reproduction mouse study
TCPP	11.6	EU RAR TCPP 2008	90	Rat, 13 weeks study, liver effects
DEHP	3.3	ECHA chemical information (scientific information)		
UV-328	13.2	ECHA chemical information (scientific information)		
Cd	0.16	EU RAR	10	Based on 4 studies with birds and 5 studies with mammals
Hg and inorganic compounds	0.02	INERIS: Annex VII PNEC values and hazard information for candidate substances, 2009.	10	CIRCA data sheet, Dir. 2008/105/EC NOEC: 0.22 mg/kg_food Rhesus monkey, 1 year, growth
Hg	0.4	2009, Munoz et al.	10	NOEC 4 mg/kg food for Coturnis c. Japonica.
Ni	8.5	EU RAR Ni 2008	10	Wild duck, tremor effects observed in chickens at day 28
Pb	3.6	Lead Water Framework Directive EQS dossier 2011	15	SSD
Bromadiolone	0.00019-0.00044	Directive 98/8/EC concerning the placing of biocidal products on the market 2010, Bromadiolone	90	NOAEL (mammals)
Permethrin	0.22	INERIS: Annex VII PNEC values and hazard information for candidate substances, 2009.	90	

EU RAR: EU Risk Assessment report

EA RER: Environmental Agency Risk Evaluation Report

3.4 Biomagnification

Field derived trophic magnification factor (TMF) can be useful to evaluate bioaccumulation when diet is the major route of exposure. TMF is a measure for biomagnification of a chemical within food web, and represents the average diet-to-consumer transfer of a chemical through food webs. TMF differs from biomagnification factors, which apply to individual species and can be highly variable between predator-prey combinations. The TMF is calculated from the slope of a regression between the chemical concentration and trophic level (TL) of organisms in the food web. The trophic level can be determined from stable N isotope ratios, $\delta^{15}N$ (Borgå et al. 2012). The general scientific consensus is that chemicals are considered bioaccumulative if they exhibit a TMF > 1.

The recommended TL equation for determining trophic magnification factor for application under the European Union Water Framework Directive (Kidd et al., 2019), and has been used for a terrestrial food chain (Huang et al. 2022):

TL (consumer)= 2 + ($\delta^{15}N_{consumer} - \delta^{15}N_{baseline}$)/3.4

where TL(consumer) is the TL of the organism/consumer, and $\delta^{15}N_{consumer}$ and $\delta^{15}N_{baseline}$ are the $\delta^{15}N$ data for an organism and the baseline species, respectively, 2.0 is the assumed TL of the baseline species.

3.4 is a recommended isotopic (trophic) enrichment factor which in principle may vary from limnic to terrestrial food webs. A value of 3.4‰ per TL step has been recommended for constructing food webs without a priori knowledge of Δ15N or the ecology of the system (Kidd et al., 2019).

Kidd et al., 2019 recommended that the TMF study ideally includes species and individual organisms that range over at least 3 TLs to achieve the objective of quantifying biomagnification potential of a chemical.

Trophic magnification factors (TMFs) were calculated as the power of 10 of the slope (b) of the linear regression between log concentration and the samples TL.

Log [compound] = a + *b*TL

TMF = 10^b

Bioaccumulation and biomagnification factors, BSAF and BAF

Field based bioaccumulation factor (BAF) or biota-soil accumulation factor (BSAF) can be used to evaluate potential bioaccumulation from soil to soil living species such as earthworm.

For hydrophobic compounds such as PCBs, BFRs, siloxanes, UV compounds, the BSAF is normally calculated with concentrations normalized with respect to total organic content (TOC) in soil and lipid normalized concentrations in biota.

BSAF= C_{EW} (ng/g lw) / C_{soil} (ng/g TOC)

For PFAS, BSAF (or BAF) has in some cases been calculated with wet or dry weight concentration for earthworm divided by soil concentration normalized to TOC or dry weight (Rich et al. 2015; Conder et al. 2020).

BMF for hydrophobic compounds are calculated as lipid normalized concentration in consumer (predator) divided by lipid normalized concentration in diet (prey). This is normally done for whole body concentrations or muscle concentrations. For PFAS, wet weight concentrations or protein normalised concentrations are most relevant to use for BMF calculations (Savoca and Pace, 2021).

BMF= $C_{predator}$ (ng/g lw) / C_{prey} (ng/g lw) for hydrophobic compounds

3.5 Analytical procedures

3.5.1 Sample preparation and quality assurance

In order to get sufficient material for analysis of the various chemical classes in each sample type, samples were pooled together for earthworms, fieldfare eggs and brown rat liver samples. Pooled earthworm samples per site consisted of as many individuals as possible, in general 15-20 individuals. Samples of fieldfare eggs consisted of two eggs from the same nest in order to get sufficient material for all the analysis. One pooled sample were used for the brown rat liver consisting of two individual liver samples of the same gender from the same location. For bees and spiders many individuals made up the pooled samples.

All of the work with sample homogenisation were done in clean cabinet or clean room. In addition a clean cabinet/clean room was used for sample extraction and clean-up for several compound classes such as: siloxanes, phthalate and OPFR.

A short description of sample preparation, extraction and analytical method are given in the QA/QC tables, and more detailed description can be found in report from the previous program period (Heimstad et al., 2021).

3.6 QA/QC

In Table 28 there is a short method description, including LOQ and an assessment and categorization of the uncertainty for every individual compound analysed. The uncertainty is divided in three groups from 1 to 3.

Group 1 includes the compounds with the highest certainty. For the compounds in this group the method is well established, both at NILU and NIVA, and internationally. This means that the quality of the analysis has been proven with intercalibration studies, and quality parameters are good. Most of these analyses is accredited according to ISO 17025.

Group 2 includes the compounds with medium certainty. The internal control parameters in the lab are good, the method is fit for purpose, but the quality cannot, or have not been proven within intercalibration studies. These groups also include parameters that have been tested in intercalibration studies, but the results within the studies show that the uncertainty of this analysis still is high (typically more than 50%).

Group 3 includes the compounds with the highest uncertainty. This could be due to not satisfying recovery data, method not fit for purpose, high variability in blanks, or others. There will be comments on all these parameters.

Table 29: Quality of analytical procedures for the various parameter groups and single parameters, including LOD or LOQ and uncertainty category.

Parameter group	Name of parameter	Cas nr	Blank	LOD range mg/kg	LOQ range mg/kg	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
Metals	Hg	7440-02-0	Method blanks following sample series. LOD/LOQ based on calculation of 3 and 10 stddev respectively	0.0001-0.0002	0.0002-0.0004	In-house accredited method. Microwave assisted decomposition with HNO3. Digestate split and one aliquot stabilized with HCl for subsequent determination of total-Hg. Analysis by ICP-MS (Agilent 7700x). CRM digested and analysed in every run	1	
	Cr	7440-47-3		0.0002-0.0003	0.0007-0.001		1	
	Ni	7440-02-0		0.0002-0.0003	0.0007-0.001		1	
	Cu	7440-50-8		0.003-0.005	0.01-0.02		1	
	Zn	7440-66-6		0.5-0.8	2-3		1	
	As	7440-38-2		0.0001-0.0002	0.0004-0.0006		1	
	Ag	7440-22-4		0.0005-0.0008	0.002-0.003		1	
	Cd	7440-43-9		0.00002-0.00004	0.0008-0.0001		1	
	Sb	440-36-0		0.0007-0.0001	0.0002-0.0004		1	
	Sn	7440-31-5		0.0005-0.0009	0.002-0.003		2	Not accredited
	Gd	7440-54-2		0.000006-0.00001	0.00002-0.00003		2	Not accredited
	Pb	7439-92-1		0.0005-0.0008	0.002-0.003		1	

Parameter group	Name of parameter	Cas nr	Blank	LOD range ng/g	LOQ range ng/g	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
PCB	PCB 28	7012-37-5	Method blanks following sample series. LOD/LOQ based on calculation of 3 and 10 stddev respectively	0.001-0.03	0.003-0.1	In-house, accredited method. Internal standard addition, extraction, GPC and/or H_2SO_4 cleanup followed by adsorption chromatography. Analysis was performed on a GC/HRMS (autspec)	1	Y
	PCB 52	35693-99-3		0.002-0.07	0.004-0.2		1	Y
	PCB 101	37680-73-2		0.001-0.1	0.003-0.3		1	Y
	PCB 118	31508-00-6		0.001-0.1	0.003-0.4		1	Y
	PCB 138	35065-28-2		0.001-0.5	0.004-1.4		1	Y
	PCB 153	35065-27-1		0.002-0.7	0.006-2		1	Y
	PCB 180	35065-29-3		0.001-0.2	0.004-0.5		1	Y

Parameter group	Name of parameter	Cas nr	Blank	LOD range ng/g	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
PFAS, soil	TFA	76-05-1	One blank pr batch. LOD calculated from average blanks + 3 x stdevs. If no peak present noise in the chromatogram was used as a proxy.		The weighed soil sample was added 1 ml of MilliQ water and 13C internal standard. Precisely 1 ml of 200 mM NaOH in methanol is added. Let stand and soak for 30 min. Add exactly 100 µl 2M HCl in methanol plus 9 ml methanol. The sample was vortex-mixed before treated three times for 10 min in ultrasonic bath with vortex in between, followed bu centrifugation. The supernatant is up-concentrated and cleaned up with suspensive EnviCarb treatment under acidic conditions. After addition of the RSTD, samples are ready for LC/MS measurements. With each sample batch a blank and a reference material sample must be run (for more than 20 samples one each 20th samples).	2	N
	PFPrA	422-64-0				2	N
	PFBA	375-22-4		0.50-1.0		2	y
	PFPA	422-64-0		0.15-1.0		2	Y
	PFHxA	307-24-4		0.05-0.15		1	y
	PFHpA	335-67-1		0.05-0.15		1	y
	PFOA	375-95-1		0.05-0.15		1	y
	PFNA	335-76-2		0.05-0.15		1	y
	PFDA	2058-94-8		0.05-0.15		1	y
	PFUnDA	307-55-1		0.05-0.15		1	y
	PFDoDA	72629-94-8		0.05-0.15		1	y
	PFTrDA	376-06-7		0.15-0.50		1	N
	PFTeDA	67905-19-5		0.05-0.15		1	y
	PFHxDA	16517-11-6		0.15-0.50		1	N
	PFOcDA	16517-11-6		0.15-0.50		2	N
	PFEtS	354-88-1				2	N
	PFPrS	423-41-6				2	N
	PFBS	375-73-5		0.02-0.10		1	y
	PFPS	2706-91-4		0.02-0.10		2	N
	PFHxS	355-46-4		0.02-0.10		1	y
	PFHpS	375-92-8		0.02-0.10		1	N
	PFOS	1763-23-1		0.02-0.10		1	y
	brPFOS	-		0.02-0.10		1	N
	PFNS	17202-41-4		0.05-0.15		2	N
	PFDcS	67906-42-7		0.05-0.15		2	N
	PFUnS	441296-91-9		0.05-0.15		2	N
	PFDoS	79780-39-5		0.05-0.15		2	N
	PFTrS	749786-16-1		0.05-0.15		2	N
	PFTS*	n/a		0.50-1.0		3	N
	PFOSA	754-91-6		0.05-0.15		2	y
	N-MeFBSA	68298-12-4		0.05-0.15		2	N
	N-EtFBSA	40630-67-9		0.15-0.5		2	N
	PFBSA	30334-69-1		0.05-0.15		2	N

Parameter group	Name of parameter	Cas nr	Blank	LOD range ng/g	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
	MeFOSA	31506-32-8		0.05-0.15		2	N
	EtFOSA	4151-50-2		0.05-0.15		2	N
	MeFOSEA*	25268-77-3		0.50-1.0		3	N
	MeFOSE	24448-09-7		0.05-0.15		2	N
	EtFOSE	1691-99-2		0.05-0.15		2	N
	FOSAA	2806-24-8		0.05-0.15		2	N
	Me-FOSAA	2355-31-9		0.05-0.15		2	N
	Et-FOSAA	2991-50-6		0.05-0.15		2	N
	4:2 FTS	757124-72-4		0.10-0.50		2	N
	6:2 FTS	27619-97-2		0.10-0.50		2	y
	8:2 FTS	481071-78-7		0.10-0.50		2	N
	10:2 FTS	120226-60-0		0.10-0.50		2	y
	12:2 FTS *	149246-64-0		0.50-1.0		3	N
	PFECHS	67584-42-3		0.10-0.50		2	N

*	PFTS	No single standard available for these compounds. Retention time and MS settings based on similar isomers and literature references
	MeFOSEA	
	12:2 FTS	

Parameter group	Name of parameter	Cas nr	Blank	LOD range ng/g	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
PFAS, biota/vegetation	TFA	76-05-1	One blank pr batch. LOD calculated from average blanks + 3 x stdevs. If no peak present noice in the chromatogram was used as a proxy.		1-2 g of biota was homogenized and added internal standard before extraction with methanol followed by vortexing and sonication for 30min. After centrifugation the supernatant was up-concentrated and	2	Y
	PFPrA	422-64-0				2	Y
	PFBA	375-22-4		0.50-1.0		2	y
	PFPA	422-64-0		0.15-1.0		2	Y
	PFHxA	307-24-4		0.05-0.15		1	y
	PFHpA	335-67-1		0.05-0.15		1	y
	PFOA	375-95-1		0.05-0.15		1	y
	PFNA	335-76-2		0.05-0.15		1	y
	PFDA	2058-94-8		0.05-0.15		1	y

Parameter group	Name of parameter	Cas nr	Blank	LOD range ng/g	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
	PFUnDA	307-55-1		0.05-0.15	cleaned up with suspensive EnviCarb treatment under acidic conditions. After addition of the RSTD, samples are ready for LC/MS measurements. With each sample batch a blank and a reference material sample must be run (for more than 20 samples one each 20th samples).	1	y
	PFDoDA	72629-94-8		0.05-0.15		1	y
	PFTrDA	376-06-7		0.15-0.50		1	N
	PFTeDA	67905-19-5		0.05-0.15		1	y
	PFHxDA	16517-11-6		0.15-0.50		1	N
	PFOcDA	16517-11-6		0.15-0.50		2	N
	PFEtS	354-88-1				2	N
	PFPrS	423-41-6				2	N
	PFBS	375-73-5		0.02-0.10		1	y
	PFPS	2706-91-4		0.02-0.10		2	N
	PFHxS	355-46-4		0.02-0.10		1	y
	PFHpS	375-92-8		0.02-0.10		1	N
	PFOS	1763-23-1		0.02-0.10		1	y
	brPFOS	-		0.02-0.10		1	N
	PFNS	17202-41-4		0.05-0.15		2	N
	PFDcS	67906-42-7		0.05-0.15		2	N
	PFUnS	441296-91-9		0.05-0.15		2	N
	PFDoS	79780-39-5		0.05-0.15		2	N
	PFTrS	749786-16-1		0.05-0.15		2	N
	PFTS *	n/a		0.50-1.0		3	N
	PFOSA	754-91-6		0.05-0.15		2	y
	N-MeFBSA	68298-12-4		0.05-0.15		2	N
	N-EtFBSA	40630-67-9		0.15-0.5		2	N
	PFBSA	30334-69-1		0.05-0.15		2	N
	MeFOSA	31506-32-8		0.05-0.15		2	N
	EtFOSA	4151-50-2		0.05-0.15		2	N
	MeFOSEA*	25268-77-3		0.50-1.0		3	N
	MeFOSE	24448-09-7		0.05-0.15		2	N
	EtFOSE	1691-99-2		0.05-0.15		2	N
	FOSAA	2806-24-8		0.05-0.15		2	N
	Me-FOSAA	2355-31-9		0.05-0.15		2	N
	Et-FOSAA	2991-50-6		0.05-0.15		2	N
	4:2 FTS	757124-72-4		0.10-0.50		2	N
	6:2 FTS	27619-97-2		0.10-0.50		2	y

Parameter group	Name of parameter	Cas nr	Blank	LOD range ng/g	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
	8:2 FTS	481071-78-7		0.10-0.50		2	N
	10:2 FTS	120226-60-0		0.10-0.50		2	y
	12:2 FTS *	149246-64-0		0.50-1.0		3	N
	PFECHS	67584-42-3		0.10-0.50		2	N

*	PFTS	No single standard available for these compounds. Retention time and MS settings based on similar isomers and literature references
	MeFOSEA	
	12:2 FTS	

Parameter group	Name of parameter	Cas nr	Blank	LOD range ng/g	LOQ range ng/g	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
BFR	ATE (TBP-AE)	3278-89-5	Method blanks following sample series. LOD/LOQ based on calculation of 3 and 10 stddev respectively	0.003-0.03	0.01-0.07	In-house method. Internal standard addition, extraction, GPC and/or H_2SO_4 cleanup followed by adsorption chromatography. GC/HRMS (autspec)	2	N
	α-TBECH	3322-93-8		0.02-0.2	0.05-0.5		2	N
	β-TBECH	3322-93-8		0.05-0.2	0.04-0.4		2	N
	γ/δ-TBECH	3322-93-8		0.008-0.09	0.01-0.09		2	N
	BATE	99717-56-3		0.003-0.03	0.01-0.8		2	N
	PBT	87-83-2		0.006-0.06	0.01-0.2		2	N
	PBEB	85-22-3		0.003-0.03	0.008-0.09		2	N
	PBBZ	608-90- 2		0.05-0.5	0.2-2		2	y
	HBB	87-82-1		0.02-0.2	0.04-0.4		2	y
	DPTE	35109-60-5		0.004-0.03	0.01-0.07		2	N
	EHTBB	183658-27-7		0.04-0.06	0.1-0.2		2	y
	BTBPE	37853-59-1		0.008-0.06	0.03-0.2		2	y
	TBPH (BEH /TBP)	26040-51-7		0.06-0.1	0.2-0.4		2	N
	DBDPE	84852-53-9		2.6-28	7.76		2	y

Parameter group	Name of parameter	Cas nr	Blank	LOD range ng/g	LOQ range ng/g	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
Dechlorane	Dibromoaldrin	20389-65-5	Method blanks following sample series. LOD/LOQ based on calculation of 3 and 10 stddev respectively	0.1-0.2	0.07-0.4	In-house method. Internal standard addition, extraction, GPC and/or H_2SO_4 cleanup followed by adsorption chromatography. GCGC-qToF 7200 in ECNI	2	N
	Dechlorane 602	31107-44-5		0.003-0.3	0.007-0.07		2	y
	Dechlorane 603	13560-92-4		0.004-0.04	0.01-0.1		2	N
	Dechlorane 604	34571-16-9		0.07-0.7	0.2-1.6		2	N
	Dechlorane 601	13560-90-2		0.006-0.07	0.02-0.2		2	N
	Dechlorane plus syn	135821-03-3		0.02-0.2	0.04-0.4		2	Y
	Dechlorane plus anti	135821-74-8		0.01-0.1	0.03-0.3		2	N

Parameter gruppe	Name parameter	Cas nr	Blank subtraction and determination of LOQ	LOQ range, µg/kg	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
Siloxanes, biota/soil	D4	556-67-2	Three blanks pr batch. Blank substraction for each batch based on the blank average. LOQ calculated from 10 x stdev. from blanks	0.4-2.0	Internal standard added to 1-2 g of sample, followed by addition of acetonitrile and hexane. Ultrasonic bath and shaking before centrifugation. No further cleanup. Recovery standard added to a sub sample before analysis on GC/MSD. A detailed description can be found in previous MILBY reports.	2	Y
	D5	541-02-6		0.5-2.0		2	y
	D6 e	540-97-6		0.8-1.8		2	y
	M3T(Ph)	2116-84-9		0.1-1.0		2	N

Parameter group	Name of parameter	Cas nr	Blank	LOD range ng/g	LOQ range ng/g	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
CP	SCCP	85535-84-8	Method blanks following sample series. SCCP og MCCP results are corrected for blanks. Blanks are subtracted on congener group level prior to deconvolution. LOD/LOQ based on calculation of 3 and 10 stddev respectively	4-16	13-51	In-house method. Internal standard addition, extraction, GPC and/or H_2SO_4 cleanup followed by adsorption chromatography. GC-qToF 7200 in ECNI	3	13C-hexachloro-decane
	MCCP	85535-85-9		13-51	43-168		3	

Parameter group	Name of parameter	Cas nr	Blank subtraction and determination of LOQ	LOQ range ng/g	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
OPFR, soil	TCEP	115-96-8	Three blanks pr batch. Blank subtraction for each batch based on the blank average. LOD and LOQ calculated from 3 x stdev and 10 x stdev. from blanks	5-10	2-5 g of soil was dried overnight and 2 g of dry material and deuterated internal standard was added and was taken for extraction with acetone using vortex and sonication for 10 min done three times. Samples was centrifuged and sample was evaporated and transferred to analytical glass. Recovery standard added and analysis on LC-MSMS.	2	Y
	TCPP	13674-84-5		2-3		2	Y
	TDCPP	13674-87-8		1-2		2	Y
	TBOEP/TBEP	78-51-3		2-3		2	N
	EHDP	1241-94-7		1-2		2	N
	TCP	1330-78-5		1-2		2	N
	TnBP	126-73-8		2-3		2	Y
	TiBP	126-71-6		1-2		2	N
	TEP	78-40-0		1-2		2	Y
	TPP	115-86-6		1-2		2	Y
	BdPhP	2752-95-6		1-2		2	N
	TPP	115-86-6		1-2		2	N
	DBPhP	2528-36-1		1-2		2	Y
	TXP	25155-23-1		1-2		2	N
	TIPPP	64532-95-2		1-2		2	N
	TEHP	78-42-2		1-2		2	Y
	TTBPP	78-33-1				2	Y

Comment:	TEP is generally lost during evaporation

Parameter group	Name of parameter	Cas nr	Blank subtraction and determination of LOQ	LOQ range ng/g	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
OPFR, biota	TCEP	115-96-8	Three blanks pr batch. Blank subtraction for each batch based on the blank average. LOD and LOQ calculated from 3 x stdev and 10 x stdev. from blanks	5-10	1-2 g of biota was homogenized and added deuterated internal standard and later extracted with acetone three times with vortexing and sonication for 10 min. Extract was evaporated and added acetic acid/water and vortex and later extracted three times with hexane using vortex and 10min sonication and centrifugation. Extract was evaporated and transferred to analytical glass. Recovery standard added and analysis on LC-MSMS.	2	Y
	TCPP	13674-84-5		2-3		2	Y
	TDCPP	13674-87-8		1-2		2	Y
	TBOEP/TBEP	78-51-3		2-3		2	N
	EHDP	1241-94-7		1-2		2	N
	TCP	1330-78-5		1-2		2	N
	TnBP	126-73-8		2-3		2	Y
	TiBP	126-71-6		1-2		2	N
	TEP	78-40-0		1-2		2	Y
	TPP	115-86-6		1-2		2	Y
	BdPhP	2752-95-6		1-2		2	N
	TPP	115-86-6		1-2		2	N
	DBPhP	2528-36-1		1-2		2	Y
	TXP	25155-23-1		1-2		2	N
	TIPPP	64532-95-2		1-2		2	N
	TEHP	78-42-2		1-2		2	Y
	TTBPP	78-33-1		1-2		2	Y

Comment:	TEP is generally lost during evaporation

Parameter group	Name parameter	CAS Number	Blank subtraction and determination of LOQ	LOQ range ng/g or ng/L	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
UV compounds	Benzophenone-3	131-57-7	Three blanks per batch. Blank-subtraction and LOQ based on average signal of blanks + 3*std. Octocylene usually has the highest levels in blanks.	0.16-3.4	Internal Standard (IS) added. Samples then extracted twice, followed by clean-up via GPC and/or PSA. GC-MS/MS detection	2	
	Ethylhexylmethoxycinnamate (EHMZ-Z)	5466-77-3		0.2-0.7		2	
	Ethylhexylmethoxycinnamate (EHMZ-E)	5466-77-3		0.9-2.8		2	
	Octocrylene	6197-30-4		3.0-11		2	
	UV-327	3864-99-1		0.1-1.4		2	
	UV-328	25973-55-1		0.4-1.3		2	
	UV-329	3147-75-9		0.6-2.1		3	
	Homosalate	118-56-9		0.7-2.2		3	
	3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-hydroxy-benzenepropanoic acid	84268-36-0	One blank pr batch. LOQ based on 10 x signal-to-noise as measured in each sample	0.5	IS added. Solid samples then extracted twice, and water samples pre-concentrated on SPE. LC-MS/MS detection	2	

Comment:	
UV-329	Tests of the extraction and analysis recovery of UV-329 based on spiking experiments give results outside the range of 60-140%. The measured results of the analysis of complex samples (such as liver) could be overestimates consequently. An alternative and more appropriate internal standard will be considered to improve accuracy in future analyses.
Homosalate	There was no spiked sample with homosalate for the batch reported. However, there are spiked results for samples from the project “Urban fjord”, analysed in the same period with expectable recoveries.

Compound group	Compound name	Cas no	Blank	Method	LOD range * ng/g	LOQ range* ng/g	Uncertainty category	stable isotope labelled (SIL) analogue
Bisphenols	4,4-bisphenol A	80-05-7	Method blanks following sample series. LOD/LOQ based on calculation of 3 and 10 stdev respectively (or instrument detection limit if this is higher)	In-house method. Internal standard addition, extraction, clean-up using molecularly imprinted polymer SPE. LC/HRMS (orbitrap)	0.1-40	0.4-97	3	Y
	2,4-bisphenol A	837-08-1			0.2-22	0.6-64	3	N
	Bisphenol E	2081-08-5			0.1-7.0	0.4-20	3	N
	Bisphenol G	127-54-8			0.08-9.6	0.3-28	3	N
	Bisphenol AP	1571-75-1			0.09-7.8	0.3-22	3	N
	Bisphenol FL	3236-71-3			0.1-10	0.4-29	3	N
	Bisphenol B	77-40-7			0.8-9.3	2.3-26	3	Y
	2,4-bisphenol S	5397-34-2			0.02-3.0	0.1-8.3	3	Y
	4,4-bisphenol F	620-92-8			0.5-6.8	1.5-18	3	Y
	2,4-bisphenol F	2467-03-0			0.9-17	3.0-49	3	N
	TBBPA	79-94-7			5.5-50	15-139	3	Y
	Bisphenol M	13595-25-0			0.04-6.6	0.1-22	3	N
	Bisphenol Z	843-55-0			1.3-15	3.7-42	3	Y
Alkylphenols	4-tert-octylphenol	140-66-9		In-house methods. Internal standard addition, extraction, clean-up using molecularly imprinted polymer SPE. LC/HRMS (orbitrap)	0.4-13	1.5-34	3	Y
	4-octylphenol	1806-26-4			0.5-18	1.7-53	3	N
	4-nonylphenol	104-40-5			2.2-35	6.4-118	3	Y
	4-dodecylphenol	104-43-8			0.9-58	2.4-194	3	N
Other phenolic compounds	MB1	118-82-1		In-house method. Internal standard addition, extraction. LC/MS	0.09-22	0.3-58	3	N

*Wide range in detection limits caused by high detection limits for honeybee (very low sample amount) and rowan (matrix interferences)

Parameter group	Name parameter	CAS Number	Blank subtraction and determination of LOQ	LOQ range, ng/g or ng/L	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
Biocides	Brodifacoum	56073-10-0	One blank pr batch. LOQ based on 10 x signal-to-noise as measured in each sample	1	Internal Standard (IS) added. Solid samples then extracted twice, while water samples were pre-concentrated on SPE. Clean-up via PSA when required. LC-MS/MS detection.	2	
	Bromodiolone	28772-56-7		1		2	
	Difenacoum	56073-07-5		1		2	
	Difethialone	104653-34-1		1		2	
	Flocumafen	90035-08-8		1		2	
	Permitrin (cis)	52645-53-1		3.0-10	IS added. Samples then extracted twice before clean-up via GPC and/or PSA. GC-MS/MS detection	3	
	Permitrin (trans)	52645-53-1		3.0-10		3	

Comment:	
Permethrin	Tests of the extraction and analysis recovery of Permethrin based on spiking experiments give results in the range of 60-140%. The measured results of the analysis of complex samples could be overestimates as a consequence. An alternative and more appropriate internal standard will be considered to improve accuracy in future analyses.

Parameter group	Name of parameter	Cas nr	Blank	LOQ range ng/g	Method	Uncertainty category	Stable isotope labeled (SIL) analogue
Phthalates, soil	DiBP	84-69-5	Three blanks pr batch. Blank subtraction for each batch based on the blank average. LOD and LOQ calculated from 3 x stdev and 10 x stdev. from blanks	1-4	2-5 g of soil was dried overnight and 2 g of dry material and deuterated internal standard was added before extraction with acetone using vortex and three times sonication for 10min. After centrifugation and up-concentration, the sample was transferred to analytical glass. Recovery standard added before analysis on LC-MSMS.	2	N
	DnBP	84-74-2		1-4		2	N
	DEHP	117-81-7		5-20		2	Y
	DiNP	28553-12-0		2--6		2	N
	DiDP	26761-40-0		2--6		2	N

Comment:	DEP is generally lost during evaporation

4 Appendix 2: GPS coordinates for sampling locations year 2021.

Note Oslo X and Bærum X refer to unknown locations.

NILU ID	Sample	Location	Latitude	Longitude
21/1928	**Soil**	Steinbruvannet	59.978014	10.881164
	Near the river	Alnabru (Alna)	59.914179	10.829140
		Svartdalsparken	59.903912	10.79292
21/1929	**Earthworm**	Steinbruvannet	59.978014	10.881164
	Near the river	Alnabru (Alna)	59.914179	10.829140
		Svartdalsparken	59.903912	10.79292
21/1930	**Fieldfare egg**	Alnabru	59.919473	10.83719
		Svartdalsparken	59.903912	10.792892
		Grønmo	59.841102	10.85619
21/1931	**Brown rat**	ROAF, Lillestrøm	60.0087557	11.06312229
21/1932	**Fieldfare chick**	Svartdalsparken	59.903912	10.792892
21/1933		Alna II	59.92159	10.84136
21/1934		Ekeberg	59.898838	10.772867
21/1944	**Roe deer**	Oslo X	unknown	unknown
21/1945		Bærum X	unknown	unknown
21/1946		Nesoddtangen	59.86072152	10.65719535
21/1935	**Rowan**	Ekeberg	59.88986	10.77712
21/1936		Alna	59.94709	10.89684
21/1937		Jar	59.92706	10.61923
21/1938	**Honey bee**	Nøklevann	59.8815265	10.8619215
21/1939		Bygdøy	59.91077603	10.68059948
21/1940		Maridalen	60.0237901	10.7861383
21/1941	**Bumble bee**	Nøklevann	59.881482	10.8610996
21/1941		Nøklevann	59.8808114	10.8608837
21/1942		Bygdøy	59.91077603	10.68059948
21/1942		Bygdøy	59.9113123	10.66792673
21/1943		Maridalen	59.9955208	10.7603579
21/1943		Maridalen	60.0249488	10.7812277
21/1947	**Spider**	Nøklevann	59.8808114	10.8608837
21/1948		Bygdøy	59.9113123	10.66792673
21/1949		Maridalen	59.9955208	10.7603579
21/1949		Maridalen	60.0249488	10.7812277
21/1949		Maridalen	60.0170107	10.7827473
21/1950	**Spanish slug**	Nordstrand	59.8665	10.80169
21/1953	**Red fox**	Hellerudmyra	60.00834	10.46559
21/1954		Hellerudmyra	60.00834	10.46559
21/1955		Bærum X	unknown	unknown
21/1956		Bærum X	unknown	unknown
21/1957		Oslo X	unknown	unknown

All samples are given in ng/g ww, except for samples of spider given as ng/sample and soil as ng/g dw.

5 Appendix 3: Isotopes, supporting parameters, and concentration data of pollutants in individual samples year 2021

Isotopes and supporting parameters.

NILU-Sample number:	Sample type:	$\delta^{13}C_{VPDB}$	$\delta^{15}N_{AIR}$	% Lipids	% dry matter	% TOC	pH
21/1928	Soil	-27.6771	2.632832	-	80.3	4.15	6.2
21/1929	Earthworm	-26.1618	2.765196	1.37	-	-	-
21/1930	Fieldfare egg	-26.7812	5.83383	4.34	-	-	-
21/1931	Brown rat	-25.1478	7.491023	3.88	-	-	-
21/1932	Fieldfare liver	-26.6964	6.942579	1.14	-	-	-
21/1933	Fieldfare liver	-25.4188	6.449806	1.55	-	-	-
21/1934	Fieldfare liver	-26.9388	8.221129	1.42	-	-	-
21/1944	Roe deer liver	-27.4629	7.083017	1.01	-	-	-
21/1945	Roe deer liver	-28.2735	4.527635	3.3	-	-	-
21/1946	Roe deer liver	-27.3696	5.790173	3.42	-	-	-
21/1935	Rowan	-30.7772	-1.13961	-	38.2	-	-
21/1936	Rowan	-29.834	-2.35622	-	30.8	-	-
21/1937	Rowan	-29.0763	-2.39903	-	41.6	-	-
21/1938	Honey bee	-25.8521	6.36941	-	-	-	-
21/1939	Honey bee	-26.6151	6.569917	-			
21/1940	Honey bee	-27.4217	4.431644	-	-	-	-
21/1941	Bumble bee	-27.1629	0.568516	-	-	-	-
21/1942	Bumble bee	-26.2874	5.511962	-	-	-	-
21/1943	Bumble bee	-27.5787	0.159304	-	-	-	-

NILU-Sample number:	Sample type:	$\delta^{13}C_{VPDB}$	$\delta^{15}N_{AIR}$	% Lipids	% dry matter	% TOC	pH
21/1947	Spider	-29.0847	8.223943	-	-	-	-
21/1948	Spider	-28.3471	12.72106	-	-	-	-
21/1949	Spider	-28.367	8.059722	-	-	-	-
21/1950	Spanish Slug	-26.9229	2.649953	1.21	-	-	-
21/1953	Red fox liver	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
21/1954	Red fox liver	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
21/1955	Red fox liver	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
21/1956	Red fox liver	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
21/1957	Red fox liver	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Metals

NILU-Sample number:	Sample type:	Cr	Ni	Cu	Zn	As	Ag	Cd	Pb	Hg	Gd	Sb	Sn
21/1928	Soil	44601	31389	40075	147063	6793	209	469	53402	143	3837	155	13080
21/1929	Earthworm	2735	1783	1936	127058	452	11.7	1966	7401	52.4	16.3	13.5	22.6
21/1930	Fieldfare egg	8.43	3.60	382	5682	5.88	<1,0	0.41	8.00	11.3	<0.01	0.34	67.8
21/1931	Brown rat	154	106	4480	25724	10495	2.38	13.3	159	29.4	0.18	6.48	19.6
21/1932	Fieldfare liver	561	322	9559	40720	91.9	15.2	67.7	296	36.5	0.12	0.65	176
21/1933	Fieldfare liver	3129	1835	10013	27455	76.0	16.7	197	112	21.7	0.12	1.41	47.6
21/1934	Fieldfare liver	380	181	10309	31283	57.3	52.4	63.7	148	23.6	0.04	0.61	69.8
21/1944	Roe deer liver	57.2	17.0	82437	27401	1.24	253	104	55.3	7.32	0.05	0.62	2.02
21/1945	Roe deer liver	238	6.06	3506	28129	0.36	<1.0	169	10.9	0.30	0.01	0.20	5.28
21/1946	Roe deer liver	49.0	4.42	3225	28601	2.61	1.08	139	17.4	1.06	0.08	0.27	<1.0
21/1935	Rowan	783	2646	8141	25235	67.7	8.27	108	656	31.0	68.0	112	220
21/1936	Rowan	515	3385	7476	14171	51.9	2.19	30.3	248	31.0	62.6	140	216
21/1937	Rowan	570	4072	8036	35405	55.8	1.27	248	282	25.8	63.5	86.5	224
21/1938	Honey bee	86.9	159	8957	53561	8.79	<0.9	121	32.5	0.30	0.77	1.78	2.99
21/1939	Honey bee	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
21/1940	Honey bee	1267	778	9555	41071	8.37	<1.0	194	80.8	0.29	0.81	2.06	4.72
21/1941	Bumble bee	136	128	10261	39225	11.6	1.02	26.8	39.9	0.24	1.78	2.08	47.3
21/1942	Bumble bee	152	104	14343	38898	40.5	1.78	18.8	67.5	<1.5	1.27	3.81	8.98
21/1943	Bumble bee	78.6	95.0	10920	43421	8.36	<1.0	43.5	51.4	0.21	1.04	2.14	3.60
21/1947	Spider	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

NILU-Sample number:	Sample type:	Cr	Ni	Cu	Zn	As	Ag	Cd	Pb	Hg	Gd	Sb	Sn
21/1948	Spider	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
21/1949	Spider	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
21/1950	Spanish Slug	20882	11859	18746	196668	569	94.0	781	537	23.0	25.1	12.9	37.3

PCB

NILU-Sample number:	Sample type:	PCB-28	PCB-52	PCB-101	PCB-118	PCB-138	PCB-153	PCB-180
21/1928	Soil	0.38	0.37	0.32	0.35	1.13	1.03	0.78
21/1929	Earthworm	0.10	0.06	0.13	<0.074	0.38	0.51	0.15
21/1930	Fieldfare egg	<0.016	0.62	4.16	1.43	15.6	28.3	11.3
21/1931	Brown rat	0.22	<0.034	0.23	0.51	2.65	2.90	2.39
21/1932	Fieldfare liver	<0.027	0.08	0.74	0.30	3.17	6.20	2.78
21/1933	Fieldfare liver	<0.032	0.24	0.85	0.26	1.80	2.57	1.43
21/1934	Fieldfare liver	<0.027	<0.069	0.24	0.16	0.68	1.00	0.38
21/1944	Roe deer liver	0.01	<0.017	<0.030	0.10	0.15	0.44	0.08
21/1945	Roe deer liver	0.01	<0.017	<0.030	<0.037	<0.115	<0.166	0.06
21/1946	Roe deer liver	<0.013	<0.017	<0.030	0.07	<0.115	0.18	0.05
21/1935	Rowan	0.07	0.07	0.13	0.10	0.13	0.15	0.04
21/1936	Rowan	0.06	0.07	0.15	0.10	0.16	0.19	0.06
21/1937	Rowan	0.06	0.07	0.12	0.09	0.14	0.15	0.06
21/1938	Honey bee	<0.013	<0.034	<0.060	<0.073	<0.228	<0.330	<0.083
21/1939	Honey bee	<0.013	<0.034	<0.060	<0.074	<0.230	<0.333	<0.083
21/1940	Honey bee	<0.013	<0.034	<0.059	<0.072	<0.226	<0.326	<0.082
21/1941	Bumble bee	0.02	<0.034	<0.060	<0.073	<0.228	<0.330	<0.083
21/1942	Bumble bee	<0.014	<0.035	<0.061	<0.075	<0.233	<0.336	<0.084
21/1943	Bumble bee	<0.013	<0.034	<0.060	<0.073	<0.228	<0.330	<0.083
21/1947	Spider	<0.011	<0.010	0.06	0.07	0.02	0.32	0.16

NILU-Sample number:	Sample type:	PCB-28	PCB-52	PCB-101	PCB-118	PCB-138	PCB-153	PCB-180
21/1948	Spider	<0.011	<0.010	0.05	0.01	0.01	0.04	0.06
21/1949	Spider	<0.011	<0.010	0.03	0.01	0.01	0.04	0.04
21/1950	Spanish Slug	0.01	<0.017	0.03	<0.037	<0.115	<0.166	<0.042

PFAS (per- and polyfluorinated alkyl substances)

NILU-Sample number:	Sample type:	TFA	PFPrA	PFBA	PFPA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnDA	PFDoDA	PFTrDA	PFTeDA	PFHxDA	PFOcDA
21/1928	Soil	n.a.	n.a.	<0.1	<0.04	<0.05	<0.05	0.19	0.14	0.09	<0.05	<0.05	<0.1	<0.05	<0.1	<0.1
21/1929	Earthworm	n.a.	n.a.	<0.1	<0.04	<0.05	0.572	0.81	0.37	0.31	0.56	1.27	1.75	2.15	0.34	<0.1
21/1930	Fieldfare egg	n.a.	n.a.	<0.1	0.05	<0.04	<0.05	0.99	1.26	3.40	3.10	14.9	8.58	12.4	0.37	<0.1
21/1931	Brown rat	n.a.	n.a.	<0.1	0.34	<0.05	<0.05	0.84	0.83	1.32	0.39	0.42	0.25	0.19	<0.1	<0.1
21/1932	Fieldfare liver	n.a.	n.a.	<0.1	0.13	<0.05	<0.05	0.33	0.40	1.13	0.95	4.80	2.68	5.64	0.16	<0.1
21/1933	Fieldfare liver	n.a.	n.a.	<0.1	<0.04	<0.05	<0.05	0.61	0.70	2.45	1.42	7.07	5.08	5.86	0.142	<0.1
21/1934	Fieldfare liver	n.a.	n.a.	<0.1	0.19	<0.05	<0.05	0.50	0.50	1.12	0.95	3.12	2.65	2.62	<0.1	<0.1
21/1944	Roe deer liver	8.36	n.a.	<0.1	<0.04	<0.05	<0.05	0.06	0.22	0.07	<0.05	<0.05	<0.1	<0.05	<0.1	<0.1
21/1945	Roe deer liver	12.9	n.a.	<0.1	<0.04	<0.05	<0.05	0.11	0.53	0.41	0.17	0.09	<0.1	<0.05	<0.1	<0.1
21/1946	Roe deer liver	8.52	n.a.	<0.1	<0.04	<0.05	<0.05	0.10	0.27	1.20	0.44	0.53	<0.1	<0.05	<0.1	<0.1
21/1935	Rowan	222	n.a.	<0.1	<0.04	<0.05	<0.05	0.11	<0.05	<0.05	<0.05	<0.05	0.26	<0.05	<0.1	<0.1
21/1936	Rowan	278	0.99	<0.1	<0.04	<0.05	<0.05	0.08	0.03	0.13	<0.05	<0.05	0.22	<0.05	<0.1	<0.1
21/1937	Rowan	106	n.a.	<0.1	<0.04	<0.05	<0.05	0.11	0.02	<0.05	<0.05	<0.05	0.12	<0.05	<0.1	<0.1
21/1938	Honey bee	16.9	n.a.	<0.1	<0.04	<0.05	<0.05	0.09	0.29	0.05	<0.05	<0.05	<0.1	<0.05	<0.1	<0.1
21/1939	Honey bee	n.a.	n.a.	<0.1	<0.04	<0.05	<0.05	0.11	0.15	0.09	0.04	0.02	<0.1	<0.05	<0.1	<0.1

NILU-Sample number:	Sample type:	TFA	PFPrA	PFBA	PFPA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnDA	PFDoDA	PFTrDA	PFTeDA	PFHxDA	PFOcDA
21/1940	Honey bee	25.9	n.a.	<0.1	<0.04	<0.05	<0.05	0.09	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.1	<0.1
21/1941	Bumble bee	7.73	n.a.	<0.1	<0.04	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.1	<0.1
21/1942	Bumble bee	n.a.	n.a.	<0.1	<0.04	<0.05	<0.05	0.08	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.1	<0.1
21/1943	Bumble bee	11.65	n.a.	<0.1	<0.04	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.1	<0.1
21/1947	Spider	n.a.	n.a.	<0.1	<0.04	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.1	<0.1
21/1948	Spider	n.a.	n.a.	<0.1	<0.04	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.1	<0.1
21/1949	Spider	n.a.	n.a.	<0.1	<0.04	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.1	<0.1
21/1950	Spanish Slug	76.4	0.72	<0.1	<0.04	0.21	0.29	0.36	0.44	0.41	0.41	0.53	0.52	0.36	0.16	0.16

PFSA (perfluorinated sulfonates)

NILU-Sample number:	Sample type:	TMFS	PFEtS	PFPrS	PFBS	PFPS	PFHxS	PFHpS	L-PFOS	Sum-PFOS	PFNS	PFDcS	PFUnS	PFDoS	PFTrS	PFTS
21/1928	Soil	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	<0.05	0.57	0.61	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1929	Earthworm	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	3.30	14.7	15.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1930	Fieldfare egg	n.a.	n.a.	n.a.	<0.05	<0.05	0.82	0.61	115	120	0.19	<0.1	<0.1	<0.1	<0.1	<0.1
21/1931	Brown rat	n.a.	n.a.	n.a.	<0.05	<0.05	0.08	0.66	13.8	20.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1932	Fieldfare liver	n.a.	n.a.	n.a.	<0.05	<0.05	0.11	0.44	25.9	27.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1933	Fieldfare liver	n.a.	n.a.	n.a.	<0.05	<0.05	0.12	0.54	46.6	48.9	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1934	Fieldfare liver	n.a.	n.a.	n.a.	<0.05	<0.05	0.27	0.65	26.4	28.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1944	Roe deer liver	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	<0.05	0.61	1.08	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1945	Roe deer liver	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	<0.05	1.88	3.30	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1946	Roe deer liver	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	<0.05	2.13	4.15	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1935	Rowan	n.a.	n.a.	n.a.	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1936	Rowan	n.a.	n.a.	n.a.	0.07	<0.05	<0.05	0.198	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1937	Rowan	n.a.	n.a.	n.a.	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1938	Honey bee	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1939	Honey bee	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	0.056	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1940	Honey bee	n.a.	n.a.	n.a.	0.21	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1941	Bumble bee	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

NILU-Sample number:	Sample type:	TMFS	PFEtS	PFPrS	PFBS	PFPS	PFHxS	PFHpS	L-PFOS	Sum-PFOS	PFNS	PFDcS	PFUnS	PFDoS	PFTrS	PFTS
21/1942	Bumble bee	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1943	Bumble bee	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1947	Spider	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1948	Spider	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1949	Spider	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1950	Spanish Slug	n.a.	n.a.	n.a.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

nPFAS (polyfluorinated neutral compounds)

NILU-Sample number:	Sample type:	PFOSA	NMeFBSA	NEtFBSA	PFBSA	MeFOSA	EtFOSA	MeFOSEA	MeFOSE	EtFOSE	FOSAA	MeFOSAA	EtFOSAA
21/1928	Soil	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1929	Earthworm	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1930	Fieldfare egg	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1931	Brown rat	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1932	Fieldfare liver	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1933	Fieldfare liver	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1934	Fieldfare liver	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1944	Roe deer liver	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1945	Roe deer liver	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1946	Roe deer liver	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1935	Rowan	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1936	Rowan	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1937	Rowan	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1938	Honey bee	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1939	Honey bee	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1940	Honey bee	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1941	Bumble bee	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1942	Bumble bee	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1943	Bumble bee	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1947	Spider	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15

NILU-Sample number:	Sample type:	PFOSA	NMeFBSA	NEtFBSA	PFBSA	MeFOSA	EtFOSA	MeFOSEA	MeFOSE	EtFOSE	FOSAA	MeFOSAA	EtFOSAA
21/1948	Spider	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1949	Spider	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15
21/1950	Spanish Slug	<0.1	<0.15	<0.15	<0.15	<0.15	<0.15	not QA	<0.15	<0.15	<0.15	<0.15	<0.15

Fluorotelomer sulfonates (New PFAS)

NILU-Sample number:	Sample type:	6:2 FTS	8:2 FTS	10:2 FTS	12:2 FTS	4:2 FTS	PFECHS
21/1928	Soil	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1929	Earthworm	0.59	0.31	<0.1	<0.1	<0.1	<0.1
21/1930	Fieldfare egg	<0.1	1.50	3.65	<0.1	<0.1	<0.1
21/1931	Brown rat	0.54	0.69	0.23	<0.1	<0.1	<0.1
21/1932	Fieldfare liver	<0.1	0.31	0.45	<0.1	<0.1	<0.1
21/1933	Fieldfare liver	<0.1	3.86	2.55	<0.1	<0.1	<0.1
21/1934	Fieldfare liver	<0.1	0.20	0.35	<0.1	<0.1	<0.1
21/1944	Roe deer liver	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1945	Roe deer liver	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1946	Roe deer liver	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1935	Rowan	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1936	Rowan	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1937	Rowan	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1938	Honey bee	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1939	Honey bee	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1940	Honey bee	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1941	Bumble bee	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1942	Bumble bee	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1943	Bumble bee	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

NILU-Sample number:	Sample type:	6:2 FTS	8:2 FTS	10:2 FTS	12:2 FTS	4:2 FTS	PFECHS
21/1947	Spider	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1948	Spider	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1949	Spider	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/1950	Spanish Slug	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

BFR

NILU-Sample number:	Sample type:	ATE (TBP-AE)	α-TBECH	β-TBECH	γ/δ-BECH	BATE	PBT	PBEB	PBBZ	HBB	DPTE	EHTBB	BTBPE
21/1928	Soil	0.028	<0.204	<0.151	0.113	0.053	0.062	0.047	<0.483	<0.188	0.052	0.039	0.089
21/1929	Earthworm	<0.013	<0.104	<0.076	<0.042	<0.014	<0.029	<0.016	<0.246	<0.096	0.014	<0.032	<0.029
21/1930	Fieldfare egg	<0.013	<0.104	<0.076	<0.042	<0.014	<0.029	<0.016	<0.246	<0.096	<0.012	<0.027	<0.029
21/1931	Brown rat	<0.013	<0.104	<0.076	<0.042	<0.014	<0.029	<0.016	<0.246	<0.096	<0.012	<0.104	<0.029
21/1932	Fieldfare liver	<0.035	<0.208	<0.153	<0.085	<0.029	<0.059	0.036	<0.492	0.198	0.034	<0.483	<0.058
21/1933	Fieldfare liver	<0.026	<0.208	<0.153	<0.085	<0.029	<0.059	<0.032	<0.492	<0.192	<0.025	<0.063	<0.058
21/1934	Fieldfare liver	<0.026	<0.208	<0.153	<0.085	<0.029	<0.059	<0.032	<0.492	<0.192	<0.025	<0.042	<0.058
21/1944	Roe deer liver	<0.007	<0.052	<0.038	<0.021	<0.007	<0.014	0.008	<0.123	<0.048	0.007	<0.028	<0.014
21/1945	Roe deer liver	<0.006	<0.052	<0.038	<0.021	<0.007	<0.015	<0.008	<0.123	<0.048	<0.006	<0.016	<0.014
21/1946	Roe deer liver	<0.006	<0.052	<0.038	<0.021	<0.07	<0.015	<0.008	<0.123	<0.048	0.007	<0.038	<0.014
21/1935	Rowan	<0.002	<0.020	<0.014	<0.008	<0.002	0.009	<0.003	<0.048	<0.018	<0.002	<0.003	<0.005
21/1936	Rowan	<0.002	<0.020	<0.015	<0.008	<0.002	0.014	<0.003	<0.049	0.022	0.011	<0.050	<0.006
21/1937	Rowan	<0.002	<0.019	<0.014	<0.008	<0.003	0.015	<0.003	<0.047	0.024	0.008	<0.040	<0.008
21/1938	Honey bee	<0.025	<0.123	<0.087	<0.052	0.021	<0.029	<0.016	<0.244	<0.095	<0.017	<0.063	<0.028
21/1939	Honey bee	<0.027	<0.150	<0.107	<0.063	<0.019	<0.029	<0.016	<0.246	<0.096	0.034	<0.050	<0.031
21/1940	Honey bee	<0.032	<0.226	<0.162	<0.095	<0.023	<0.029	<0.015	<0.240	<0.094	<0.016	<0.058	<0.028
21/1941	Bumble bee	<0.053	<0.263	0.229	<0.112	<0.027	0.03	<0.016	<0.244	<0.095	<0.017	<0.107	<0.028
21/1942	Bumble bee	<0.061	0.533	0.507	<0.115	<0.024	<0.029	<0.016	<0.248	<0.097	<0.025	<0.115	<0.029
21/1943	Bumble bee	<0.056	<0.419	<0.300	<0.177	0.035	0.036	<0.016	<0.244	<0.095	<0.017	<0.085	<0.039
21/1947	Spider	0.015	<0.104	<0.076	<0.042	<0.014	<0.029	<0.016	<0.246	<0.096	<0.012	<0.017	<0.029

NILU-Sample number:	Sample type:	ATE (TBP-AE)	α-TBECH	β-TBECH	γ/δ-BECH	BATE	PBT	PBEB	PBBZ	HBB	DPTE	EHTBB	BTBPE
21/1948	Spider	<0.013	<0.104	<0.076	<0.042	<0.014	<0.029	<0.016	<0.246	<0.096	<0.012	<0.017	<0.029
21/1949	Spider	<0.013	<0.104	<0.076	<0.042	<0.014	<0.029	<0.016	<0.246	<0.096	<0.0126	<0.017	<0.029
21/1950	Spanish Slug	<0.006	<0.052	<0.038	<0.021	<0.007	<0.014	<0.008	<0.123	<0.048	0.009	<0.011	<0.014

BFR

NILU-Sample number:	Sample type:	TBPH (BEH/TBP)	DBDPE	α-HBCD	β-HBCD	γ-HBCD
21/1928	Soil	<0.138	<26.9	<0.210	<0.063	<0.077
21/1929	Earthworm	<0.072	<13.6	<0.024	<0.019	<0.024
21/1930	Fieldfare egg	<0.070	<13.6	0.158	<0.019	<0.024
21/1931	Brown rat	1.28	<13.6	1.30	<0.019	<0.024
21/1932	Fieldfare liver	<0.141	<27.5	<0.048	<0.037	<0.048
21/1933	Fieldfare liver	<0.141	<27.5	<0.048	<0.037	<0.048
21/1934	Fieldfare liver	<0.141	<27.5	<0.048	<0.037	<0.048
21/1944	Roe deer liver	<0.035	<6.86	<0.012	<0.009	<0.012
21/1945	Roe deer liver	<0.035	<6.86	<0.012	<0.009	<0.012
21/1946	Roe deer liver	<0.035	<6.87	<0.015	<0.012	<0.015
21/1935	Rowan	<0.013	<2.67	<0.005	<0.004	<0.005
21/1936	Rowan	<0.043	<2.71	<0.005	<0.004	<0.005
21/1937	Rowan	<0.058	<2.6	<0.005	<0.004	<0.005
21/1938	Honey bee	<0.163	<13.6	<0.024	<0.018	<0.024
21/1939	Honey bee	<0.256	<13.6	<0.024	<0.019	<0.024
21/1940	Honey bee	<0.149	<13.5	<0.024	<0.018	<0.024
21/1941	Bumble bee	<0.103	<13.6	<0.032	<0.018	<0.024
21/1942	Bumble bee	<0.120	<13.8	<0.024	<0.019	<0.024
21/1943	Bumble bee	<0.150	<13.6	<0.026	<0.018	<0.024
21/1947	Spider	<0.070	<13.6	<0.024	<0.019	<0.024

NILU-Sample number:	Sample type:	TBPH (BEH/TBP)	DBDPE	α-HBCD	β-HBCD	γ-HBCD
21/1948	Spider	<0.070	<13.6	<0.024	<0.019	<0.024
21/1949	Spider	<0.070	<13.6	<0.024	<0.019	<0.024
21/1950	Spanish Slug	<0.035	<6.86	<0.012	<0.009	<0.012

Chlorinated paraffins (CP)

NILU-Sample number:	Sample type:	SCCP	MCCP
21/1928	Soil	<15.4	<50.6
21/1929	Earthworm	12.7	51
21/1930	Fieldfare egg	10.5	26.5
21/1931	Brown rat	27.6	1013
21/1932	Fieldfare liver	<15.7	<51.6
21/1933	Fieldfare liver	<15.7	55.4
21/1934	Fieldfare liver	18.1	57.5
21/1944	Roe deer liver	<3.9	<12.9
21/1945	Roe deer liver	4.59	21.4
21/1946	Roe deer liver	<3.9	<12.9
21/1935	Rowan	12.3	36.5
21/1936	Rowan	43.2	75.0
21/1937	Rowan	13.2	34.7
21/1938	Honey bee	<7.8	<25.6
21/1939	Honey bee	<7.9	<25.8
21/1940	Honey bee	<7.7	<25.3
21/1941	Bumble bee	n.a.	n.a.
21/1942	Bumble bee	<7.9	<26.1
21/1943	Bumble bee	<7.8	<25.6
21/1947	Spider	<7.9	<25.8

NILU- Sample number:	Sample type:	SCCP	MCCP
21/1948	Spider	<7.9	<25.8
21/1949	Spider	<7.9	<25.8
21/1950	Spanish Slug	8.9	97.7

Cyclic siloxanes (cVMS)

NILU-Sample number:	Sample type:	D4	D5	D6	M3T (ph)
21/1928	Soil	<2.00	<2.04	<1.26	<0.02
21/1929	Earthworm	<2.00	<2.04	<1.26	<0.02
21/1930	Fieldfare egg	<2.00	<2.04	<1.26	<0.02
21/1931	Brown rat	9.32	53.09	7.84	0.73
21/1932	Fieldfare liver	<1.078	<0.629	0.867	<0.083
21/1933	Fieldfare liver	5.65	3.39	1.86	0.17
21/1934	Fieldfare liver	5.39	3.41	1.89	0.11
21/1944	Roe deer liver	6.55	5.34	3.92	0.38
21/1945	Roe deer liver	7.12	5.79	2.77	<0.083
21/1946	Roe deer liver	7.24	5.38	3.09	<0.083
21/1935	Rowan	<0.417	<1.071	<1.071	<0.11
21/1936	Rowan	<0.417	<1.071	<1.071	<0.11
21/1937	Rowan	<0.417	<1.071	<1.071	<0.11
21/1938	Honey bee	<0.417	<1.071	<1.071	<0.11
21/1939	Honey bee	0.46	<1.071	<1.071	<0.11
21/1940	Honey bee	<0.417	<1.071	<1.071	<0.11
21/1941	Bumble bee	<0.417	<1.071	<1.071	<0.11
21/1942	Bumble bee	<0.417	<1.071	<1.071	<0.11
21/1943	Bumble bee	<0.417	<1.071	<1.071	<0.11
21/1947	Spider	5.23	2.86	2.13	<1.82

NILU- Sample number:	Sample type:	D4	D5	D6	M3T (ph)
21/1948	Spider	1.65	1.13	<1.82	<1.82
21/1949	Spider	0.65	0.80	<1.82	<1.82
21/1950	Spanish Slug	0.58	<1.071	<1.071	<0.11

Organic phosphorous flame retardants (OPFR)

NILU-Sample number:	Sample type:	TCEP	TCPP/ TCIPP	TDCPP/ TDCIPP	TBEP/ TBOEP	EHDP/E HDPP	TCP	TBP/ TnBP	TBP/ TiBP	TEP
21/1928	Soil	<0.06	0.51	<0.16	0.2	<0.03	0.14	<0.18	<0.18	<0.03
21/1929	Earthworm	<1.4	1.17	<0.2	<0.1	<0.2	<0.1	<0.2	<0.2	n.a.
21/1930	Fieldfare egg	<1.4	<0.9	<0.2	<0.1	<0.2	<0.1	<0.2	<0.2	n.a.
21/1931	Brown rat	<1.4	1.23	<0.2	0.29	<0.2	<0.1	<0.2	<0.2	n.a.
21/1932	Fieldfare liver	<1.4	1.82	<0.2	<0.1	<0.2	<0.1	<0.2	<0.2	n.a.
21/1933	Fieldfare liver	<1.4	<0.9	<0.2	<0.1	<0.2	<0.1	<0.2	<0.2	n.a.
21/1934	Fieldfare liver	<1.4	<0.9	<0.2	<0.1	<0.2	<0.1	<0.2	<0.2	n.a.
21/1944	Roe deer liver	<1.4	1.28	<0.2	0.31	<0.2	<0.1	0.32	<0.2	n.a.
21/1945	Roe deer liver	<1.4	<0.9	<0.2	<0.1	<0.2	<0.1	<0.2	<0.2	n.a.
21/1946	Roe deer liver	<1.4	<0.9	<0.2	<0.1	<0.2	<0.1	<0.2	<0.2	n.a.
21/1935	Rowan	<1.4	4.61	0.65	0.27	5.34	0.31	0.33	<0.2	n.a.
21/1936	Rowan	<1.4	<0.9	0.58	0.29	2.23	0.25	<0.2	<0.2	n.a.
21/1937	Rowan	<1.4	2.48	0.81	0.34	<0.2	<0.1	0.29	<0.2	n.a.
21/1938	Honey bee	<1.4	13.8	0.59	0.85	<0.2	<0.1	2.33	1.15	n.a.
21/1939	Honey bee	<1.4	20.9	0.6	0.62	<0.2	<0.1	<0.2	2.33	n.a.
21/1940	Honey bee	<1.4	13.1	0.28	0.28	<0.2	<0.1	1.39	0.94	n.a.
21/1941	Bumble bee	<1.4	11.0	<0.2	<0.1	<0.2	<0.1	2.46	0.61	n.a.
21/1942	Bumble bee	<1.4	9.29	<0.2	<0.1	<0.2	<0.1	1.23	0.66	n.a.
21/1943	Bumble bee	<1.4	8.85	<0.2	<0.1	<0.2	<0.1	1.12	0.67	n.a.
21/1947	Spider	<0.2	5.47	<0.2	<0.2	<0.2	<0.2	<0.4	<0.2	1.04

NILU-Sample number:	Sample type:	TCEP	TCPP/ TCIPP	TDCPP/ TDCIPP	TBEP/ TBOEP	EHDP/E HDPP	TCP	TBP/ TnBP	TBP/ TiBP	TEP
21/1948	Spider	<0.2	2.17	<0.2	<0.2	<0.2	<0.2	<0.4	<0.2	0.76
21/1949	Spider	<0.2	2.15	<0.2	<0.2	<0.2	<0.2	<0.4	<0.2	0.85
21/1950	Spanish Slug	<1.4	3.47	0.79	2.48	0.4	<0.1	<0.2	<0.2	n.a.

Organic phosphorous flame retardants (OPFR)

NILU-Sample number:	Sample type:	TPrP/ TPP	TiBP	BdPhP	TPP/ TPhP	DBPhP	TXP	TIPPP/ T4IPP	TTBPP	TEHP
21/1928	Soil	<0.02	n.a.	<0.03	<0.03	<0.03	<0.1	<0.04	<0.1	0.1
21/1929	Earthworm	<0.06	n.a.	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.2
21/1930	Fieldfare egg	<0.06	n.a.	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.2
21/1931	Brown rat	<0.06	n.a.	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.2
21/1932	Fieldfare liver	<0.06	n.a.	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.2
21/1933	Fieldfare liver	<0.06	n.a.	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.2
21/1934	Fieldfare liver	<0.06	n.a.	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.2
21/1944	Roe deer liver	<0.06	n.a.	<0.2	0.6	<0.2	<0.2	<0.1	<0.1	<0.2
21/1945	Roe deer liver	<0.06	n.a.	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.2
21/1946	Roe deer liver	<0.06	n.a.	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.2
21/1935	Rowan	<0.06	n.a.	<0.2	2.15	<0.2	<0.2	<0.1	<0.1	<0.2
21/1936	Rowan	<0.06	n.a.	<0.2	5.49	<0.2	<0.2	<0.1	<0.1	<0.2
21/1937	Rowan	<0.06	n.a.	<0.2	2.9	<0.2	<0.2	<0.1	<0.1	<0.2
21/1938	Honey bee	<0.06	n.a.	<0.2	0.41	<0.2	<0.2	<0.1	<0.1	<0.2
21/1939	Honey bee	<0.06	n.a.	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.2
21/1940	Honey bee	<0.06	n.a.	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.2
21/1941	Bumble bee	<0.06	n.a.	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.2
21/1942	Bumble bee	<0.06	n.a.	<0.2	<0.2	<0.2	0.54	<0.1	<0.1	<0.2
21/1943	Bumble bee	<0.06	n.a.	<0.2	<0.2	<0.2	0.6	<0.1	<0.1	<0.2
21/1947	Spider	<0.2	<13	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

NILU-Sample number:	Sample type:	TPrP/ TPP	TiBP	BdPhP	TPP/ TPhP	DBPhP	TXP	TIPPP/ T4IPP	TTBPP	TEHP
21/1948	Spider	<0.2	<13	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
21/1949	Spider	<0.2	<13	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
21/1950	Spanish Slug	<0.06	n.a.	<0.2	0.58	<0.2	<0.2	2.42	<0.1	1.72

Dechloranes and dibromoaldrin

NILU Sample number:	Sample type:	Dibromoaldrin	Dechlorane 602	Dechlorane 603	Dechlorane 604	Dechlorane 601	Dechlorane plus syn	Dechlorane plus anti
21/1928	Soil	<0.15	0.04	<0.04	<0.72	<0.07	<0.15	0.56
21/1929	Earthworm	<0.07	<0.02	<0.02	<0.37	<0.03	<0.08	<0.06
21/1930	Fieldfare egg	<0.07	0.581	0.112	<0.37	<0.03	<0.08	0.137
21/1931	Brown rat	<0.07	<0.02	<0.02	<0.37	<0.03	0.902	2.42
21/1932	Fieldfare liver	<0.29	<0.078	<0.09	<1.07	<0.136	<0.162	<0.252
21/1933	Fieldfare liver	<0.15	<0.03	<0.04	<0.73	<0.07	0.16	0.27
21/1934	Fieldfare liver	<0.15	0.0423	<0.042	<0.730	<0.067	<0.156	<0.127
21/1944	Roe deer liver	<0.104	<0.028	<0.034	<0.386	<0.051	<0.061	<0.094
21/1945	Roe deer liver	<0.04	<0.007	<0.010	<0.182	<0.017	<0.039	<0.031
21/1946	Roe deer liver	<0.04	<0.007	<0.010	<0.182	<0.017	<0.039	<0.031
21/1935	Rowan	<0.015	<0.003	<0.004	<0.071	<0.007	<0.015	<0.012
21/1936	Rowan	<0.015	<0.003	<0.004	<0.072	<0.006	<0.015	0.0201
21/1937	Rowan	<0.014	<0.002	<0.004	<0.069	<0.006	<0.014	<0.012
21/1938	Honey bee	<0.07	<0.01	<0.02	<0.36	<0.03	<0.04	<0.05
21/1939	Honey bee	<0.07	<0.02	<0.02	<0.37	<0.03	<0.08	<0.06
21/1940	Honey bee	<0.07	<0.01	<0.02	<0.36	<0.03	<0.08	<0.06
21/1941	Bumble bee	<0.07	<0.01	<0.02	<0.36	<0.03	<0.08	<0.06
21/1942	Bumble bee	<0.08	<0.02	<0.02	<0.37	<0.03	<0.08	<0.06
21/1943	Bumble bee	<0.07	<0.01	<0.02	<0.36	<0.03	<0.08	<0.06
21/1947	Spider	<0.07	<0.02	<0.02	<0.37	<0.03	<0.08	<0.06

NILU Sample number:	Sample type:	Dibromoaldrin	Dechlorane 602	Dechlorane 603	Dechlorane 604	Dechlorane 601	Dechlorane plus syn	Dechlorane plus anti
21/1948	Spider	<0.07	<0.02	<0.02	<0.37	<0.03	<0.08	<0.06
21/1949	Spider	<0.07	<0.02	<0.02	<0.37	<0.03	<0.08	<0.06
21/1950	Spanish Slug	<0.04	<0.01	<0.01	<0.18	<0.02	<0.04	<0.03

UV compounds

NILU-Sample number:	Sample type:	OC	BP3	EHMC-Z	EHMC-E	UV-327	UV-328	UV329	Homo-salate
21/1928	Soil	<3.4	<0.8	<0.2	<0.9	0.20	1.80	<0.6	4.60
21/1929	Earthworm	<3.4	<0.8	<0.2	<0.9	<0.5	<0.4	<0.6	4.20
21/1930	Fieldfare egg	<6	<1.2	<0.4	<1.4	1.13	0.57	<1.1	1.40
21/1931	Brown rat	<2	<1	i	<0.3	1.40	5.60	3.1	n.a.
21/1932	Fieldfare liver	<9	<2	<0.6	<2.3	1.44	<1	<1.7	3.80
21/1933	Fieldfare liver	<9	<2	<0.6	<2.3	1.21	<1	<1.7	2.60
21/1934	Fieldfare liver	<9	<2	<0.6	<2.3	1.60	<1	<1.7	1.80
21/1944	Roe deer liver	<3.4	<0.8	<0.2	<0.9	<0.1	<0.4	<0.6	0.86
21/1945	Roe deer liver	<3.4	<0.8	<0.2	<0.9	<0.1	<0.4	<0.6	0.85
21/1946	Roe deer liver	<3.4	<0.8	<0.2	<0.9	<0.1	<0.4	<0.6	0.87
21/1935	Rowan	29.0	10.3	<0.2	<1.4	0.91	1.02	<1.1	71.0
21/1936	Rowan	50.0	27.7	<0.2	<1.4	1.18	1.53	<1.1	55.0
21/1937	Rowan	19.2	18.7	<0.2	<1.4	1.25	2.29	<1.1	125
21/1938	Honey bee	31.4	<2.4	<0.8	<2.8	<0.2	<1.3	<2.1	10.0
21/1939	Honey bee	<11	<2.4	<0.8	<2.8	<0.2	<1.3	<2.1	21.0
21/1940	Honey bee	<11	<2.4	<0.8	<2.8	<0.2	<1.3	<2.1	13.0
21/1941	Bumble bee	11.3	<2	<0.7	<2.3	<0.1	<1	<1.7	23.0
21/1942	Bumble bee	24.2	<2	<0.7	<2.3	0.31	<1	<1.7	14.0
21/1943	Bumble bee	<9	<2	<0.7	<2.3	<0.1	<1	<1.7	15.0
21/1947	Spider	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

NILU-Sample number:	Sample type:	OC	BP3	EHMC-Z	EHMC-E	UV-327	UV-328	UV329	Homo-salate
21/1948	Spider	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a
21/1949	Spider	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
21/1950	Spanish Slug	3.7	<0.8	<0.2	<0.9	<0.7	<0.4	<0.6	7.40

Phenols

NILU Sample number:	Sample type:	TBBPA	4,4 Bis-A	2,4 Bis-A	2,4 Bis-S	2,4 Bis-A	4,4 Bis-A	2,4 Bis-A	Bis-G	Bis-FL	Bis-AP	Bis-Z
21/1928	Soil	< 5.5	< 4.4	< 2.5	< 0.4	0.8	< 2	< 1.1	< 1.2	< 0.9	< 1.7	< 5.5
21/1929	Earthworm	n.a.	41	< 2.3	< 0.3	8.5	17	< 1	< 1.1	< 0.8	< 2.2	n.a.
21/1930	Fieldfare egg	n.a.	71	< 6	< 1.3	15	*17*	< 2.6	< 4.2	< 2.9	< 5.2	n.a.
21/1931	Brown rat	n.a.	12	< 2.1	< 0.3	< 0.7	< 1.7	< 0.9	< 01	< 0.7	< 1.4	n.a.
21/1932	Fieldfare liver	n.a.	< 3.8	< 2.1	< 0.3	< 1.6	< 2	< 0.9	< 1	< 0.7	< 1.5	n.a.
21/1933	Fieldfare liver	n.a.	*7.4*	< 2.2	< 0.3	< 1.1	< 1.7	< 1	< 1	< 0.8	< 1.5	n.a.
21/1934	Fieldfare liver	n.a.	*7.9*	< 2.3	< 0.3	< 1.5	< 1.8	< 1	< 1.3	< 0.8	n.a.	n.a.
21/1944	Roe deer liver	n.a.	*6.9*	< 2.3	< 0.3	< 0.7	< 1.8	< 1	< 1.1	< 0.8	< 1.6	n.a.
21/1945	Roe deer liver	n.a.	*5.4*	< 2.2	< 0.3	< 1.3	< 1.9	< 1	< 1	< 0.8	< 1.5	n.a.
21/1946	Roe deer liver	n.a.	< 3.8	< 2.1	< 0.3	< 0.7	< 1.7	< 0.9	< 1	< 0.7	< 1.4	n.a.
21/1935	Rowan	n.a.	n.a.	n.a.	< 0.02	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
21/1936	Rowan	n.a.	n.a.	n.a.	< 0.07	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
21/1937	Rowan	n.a.	< 0.1	< 0.2	< 0.02	< 0.5	< 0.9	< 0.08	< 0.1	< 0.09	n.a.	n.a.
21/1938	Honey bee	< 50	< 40	< 22	< 3	< 6.8	< 17	< 9.6	< 10	< 7.8	< 15	< 50
21/1939	Honey bee	< 50	< 40	< 22	< 3	< 6.8	< 17	< 9.6	< 10	< 7.8	< 15	< 50
21/1940	Honey bee	< 20	< 16	< 8.8	< 1.2	< 2.7	< 6.9	< 3.9	< 4.2	< 3.1	< 5.9	< 20
21/1941	Bumble bee	< 9.1	< 7.3	< 4	< 0.5	< 1.2	< 3.2	< 1.8	< 1.9	< 1.4	< 2.7	< 9.1
21/1942	Bumble bee	< 8.3	< 6.7	< 3.4	< 0.5	< 1.1	< 2.3	< 1.6	< 1.7	< 1.3	< 2.5	< 8.3
21/1943	Bumble bee	< 5.9	< 4.7	< 2.6	< 0.4	< 0.8	< 2	< 1.1	< 1.2	< 0.9	< 1.7	< 5.9
21/1950	Spanish Slug	n.a.	< 3.5	< 3.8	< 0.3	7.8	7.7	< 1.6	< 2.7	< 1.8	< 1.3	n.a.

NILU Sample number:	Sample type:	Bis-E	Bis-B	Bis-M	AO-MB1	4-Dodecyl-phenol	4-n-Nonyl-phenol	4-n-Octyl-phenol	4-t-Octyl-phenol
21/1928	Soil	< 0.8	< 1	< 0.04	< 2.4	< 0.9	< 2.8	< 2.2	< 1.4
21/1929	Earthworm	< 0.7	< 1	< 1.8	< 2.4	n.a.	n.a.	< 5.3	< 4.5
21/1930	Fieldfare egg	< 4	< 4	< 1.8	< 3	< 4.4	< 7.5	n.a.	n.a.
21/1931	Brown rat	< 0.7	< 0.9	< 0.7	< 2.1	< 1.5	< 2.7	< 1.7	< 1.2
21/1932	Fieldfare liver	< 0.7	< 0.9	n.a.	< 2.1	n.a.	n.a.	< 1.7	< 1.2
21/1933	Fieldfare liver	< 0.7	< 0.9	< 0.5	< 2.2	< 0.9	< 2.5	< 1.8	< 1.3
21/1934	Fieldfare liver	< 1.2	< 3.8	n.a.	< 2.4	n.a.	n.a.	n.a.	n.a.
21/1944	Roe deer liver	< 0.7	< 1	< 0.9	< 2.4	< 2.5	< 4.2	< 1.9	< 1.4
21/1945	Roe deer liver	< 0.7	< 0.9	< 0.9	< 2.2	< 7.9	< 3.1	< 1.8	< 1.3
21/1946	Roe deer liver	< 0.7	< 0.9	< 1.2	< 2.1	< 2.2	< 3.8	< 1.7	< 1.2
21/1935	Rowan	n.a.	n.a.	n.a.	< 2.2	< 26	< 35	< 2.8	14
21/1936	Rowan	n.a.	n.a.	< 4.7	< 1.7	< 11	< 15	< 0.5	< 0.4
21/1937	Rowan	< 0.1	n.a.	n.a.	< 0.09	< 12	< 17	4	2
21/1938	Honey bee	< 7	< 9.3	< 1.5	< 22	< 58	< 25	< 18	< 13
21/1939	Honey bee	< 7	< 9.3	< 1.5	< 22	< 35	< 25	< 18	< 13
21/1940	Honey bee	< 2.8	< 3.7	< 0.6	< 8.9	< 16	< 10	< 7.3	< 5.2
21/1941	Bumble bee	< 1.3	< 1.7	< 0.4	< 4	< 19	< 7	< 3.3	< 2.2
21/1942	Bumble bee	< 1.2	< 1.6	< 0.4	< 3.7	< 22	< 8	< 3	< 2.2
21/1943	Bumble bee	< 0.8	< 1.1	< 0.3	< 2.6	< 13	< 4.7	< 2.1	< 1.5
21/1950	Spanish Slug	< 2.5	< 0.8	< 6.6	< 1.9	< 0.9	< 2.2	< 1.6	< 1.1

Biocides

NILU Sample number:	Sample type:	Bromadiolon	Brodifacoum	Flocumafen	Difenacoum	Difethialone	Permethrin
21/1931	Brown rat	3.1	<1	<1	<1	<1	144
21/1953	Red fox liver	48.8	<1	<1	8.2	<1	<3
21/1954	Red fox liver	139	46.9	<1	1.3	<1	65.0
21/1955	Red fox liver	<1	1.8	<1	3.6	<1	<3
21/1956	Red fox liver	268	51.9	<1	46.0	<1	<3
21/1957	Red fox liver	1.7	1.3	<1	<1	<1	<3

Phthalates

NILU-Sample number:	Sample type:	DEHP	DPHP+ (DiDP)	DiNP	DiBP	DnBP
21/1928	Soil	40.6	6.5	<0.6	<0.4	13.9

NILU – Norwegian Institute for Air Research

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