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Supplementary Information

A review of PFAS fingerprints in fish from Norwegian freshwater bodies subject to different source inputs

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Pages: 29

Tables: 9

Figures: 6

Table of content

Lake descriptions

Short descriptions of each of the large lakes: lake Mjøsa, lake Femunden, and lake Randsfjorden is given below. A summary of all the investigated water bodies is shown in Table S1.

Lake Mjøsa

Lake Mjøsa is the largest lake in Norway (surface area: 369 km^2). It is a deep lake (maximum 453 m) situated in the central-eastern part of Norway and is subject to several possible environmental impacts. These include runoff from major roads, industries, urban areas (five cities located at the lake), and discharge from waste water treatment plants (WWTPs), including three large and several smaller plants, with a total of 200 000 population equivalents (PE) (Blytt and Stang, 2019). Agricultural runoff and input from major rivers also provide significant pollutant fluxes to the lake. Theoretical mean residence time for Lake Mjøsa is 4.9 years. Lake Mjøsa contains over 20 different fish species, such as brown trout (*Salmo trutta*), pike (*Esox Lucius*), perch (*Perca fluviatilis*) and burbot (*Lota lota*) (e.g. (Spikkeland *et al.*, 2016; Fjeld *et al.*, 2017; Sandlund *et al.*, 2017). The biodiversity of Lake Mjøsa is rich and it causes the top-predator brown trout and E. smelt to be at a higher trophic level in this lake compared to similar lakes in Norway.

Femunden

Lake Femunden is the third largest lake in Norway (surface area: 203 km^2) and is, contrary to Lake Mjøsa, situated in a forested and mountainous catchment area. It is characterized as a low productive oligotrophic lake with no artificial regulation and with limited anthropogenic impacts, mostly from backpacking hikers and some minor roads. 62 % of the catchment area consist of bare mountain, whereas 26 % is forests, 12 % water bodies and only 0.2 % agriculture. To the best of our knowledge, the main environmental impact comes from long-range transport. There is a small wastewater facility close to the lake (PE: ~200), but it has infiltration to the ground and no direct discharges to the lake. The lake is 60 km long and 10 km wide (widest area). Several areas are quite deep, at up to 90 m deep in the northern part and 150 m deep in the southern end of the lake. Riverine inputs peak in the snow melting season in May/June with a mean discharge of 12-16 $Ls^{-1}km^{-2}$. The theoretical mean residence time is 7.6 years. The ecosystem in lake Femunden consist of eight species of fish including brown trout, European whitefish (*Coregonus lavaretus*) and Arctic char (*Salvelinus alpinus*). E. whitefish is the main prey for brown trout as they become piscivorous at the age of 3-9 years, or approximately 30 cm (Sandlund et al., 2012). Only a small proportion of the brown trout population in Lake Femunden is pelagic, the majority prey in the littoral zone on benthic or terrestrial (insects) organisms (Næsje *et al.*, 1996; Jonsson *et al.*, 1999).

Lake Randsfjorden

Lake Randsfjorden is the fourth largest lake in Norway (surface area: 140 km^2), containing 11 fish species. Local human impact to Lake Randsfjorden takes the form of a significant amount of agricultural runoff with limited local sources of contaminants. Treated sewage from approximately 30 000 PE runs into the lake in addition to private scattered drains. The lake is 77 km long and has an area of 140 km^2, with a theoretical mean residence time of 2.5 years. Top predators in the pelagic food web include brown trout and arctic char (*Salvelinus alpinus*). Planktivore fish species are dominated by European smelt and whitefish. Contrary to Lake Mjøsa, the pelagic food web in Lake Randsfjorden does not contain the invertebrate opossum shrimp *Mysis relicta* consequently making the pelagic food web chain in Lake Randsfjorden shorter than in Lake Mjøsa.

Chemical analyses

Eurofins Environment Testing Norway AS

Chemical analysis of samples from sites 1-3 (Oslo airport, Evenes airport, and Fagernes airport), as well as muscle samples from site 4 (Rygge airport) were carried out by Eurofins Environment Testing Norway AS. Up to 22 PFAS were targeted according to method DIN EN ISO/IEC 17025:2005 using high performance liquid chromatography and mass spectrometric detection (HPLC/MS-MS). Approximately 1.5 g material was freeze dried and 18 surrogate standards (^{13}C-PFOS, $13C_2$-PFDoA, $^{18}0_2$-PFHxS, $^{18}0_2$-PFHxS, $^{13}C_8$-PFOSA, $^{13}C_2$-PFTeDA, ^{13}C-PFBS, ^{13}C-PFBS, $^{13}C_4$-PFHpA, $^{13}C_5$-PFPeA, $^{13}C_2$-6:2FTS, $^{13}C_2$-6:2FTS, $^{13}C_4$-PFBA, $^{13}C_2$-PFHxA, $^{13}C_8$-PFOA, $^{13}C_5$-PFNA, $^{13}C_2$-PFDA, and $^{13}C_2$-PFUnA) were added. Extraction was performed using methanol in an ultrasonic bath followed by vaporization. Acetonitrile and hexane were added for solvent exchange. The acetonitrile phase was cleaned up, vaporized, and dissolved in methanol. $^{13}C_4$-PFOA was used as internal standard. Sample intake weights were used to calculate sample specific limits of quantifications (LOQ).

Norwegian Institute for Water Research (NIVA)

Analysis of samples from sites 5-8, as well as liver samples from site 4, were performed by the Norwegian Institute for Water Research (NIVA) following previously described methods (Langberg *et al.*, 2020). Analyses were performed using liquid chromatography quadrupole time-of-flight mass spectrometry (LC-qTOF-MS). A mixture of isotope labelled PFAS (MPFAC-MX_C-ES purchased from Wellington Laboratories: M8PFOSA, M2-6:2FTS, M2-8:2FTS, d5-N-MeFOSA-M, d9-N-etFOSE-M, d5-N-EtFOSAA-M, M4-8:2 diPAP) was added as internal standards (IS) for quantification before extraction. Approximately 2 grams of wet biota sample was weighed and IS was added. Extraction was carried out twice using acetonitrile (5+4 mL), ultrasonic bath (30+30 min) and shaking (30+30 min). Extracts were

concentrated under a nitrogen flow. Aliquots of 7 µL extract were injected onto a Waters Acquity BEH C8 reversed phase column (100 x 2.1 mm, 1.8 µm particles, using an Acquity Ultra Performance HPLC system (Waters). The target compounds were separated at a flow rate of 0.5 mL min^{-1} using acetonitrile (A) and 5.2 mM NH_4OAc in water (B). The following binary gradient was applied: 0-1.5 min, 12% of A; 1.5-11 min, linear change to 99% of A; 11-13 min, 99% of A. The Acquity system was coupled to a Xevo G2-S Q-ToF-HRMS instrument (Waters) using negative ion electrospray ionization (ESI(-)). Mass spectra were registered in full scan mode (mass range m/z of 150-1100). The following optimized parameters were applied: Capillary voltage, 0.7 kV; desolvation temperature, 500 °C; source temperature, 120 °C; nitrogen desolvation gas flow, 800 L h^{-1}. Quantitative analysis was performed employing extracted mass chromatograms from full scan recording using the m/z (typical mass tolerance of 0.03 µ) for the different analytes.

Blank samples and standard addition samples were used for each batch of samples for analyses (20-25 samples). Concentrations in the blank samples were low (<0.5 ng g^{-1} or ng L^{-1}) and consistent regardless of different equipment, indicating little cross contamination. Blank values were subtracted from results when calculating concentrations in samples. The autosampler was set up with a stainless-steel needle and a washing program using MeOH/Isopropyl alcohol (IPA) as a strong washing solution. Instruments were cleaned daily, and blank samples were run before and after each analysis batch (typically 20-30 samples). A random sample was selected for duplicate analysis to control for repeatability. Recoveries of QA samples (matrix matched standard addition samples) in the present work were satisfactory (within the range of 70-110%). LOQ for individual PFAS are reported in Table S*3*.

Statistical analyses

Concentrations are given on a wet weight basis (w.w.). Averages are presented as arithmetic means with the standard error of the mean (SEM) where appropriate. Differences in PFAS profiles (composition, expressed as relative distribution profiles of the total ∑PFAS) between sites were explored using PCA. For each individual PCA, the PFAS profiles were standardized to have mean zero and standard deviation of one before performing PCA. According to the Shapiro-Wilk w-test and shape of data histograms, not all of the datasets were normally distributed. Therefore, differences in PFAS concentrations, percentages, and ratios, as well as differences in PC1 scores were tested using the non-parametric Kruskal-Wallis test and Bonferroni correction. The level of significance was set to 0.05. Statistical analyses were carried out using R version 3.4.2; R Core Team; Vienna, Austria(R Core Team, 2017) (packages agricolae (de Mendiburu, 2019) factoextra (Kassambara and Mundt, 2017) and FactoMineR (Lê *et al.*, 2008), functions: kruskal.test, kruskal, prcomp (scale=T and center=T)).

Selection of sites and PFAS for Principal Components Analyses (PCA)

The number of targeted PFAS varied between sites and sampling year, summarised in Table S4 and Table S5. The same PFAS need to be targeted in all samples that are included in a PCA in order to make a meaningful comparison. Therefore, the number of PFAS that could be included in the different PCAs differed, and was limited by the PFAS that were targeted at the different sites. The selection of the sites and PFAS for the PCA are described in the following.

Seven PFAS were targeted for all muscle samples: perfluorohexanoic acid (PFHxA), perfluoroheptanoic acid (PFHpA), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), perfluorobutanesulfonate (PFBS), perfluorohexanesulfonate (PFHxS), and perfluorooctanesulfonate (PFOS). Perfluorobutanoic acid (PFBA) and perfluoropentanoic acid (PFPA) were analysed in most samples. PFBA was only detected in one sample (one brown trout muscle from Evenes airport), while PFPA was not detected in any sample. Therefore, these two PFAS were not included in further data analyses and interpretations. Perfluorooctanoic acid (PFOA) was targeted in all samples except for in brown trout sampled in lake Mjøsa in 2016. 6:2 fluorotelomer sulfonate (6:2 FTS) was analysed in all samples, except samples from lake Mjøsa. Perfluorodecanesulfonate (PFDS) and perfluorooctanesulfonamide (FOSA) were analysed in all samples, except those from Rygge airport. Perfluoroundecanoic acid (PFUnDA), perfluorododecanoic acid (PFDoDA), perfluorotridecanoic acid (PFTrDA), and perfluorotetradecanoic acid (PFTeDA) were analysed in all samples, except those from lake Mjøsa and Rygge airport. 8:2 FTS was targeted in all samples, except from samples from lake Mjøsa and a few samples from lake Randsfjorden.

23 PFAS were targeted for all liver samples: PFPA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFTrDA, PFTeDA, PFBS, PFHxS, PFOS, PFDS, Perfluorododecansulfonate (PFDoDS), FOSA, *N*-methyl perfluorooctanesulfonamide (MeFOSA), *N*-ethyl perfluorooctanesulfonamide (EtFOSA), *N*-methyl perfluorooctanesulfonamido ethanol (MeFOSE), *N*-ethyl perfluorooctanesulfonamido ethanol (EtFOSE), *N*-methyl perfluorooctansulfonamido acetic acid (MeFOSAA), *N*-ethyl perfluorooctansulfonamido acetic acid (EtFOSAA), and 6:2 FTS. Of these, six were not detected in any of the samples: PFPA, PFDoDS, MeFOSA, MeFOSE, EtFOSE, MeFOSAA. 8:2 FTS was targeted for all samples, except samples from 2014 in lake Femunden, lake Mjøsa, and lake Randsfjorden. PFBA was targeted in most samples, but not detected in any and was therefore not included in the statistical analyses.

Brown trout muscle

PFAS profiles in brown trout muscle were used to explore if and how PFAS fingerprints in fish affected by each of the three source types differed from each other. Brown trout muscle was the only tissue where PFAS was targeted in multiple samples covering all three source types.

PFOA was targeted for all brown trout muscle samples, except for brown trout sampled in lake Mjøsa in 2016. Therefore, the brown trout from lake Mjøsa in 2016 was not included in the PCA. Ten PFAS (PFHxA, PFHpA, PFOA, PFNA, PFDA, PFBS, PFHxS, PFOS, PFDS, and FOSA) were targeted for all the remaining samples of brown trout. PFHpA and PFBS were not detected in any sample and they were excluded from the analysis. Three individuals from Fagernes airport did not contain PFAS concentrations above the LOQ (0.5-1.0 μg kg^{-1}) and were excluded from the PCA shown in Figure S3.

The PCA plot (Figure S3) showed groupings according to the different sites and hence, the different sources. In the score plot, samples from AFFF impacted sites (Evenes airport and Fagernes airport) grouped to the right, while samples from the other sites plotted generally to the left of the AFFF samples. In the loading plot, PFOS plotted to the right, while PFOA and PFDA plotted to the left. This reflects the fact that the samples from AFFF impacted sites generally had higher percentages of PFOS compared to the other sites.

It is also clear from Figure S3 that some trout muscle samples from the different sites plotted together in the PCA. Some of the samples from the sites not expected to be directly affected by AFFF (lake Randsfjorden and lake Mjøsa) plotted together with some samples from the sites expected to be directly affected by AFFF (Evenes airport and Fagernes airport). The main reason for this was that there were few PFAS above the LOQ in many samples. PFOS was the only above the LOQ in 20 of 34 samples from Evenes airport, 29 of 43 from Fagernes airport, 31 of 121 from lake Mjøsa, 17 of 24 from lake Randsfjorden, and one of six samples from lake Tyrifjorden. Therefore, to further explore differences in trout muscle profiles depending on the sources, samples from lake Mjøsa were excluded in order to include the C11-C14 PFCA in the analysis, shown in Figure 2 in the main paper (the C11-C14 PFCA: PFUnDA; PFDoDA; PFTrDA; and PFTeDA, were targeted for all sites but lake Mjøsa). PFOA was only detected in samples from lake Mjøsa and was therefore excluded from this PCA. 6:2 FTS and 8:2 FTS were not detected in any sample and were therefore not included in the PCA. When including the C11-C14 PFCA in the analysis, a clear grouping according to the different sites were observed reflecting distinct differences in PFAS profiles between the sites (Figure 2 in the main paper).

Perch muscle

A similar pattern as in trout muscle was observed for PFAS profiles (ten PFAS) in perch muscle from Fagernes airport, Rygge airport and lake Tyrifjorden, shown in Figure S4. Concentrations below the LOQ and varying number of targeted PFAS between sites complicated interpretations (e.g. PFOS was the only detected PFAS in 21 of 34 samples from Fagernes airport and in two of 42 samples from lake Tyrifjorden). However, a general trend was observed where samples from the AFFF affected sites (Fagernes airport and Rygge airport) were dominated by PFOS, while samples from lake Tyrifjorden had higher percentages of PFCA.

Due to the fact that some PFAS (PFUnDA, PFDoDA, PFTrDA, PFTeDA, PFDS, and FOSA) were not targeted for samples from Rygge airport, a separate PCA for samples from Fagernes airport and lake Tyrifjorden (16 PFAS) was carried out, shown in Figure S5. As for trout muscle, a more distinct grouping according to percentages of PFOS (and other PFSA: PFHxS, PFHpS, and PFDS) and long chained PFCA was shown when more PFAS were included. However, PFOS was the only compound of the 16 targeted PFAS which was found at concentrations above the LOQ in 11 samples from Fagernes airport, reflecting the low concentrations in muscle tissue. PC 1 (X-axis) explained 34% of the variance. PFSA plotted to the right, while C10-C14 PFCA plotted to the left. As for trout muscle, perch muscle samples from the AFFF impacted site (Fagernes airport) grouped on the side of the plot dominated by PFOS and other PFSA (right) while samples from lake Tyrifjorden (paper industry) plotted on the side associated with long chained PFCA (left) or close to the centre. A few samples plotted low on the Y-axis (PC 2) due to having concentrations of one or several of PFHpA, PFOA, and/or PFNA above the LOQ, which were only detected in a few individuals.

Supplementary tables

Table S1. Overview of the investigated water bodies, including the main known (and suspected) contaminant sources.

	Location (UTM33 EUREF89)		Volume (km^3)	Surface area (km^2)	Max depth (m)	Catchment area (km^2)	Person equivalents	Main contaminant sources
Lake Mjøsa	N: 6746114	E: 282000	65	369	453	17 251	200 000	Five urban areas, major roads, (old) industry, 3 major WWTP [a], agriculture
Lake Femunden	N: 6898700	E: 338500	6	203	153	1 790	~200	Long range transport
Lake Randsfjorden	N: 6717603	E: 244543	7	140	131	3 700	29 000	Long range transport (Rural areas, agriculture, roads)
Lake Tyrifjorden	N: 6642656	E: 554074	13	138	288	9 900	35 000	Paper industry, urban areas, agriculture
Lake Vansjø (Rygge airport)	N: 6590832	E: 263411	0.3	36	35	680	30 000	Military/civil airport, fire training facility, agriculture
Lake Lavangsvatnet (Evenes airport)	N: 7599017	E: 568141	-	1.60		76	-	Evenes airport, fire training facility
Lake Langvatnet (Evenes airport)	N: 7599400	E: 569040		0.9		76		Evenes airport, fire training facility, outlet to Lavangsvatnet
Lake Leirin, included lake Kalken (Fagernes airport)	N: 6778672	E: 568141		1.70		35		Fagernes airport, fire training facility
River Leira (Oslo airport)	N: 6676300	E: 281245		Length: 101 km		670		Oslo airport, (agriculture)

WWTP: wastewater treatment plant

Table S2. Number of samples (liver and muscle) of different fish species at the different sites.

	PFAS source	*AFFF*				*Paper industry*	*Diffuse*	*Long-range transport*	
	Site	**Oslo Airport**	**Evenes Airport**	**Fagernes Airport**	**Rygge Airport**	**Lake Tyrifjorden**	**Lake Mjøsa**	**Lake Femunden**	**Lake Randsfjorden**
					Liver				
Species	Arctic char					1			7
	Bream					2			
	Brown trout					6	84	66	34
	E. smelt [a]						61		28
	Perch				15	42			
	Pike					14			
	Roach					8			
	Vendace						37		
	Whitefish					13		36	
					Muscle				
Species	Arctic char		15			1			1
	Brown trout		34	46 (3) [c]		6	125		24
	E. smelt [a]						120 (1) [c]		21 (7) [c]
	Perch			34	16	42			
	Pike	2			14	14			
	E. chub [b]	1							
	Whitefish			30 (2) [c]				24 (23) [c]	
	Zander				11				

[a] *European smelt*

[b] European chub

[c] *Numbers inside brackets () are the number of samples where PFAS were not detected*

Table S3. Full name and abbreviations for the per- and polyfluorinated alkyl substances (PFAS) included in the present study [a]

Full name	Abbreviation	LOQ (NIVA analyses)
Perfluorobutanoic acid	PFBA	1.0
Perfluoropentanoic acid	PFPA	0.5
Perfluorohexanoic acid	PFHxA	0.5
Perfluoroheptanoic acid	PFHpA	0.5
Perfluorooctanoic acid	PFOA	0.5
Perfluorononanoic acid	PFNA	0.4
Perfluorodecanoic acid	PFDA	0.4
Perfluoroundecanoic acid	PFUnDA	0.4
Perfluorododecanoic acid	PFDoDA	0.4
Perfluorotridecanoic acid	PFTrDA	0.4
Perfluorotetradecanoic acid	PFTeDA	0.4
Perfluoropentadecanoic acid [b, c]	PFPeDA	0.4
Perfluorohexadecanoic acid	PFHxDA	0.4
Perfluorobutanesulfonate	PFBS	0.1
Perfluoropentanesulfonate	PFPeS	0.1
Perfluorohexanesulfonate	PFHxS	0.1
Perfluoroheptanesulfonate	PFHpS	0.1
Linear perfluorooctanesulfonate	PFOS	0.1
Branched perfluorooctanesulfonate isomers [d]	Br-PFOS	0.2
Perfluorononanesulfonate	PFNS	0.1
Perfluorodecanesulfonate	PFDS	0.1
Perfluorododecansulfonate	PFDoDS	0.2
Perfluorooctanesulfonamide	FOSA	0.1
N-methyl perfluorooctanesulfonamide	MeFOSA	0.2
N -ethyl perfluorooctanesulfonamide	EtFOSA	0.2
N -methyl perfluorooctanesulfonamido ethanol	MeFOSE	2.0
N -ethyl perfluorooctanesulfonamido ethanol	EtFOSE	2.0
Perfluorooctanesulfonamido acetic acid	FOSAA	0.3
N -methyl perfluorooctansulfonamido acetic acid	MeFOSAA	0.3
N -ethyl perfluorooctansulfonamido acetic acid	EtFOSAA	0.3

Full name	Abbreviation	LOQ (NIVA analyses)
4:2 fluorotelomer sulfonate	4:2 FTS	0.3
6:2 fluorotelomer sulfonate	6:2 FTS	0.3
8:2 fluorotelomer sulfonate	8:2 FTS	0.3
10:2 fluorotelomer sulfonate	10:2 FTS	0.3
12:2 fluorotelomer sulfonate	12:2 FTS	0.3
14:2 fluorotelomer sulfonate	14:2 FTS	0.3
Perfluoro(3,7-dimethyloctanoic acid) [e]	PF-3,7-DMOA	
7H-Dodecafluoroheptanoic acid [e]	HPFHpA	

[a] PFAS that were targeted or screened for, but not detected in Langberg et al. (2020) are not included.

[b] For analyses at NIVA: standard was not available, detected using exact mass and estimated retention time.

[c] For analyses at NIVA: quantified using the standard for PFHxDA.

[d] For analyses at NIVA: quantified using the standard for linear PFOS.

[e] Not analysed at NIVA

Table S4. Targeted PFAS in muscle samples at the different sites and species (X marks targeted PFAS).

Site	Lake/stream/ year	Species	Latin	PFBA	PFPA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnDA	PFDoDA	PFTrDA	PFTeDA	PFPeDA	PFHxDA	PFBS	PFPeS	PFHxS	PFHpS	PFOS	Br-PFOS
Evenes	Langvatnet/2019	Arctic char	*Salvelinus alpinus*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Evenes	Lavangsvatnet/2019	Arctic char	*Salvelinus alpinus*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Evenes	Kjerkvatnet/2019	Brown Trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Evenes	Lavangsvatnet/2019	Brown Trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Fagernes	Kalken/2018	Brown Trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Fagernes	Storfjorden/2018	Brown Trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Fagernes	Leirin midt/2018	Brown Trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Fagernes	Susfjorden/2018	Brown Trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Fagernes	Kalken/2018	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Fagernes	Storfjorden/2018	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Fagernes	Leirin midt/2018	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Fagernes	Kalken/2018	Whitefish	*Coregonus lavaretus*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Fagernes	Storfjorden/2018	Whitefish	*Coregonus lavaretus*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Fagernes	Leirin midt/2018	Whitefish	*Coregonus lavaretus*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Femunden	Femunden/2013-2016	Whitefish	*Coregonus lavaretus*		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Mjøsa	2009	Brown trout	*Salmo trutta*	X		X	X	X	X	X	X						X		X		X	
Mjøsa	2010	Brown trout	*Salmo trutta*	X		X	X	X	X	X	X						X		X		X	
Mjøsa	2011	Brown trout	*Salmo trutta*	X		X	X	X	X	X	X						X		X		X	
Mjøsa	2012	Brown trout	*Salmo trutta*	X		X	X	X	X	X	X						X		X		X	
Mjøsa	2008	Brown trout	*Salmo trutta*	X		X	X	X	X	X	X						X		X		X	
Mjøsa	2013	Brown trout	*Salmo trutta*	X		X	X	X	X	X	X						X		X		X	
Mjøsa	2014	Brown trout	*Salmo trutta*			X	X	X	X	X	X						X		X		X	
Mjøsa	2015	Brown trout	*Salmo trutta*			X	X	X	X	X	X						X		X		X	
Mjøsa	2016	Brown trout	*Salmo trutta*			X	X		X	X	X						X		X		X	
Mjøsa	2009	European smelt	*Osmerus eperlanus*	X		X	X	X	X	X	X						X		X		X	
Mjøsa	2010	European smelt	*Osmerus eperlanus*	X		X	X	X	X	X	X						X		X		X	
Mjøsa	2011	European smelt	*Osmerus eperlanus*	X		X	X	X	X	X	X						X		X		X	
Mjøsa	2012	European smelt	*Osmerus eperlanus*	X		X	X	X	X	X	X						X		X		X	
Mjøsa	2008	European smelt	*Osmerus eperlanus*			X	X	X	X	X	X						X		X		X	
Mjøsa	2013	European smelt	*Osmerus eperlanus*	X		X	X	X	X	X	X						X		X		X	
Mjøsa	2014	European smelt	*Osmerus eperlanus*			X	X	X	X	X	X						X		X		X	

Site	Lake/stream/ year	Species	Latin	PFBA	PFPA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnDA	PFDoDA	PFTrDA	PFTeDA	PFPeDA	PFHxDA	PFBS	PFPeS	PFHxS	PFHpS	PFOS	Br-PFOS
Mjøsa	2015	European smelt	*Osmerus eperlanus*			X	X	X	X	X	X						X		X		X	
Oslo airport	Leira/2018	Pike	*Esox lucius*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Oslo airport	Leira/2018	Squalius cephalus	*Squalius cephalus*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Randsfjorden	2015	Arctic char	*Salvelinus alpinus*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Randsfjorden	2016	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Randsfjorden	2015	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Randsfjorden	2014	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Randsfjorden	2013	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Randsfjorden	2016	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Randsfjorden	2014	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Randsfjorden	2013	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Tyrifjorden[a]	Tyrifjorden/2018	Arctic char	*Salvelinus alpinus*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tyrifjorden[a]	Tyrifjorden/2018	Brown Trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tyrifjorden[a]	Tyrifjorden/2018	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tyrifjorden[a]	Tyrifjorden/2018	Pike	*Esox lucius*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Rygge airport	Lake Vansjø/2013	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X							X		X		X	
Rygge airport	Lake Vansjø/2013	Pike	*Esox lucius*	X	X	X	X	X	X	X							X		X		X	
Rygge airport	Lake Vansjø/2013	Zander	*Sander lucioperca*	X	X	X	X	X	X	X							X		X		X	
Oslo airport	Leira/2018	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	
Oslo airport	Sogna/2018	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	

[a] PFAS analysed/screened for in lake Tyrifjorden (Langberg *et al.*, 2020), but not detected are not included in the table.

Table S4 (continuation, showing remaining PFAS). Targeted PFAS in muscle samples at the different sites and species (X marks targeted PFAS).

Site	Lake/stream/ year	Species	Latin	PFNS	PFDS	PFDoDS	FOSA	MeFOSA	EtFOSA	MeFOSE	EtFOSE	FOSAA	MeFOSAA	EtFOSAA	4:2 FTS	6:2 FTS	8:2 FTS	10:2 FTS	12:2 FTS	14:2 FTS	PF-3,7-DMOA	HPFHpA
Evenes	Langvatnet/2019	Arctic char	*Salvelinus alpinus*		X		X								X	X	X				X	X
Evenes	Lavangsvatnet/2019	Arctic char	*Salvelinus alpinus*		X		X								X	X	X				X	X
Evenes	Kjerkvatnet/2019	Brown Trout	*Salmo trutta*		X		X								X	X	X				X	X
Evenes	Lavangsvatnet/2019	Brown Trout	*Salmo trutta*		X		X								X	X	X				X	X
Fagernes	Kalken/2018	Brown Trout	*Salmo trutta*		X		X								X	X	X				X	X
Fagernes	Storfjorden/2018	Brown Trout	*Salmo trutta*		X		X								X	X	X				X	X
Fagernes	Leirin midt/2018	Brown Trout	*Salmo trutta*		X		X								X	X	X				X	X
Fagernes	Susfjorden/2018	Brown Trout	*Salmo trutta*		X		X								X	X	X				X	X
Fagernes	Kalken/2018	Perch	*Perca fluviatilis*		X		X								X	X	X				X	X
Fagernes	Storfjorden/2018	Perch	*Perca fluviatilis*		X		X								X	X	X				X	X
Fagernes	Leirin midt/2018	Perch	*Perca fluviatilis*		X		X								X	X	X				X	X
Fagernes	Kalken/2018	Whitefish	*Coregonus lavaretus*		X		X								X	X	X				X	X
Fagernes	Storfjorden/2018	Whitefish	*Coregonus lavaretus*		X		X								X	X	X				X	X
Fagernes	Leirin midt/2018	Whitefish	*Coregonus lavaretus*		X		X								X	X	X				X	X
Femunden	Femunden/2013-2016	Whitefish	*Coregonus lavaretus*	*X*	X	X	X	X	X	X	X		X	X	X	X	X					
Mjøsa	2009	Brown trout	*Salmo trutta*		X		X															
Mjøsa	2010	Brown trout	*Salmo trutta*		X		X															
Mjøsa	2011	Brown trout	*Salmo trutta*		X		X															
Mjøsa	2012	Brown trout	*Salmo trutta*		X		X															
Mjøsa	2008	Brown trout	*Salmo trutta*		X		X															
Mjøsa	2013	Brown trout	*Salmo trutta*		X		X															
Mjøsa	2014	Brown trout	*Salmo trutta*		X		X															
Mjøsa	2015	Brown trout	*Salmo trutta*		X		X															
Mjøsa	2016	Brown trout	*Salmo trutta*		X		X															
Mjøsa	2009	European smelt	*Osmerus eperlanus*		X		X															
Mjøsa	2010	European smelt	*Osmerus eperlanus*		X		X															
Mjøsa	2011	European smelt	*Osmerus eperlanus*		X		X															
Mjøsa	2012	European smelt	*Osmerus eperlanus*		X		X															
Mjøsa	2008	European smelt	*Osmerus eperlanus*		X		X															

Site	Lake/stream/ year	Species	Latin	PFNS	PFDS	PFDoDS	FOSA	MeFOSA	EtFOSA	MeFOSE	EtFOSE	FOSAA	MeFOSAA	EtFOSAA	4:2 FTS	6:2 FTS	8:2 FTS	10:2 FTS	12:2 FTS	14:2 FTS	PF-3,7-DMOA	HPFHpA
Mjøsa	2013	European smelt	*Osmerus eperlanus*		X		X															
Mjøsa	2014	European smelt	*Osmerus eperlanus*		X		X															
Mjøsa	2015	European smelt	*Osmerus eperlanus*		X		X															
Oslo airport	Leira/2018	Pike	*Esox lucius*		X		X								X	X	X				X	X
Oslo airport	Leira/2018	Squalius cephalus	*Squalius cephalus*		X		X								X	X	X				X	X
Randsfjorden	2015	Arctic char	*Salvelinus alpinus*		X	X	X	X	X	X	X		X	X		X	X					
Randsfjorden	2016	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Randsfjorden	2015	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X		X	X		X	X					
Randsfjorden	2014	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X		X	X		X						
Randsfjorden	2013	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X					X						
Randsfjorden	2016	European smelt	*Osmerus eperlanus*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Randsfjorden	2014	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X		X	X		X						
Randsfjorden	2013	European smelt	*Osmerus eperlanus*	X	X	X	X	X	X	X	X					X						
Tyrifjorden[a]	2018	Arctic char	*Salvelinus alpinus*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Tyrifjorden[a]	2018	Brown Trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Tyrifjorden[a]	2018	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Tyrifjorden[a]	2018	Pike	*Esox lucius*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Rygge airport	2013	Perch	*Perca fluviatilis*													X	X					
Rygge airport	2013	Pike	*Esox lucius*													X	X					
Rygge airport	2013	Zander	*Sander lucioperca*													X	X					

[a] PFAS analysed/screened for in lake Tyrifjorden (Langberg *et al.*, 2020), but not detected are not included in the table.

Table S5. Targeted PFAS in liver samples at the different sites and species (X marks Targeted PFAS).

Site	Year	Species	Latin	PFBA	PFPA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnDA	PFDoDA	PFTrDA	PFTeDA	PFPeDA	PFHxDA	PFBS	PFPeS	PFHxS	PFHpS	PFOS	Br-PFOS
Femunden	2014	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Femunden	2015	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Femunden	2016	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Femunden	2017	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Femunden	2018	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Femunden	2019	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Femunden	2014	Whitefish	*Coregonus lavaretus*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Femunden	2015	Whitefish	*Coregonus lavaretus*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Femunden	2016	Whitefish	*Coregonus lavaretus*		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Mjøsa	2014	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Mjøsa	2015	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Mjøsa	2016	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Mjøsa	2017	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Mjøsa	2018	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Mjøsa	2019	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Mjøsa	2014	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Mjøsa	2015	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Mjøsa	2016	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Mjøsa	2017	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Mjøsa	2018	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Mjøsa	2019	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Mjøsa	2014	Vendace	*Coregonus albula*		X	X	X	X	X	X	X	X	X	X			X		X		X	
Mjøsa	2016	Vendace	*Coregonus albula*		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Mjøsa	2017	Vendace	*Coregonus albula*		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Mjøsa	2018	Vendace	*Coregonus albula*		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Mjøsa	2019	Vendace	*Coregonus albula*		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Randsfjorden	2015	Arctic char	*Salvelinus alpinus*	X	X	X	X	X	X	X	X	X	X	X			X		X		X	
Randsfjorden	2016	Arctic char	*Salvelinus alpinus*	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Randsfjorden	2014	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X			X		X		X	
Randsfjorden	2015	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X			X		X		X	
Randsfjorden	2016	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Randsfjorden	2014	European smelt	*Osmerus eperlanus*	X	X	X	X	X	X	X	X	X	X	X			X		X		X	
Randsfjorden	2015	European smelt	*Osmerus eperlanus*	X	X	X	X	X	X	X	X	X	X	X			X		X		X	
Randsfjorden	2016	European smelt	*Osmerus eperlanus*	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Tyrifjorden	2014	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X			X		X		X	
Tyrifjorden	2015	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X			X		X		X	
Tyrifjorden	2016	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Tyrifjorden	2018	Arctic char	*Salvelinus alpinus*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tyrifjorden	2018	Bream	*Abramis brama*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tyrifjorden	2018	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tyrifjorden	2018	Pike	*Esox lucius*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tyrifjorden	2018	Roach	*Rutilus rutilus*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Site	Year	Species	Latin	PFBA	PFPA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnDA	PFDoDA	PFTrDA	PFTeDA	PFPeDA	PFHxDA	PFBS	PFPeS	PFHxS	PFHpS	PFOS	Br-PFOS
Tyrifjorden	2018	Trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tyrifjorden	2018	Whitefish	*Coregonus lavaretus*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Rygge airport	2014	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X			X		X		X	
Rygge airport	2015	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X			X		X		X	
Rygge airport	2016	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	

Table S5 (continuation). Targeted PFAS in liver samples at the different sites and species (X marks targeted PFAS).

Site	Year	Species	Latin	PFNS	PFDS	PFDoDS	FOSA	MeFOSA	EtFOSA	MeFOSE	EtFOSE	FOSAA	MeFOSAA	EtFOSAA	4:2 FTS	6:2 FTS	8:2 FTS	10:2 FTS	12:2 FTS	14:2 FTS	PF-3,7-DMOA	HPFHpA
Femunden	2014	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X		X	X		X						
Femunden	2015	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X		X	X		X	X					
Femunden	2016	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Femunden	2017	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Femunden	2018	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X		X	X	X	X	X	X				
Femunden	2019	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X		X	X	X	X	X	X				
Femunden	2014	Whitefish	*Coregonus lavaretus*		X	X	X	X	X	X	X		X	X		X						
Femunden	2015	Whitefish	*Coregonus lavaretus*		X	X	X	X	X	X	X		X	X		X	X					
Femunden	2016	Whitefish	*Coregonus lavaretus*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Mjøsa	2014	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X		X	X		X						
Mjøsa	2015	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X		X	X		X	X					
Mjøsa	2016	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Mjøsa	2017	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Mjøsa	2018	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X		X	X	X	X	X	X				
Mjøsa	2019	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X		X	X	X	X	X	X				
Mjøsa	2014	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X		X	X		X						
Mjøsa	2015	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X		X	X		X	X					
Mjøsa	2016	European smelt	*Osmerus eperlanus*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Mjøsa	2017	European smelt	*Osmerus eperlanus*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Mjøsa	2018	European smelt	*Osmerus eperlanus*	X	X	X	X	X	X	X	X		X	X	X	X	X	X				
Mjøsa	2019	European smelt	*Osmerus eperlanus*	X	X	X	X	X	X	X	X		X	X	X	X	X	X				
Mjøsa	2014	Vendace	*Coregonus albula*		X	X	X	X	X	X	X		X	X		X						
Mjøsa	2016	Vendace	*Coregonus albula*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Mjøsa	2017	Vendace	*Coregonus albula*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Mjøsa	2018	Vendace	*Coregonus albula*	X	X	X	X	X	X	X	X		X	X	X	X	X	X				
Mjøsa	2019	Vendace	*Coregonus albula*	X	X	X	X	X	X	X	X		X	X	X	X	X	X				

Site	Year	Species	Latin	PFNS	PFDS	PFDoDS	FOSA	MeFOSA	EtFOSA	MeFOSE	EtFOSE	FOSAA	MeFOSAA	EtFOSAA	4:2 FTS	6:2 FTS	8:2 FTS	10:2 FTS	12:2 FTS	14:2 FTS	PF-3,7-DMOA	HPFHpA
Randsfjorden	2015	Arctic char	*Salvelinus alpinus*		X	X	X	X	X	X	X		X	X		X	X					
Randsfjorden	2016	Arctic char	*Salvelinus alpinus*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Randsfjorden	2014	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X		X	X		X						
Randsfjorden	2015	Brown trout	*Salmo trutta*		X	X	X	X	X	X	X		X	X		X	X					
Randsfjorden	2016	Brown trout	*Salmo trutta*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Randsfjorden	2014	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X		X	X		X						
Randsfjorden	2015	European smelt	*Osmerus eperlanus*		X	X	X	X	X	X	X		X	X		X	X					
Randsfjorden	2016	European smelt	*Osmerus eperlanus*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Tyrifjorden	2014	Perch	*Perca fluviatilis*		X	X	X	X	X	X	X		X	X		X						
Tyrifjorden	2015	Perch	*Perca fluviatilis*		X	X	X	X	X	X	X		X	X		X	X					
Tyrifjorden	2016	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X		X	X	X	X	X					
Tyrifjorden	2018	Arctic char	*Salvelinus alpinus*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Tyrifjorden	2018	Bream	*Abramis brama*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Tyrifjorden	2018	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		

Site	Year	Species	Latin	PFNS	PFDS	PFDoDS	FOSA	MeFOSA	EtFOSA	MeFOSE	EtFOSE	FOSAA	MeFOSAA	EtFOSAA	4:2 FTS	6:2 FTS	8:2 FTS	10:2 FTS	12:2 FTS	14:2 FTS	PF-3,7-DMOA	HPFHpA
Tyrifjorden	2018	Pike	*Esox lucius*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Tyrifjorden	2018	Roach	*Rutilus rutilus*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Tyrifjorden	2018	Trout	*Salmo trutta*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Tyrifjorden	2018	Whitefish	*Coregonus lavaretus*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Rygge airport	2014	Perch	*Perca fluviatilis*		X	X	X	X	X	X	X		X	X		X						
Rygge airport	2015	Perch	*Perca fluviatilis*		X	X	X	X	X	X	X		X	X		X	X					
Rygge airport	2016	Perch	*Perca fluviatilis*	X	X	X	X	X	X	X	X		X	X	X	X	X					

Table S6. Mean concentrations of ∑PFAS 17 in liver samples of various fish species at the different sites. Significant differences (Kruskal-Wallis and Bonferroni correction) are indicated by different significance letters. Limit of significance was set to 0.05. Mean concentrations are shown with the standard error of the mean (SEM).

Site, Species	Significance letter	Mean concentration (µg kg^{-1})
Rygge airport, Perch	a	298.9±37.6
Lake Tyrifjorden, Arctic char	ab	232.5 [a]
Lake Tyrifjorden, Perch	ab	287.5±37.3
Lake Tyrifjorden, Brown trout	ab	241.6±58.9
Lake Tyrifjorden, Bream	ab	167.5±9.5
Lake Tyrifjorden, Whitefish	ab	181.4±52.7
Lake Tyrifjorden, Pike	ab	121.8±17.1
Lake Tyrifjorden, Roach	ab	90.5±21.9
Lake Randsfjorden, Brown trout	b	71.4±10.7
Lake Femunden, Brown trout	b	58.9±7.2
Lake Mjøsa, Brown trout	b	41.8±3.2
Lake Mjøsa, European smelt	b	36.9±3.2
Lake Randsfjorden, Arctic char	bc	27.7±4.5
Lake Randsfjorden, European smelt	bc	21.6±2.0
Lake Femunden, Whitefish	bc	20.6±1.6
Lake Mjøsa, Vendace	c	9.7±1.1

[a] Only one sample

Table S7. Mean concentrations of ∑PFAS 7 in muscle samples of various fish species at the different sites. Significant differences (Kruskal-Wallis and Bonferroni correction) are indicated by different significance letters. The level of significance was set to 0.05. Mean concentrations are shown with the standard error of the mean (SEM).

Site, Species	Significance letter	Mean concentration (µg kg^{-1})
Oslo Airport, Pike	a	22.9±1.25
Fagernes, Perch	a	64.4±13.3
Rygge airport, Perch	a	20.0±2.6
Evenes, Arctic char	a	19.1±2.6
Rygge airport, Pike	a	22.1±6.1
Lake Tyrifjorden, Perch	a	15.0±1.6
Evenes, Brown Trout	a	18.8±2.6
Rygge airport, Zander	a	13.0±2.5
Oslo airport, Brown trout	a	271.5±118.4
Oslo airport, *Squalius cephalus*	ab	7.9 [a]
Fagernes, Brown Trout	ab	11.3±1.5
Lake Tyrifjorden, Arctic char	ab	5.9 [a]
Fagernes, Whitefish	ab	14.0±4.3
Lake Tyrifjorden, Pike	ab	5.4±0.9
Lake Tyrifjorden, Brown Trout	ab	5.0±1.2
Lake Mjøsa, European Smelt	b	4.1±0.3
Lake Mjøsa, Brown Trout	b	3.2±0.2
Lake Randsfjorden, Arctic Char	b	1.6 [a]
Lake Randsfjorden, Brown Trout	b	1.4±0.1
Lake Femunden, Whitefish	b	1.2±0.004
Lake Randsfjorden, European Smelt	b	1.2±0.04

[a] Only one sample

Table S8. Mean values in ratios between PFUnDA and PFDA in brown trout livers. Significant differences (Kruskal-Wallis and Bonferroni correction) are indicated by different significance letters. The level of significance was set to 0.05. Mean values are shown with the standard error of the mean (SEM).

Site, Species	Mean value	Significance letter
Lake Randsfjorden	5.0±0.3	a
Lake Femunden	4.9±0.3	a
Lake Mjøsa	2.8±0.1	b
Lake Tyrifjorden	1.8±0.3	b

Table S9. Mean values in ratios between PFTrDA and PFDoDA in brown trout livers. Significant differences (Kruskal-Wallis and Bonferroni correction) are indicated by different significance letters. The level of significance was set to 0.05. Mean values are shown with the standard error of the mean (SEM).

Site, Species	Mean value	Significance letter
Lake Randsfjorden	4.3±0.4	a
Lake Femunden	4.7±0.3	a
Lake Mjøsa	1.7±0.1	b
Lake Tyrifjorden	0.7±0.3	b

Supplementary figures

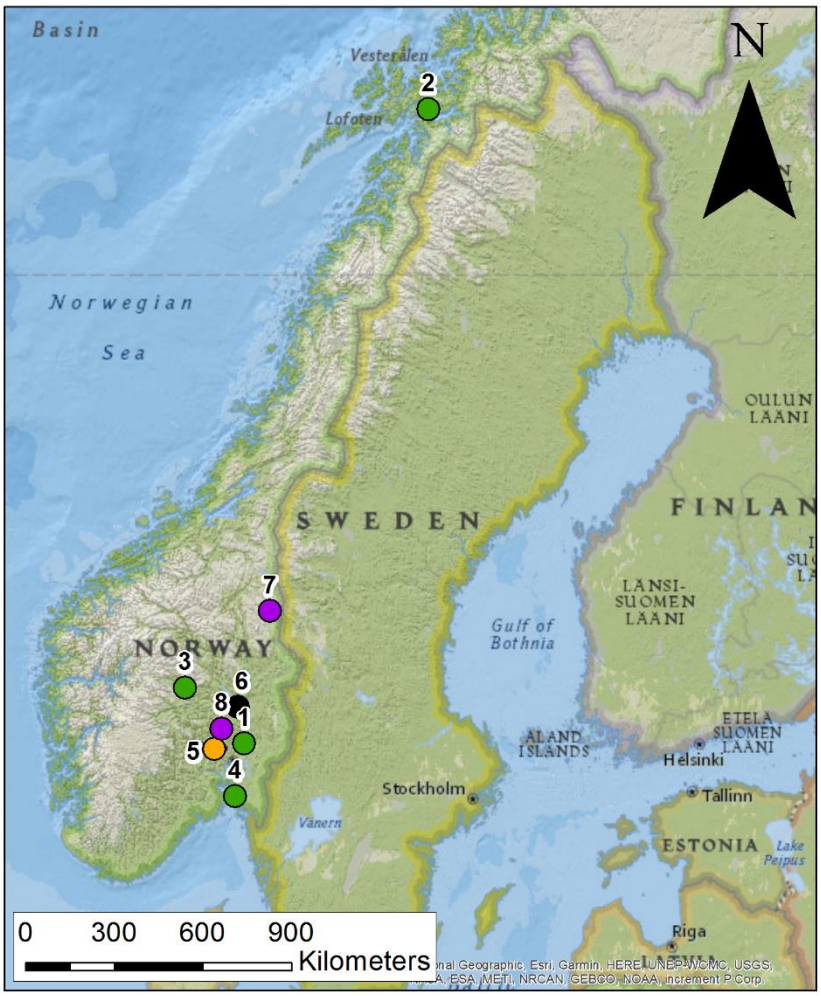

Figure S1. Overview map showing the investigated point sources, AFFF sources (green dots); production of paper products (orange dot); urban runoff, and mixed sources (black dot); and long range transport (purple dots): 1) Oslo Airport; 2) Evenes Airport; 3) Fagernes Airport; 4) Rygge Airport; 5) Lake Tyrifjorden; 6) Lake Mjøsa; 7) Lake Femunden; and 8) Lake Randsfjorden.

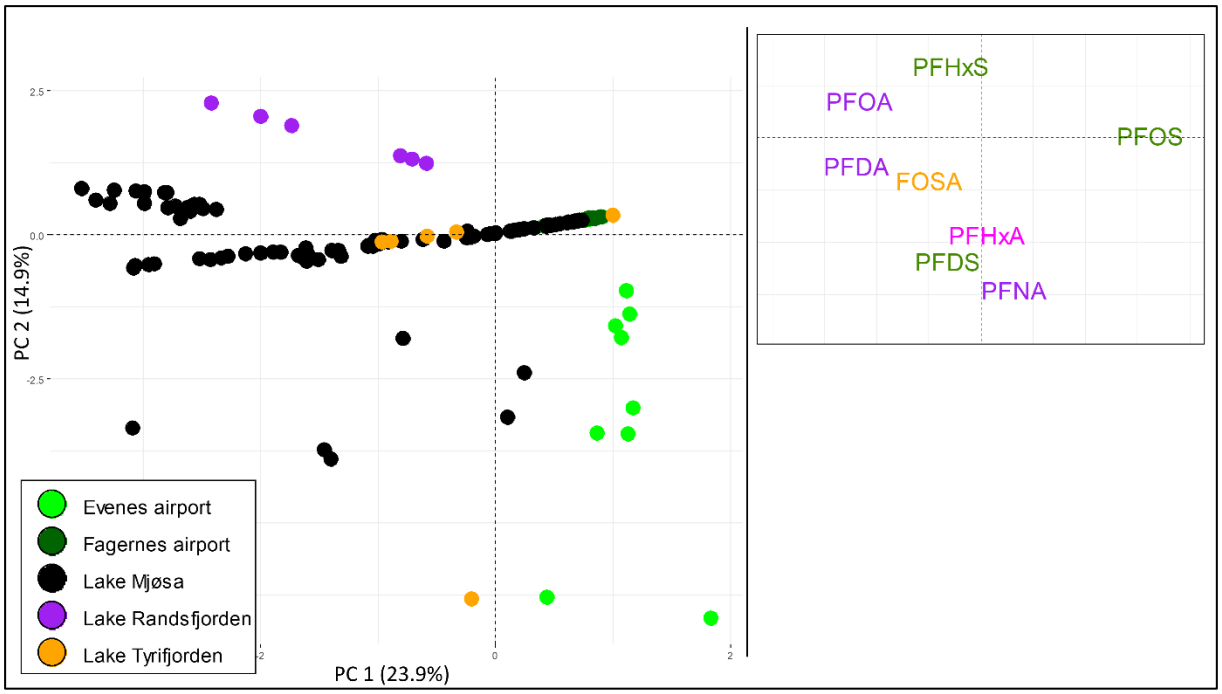

Figure S2. Principal Component Analysis (PCA) for PFAS profiles in Brown trout muscle from two sites affected by AFFF (Evenes airport and Fagernes airport), lake Mjøsa, polluted by diffuse sources including industry, WWTP, and urban runoff, lake Randsfjorden that was considered to receive the majority of PFAS pollution from long range transport, and lake Tyrifjorden polluted by PFAS from production of paper products. The score plot is shown to the left and the loading plot is shown to the right. In the loading plot, PFCA are coloured purple and pink, PFSA are coloured green, and preFOS are coloured yellow. Only PFAS targeted at all sites and detected above the LOQ in at least one sample were included. Concentrations below the LOQ were treated as 0.

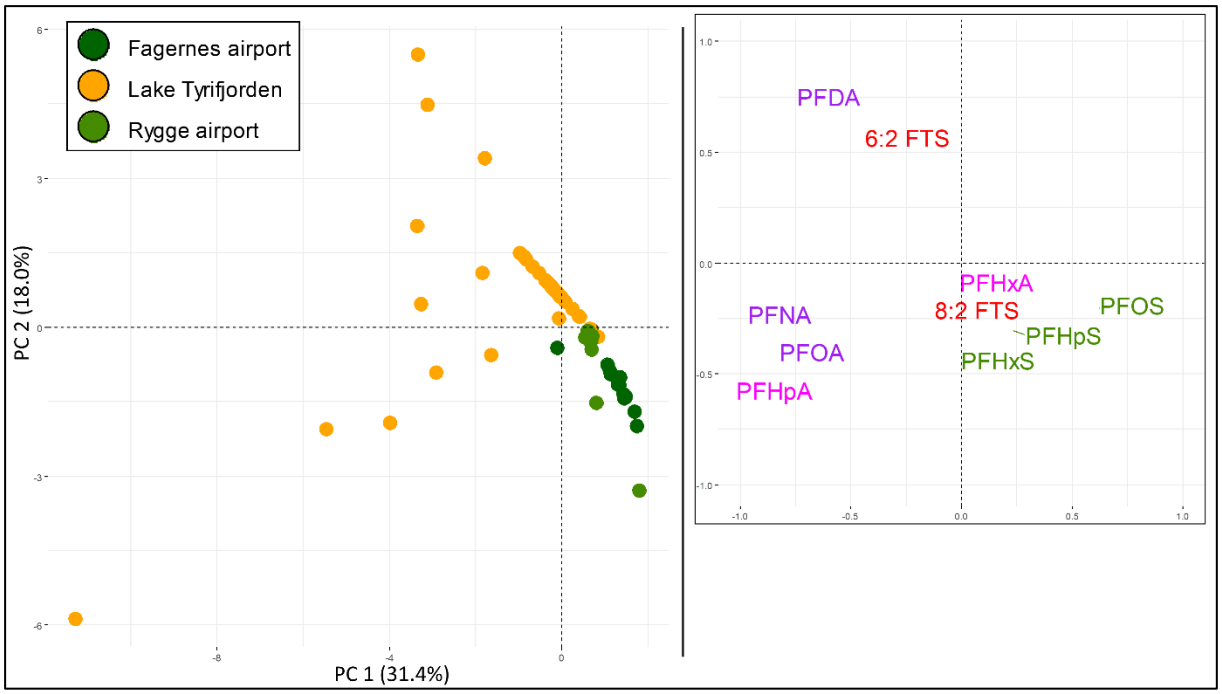

Figure S3. Principal Component Analysis (PCA) for PFAS profiles in perch muscle from two sites affected by AFFF (Fagernes airport and Rygge airport), and lake Tyrifjorden polluted by PFAS from production of paper products. The score plot is shown to the left and the loading plot is shown to the right. In the loading plot, PFCA are coloured purple and pink, PFSA are coloured green, and preFOS are coloured yellow. Only PFAS targeted at all sites and detected above the LOQ in at least one sample were included. Concentrations below the LOQ were treated as 0.

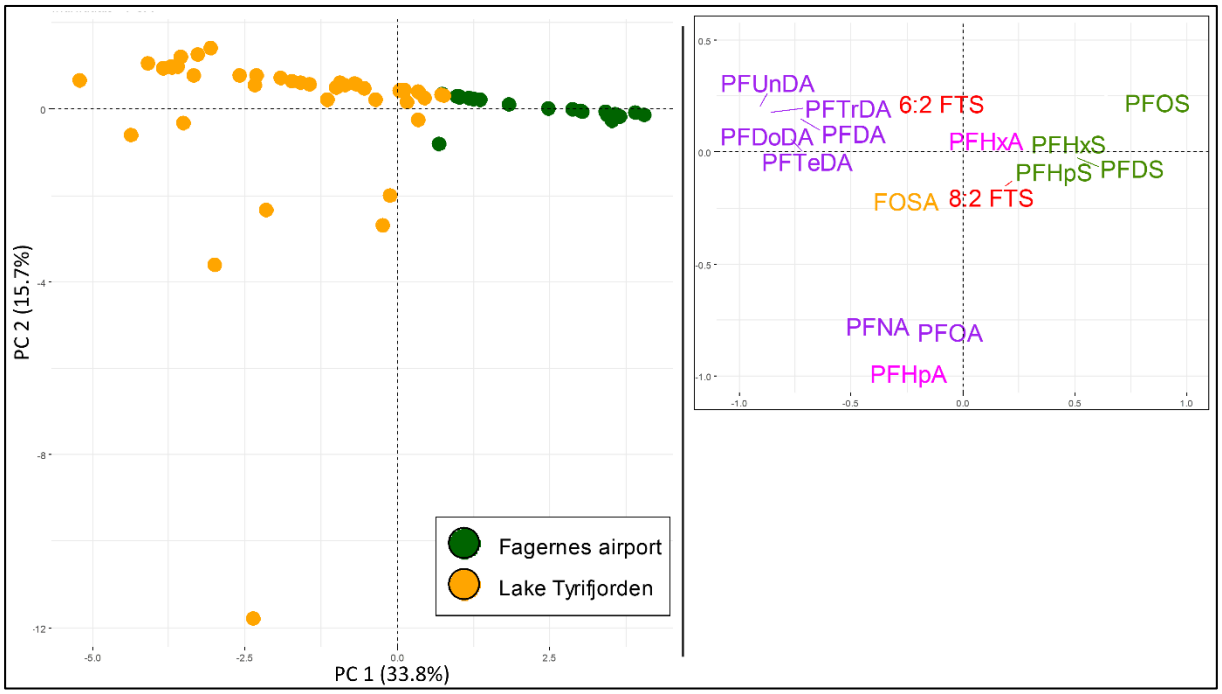

Figure S4. Principal Component Analysis (PCA) for PFAS profiles in perch muscle from Fagernes airport, polluted by AFFF, and lake Tyrifjorden polluted by PFAS from production of paper products. The score plot is shown to the left and the loading plot is shown to the right. In the loading plot, PFCA are coloured purple and pink, PFSA are coloured green, and preFOS are coloured yellow. Only PFAS targeted at all sites and detected above the LOQ in at least one sample were included. Concentrations below the LOQ were treated as 0.

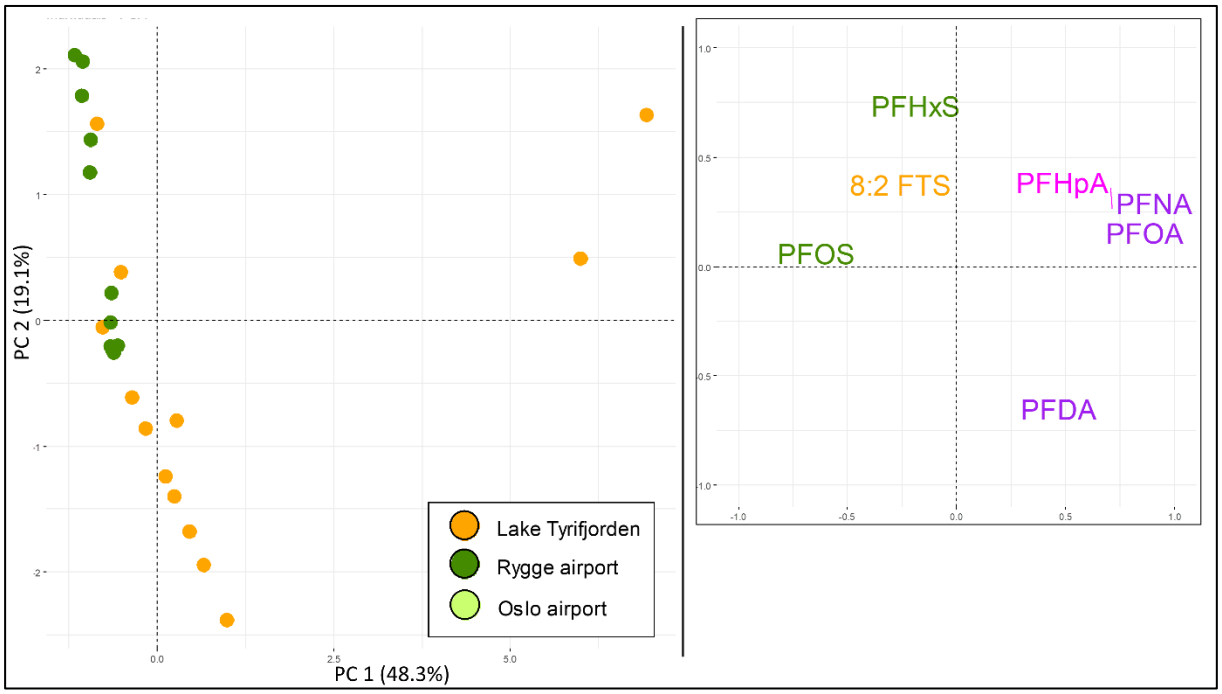

Figure S5. Principal Component Analysis (PCA) for PFAS profiles in pike muscle from two sites affected by AFFF (lake Vansjø (Rygge airport) and Oslo airport), and lake Tyrifjorden polluted by PFAS from production of paper products. The score plot is shown to the left and the loading plot is shown to the right. In the loading plot, PFCA are coloured purple and pink, PFSA are coloured green, and preFOS are coloured yellow. Only PFAS targeted at all sites and detected above the LOQ in at least one sample were included. Concentrations below the LOQ were treated as 0.

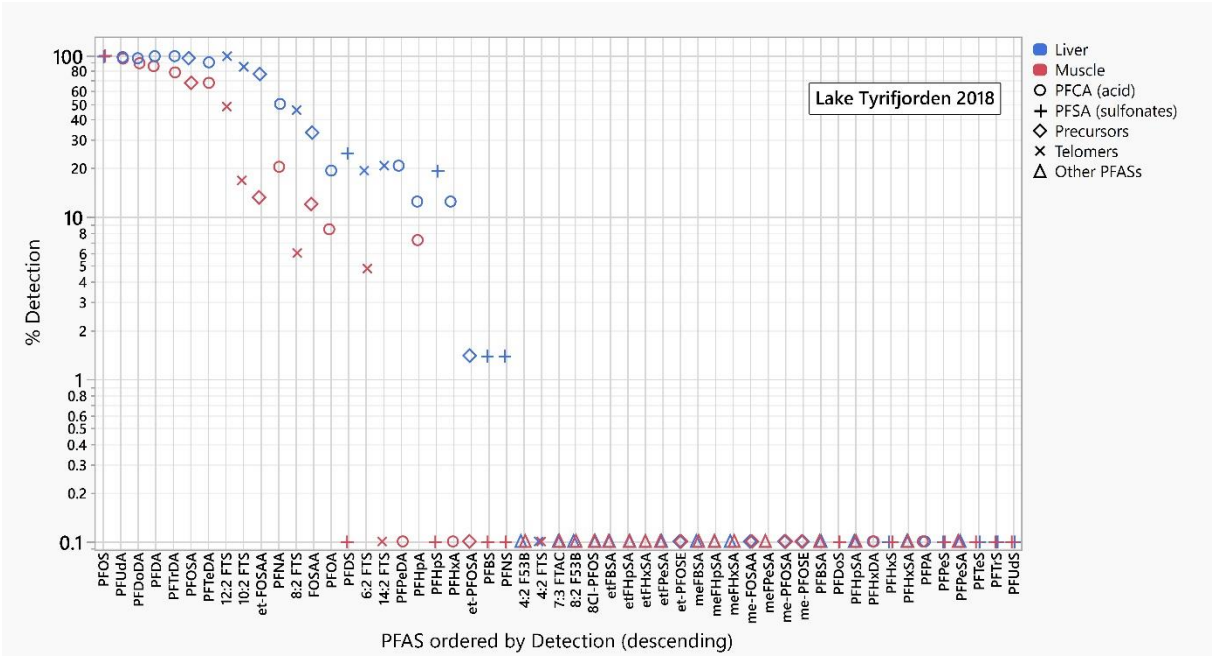

Figure S6. Overview of PFAS detections in liver (blue) and muscle (red) for target PFAS in samples of perch and trout from Lake Tyrifjorden (data from Langberg et al. (2020)).

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