Overvåking av miljøgifter i ferskvannsnæringsnett– de lange tidseriene, og de nye miljøgiftene

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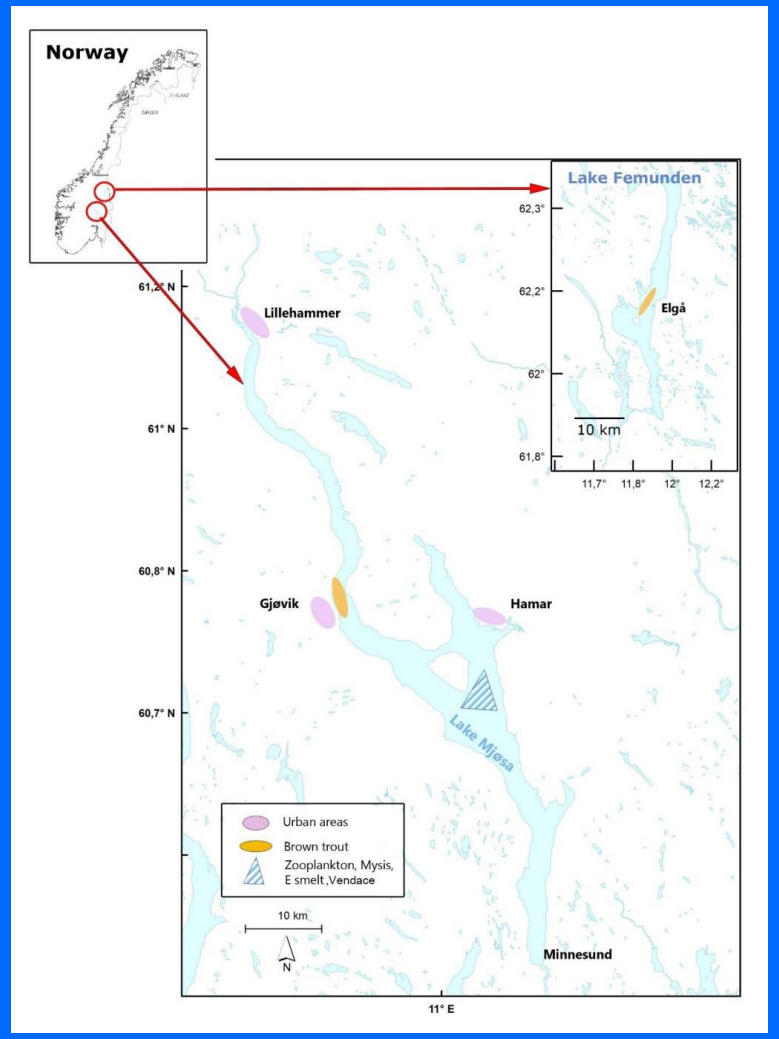
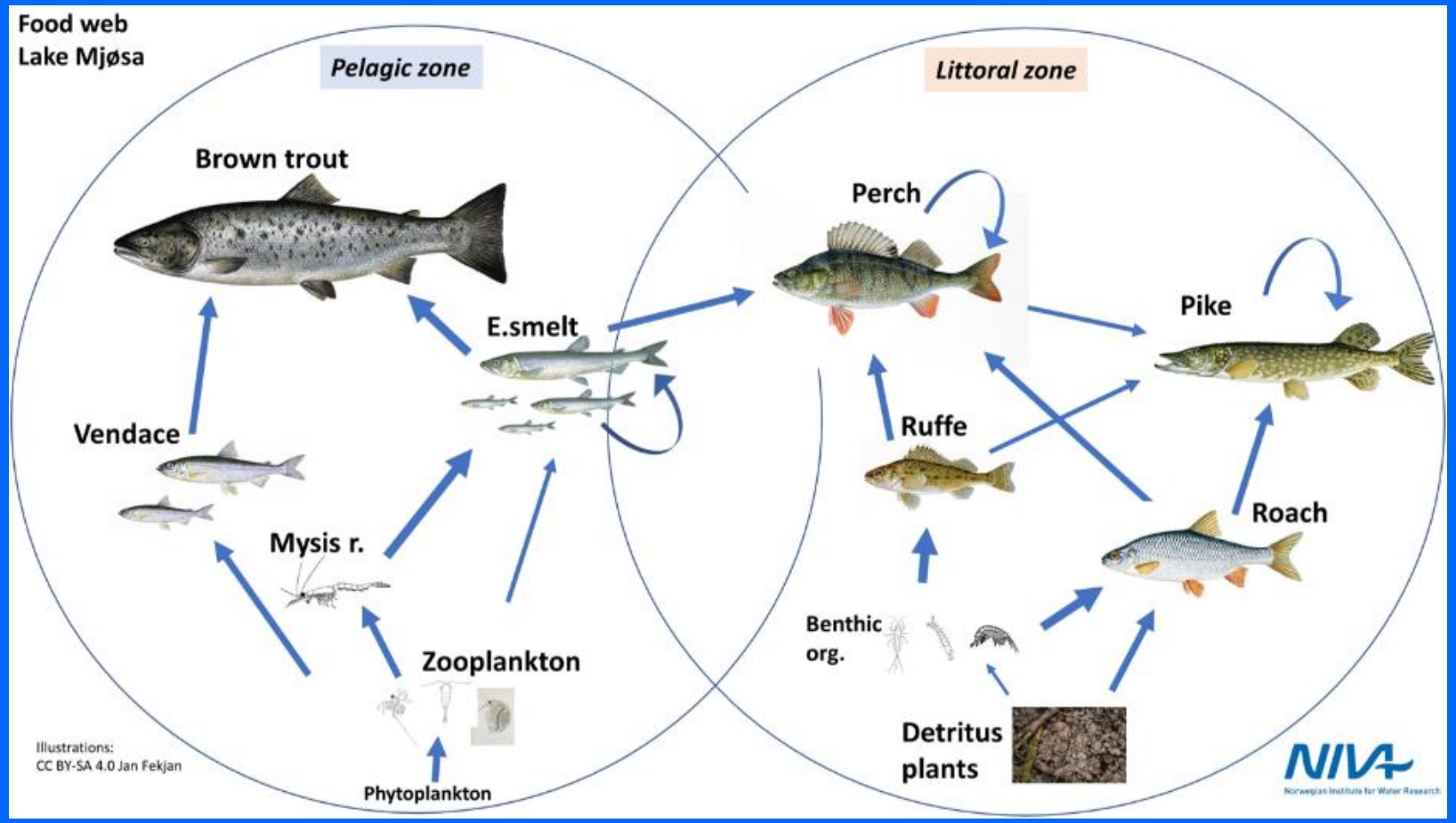
Prosjektleder
Overvåking av miljøgifter i ferskvannsnæringsnett (MILFERSK) Norsk Institutt for Vannforskning, NIVA


Møre og Romsdal
Innlandet
Vestland
Buskerud
Oslo
Telemark
Akershus
Rogaland
Vestfold
Østfold
Agder
Karlstad
50 km


Norway
Lake Femunden
62,3°
62,2°
62°
61,8°
11,7°
11,8°
12°
12,2°
Elgå
10 km
61,2° N
61° N
60,8° N
60,7° N
Lillehammer
Gjøvik
Hamar
Lake Mjøsa
Minnesund
Urban areas
Brown trout
Zooplankton, Mysis, E smelt,Vendace
10 km
N
11° E


Moelv
Veldre
Rudshøgda
Smedmoen
Ringsaker
Brumunddal
Vangsåsen
Høsbjør
Kvarberg
Furnesfjorden
Furnes
Ingeberg
Solberg-åsen
Bråstad-brua
Tranberg
Mengshol
Gjøvik
Hamar
Ridabu
Tingnes
Bekkelaget
Ottestad
Helgøya
Kapp
Stange
Mjøsa
5 km
Legend
Chironomids
Ruffe Sediment
Perch
Pike
Brown trout


Food web
Lake Mjøsa
Pelagic zone
Littoral zone
Brown trout
Perch
E.smelt
Pike
Vendace
Ruffe
Roach
Mysis r.
Benthic org.
Zooplankton
Detritus plants
Phytoplankton
Illustrations:
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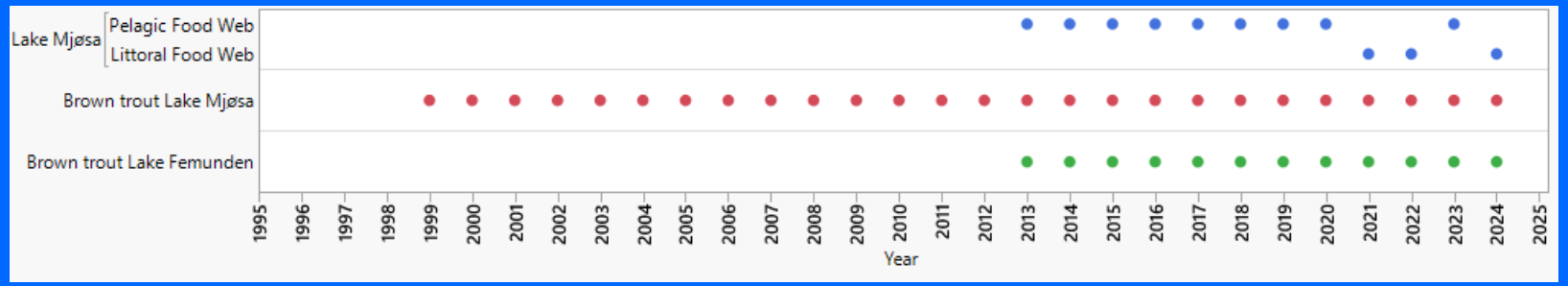

Lake Mjøsa
Pelagic Food Web
Littoral Food Web
Brown trout Lake Mjøsa
Brown trout Lake Femunden
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Year

NIVA

- Feltarbeid og innsamling
- Prøveopparbeiding
- «Screening»

Innsamlingsprogram 2022

185 enkeltforbindelser/isomerer

	Parameters	Sediment	Chironomids[1,2]	Ruffe	Perch[2]	Pike[2]	Brown trout. Mjøsa[2]	Brown trout. Femunden[2]	Brown trout (BT) pooled samples. Mjøsa[2]	N analyses
NILU	Mercury (Hg)	3	2	6	6	6	15	3	3	44
	Metals	3	2							5
	Rare earth metals	3	2							5
	Siloxanes	3	2	6	6	6	15	3	3	44
	PBDEs	3	2	6	6	6	15	3	3	44
	Chlorinated paraffins (CP)	3	2	6	6	6	15	3	3	44
	Musk	3	2	6	6	6				23
	Metabolites of 1) oPFR and 2) phtalates					6	15	3		24
	LCCP					6	15	3		24
NIVA	PFAS	3								3
	REDUCED PFAS (biota). excl. Short-chained PFCAs		2	6	6	6	15	3	3	41
	UV-compounds	3	2	6	6	6	15	3	3	44
	Benzothiazoles	3								3
	Quaternary Ammonium Compounds (QAC)	3	2	6	6	6				23
IFE	Isotopes ($\delta^{13}C$. $\delta^{15}N$)		4	15	15	9	15	15	3	76

[1] Only one sample of Chironomids, because of low population density in 2022. In addition: one sample of stomach content of ruffe.
[2] Chironomids, ruffe, and ruffe stomach: whole body samples. For fish: samples of muscle and liver.

2023

205 enkeltforbindelser/isomerer

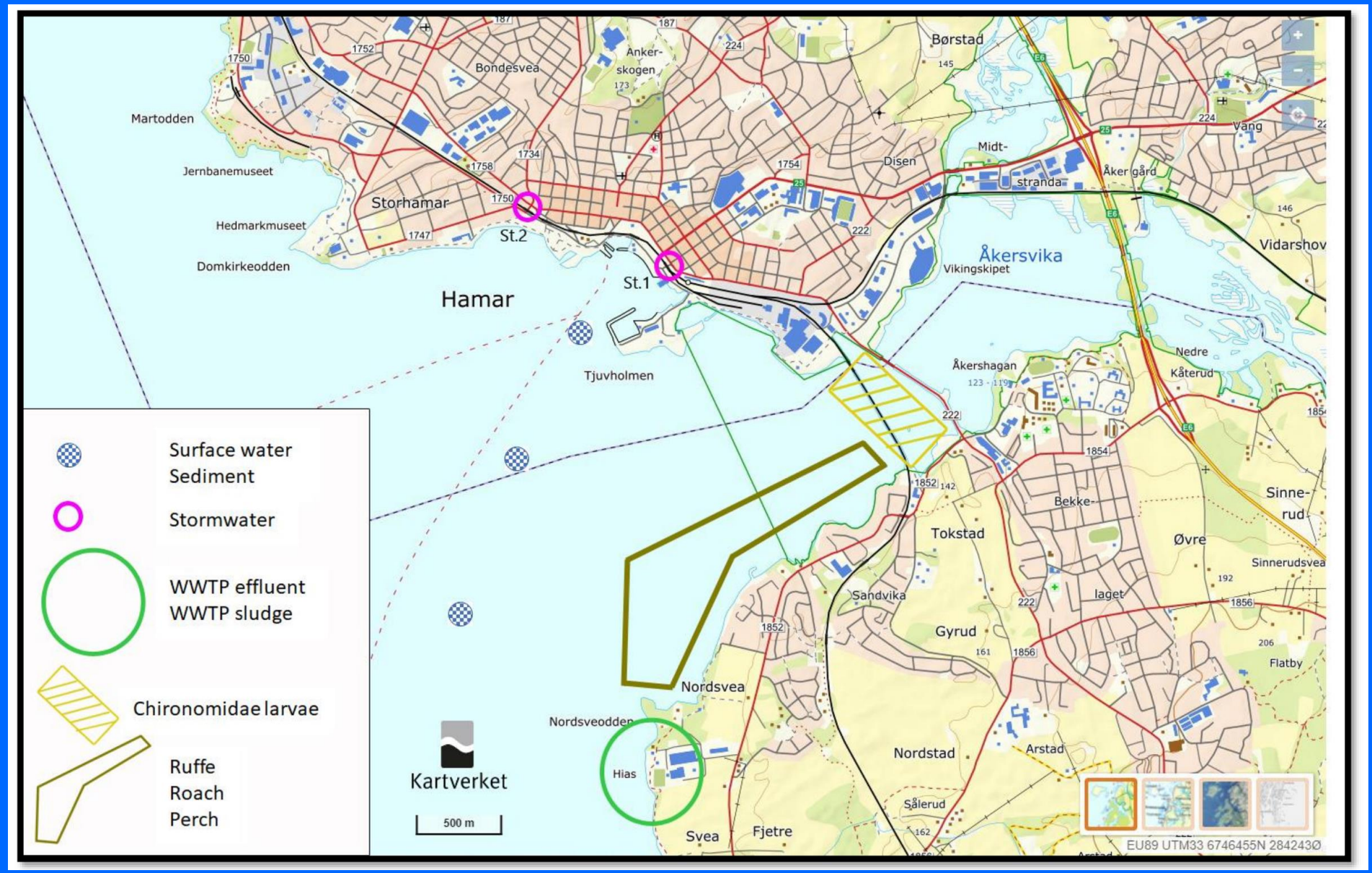
	Parameters	Zooplankton[1,2.]	Mysis[2]	E. smelt[2]	Vendace[2]	Vendace, stomach[2]	Brown trout. Mjøsa[2]	Brown trout. Femunden[2]	N analyses
NILU	Mercury (Hg)	3	3	3	3	3	15	3	33
	Metals	3	3						6
	Rare earth metals	3	3						6
	Siloxanes	3	3	3	3	3	15	3	33
	PBDEs	3	3	3	3	3	15	3	33
	Chlorinated paraffins (S/MCCP)	3	3	3	3	3	15	3	33
	Chlorinated paraffins (LCCP)						15	3	18
	Organic phosphorus flame retardants (oPFR)	3	3						6
	Phenols	3	3	3	3	3	3	3	21
	Musk	3	3	3	3	3			15
	Phthalates	3	3						6
NIVA	PFCA (perfluorinated carboxylate acids)			3	3	3	15	3	27
	PFSA (Perfluorinated sulfonates)			3	3	3	15	3	27
	nPFAS (polyfluorinated neutral compounds)			3	3	3	15	3	27
	newPFAS			3	3	3	15	3	27
	UV-compounds	3	3	3	3	3	15	3	33
	Benzothiazoles	3	3						6
	Quaternary Ammonium Compounds (QAC)	3	3	3	3	3			15
IFE	Isotopes ($\delta^{13}C$. $\delta^{15}N$)	3	3	3	3	3	15	15	45

[1] Samples of epipelagic zooplankton consisted of between 50 and 90 % *Daphnia* spp. [2]Zooplankton, mysis, E. smelt, vendace, and stomach: whole body samples. For trout: samples of muscle and liver.

Innsamlingsprogram

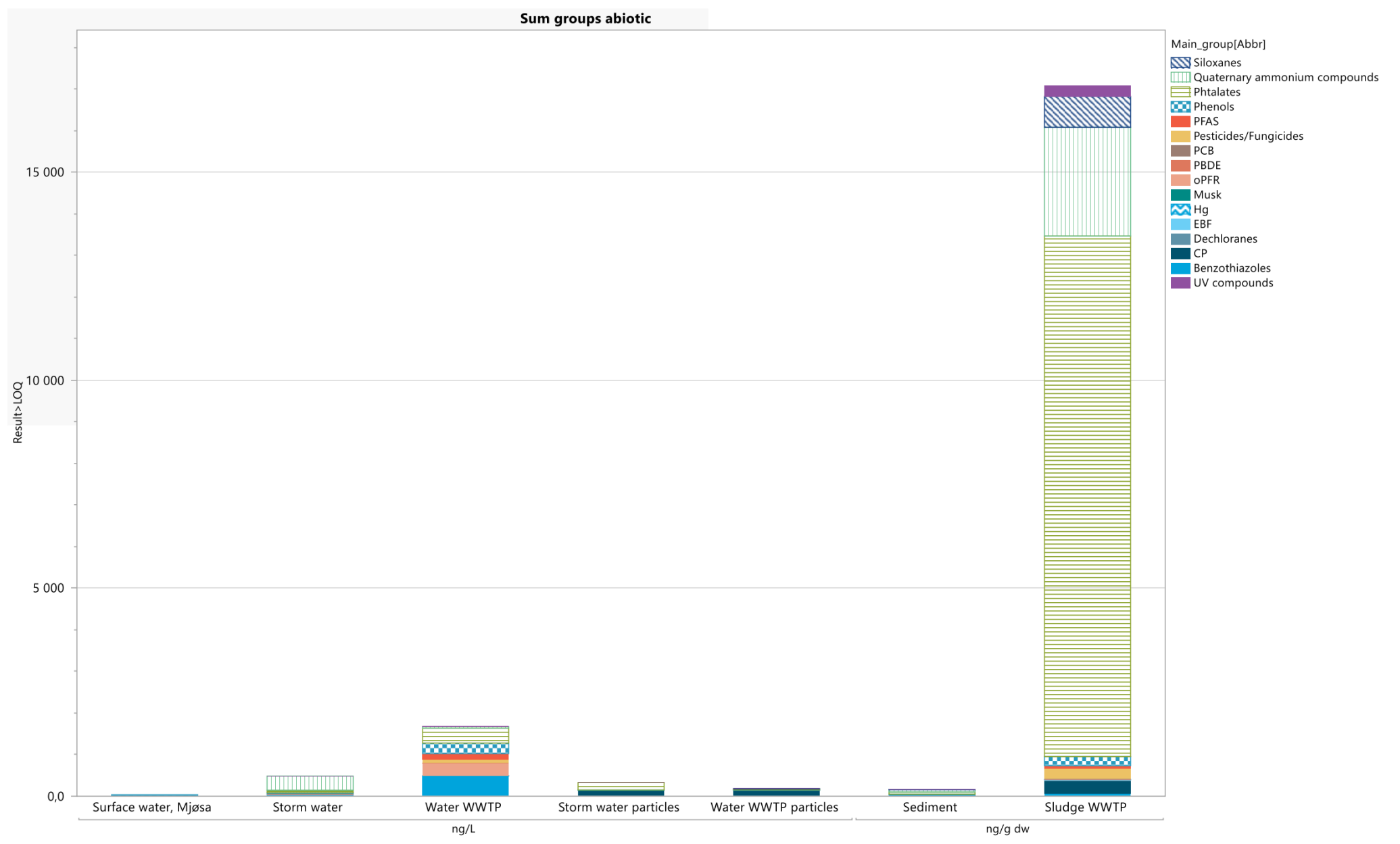
2021

260 enkeltforbindelser/isomerer



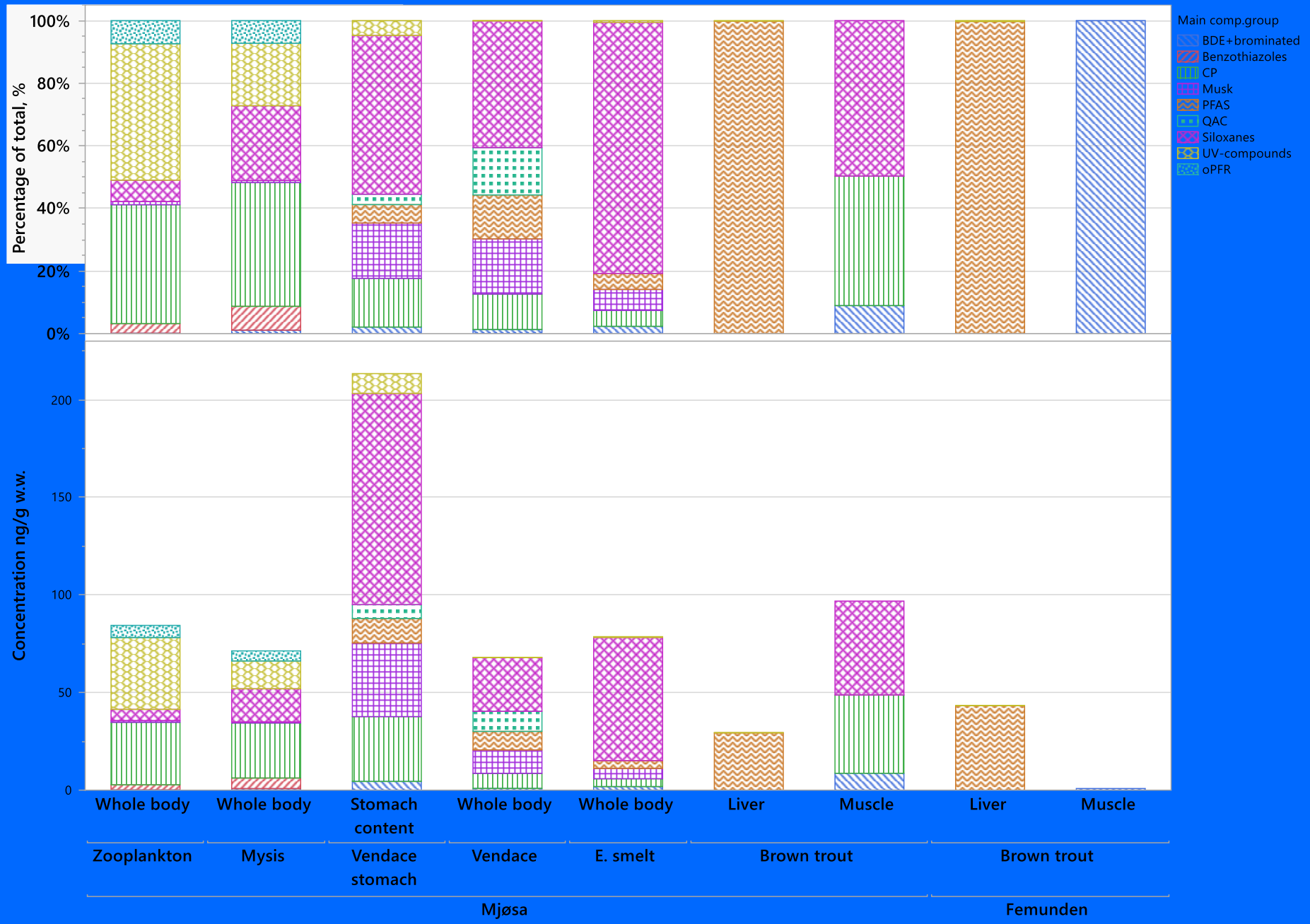
2021

Abiotic matrices



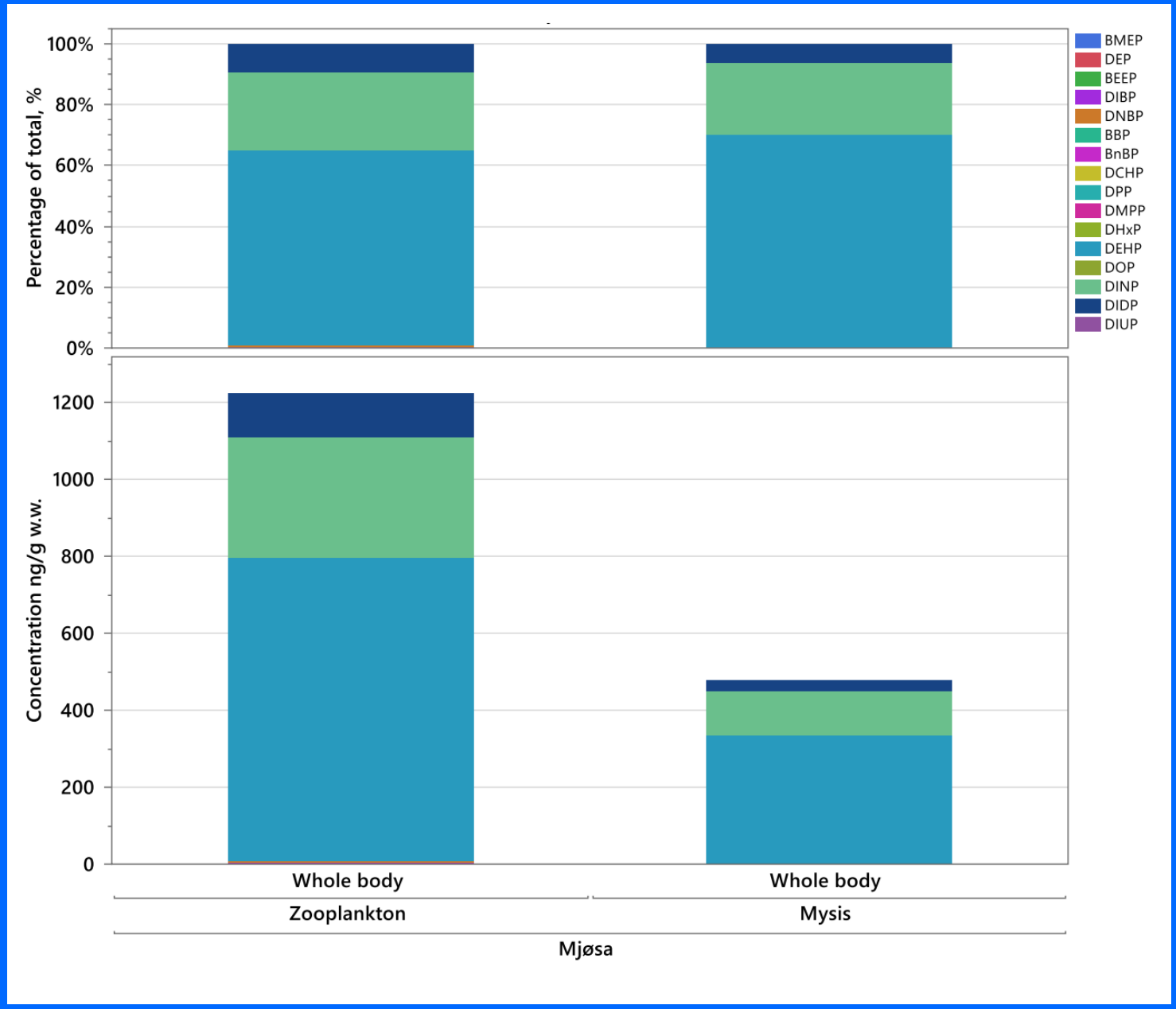
Biologiske matrikser

2023



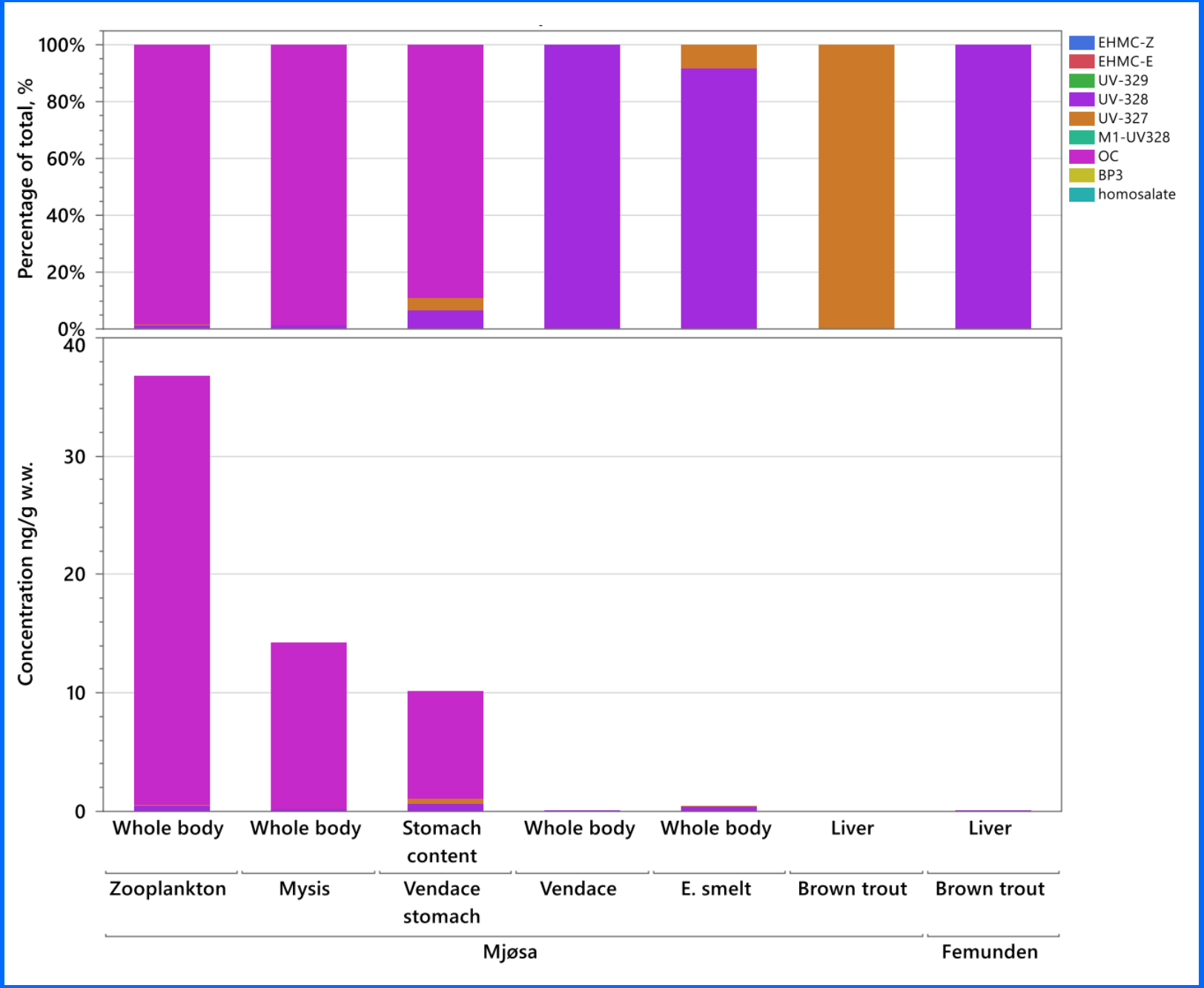
2023

Ftalater



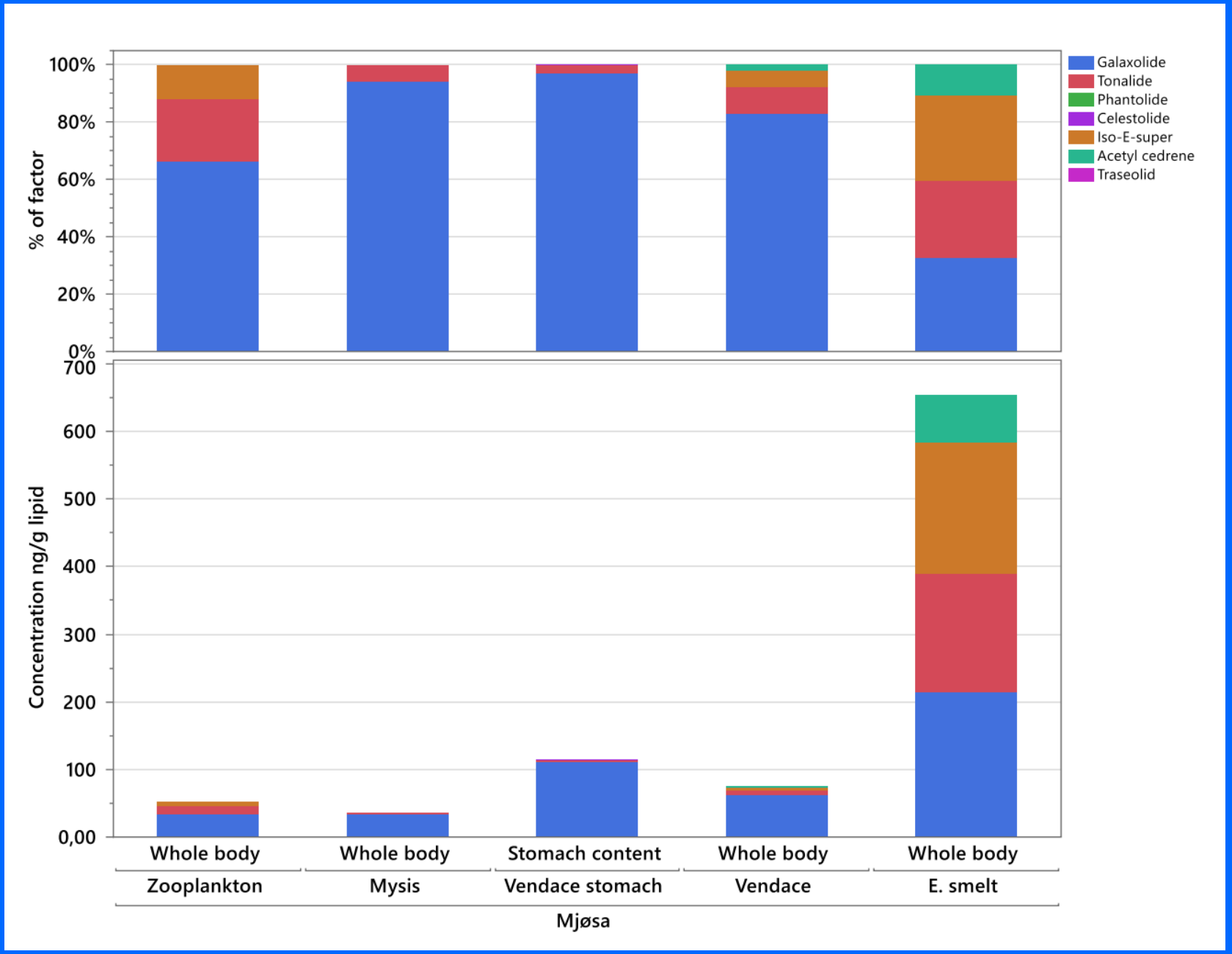
2023

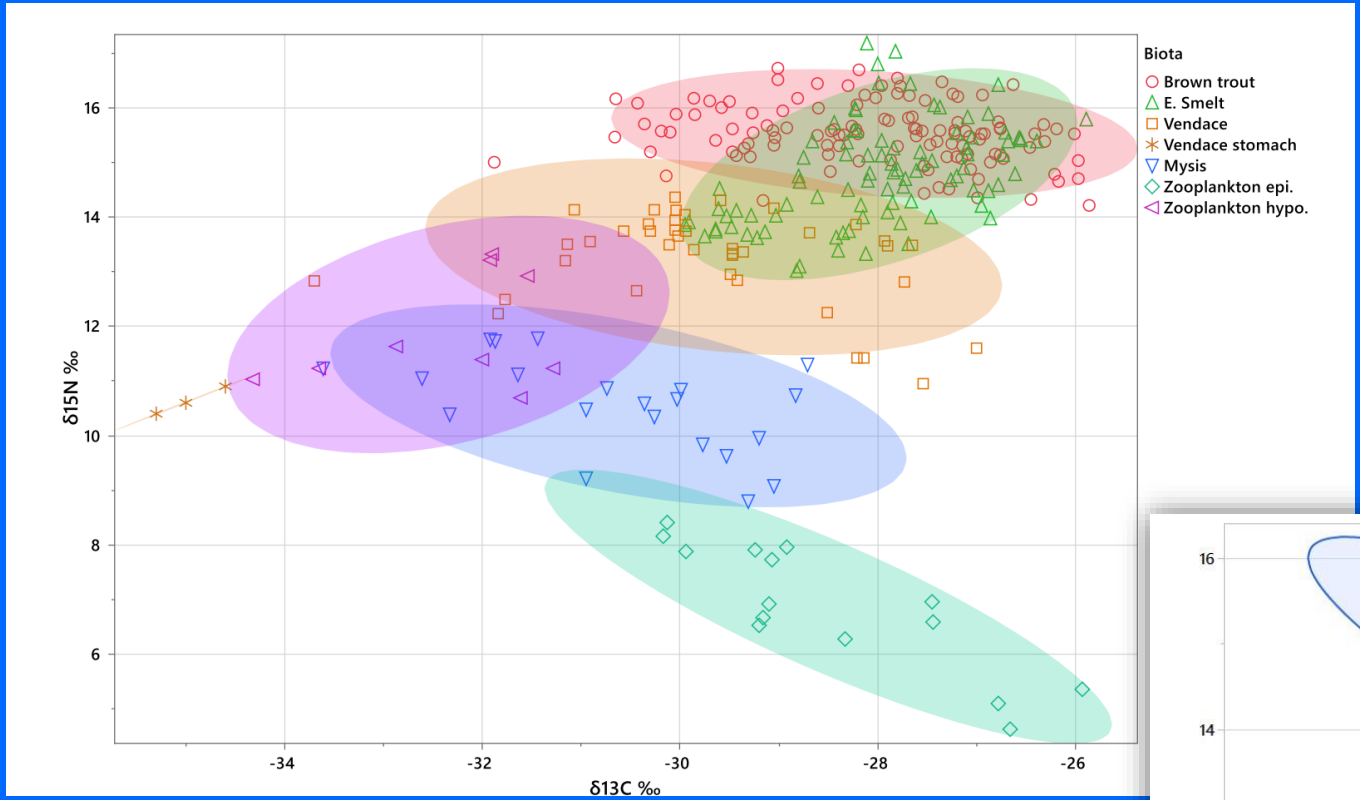
UV- stoffer

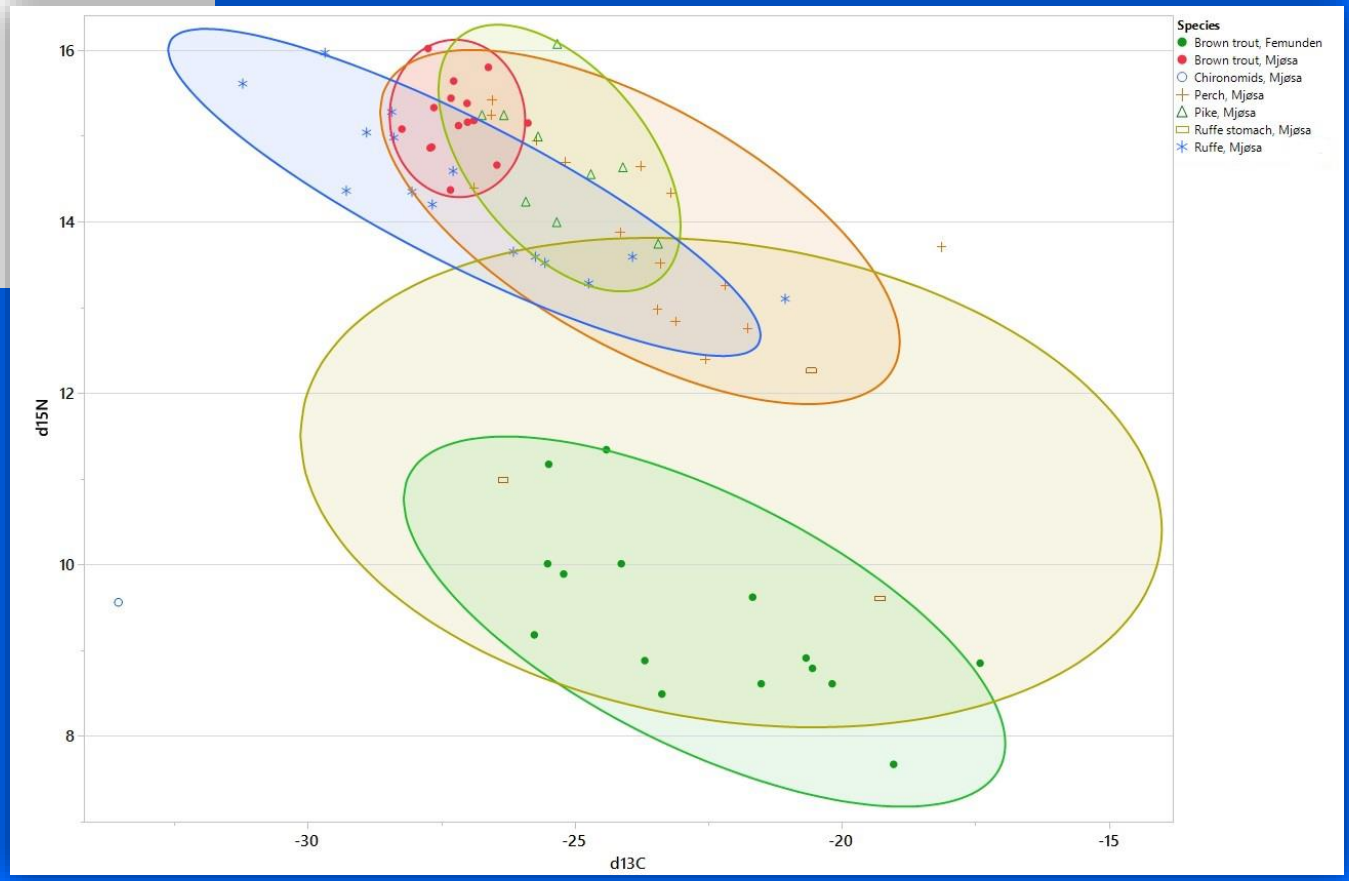


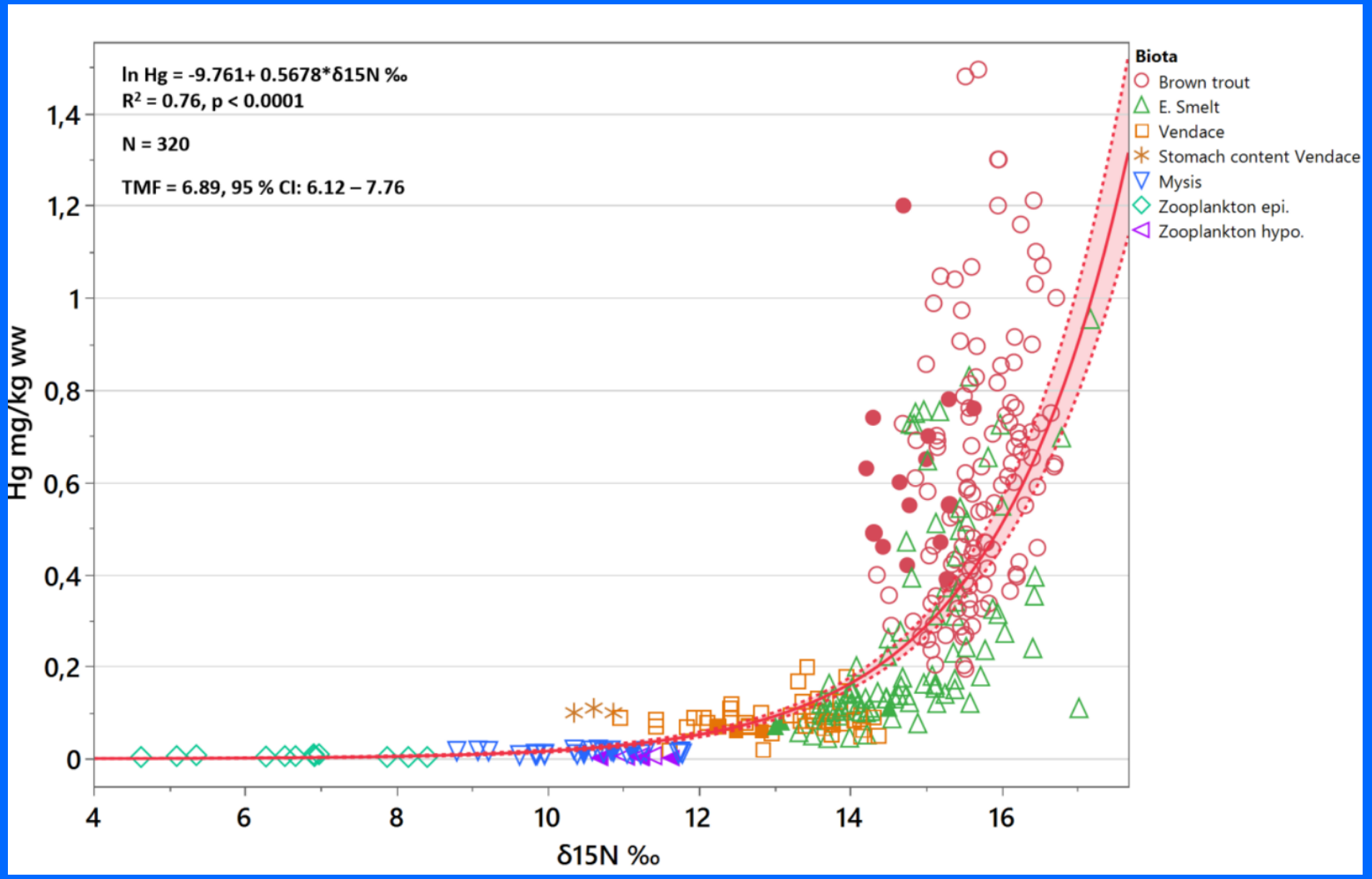
2023

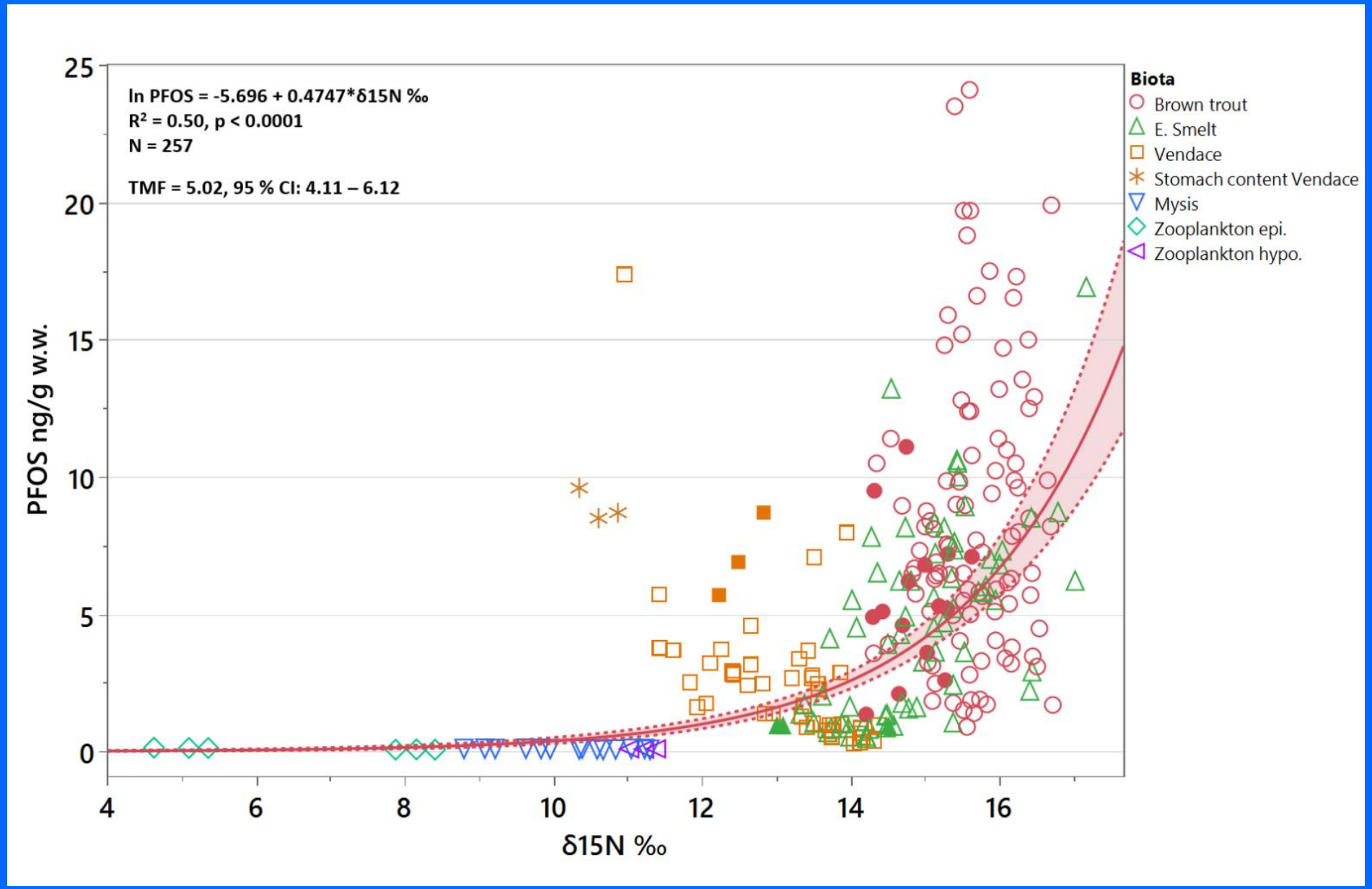
Musk-
forbindelser

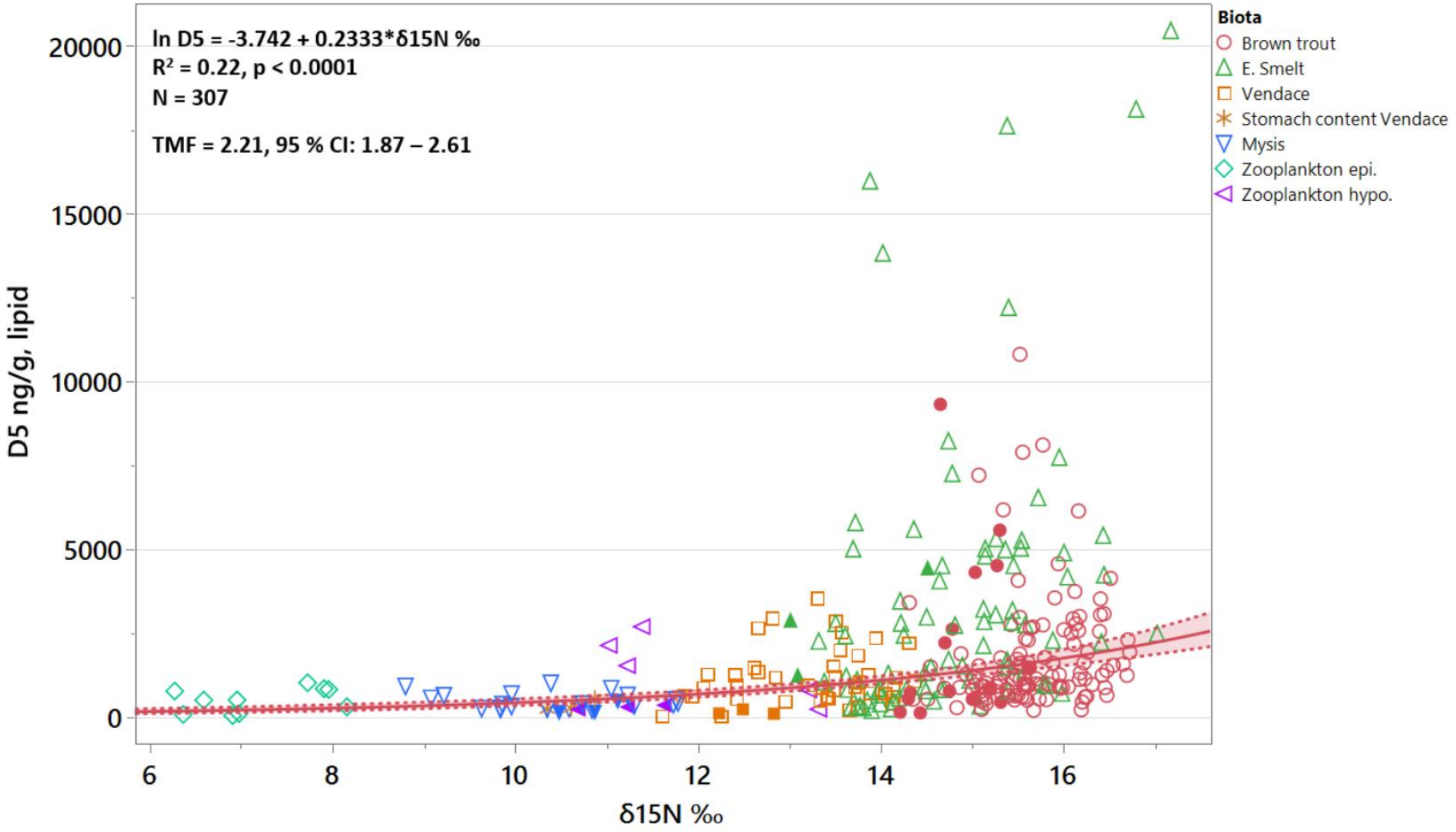


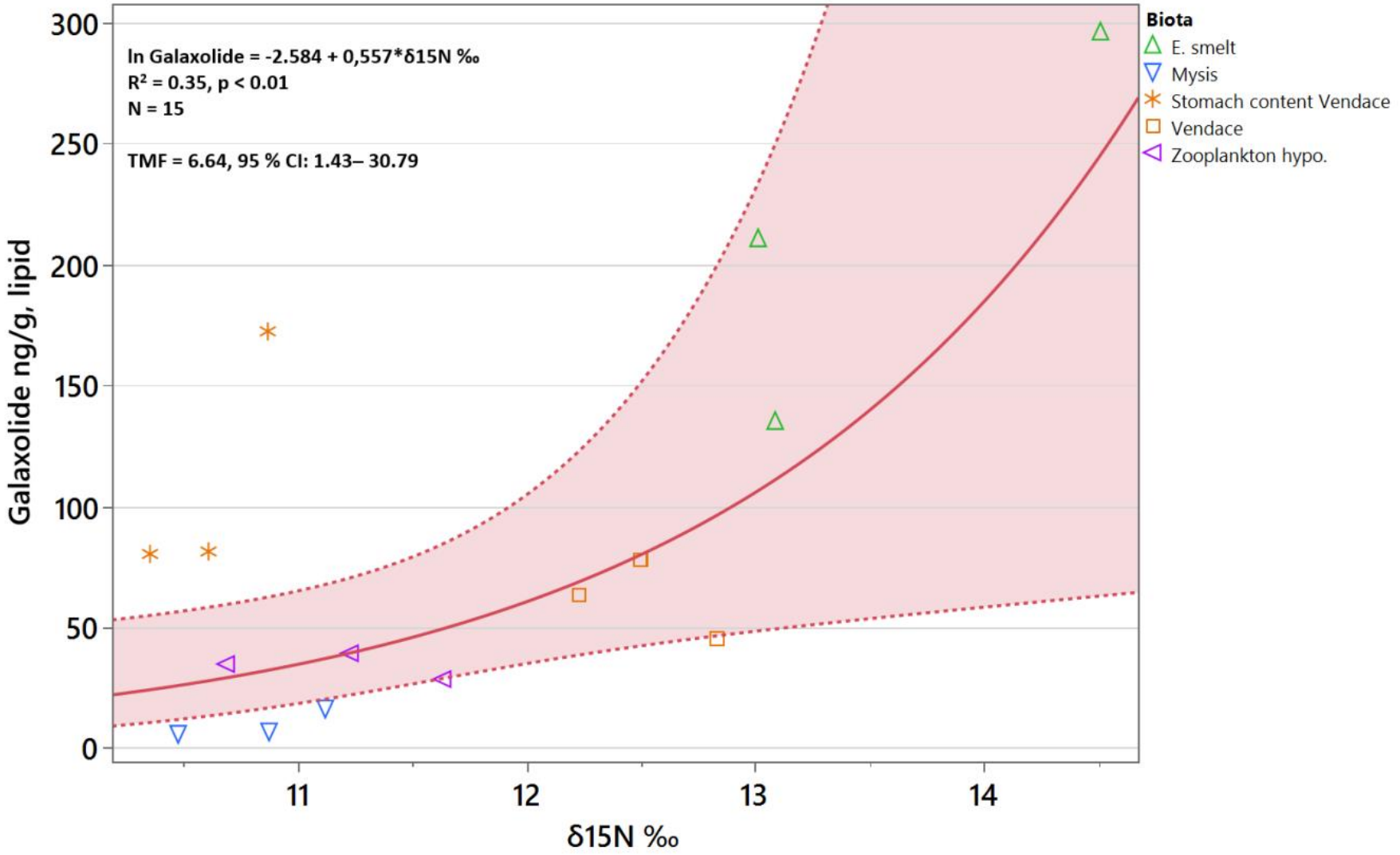

Biota
Brown trout
E. Smelt
Vendace
Vendace stomach
Mysis
Zooplankton epi.
Zooplankton hypo.
δ15N ‰
δ13C ‰
16
14
12
10
8
6
-34
-32
-30
-28
-26

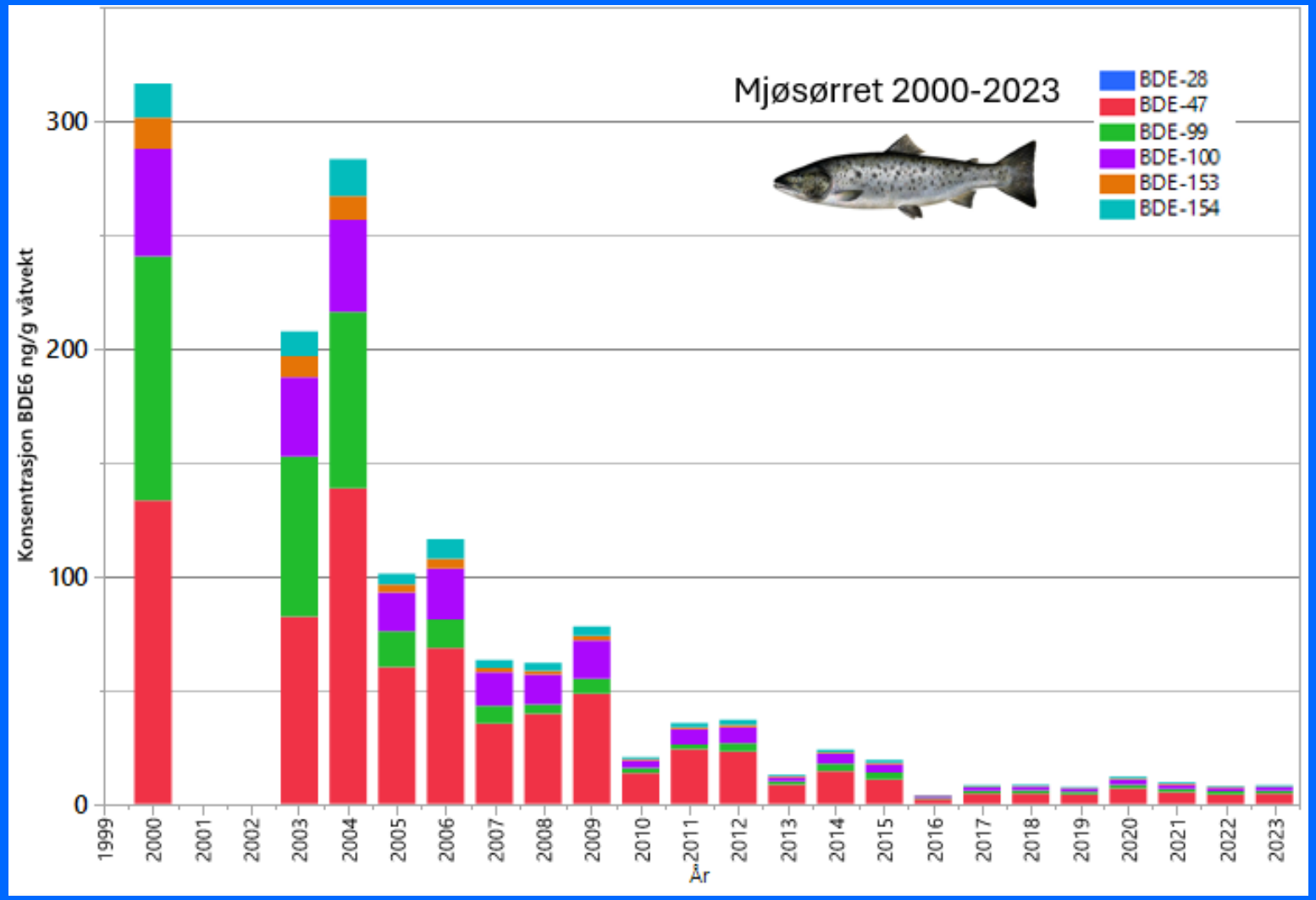

Species
Brown trout, Femunden
Brown trout, Mjøsa
Chironomids, Mjøsa
Perch, Mjøsa
Pike, Mjøsa
Ruffe stomach, Mjøsa
Ruffe, Mjøsa
d15N
d13C
16
14
12
10
8
-30
-25
-20
-15


ln Hg = -9.761+ 0.5678*δ15N ‰
R² = 0.76, p < 0.0001
N = 320
TMF = 6.89, 95 % CI: 6.12 – 7.76
Hg mg/kg ww
δ15N ‰
Biota
Brown trout
E. Smelt
Vendace
Stomach content Vendace
Mysis
Zooplankton epi.
Zooplankton hypo.


ln PFOS = -5.696 + 0.4747*δ15N ‰
R² = 0.50, p < 0.0001
N = 257
TMF = 5.02, 95 % CI: 4.11 – 6.12
PFOS ng/g w.w.
δ15N ‰
Biota
Brown trout
E. Smelt
Vendace
Stomach content Vendace
Mysis
Zooplankton epi.
Zooplankton hypo.


ln D5 = -3.742 + 0.2333*δ15N ‰
R² = 0.22, p < 0.0001
N = 307
TMF = 2.21, 95 % CI: 1.87 – 2.61
D5 ng/g, lipid
20000
15000
10000
5000
0
6
8
10
12
14
16
δ15N ‰
Biota
Brown trout
E. Smelt
Vendace
Stomach content Vendace
Mysis
Zooplankton epi.
Zooplankton hypo.


ln Galaxolide = -2.584 + 0,557*δ15N ‰
R² = 0.35, p < 0.01
N = 15
TMF = 6.64, 95 % CI: 1.43– 30.79
Galaxolide ng/g, lipid
δ15N ‰
300
250
200
150
100
50
0
11
12
13
14
Biota
E. smelt
Mysis
Stomach content Vendace
Vendace
Zooplankton hypo.


Mjøsørret 2000-2023
BDE-28
BDE-47
BDE-99
BDE-100
BDE-153
BDE-154
Konsentrasjon BDE6 ng/g våtvekt
300
200
100
0
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
År

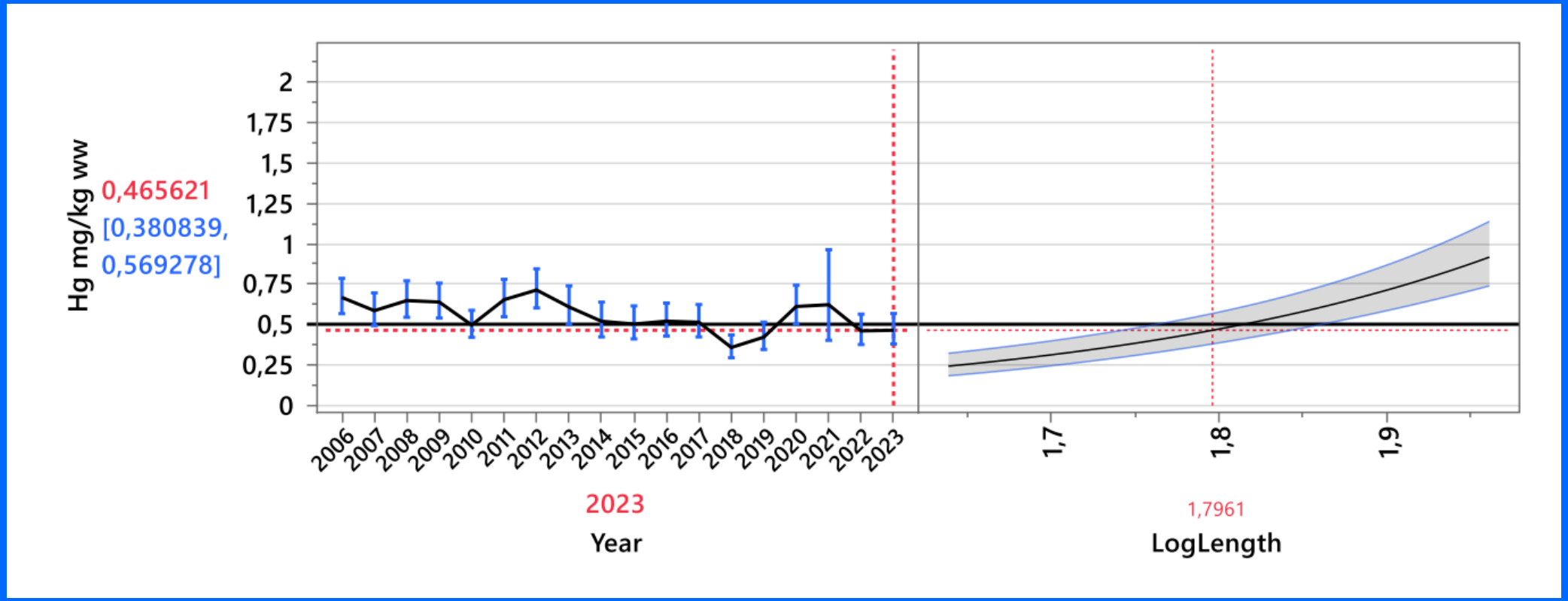

Hg mg/kg ww
0,465621
[0,380839,
0,569278]
2
1,75
1,5
1,25
1
0,75
0,5
0,25
0
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2023
Year
1,7
1,8
1,9
1,7961
LogLength

Table 4 Concentrations of contaminants (µg/kg wet wt.) with Norwegian environmental quality standards (Direktoratsgruppen vanndirektivet 2018) in samples of brown trout (muscle and liver) from Lakes Mjøsa and Femunden. Red numbers indicate concentrations exceeding the quality standard.

	Biota (Brown trout) in Lake Mjøsa and Lake Femunden 2022			
Contaminant	EQS_{biota}	Concentration range (min-max) for Brown trout		$n>EQS_{biota}$
	µg/kg w.w.	µg/kg w.w.		n
Priority substances				
Hg	20	Mjøsa	394 – 1198	15/15
		Femunden	292 – 595	3/3
PBDEs (ΣBDE_6)*	0.0085	Mjøsa	3 – 13	3/3
		Femunden	0.27 – 0.72	3/3
PFOS (in liver)	9.1	Mjøsa	1.35 – 11	2/15
		Femunden	2.5-2.8	0/3
SCCPs	6000	Mjøsa	< 15.1-20.5	0/15
		Femunden	<15.1	0/3
River basin-specific pollutants				
MCCPs	170	Mjøsa	12.1-39.3	0/15
		Femunden	<3.3	0/15
D5	15000	Mjøsa	12.1 – 81.3	0/15
		Femunden	<1.1	0/3
PFOA (in liver)	91	Mjøsa	<0.5- 0.68	0/15
		Femunden	<0.5-0.65	0/3

Takk for oppmerksomheten!