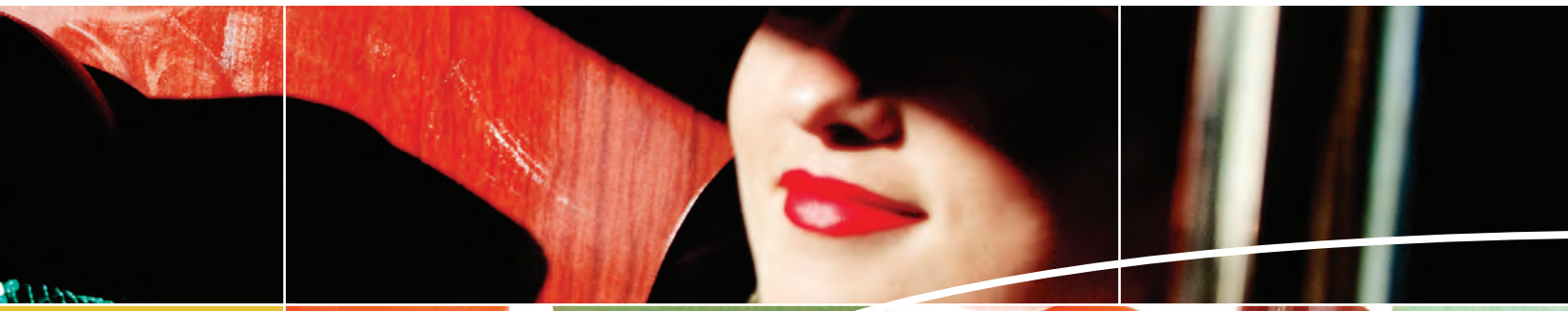
PPCP monitoring in the Nordic Countries – Status Report

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TemaNord 2012:519

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TemaNord 2012:519
ISBN 978-92-893-2346-8

Print: Kailow Express ApS

Cover photo: Karin Beate Nøsterud, ImageSelect

This publication has been published with financial support by the Nordic Council of Ministers. However, the contents of this publication do not necessarily reflect the views, policies or recommendations of the Nordic Council of Ministers.

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Content

Abbreviations

AD	average detected value, this average does not include non detected values
CAS nr	chemical abstract service number
dw	dry weight
EC50	effect concentration 50 %
fw	fat weight
Hospital WW	hospital waste water
LC50	lethal concentration 50%
LD50	lethal dose 50%
LOEC	lowest observed effect concentration
Max	maximum
Min	minimum
NA	not available
ND	not detected
NOEC	no observed effect concentration
Nr.S	number of samples
PNEC	predicted non-effect concentration
PPCP	pharmaceuticals and personal care products
Ref	reference
STP	sewage treatment plant
ww	wet weight

Introduction

Pharmaceuticals and Personal Care Products (PPCPs) are substances used by individuals for personal health or cosmetic reasons, and products used by agribusiness to boost growth or health of livestock. Personal care products, such as creams, detergents, deodorants, cosmetics, perfumes etc. are used in an increasing extent worldwide. These products contain a wide variety of chemicals, used either as an active ingredient or as an additive to improve qualities of the product.

Chemicals used in PPCPs are expected to emit into the environment in their consumed form or in a degraded form. The question remains as regards to which compounds are present in our environment, and if they may negatively impact the environment and public health. In this manner, in the past few years, there has been an increased focus on the environmental impacts of pharmaceuticals, both human and veterinary, and personal care products. Thereby, environmental monitoring has been carried out to assess the occurrence of PPCPs in different compartments of the environment.

Several PPCP monitoring reports have been published in the Nordic countries. However, to date, no general overview of the results in the Nordic countries has been established.

The objective of this report is to give an overview of the results of PPCP monitoring in the Nordic countries, by identifying which compounds have been monitored, in which countries and if the are important differences in the values detected amongst the Nordic countries. This report presents the results and does not intend to interpret the results.

This project has been initiated by the Nordic Screening group and financed by the Nordic Council of Ministers.

The monitoring data available is illustrated as maps, graphs and tables, which will allow the reader to rapidly identify the countries in which compounds have been monitored and appreciate the average values detected in the different countries as well as the disparity of the results within a country and amongst the Nordic countries.

1. Methodology

The objective of this report is to give an overview of the existing monitoring data available for PPCPs in the Nordic environment. This report focuses on making extensive monitoring data easily available to the reader and does not focus on giving an interpretation to the results detected.

PPCP includes a very extensive number of compounds. The Nordic screening group selected the following compound groups to be included in this report:

- Analgesics and anti-inflammatories
- Antibiotics, antiseptics and germicides, anti-fungals
- Hormones (synthetic and natural) and hormone antagonists
- Cardiac, blood pressure medicine and diuretics
- Complexing forms
- Fragrances
- UV-filter compounds
- Mosquito repellents

In order to have an overview of the various PPCP monitoring data in the Nordic countries, each Nordic country identified relevant monitoring reports. All the reports were reviewed and compounds belonging to the PPCP groups of interest were identified. Metabolites were not included in this report.

The large majority of PPCPs for human use are expected to emit to the environment via the waste water system. Indeed most pharmaceuticals are evacuated by the urines and faeces. In the same way personal care products, which will be used directly on skin and hair are expected to be washed off and end in the waste water system.

Pharmaceuticals for veterinary use are expected to be found in soil and leachates of lands used for animal breeding or water and sediment surrounding fish farms.

The monitoring reports reviewed included monitoring in the following matrices:

- Sewage treatment plants (STPs): influent, effluent and sludge
- Surface water, included water and sediment samples: STP recipient, up and down stream from fish farms, other fresh or sea waters
- Groundwater, in particular at proximity of hospitals and farms

- Air samples
- Hospitals waste water eachates/runoff from landfills
- Farms: soil, manure, runoff

Some of the reports included monitoring data from background locations (reference values), in particular for surface water, sediment and air.

In a few studies, monitoring was also carried out at different process/treatment stages of STPs and various industrial plants. The results from the latter monitoring are not presented in this report, as they only reflect the removal rate at different stages of the process.

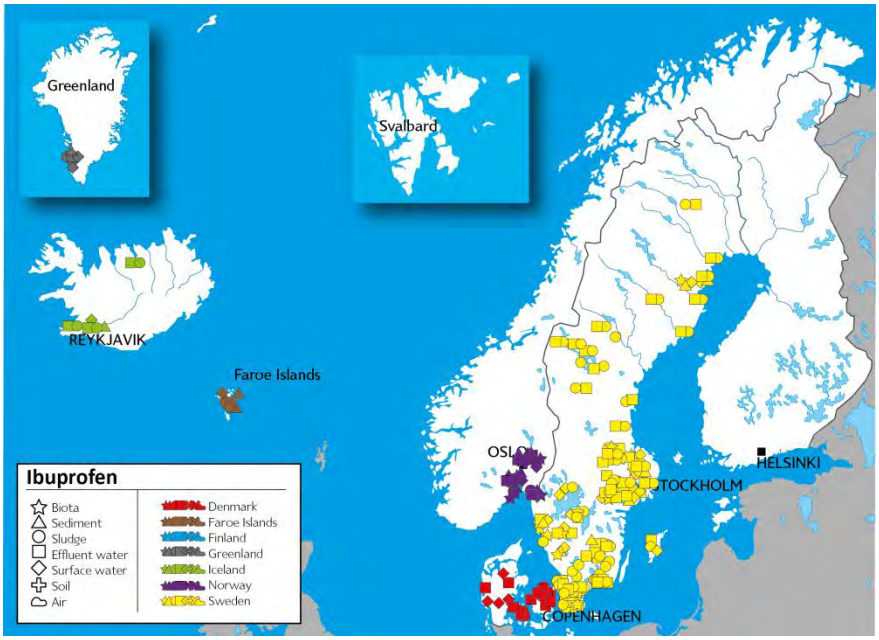
Only monitoring data was considered of interest for this report. Predicted environmental concentrations were not considered. In the same way, averages quoted in studies with no reference to sampling locations and results were not used, with the exception of one Finnish study (Vieno, 2008), as there was little data available for this country.

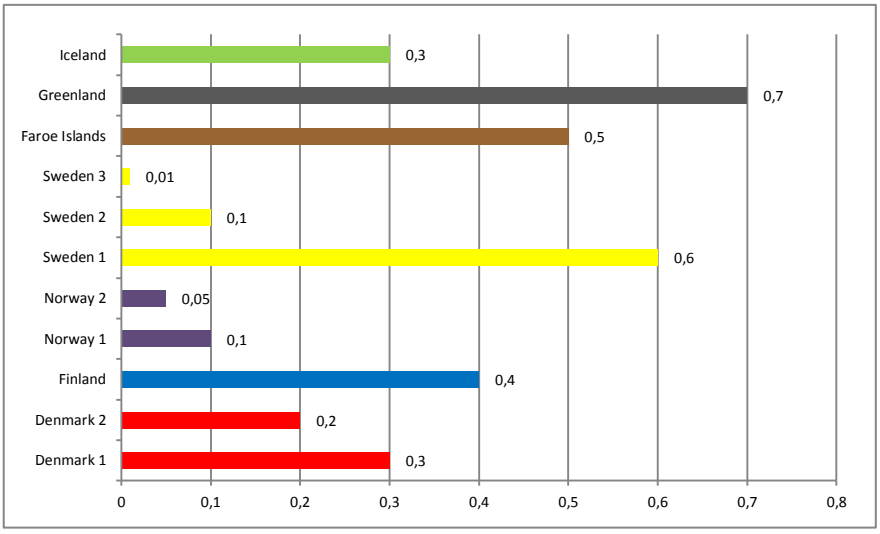
Compounds monitored in a matrix in three or more studies

Compounds monitored in three or more studies in the same matrix are presented in this report as maps and graphs. Compounds monitored in two or more studies in biota are also presented as maps and graphs. However, influent levels were not considered for mapping and graphs as the removal rate will vary depending on the STP processes used and will thereby not be relevant to appreciate the potential levels found in the environment. Hospital effluent is expected be transferred to the local waste water treatment plant and consequently contributes to STP influent. In this manner hospital effluent was not illustrated in maps and graphs either.

As indicated in the example below, the map indicates the sampling location and matrices monitored. Each country has been attributed a colour which is also referred to in the graphs and tables, and each matrix is represented by a different symbol. The objective of the maps is to allow the ready to rapidly have an overview of where the compound has been monitored and appreciate the scope of the monitoring in each country. The monitoring locations indicated on the maps represent the city in which the sampling was carried out and not the precise GPS location of of the sample.

For each matrix monitored three or more times, a graph is available to present the results for each location monitored. Graphs are also available for compounds monitored in biota in two or more studies. In the case where a same sampling location was monitored more than once, only one result will be presented for this location and it will correspond to the average detected value for this specific location, this average does not take into consideration non-detected values. Background values were not differenciated from the rest of the values for the same matrix.





In the case, a compound was monitored in the same matrix in more than two studies but was not detected in any samples; the results were not presented as a graph.

Compounds monitored in at least two studies

All compounds monitored in at least two studies are presented in tables as that below. The tables present the minimum and maximum values detected and the average detected value (AD) for each matrix, per country. The average detected value (AD) does not take into consideration non-detected values. The total number of samples (NS) analysed for one given matrix and country is indicated. The latter will allow the reader to appreciate the representivity of the results.

The results for all matrices monitored for the compound are indicated in the table, including STP influent and hospital waste water values.

	Denmark		Finland		Sweden		Iceland	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Matrix 1	nd	6 (a)	nd	3(c)	0,01 0,06 0,02	16 (def)	nd	2[4](g)[d]
Matrix 2	0,1[1] 0,3[2] 0,2[3]	17(ab)	nd 0,5 0,3	3(c)	nd 0,9 0,3	64(def)	0,01 0,6 0,2	6[5](g)
Matrix 3	nd	10(a)	nd	2(c)	nd	9(df)	nd	5(g)

1: Minimum
2: Maximu
3: Average detected
4: References
5: Number of samples

References*:*

a) (Aaa et al, 2001)
b) (Bbb et al, 2002)
c) (Ccc et al, 2003)
d) (Ddd et al, 2004)
e) (Eee et al, 2005)
f) (Fff et al, 2001)
g) (Ggg et al, 2002)

When the compound was monitored in a matrix in more than one study for one country, the minimum, maximum and average detected value were determined from all the monitoring data available for that country and not specified for each study. In the same way, no difference was made between the values detected in "background" locations and other locations monitored. The tables express the minimum, maximum and average detected values for a country and a given matrix.

Available PNEC values are also indicated in order to allow the reader to easily appreciate the significance of the monitored values. Available toxicity data is also indicated.

The toxicity reference values and PNEC values indicated in this report were identified in monitoring studies assessed in this report.

A factual conclusion is given for each compound. The conclusion does not intend to give an interpretation to the results but an overview of the main observations.

Compounds monitored in only one study

Compounds monitored in only one study are grouped by study and presented in tables which indicate the minimum and maximum values detected and the average detected value (AD) for each matrix. No PNEC or toxicity reference values are indicated for these compounds.

Additional specifications

On the contrary of the graphs, in tables, all results were considered individually regardless of whether the results were from a same monitoring location. In this manner, for some compounds the minimum and maximum values indicated in a graph may vary from the minimum and maximum values indicated in a table. As mentioned earlier, in the case where a same sampling location was monitored more than once, only one result will be presented for this location in a graph and it will correspond to the average detected value for this specific location.

In the case of the Finnish study (Vieno, 2008), as the monitoring locations were not specified, the study is illustrated as "14 STPs" on maps and in graphs. For most compounds monitored in this study, the results were presented as the "mean" value for all 14 STPs. In this manner in tables the minimum and maximum values are indicated as not available (NA) and the average detected value corresponds to the "mean" value indicated in the study. Whenever the maximum or minimum values detected were indicated in the study, the latter was indicated in the table.

2. Analgesics and anti-inflammatories

2.1 Scope and definition

Analgesics are defined as drugs or medicine given to reduce pain without resulting in loss of consciousness. Analgesics are sometimes referred to as painkiller medications.

Anti-inflammatory are defined as medicine used to relieve swelling, pain, and other symptoms of inflammation. In this manner some anti-inflammatories also have analgesic effects and thereby are included in this category.

Table 1 presents the compounds classified in this category and identified in monitoring studies in the Nordic countries.

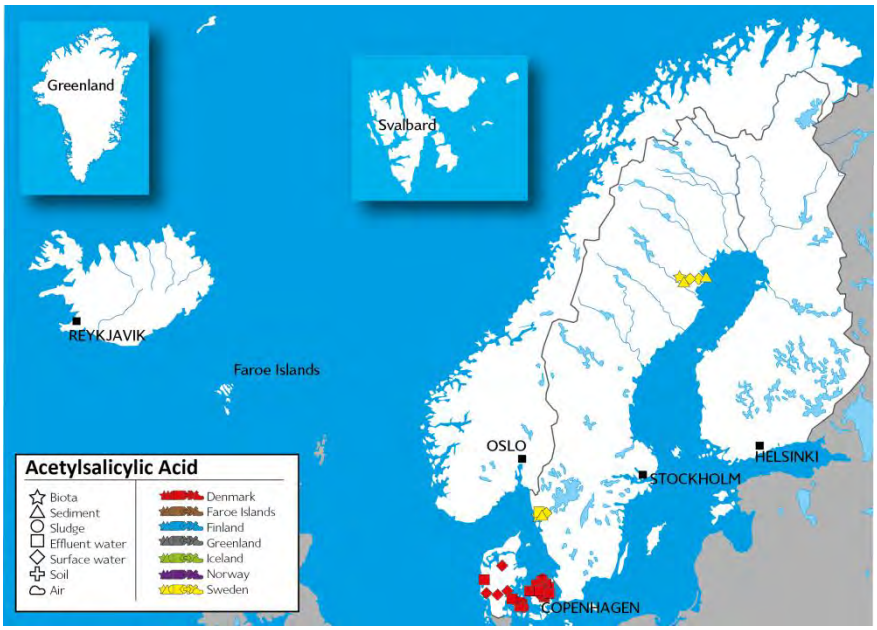
Table 1: Analgesics and anti-inflammatories monitored in the Nordic countries

Compounds monitored	CAS nr
Acetylsalicylic acid (analgesic)	50-78-2
Buprenorphine (analgesic)	52485-79-7
Codeine (analgesic)	76-57-3
Dextropropoxyphen (analgesic)	469-62-5
Diclofenac (inflammatories)	15307-86-5
Fentanyl (narcotic analgesic)	437-38-7
Ibuprofen (anti-inflammatory	15687-27-1
Ketoprofen (anti-inflammatory)	22071-15-4
Morphine (analgesic)	57-27-2
Naproxen (anti-inflammatory)	22204-53-1
Oxycondone (analgesic)	76-42-6
Paracetamol (anti-inflammatory)	103-90-2
Tramadol (analgesic)	46941-76-8/27203-92-5

2.2 Compounds mapped

2.2.1 Acetylsalicylic Acid

CAS nr.: 50-78-2
Info: Globally known as Aspirin, analgesic and anti-inflammatory.
Toxicity data: NA
PNEC = NA



Acetylsalicylic Acid	Denmark		Sweden	
Matrix	*Min* *max* *AD*	*Nr.S* *(ref)*	*min* *max* *AD*	*Nr.S* *(ref)*
Biota			nd nd nd	6 (c)
STP effluent (µg/l)	nd nd nd	16 (ab)	nd nd nd	4 (c)
STP sludge	nd nd nd	10(a)		
Surface water	nd nd nd	16(a)	nd nd nd	8 (c)
Sediment			nd nd nd	4 (c)

Acetylsalicylic Acid	Denmark		Sweden	
STP Influent (µg/l)	nd 2 1,6	9(a)	nd nd nd	4 (c)
Warning system for pesticide leaching to groundwater	nd nd nd	7(a)		
Pig slurry	nd nd nd	4(a)		
Groundwater	nd nd nd	3(a)		
Drain water	nd nd nd	1(a)		

References*:*

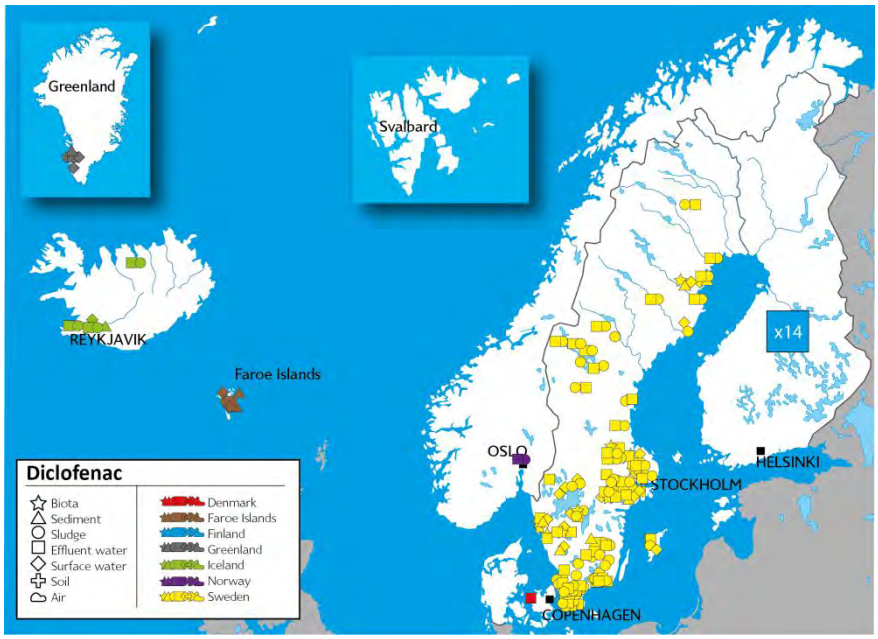
a) (Mogensen, et al., 2008)
b) (Kjølholt, et al., 2003)
c) (Remberger, et al., 2009)

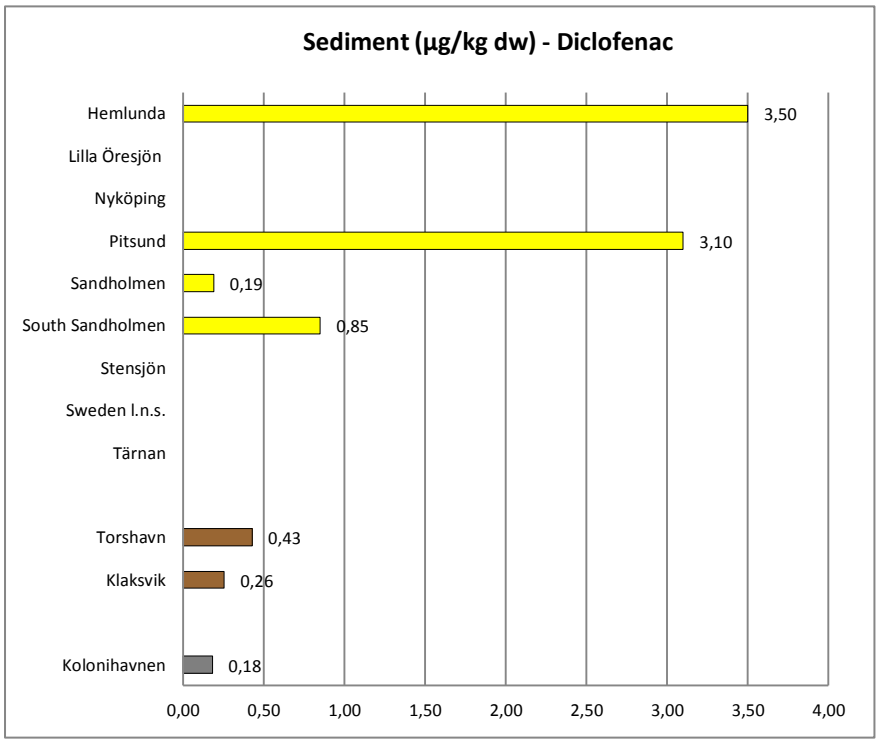
Conclusion:

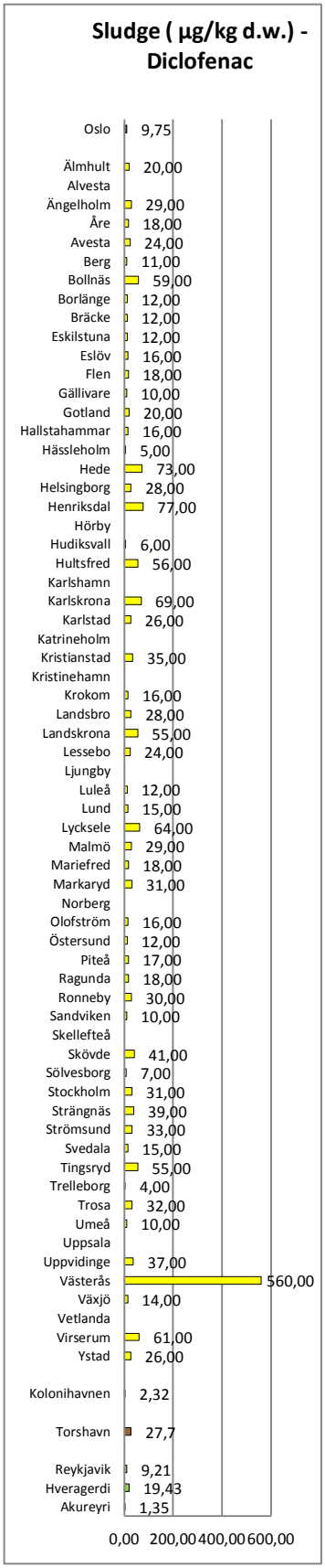
The compound has been monitored in two Danish studies and one Swedish study. It was only detected in STP influent samples in Denmark, not in Sweden. The compound was not detected in any other matrix.

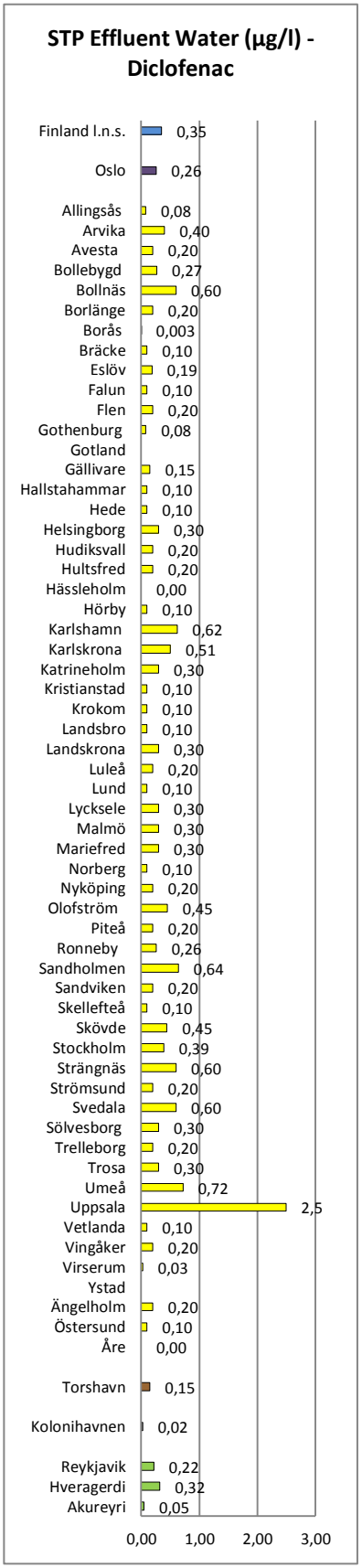
2.2.2 *Diclofenac*

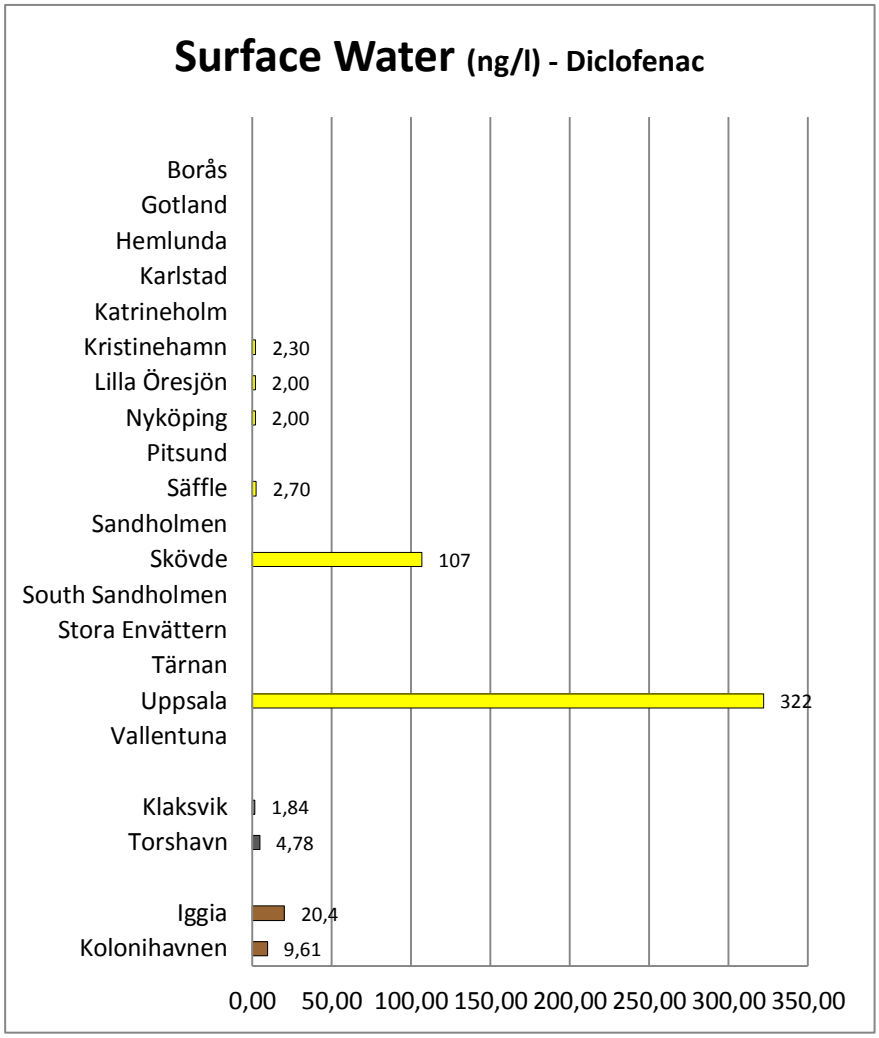
CAS nr.: 15307-86-5
Info: Non-steroidal anti-inflammatory drug
Toxicity data: NA
PNEC = NA






Sludge (µg/kg d.w.) - Diclofenac
Oslo 9,75
Älmhult 20,00
Alvesta
Ängelholm 29,00
Åre 18,00
Avesta 24,00
Berg 11,00
Bollnäs 59,00
Borlänge 12,00
Bräcke 12,00
Eskilstuna 12,00
Eslöv 16,00
Flen 18,00
Gällivare 10,00
Gotland 20,00
Hallstahammar 16,00
Hässleholm 5,00
Hede 73,00
Helsingborg 28,00
Henriksdal 77,00
Hörby
Hudiksvall 6,00
Hultsfred 56,00
Karlshamn
Karlskrona 69,00
Karlstad 26,00
Katrineholm
Kristianstad 35,00
Kristinehamn
Krokom 16,00
Landsbro 28,00
Landskrona 55,00
Lessebo 24,00
Ljungby
Luleå 12,00
Lund 15,00
Lycksele 64,00
Malmö 29,00
Mariefred 18,00
Markaryd 31,00
Norberg
Olofström 16,00
Östersund 12,00
Piteå 17,00
Ragunda 18,00
Ronneby 30,00
Sandviken 10,00
Skellefteå
Skövde 41,00
Sölvesborg 7,00
Stockholm 31,00
Strängnäs 39,00
Strömsund 33,00
Svedala 15,00
Tingsryd 55,00
Trelleborg 4,00
Trosa 32,00
Umeå 10,00
Uppsala
Uppvidinge 37,00
Västerås 560,00
Växjö 14,00
Vetlanda
Virserum 61,00
Ystad 26,00
Kolonihavnen 2,32
Torshavn 27,7
Reykjavik 9,21
Hveragerdi 19,43
Akureyri 1,35
0,00 200,00 400,00 600,00


STP Effluent Water (µg/l) - Diclofenac
Finland l.n.s. 0,35
Oslo 0,26
Allingsås 0,08
Arvika 0,40
Avesta 0,20
Bollebygd 0,27
Bollnäs 0,60
Borlänge 0,20
Borås 0,003
Bräcke 0,10
Eslöv 0,19
Falun 0,10
Flen 0,20
Gothenburg 0,08
Gotland
Gällivare 0,15
Hallstahammar 0,10
Hede 0,10
Helsingborg 0,30
Hudiksvall 0,20
Hultsfred 0,20
Hässleholm 0,00
Hörby 0,10
Karlshamn 0,62
Karlskrona 0,51
Katrineholm 0,30
Kristianstad 0,10
Krokom 0,10
Landsbro 0,10
Landskrona 0,30
Luleå 0,20
Lund 0,10
Lycksele 0,30
Malmö 0,30
Mariefred 0,30
Norberg 0,10
Nyköping 0,20
Olofström 0,45
Piteå 0,20
Ronneby 0,26
Sandholmen 0,64
Sandviken 0,20
Skellefteå 0,10
Skövde 0,45
Stockholm 0,39
Strängnäs 0,60
Strömsund 0,20
Svedala 0,60
Sölvesborg 0,30
Trelleborg 0,20
Trosa 0,30
Umeå 0,72
Uppsala 2,5
Vetlanda 0,10
Vingåker 0,20
Virserum 0,03
Ystad
Ängelholm 0,20
Östersund 0,10
Åre 0,00
Torshavn 0,15
Kolonihavnen 0,02
Reykjavik 0,22
Hveragerdi 0,32
Akureyri 0,05
0,00 1,00 2,00 3,00


Surface Water (ng/l) - Diclofenac
Borås
Gotland
Hemlunda
Karlstad
Katrineholm
Kristinehamn
Lilla Öresjön
Nyköping
Pitsund
Säffle
Sandholmen
Skövde
South Sandholmen
Stora Envättern
Tärnan
Uppsala
Vallentuna
Klaksvik
Torshavn
Iggia
Kolonihavnen
2,30
2,00
2,00
2,70
107
322
1,84
4,78
20,4
9,61
0,00
50,00
100,00
150,00
200,00
250,00
300,00
350,00

Diclofenac	Finland		Norway		Sweden		Faroe Islands		Greenland		Iceland	
Matrix	*Min* *max* *AD*	*Nr.S (ref)*	*Min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*
Biota (µg/kg ww)					nd	24 (def)						
Sediment (µg/kg dw)					nd 3,5 1,9	11 (df)	0,26 0,49 0,4	3 (h)	0,18 0,19 0,185	2 (h)		
STP effluent (ng/l)	NA NA 350	14 (a)	160 370 260	6 (c)	nd 3900 370	77 (efg)	148 148 148	1 (h)	23 23 23	1 (h)	33,4 341,9 190,8	5 (h)
STP sludge (µg/kg dw)			nd 20 9,75	7 (c)	nd 560 37,3	66 (ef)	26,9 28,5 27,7	2 (h)	0,002 0,003 0,002	2 (h)	1,00 19,4 7,8	4 (h)
Surface water (ng/l)					nd 880 110	40 (def)	1 8 4	5 (h)	2 30 14	5 (h)		
STP Influent (ng/l)	NA NA 420	14 (a)			1 9700 1050	35 (def)	110 190 150	2 (h)			024 690 250	5 (h)
Drinking water (ng/l)					nd 140 140	6 (e)						
Landfill leacha-tes (ng/l)					nd 20 15	8[1] (f)						
Settleable particulate material	nd	11 (b)										
Manure					nd	5 (f)						
Hospital WW (ng/l)					nd 5 1,4	7 (f)	0,138 0,597 0,367	2 (h)	0,014 0,014 0,014	1 (h)		

References:

a) (Vieno, 2008)
b) (Lahti & Oikari, 2011)
c) (Thomas, et al., 2007)
d) (Remberger, et al., 2009)
e) (Fick, et al., 2011);
f) (Andersson, et al., 2006)
g) (Lilja, et al., 2010)
h) (Huber, et al., NA)

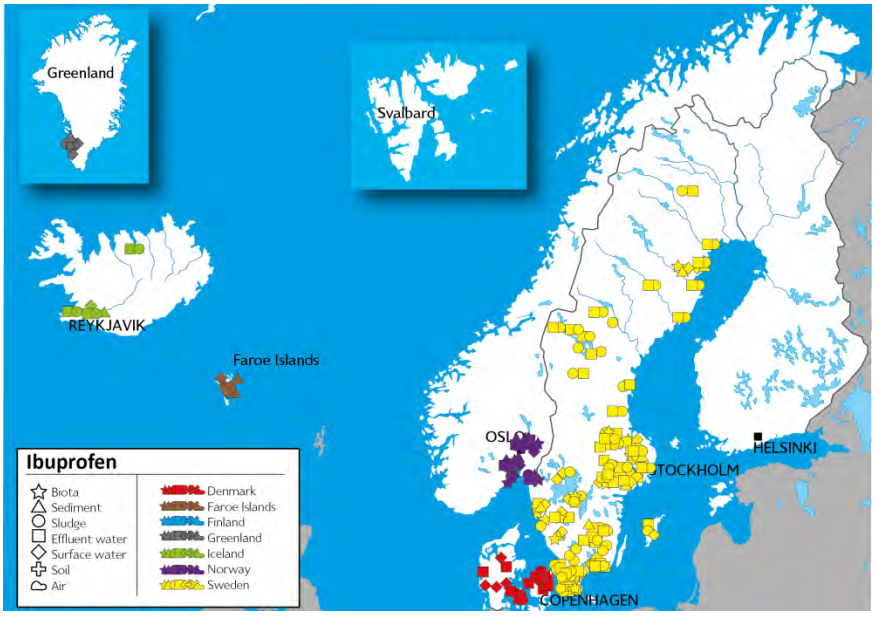
[1] One treated sample. Only detected in non treated samples.

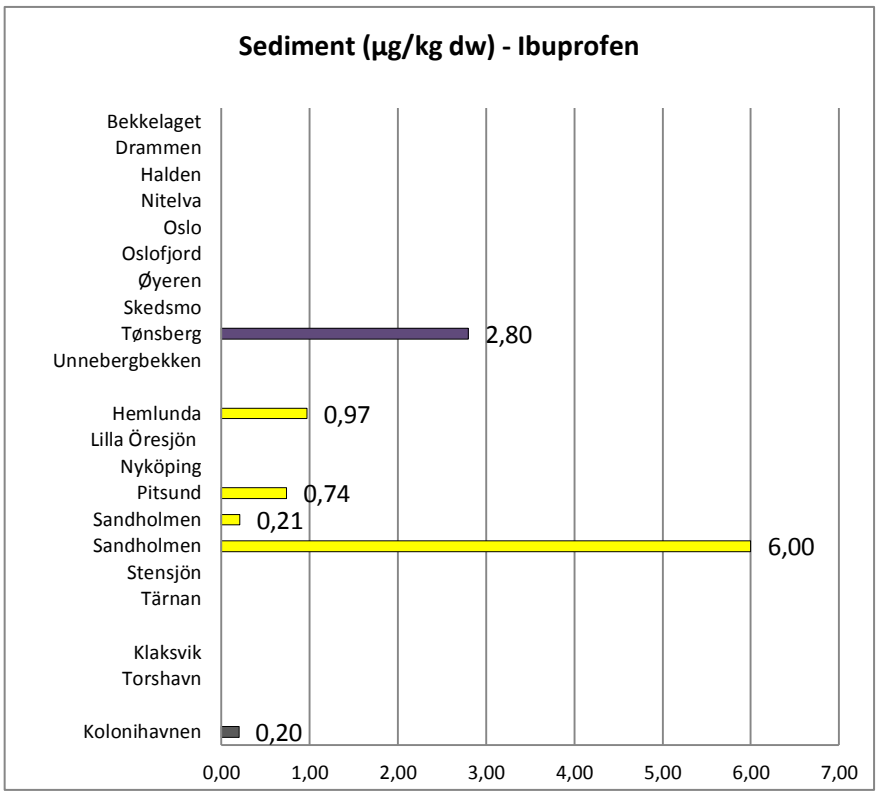
Conclusion:
The compound was monitored in two Finnish, one Norwegian study, four Swedish studies, and one international study covering Faroe Isalands, Greenland and Iceland. The compound was detected in several matrices:

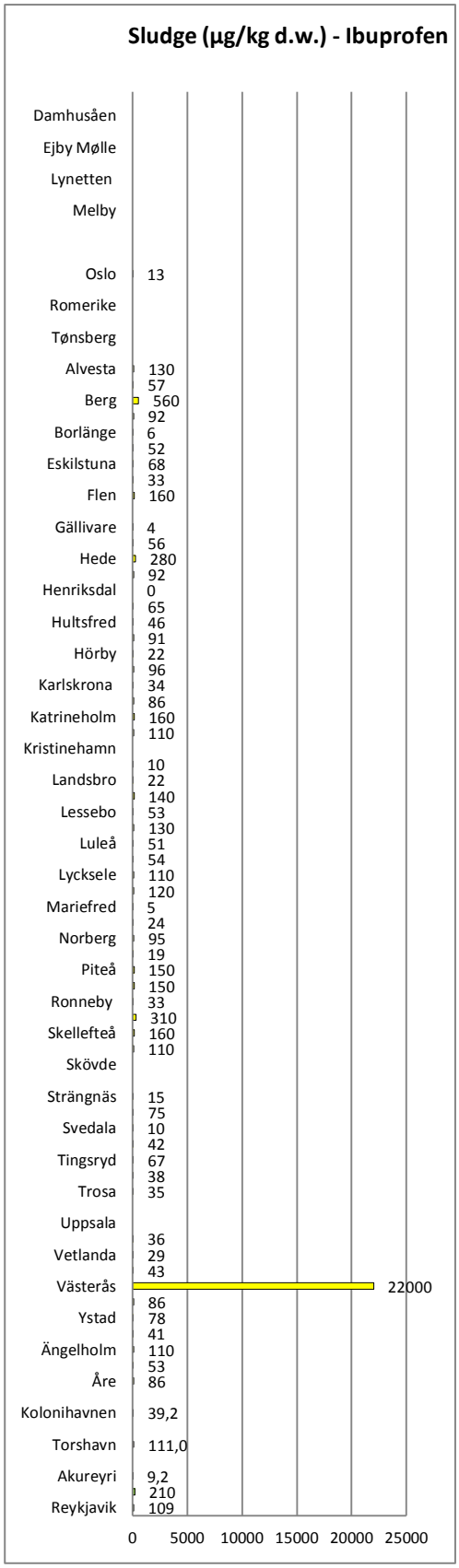
- In sediment in Sweden, Faroe Islands and Greenland. The highest values were detected in Sweden
- In STP effluent samples in all countries
- In STP sludge in all the countries except Finland were the compound was not monitored in sludge. The values detected were significantly higher in Sweden
- In surface water in Sweden, Faroe Islands and Greenland. The highest values were detected in Sweden
- In landfill leachates in Sweden
- In STP influent in Sweden, Finland, Faroe Islands and Iceland. The values detected were significantly higher in Sweden
- In hospital waste water in Sweden, Faroe Island and Greenland
- In one drinking water sample in Sweden

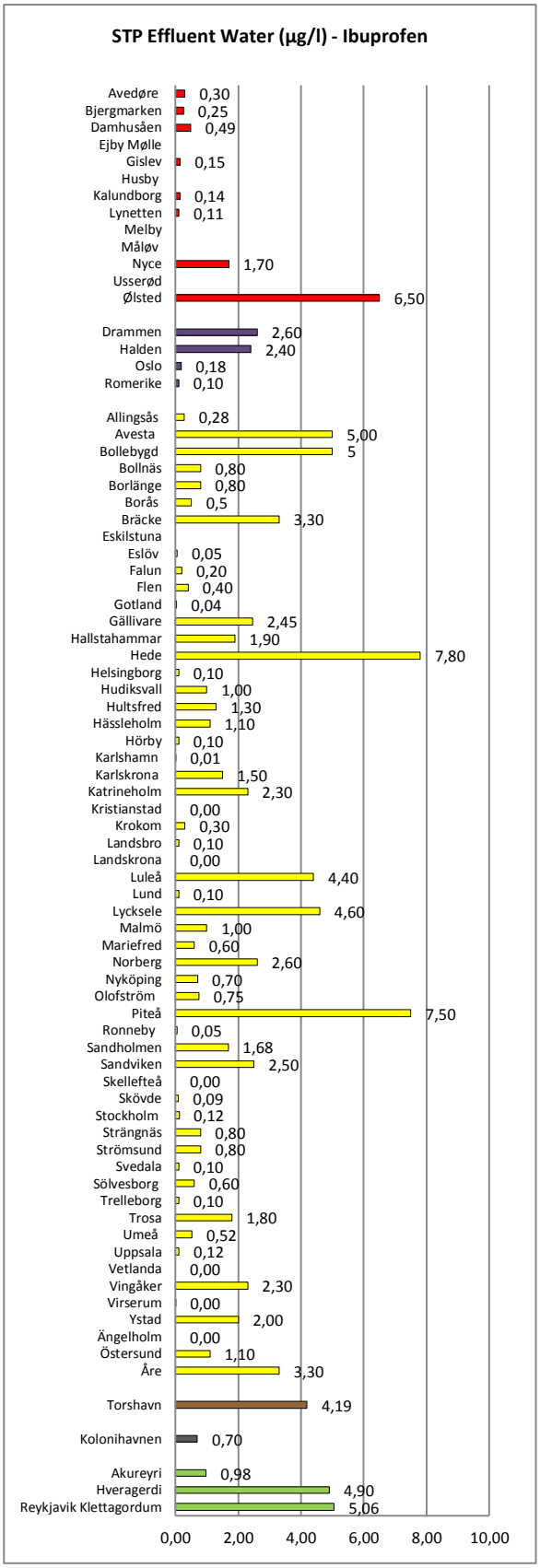
2.2.3 Ibuprofen

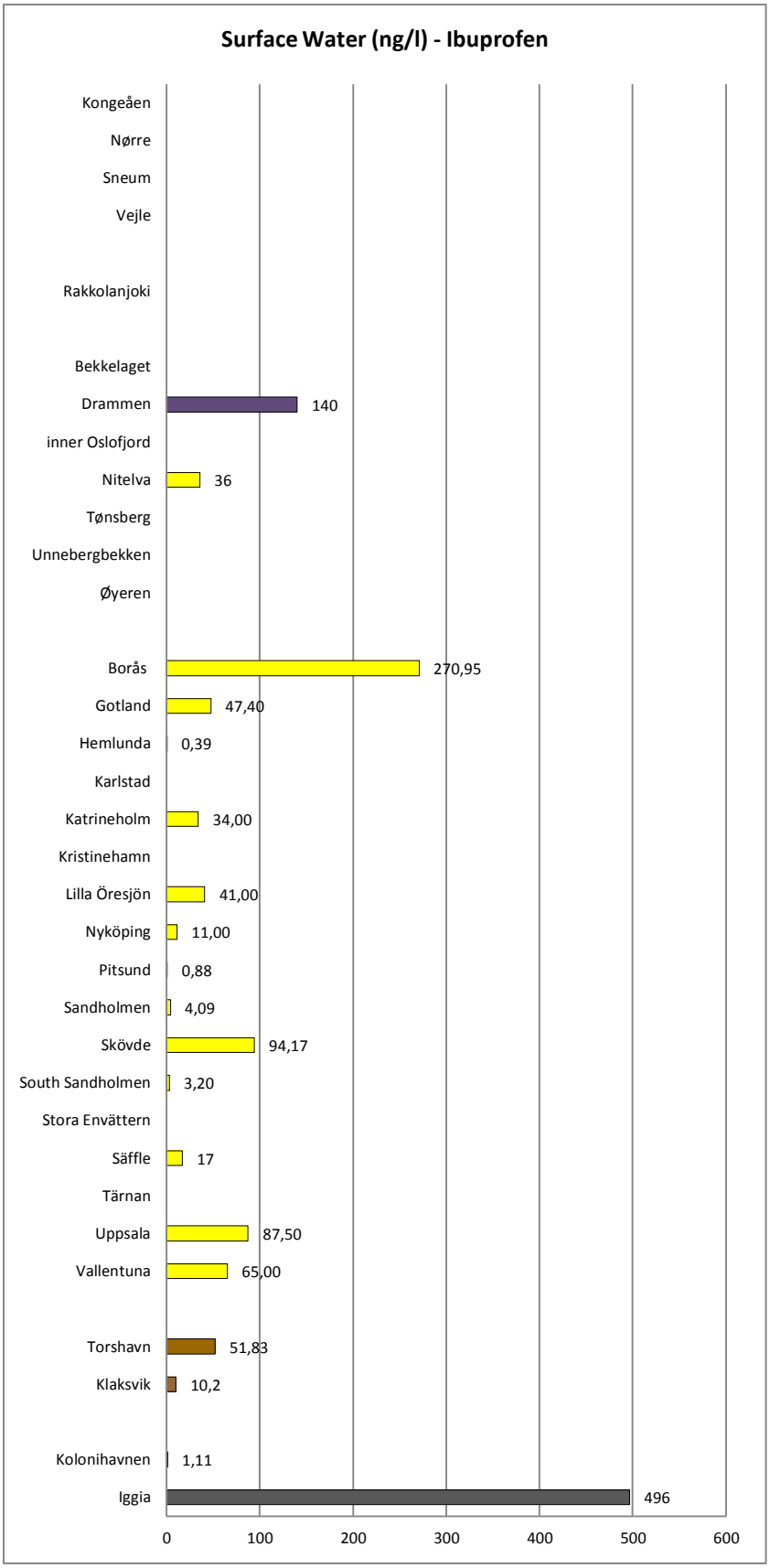
CAS nr.: 15687-27-1
Info: A nonsteroidal anti-inflammatory drug also used as an analgesic
Toxicity data:
NOEC 7 days (Lemna gibba) >1000 µg/l
NOEC 96hr (Lepomis macrochirus)= 10 mg/l
NOEC 48 h (Daphnia Magna)= 3.37 mg/l
EC50 96 hr (Skeletonema costatum)= 7.1 mg/l
PNEC = 71 µg/l (Andersson, et al., 2006)




Sediment (µg/kg dw) - Ibuprofen
Bekkelaget
Drammen
Halden
Nitelva
Oslo
Oslofjord
Øyeren
Skedsmo
Tønsberg
Unnebergbekken
Hemlunda
Lilla Öresjön
Nyköping
Pitsund
Sandholmen
Sandholmen
Stensjön
Tärnan
Klaksvik
Torshavn
Kolonihavnen
2,80
0,97
0,74
0,21
6,00
0,20
0,00
1,00
2,00
3,00
4,00
5,00
6,00
7,00


Sludge (µg/kg d.w.) - Ibuprofen
Damhusåen
Ejby Mølle
Lynetten
Melby
Oslo 13
Romerike
Tønsberg
Alvesta 130
57
Berg 560
92
Borlänge 6
52
Eskilstuna 68
33
Flen 160
Gällivare 4
56
Hede 280
92
Henriksdal 0
65
Hultsfred 46
91
Hörby 22
96
Karlskrona 34
86
Katrineholm 160
110
Kristinehamn
10
Landsbro 22
140
Lessebo 53
130
Luleå 51
54
Lycksele 110
120
Mariefred 5
24
Norberg 95
19
Piteå 150
150
Ronneby 33
310
Skellefteå 160
110
Skövde
Strängnäs 15
75
Svedala 10
42
Tingsryd 67
38
Trosa 35
Uppsala
36
Vetlanda 29
43
Västerås 22000
86
Ystad 78
41
Ängelholm 110
53
Åre 86
Kolonihavnen 39,2
Torshavn 111,0
Akureyri 9,2
210
Reykjavik 109
0 5000 10000 15000 20000 25000


STP Effluent Water (µg/l) - Ibuprofen
Avedøre 0,30
Bjergmarken 0,25
Damhusåen 0,49
Ejby Mølle
Gislev 0,15
Husby
Kalundborg 0,14
Lynetten 0,11
Melby
Måløv
Nyce 1,70
Usserød
Ølsted 6,50
Drammen 2,60
Halden 2,40
Oslo 0,18
Romerike 0,10
Allingsås 0,28
Avesta 5,00
Bollebygd 5
Bollnäs 0,80
Borlänge 0,80
Borås 0,5
Bräcke 3,30
Eskilstuna
Eslöv 0,05
Falun 0,20
Flen 0,40
Gotland 0,04
Gällivare 2,45
Hallstahammar 1,90
Hede 7,80
Helsingborg 0,10
Hudiksvall 1,00
Hultsfred 1,30
Hässleholm 1,10
Hörby 0,10
Karlshamn 0,01
Karlskrona 1,50
Katrineholm 2,30
Kristianstad 0,00
Krokom 0,30
Landsbro 0,10
Landskrona 0,00
Luleå 4,40
Lund 0,10
Lycksele 4,60
Malmö 1,00
Mariefred 0,60
Norberg 2,60
Nyköping 0,70
Olofström 0,75
Piteå 7,50
Ronneby 0,05
Sandholmen 1,68
Sandviken 2,50
Skellefteå 0,00
Skövde 0,09
Stockholm 0,12
Strängnäs 0,80
Strömsund 0,80
Svedala 0,10
Sölvesborg 0,60
Trelleborg 0,10
Trosa 1,80
Umeå 0,52
Uppsala 0,12
Vetlanda 0,00
Vingåker 2,30
Virserum 0,00
Ystad 2,00
Ängelholm 0,00
Östersund 1,10
Åre 3,30
Torshavn 4,19
Kolonihavnen 0,70
Akureyri 0,98
Hveragerdi 4,90
Reykjavik Klettagordum 5,06
0,00 2,00 4,00 6,00 8,00 10,00


Surface Water (ng/l) - Ibuprofen
Kongeåen
Nørre
Sneum
Vejle
Rakkolanjoki
Bekkelaget
Drammen
140
inner Oslofjord
Nitelva
36
Tønsberg
Unnebergbekken
Øyeren
Borås
270,95
Gotland
47,40
Hemlunda
0,39
Karlstad
Katrineholm
34,00
Kristinehamn
Lilla Öresjön
41,00
Nyköping
11,00
Pitsund
0,88
Sandholmen
4,09
Skövde
94,17
South Sandholmen
3,20
Stora Envättern
Säffle
17
Tärnan
Uppsala
87,50
Vallentuna
65,00
Torshavn
51,83
Klaksvik
10,2
Kolonihavnen
1,11
Iggia
496
0
100
200
300
400
500
600

Ibuprofen	Denmark		Finland		Norway		Sweden		Faroe Islands		Greenland		Iceland	
Matrix	*Min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Biota (µg/kg ww)					nd	6 (b)	nd	24 (def)						
Sediment (µg/kg dw)					nd 2,8 2,8	16 (b)	nd 6 1,98	11 (ef)	nd	3 (k)	0,18 0,21 0,198	2 (k)		
STP sludge (µg/kg dw)	nd	10 (a)			nd 17 12,5	13 (bc)	nd 22000 450,9	66 (df)	53,5 169 111	2 (k)	30,1 48,2 39,2	2 (k)	2,6 209,5 84,2	4 (k)
Surface water (µg/l)	nd	16 (a)			nd 0,14 0,09	8 (b)	nd 0,18 0,05	32 (def)	0,003 0,13 0,044	5 (k)	nd 0,87 0,25	5 (k)		
STP effluent (µg/l)	nd 6,5 1,5	8 (ah)	NA NA 2,06	14 (i)	nd 2,6 0,75	10 (bc)	nd 7,8 1,3	82 (defgh)	4,19 4,19 4,19	1 (k)	0,7 0,7 0,7	1 (k)	0,64 5,08 3,36	5 (k)
Hospital WW (µg/l)							0,0034 12,1 10,7	7 (f)	3,38 4,5 3,94	2 (k)	2,81 2,81 2,81	1 (k)		
Drinking water							nd	6 (d)						
Landfill leachates untreated (µg/l)					nd 1,3 1,15	4 (b)	1,1 1,1 1,1	1 (f)						
Landfill leachates treated (µg/l)					0,61 1,8 1,2	5 (b)	nd 1,6 0,76	7 (f)						
Warning system for pesticide leaching to groundwater	nd	6 (a)												
Manure							nd	5 (f)						
Pig slurry	nd	4 (a)												
Drain water	nd	1 (a)												
Groundwater	nd	3 (a)												
STP Influent (µg/l)	4,4 16 7,9	9 (a)	NA NA 0,16	14 (i)	nd 3,05 2,6	8 (b)	0,0013 11,8 4,8	35 (def)	3,5 11,47 7,5	2 (k)			0,0016 5,04 2,14	5 (k)
Settleable particu-late material (ng/g dw)			nd 152 30,2	11 (j)										

References:

a) (Mogensen, et al., 2008)
b) (Møskeland, et al., 2006)
c) (Thomas, et al., 2007)
d) (Fick, et al., 2011)
e) (Remberger, et al., 2009)
f) (Andersson, et al., 2006)

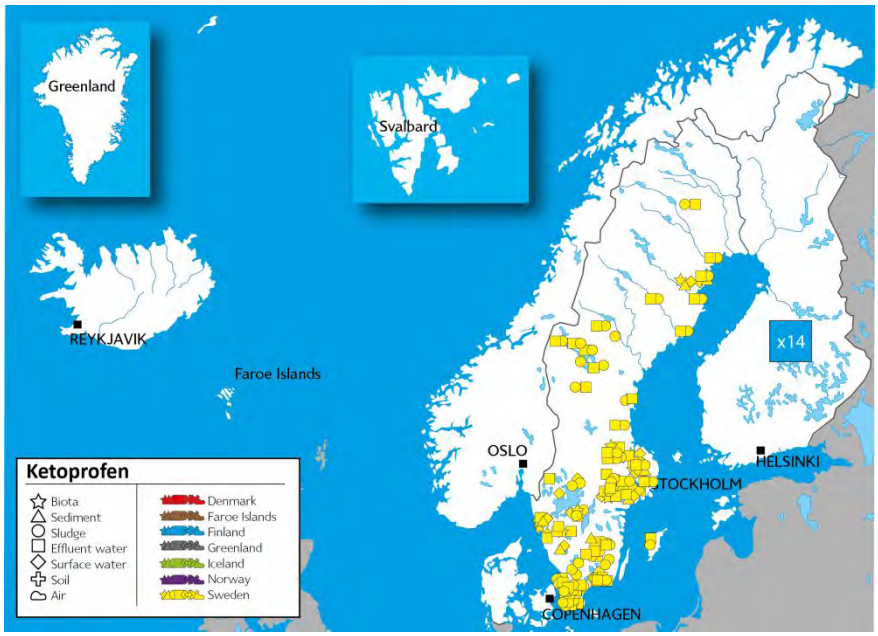
g) (Lilja, et al., 2010)
h) (Kjølholt, et al., 2003)
i) (Vieno, 2008)
j) (Lahti & Oikari, 2011)
k) (Huber, et al., NA)

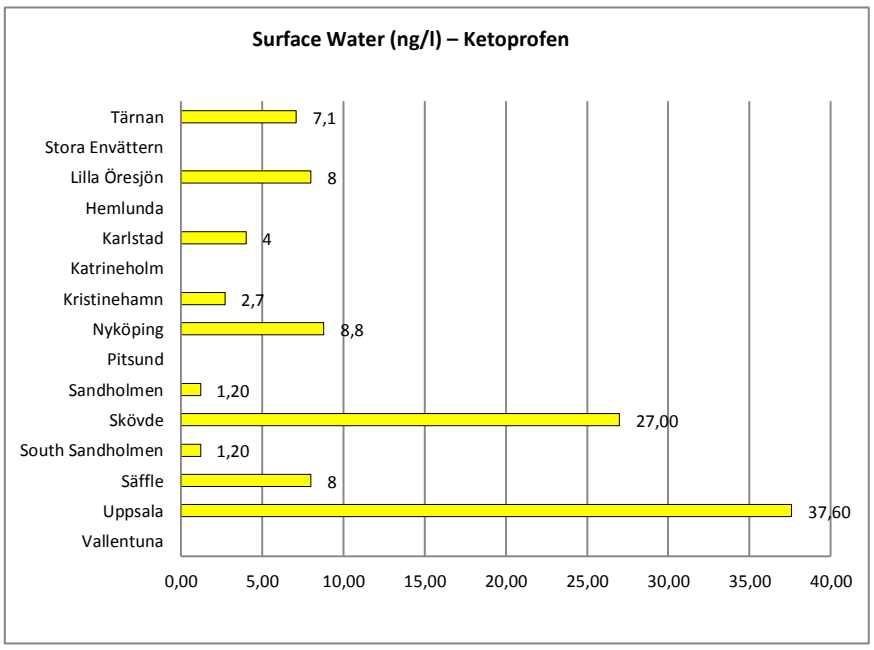
Conclusion:
The compound was broadly monitored in the nordic countries, in one study in Denmark, two in Norway and Finland, five in Sweden and one international study covering Faroe Islands, Greenland and Iceland. The compound was detected in several matrices:

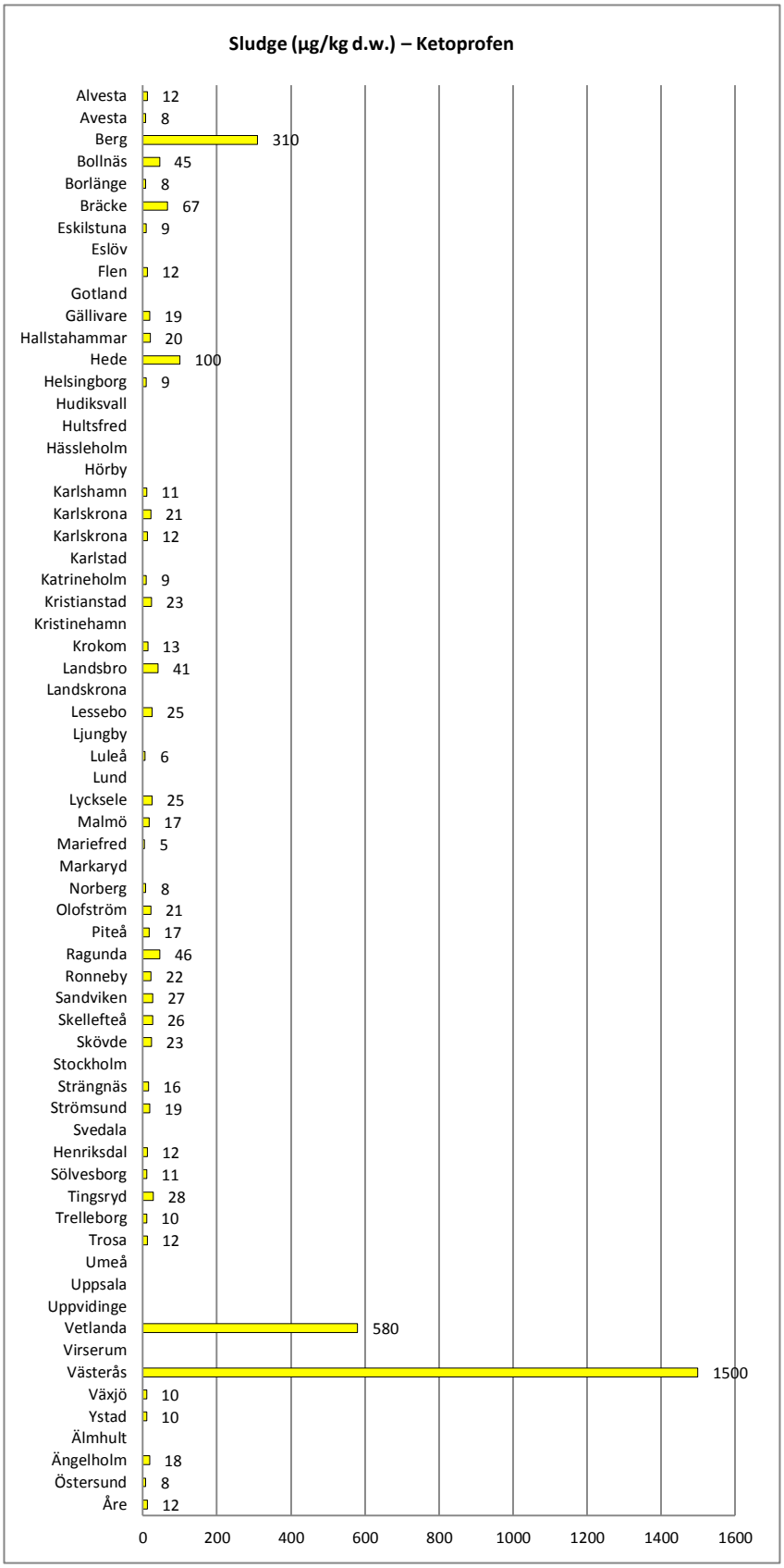
- Surface water in Norway, Sweden, Faroe Islands and Greenland. But was not detected in surface water in Denmark. Detected in concentrations higher than the PNEC in Sweden
- Sediment in all countries monitored, with the exception of Denmark and Finland
- STP sludge in Norway, Sweden, Faroe Islands, Greenland and Iceland. But was not detected in Denmark. One very high value detected in Sweden
- STP effluent in all four countries
- Landfill leachates
- STP influent in all countries
- Hospital waste water in Sweden

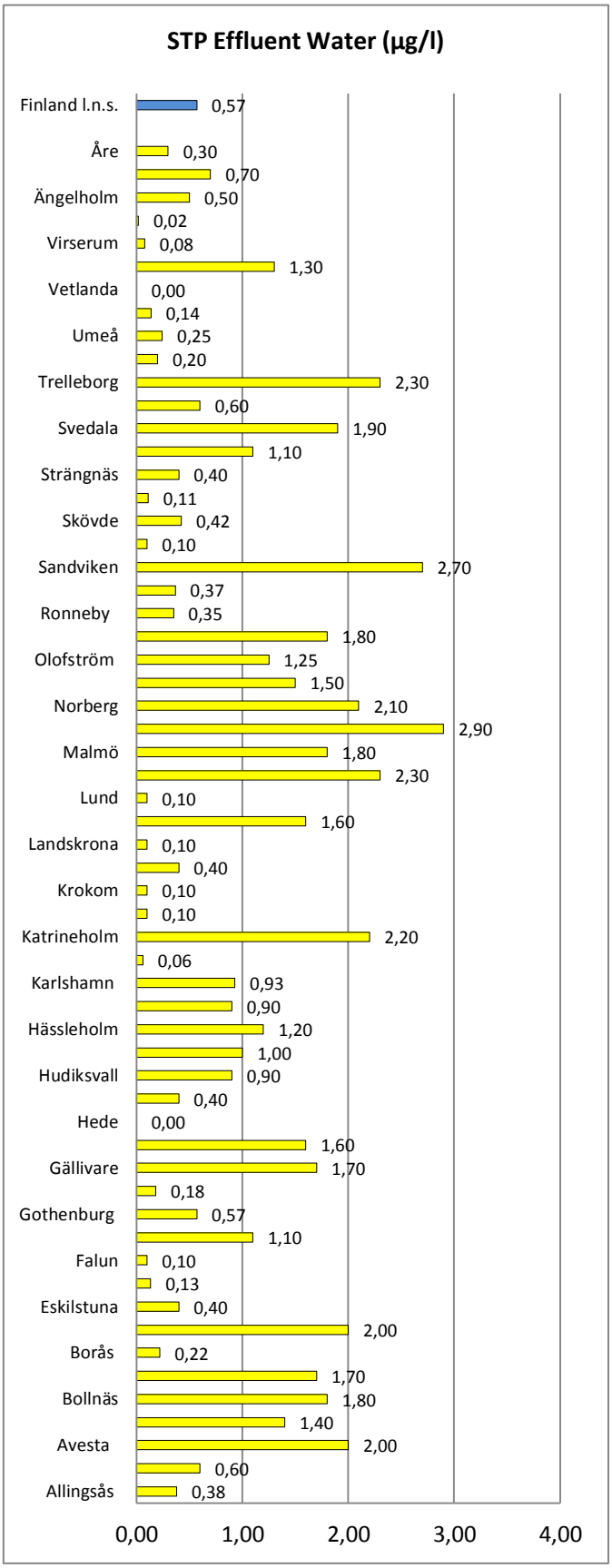
2.2.4 *Ketoprofen*

CAS nr.: 22071-15-4
Info: Propionic acid class of non-steroidal anti-inflammatory drug with analgesic and antipyretic effects
Toxicity data: NA
PNEC = NA






Sludge (µg/kg d.w.) – Ketoprofen
Alvesta 12
Avesta 8
Berg 310
Bollnäs 45
Borlänge 8
Bräcke 67
Eskilstuna 9
Eslöv
Flen 12
Gotland
Gällivare 19
Hallstahammar 20
Hede 100
Helsingborg 9
Hudiksvall
Hultsfred
Hässleholm
Hörby
Karlshamn 11
Karlskrona 21
Karlskrona 12
Karlstad
Katrineholm 9
Kristianstad 23
Kristinehamn
Krokom 13
Landsbro 41
Landskrona
Lessebo 25
Ljungby
Luleå 6
Lund
Lycksele 25
Malmö 17
Mariefred 5
Markaryd
Norberg 8
Olofström 21
Piteå 17
Ragunda 46
Ronneby 22
Sandviken 27
Skellefteå 26
Skövde 23
Stockholm
Strängnäs 16
Strömsund 19
Svedala
Henriksdal 12
Sölvesborg 11
Tingsryd 28
Trelleborg 10
Trosa 12
Umeå
Uppsala
Uppvidinge
Vetlanda 580
Virserum
Västerås 1500
Växjö 10
Ystad 10
Älmhult
Ängelholm 18
Östersund 8
Åre 12
0 200 400 600 800 1000 1200 1400 1600


STP Effluent Water (µg/l)
Finland l.n.s.
0,57
Åre
0,30
0,70
Ängelholm
0,50
0,02
Virserum
0,08
1,30
Vetlanda
0,00
0,14
Umeå
0,25
0,20
Trelleborg
2,30
0,60
Svedala
1,90
1,10
Strängnäs
0,40
0,11
Skövde
0,42
0,10
Sandviken
2,70
0,37
Ronneby
0,35
1,80
Olofström
1,25
1,50
Norberg
2,10
2,90
Malmö
1,80
2,30
Lund
0,10
1,60
Landskrona
0,10
0,40
Krokom
0,10
0,10
Katrineholm
2,20
0,06
Karlshamn
0,93
0,90
Hässleholm
1,20
1,00
Hudiksvall
0,90
0,40
Hede
0,00
1,60
Gällivare
1,70
0,18
Gothenburg
0,57
1,10
Falun
0,10
0,13
Eskilstuna
0,40
2,00
Borås
0,22
1,70
Bollnäs
1,80
1,40
Avesta
2,00
0,60
Allingsås
0,38
0,00
1,00
2,00
3,00
4,00

Ketoprofen	Finland		Sweden	
Matrix	*Min* *max* *AD*	*Nr.S* *(ref)*	*Min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg ww)			nd	24 (cde)
Sediment (µg/kg dw)			nd	11 (de)
STP sludge (µg/kg dw)			nd 1500 70,9	66 (ce)
STP effluent (µg/l)	NA NA 0,57	14 (a)	nd 2,9 0,82	76 (cdef)
Surface water (µg/l)			nd 1 0,12	40 (cde)
Hospital WW (µg/l)			1,3 6,1 3,7	6 (e)
Drinking water			nd	6 (c)
Landfill leachates untreated (µg/l)			nd 0,23 0,15	7 (e)
Landfill leachates treated (µg/l)			0,1 0,1 0,1	1 (e)
Influent (µg/l)	NA NA 0,37	14 (a)	nd 6 1,8	36 (cde)
Manure (ug/kg dw)			nd 14 7,3	5[2] (e)
Settleable particulate material (ng/g dw)	nd 209 154,5	11 (b)		

References:

a) (Vieno, 2008)
b) (Lahti & Oikari, 2011)
c) (Fick, et al., 2011)
d) (Remberger, et al., 2009)
e) (Andersson, et al., 2006)
f) (Lilja, et al., 2010)

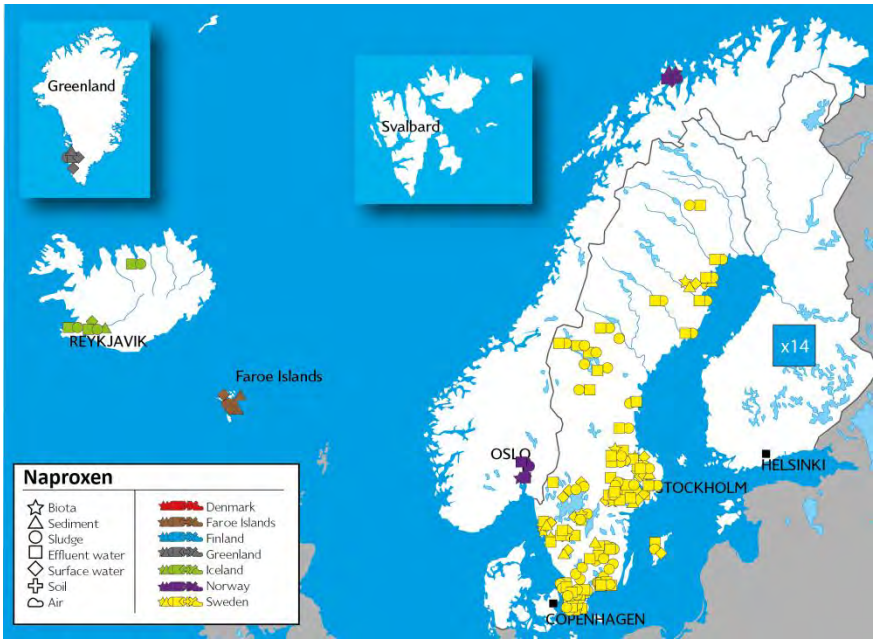
[2] Only detected in pig farms

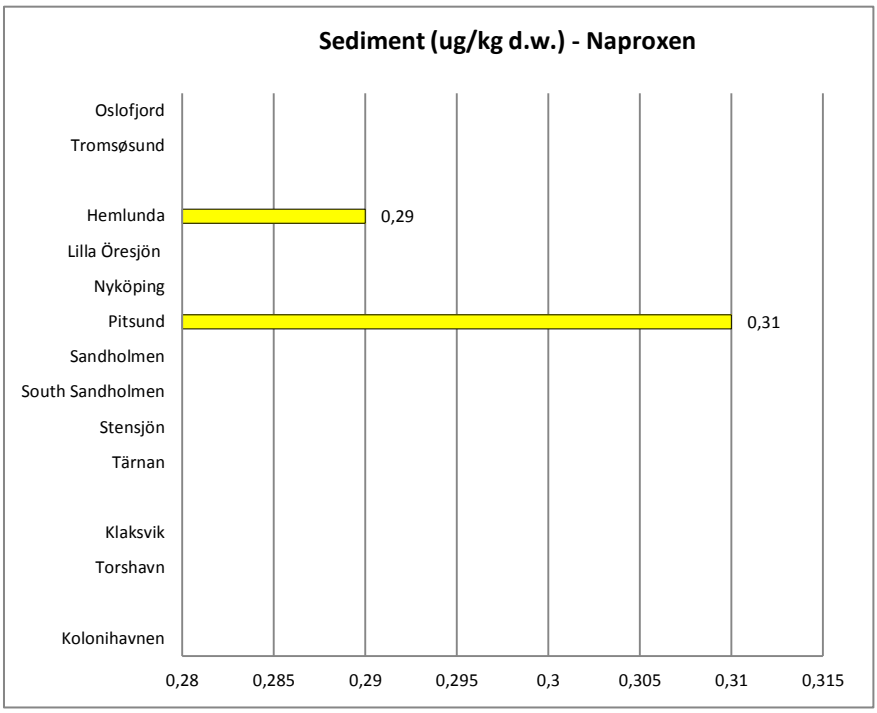
Conclusion:
The compound was monitored in two Finnish studies and four Swedish studies. It was detected in several matrices:

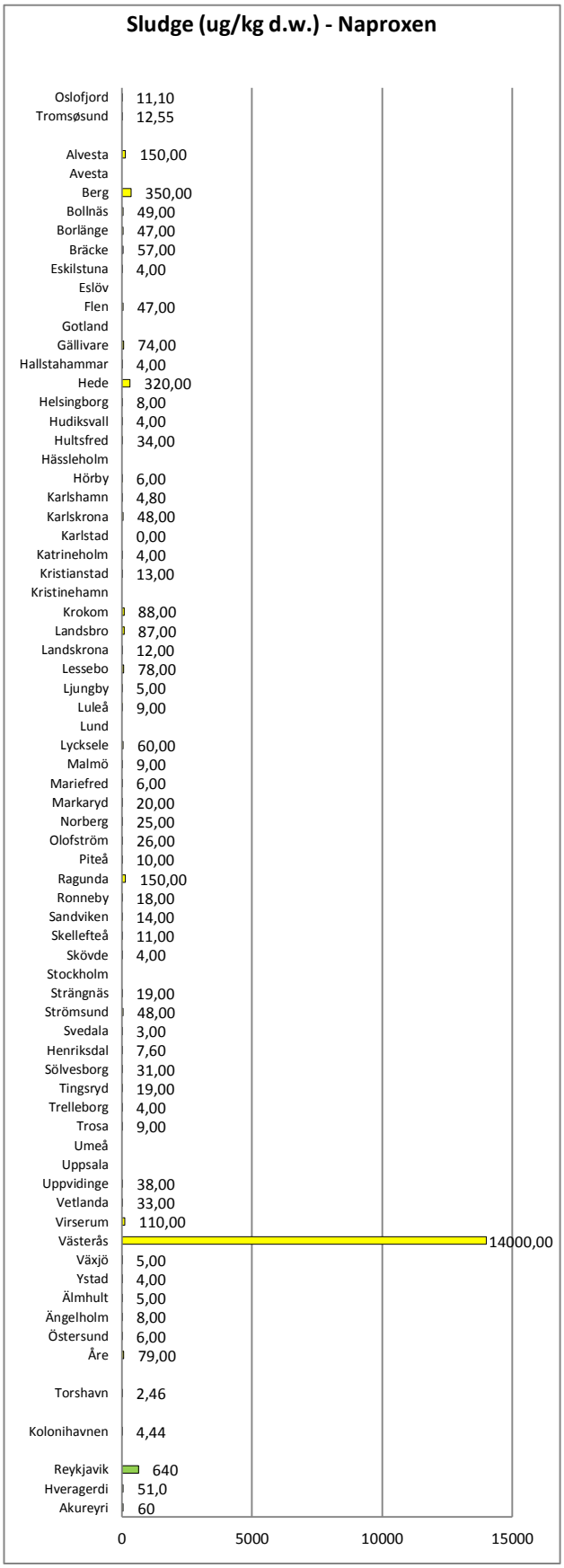
- In STP sludge in high concentrations in Sweden
- In STP effluent in both countries
- In surface water in Sweden
- In landfill leachates in Sweden
- In manure in Sweden
- In settleable particulate material in Finland
- In STP influent in both countries
- In hospital waste water in Sweden

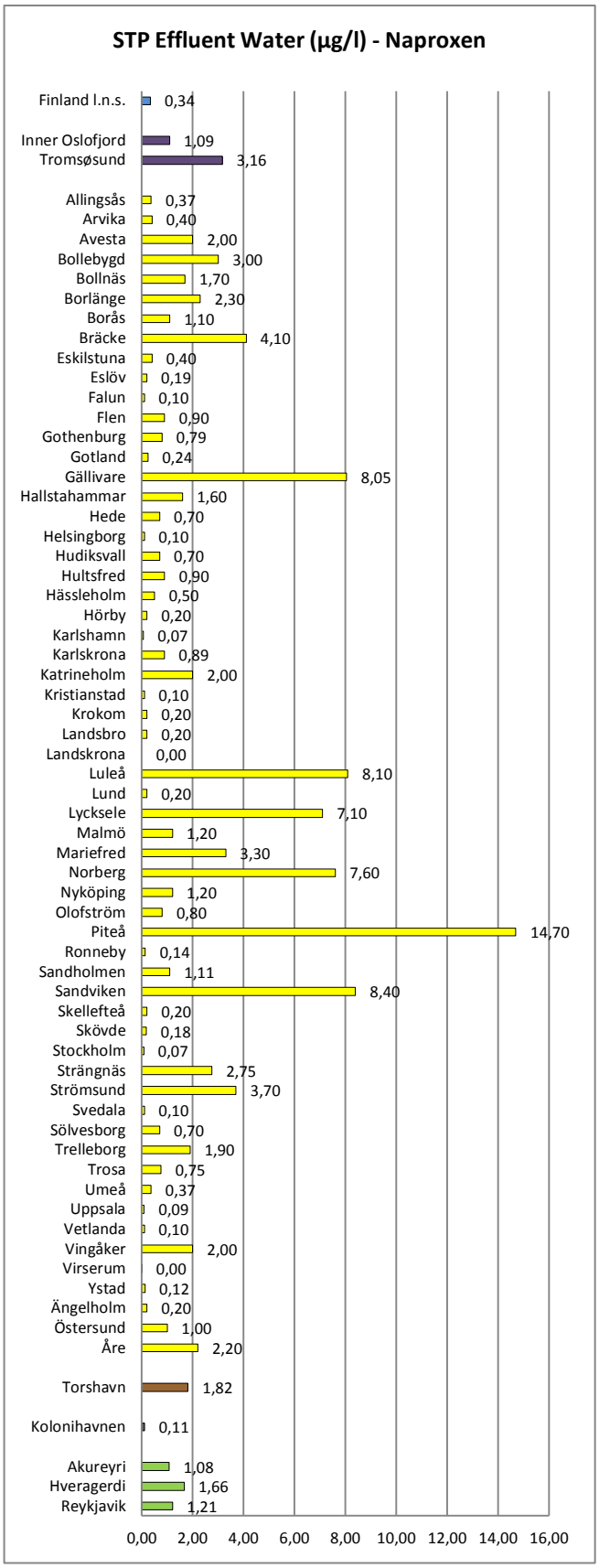
2.2.5 Naproxen

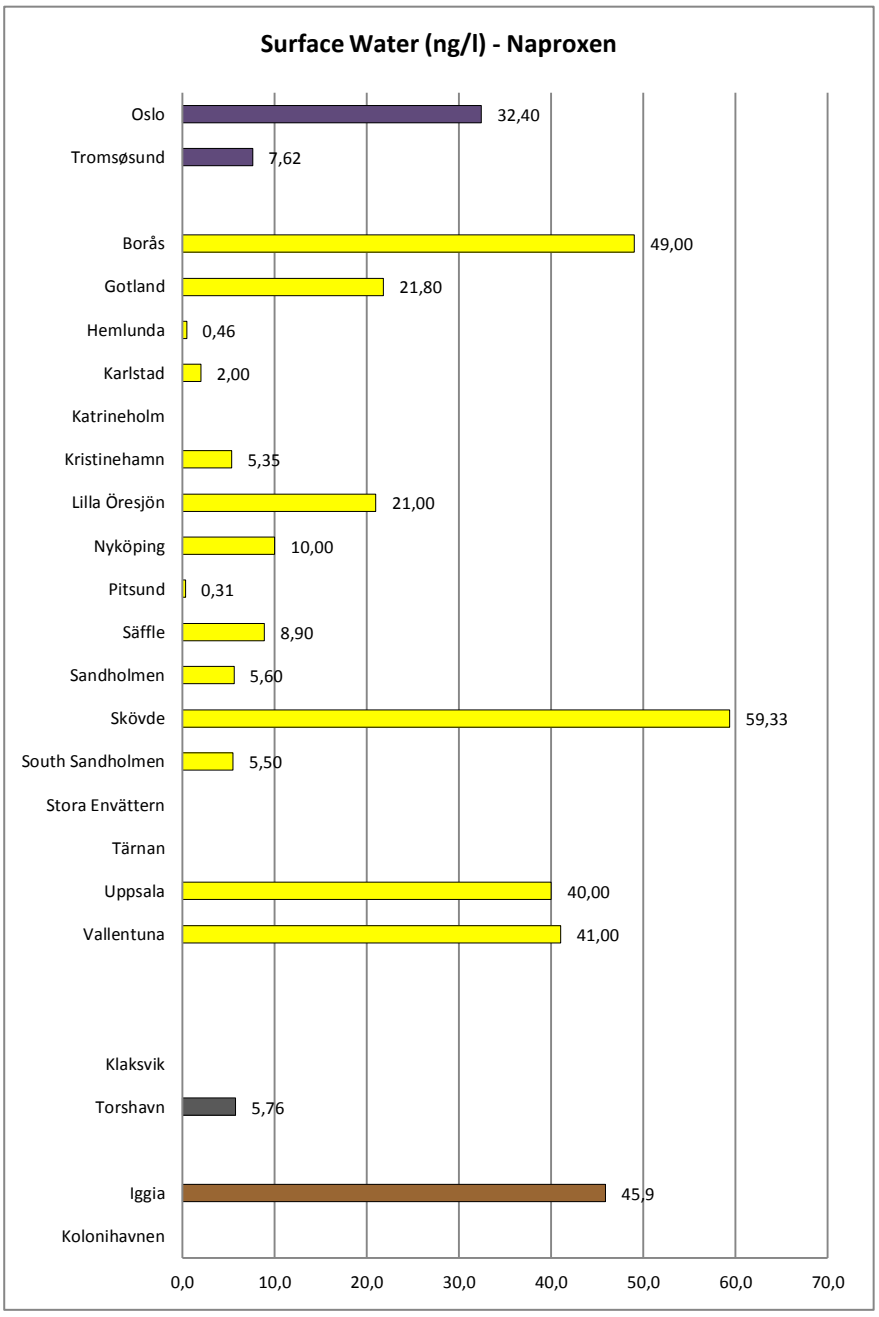
CAS nr.: 22204-53-1
Info: A nonsteroidal anti-inflammatory drug with analgesic and antipyretic effects
Toxicity data: LOEC (Ceriodaphnia dubia)=32 µg/L (Schlabach, et al., 2009)
PNEC = 35 µg/l (Andersson, et al., 2006)




Sediment (ug/kg d.w.) - Naproxen
Oslofjord
Tromsøsund
Hemlunda
Lilla Öresjön
Nyköping
Pitsund
Sandholmen
South Sandholmen
Stensjön
Tärnan
Klaksvik
Torshavn
Kolonihavnen
0,29
0,31
0,28
0,285
0,29
0,295
0,3
0,305
0,31
0,315


Sludge (ug/kg d.w.) - Naproxen
Oslofjord 11,10
Tromsøsund 12,55
Alvesta 150,00
Avesta
Berg 350,00
Bollnäs 49,00
Borlänge 47,00
Bräcke 57,00
Eskilstuna 4,00
Eslöv
Flen 47,00
Gotland
Gällivare 74,00
Hallstahammar 4,00
Hede 320,00
Helsingborg 8,00
Hudiksvall 4,00
Hultsfred 34,00
Hässleholm
Hörby 6,00
Karlshamn 4,80
Karlskrona 48,00
Karlstad 0,00
Katrineholm 4,00
Kristianstad 13,00
Kristinehamn
Krokom 88,00
Landsbro 87,00
Landskrona 12,00
Lessebo 78,00
Ljungby 5,00
Luleå 9,00
Lund
Lycksele 60,00
Malmö 9,00
Mariefred 6,00
Markaryd 20,00
Norberg 25,00
Olofström 26,00
Piteå 10,00
Ragunda 150,00
Ronneby 18,00
Sandviken 14,00
Skellefteå 11,00
Skövde 4,00
Stockholm
Strängnäs 19,00
Strömsund 48,00
Svedala 3,00
Henriksdal 7,60
Sölvesborg 31,00
Tingsryd 19,00
Trelleborg 4,00
Trosa 9,00
Umeå
Uppsala
Uppvidinge 38,00
Vetlanda 33,00
Virserum 110,00
Västerås 14000,00
Växjö 5,00
Ystad 4,00
Älmhult 5,00
Ängelholm 8,00
Östersund 6,00
Åre 79,00
Torshavn 2,46
Kolonihavnen 4,44
Reykjavik 640
Hveragerdi 51,0
Akureyri 60
0
5000
10000
15000


STP Effluent Water (µg/l) - Naproxen
Finland l.n.s. 0,34
Inner Oslofjord 1,09
Tromsøsund 3,16
Allingsås 0,37
Arvika 0,40
Avesta 2,00
Bollebygd 3,00
Bollnäs 1,70
Borlänge 2,30
Borås 1,10
Bräcke 4,10
Eskilstuna 0,40
Eslöv 0,19
Falun 0,10
Flen 0,90
Gothenburg 0,79
Gotland 0,24
Gällivare 8,05
Hallstahammar 1,60
Hede 0,70
Helsingborg 0,10
Hudiksvall 0,70
Hultsfred 0,90
Hässleholm 0,50
Hörby 0,20
Karlshamn 0,07
Karlskrona 0,89
Katrineholm 2,00
Kristianstad 0,10
Krokom 0,20
Landsbro 0,20
Landskrona 0,00
Luleå 8,10
Lund 0,20
Lycksele 7,10
Malmö 1,20
Mariefred 3,30
Norberg 7,60
Nyköping 1,20
Olofström 0,80
Piteå 14,70
Ronneby 0,14
Sandholmen 1,11
Sandviken 8,40
Skellefteå 0,20
Skövde 0,18
Stockholm 0,07
Strängnäs 2,75
Strömsund 3,70
Svedala 0,10
Sölvesborg 0,70
Trelleborg 1,90
Trosa 0,75
Umeå 0,37
Uppsala 0,09
Vetlanda 0,10
Vingåker 2,00
Virserum 0,00
Ystad 0,12
Ängelholm 0,20
Östersund 1,00
Åre 2,20
Torshavn 1,82
Kolonihavnen 0,11
Akureyri 1,08
Hveragerdi 1,66
Reykjavik 1,21
0,00 2,00 4,00 6,00 8,00 10,00 12,00 14,00 16,00


Surface Water (ng/l) - Naproxen
Oslo
Tromsøsund
Borås
Gotland
Hemlunda
Karlstad
Katrineholm
Kristinehamn
Lilla Öresjön
Nyköping
Pitsund
Säffle
Sandholmen
Skövde
South Sandholmen
Stora Envättern
Tärnan
Uppsala
Vallentuna
Klaksvik
Torshavn
Iggia
Kolonihavnen
32,40
7,62
49,00
21,80
0,46
2,00
5,35
21,00
10,00
0,31
8,90
5,60
59,33
5,50
40,00
41,00
5,76
45,9
0,0
10,0
20,0
30,0
40,0
50,0
60,0
70,0

Naproxen	Finland		Norway		Sweden		Faroe Islands		Greenland		Iceland	
Matrix	*Min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*
Biota (µg/kg ww)			nd nd nd	3 (c)	nd nd nd	24 (de)						
Sediment (µg/kg dw)			nd nd nd	6 (c)	nd 0,31 0,30	11 (ef)	nd	3 (h)	nd	5 (h)		
STP sludge (µg/kg dw)			8,1 17 11,8	4 (c)	nd 14000 296,9	66 (df)	0,32 4,6 2,46	2 (h)	0,87 8,01 4,44	2 (h)	0,8 640,3 203,1	4 (h)
STP effluent (µg/l)	NA NA 0,34	14 (a)	nd 3,16 1,32	10 (c)	0,0003 14,7 1,56	76 (defg)	1,8 1,8 1,8	1 (h)	0,106 0,106 0,106	1 (h)	0,52 1,92 1,34	5 (h)
Surface water (µg/l)			0,003 0,053 0,02	12 (c)	nd 0,12 0,02	40 (def)	nd 0,0058 0,0058	5 (h)	nd 0,046 0,046	5 (h)		
Hospital WW (µg/l)					nd 11 4,87	7 (f)	nd 7,88 7,88	2 (h)	0,0035 0,0035 0,0035	1 (h)		
Drinking water (µg/l)					nd 0,045 0,04	6 (d)						
Landfill leachates untreated (µg/l)					nd 0,02 0,015	8 (f)						
Landfill leachates treated (µg/l)					nd nd nd	1 (f)						
Influent (µg/l)	NA NA 0,69	14 (a)			0,0002 20,9 4,33	35 (def)	0,0027 0,17 0,086	2 (h)			0,175 2,3 1,67	5 (h)
Manure					nd nd nd	5 (f)						
Settleable particulate material (ng/g dw)	nd 49,2 49,2	11 (b)										

References:

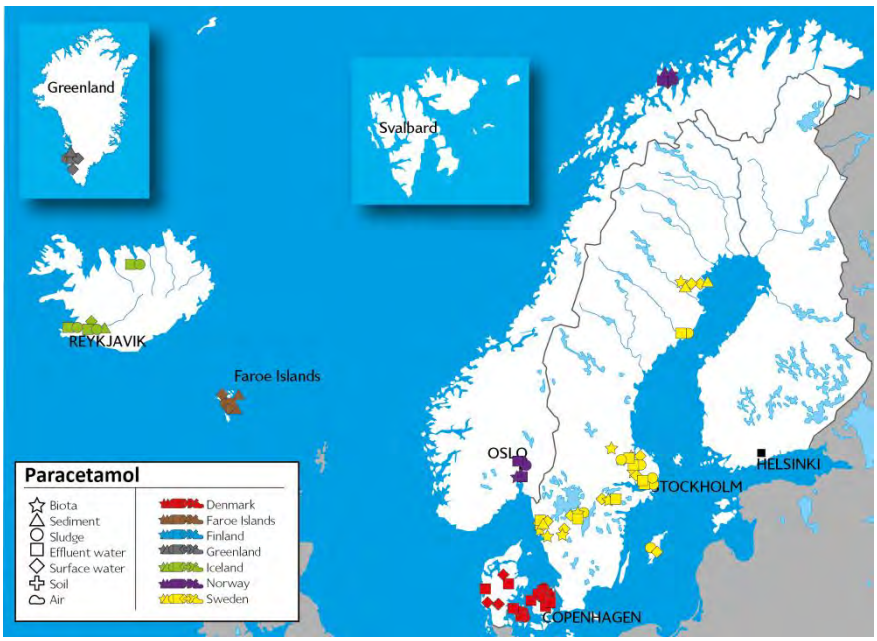
a) (Vieno, 2008)
b) (Lahti & Oikari, 2011)
c) (Schlabach, et al., 2009)
d) (Fick, et al., 2011)
e) (Remberger, et al., 2009)
f) (Andersson, et al., 2006)
g) (Lilja, et al., 2010)
h) (Huber, et al., NA)

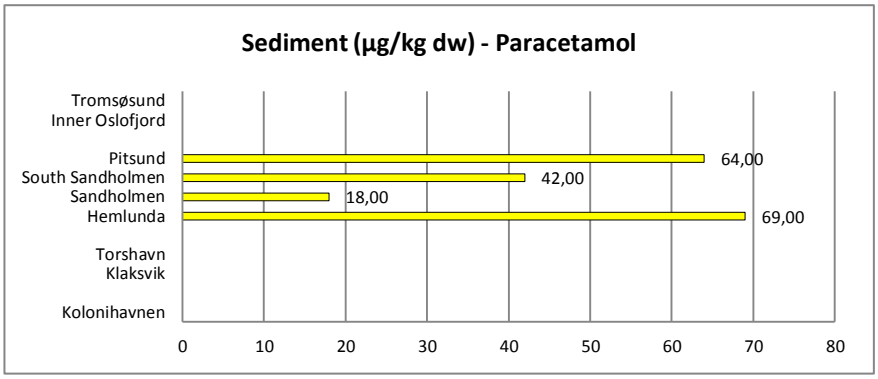
Conclusion:
The compound has been monitored in one Norwegian study, two Finnish studies, four Swedish studies, and one international study covering Faroe Islands, Greenland, and Iceland. It has been detected in several matrices:

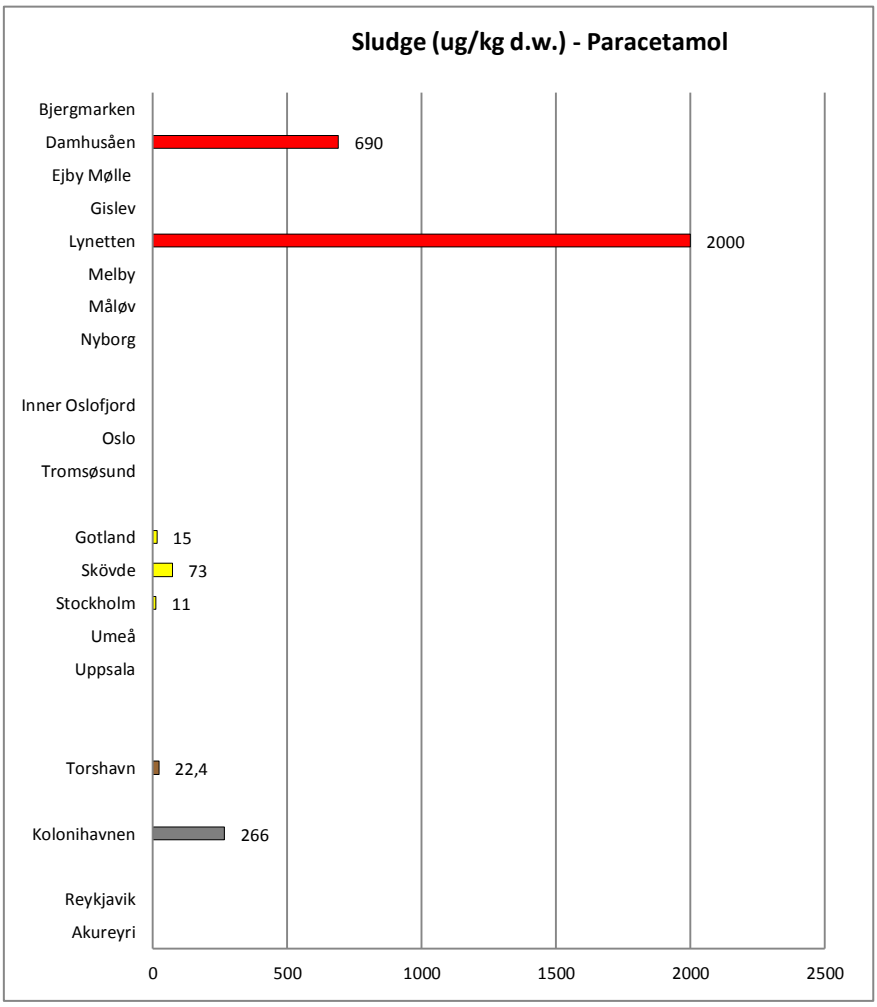
- Sediment only in Sweden
- Sludge in all countries except Finland were the compound was not monitored. A very high value was detected in one location in Sweden.
- STP effluent in all countries, in concentrations below the PNEC
- Surface water in Sweden, Norway, Faroe Islands and Greenland, in concentrations below the PNEC
- In one sample of settleable particulate material in Finland
- Non-treated landfill leachates in Sweden but not in treated leachates
- STP influent in all countries monitored in all countries monitored
- Hospital waste water

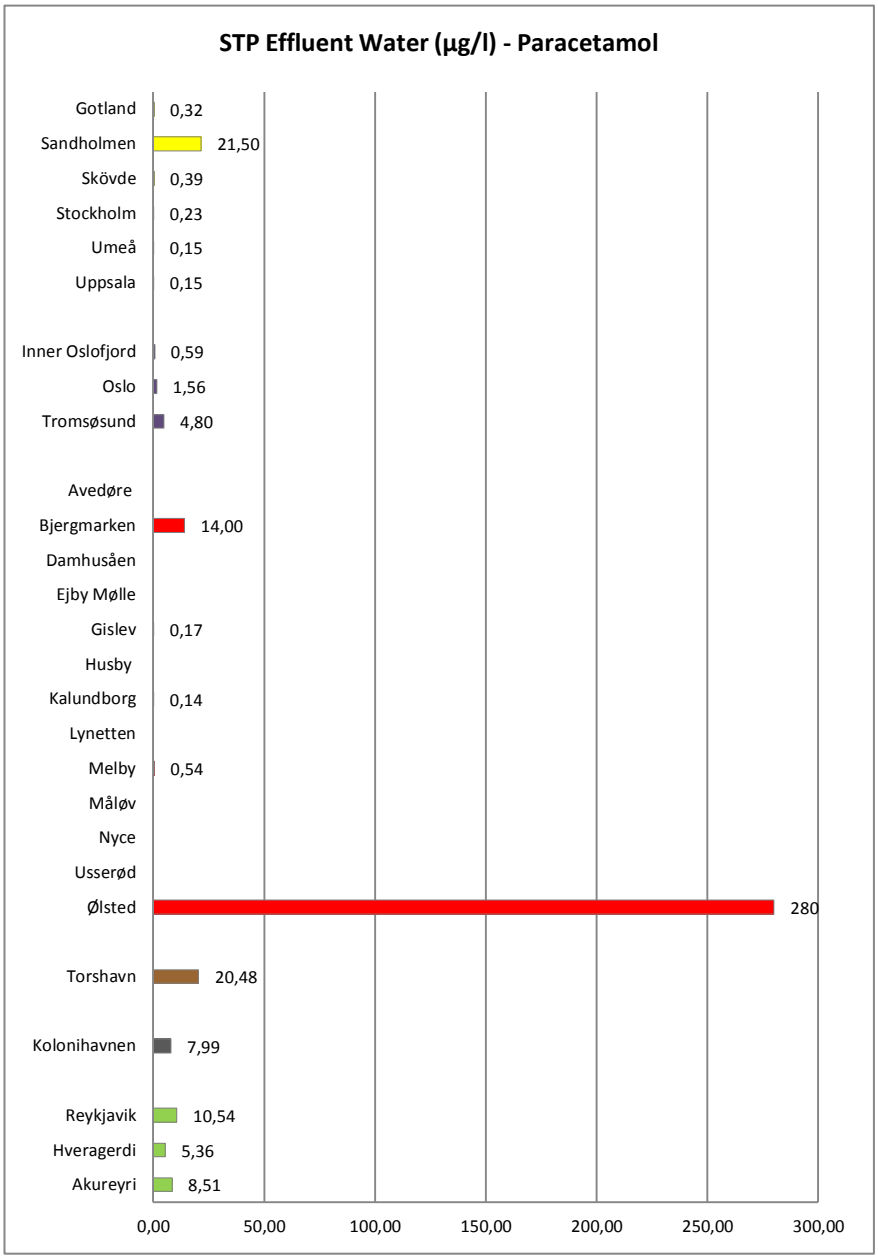
2.2.6 Paracetamol

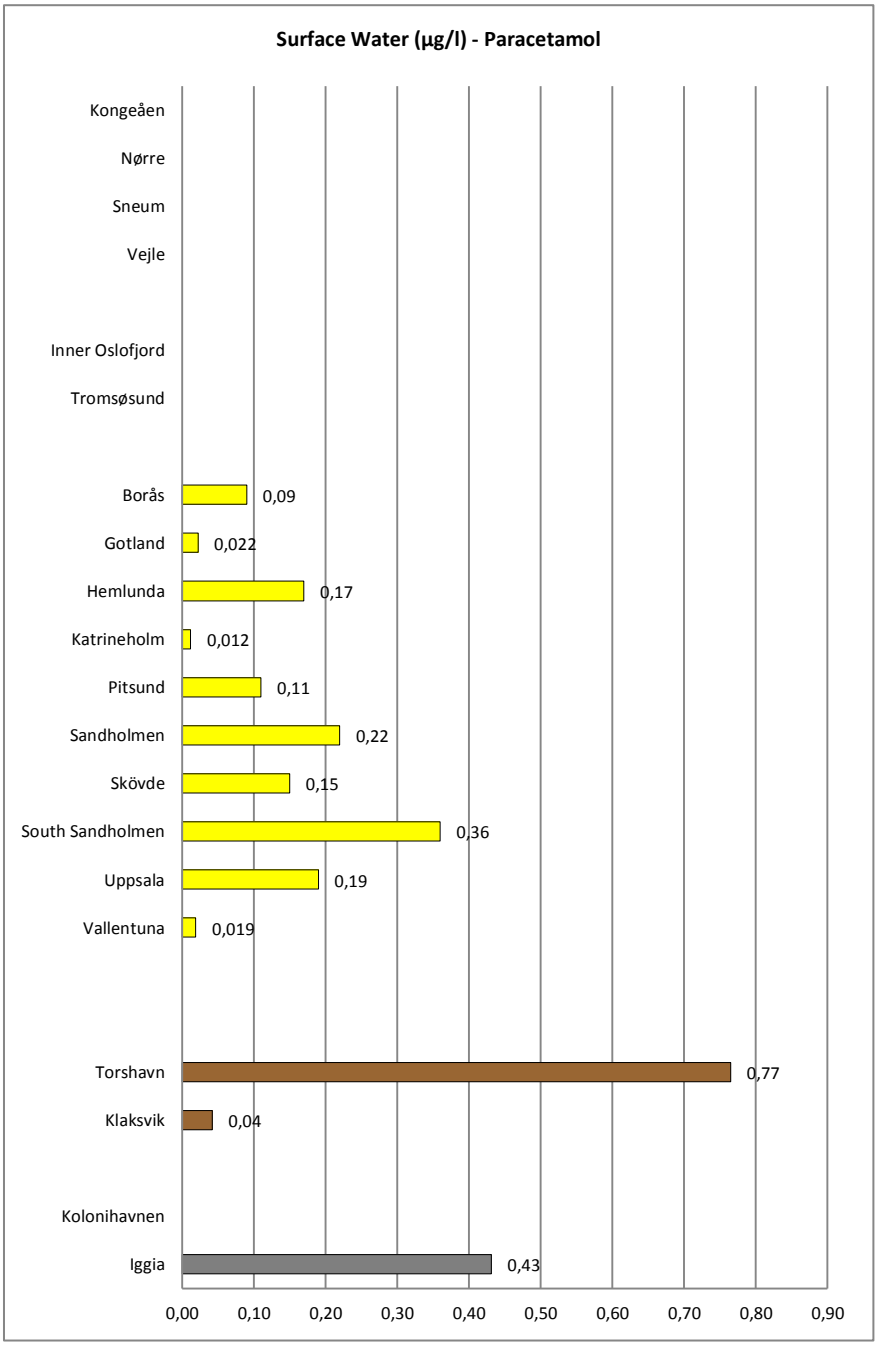
CAS nr.: 103-90-2
Info: Analgesic and antipyretic
Toxicity data: LOEC (Lemna gibba)= 1000 µg/L (Schlabach, et al., 2009)
PNEC = NA




Sediment (µg/kg dw) - Paracetamol
Tromsøsund
Inner Oslofjord
Pitsund
South Sandholmen
Sandholmen
Hemlunda
Torshavn
Klaksvik
Kolonihavnen
64,00
42,00
18,00
69,00
0
10
20
30
40
50
60
70
80


Sludge (ug/kg d.w.) - Paracetamol
Bjergmarken
Damhusåen
Ejby Mølle
Gislev
Lynetten
Melby
Måløv
Nyborg
Inner Oslofjord
Oslo
Tromsøsund
Gotland
Skövde
Stockholm
Umeå
Uppsala
Torshavn
Kolonihavnen
Reykjavik
Akureyri
690
2000
15
73
11
22,4
266
0
500
1000
1500
2000
2500


STP Effluent Water (µg/l) - Paracetamol
Gotland
0,32
Sandholmen
21,50
Skövde
0,39
Stockholm
0,23
Umeå
0,15
Uppsala
0,15
Inner Oslofjord
0,59
Oslo
1,56
Tromsøsund
4,80
Avedøre
Bjergmarken
14,00
Damhusåen
Ejby Mølle
Gislev
0,17
Husby
Kalundborg
0,14
Lynetten
Melby
0,54
Måløv
Nyce
Usserød
Ølsted
280
Torshavn
20,48
Kolonihavnen
7,99
Reykjavik
10,54
Hveragerdi
5,36
Akureyri
8,51
0,00
50,00
100,00
150,00
200,00
250,00
300,00


Surface Water (µg/l) - Paracetamol
Kongeåen
Nørre
Sneum
Vejle
Inner Oslofjord
Tromsøsund
Borås
0,09
Gotland
0,022
Hemlunda
0,17
Katrineholm
0,012
Pitsund
0,11
Sandholmen
0,22
Skövde
0,15
South Sandholmen
0,36
Uppsala
0,19
Vallentuna
0,019
Torshavn
0,77
Klaksvik
0,04
Kolonihavnen
Iggia
0,43
0,00
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90

Paracetamol	Denmark		Finland		Norway		Sweden		Faroe Islands		Greenland		Iceland	
Matrix	Min max AD	Nr.S (ref)	Min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota (µg/kg ww)					nd	3 (c)	nd	21 (ef)						
Sediment (µg/kg dw)					nd	6(c)	18 69 48,25	4 (f)	nd	3 (h)	nd	2 (h)		
STP sludge (µg/kg dw)	nd 2000 1345	10 (a)			nd	11(cd)	nd 73 33	5 (f)	nd 22,4 22,4	3 (h)	85,2 447 266	2 (h)	nd	3 (h)
STP effluent (µg/l)	nd 280 59,66	16 (ab)			nd 6,01 2,33	16(cd)	nd 29 3,03	17 (ef)	20,5 20,5 20,5	1 (h)	8 8 8	1 (h)	3,66 10,53 7,65	5 (h)
Surface water (µg/l)	nd	16 (a)			nd	12(c)	nd 0,36 0,1	23 (ef)	nd 0,93 0,52	5 (h)	nd 0,7 0,4	5 (h)		
Ground water	nd	3 (a)												
Drinking water(µg/l)							nd 0,015 0,013	6 (e)						
STP Influent (µg/l)	140 1200 407,8	9 (a)					nd 540 150,6	16 (ef)	26 50,6 38,3	2 (h)			nd 11,2 5,3	5 (h)
Pig slurry (µg/l)	nd 0,14 0,14	4 (a)												
Warning system for pesticide leaching to groundwater	nd	8 (a)												
Drain water (µg/l)	0,56 0,56 0,56	1 (a)												
settleable particulate material (ng/g dw)			nd 69,6 34,8	11 (g)										
Hospital WW (µg/l)									40,3 71,5 55,9	2 (h)	20,6 25,8 23,2	1 (h)		

References:

a) (Mogensen, et al., 2008)
b) (Kjølholt, et al., 2003)
c) (Schlabach, et al., 2009)
d) (Thomas, et al., 2007)
e) (Fick, et al., 2011)
f) (Remberger, et al., 2009)

g) (Lahti & Oikari, 2011)
h) (Huber, et al., NA)

Conclusion:
The compound has been monitored in one study in Finland, two in Denmark, Norway and Swede, and one international study covering Faroe Islands, Greenland and Iceland. The compound has been detected in several matrices:

- Sediment in Sweden, but not in Norway, Faroe Islands and Greenland
- Surface water in Sweden, Faroe Islands, and Greenland, not Norway and Denmark
- STP sludge in Denmark, Sweden, Faroe Islands and Greenland, not in Norway and Iceland. The values detected in Denmark were significantly higher than in the other countries
- STP effluent water, in Denmark, Norway, Sweden, Faroe Islands and Iceland. However the values detected in Denmark were much higher than in the other countries
- Drinking water in Sweden
- STP influent water in Denmark, Sweden, Faroe Islands and Iceland, in higher concentrations in Denmark
- Hospital waste water in Faroe Islands and Greenland
- Pig slurry in Denmark

2.3 Compounds monitored in at least two studies

2.3.1 Fentanyl

CAS nr.: 437-38-7
Info: Potent synthetic narcotic analgesic
Toxicity data: NA
PNEC = NA

Fentanil	**Sweden**	
Matrix	Min max AD	Nr.S (ref)
Biota (µg/kg ww)	nd	24 (ab)
Sediment	nd	9 (a)
STP effluent (µg/l)	nd 3,7 2,4	13 (b)
STP sludge (µg/kg dw)	nd 0,79 0,75	40 (ab)
Surface water (µg/l)	nd 0,004 0,002	33 (ab)
STP Influent (µg/l)	nd 0,008 0,002	67 (ab)
Drinking water	nd	6 (b)
Hospital WW	nd	2 (a)

References:
a) (Woldegiorgis, et al., 2007b)
b) (Fick, et al., 2011)

Conclusion:
The compound has only been monitored in Sweden and was detected in surface water, STP sludge, influent and effluent.

2.4 Compounds monitored in one study

	Dextropropoxyphen (469-62-5)	
Matrix	Min max AD	Nr.S
Biota (ng/g ww)	nd	9
Sediment (ng/g dw)	nd	9
STP sludge (ng/g dw)	nd 1 1	35
STP effluent and influent (ng/l)	nd	49
Surface water (ng/l)	nd	19
Landfill leachates (ng/l)	nd	5
Hospital WW (ng/l)	nd	2

Reference:

- (Woldegiorgis, et al., 2007b)

	Buprenorphine (52485-79-7)	Codeine (76-57-3)	Tramadol (46941-76-8/ 27203-92-5)	
Matrix	Min max AD	Min max AD	Min max AD	Nr.S
Biota (µg/kg)	nd 17 17	nd 0,84 0,84	nd	15
Sludge (µg/kg dw)	21 140 63,4	9,5 29 17,7	nd 68 62,5	5
Effluent (ng/l)	10 64 27,1	78 780 358	300 3000 1687	13
Surface water (ng/l)	nd 33 25,7	nd 340 59,9	nd 1800 376	15
STP influent (ng/l)	31 1000 239	390 4200 1242	770 6100 1972	12
Drinking water (ng/l)	nd 16 16	nd	nd	6

Reference:

- (Fick, et al., 2011)

	Morphine (57-27-2)	
Matrix	Min max AD	Nr.S
Biota	nd	3
Sediment	nd	6
STP sludge (ng/g dw)	nd	4
STP effluent (ng/l)	nd 980 604,7	10
Surface water (ng/l)	nd 21,7 13,8	12

Reference:

- (Schlabach, et al., 2009)

3. Antibiotics, antiseptics, germicides and anti-fungals

3.1 Scope and definition

Antibiotics are defined as the subgroup of anti-infectives that are derived from bacterial sources and are used to treat bacterial infections. Other classes of drugs, most notably the sulfonamides, are an effective antibacterial that will also be included as antibiotic. (Internal and external use).

Antiseptics and germicides are chemical agents that destroy microorganisms that cause disease. Antiseptics are applied to the skin or mucus membranes to cleanse wounds and prevent infections. (External use).

A microorganism or microbe is a microscopic organism that comprises either a single cell (unicellular), cell clusters, or no cell at all (acellular).

Antifungal is a drug used to treat fungal infections (external and internal use). Anti-fungals used in human or veterinary treatment are included in this study. Fungicides for other agricultural uses are not included.

Fungus is defined as a single-celled or multicellular organism. Fungi can be true pathogens (such as histoplasmosis and coccidioidomycosis) that cause infections in healthy persons or they can be opportunistic pathogens (such as aspergillosis, candidiasis, and cryptococcosis) that cause infections in immune-compromised persons.

The PPCP category "Antibiotics, antiseptics, germicides and anti-fungals" does not include: disinfectants, detergents that may have antimicrobial effects, other anti-parasitics (e.g. intestinal or heart worm infection, malaria, etc.) and pesticides.

Disinfectant is defined as an agent freeing from infection or infection-producing organisms and applied to inanimate objects, as they are typically too strong to be used on living tissues.

The environmental risks related to the emission of these compounds in the environment is expected to vary from one compound to another, as their ability to persist, bioaccumute and their intrinsic toxicity will be different from one compound to the other. However, the primary risk related to the increased use and thereby emission of these compounds and in particular antibiotics, is the risk of developing antibiotic resistant bacteria in the environment. Resistance can be disseminated to pathogenic bacteria, which is an important threat to public health. In addition, changing the natural composition of micro-organisms in the environment may also have effects on the whole ecosystem.

Table 2 presents the antibiotics, antiseptic, germicides and anti-fungal identified in monitoring studies in the Nordic countries.

Table2: Antibiotics, antiseptic, germicides and anti-fungal identified in monitoring studies in the Nordic countries

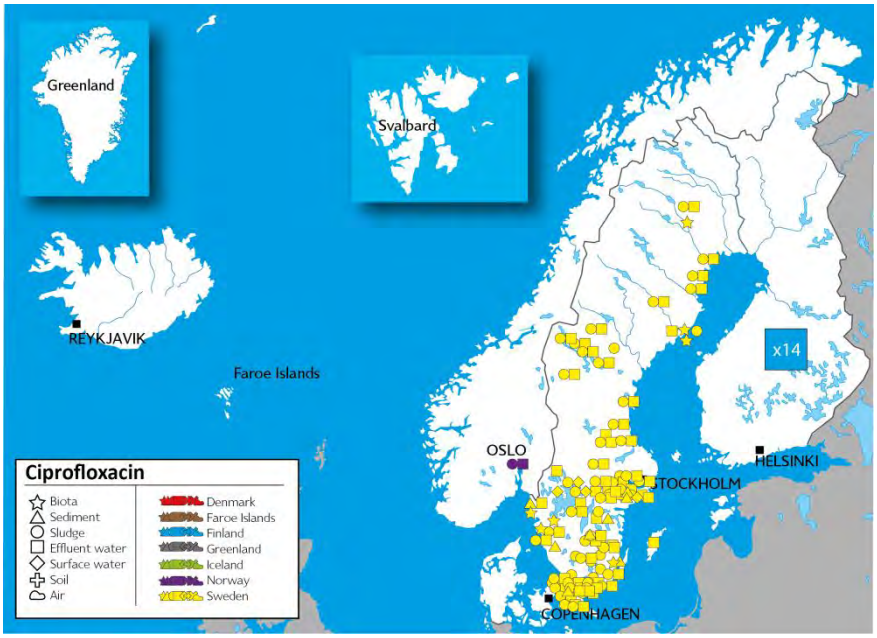
Compounds monitored	CAS nr
1,2,3,4-Tetrachlorobenzene (antimicrobial and antifungal activity)	634-66-2
1,2,3,5-Tetrachlorobenzene (antimicrobial and antifungal activity)	634-90-2
1,2,4,5-Tetrachlorobenzene (antimicrobial and antifungal activity)	95-94-3
1,2,3-Trichlorobenzene (antimicrobial and antifungal activity)	87-61-6
1,2,4-Trichlorobenzene (antimicrobial and antifungal activity)	120-82-1
1,3,5-Trichlorobenzene (antimicrobial and antifungal activity)	108-70-3
2(Tiocyanomethylthio)benzothiazole (biocide)	21564-17-0
4-Chloro-3-cresol (antiseptic, desinfectans, and fungicide)	59-50-7
4-chloro-3-methylphenol (antiseptic)	59-50-7
Amoxicillin (antibiotic)	26787-78-0
Ampicillin (antibiotic)	69-53-4
ATAC-C16 : Cetrimonium salts (antispetic)	112-02-7/57-09-0
Azithromycin (antibiotic)	83905-01-5
Benzyl penicillin (antibiotic)	61-33-6
Bronopol (antimicrobial, preservative)	52-51-7
Cefadroxil (antibiotic)	66592-87-8
Cefalotin(antibiotic)	153-61-7
Cefotaxime (antibiotic)	63527-52-6
Cefuroxime	55268-75-2
Chlorhexidine (antiseptic)	55-56-1
Chlorocycline	82-93-9
Chlortetracycline (antibiotic)	57-62-5
Ciprofloxacin (antibiotic)	85721-33-1
Clarithromycin (antibiotic)	81103-11-9
Clindamycin (antibiotic)	18323-44-9
Danofloxacin (antibiotic)	112398-08-0
DDMAC	7173-51-5
Demeclocycline (antibiotic)	127-33-3
Difloxacillin (antibiotic)	3116-76-5
Dihydrostreptomycin (antibiotic)	128-46-1
Doxycycline (antibiotic)	564-25-0
Enrofloxacin (antibiotic)	93106-60-6
Erythromycin (antibiotic)	114-07-8
Florfenicol (antibiotic)	73231-34-2
Fluconazole (Antifungal drug)	86386-73-4
Flumequine (antibiotic)	42835-25-6
Gentamycin (antibiotic)	1403-66-3
Ketoconazol (antifungal)	65277-42-1
Linezolid (antibacterial agent)	165800-03-3
Marbofloxacin (antibiotic)	115550-35-1
Meclocycline (antibiotic)	2013-58-3
Meropenem (antibiotic)	119478-56-7
Metronidazol (antibiotic)	443-48-1
Miconazol (antifungal agent)	22916-47-8
Norfloxacin (antibiotic)	70458-96-7
Ofloxacin (antibiotic)	82419-36-1
Oxolinic acid (antibiotic)	14698-29-4
Oxytetracycline (antibiotic)	79-57-2
Penicillin V	87-08-1
Phenoxymethylpenicillin (antibiotic)	87-08-1
Pivmecillinam (antibiotic)	33817-20-8
Propiconazole (fungicide)	60207-90-1
Resorcinol (antiseptic and disinfectant)	108-46-3
Roxithromycin (antibiotic)	80214-83-1
Sarafloxacin (antibiotic)	98105-99-8
Silver (germicide)	
Spiramycin (antibiotic)	8025-81-8
Sulfabenzamide (antibacterial/antimicrobial)	127-71-9
Sulfacetamide (antibiotic)	144-80-9
Sulfachloropyridazine (Antibacterial)	80-32-0
Sulfaclozin (antibiotic)	102-65-8
Sulfadiazine (antibiotic)	68-35-9

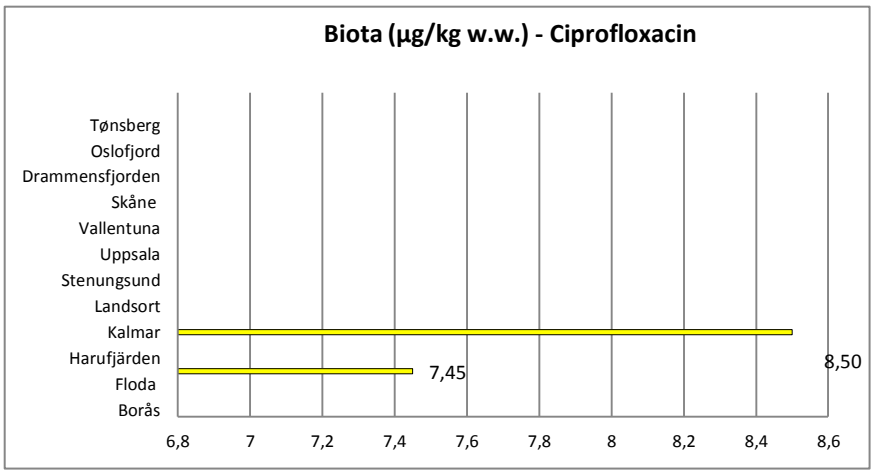
Compounds monitored	CAS nr
Sulfadimethoxine (antibiotic)	122-11-2
Sulfadimidine(antibiotic)	57-68-1
Sulfadoxine (Anti-Infective Agents also used in Antimalarials)	2447-57-6
Sulfaguanidine(antibiotic)	57-67-0
Sulfamerazine (sulfonamide anitbacterial)	127-79-7
Sulfameter (sulfonamide antibacerial)	651-06-9
Sulfamethizol (antibiotic)	144-82-1
Sulfamethoxazole (antibiotic)	723-46-6
Sulfamethoxypyridazine (sulfonamide antibacterial)	000080-35-3
Sulfamonomethoxine (antibiotic)	1220-83-3
Sulfamoxole (sulfonamide antibacterial)	729-99-7
Sulfanilamide (sulfonamide antibacterial)	63-74-1
Sulfapyridine (sulfonamide antibacterial)	000144-83-2
Sulfaquinoxaline (Coccidia treatment, intestinal unicellular parasite)	59-40-5
Sulfathiazol (antimicrobial)	72-14-0
Sulfatroxazole (sulfonamide antibacterial)	23256-23-7
Sulphafurazole (antibiotic)	127-69-5
Tetracycline (antibiotic)	60-54-8
Tiamulin (antibiotic)	55297-95-5
Triclosan	3380-34-5
Trimethoprim (antibiotic)	738-70-5
Tylosin ((antibiotic)	1401-69-0
Zinc pyrithione (ZPT) (antimicrobial to fungi and bacteria, used in particular to combat dandruf fungi)	13463-41-7

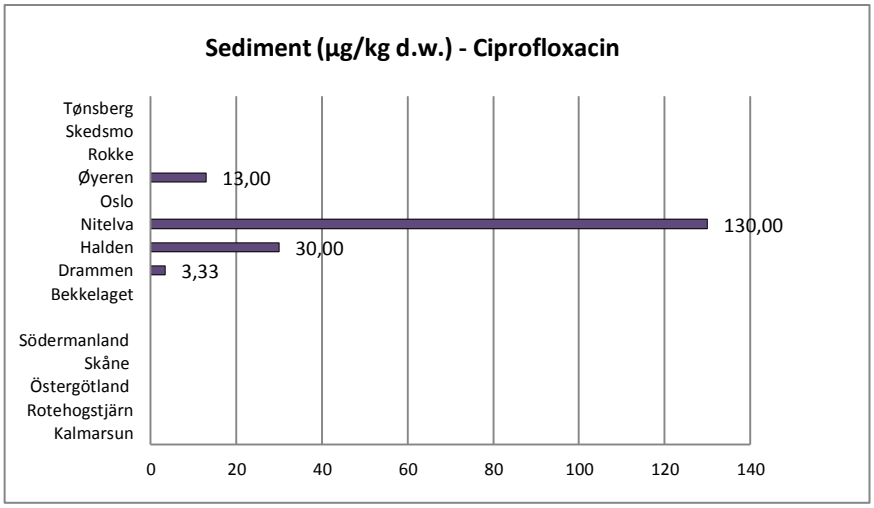
3.2 Compounds mapped

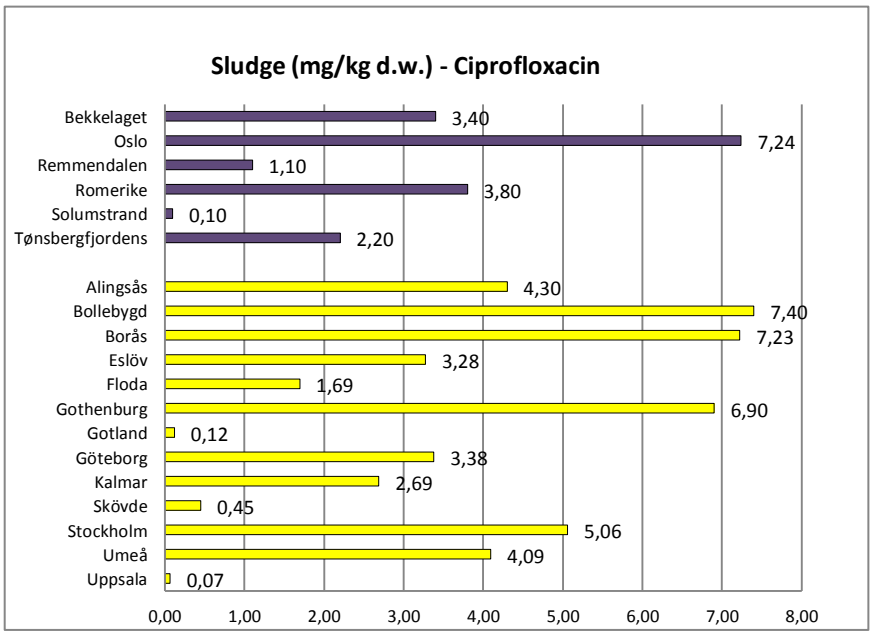
3.2.1 Ciprofloxacin

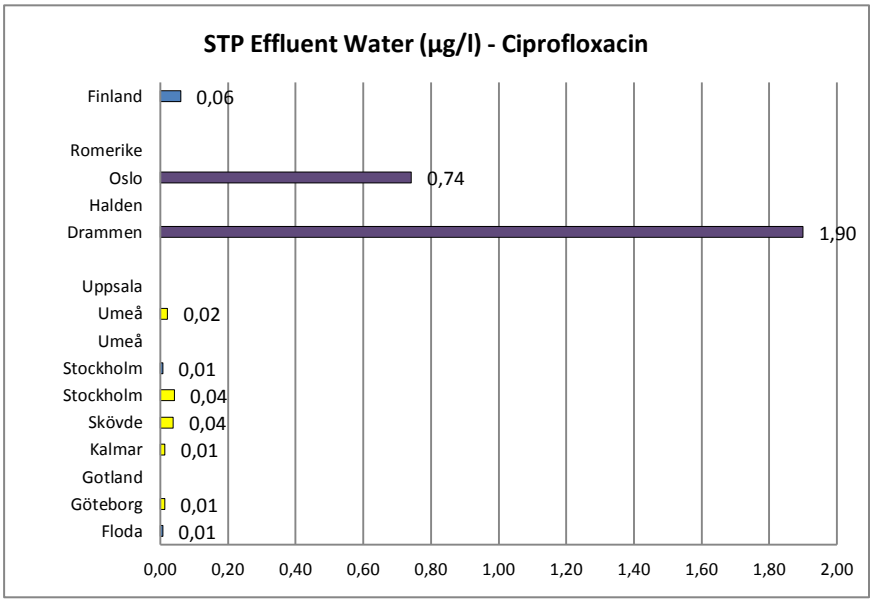
CAS nr.: 85721-33-1
Info: Synthetic chemotherapeutic antibiotic of the fluoroquinolone drug class
Toxicity data: NA
PNEC = NA

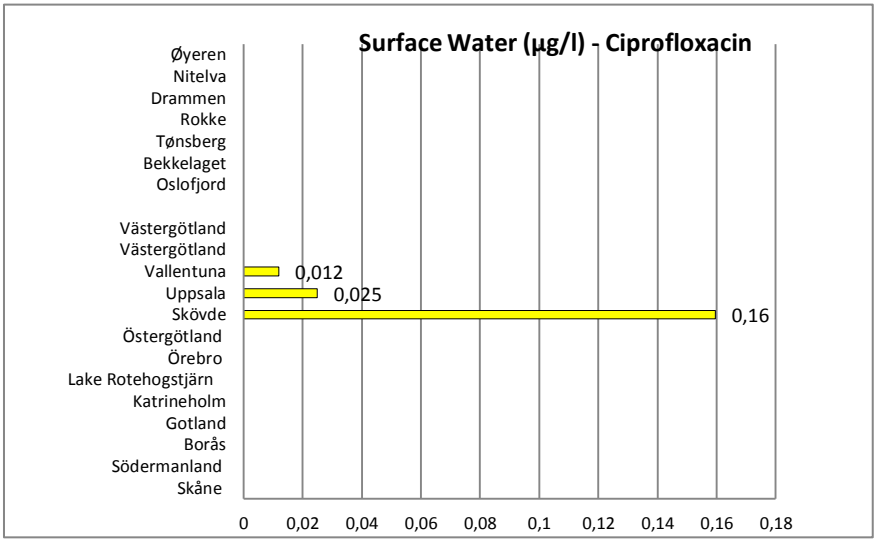



Biota (µg/kg w.w.) - Ciprofloxacin
Tønsberg
Oslofjord
Drammensfjorden
Skåne
Vallentuna
Uppsala
Stenungsund
Landsort
Kalmar
Harufjärden
Floda
Borås
7,45
8,50
6,8
7
7,2
7,4
7,6
7,8
8
8,2
8,4
8,6


Sediment (µg/kg d.w.) - Ciprofloxacin
Tønsberg
Skedsmo
Rokke
Øyeren
Oslo
Nitelva
Halden
Drammen
Bekkelaget
Södermanland
Skåne
Östergötland
Rotehogstjärn
Kalmarsun
13,00
130,00
30,00
3,33
0
20
40
60
80
100
120
140


Sludge (mg/kg d.w.) - Ciprofloxacin
Bekkelaget
Oslo
Remmendalen
Romerike
Solumstrand
Tønsbergfjordens
Alingsås
Bollebygd
Borås
Eslöv
Floda
Gothenburg
Gotland
Göteborg
Kalmar
Skövde
Stockholm
Umeå
Uppsala
3,40
7,24
1,10
3,80
0,10
2,20
4,30
7,40
7,23
3,28
1,69
6,90
0,12
3,38
2,69
0,45
5,06
4,09
0,07
0,00
1,00
2,00
3,00
4,00
5,00
6,00
7,00
8,00





Ciprofloxacin	Finland		Norway		Sweden	
Matrix	Min max AD	Nr.S (ref)	Min max AD	Nr.S (ref)	Min max AD	Nr.S (ref)
Biota (µg/kg ww)			nd	5 (b)	nd 8,5 7,97	15 (de)
Sediment (µg/kg dw)			nd 130 44,1	9 (b)	nd	5 (df)
STP effluent (µg/l)	NA NA 0,06	14 (a)	nd 1,9 1,32	4 (bc)	nd 0,041 0,02	10 (de)

Ciprofloxacin	Finland		Norway		Sweden	
STP sludge (mg/kg dw)			0,10 7,24 2,97	13 (bc)	0,07 7,40 3,6	41 (degh)
Surface water(µg/l)			nd	7 (b)	nd 0,16 0,066	13 (de)
Groundwater					nd	2 (f)
Manure					nd	6 (f)
Soil from farms					nd	6 (f)
STP Influent (µg/l)	NA NA 0,6	14 (a)	nd 5,4 2,92	8 (b)	0,09 0,194 0,133	5 (d)
Hospital WW (µg/l)					2,4 101 NA	2 (de)
Drinking water					Nd	6 (de)
Untreated landfill leachates µg/l			nd 0,69 0,69	4 (b)		
Treated landfill leachates (µg/l)			nd	5 (b)		
Landfill leachate sediment (µg/kg dw)			nd	4 (b)		

References:

a) (Vieno, 2008)
b) (Møskeland, et al., 2006)
c) (Thomas, et al., 2007)
d) (Johansson, et al., 2003)
e) (Fick, et al., 2011)
f) (Sternbeck, et al., 2007a)
g) (Haglund & Olofsson, 2006)
h) (Haglund & Olofsson, 2007)

Conclusion:

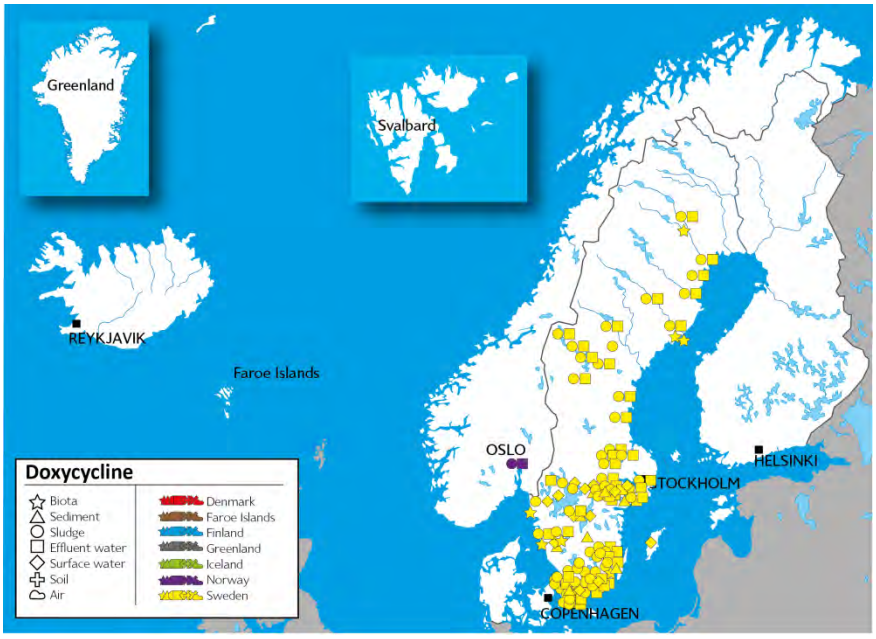
The compound was monitored in 14 STPs in Finland, two studies in the South East of Norway and five studies throughout Sweden. The compound was detected in several matrices:

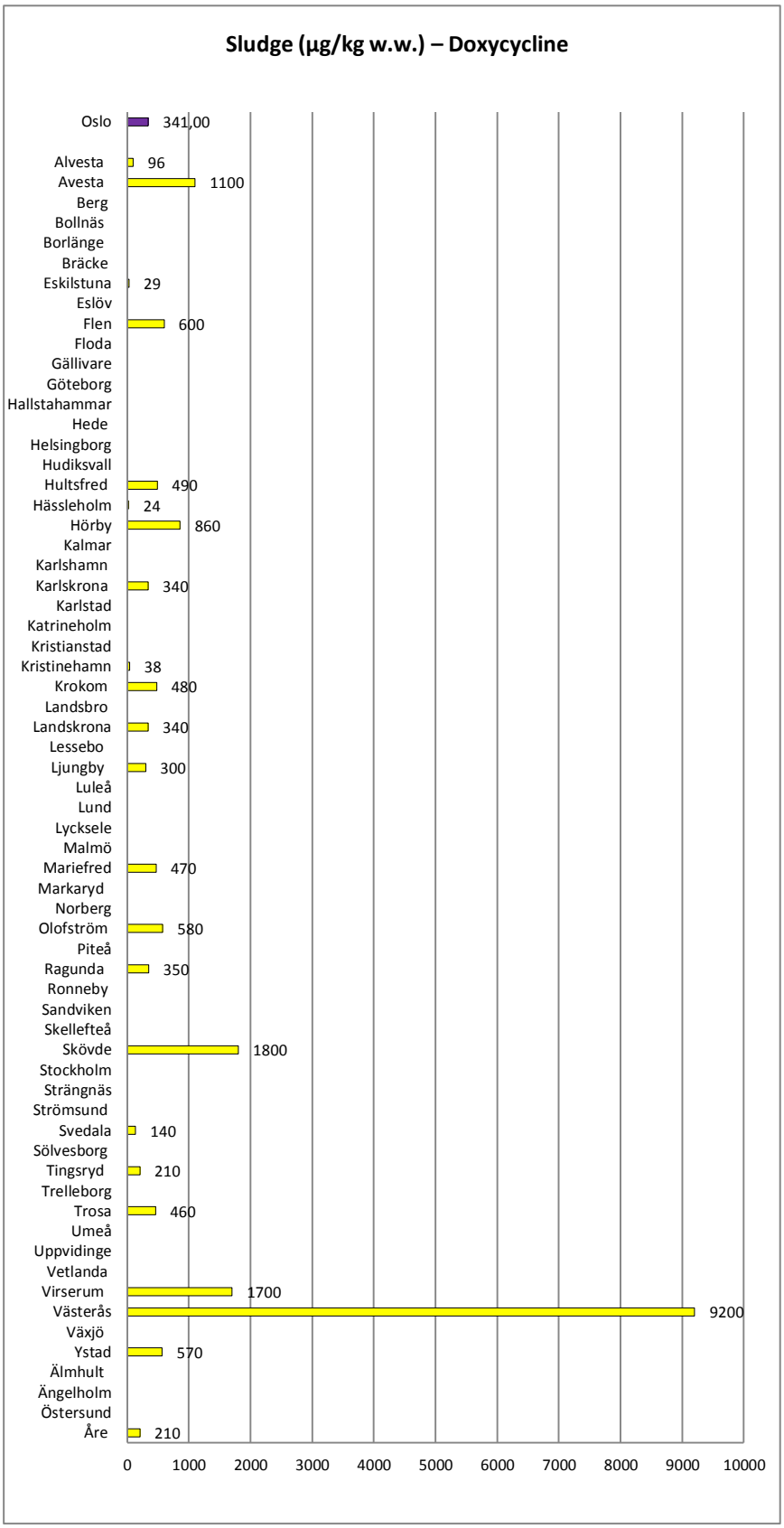
- Biota in two locations in Sweden, not in Norway
- Sediment in approx. 50% of all samples in Norway, not in Sweden
- STP effluent water in all three countries, however the values detected in Norway were approx. 20 times higher than those observed in Finland and Sweden
- STP sludge in all samples in Sweden and Norway. There were important variations in the values detected within each country

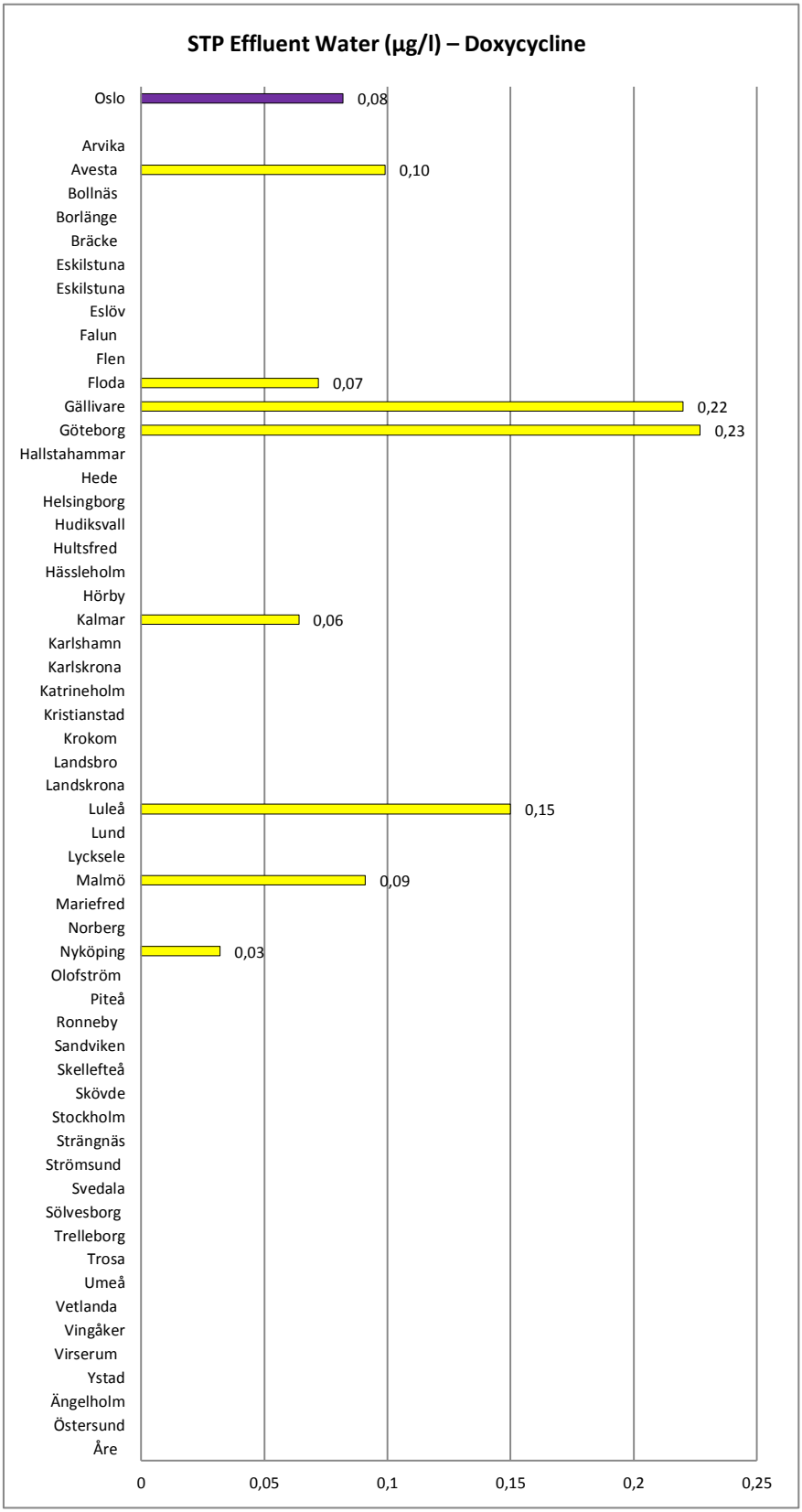
- Surface water in three locations in Sweden, the concentration was about ten times higher in one location. The compound was not detected in surface water in Norway
- In one untreated landfill leachate sample in Norway
- STP influent in all three countries
- Hospital waste water in Sweden

3.2.2 Doxycycline

CAS nr.: 564-25-0
Info: Tetracycline antibiotic
Toxicity data:
LOEC 7 days (Lemna gibba), growth = 300 µg/l
LC50 14 days (Eisenia fotida) >1000 mg/l
LC50 48 hr (Microcystis aeruginosa) = 0,0037 mg/l
LC50 48 hr (Daphnia magna)= 156,4 mg/l
EC50 24 hr (Vibrio fischeri) =163 mg/l
(Hellström & Kreuger, 2005)
PNEC = NA




Sludge (µg/kg w.w.) – Doxycycline
Oslo
341,00
Alvesta
96
Avesta
1100
Berg
Bollnäs
Borlänge
Bräcke
Eskilstuna
29
Eslöv
Flen
600
Floda
Gällivare
Göteborg
Hallstahammar
Hede
Helsingborg
Hudiksvall
Hultsfred
490
Hässleholm
24
Hörby
860
Kalmar
Karlshamn
Karlskrona
340
Karlstad
Katrineholm
Kristianstad
Kristinehamn
38
Krokom
480
Landsbro
Landskrona
340
Lessebo
Ljungby
300
Luleå
Lund
Lycksele
Malmö
Mariefred
470
Markaryd
Norberg
Olofström
580
Piteå
Ragunda
350
Ronneby
Sandviken
Skellefteå
Skövde
1800
Stockholm
Strängnäs
Strömsund
Svedala
140
Sölvesborg
Tingsryd
210
Trelleborg
Trosa
460
Umeå
Uppvidinge
Vetlanda
Virserum
1700
Västerås
9200
Växjö
Ystad
570
Älmhult
Ängelholm
Östersund
Åre
210
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000


STP Effluent Water (µg/l) – Doxycycline
Oslo
Arvika
Avesta
Bollnäs
Borlänge
Bräcke
Eskilstuna
Eskilstuna
Eslöv
Falun
Flen
Floda
Gällivare
Göteborg
Hallstahammar
Hede
Helsingborg
Hudiksvall
Hultsfred
Hässleholm
Hörby
Kalmar
Karlshamn
Karlskrona
Katrineholm
Kristianstad
Krokom
Landsbro
Landskrona
Luleå
Lund
Lycksele
Malmö
Mariefred
Norberg
Nyköping
Olofström
Piteå
Ronneby
Sandviken
Skellefteå
Skövde
Stockholm
Strängnäs
Strömsund
Svedala
Sölvesborg
Trelleborg
Trosa
Umeå
Vetlanda
Vingåker
Virserum
Ystad
Ängelholm
Östersund
Åre
0,08
0,10
0,07
0,22
0,23
0,06
0,15
0,09
0,03
0
0,05
0,1
0,15
0,2
0,25

Doxycycline	Norway		Sweden	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota			nd	12[3] (bc)
Sediment			nd	27[4] (bcd)
STP sludge (µg/kg dw)	nd 1293 341,2	7 (a)	nd 9200 901,5	65 (bc)
STP effluent water (µg/l)	nd 0,08 0,08	7 (a)	nd 0,23 0,12	57 (bc)
Surface water			nd	45[5] (cd)
Soil			nd	6 (d)
Groundwater			nd	2 (d)
Manure			nd	11 (cd)
Hospital WW (µg/l)			nd 6,7 2,07	8 (bc)
STP influent (µg/l)			nd 2,3 0,46	24 (bc)
Landfill leachates (µg/l)			nd 0,091 0,091	10[6] (c)

References:

a) (Thomas, et al., 2007)
b) (Johansson, et al., 2003)
c) (Andersson, et al., 2006)
d) (Sternbeck, et al., 2007a)

Conclusion:

The compound was monitored in Norway in the Oslo region and in three studies throughout Sweden. The compound was detected in several matrices:

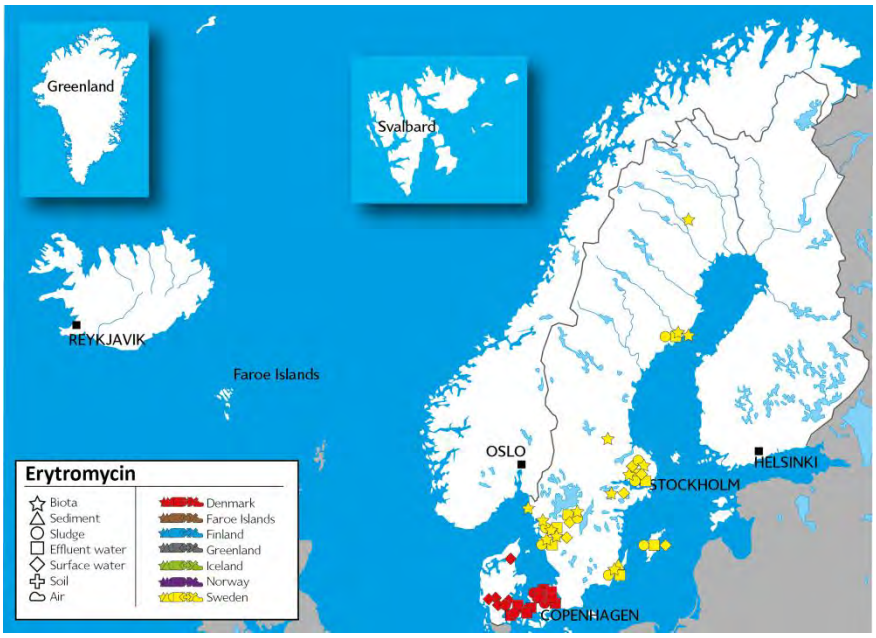
- STP sludge in high values in both countries. The concentration detected in one location in Sweden was very high
- STP effluent in one sample in Norway and in a few samples in Sweden

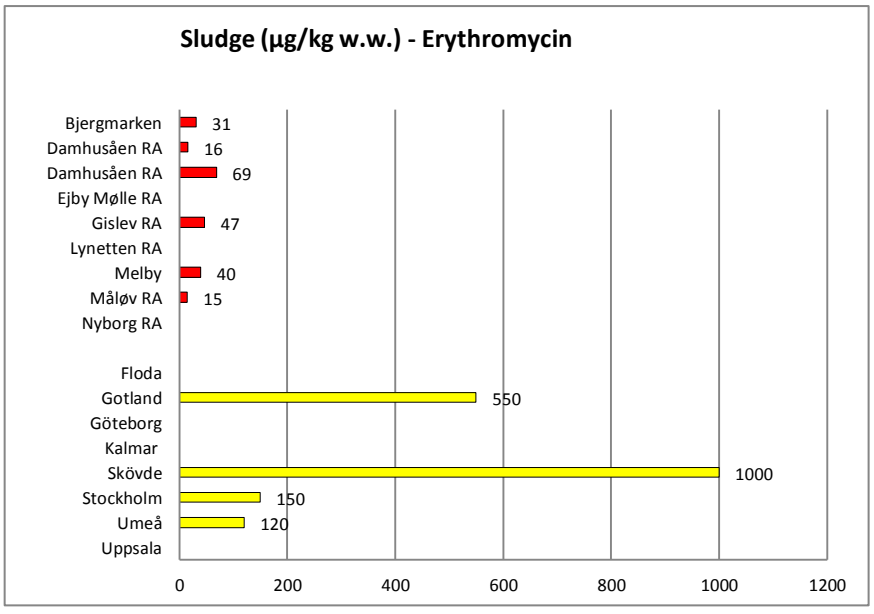
[3] Fish for human consumption
[4] Includes 4 samples from farms.
[5] Includes 7 samples at proximity of farms.
[6] Includes 1 treated sample

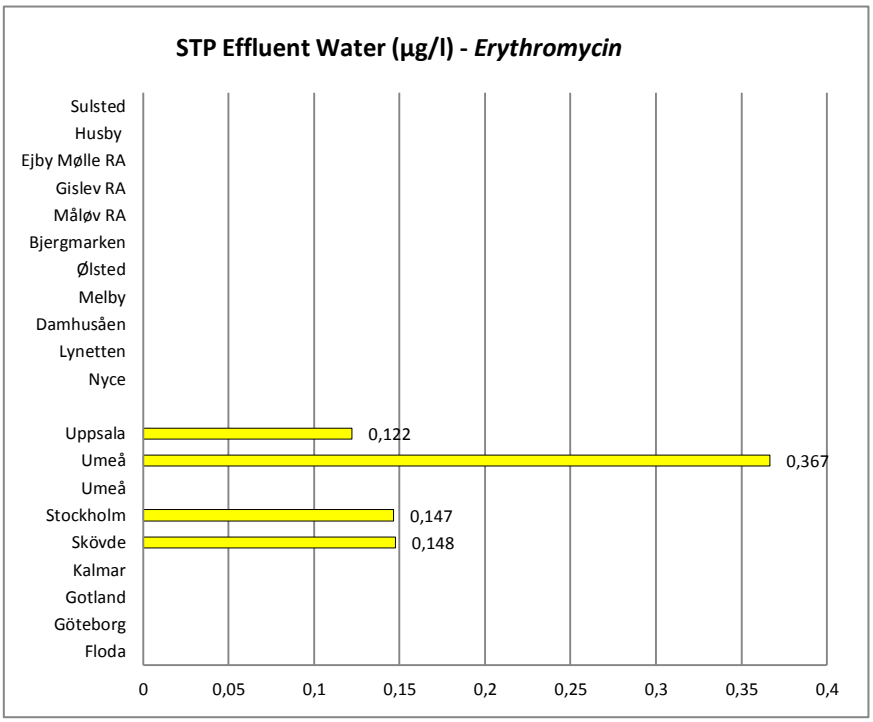
- In one landfill leachate sample in Sweden
- Hospital waste water in Sweden
- STP influent in Sweden

3.2.3 Erythromycin

CAS nr.: 114-07-8
Info: macrolide antibiotic
Toxicity data: NA
PNEC = 0,02 µg/l (Pedersen, et al., 2007)







Erythromycin	Denmark		Sweden	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota			nd	24 (bc)
STP sludge (µg/kg dw)	nd 69 36,3	10 (a)	nd 1000 455	10 (bc)
STP effluent (µg/l)	nd	9 (a)	nd 0,53 0,19	18 (bc)
Surface water (µg/l)	nd	16[7] (a)	nd 0,065 0,059	15 (b)
Sediment			nd	1 (b)
Drinking water			nd	6 (c)
STP influent (µg/l)	nd	9 (a)	nd 2,1 0,46	17 (bc)

[7] Upstream and downstream of fish farms

Erythromycin	Denmark		Sweden	
Hospital WW			nd	2 (b)
Warning system for pesticide leaching to groundwater	nd	8 (a)		
Drain water	nd	1 (a)		
Groundwater	nd	3[8] (a)		

References:

a) (Mogensen, et al., 2008)
b) (Johansson, et al., 2003)
c) (Fick, et al., 2011)

Conclusion:

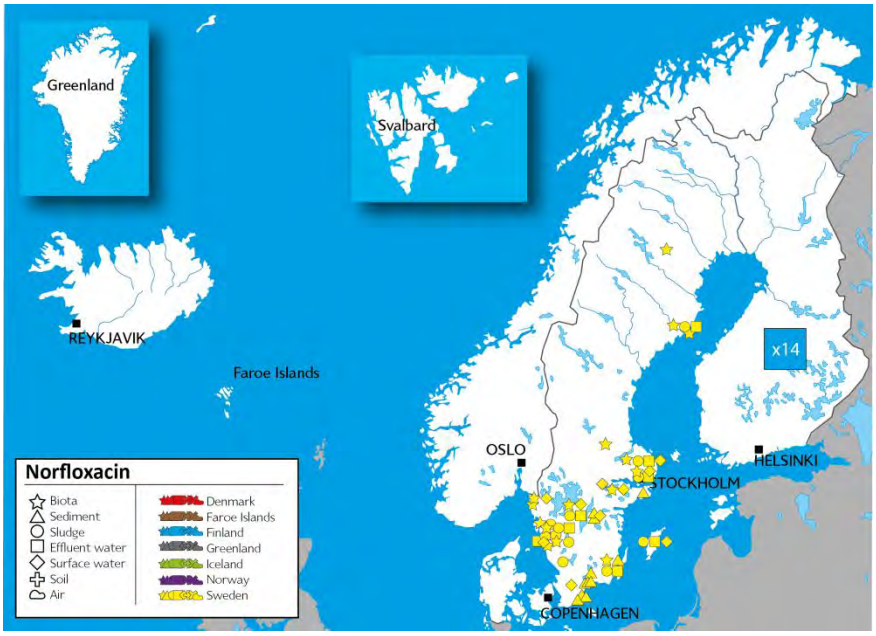
The compound was monitored in one study throughout Denmark and two studies throughout Sweden. It was detected in several matrices:

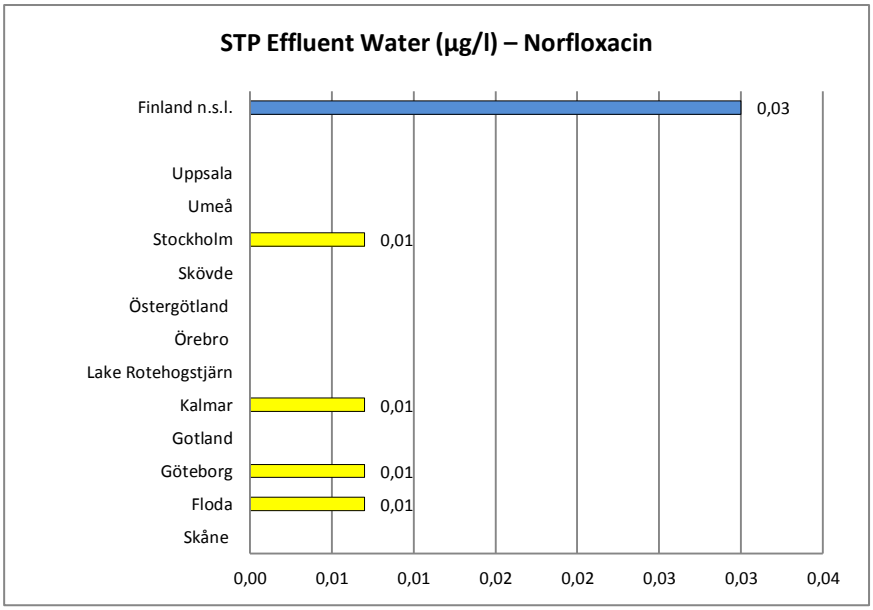
- STP sludge in both countries. The values detected in Sweden were higher (at least twice as high)
- STP effluent water in Sweden but not in Denmark. The compound was detected in approx. 50% of all locations monitored and in concentrations above the PNEC
- Surface water in Sweden but not in Denmark. The average detected value was above the PNEC
- STP influent water in Sweden but not in Denmark

[8] Including 2 measurements in groundwater at proximity of a hospital

3.2.4 Norfloxacin

CAS nr.: 70458-96-7
Info: synthetic chemotherapeutic antibacterial agent
Toxicity data: NA
PNEC = NA





Norfloxacin	Finland		Sweden	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota			nd	24 (bc)
STP sludge (mg/kg dw)			nd 6,1 1,93	41 (bcde)
STP effluent (µg/l)	NA 0,03 NA	14 (a)	nd 0,007 0,007	18 (bc)
Surface water			nd	45 (bf)
Sediment			nd	20 (bf)
Drinking water (µg/l)			nd 0,01 0,01	6 (b)
STP Influent (µg/l)	NA NA 0,12	14 (a)	nd 0,17 0,08	17 (bc)
Surface water			nd	43 (bf)
Hospital WW (µg/l)			nd 0,8 0,8	2 (c)
Groundwater by farms			nd	2 (f)
Manure			nd	6 (f)
Soil from farms			nd	6 (f)

References:

a) (Vieno, 2008)
b) (Fick, et al., 2011)
c) (Johansson, et al., 2003)
d) (Haglund & Olofsson, 2006)
e) (Haglund & Olofsson, 2007)
f) (Sternbeck, et al., 2007a)

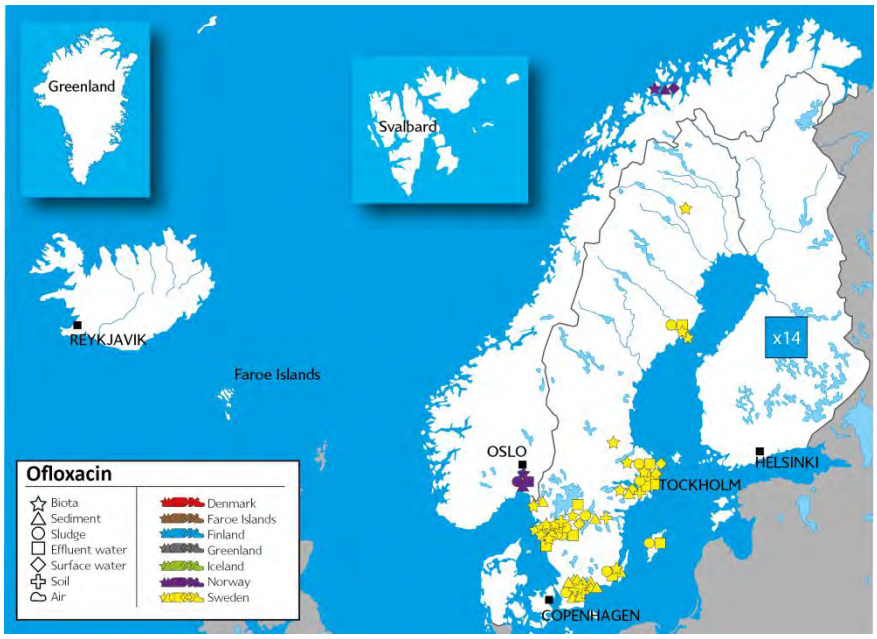
Conclusion:

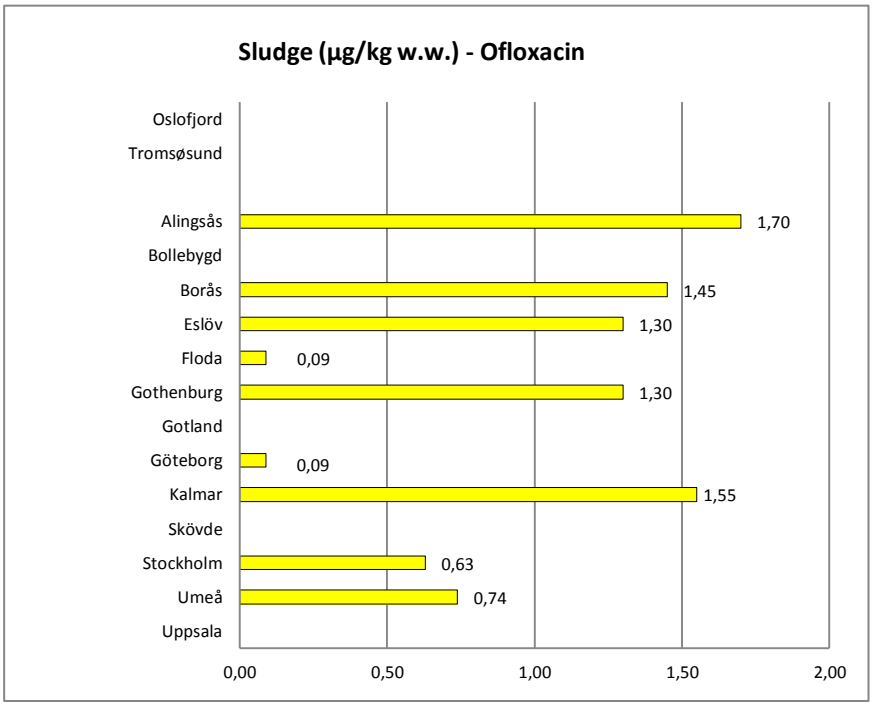
The compound was monitored in 14 STPs in Finland and five studies, mainly in the south of Sweden. It was detected in several matrices:

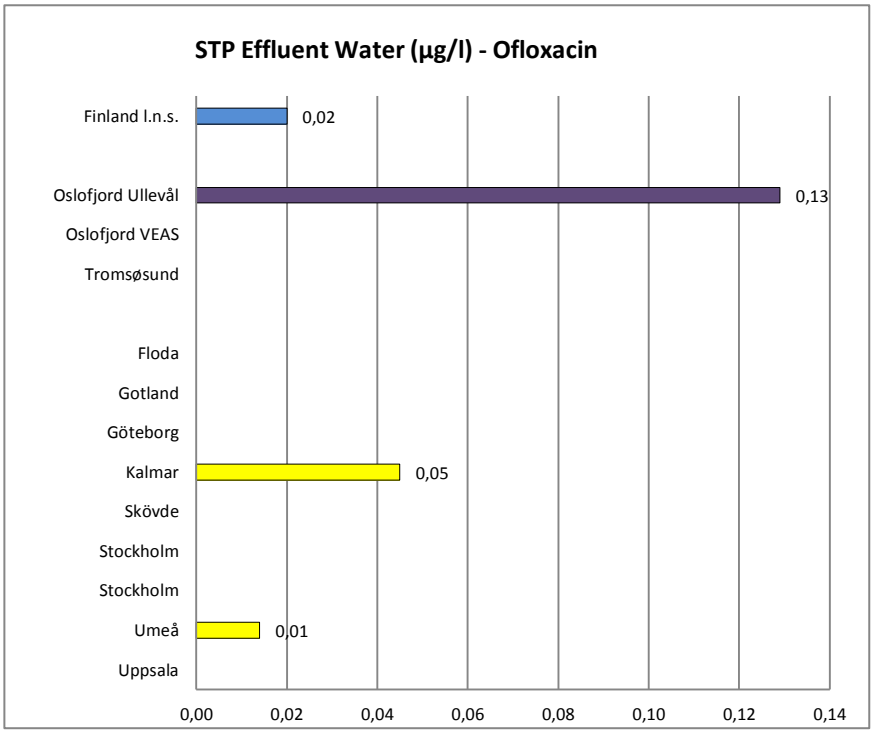
- STP sludge in Sweden
- STP effluent water in Finland and in one sample in Sweden
- In one drinking water sample in Sweden
- STP influent in both countries
- In one hospital waste water sample in Sweden

3.2.5 Ofloxacin

CAS nr.: 82419-36-1
Info: Synthetic chemotherapeutic antibiotic of the fluoroquinolone drug class
Toxicity data: NA
PNEC = NA







Ofloxacin	Finland		Norway (c)		Sweden	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota			nd	4[9]	nd	24 (de)
Sediment			nd	6	nd	20 (df)
STP sludge (µg/kg dw)			nd	4	nd 1,7 0,91	41 (degh)
STP effluent (µg/l)	NA NA 0,02	14 (a)	nd 0,13 0,13	14	nd 0,04 0,03	18 (de)
Surface water (µg/l)			nd	11	nd	45 (df)
Drinking water (µg/l)					nd 0,02 0,018	6 (d)
STP influent (µg/l)	NA NA 0,1	14 (a)			nd 0,29 0,1	17 (de)
Groundwater					nd	2 (f)

[9] Mussel

Ofloxacin	Finland		Norway (c)		Sweden	
Manure					nd	6 (f)
Soil from farms					nd	6 (f)
Hospital WW (µg/l)			nd 0,13 0,13	5	nd 7,6 3,9	2 (e)
Settleable particulate material (ng/g dw)	nd 79,2 34,6	11 (b)				

References:

a) (Vieno, 2008)
b) (Lahti & Oikari, 2011)
c) (Schlabach, et al., 2009)
d) (Fick, et al., 2011)
e) (Johansson, et al., 2003)
f) (Sternbeck, et al., 2007a)
g) (Haglund & Olofsson, 2006)
h) (Haglund & Olofsson, 2007)

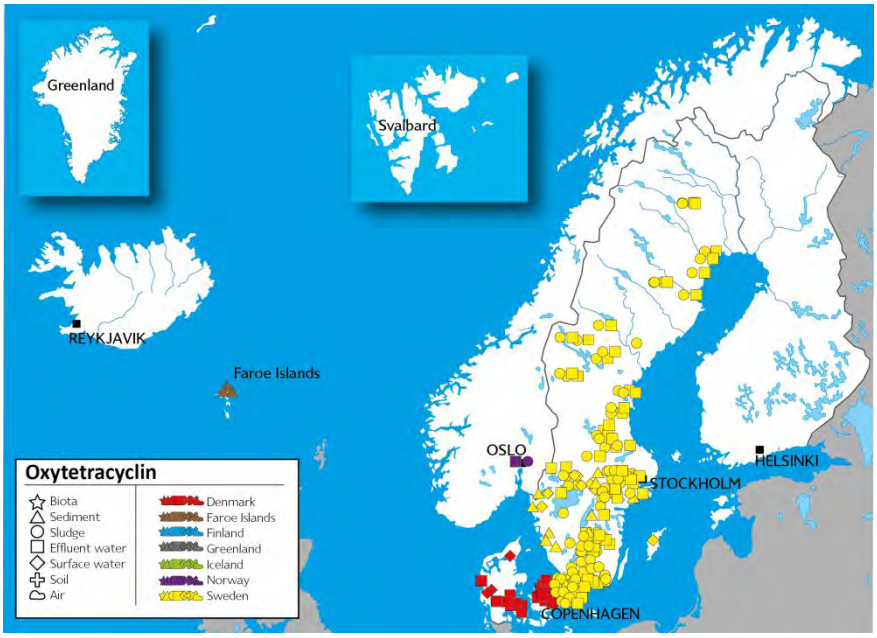
Conclusion:

The compound has been monitored in one study in Norway, two in Finland and five in Sweden. It was detected in several matrices:

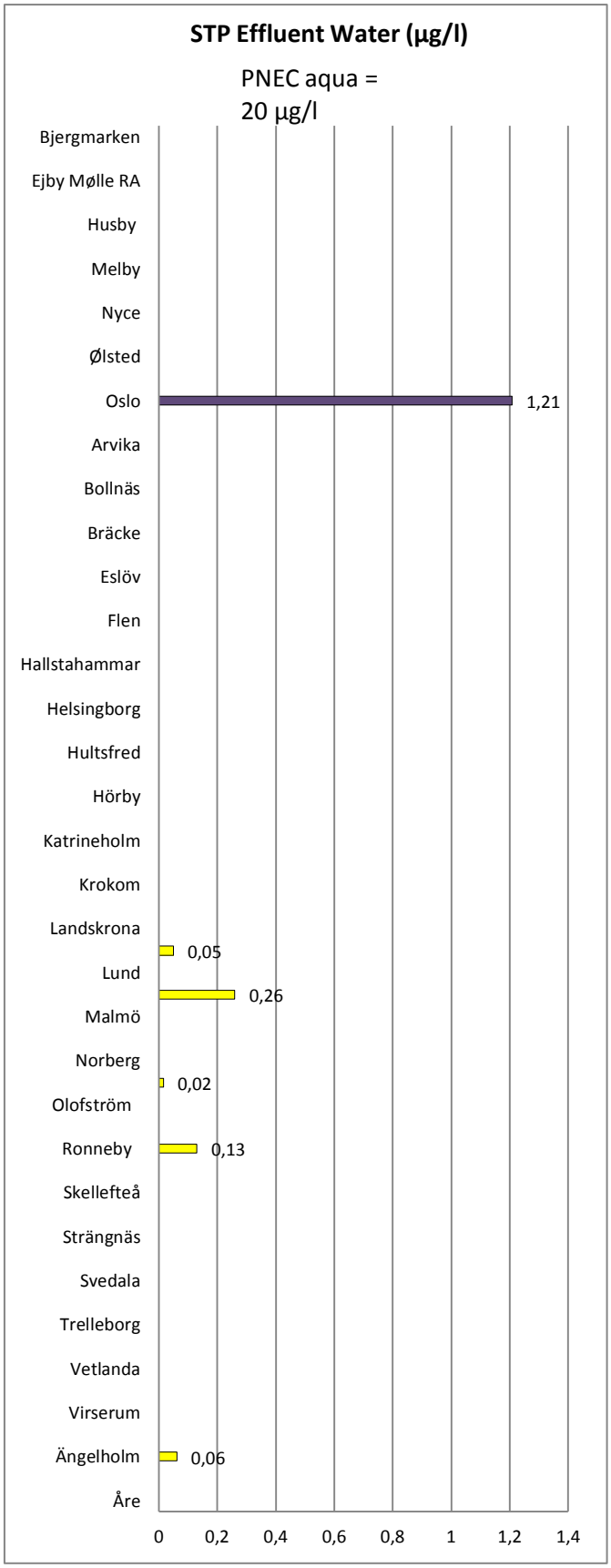
- STP sludge in Sweden but not in Norway
- STP effluent in Finland, Sweden and Norway
- Drinking water in Sweden
- Settleable particulate material in Finland
- Hospital waste water in Sweden and in one sample in Norway
- STP influent in Finland and Sweden

3.2.6 Oxytetracycline

CAS nr. 2058-46-0
Info: Broadspectrum tetracycline antibiotic
Toxicity data: NA
PNEC = 20 µg/l




Sludge (µg/kg d.w.) – Oxytetracycline
Oslo
539,86
Alvesta
Avesta
Berg
Bollnäs
Borlänge
Bräcke
Eskilstuna
Eslöv
1400,00
Flen
Gällivare
Hallstahammar
Hede
Helsingborg
920,00
Hudiksvall
Hultsfred
Hässleholm
Hörby
Karlskrona
1600,00
Karlstad
Katrineholm
Kristianstad
Kristinehamn
Krokom
Landsbro
Landskrona
Lessebo
Ljungby
Luleå
Lund
Lycksele
Malmö
Mariefred
970,00
Markaryd
Norberg
Olofström
Piteå
Ragunda
Ronneby
Sandviken
Skellefteå
Skövde
Strängnäs
Strömsund
Svedala
Sölvesborg
Tingsryd
Trelleborg
Trosa
210,00
Uppvidinge
Vetlanda
Virserum
Västerås
Växjö
Ystad
Älmhult
Ängelholm
Östersund
Åre
0
200
400
600
800
1000
1200
1400
1600
1800


STP Effluent Water (µg/l)
PNEC aqua =
20 µg/l
Bjergmarken
Ejby Mølle RA
Husby
Melby
Nyce
Ølsted
Oslo
Arvika
Bollnäs
Bräcke
Eslöv
Flen
Hallstahammar
Helsingborg
Hultsfred
Hörby
Katrineholm
Krokom
Landskrona
Lund
Malmö
Norberg
Olofström
Ronneby
Skellefteå
Strängnäs
Svedala
Trelleborg
Vetlanda
Virserum
Ängelholm
Åre
1,21
0,05
0,26
0,02
0,13
0,06
0
0,2
0,4
0,6
0,8
1
1,2
1,4

Oxytetracycline	Denmark (a)		Norway (b)		Sweden		Faroe Islands (e)		Finland (f)	
Matrix	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Biota					nd	3[10] (c)				
Surface water	nd	16[11]			nd	47[12] (cd)				
Sediment (ng/g dw)					nd	26 (cd)	0,07 0,35 0,18	12		
STP sludge (mg/kg dw)			nd 2,07 0,63	7	nd 1,6 1,02	61 (c)				
STP effluent (µg/l)	nd	9	nd 1,21 1,21	7	nd 0,26 0,10	52 (c)				
STP Influent (µg/l)	nd	9			nd 0,79 0,32	19 (c)				
Warning system for pesticide leaching to groundwater (mg/kg dw)	nd 0,51 0,51	9								
Settleable particulate material (ng/g dw)									nd 31,4 31,4	11
Pig slurry	nd	4								
Drain water	nd	1								
Groundwater	nd	3[13]			nd	2[14] (c)				
Farm soil					nd	6 (c)				
Manure					nd	11 (cd)				
Landfill leachates					nd	8 (c)				
Hospital WW					nd	7 (c)				

References:

a) (Mogensen, et al., 2008)
b) (Thomas, et al., 2007)
c) (Andersson, et al., 2006)
d) (Sternbeck, et al., 2007a)
e) (Gustavson, et al., 2009)
f) (Lahti & Oikari, 2011)

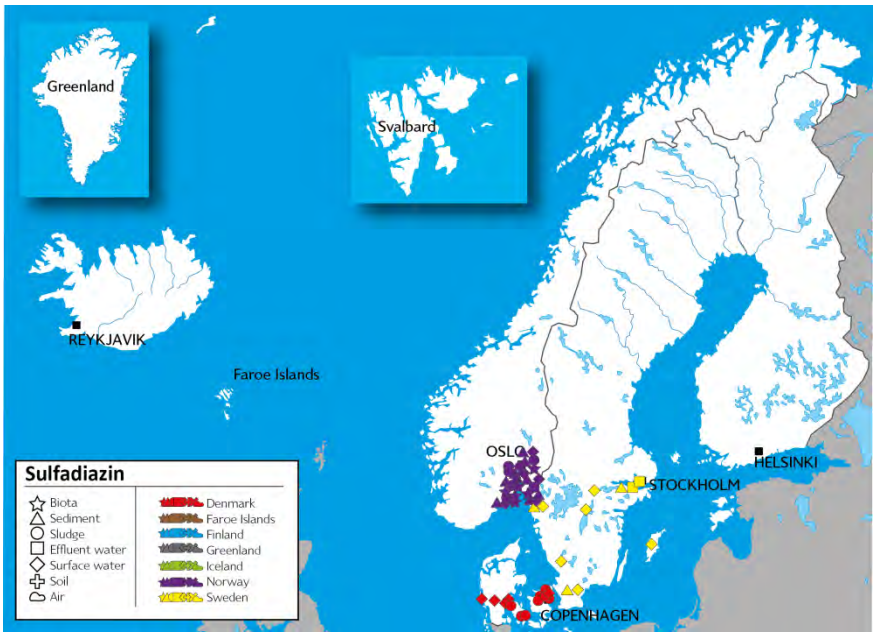
[10] Fish for human consumption
[11] Up and downstream of fish farms
[12] Includes 9 samples at proximity of farms. The compound was detected in only one sample at proximity of a cattle farm.
[13] Include 2 samples at proximity of hospitals
[14] At proximity of farms

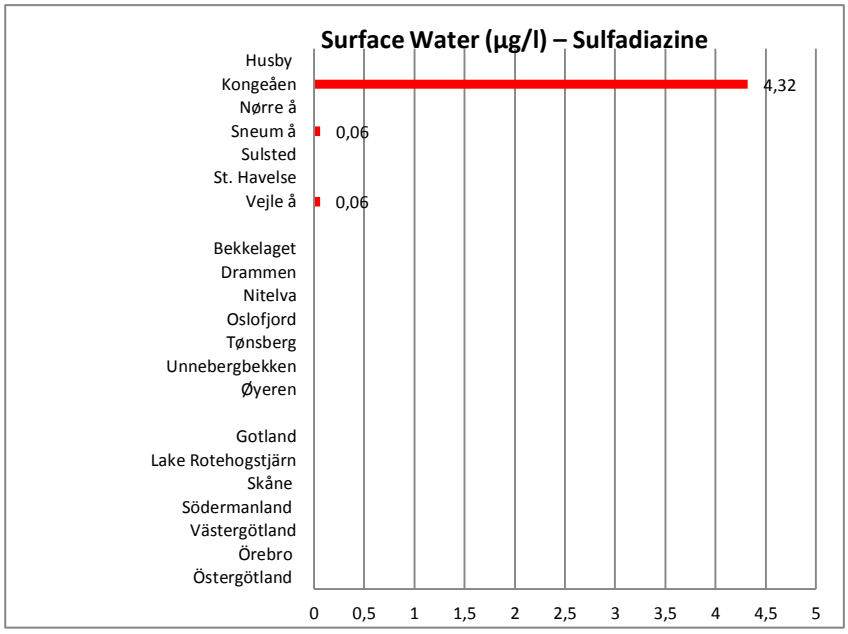
Conclusion:
The compound was monitored in two Swedish studies, and one Norwegian, one Danish, one Faroe Islands, and one Finnish study. The compound was detected in several matrices:

- STP sludge in Norway and Sweden
- STP effluent in Norway and Sweden but not Denmark. The values detected in Norway were higher than in Sweden
- STP influent in Sweden but not in Denmark
- In one sample for "pesticide leaching warning system"
- In settleable particulate material in Finland

3.2.7 Sulfadiazine

CAS nr.: 68-35-9
Info: a sulfonamide antibiotic
Toxicity data:
EC50 (M. aeruginosa)= 0,135 mg/l
EC50 (S. capricornutum)= 7,8 mg/l
EC50 (R. Salina)= 403 mg/l
EC50 72 hr (crustaceans) = 57 mg/l
(Hellström & Kreuger, 2005)
PNEC = NA





Sulfadiazine	**Denmark (a)**		**Norway (b)**		**Sweden (c)**	
Matrix	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*
Biota			nd	5		
STP sludge	nd	10	nd	6		
Surface water (µg/l)	nd 19 1,8	16[15]	nd	7	nd	30[16]
Sediment (µg/k dw)			nd 2,1 2,1	16	nd	19
Groundwater	nd	3[17]			nd	2[18]
STP Influent µg/l)	nd 0,29 0,29	29	nd	4		
STP effluent (µg/l)	nd 0,16 0,08	9	nd	2		
Pig slurry	nd	4				
Warning system for pesticide leaching to groundwater	nd	9				
Drain water	nd	1				

[15] Up and downstream of fish farms
[16] Includes 2 samples at proximity of farms
[17] includes 2 samples at proximity of hospitals
[18] At proximity of farms

Sulfadiazine	Denmark (a)	Norway (b)		Sweden (c)	
Landfill leachates, water		nd	9[19]		
Landfill leachates, sediment		nd	4		
Manure				nd	6
Farm soil				nd	6

References:

a) (Mogensen, et al., 2008)
b) (Møskeland, et al., 2006)
c) (Sternbeck, et al., 2007a)

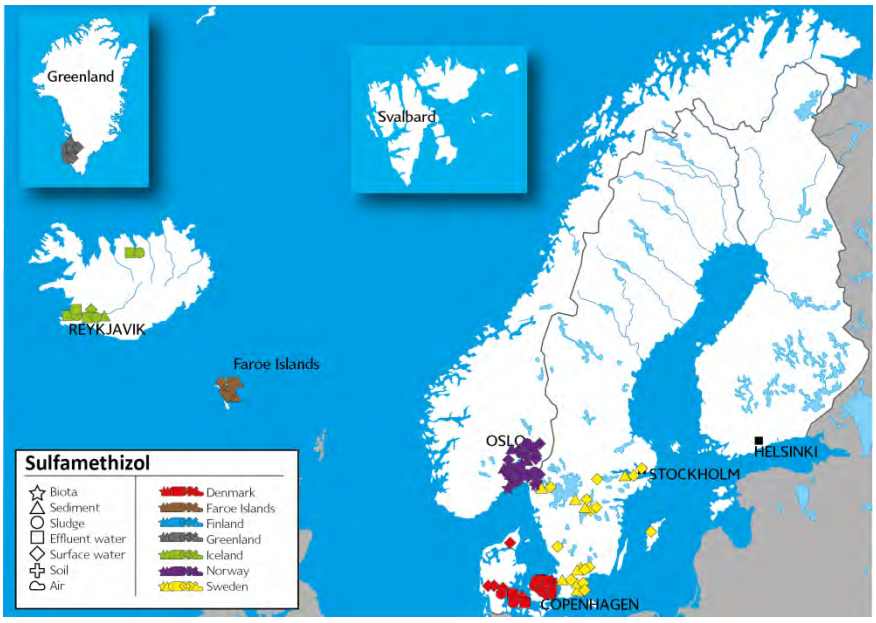
Conclusion:

The compound was monitored in one Danish, one Norwegian and one Swedish study and was detected in several matrices:

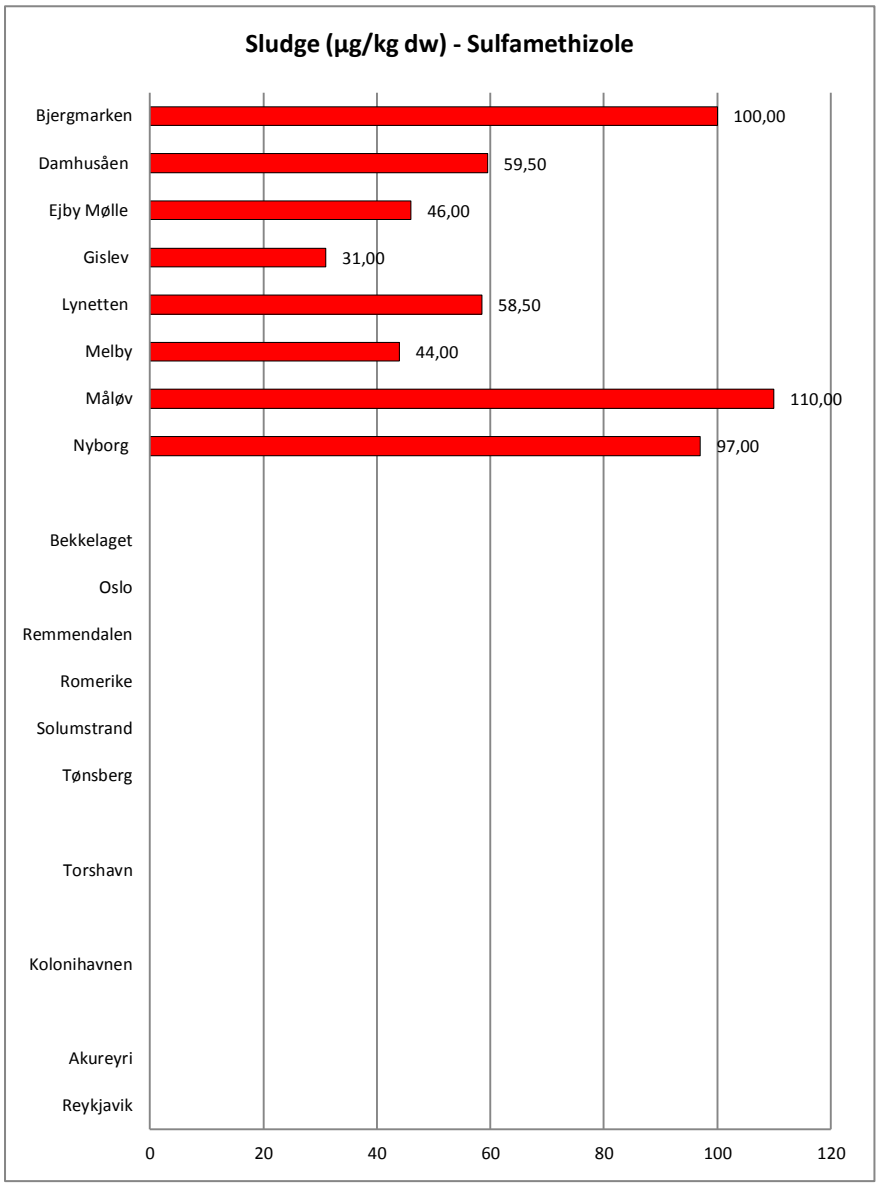
- Surface water in Denmark but not in Norway or Sweden
- Sediment in Norway but not in Sweden
- STP effluent and influent in Denmark, not Norway

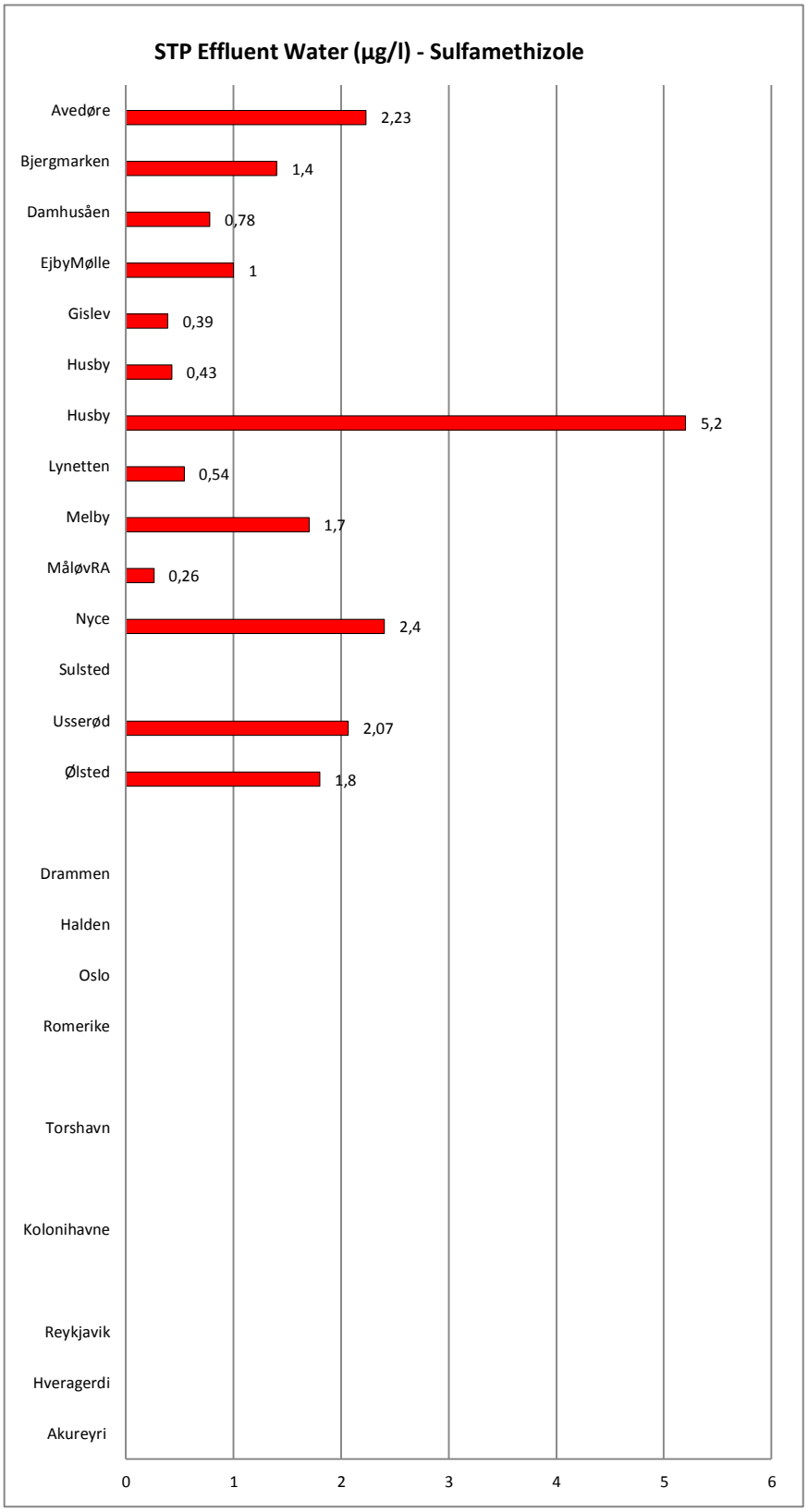
3.2.8 Sulfamethizol

CAS nr.: 144-82-1
Info: Sulfonamide antibiotic
Toxicity data: NA
PNEC = NA



[19] includes 5 treated samples


Sludge (µg/kg dw) - Sulfamethizole
Bjergmarken
Damhusåen
Ejby Mølle
Gislev
Lynetten
Melby
Måløv
Nyborg
Bekkelaget
Oslo
Remmendalen
Romerike
Solumstrand
Tønsberg
Torshavn
Kolonihavnen
Akureyri
Reykjavik
100,00
59,50
46,00
31,00
58,50
44,00
110,00
97,00
0
20
40
60
80
100
120


STP Effluent Water (µg/l) - Sulfamethizole
Avedøre
Bjergmarken
Damhusåen
EjbyMølle
Gislev
Husby
Husby
Lynetten
Melby
MåløvRA
Nyce
Sulsted
Usserød
Ølsted
Drammen
Halden
Oslo
Romerike
Torshavn
Kolonihavne
Reykjavik
Hveragerdi
Akureyri
2,23
1,4
0,78
1
0,39
0,43
5,2
0,54
1,7
0,26
2,4
2,07
1,8
0
1
2
3
4
5
6

Sulfamethizol	Norway		Denmark		Sweden		Faroe Islands		Greenland		Iceland	
Matrix	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Biota	nd	6 (a)										
STP sludge (µg/l)	nd	6 (a)	31 110 66,4	10 (c)			nd	2 (e)	nd	2 (e)	nd	3 (e)
Sediment	nd	12 (a)					nd	3 (e)	nd	2 (e)		
Landfill leachates, sediment	nd	4 (a)										
Landfill leachates, water	nd	9[20] (a)										
Surface water	nd	8 (a)	nd	16[21] (c)	nd	30[22]	nd	5 (e)	nd	5 (e)		
Groundwater			nd	3[23] (c)	nd	2[24]						
STP Influent	nd	8 (a)					nd	1 (e)	nd	1 (e)	nd	5 (e)
STP effluent (µg/l)	nd	4 (a)	nd 5,2 1,5	16 (cd)			nd	1 (e)	nd	1 (e)	nd	5 (e)
Sediment					nd	19						
Manure					nd	6						
Farm soil					nd	6						
Pig slurry			nd	(d)								
Warning system for pesticide leaching to groundwater			nd	9 (c)								
Drain water (µg/l)			0,21 0,21 0,21	1 (c)								
Influent (µg/l)			0,34 6,4 2,9	9 (c)								
Hospital WW							nd	3 (e)				

References:

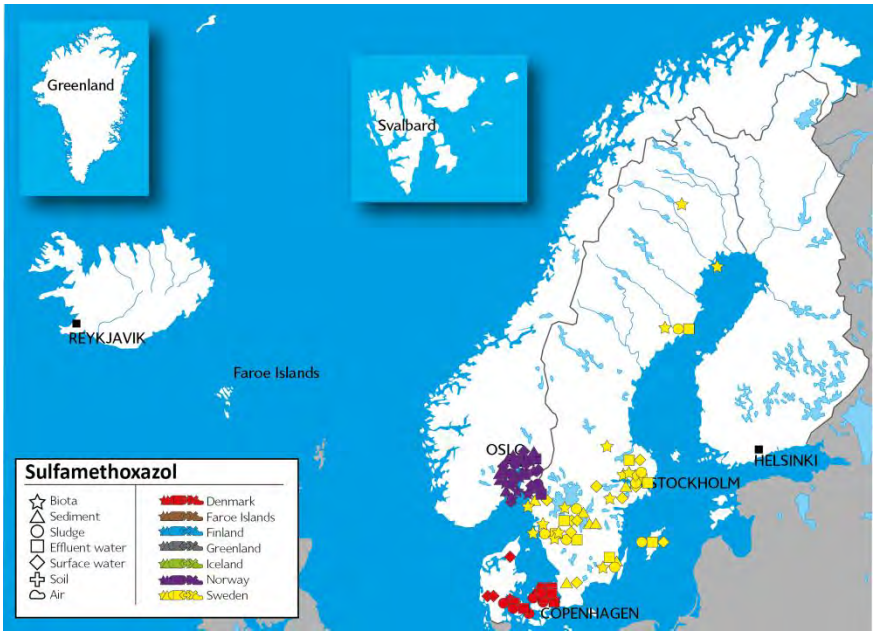
a) (Møskeland, et al., 2006)
b) (Sternbeck, et al., 2007a)
c) (Mogensen, et al., 2008)
d) (Kjølholt, et al., 2003)
e) (Huber, et al., NA)

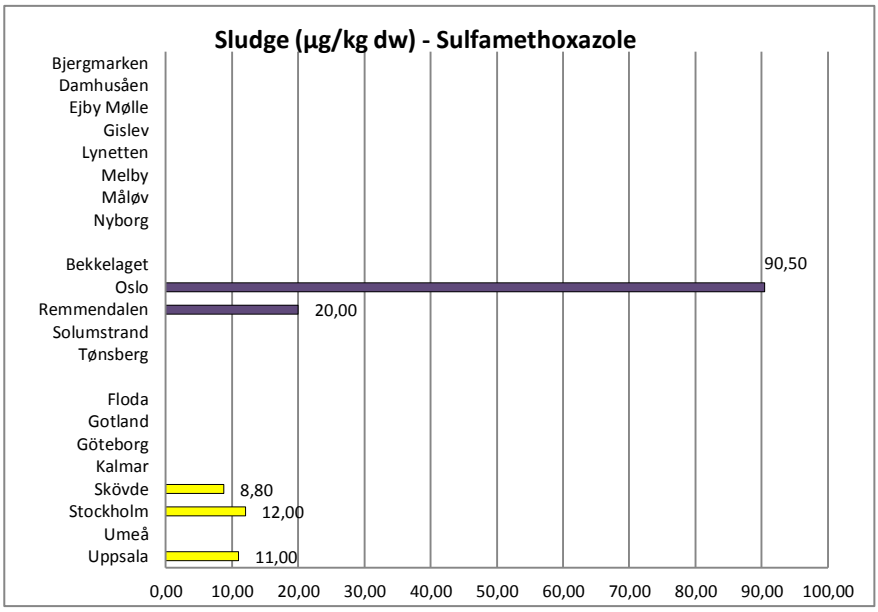
[20] includes 5 treated samples
[21] Up and downstream of fish farms
[22] Including 2 at proximity of farms
[23] 2 samples at proximity of hospitals
[24] From farms

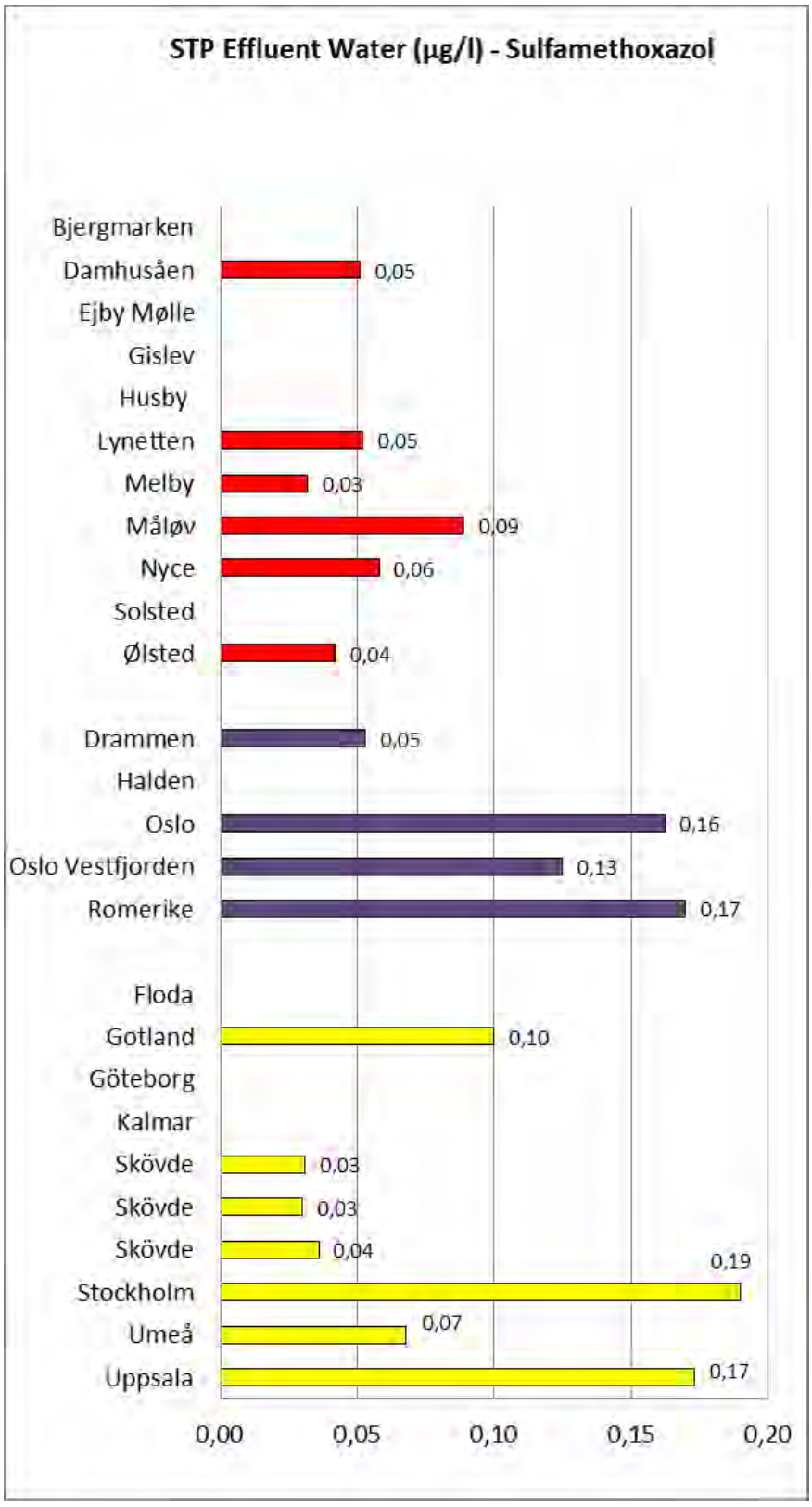
Conclusion:
The compound was monitored in one Norwegian, one Swedish, two Danish studies and one international study covering Faroe Islands, Greenland and Iceland. It was not detected in any other country than Denmark. In Denmark, the compound was detected in STP sludge, effluent and influent as well as in the one drain water sample.

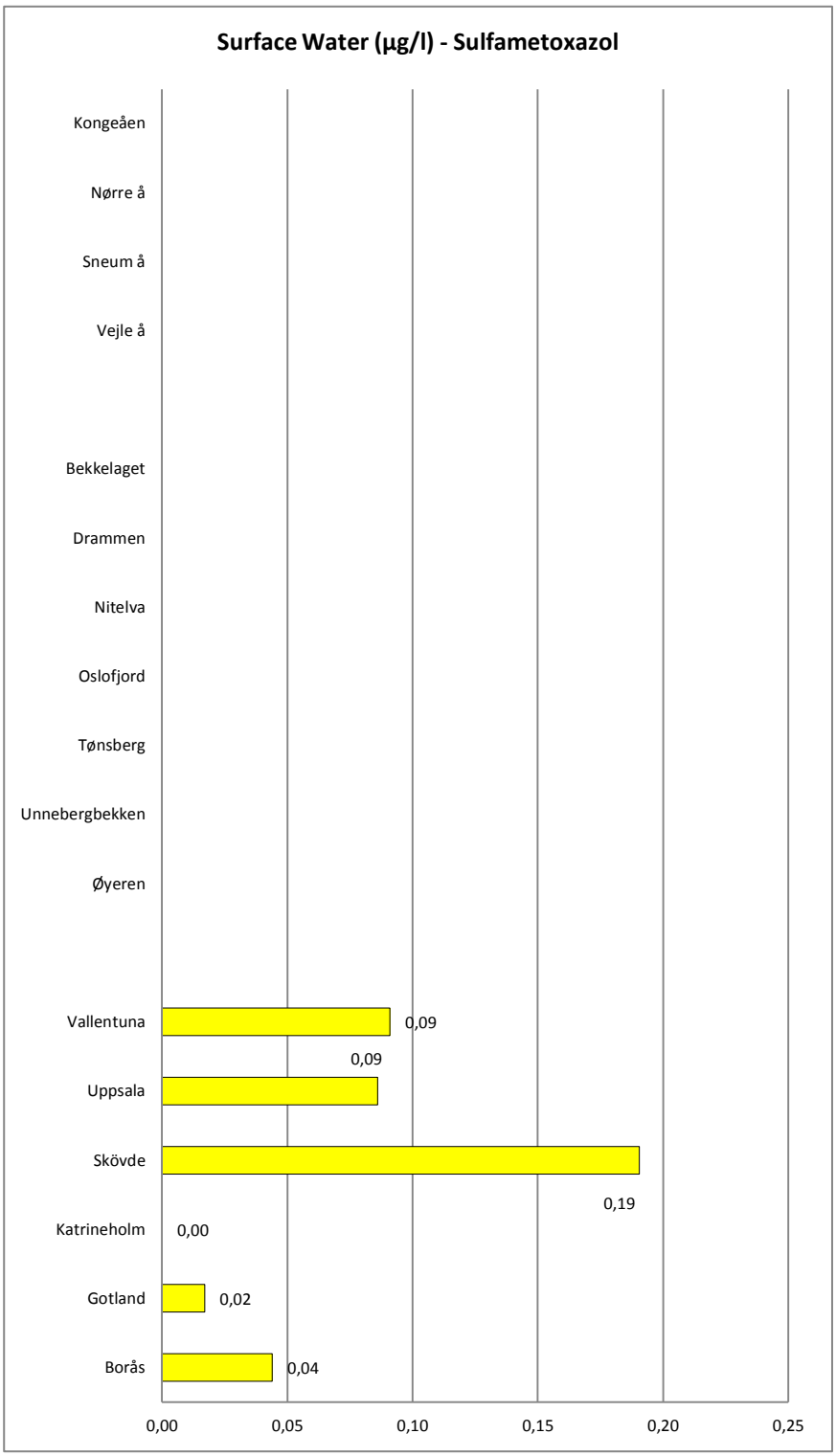
3.2.9 Sulfamethoxazole

*CAS nr.:*723-46-6
Info: Sulfonamide bacteriostatic antibiotic
Toxicity data: NA
PNEC = NA




Sludge (µg/kg dw) - Sulfamethoxazole
Bjergmarken
Damhusåen
Ejby Mølle
Gislev
Lynetten
Melby
Måløv
Nyborg
Bekkelaget
Oslo
Remmendalen
Solumstrand
Tønsberg
Floda
Gotland
Göteborg
Kalmar
Skövde
Stockholm
Umeå
Uppsala
90,50
20,00
8,80
12,00
11,00
0,00
10,00
20,00
30,00
40,00
50,00
60,00
70,00
80,00
90,00
100,00


STP Effluent Water (µg/l) - Sulfamethoxazol
Bjergmarken
Damhusåen
Ejby Mølle
Gislev
Husby
Lynetten
Melby
Måløv
Nyce
Solsted
Ølsted
Drammen
Halden
Oslo
Oslo Vestfjorden
Romerike
Floda
Gotland
Göteborg
Kalmar
Skövde
Skövde
Skövde
Stockholm
Umeå
Uppsala
0,05
0,05
0,03
0,09
0,06
0,04
0,05
0,16
0,13
0,17
0,10
0,03
0,03
0,04
0,19
0,07
0,17
0,00
0,05
0,10
0,15
0,20


Surface Water (µg/l) - Sulfametoxazol
Kongeåen
Nørre å
Sneum å
Vejle å
Bekkelaget
Drammen
Nitelva
Oslofjord
Tønsberg
Unnebergbekken
Øyeren
Vallentuna
0,09
0,09
Uppsala
Skövde
0,19
Katrineholm
0,00
Gotland
0,02
Borås
0,04
0,00
0,05
0,10
0,15
0,20
0,25

Sulfamethoxazole	Denmark (a)		Norway		Sweden	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota (µg/kg dw)			nd	6 (b)	nd 13 13	24 (de)
Sediment			nd	16 (b)	nd	20 (df)
STP sludge (µg/kg dw)	nd	10	nd 171 51,5	13 (bc)	nd 12 10,6	10 (de)
Drinking water					nd	6 (d)
STP effluent (µg/l)	nd 0,09 0,05	9	nd 0,21 0,13	11 (bc)	nd 0,29 0,13	18 (de)
Surface water (µg/l)	nd	16[25]	nd	8 (b)	nd 0,62 0,13	45 (df)
Groundwater	nd	3[26]			nd	2[27] (f)
Manure					nd	6 (f)
Farm soil					nd	6 (f)
Hospital WW (µg/l)					nd 6,6 6,6	2 (e)
Influent (µg/l)	nd 0,31 0,19	9	nd 0,69 0,42	8 (b)	nd 1,5 0,45	17 (de)
Pig slurry	nd	4				
Warning system for pesticide leaching to groundwater	nd	9				
Drain water	nd	1				
Landfill leachates			nd	9[28] (b)		

References:

a) (Mogensen, et al., 2008)
b) (Møskeland, et al., 2006)
c) (Thomas, et al., 2007)
d) (Fick, et al., 2011)
e) (Johansson, et al., 2003)
f) (Sternbeck, et al., 2007a)

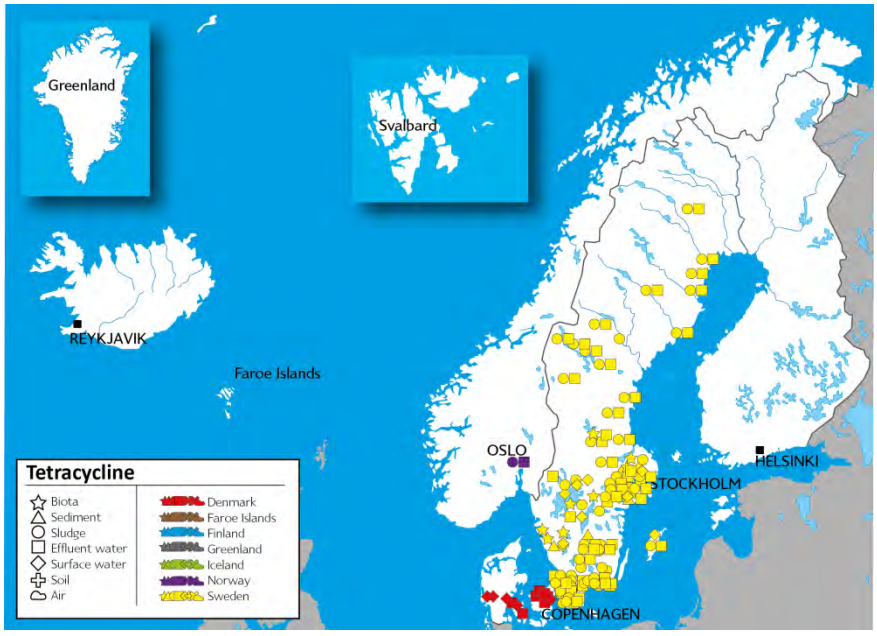
[25] Up and downstream of fish farms
[26] Includes 2 samples at proximity of hospitals
[27] Samples at proximity of farms
[28] Includes 5 treated samples

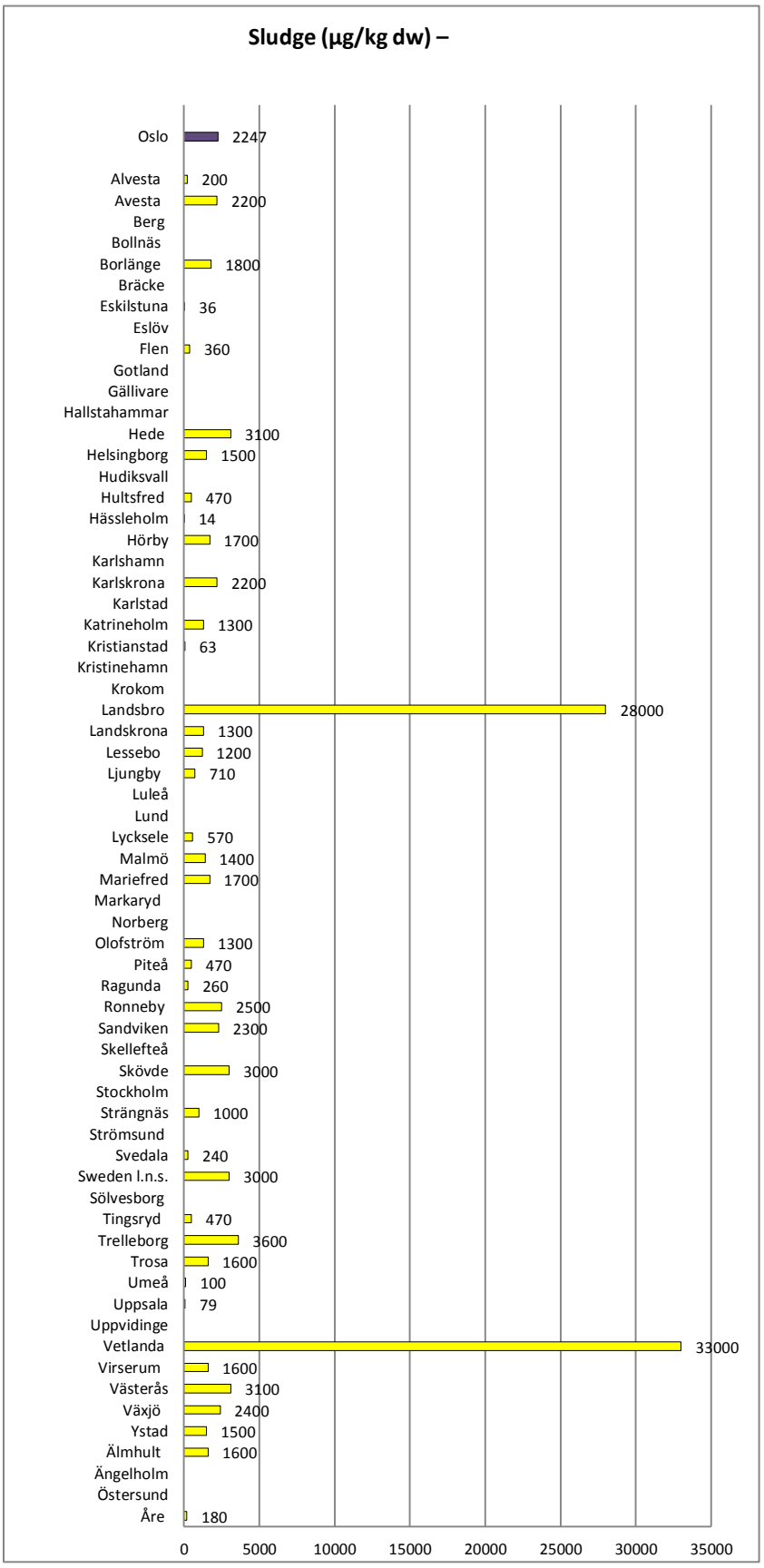
Conclusion:
The compound was monitored in three Swedish studies, two Norwegian and one Danish studies. The compound was detected in several matrices:

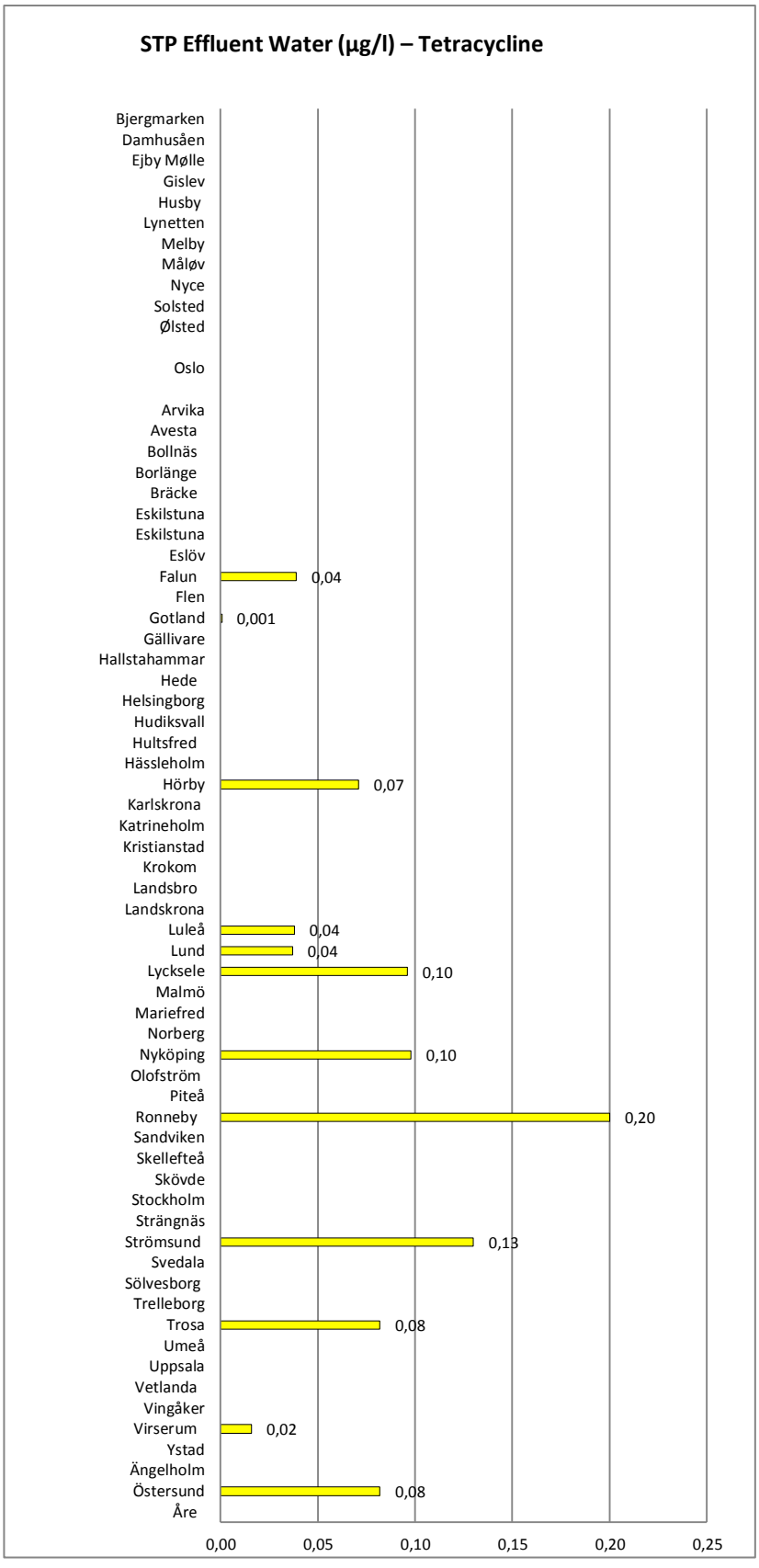
- In one biota sample in Sweden, not in any other country
- STP sludge in Sweden and Norway but not Denmark
- Effluent in all three countries
- Surface water in Sweden
- STP influent water in all three countries

3.2.10 Tetracycline

CAS nr.: 60-54-8
Info: Broad spectrum antibiotic
Toxicity data:
EC50 21 days (Daphnia magna)= 44.8mg/l
EC50 7 days (Microcystis aeruginosa)= 0.09 mg/l
EC50 3 days (Selenastrum capricomutum) = 2.2 mg/l
Nitszscha closterium EC50, 72 h 16 mg/l
EC50 96h (Salvenius namaycush)= 220 mg/l
LC50 96 h (Morone saxatilis) >182mg/L
EC50 7 days (Lemna Gibba)= 723 µg/l
(Andersson, et al., 2006)
PNEC = 9 ug/l (Andersson, et al., 2006)




Sludge (µg/kg dw) –
Oslo 2247
Alvesta 200
Avesta 2200
Berg
Bollnäs
Borlänge 1800
Bräcke
Eskilstuna 36
Eslöv
Flen 360
Gotland
Gällivare
Hallstahammar
Hede 3100
Helsingborg 1500
Hudiksvall
Hultsfred 470
Hässleholm 14
Hörby 1700
Karlshamn
Karlskrona 2200
Karlstad
Katrineholm 1300
Kristianstad 63
Kristinehamn
Krokom
Landsbro 28000
Landskrona 1300
Lessebo 1200
Ljungby 710
Luleå
Lund
Lycksele 570
Malmö 1400
Mariefred 1700
Markaryd
Norberg
Olofström 1300
Piteå 470
Ragunda 260
Ronneby 2500
Sandviken 2300
Skellefteå
Skövde 3000
Stockholm
Strängnäs 1000
Strömsund
Svedala 240
Sweden l.n.s. 3000
Sölvesborg
Tingsryd 470
Trelleborg 3600
Trosa 1600
Umeå 100
Uppsala 79
Uppvidinge
Vetlanda 33000
Virserum 1600
Västerås 3100
Växjö 2400
Ystad 1500
Älmhult 1600
Ängelholm
Östersund
Åre 180
0 5000 10000 15000 20000 25000 30000 35000


STP Effluent Water (µg/l) – Tetracycline
Bjergmarken
Damhusåen
Ejby Mølle
Gislev
Husby
Lynetten
Melby
Måløv
Nyce
Solsted
Ølsted
Oslo
Arvika
Avesta
Bollnäs
Borlänge
Bräcke
Eskilstuna
Eskilstuna
Eslöv
Falun
Flen
Gotland
Gällivare
Hallstahammar
Hede
Helsingborg
Hudiksvall
Hultsfred
Hässleholm
Hörby
Karlskrona
Katrineholm
Kristianstad
Krokom
Landsbro
Landskrona
Luleå
Lund
Lycksele
Malmö
Mariefred
Norberg
Nyköping
Olofström
Piteå
Ronneby
Sandviken
Skellefteå
Skövde
Stockholm
Strängnäs
Strömsund
Svedala
Sölvesborg
Trelleborg
Trosa
Umeå
Uppsala
Vetlanda
Vingåker
Virserum
Ystad
Ängelholm
Östersund
Åre
0,04
0,001
0,07
0,04
0,04
0,10
0,10
0,20
0,13
0,08
0,02
0,08
0,00
0,05
0,10
0,15
0,20
0,25

Tetracycline	Denmark (a)		Norway (b)		Sweden	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota (µg/kg dw)					nd	18 (cd)
Sediment					nd	7 (c)
STP sludge (mg/kg dw)			0,16 6,7 2,2	7	nd 33 2,7	66 (cd)
Drinking water					nd	6 (d)
STP effluent (µg/l)	nd	9	nd	7	nd 0,2 0,08	68 (cd)
Surface water (µg/l)	nd	16			nd 0,002 0,002	32 (cd)
Groundwater	nd	3[29]				
Hospital WW (µg/l)					nd 1400 650,3	7 (c)
Influent (µg/l)	nd 0,34 0,25	9			nd 1800 310	31 (cd)
Pig slurry	nd	4				
Warning system for pesticide leaching to groundwater (mg/kg dw)	nd 0,18 0,18	9				
Drain water	nd	1				
Manure (µg/kg dw)					nd 400 400	5 (c)
Landfill leachates water (µg/l)					nd 0,03 0,03	8 (c)

References:

a) (Mogensen, et al., 2008)
b) (Thomas, et al., 2007)
c) (Andersson, et al., 2006)
d) (Fick, et al., 2011)

Conclusion:

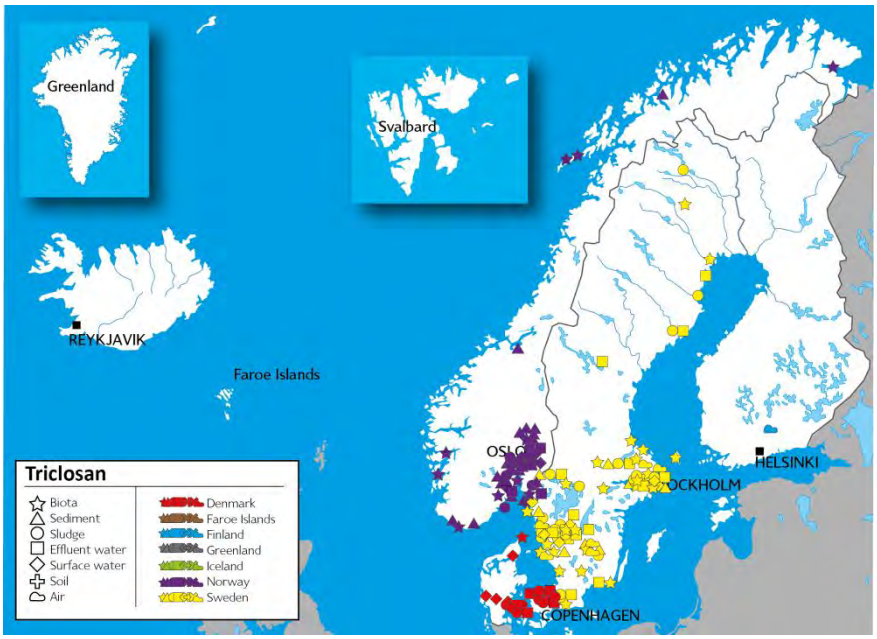
The compound was monitored in one Danish, one Norwegian and two Swedish studies. The compound was detected in several matrices:

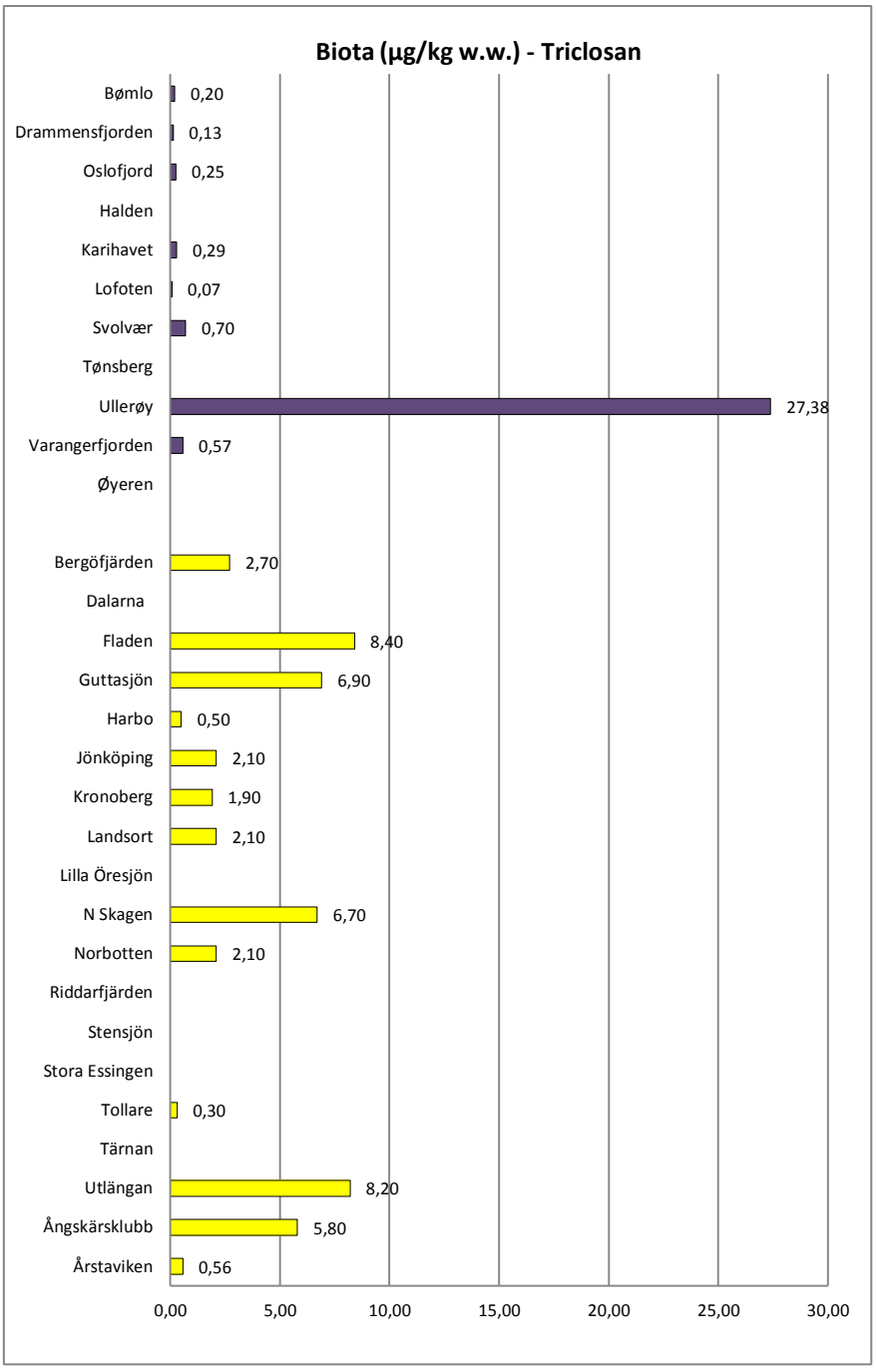
[29] Includes 2 samples at proximity of hospitals

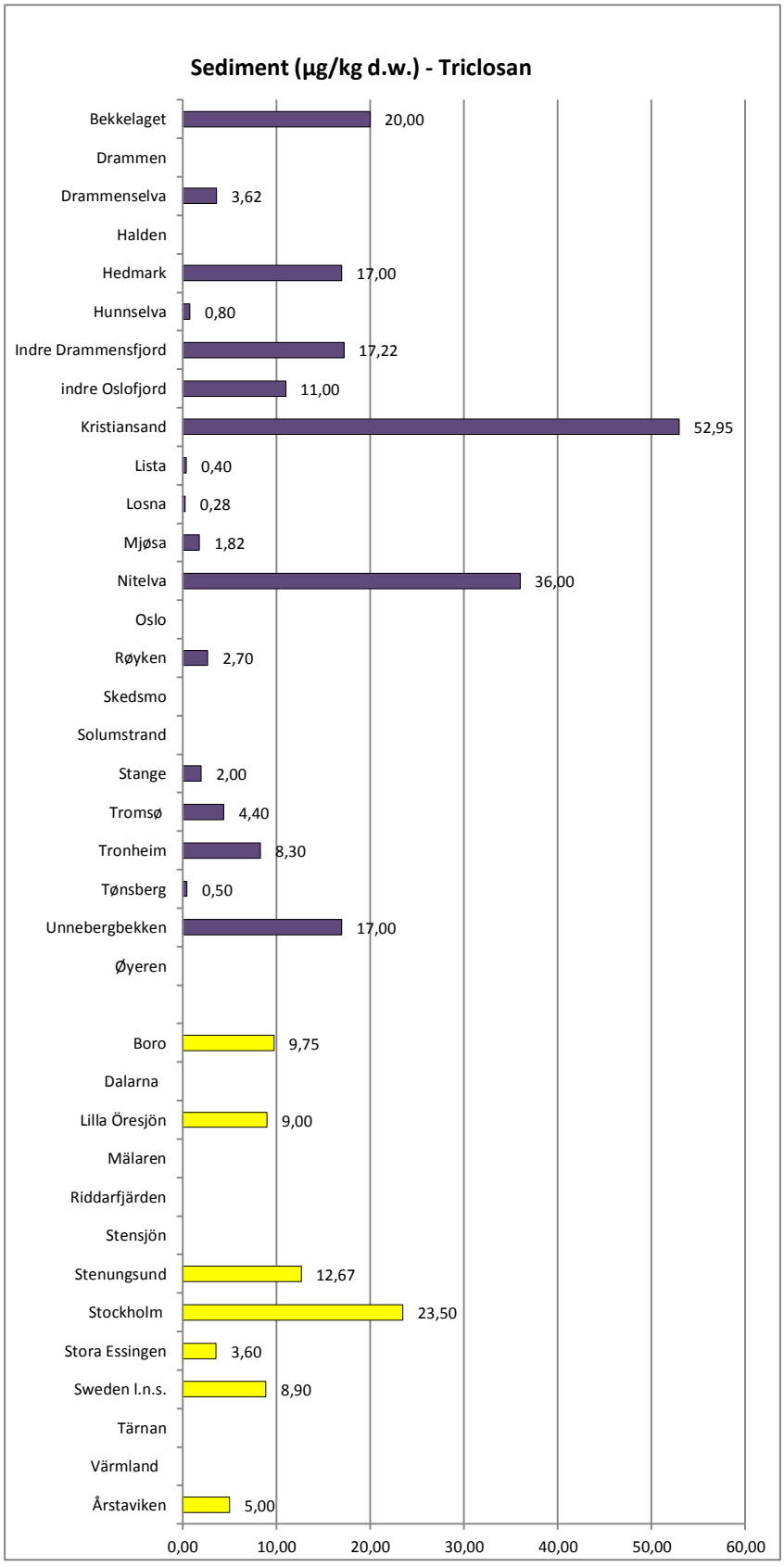
- STP sludge in Norway and Sweden. Very high concentrations were detected in two locations in Sweden
- STP effluent in Sweden, in concentrations below the PNEC value. It was not detected in Norway or Denmark
- In one sample of surface water in Sweden, the value detected was below the PNEC
- In one sample of manure in Sweden
- In one sample of landfill leachates in Sweden, the value detected was below the PNEC
- Hospital waste water in Sweden, in high concentrations, well above the PNEC
- STP influent in Sweden and Denmark, in much higher concentrations in Sweden. Values detected in Sweden were above the PNEC, and below the PNEC in Denmark

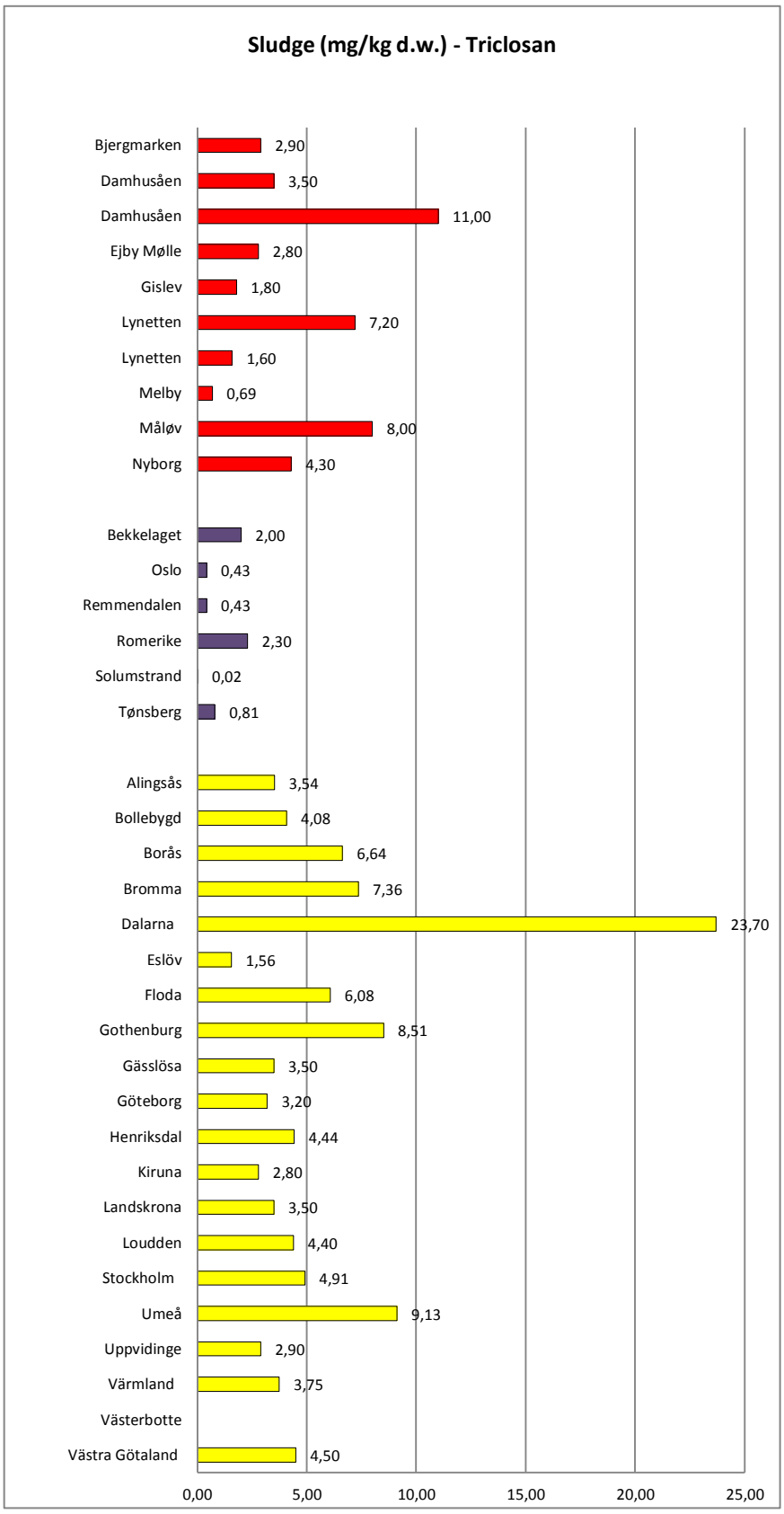
3.2.11 Triclosan

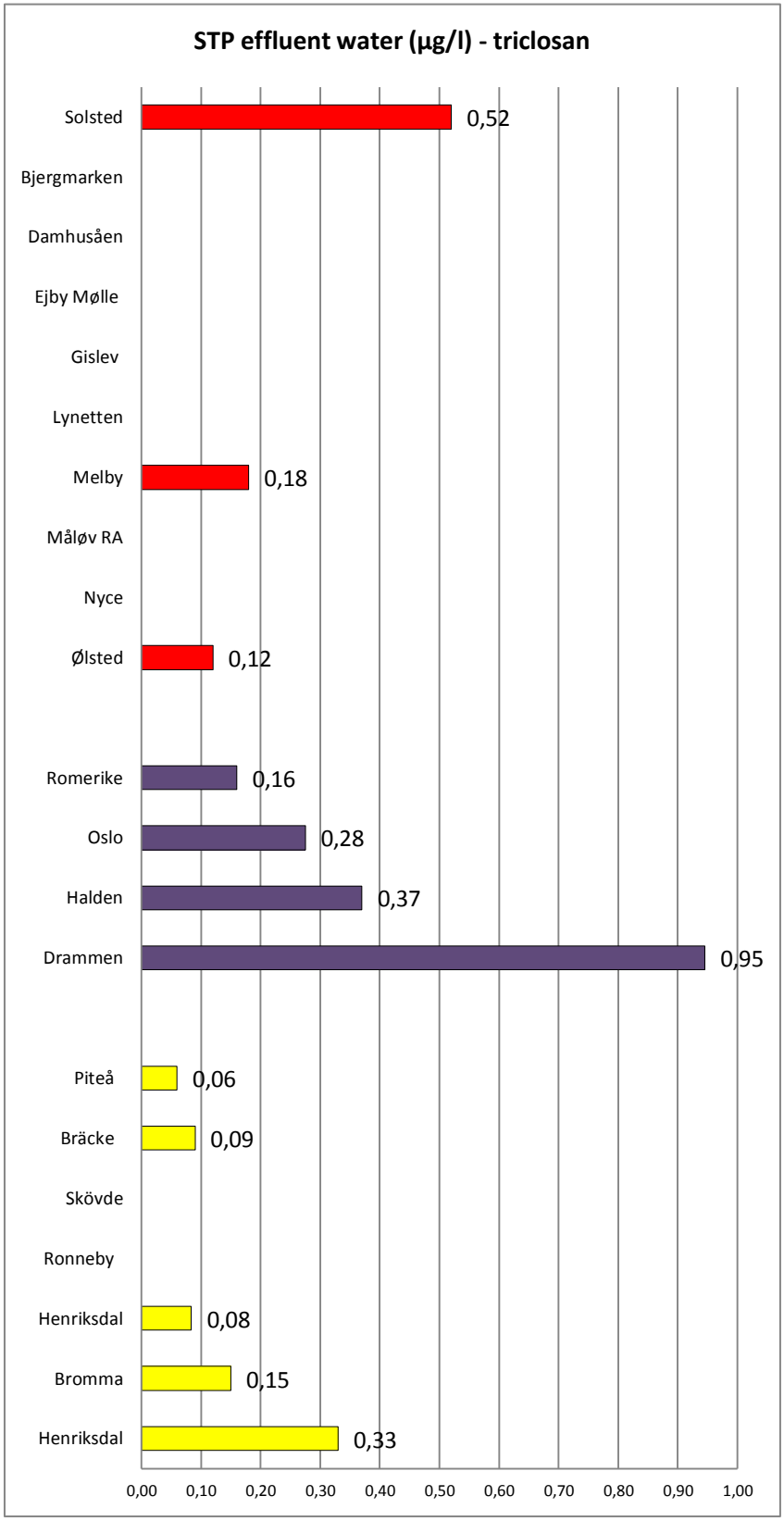
CAS nr.: 3380-34-5
Info: A polychloro phenoxy phenol used as an antibacterial and antifungal agent
Toxicity data: NA
PNEC =
PNECaqua = 0,05 µg/l (calculation)
PNECsediment = ca 1 mg/kg (calculation)
(Sternbeck, et al., 2007a)

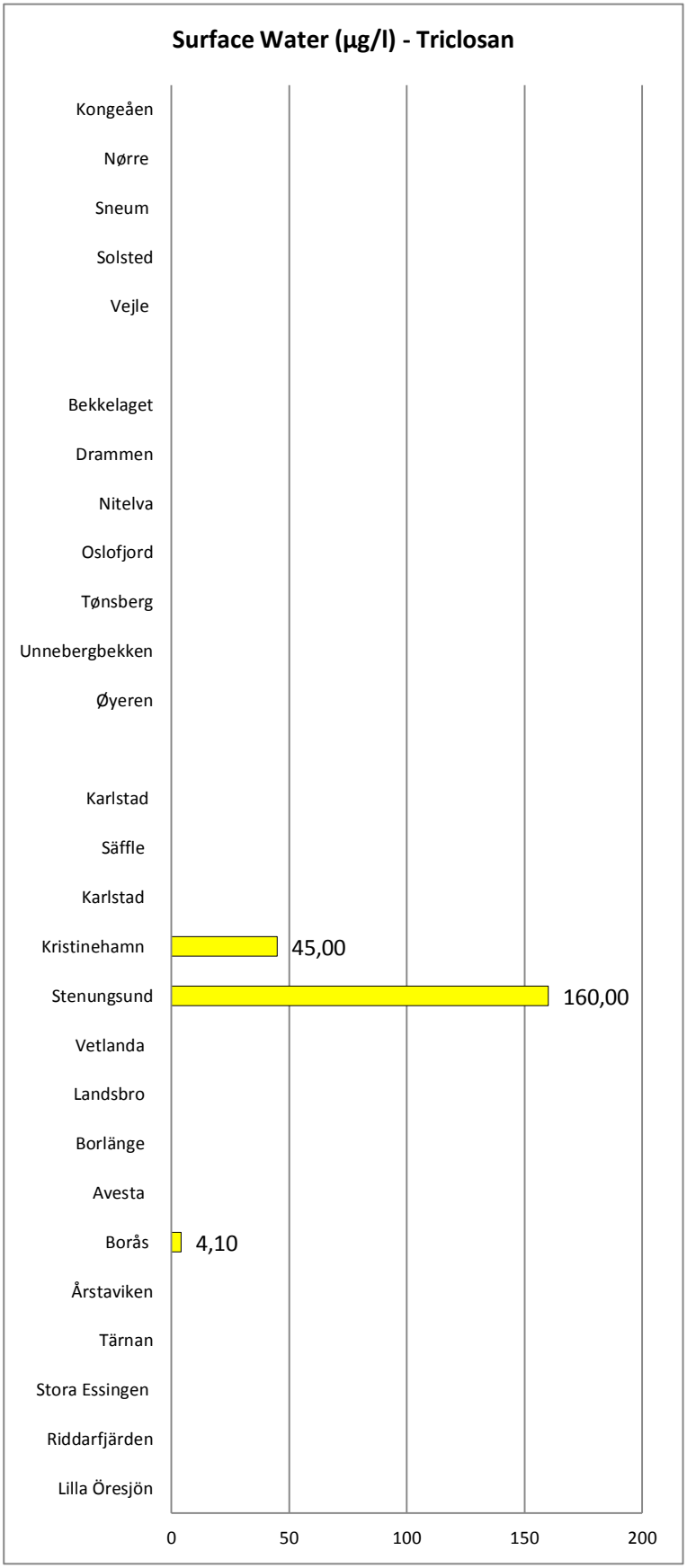


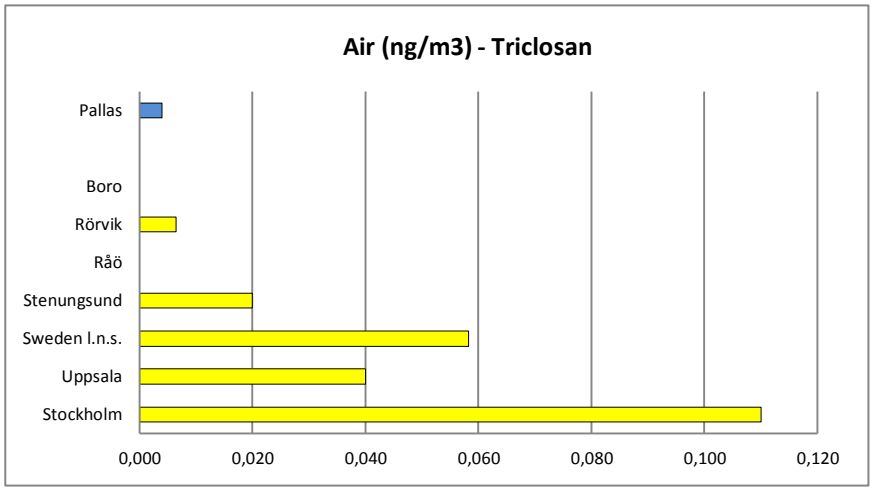

Biota (µg/kg w.w.) - Triclosan
Bømlo
Drammensfjorden
Oslofjord
Halden
Karihavet
Lofoten
Svolvær
Tønsberg
Ullerøy
Varangerfjorden
Øyeren
Bergöfjärden
Dalarna
Fladen
Guttasjön
Harbo
Jönköping
Kronoberg
Landsort
Lilla Öresjön
N Skagen
Norbotten
Riddarfjärden
Stensjön
Stora Essingen
Tollare
Tärnan
Utlängan
Ångskärsklubb
Årstaviken
0,20
0,13
0,25
0,29
0,07
0,70
27,38
0,57
2,70
8,40
6,90
0,50
2,10
1,90
2,10
6,70
2,10
0,30
8,20
5,80
0,56
0,00
5,00
10,00
15,00
20,00
25,00
30,00


Sediment (µg/kg d.w.) - Triclosan
Bekkelaget
Drammen
Drammenselva
Halden
Hedmark
Hunnselva
Indre Drammensfjord
indre Oslofjord
Kristiansand
Lista
Losna
Mjøsa
Nitelva
Oslo
Røyken
Skedsmo
Solumstrand
Stange
Tromsø
Tronheim
Tønsberg
Unnebergbekken
Øyeren
Boro
Dalarna
Lilla Öresjön
Mälaren
Riddarfjärden
Stensjön
Stenungsund
Stockholm
Stora Essingen
Sweden l.n.s.
Tärnan
Värmland
Årstaviken
20,00
3,62
17,00
0,80
17,22
11,00
52,95
0,40
0,28
1,82
36,00
2,70
2,00
4,40
8,30
0,50
17,00
9,75
9,00
12,67
23,50
3,60
8,90
5,00
0,00
10,00
20,00
30,00
40,00
50,00
60,00


Sludge (mg/kg d.w.) - Triclosan
Bjergmarken 2,90
Damhusåen 3,50
Damhusåen 11,00
Ejby Mølle 2,80
Gislev 1,80
Lynetten 7,20
Lynetten 1,60
Melby 0,69
Måløv 8,00
Nyborg 4,30
Bekkelaget 2,00
Oslo 0,43
Remmendalen 0,43
Romerike 2,30
Solumstrand 0,02
Tønsberg 0,81
Alingsås 3,54
Bollebygd 4,08
Borås 6,64
Bromma 7,36
Dalarna 23,70
Eslöv 1,56
Floda 6,08
Gothenburg 8,51
Gässlösa 3,50
Göteborg 3,20
Henriksdal 4,44
Kiruna 2,80
Landskrona 3,50
Loudden 4,40
Stockholm 4,91
Umeå 9,13
Uppvidinge 2,90
Värmland 3,75
Västerbotte
Västra Götaland 4,50
0,00
5,00
10,00
15,00
20,00
25,00


STP effluent water (µg/l) - triclosan
Solsted
0,52
Bjergmarken
Damhusåen
Ejby Mølle
Gislev
Lynetten
Melby
0,18
Måløv RA
Nyce
Ølsted
0,12
Romerike
0,16
Oslo
0,28
Halden
0,37
Drammen
0,95
Piteå
0,06
Bräcke
0,09
Skövde
Ronneby
Henriksdal
0,08
Bromma
0,15
Henriksdal
0,33
0,00
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00


Surface Water (µg/l) - Triclosan
Kongeåen
Nørre
Sneum
Solsted
Vejle
Bekkelaget
Drammen
Nitelva
Oslofjord
Tønsberg
Unnebergbekken
Øyeren
Karlstad
Säffle
Karlstad
Kristinehamn
45,00
Stenungsund
160,00
Vetlanda
Landsbro
Borlänge
Avesta
Borås
4,10
Årstaviken
Tärnan
Stora Essingen
Riddarfjärden
Lilla Öresjön
0
50
100
150
200



Triclosan	Denmark (a)		Norway		Sweden	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Air (ng/m3)					nd 0,17 0,04	29 (def)
Biota (µg/kg ww)			nd 27,4 3,3	21 (bc)	nd 13 4,2	21 (de)
Biota (µg/kg dw)			nd 0,37 0,1	12 (c)		
Biota (ng/g fw)					nd 6,9 4,3	7 (ef)
Sediment (µg/kg dw)			nd 105 11,7	41 (bc)	nd 25 9,3	22 (def)
STP sludge (mg/kg dw)	0,69 11 4,4	10	nd 23 0,9	6 (b)	nd 35 5,3	68 (defghij)
STP effluent (µg/l)	nd 0,52 0,27	7	0,16 0,94 0,44	4 (b)	nd 0,33 0,14	7 (ej)
Surface water (µg/l)	nd	16	nd	8 (b)	nd 0,16 0,07	34 (def)
Groundwater	nd	3				
Soil (µg/kg dw)					nd 15 9,5	7 (d)
Influent (µg/l)	nd 1,4 0,71	9	0,13 3,9 1	8 (b)	0,6 0,6 0,6	1 (e)

Triclosan	Denmark (a)		Norway		Sweden	
Pig slurry	nd	4				
Deposition (ng/m2/day)					nd 20 5,9	11 (def)
Food (µg/kg ww)					nd 8,4 4,5	18 (d)
Landfill leachates sediment (µg/kg dw)			nd 63 63	4 (b)		
Landfill leachates water			nd	9 (b)	nd	3[30] (e)
Warning system for pesticide leaching to groundwater	nd	6				
Drain water	nd	1				
Precipitation (µg/l)					nd	3 (e)

References:

a) (Mogensen, et al., 2008)
b) (Møskeland, et al., 2006)
c) (Fjeld, et al., 2006)
d) (Remberger, et al., 2002)
e) (Remberger, et al., 2006)
f) (Sternbeck, et al., 2007 b)
g) (Haglund & Olofsson, 2006)
h) (Haglund & Olofsson, 2007)
i) (Haglund & Olofsson, 2008)
j) (Adolfsson-Erici, et al., 2003)

Conclusion:

The compound was monitored in one study in Denmark, two in Norway and seven throughout Sweden. It was detected in several matrices:

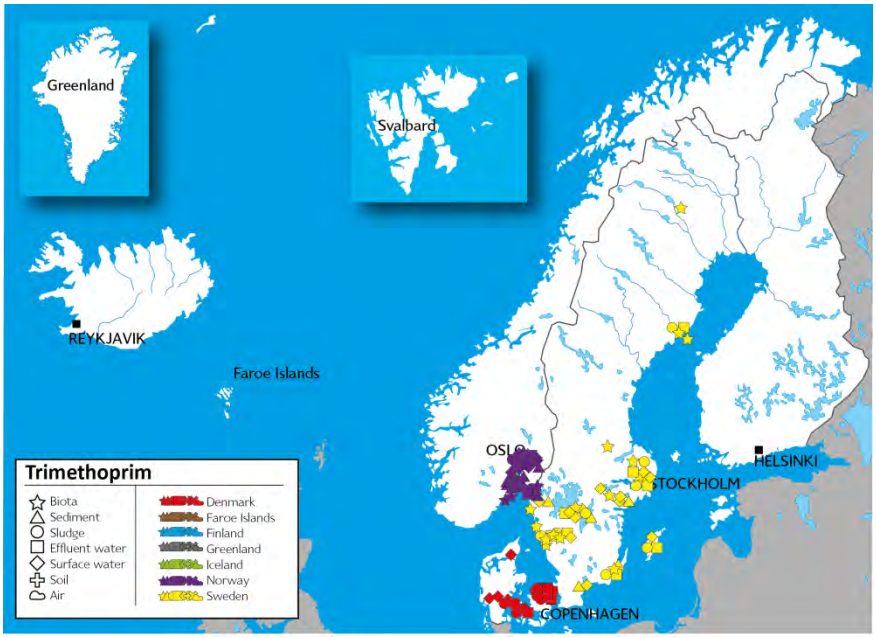
- Air samples from Sweden
- Biota in Norway and Sweden
- Sediment in Norway and Sweden, in concentrations below the PNEC
- STP sludge in all three countries. Higher values were observed in Norway
- STP effluent in all three countries, with average detected values above the PNEC
- Surface water only in Sweden, in concentrations above the PNEC. The compound was not detected in Finland or Norway

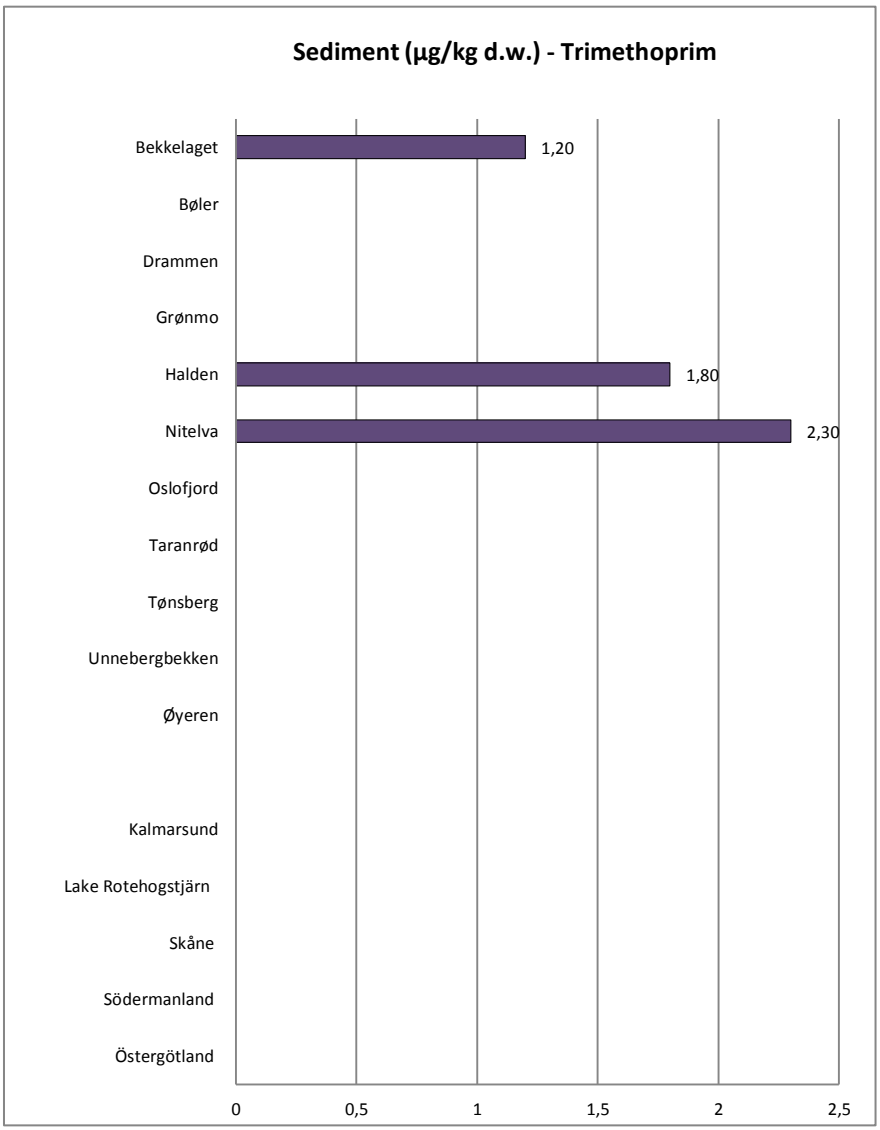
[30] Includes one sampe after treatment

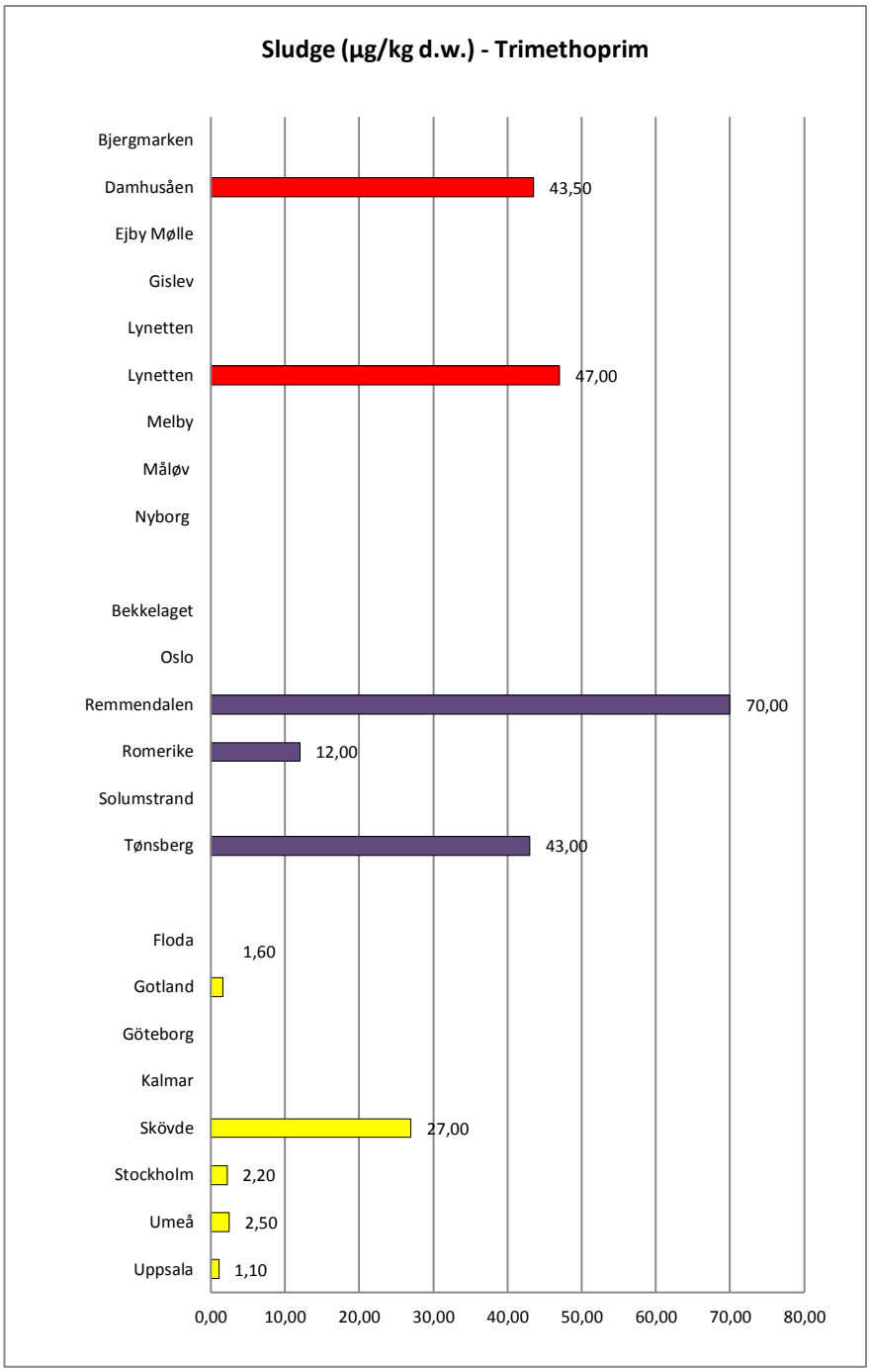
- Soil in Sweden
- Air deposition samples in Sweden
- Food samples from Sweden
- Sediment leachates from landfills in Norway, values were below the PNEC
- STP influent in all three countries

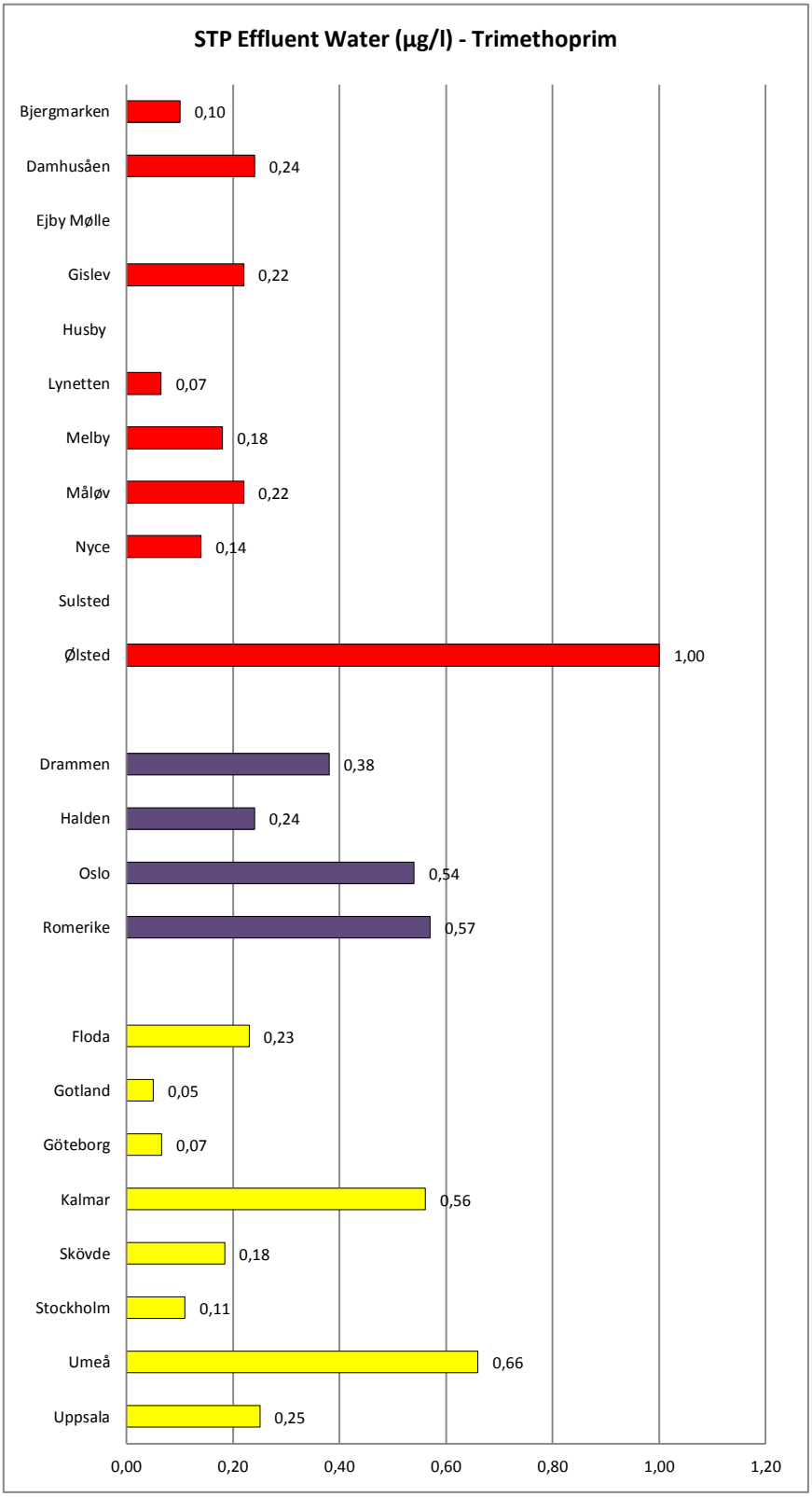
3.2.12 Trimethoprim

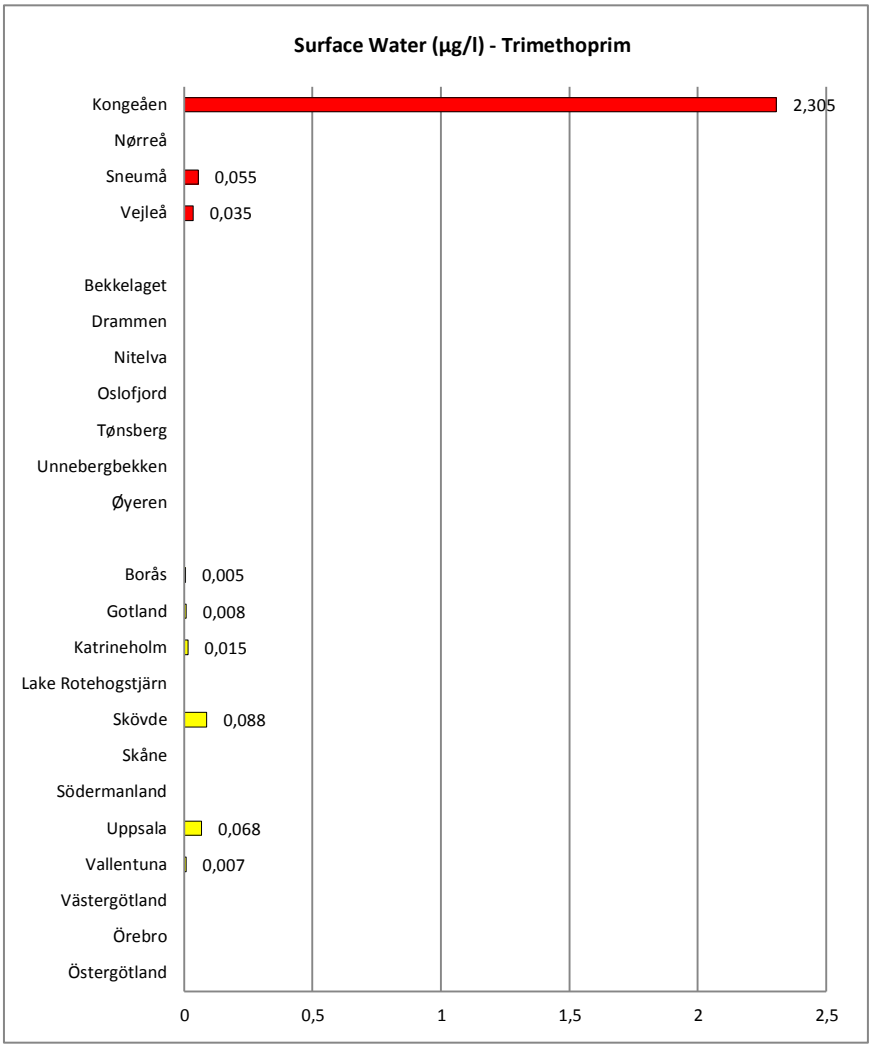
CAS nr. 738-70-5
Info: A bacteriostatic antibiotic
Toxicity data:
LOEC 7 days (Lemna gibba) >1 000 µg/l
EC50 (cyanobacteria) >200 000 µg/l
EC50 (R. salina) = 160 µg/l
(Sternbeck, et al., 2007a)
NOEC 7 days (Lemna gibba) = 1 mg/l
EC50 (M. aeruginosa)= 112 mg/l
EC50 (S. Capricornutum)= 130 mg/l
(Hellström & Kreuger, 2005)
PNEC = NA




Sediment (µg/kg d.w.) - Trimethoprim
Bekkelaget
Bøler
Drammen
Grønmo
Halden
Nitelva
Oslofjord
Taranrød
Tønsberg
Unnebergbekken
Øyeren
Kalmarsund
Lake Rotehogstjärn
Skåne
Södermanland
Östergötland
1,20
1,80
2,30
0
0,5
1
1,5
2
2,5


Sludge (µg/kg d.w.) - Trimethoprim
Bjergmarken
Damhusåen
Ejby Mølle
Gislev
Lynetten
Lynetten
Melby
Måløv
Nyborg
Bekkelaget
Oslo
Remmendalen
Romerike
Solumstrand
Tønsberg
Floda
Gotland
Göteborg
Kalmar
Skövde
Stockholm
Umeå
Uppsala
43,50
47,00
70,00
12,00
43,00
1,60
27,00
2,20
2,50
1,10
0,00
10,00
20,00
30,00
40,00
50,00
60,00
70,00
80,00


STP Effluent Water (µg/l) - Trimethoprim
Bjergmarken
0,10
Damhusåen
0,24
Ejby Mølle
Gislev
0,22
Husby
Lynetten
0,07
Melby
0,18
Måløv
0,22
Nyce
0,14
Sulsted
Ølsted
1,00
Drammen
0,38
Halden
0,24
Oslo
0,54
Romerike
0,57
Floda
0,23
Gotland
0,05
Göteborg
0,07
Kalmar
0,56
Skövde
0,18
Stockholm
0,11
Umeå
0,66
Uppsala
0,25
0,00
0,20
0,40
0,60
0,80
1,00
1,20



Trimethoprim	Denmark (a)		Norway		Sweden	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota			nd	6 (b)	nd	24 (de)
STP sludge (µg/kg dw)	nd 76 44,7	10	nd 43 43	13 (bc)	nd 27 6,9	30 (def)
Sediment			nd	12 (b)		
Drinking water (µg/l)					0,002 0,007 0,005	6 (e)

Trimethoprim	Denmark (a)		Norway		Sweden	
STP effluent (µg/l)	nd 1 0,27	9	nd 1,26 0,59	11 (bc)	0,05 1,4 0,32	19 (deg)
Surface water (µg/l)	nd 10 1,18	16[31]	nd	8 (b)	nd 0,21 0,06	45 (ef)
STP Influent (µg/l)	0,13 4,4 0,74	9	nd 1,44 0,69	(b)	0,15 1,4 0,43	18 (deg)
Groundwater	nd	3[32]			nd	2 (f)
Farm soil					nd	6 (f)
Manure	nd	4[33]			nd	6 (f)
Hospital wastewater (µg/l)					nd 4,1 4,1	2 (d)
Warning system for pesticide leaching to groundwater	nd	9				
Drain water	nd	1				
Landfill leachates, water			nd	9[34] (b)		
Landfill leachates, sediment			nd	4 (b)		

References:

a) (Mogensen, et al., 2008)
b) (Møskeland, et al., 2006)
c) (Thomas, et al., 2007)
d) (Johansson, et al., 2003)
e) (Fick, et al., 2011)
f) (Sternbeck, et al., 2007a)
g) (Hellström & Kreuger, 2005)

Conclusion:

The compound was monitored in one study in Denmark, two in Norway and four in Sweden. It was detected in several matrices:

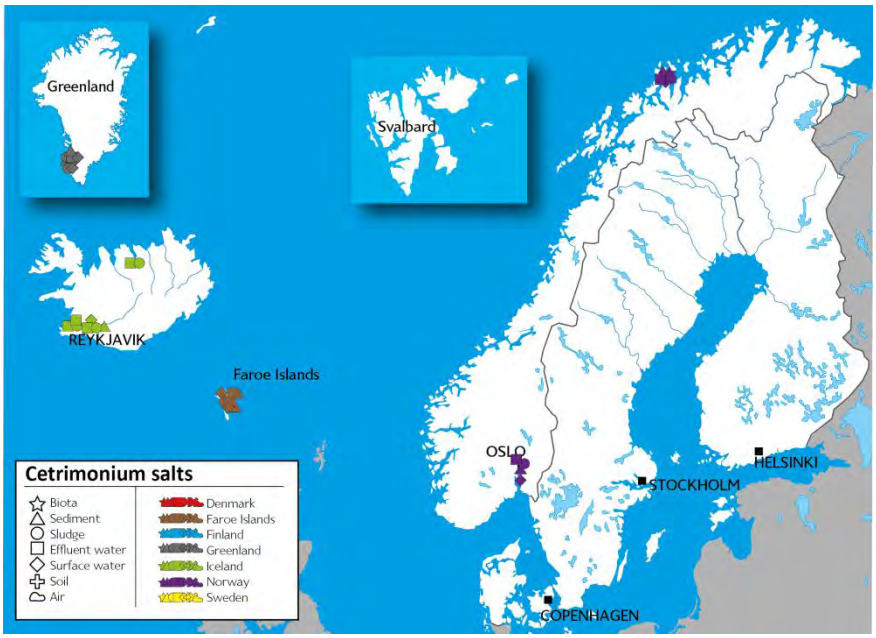
- Surface water in Denmark and Sweden, not in Norway
- STP sludge in Denmark and Sweden and in one sample in Norway. The values detected in Sweden were lower than in the other countries

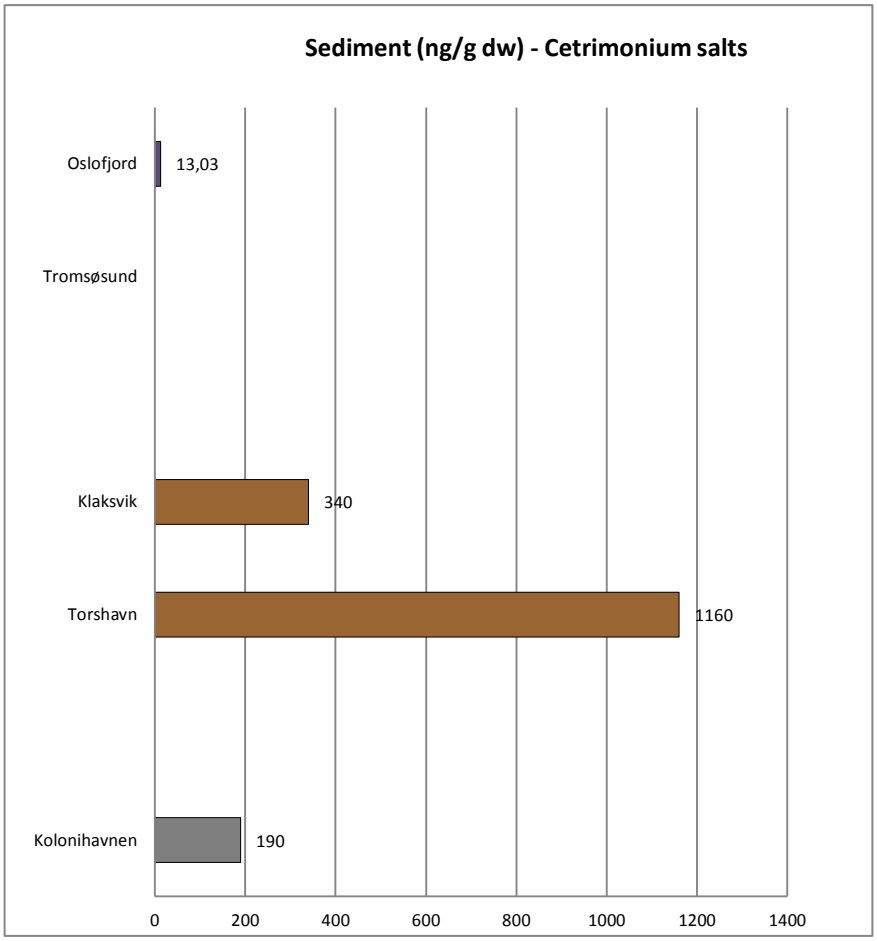
[31] Up and downstream of fish farms
[32] 2 samples at proximity of hospitals
[33] Pig slurry
[34] Includes 5 treated samples

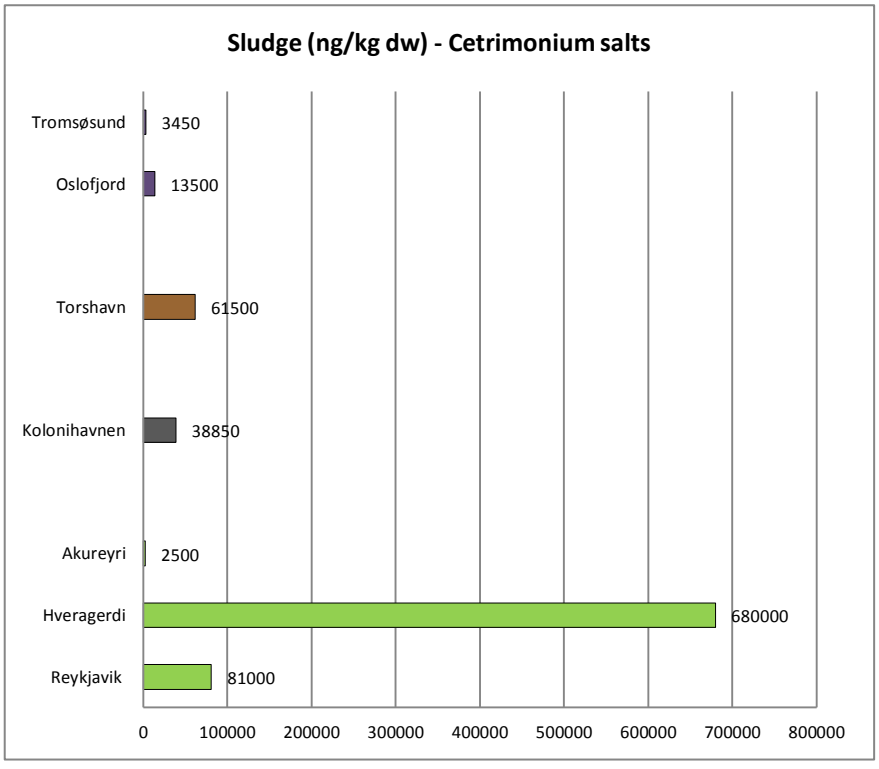
- STP effluent in all three countries
- Drinking water in Sweden
- In one hospital waste water sample in Sweden
- STP influent in all three countries

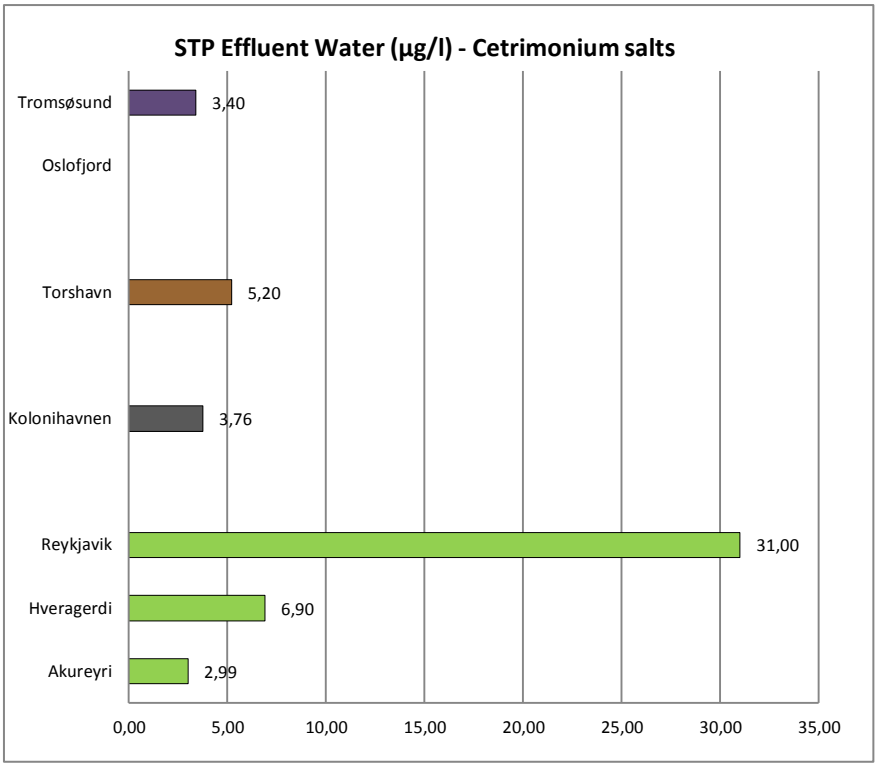
3.2.13 Cetrimonium salts

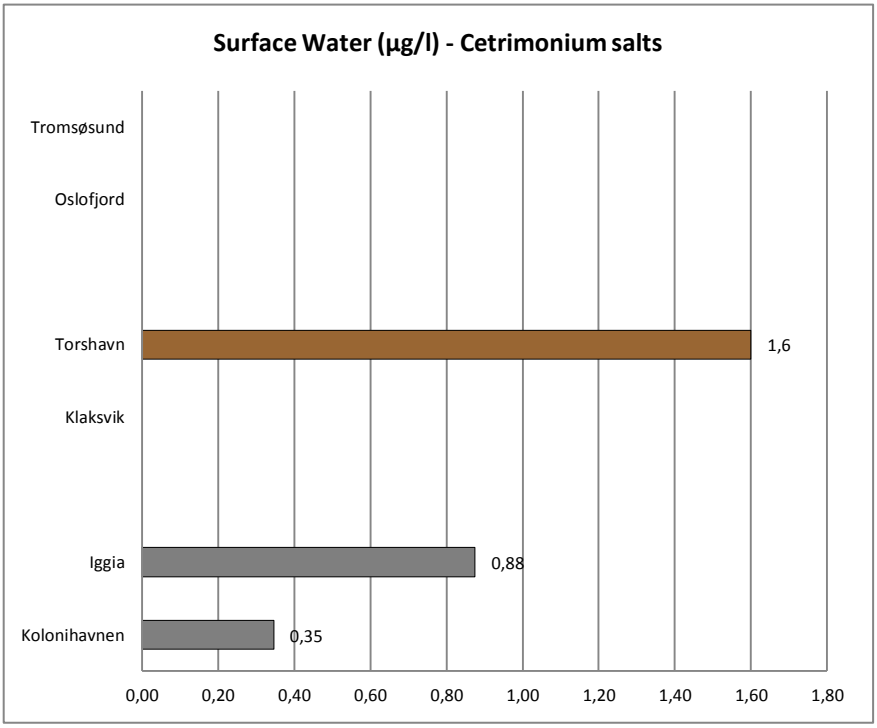
CAS nr.: 112-02-7/ 57-09-0
Info: Quaternary ammonium salts or quaternary ammonium compounds used as antiseptic
Toxicity data: LOEC (Microcystis sp.) = 25 000 ng/L
PNEC = NA




Sediment (ng/g dw) - Cetrimonium salts
Oslofjord
13,03
Tromsøsund
Klaksvik
340
Torshavn
1160
Kolonihavnen
190
0
200
400
600
800
1000
1200
1400


Sludge (ng/kg dw) - Cetrimonium salts
Tromsøsund
3450
Oslofjord
13500
Torshavn
61500
Kolonihavnen
38850
Akureyri
2500
Hverageri
680000
Reykjavik
81000
0
100000
200000
300000
400000
500000
600000
700000
800000


STP Effluent Water (µg/l) - Cetrimonium salts
Tromsøsund
Oslofjord
Torshavn
Kolonihavnen
Reykjavik
Hveragerdi
Akureyri
3,40
5,20
3,76
31,00
6,90
2,99
0,00
5,00
10,00
15,00
20,00
25,00
30,00
35,00


Surface Water (µg/l) - Cetrimonium salts
Tromsøsund
Oslofjord
Torshavn
Klaksvik
Iggia
Kolonihavnen
1,6
0,88
0,35
0,00
0,20
0,40
0,60
0,80
1,00
1,20
1,40
1,60
1,80

Cetrominium salts	Norway		Faroe Islands		Greenland		Iceland	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota (µg/kg ww)	nd 500 303,17	4 (a)						
STP sludge (ng/g dw)	3300 15000 8475	4 (a)	44000 79000 61500	2 (b)	1700 76000 38850	2 (b)	1000 680000 191500	4 (b)
Sediment (ng/g dw)	nd 17 13,3	6 (a)	340 1500 886,67	3 (b)	nd 190 190	2 (b)		
Surface water (µg/l)	nd	6 (a)	nd 1,6 1,5	5 (b)	nd 0,88 0,61	5 (b)		
STP Influent (µg/l)			2,7 87 44,8	2 (b)			4,1 61 41	3 (b)
STP effluent (µg/l)	nd 3,60 3,40	6 (a)	5,2 5,2 5,2	1 (b)	3,8 3,8 3,8	1 (b)	3,0 31,0 13,6	3 (b)
Hospital WW (µg/l)			11 29 20	2 (b)	3,4 3,4 3,4	1 (b)		

References:

a) (Schlabach, et al., 2009)
b) (Huber, et al., NA)

Conclusion:

The compound was monitored in Norway, Faroe Islands, Greenland and Iceland. It was detected in several matrices:

- Biota in Norway
- STP sludge in all countries and in all samples analysed. The values detected were high
- Surface water in Faroe Islands and Greenland, not in Norway. Higher values were detected in Iceland
- STP effluent water in all countries
- Hospital waste water in all countries monitored. Higher values were detected in Faroe Islands
- STP influent in all countries monitored

3.3 Compounds monitored in at least two studies

3.3.1 Amoxicillin

CAS nr.: 26787-78-0
Info: Beta-lactam antibiotic
Toxicity data: LOEC (Pseudokirchneriella subcapitata)= 2200 ng/L
PNECaqua = 0,0037 µg/l (Schlabach, et al., 2007)

Amoxicillin	**Norway (a)**		**Sweden (b)**	
Matrix	Min max AD	Nr.S (ref)	Min max AD	Nr.S (ref)
Biota	nd	4	nd	9
Sediment	nd	6	nd	1
STP sludge	nd	4	nd	5
STP effluent	nd	14	nd	5
Surface water	nd	11		
Hospital WW	nd	5	nd	2
Influent			nd	5

References:
a) (Schlabach, et al., 2007)
b) (Johansson, et al., 2003)

Conclusion:
The compound has been monitored in one study in Norway and one in Sweden. It was not detected in any matrix in either study.

3.3.2 Ampicillin

CAS nr.: 69-53-4
Info: beta-lactam antibiotic
Toxicity data: EC50 for bacteriae (Vibrio fischeri) (24 hours): 163 mg/l (Hellström & Kreuger, 2005)
PNEC = 45,7 µg/l (Schlabach, et al., 2007)

Ampicillin	**Denmark (a)**		**Sweden (b)**	
Matrix	Min max AD	Nr.S (ref)	Min max AD	Nr.S (ref)
STP sludge	nd	10	nd	5
Sediment			nd	1
STP effluent	nd	9	nd	5
Biota			nd	9
Pig slurry	nd	4		
influent	nd	9	nd	5
Hospital WW			nd	2
Surface water (up stream and down stream of fish farms)	nd	16		
Ground water	nd	3		
Warning system for pesticide leaching to groundwater	nd	8		
Drain water	nd	1		

References:
a) (Mogensen, et al., 2008)
b) (Johansson, et al., 2003)

Conclusion:
The compound was monitored in one study in Denmark and one in Sweden. It was not detected in any matrix in either country.

3.3.3 Benzylpenicillin

CAS nr.: 61-33-6 (free acid) / 69-57-8 (sodium salt)
Info: beta-lactam antibiotic also known as penicillin G
Toxicity data: LOEC (Microcystis aeruginosa)= 6 000 ng/L (Schlabach, et al., 2009)
PNEC = NA

Benzylpenicillin	**Denmark (a)**		**Norway (b)**	
Matrix	Min max AD	Nr.S (ref)	Min max AD	Nr.S (ref)
STP sludge	nd	10	nd	4
STP effluent	nd	9	nd	14
Biota (mussel)			nd	4
Sediment			nd	6
Surface water			nd	16
Pig slurry	nd	4		
influent	nd	9		
Surface water (up stream and down stream of fish farms)	nd	16		
Ground water	nd	3		
Warning system for pesticide leaching to groundwater	nd	8		
Drain water	nd	1		

References:
a) (Mogensen, et al., 2008)
b) (Schlabach, et al., 2009)

Conclusion:
The compound was monitored in one study in Denmark and one in Norway. The compound was not detected in any sample in either country.

3.3.4 Cefuroxime

CAS nr.: 55268-75-2
Info: second-generation cephalosporin antibiotic
Toxicity data:
NOEL 72 hr (Selenastrum capricornutum) = 91 mg/l
NOEL 96 hr (Selenastrum capricornutum)= 120 mg/l
EC50 21 days (Daphnia sp.)> 1000 mg/l
(SFT, 2006)
PNEC = 91 µg/l (Thomas, et al., 2007)

LCefuroxime	Norway (a)		Sweden (b)	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
STP sludge	nd	7	nd	4
STP effluent (µg/l)	nd	7	nd 0,15 0,15	5
Biota			nd	9
Sediment			nd	1
Influent (µg/l)			0,138 0,243 0,195	4
Hospital WW			nd	2

References:

a) (Thomas, et al., 2007)
b) (Johansson, et al., 2003)

Conclusion:

The compound was monitored in one study in Norway and one in Sweden. It was detected in influent and in only one effluent sample in Sweden, at a concentration below the PNEC. It was also detected in STP influent in Sweden at concentrations below the PNEC.

3.3.5 Chlortetracycline

CAS nr.: 57-62-5
Info: Tetracycline antibiotic
Toxicity data:
(Park & Choi, 2008)
LOEC 7 days (L. gibba) = 0,069 – 0,65 mg/l
EC50 7 days (M. aeruginosa)= 0,05 mg/l
PNEC = 0,05 µg/l (Park & Choi, 2008)

Chlortetracycline	Denmark (a)		Norway (b)		Sweden (c)	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Surface water	nd	16[35]			nd	18
Groundwater	nd	3[36]			nd	2[37]

[35] up and downstream of fish farms
[36] include 2 samples in groundwater located by a hospital

Chlortetracycline	Denmark (a)		Norway (b)		Sweden (c)	
STP Influent	nd	9				
Effluent	nd	9	nd	7		
Sediment					nd	19
Warning system for pesticide leaching to ground-water (mg/kg dw)	nd 2,1 2,1	9				
Drain water	nd	1				
Pig slurry	nd	4				
Manure from farms					nd	6
Soil from farms					nd	6
STP Influent	nd	9				
STP sludge			nd	7		

References:

a) (Mogensen, et al., 2008)
b) (Thomas, et al., 2007)
c) (Sternbeck, et al., 2007a)

Conclusion:

The compound was monitored in Denmark, Norway and Sweden and was only detected in one sample for Warning system for pesticide leaching to groundwater. The compound was not detected in any other matrix monitored in either country.

3.3.6 Demeclocycline

CAS nr.: 127-33-3
Info: Tetracycline anibiotic
Toxicity data:
Toxicity of tetracycline (SFT, 2006)
EC50 7 days (Microcystis aeruginosa)= 0,09 mg/l
EC50 21 days (Daphnia sp.)= 44,8 mg/l
LC50 96 hr (Salvelinus namaycush)= 220 mg/l
PNEC (tetracycline) = 0,09 µg/l (SFT, 2006)

[37] groundwater located by farms

Demeclocycline	Norway (a)		Sweden (b)	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*	*min* *max* *AD*	*Nr.S* *(ref)*
STP sludge (µg/kg dw)	nd	7	nd 1200 650	61
Effluent	nd	7	nd	52
Biota			nd	3[38]
Sediment (µg/kg dw)			nd 29 29	7[39]
Surface water			nd	13[40]
Leachates from landfill			nd	10[41]
Influent (µg/l)			nd 0,049 0,049	19
Manure			nd	5
Hospital WW			nd	7

References:
a) (Thomas, et al., 2007)
b) (Andersson, et al., 2006)

Conclusion:
The compound was monitored in one study in Norway and one in Sweden. The compound was detected not detected in any matrix in Norway, but was detected in several matrices in Sweden. It was detected in Sweden in STP sludge, sediment and in only one STP influent sample. The value detected in STP influent was below the PNEC determined for tetracyclines.

3.3.7 Enrofloxacin

CAS nr.: 93106-60-6
Info: Fluoroquinolone antibiotic
Toxicity data
EC50 24 hr(Daphnia magna)= 11,47 mg/l
EC50 5 days (M. aeruginosa)= 0,049 mg/l
LC50 96 hr (L. macrochirus) > 10 mg/l

[38] fish for human consumption
[39] includes 3 samples from farms
[40] includes 7 samples at proximity of farms
[41] included 1 treated sample

(Park & Choi, 2008)
PNEC = 0,049 µg/l (Park & Choi, 2008)

Enrofloxacin	**Denmark (a)**		**Norway (b)**		**Sweden (c)**	
Matrix	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Biota			nd	6		
Sediment (µg/kg dw)			nd 17 12,7	16	nd	19
Surface water	nd	16[42]	nd	8	nd	30
Groundwater	nd	3[43]			nd	2[44]
STP Influent	nd	9	nd	8		
STP effluent (µg/l)	nd	9	nd	4		
STP sludge (µg/kg dw)	nd	10	nd	6		
Warning system for pesticide leaching to groundwater	nd	8				
Farm soil					nd	6
Drain water	nd	1				
manure					nd	6
Landfill water leachates			nd	9[45]		
Pig slurry	nd	4				

References:

a) (Mogensen, et al., 2008)
b) (Møskeland, et al., 2006)
c) (Sternbeck, et al., 2007a)

Conclusion:

The compound was monitored in Denmark, Norway and Sweden. It was only detected in sediment samples from Norway. The compound was not detected in any other matrice in either country.

[42] upstream and downstream of fish farms
[43] including 2 measurements in groundwater at proximity of a hospital
[44] groundwater located at proximity of farms
[45] both treated and untreated leachates

3.3.8 Flumequine

CAS nr.: 42835-25-6
Info: Synthetic chemotherapeutic antibiotic of the fluoroquinolone drug class
Toxicity data:
EC50 (Microcystis aeruginosa)= 1,96 mg/l
EC50 (Pseudokirchneriella subcapitata)= 5 mg/l
EC50 (Vibrio fischeri) = 0,198 mg/l
(Sternbeck, et al., 2007a)
PNEC = NA

Flumequine	Norway (a)		Sweden (b)		Faroe Islands (c)	
Matrix	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Biota	nd	4[46]				
Sediment (ng/g dw)	nd	9[47]	nd	19	0,24 0,34 0,29	12
Surface water	nd	11[48]	nd	30[49]		
Groundwater			nd	2		
Farm soil			nd	6		
Manure			nd	6		

References:
a) (Schlabach, et al., 2009)
b) (Sternbeck, et al., 2007a)
c) (Gustavson, et al., 2009)

Conclusion:
The compound was monitored in one Norwegian, one Swedish, and one Faroes Island study. It was detected only in sediment in Faroe Islands.

3.3.9 Oxolinic Acid

CAS nr.: 14698-29-4
Info: Quinolone antibiotic
Toxicity data: NA

[46] mussel
[47] at proximity of fish farms
[48] at proximity of fish farms
[49] includes sampling at proximity of farms

PNEC = 0,42 µg/l (Schlabach, et al., 2007)

Oxolinic Acid	Norway (a)		Sweden (b)		Faroe Islands (c)	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*	*min* *max* *AD*	*Nr.S* *(ref)*	*min* *max* *AD*	*Nr.S* *(ref)*
Biota	nd	4[50]				
Sediment (µg/kg dw)	nd 11,2 5,57	9[51]	nd	19	0,45 3,47 1,91	12
Surface water (µg/l)	nd 0,002 0,0015	10[52]	nd	30[53]		
Groundwater			nd	2		
Farm soil			nd	6		
Manure			nd	6		

References:

a) (Schlabach, et al., 2009)
b) (Sternbeck, et al., 2007a)
c) (Gustavson, et al., 2009)

Conclusion:

The compound was monitored in one Swedish, one Norwegian study and one study in Faroe Islands

It was not detected in any samples from Sweden

The compound was detected in sediment samples and surface water samples at proximity of fish farms in Norway

The compound was detected in sediment samples samples at proximity of fish farms in Faroe Islands

3.3.10 Penicillin V

CAS nr.: 87-08-1
Info: Penicillin antibiotic
Toxicity data: NA
PNEC = NA

[50] mussel
[51] at proximity of fish farms
[52] at proximity of fish farms
[53] includes sampling at proximity of farms

Penicillin V	Denmark (a)		Sweden (b)	
Matrix	*Mi max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Biota			nd	9
Effluent	nd	6	nd	5
Sediment			nd	1
STP sludge			nd	5
STP Influent			nd	5
Hospital WW			nd	2

References:

a) (Kjølholt, et al., 2003)
b) (Johansson, et al., 2003)

Conclusion:

The compound was monitored in one Danish and one Swedish study, but was not detected in any matrice sampled in either country.

3.3.11 Silver

CAS nr.: 7440-22-4
Info: Antiseptic and desinfectant
Toxicity data
Ag^+ LC50 7day (Oncorhynchus mykiss) = 0.0032 mg/l
(Svenson, et al., 2009)
PNEC = NA

Silver	Norway		Sweden	
Matrix	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Biota(mg/kg dw)	0,003 0,019 0,085	9 (a)		
Biota(µg/kg fat weight)			nd 1,0 0,65	21 (c)
Sediment (mg/kg dw)	192,6 426,6 310,8	7 (b)	0,1 44 3,03	49 (c)
Sludge (mg/kg dw)			0,12 88,7 10,78	45 (c)
Surface water (µg/l)			nd 0,06 0,015	27 (cd)
Influent (µg/l)			nd 1,4 0,05	137 (cd)
Hospital waste water (µg/l)			0,006 0,07 0,022	8 (c)

Silver	Norway	Sweden	
Laundry effluent (µg/l)		0,054 0,054 0,054	1 (c)
Landfill runoff (µg/l)		0,013 0,83 0,29	9 (c)
Urban runoff (µg/l)		0,018 1,9 0,39	7 (c)
Drinking water (µg/l)		nd 0,011 0,011	5 (c)
Power plant condensate (µg/l)		0,049 0,049 0,049	1 (c)

References:

a) (Green, et al., 2009)
b) (Evenset, et al., 2009)
c) (Svenson, et al., 2009)
d) (Lilja, et al., 2010)

Conclusion:

The compound was monitored in two Swedish and two Norwegian studies and was detected in all matrices monitored in both countries, including surface water and in one drinking water sample. The compound was detected in higher concentraions in biota in Sweden than in Norway. The concentrations detected in sediment were high and ca. 100 times higher in Norway than in Sweden.

3.3.12 Spiramycin

CAS nr.: 8025-81-8
Info: Macrolide antibiotic
Toxicity data: LOEC (Microcystis aeruginosa) = 7 µg/l (Schlabach, et al., 2009)
PNEC = 0,005 µg/l (Schlabach, et al., 2007)

Spiramycin	Norway (a)		Sweden (b)	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*	*min* *max* *AD*	*Nr.S* *(ref)*
Biota	nd	3[54]		

[54] mussel

Spiramycin	Norway (a)		Sweden (b)	
Sediment	nd	6[55]	nd	19
STP sludge	nd	4		
STP effluent (µg/l)	nd 0,03 0,02	10		
Surface water	nd	12[56]	nd	30[57]
Groundwater			nd	2
Farm soil			nd	6
Manure			nd	6

References:

a) (Schlabach, et al., 2009)

b) (Sternbeck, et al., 2007a)

Conclusion:

The compound was monitored in one Swedish and one Norwegian study and was only detected in STP effluent in Norway. The compound was not detected in any other matrice sampled in either country.

3.3.13 Sulfadimidine

CAS nr.: 57-68-1
Info: A sulfonamide antibacterial
Toxicity data: NA
PNEC = NA

Sulfadimidine	Denmark (a)		Sweden (b)	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*	*min* *max* *AD*	*Nr.S* *(ref)*
Sediment			nd	19
STP sludge	nd	10		
Effluent	nd	9		
Surface water	nd	16[58]	nd	30[59]
Pig slurry	nd	3		
Groundwater	nd	3[60]		
Warning system for pesticide leaching to groundwater	nd	9		
Drain water	nd	1		
Influent	nd	9		
Ground water			nd	2

[55] at proximity of fish farms
[56] at proximity of fish farms
[57] includes sampling at proximity of farms
[58] up and downstream of fish farms
[59] includes sampling at proximity of farms
[60] including 2 at proximity of hospital

Sulfadimidine	Denmark (a)	Sweden (b)	
Farm soil		nd	6
manure		nd	6

References:

a) (Mogensen, et al., 2008)
b) (Sternbeck, et al., 2007a)

Conclusion:

The compound was monitored in one Swedish and one Danish study and was not detected in any matrix in either country.

3.3.14 Sulfadoxine

CAS nr.: 2447-57-6
Info: An ultra-long-lasting sulfonamide
Toxicity data: NA
PNEC = NA

Sulfadoxine		Denmark (a)		Sweden (b)
Matrix	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Sediment			nd	19
STP sludge	nd	10		
STP effluent	nd	9		
Surface water	nd	16[61]	nd	30[62]
Pig slurry	nd	3		
Groundwater	nd	3[63]	nd	2
Warning system for pesticide leaching to groundwater (mg/kg dw)	nd 0,19 0,19	9		
Drain water	nd	1		
Influent	nd	9		
Farm soil			nd	6
Manure			nd	6

[61] up and downstream of fish farms
[62] includes sampling at proximity of farms
[63] including 2 at proximity of hospital

References:
a) (Mogensen, et al., 2008)
b) (Sternbeck, et al., 2007a)

Conclusion:
The compound was monitored in one Swedish and one Danish study and was detected in only one sample for Warning system for pesticide leaching to groundwater.The compound was not detected in any other matrix in either country.

3.3.15 Tylosine

CAS nr.: 1401-69-0
Info: Macrolide-class antibiotic used in veterinary medicine
Toxicity data:
EC50 7 days (Microcystis aeruginosa) = 34 µg/l
NOEC 7 days (Lemna gibba) = 300 – 1 000 µg/l
NOEC 21 days (Daphnia magna) = 45 000 µg/l
EC50 72 hr (Selenastrum capricornutum) = 950 µg/l
EC50 21 days (Aporrectodea caliginosa) = 4530 mg/kg dw
(Sternbeck, et al., 2007a)
PNEC = NA

	Denmark (a)		Sweden (b)	
Matrix	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Sediment			nd	19
STP sludge	nd	10		
Effluent	nd	9		
Surface water	nd	16[64]	nd	30
Pig slurry	nd	3		
Groundwater	nd	3[65]	nd	2
Warning system for pesticide leaching to groundwater (mg/kg dw)	nd	9		
Drain water	nd	1		
Influent	nd	9		
Farm soil			nd	6
Manure			nd	6

References:
a) (Mogensen, et al., 2008)
b) (Sternbeck, et al., 2007a)

[64] up and downstream of fish farms
[65] including 2 at proximity of hospital

Conclusion:
The compound was monitored in one Swedish and one Danish study and was not detected in any matrix in either country.

3.4 Compounds monitored in one study

	1,2,3,4-Tetrachloro benzene (634-66-2)	1,3,5-Trichloro-benzene (108-70-3)	1,2,4-Trichloro-benzene (120-82-1)	1,2,3-Trichloro-benzene (87-61-6)	1,2,3,5- + 1,2,4,5-Tetrachloro-benzene	
Matrix	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*Nr.S*
STP influent	nd	nd	nd	nd	nd	7

Reference:

- (Lilja, et al., 2010)

	Bronopol (52-51-7)		DDMAC (7173-51-5)		Propiconazole (60207-90-1)		Resorcinol (108-46-3)		2(Tiocyano-methylthio)benzo-thiazole (21564-17-0)		4-Chloro-3-cresol (59-50-7)		4-chloro-3-methylphenol (59-50-7)	
Matrix	*min* *max* *AD*	*Nr.S*	*min* *max* *AD*	*Nr.S*	*min* *max* *AD*	*Nr.S*	*min* *max* *AD*	*Nr.S*	*min* *max* *AD*	*Nr.S*	*min* *max* *AD*	*Nr.S*	*min* *max* *AD*	*Nr.S*
Air (ng/m3)	nd	9			nd 0,39 0,3	6[66]	nd nd nd	9					nd	6
Biota	nd	8	nd	4	nd nd nd	7	nd nd nd	8	nd	1	nd	1	nd	6
Sediment (µg/kg dw)	nd	15	nd	15	nd nd nd	17	nd nd nd	17	nd	7	nd	7	nd	9
STP sludge (µg/kg dw)	nd	14	nd 61000 13080	25	nd 54 36	28	nd 380 187	22	nd	11	nd 40 19,6	11	nd 67 25,1	19
STP effluent (µg/l)	nd	2	nd	2	nd 0,1 0,06	7	nd nd nd	2					nd 0,02 0,02	4
Influent water (µg/l)	nd	1	nd	1	nd nd nd	1	0,078 0,078 0,078	1	nd	1	nd	1		
Surface water (µg/l)	nd	19	nd	22	nd 0,03	24	nd nd	25	nd	16	nd 0,11	16	nd	9

[66] was only detected in air samples from a wood impregnation plant

	Bronopol (52-51-7)		DDMAC (7173-51-5)		Propiconazole (60207-90-1)		Resorcinol (108-46-3)		2(Tiocyano-methylthio)benzo-thiazole (21564-17-0)	4-Chloro-3-cresol (59-50-7)	4-chloro-3-methylphenol (59-50-7)	
					0,03		nd			0,06		
Precipitation	nd	3					nd nd nd	2				
Deposition (ng/m2.d)					nd nd nd	3					nd 1,8 1,8	3
Leachates from land-fill (µg/l)			nd	3	nd nd nd	3					nd 0,7 0,7	3
Food	nd	5	nd	6								

Reference:

- (Remberger, et al., 2006)

	Danofloxacin (112398-08-0)	**Difloxacin (3116-76-5)**	**Dihydro-streptomycin (128-46-1)**	**Gentamycin (1403-66-3)**	**Marbofloxacin (115550-35-1)**	**Sarafloxacin (98105-99-8)**	**Sulfabenz-amide (127-71-9)**	**Sulfacet-amide (144-80-9)**	**Sulfachloro-pyridazine (80-32-0)**	**Sulfaclozin (102-65-8)**	**Sulfadi-methoxine (122-11-2)**	
Matrix	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*Nr.S*
Sediment (µg/kg dw)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	19
Surface water (ng/l)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	30
Ground water (ng/l)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	2
Manure (µg/kg dw)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	6
Soil (µg/kg dw)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	6

	Sulphafurazole (127-69-5)	**Sulfaguanidine (57-67-0)**	**Sulfamerazine (127-79-7)**	**Sulfameter (651-06-9)**	**Sulfamethoxy-pyridazine (000080-35-3)**	**Sulfamono-methoxine (1220-83-3)**	**Sulfamoxole (729-99-7)**	**Sulfanilamide (63-74-1)**	**Sulfapyridine (000144-83-2)**	**Sulfaquinox-aline (59-40-5)**	**Sulfatiazol 872-14-0)**	
Matrix	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*Nr.S*
Sediment (µg/kg dw)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	19
Surface water (ng/l)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	30
Ground water (ng/l)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	2
Manure (µg/kg dw)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	6
Soil (µg/kg dw)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	6

Reference:

- (Sternbeck, et al., 2007)

	Azithromycin (83905-01-5)	Clarithromycine (81103-11-9)	Clindamycin (18323-44-9)	Roxithromycin (80214-83-1)	Fluconazole (86386-73-4)	Miconazol (2013-58-3)	
Matrix	min max AD	min max AD	min max AD	min max AD	min max AD	min max AD	Nr.S
Biota (µg/kg)	nd	nd	nd	nd	nd 0,9 0,9	nd	15
Sludge (µg/kg dw)	nd 5,6 5,6	nd 13 5,23	5,9 21 15,2	nd	2,6 47 13,84	170 410 262	5
Effluent (ng/l)	nd 27 15,3	nd 780 123,6	31 280 137,8	nd 980 252,8	55 1100 373,6	nd 9,2 7,7	13
Surface water (ng/l)	nd 27 16,2	nd 1100 165,2	nd 140 37,3	nd 1100 463,3	1,8 290 50,18	nd	15
STP influent (ng/l)	nd 44 13,5	38 620 262,4	37 230 97,7	nd 890 398,8	97 2100 679,7	nd 48 14,3	12
Drinking water (ng/l)	nd	nd	nd	nd	nd 3,3 2,63	nd	6

Reference:

- (Fick, et al., 2011)

	Cefadroxil (66592-87-8)	Metronidazol (443-48-1)	
Matrix	*min* *max* *AD*	*min* *max* *AD*	*Nr.S*
Biota	nd	nd	9
Sediment	nd	nd	1
STP sludge	nd	nd	5
STP Influent (µg/l)	nd 0,077 0,077	nd 0,081 0,081	5
STP effluent (µg/l)	nd 0,082 0,082	nd	5
Hospital WW (µg/l)	nd	nd 45,15 45,15	2

References:

- (Johansson, et al., 2003)

	Chlorocycline (57-62-5)	
Matrix	*min* *max* *AD*	*Nr.S*
Biota	nd	3
Sediment (µg/kg dw)	nd	7
STP sludge (µg/kg dw)	nd	60
STP effluent (µg/l)	nd 0,68 0,26	52
Influent water (µg/l)	nd 0,34 0,26	19
Surface water	nd	5
Leachates from landfill (µg/l)	nd 0,005 0,005	8d
Hospital WW (µg/l)	nd 0,001 0,001	12
Manure	nd	5

***Reference*:**

- (Andersson, et al., 2006)

	Zinc pyrithione (13463-41-7)	
Matrix	*min* *max* *AD*	*Nr.S*
Sediment	nd	16
STP sludge	nd	34
STP effluent and influent (ng/l)	nd 17 9,45	40
Surface water (ng/l)	nd	13
Landfill leachates (ng/l)	nd	1
Hospital WW (ng/l)	nd 32 32	2

Reference:

- (Woldegiorgis, et al., 2007a)

	Chlorhexidine (55-56-1)	
Matrix	*min* *max* *AD*	*Nr.S*
Biota	nd	7
Sediment	nd	7
STP sludge	nd	11
Farm soil	nd	3
Effluent	nd	16
STP influent	nd	10
Surface water	nd	12

Reference:

- (Törneman, 2011a)

	Florfenicol (73231-34-2)	Phenoxymethyl-penicillin (87-08-1)	Sulfatroxazol (23256-23-7)	Tiamulin (55297-95-5)	
Matrix	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*Nr.S*
STP sludge (µg/kg dw)	nd	nd	nd	nd	10
Surface water (µg/l)	nd 0,22 0,1	nd	nd	nd	16
Effluent (µg/l)	nd	nd	nd	nd	9
STP influent (µg/l)	nd	nd	nd	nd	9
Pig slurry	nd	nd	nd	nd	4
Groundwater	nd	nd	nd	nd	3

	Florfenicol (73231-34-2)	Phenoxymethyl-penicillin (87-08-1)	Sulfatroxazol (23256-23-7)	Tiamulin (55297-95-5)	
Warning system for pesticide leaching to groundwater (mg/kg dw)	nd	nd	nd	nd 0,21 0,21	8
Drain water	nd	nd	nd	nd	1

Reference:

- (Mogensen, et al., 2008)

	Ketoconazol (65277-42-1)	
Matrix	*min* *max* *AD*	*Nr.S*
Effluent	nd	7

Reference:

- (Kjølholt, et al., 2003)

	Meclocycline (2013-58-3)	
Matrix	*min* *max* *AD*	*Nr.S*
STPsludge	nd	7
Effluent	nd	7

***Reference*:**

- (Thomas, et al., 2007)

	Cefalotin (153-61-7)	Cefotaxime (63527-52-6)	Meropenem 8119478-56-7)	Pivmecillinam (33817-20-8)	
Matrix	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*Nr.S*
Biota	nd	nd	nd		3
Sediment	nd	nd	nd		6
STP sludge (ng/g dw)	nd	nd	nd		4
Effluent (ng/l)	nd	nd 577 187,3	nd		10
Surface water (ng/l)	nd	nd 441 167	nd		12

***Reference*:**

- (Schlabach, et al., 2009)

	Linezolid (165800-03-3)	
Matrix	*min* *max* *AD*	*Nr.S*
Biota	nd	6
Sediment (µg/kg dw)	nd 25 25	16
STP sludge(µg/kg dw)	nd 720 720	6
Effluent (µg/l)	nd 6,1 6,1	4
STP influent (µg/l)	nd 5,4 5,4	8
Surface water (µg/l)	nd	8
Treated landfill leachates (µg/l)	nd 0,66 0,66	5
Untreated landfill leachates (µg/l)	nd 2,8 2,8	4

***Reference*:**

- (Møskeland, et al., 2006)

4. Hormones and hormone antagonists

4.1 Scope and definition

This category includes natural and synthetic hormones as well as hormone antagonists. The antagonists are typically active ingredients used in the treatment of prostatic and breast cancer.

These compounds have an endocrine disruption effect, that may affect wild species when released to the environment.

Table 3 presents hormones and hormone antagonists identified in monitoring studies the Nordic countries.

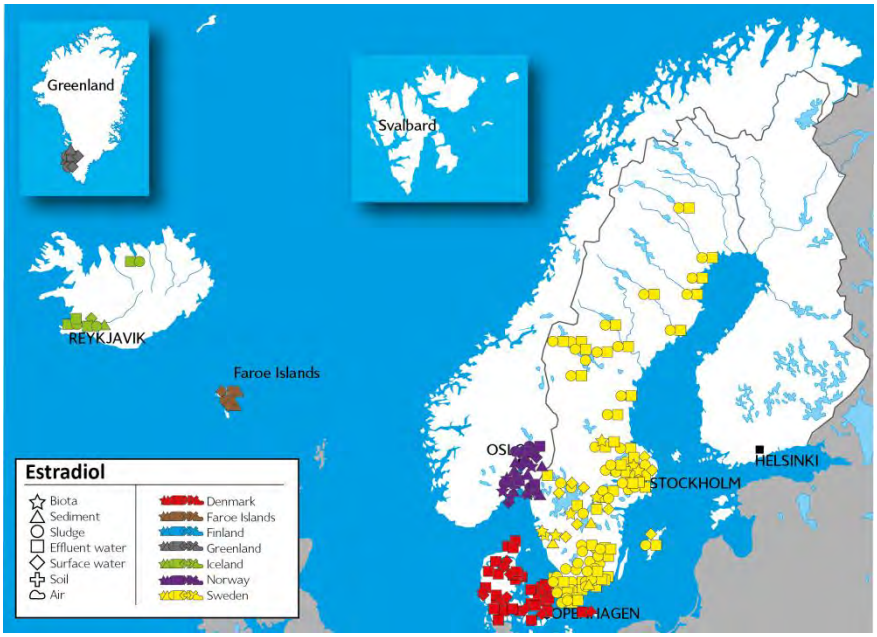
Table 3: Hormones and hormone antagonists monitored in the Nordic countries

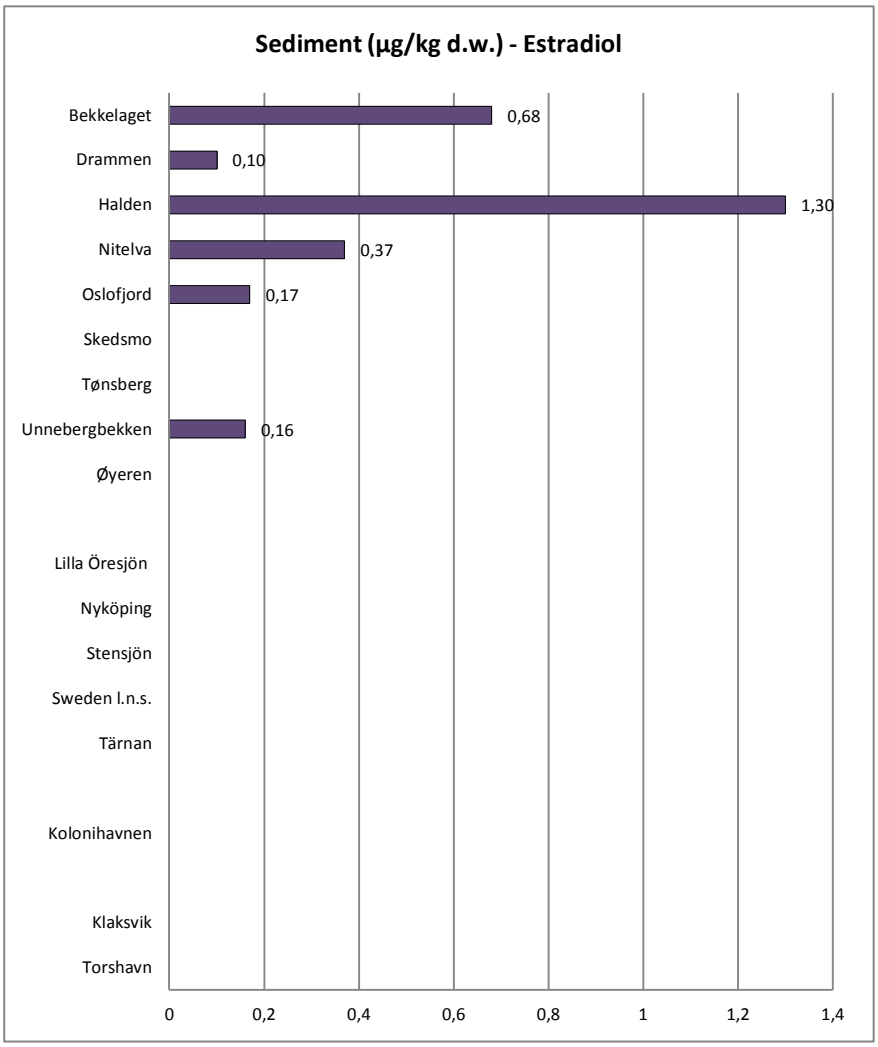
Compounds monitored	CAS nr
Estradiol	50-28-2
Estriol (hormone)	50-27-1
Estrone (hormone)	53-16-7
Ethinylestradiol (hormone)	57-63-6
Etonogestrel (progesterone)	54048-10-1
Finasteride (synthetic antiandrogen)	98319-26-7
Flutamide, antiandrogen (antagonist)	13311-84-7
Levonorgestrel (progestogen)	797-63-7
Norethindrone (progestogen)	68-22-4
Progesterone (hormone)	57-83-0
Tamoxifen (antagonist of estrogen)	10540-29-1

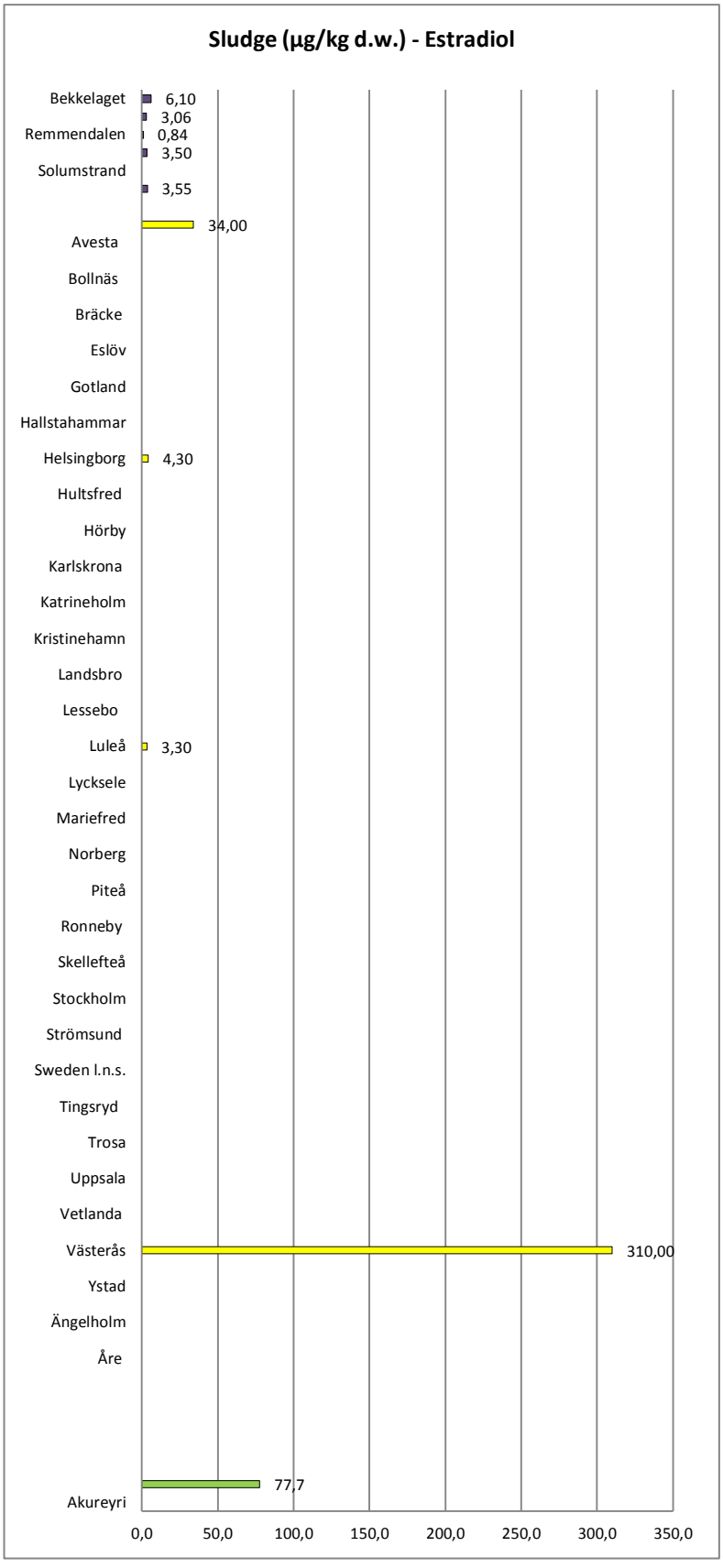
4.2 Compounds mapped

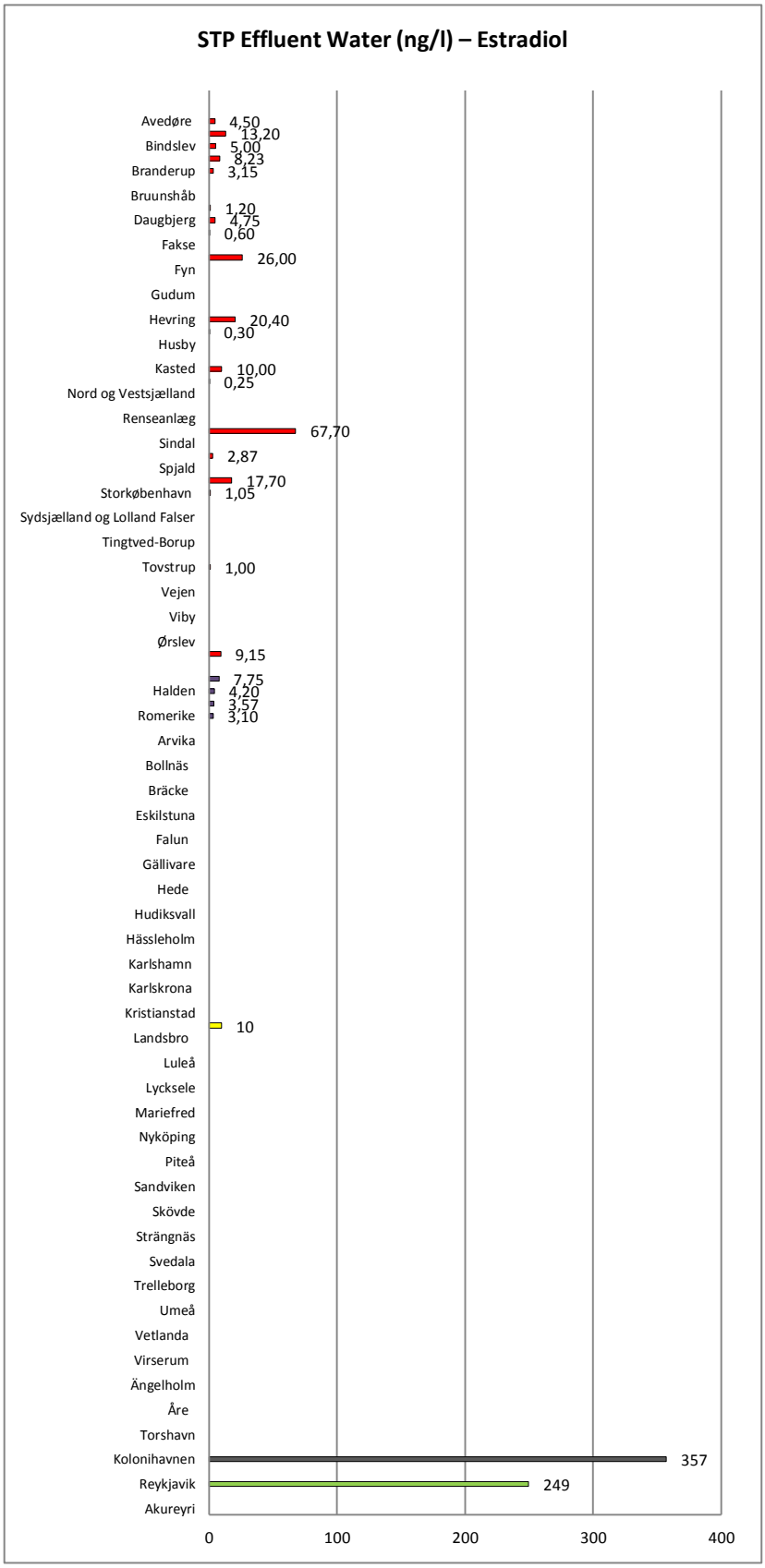
4.2.1 Estradiol (17β-estradiol)

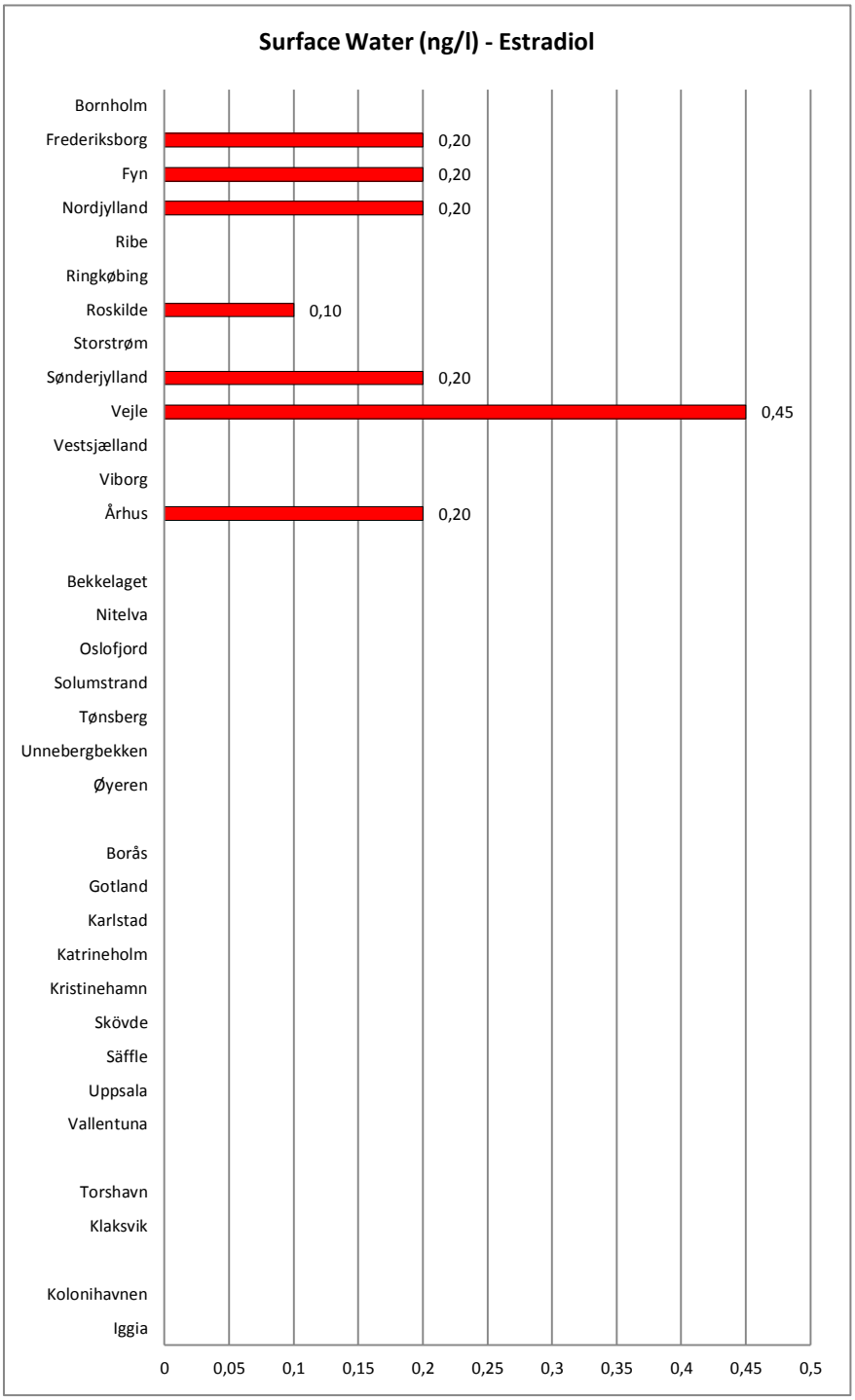
CAS nr.: 50-28-2
Info: Estradiol (E2 or 17β-estradiol, also oestradiol) is a sex hormone. It is also a metabolite of testosterone.
Toxicity data:
LOEL (Oryzias latipes) = 0,004 µg/l
NOEL (Oryzias latipes) induced intersex (testis-ova) = 0,0004 µg/l (Andersson, et al., 2006)
NEC = 0,00002 µg/l (Schlabach, et al., 2007)


Greenland
Svalbard
REYKJAVIK
Faroe Islands
OSLO
STOCKHOLM
HELSINKI
COPENHAGEN
Estradiol
Biota
Sediment
Sludge
Effluent water
Surface water
Soil
Air
Denmark
Faroe Islands
Finland
Greenland
Iceland
Norway
Sweden


Sediment (µg/kg d.w.) - Estradiol
Bekkelaget
Drammen
Halden
Nitelva
Oslofjord
Skedsmo
Tønsberg
Unnebergbekken
Øyeren
Lilla Öresjön
Nyköping
Stensjön
Sweden l.n.s.
Tärnan
Kolonihavnen
Klaksvik
Torshavn
0,68
0,10
1,30
0,37
0,17
0,16
0
0,2
0,4
0,6
0,8
1
1,2
1,4


Sludge (µg/kg d.w.) - Estradiol
Bekkelaget
Remmendalen
Solumstrand
Avesta
Bollnäs
Bräcke
Eslöv
Gotland
Hallstahammar
Helsingborg
Hultsfred
Hörby
Karlskrona
Katrineholm
Kristinehamn
Landsbro
Lessebo
Luleå
Lycksele
Mariefred
Norberg
Piteå
Ronneby
Skellefteå
Stockholm
Strömsund
Sweden l.n.s.
Tingsryd
Trosa
Uppsala
Vetlanda
Västerås
Ystad
Ängelholm
Åre
Akureyri
6,10
3,06
0,84
3,50
3,55
34,00
4,30
3,30
310,00
77,7
0,0
50,0
100,0
150,0
200,0
250,0
300,0
350,0


STP Effluent Water (ng/l) – Estradiol
Avedøre
Bindslev
Branderup
Bruunshåb
Daugbjerg
Fakse
Fyn
Gudum
Hevring
Husby
Kasted
Nord og Vestsjælland
Renseanlæg
Sindal
Spjald
Storkøbenhavn
Sydsjælland og Lolland Falser
Tingtved-Borup
Tovstrup
Vejen
Viby
Ørslev
Halden
Romerike
Arvika
Bollnäs
Bräcke
Eskilstuna
Falun
Gällivare
Hede
Hudiksvall
Hässleholm
Karlshamn
Karlskrona
Kristianstad
Landsbro
Luleå
Lycksele
Mariefred
Nyköping
Piteå
Sandviken
Skövde
Strängnäs
Svedala
Trelleborg
Umeå
Vetlanda
Virserum
Ängelholm
Åre
Torshavn
Kolonihavnen
Reykjavik
Akureyri
4,50
13,20
5,00
8,23
3,15
1,20
4,75
0,60
26,00
20,40
0,30
10,00
0,25
67,70
2,87
17,70
1,05
1,00
9,15
7,75
4,20
3,57
3,10
10
357
249
0
100
200
300
400


Surface Water (ng/l) - Estradiol
Bornholm
Frederiksborg
Fyn
Nordjylland
Ribe
Ringkøbing
Roskilde
Storstrøm
Sønderjylland
Vejle
Vestsjælland
Viborg
Århus
Bekkelaget
Nitelva
Oslofjord
Solumstrand
Tønsberg
Unnebergbekken
Øyeren
Borås
Gotland
Karlstad
Katrineholm
Kristinehamn
Skövde
Säffle
Uppsala
Vallentuna
Torshavn
Klaksvik
Kolonihavnen
Iggia
0,20
0,20
0,20
0,10
0,20
0,45
0,20
0
0,05
0,1
0,15
0,2
0,25
0,3
0,35
0,4
0,45
0,5

Estradiol	Norway		Denmark		Sweden		Faroe Islands (h)		Greenlan (h)		Iceland (h)	
Matrix	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Biota (µg/kg ww)	nd	6 (a)			nd	18 (fg)						
STP sludge (µg/kg dw)	nd 7 3,28	13 (ab)			nd 310 87,90	66 (fg)	nd	2	nd	2	nd 77,7 77,7	3
Sediments (µg/kg dw)	nd 1,30 0,46	12 (a)			nd	7 (f)	nd	3	nd	2		
Landfild leachate sediments (µg/kg dw)	nd 0,77 0,77	4 (a)										
Untreated landfill leachates (ng/l)	nd 5 3,83	4 (a)			nd	7 (f)						
Treated landfill leachates (ng/l)	nd 3 2,63	5 (a)										
Surface water (ng/l)	nd 0,25 1,19	8 (a)	nd 0,70 0,26	124 (c)	nd 2 2	32 (fg)	nd	5	nd	5		
STP Influent (ng/l)	nd 15,50 8,54	8 (a)	0,10 25,5 10,29	14 (c)	nd 1,20 1,20	31 (fg)	nd 465 465	2			nd	5
STP effluent (ng/l)	nd 7,75 4,29	11 (ab)	nd 67,7 8,16	100 (cde)	nd 10 10	68 (fg)	nd	2	357 357 357	1	nd 249 249	5
Drinking water (ng/l)					nd	6 (g)						
Manure					nd	5 (f)						
Hospital WW (ng/l)					nd	7 (f)	nd	2	342 375 358,4	2		
Miscellaneous[67] (ng/l)			0,10 23,3 1,89	107 (c)								

References:

a) (Møskeland, et al., 2006)
b) (Thomas, et al., 2007)
c) (Stuer-Lauridsen, et al., 2005)
d) (Kjølholt, et al., 2003)
e) (Ingerslev, et al., 2003)
f) (Andersson, et al., 2006)

[67] Samples where distinction between upstram/downstream and influent/effluent makes no sense

g) (Fick, et al., 2011)
h) (Huber, et al., NA)

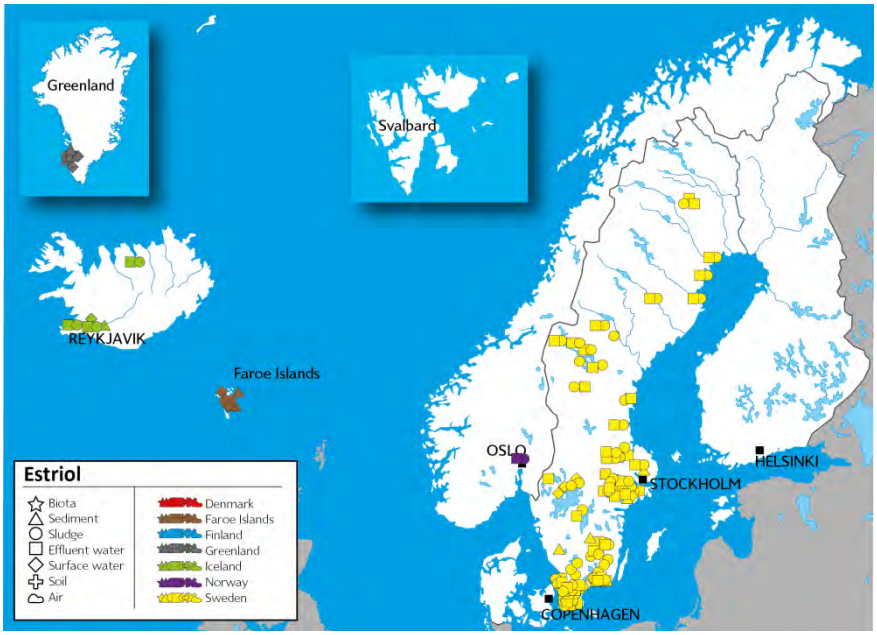
Conclusion:
The compound has been monitored in two studies in Norway, three studies in Denmark, two studies in Sweden and one study for Faroe Islands, Greenland and Iceland.

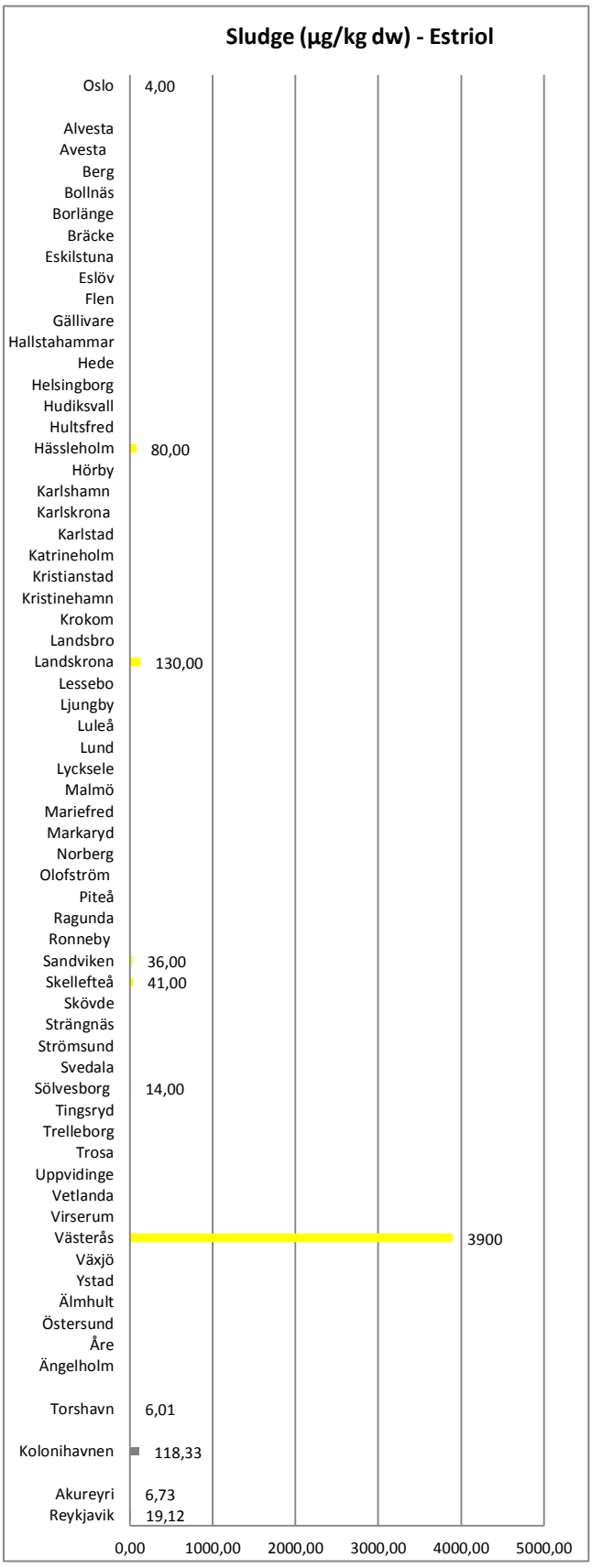
Estradiol has been detected in several matrices:

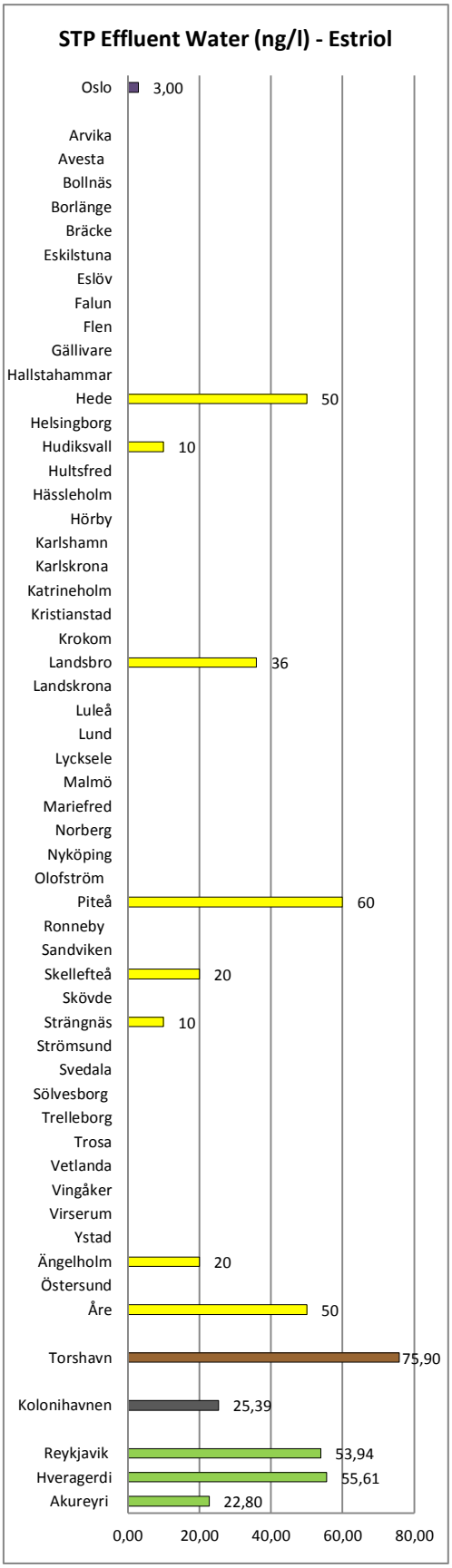
- STP sludge in Norway, Sweden and Iceland. The lowest values were detected in Norway. The highest values were detected in Sweden, five times higher than in Iceland and about fourty times higher than in Norway
- Sediment in Norway only
- Surface water only in Norway, Denmark, and Sweden in concentration above the PNEC
- STP effluent water, in all the countries except Faroe Island. The lowest values were detected in Norway. The concentration in Denmark was almost ten times higher than in Norway. The highest concentration was detected in Greenland and Iceland. All detected values were above PNEC value
- STP influent in Norway, Denmark and Sweden. The lowest concentration was detected in Sweden while the highest in Faroe Islands
- Hospital wastewater in similar concentration only in Greenland

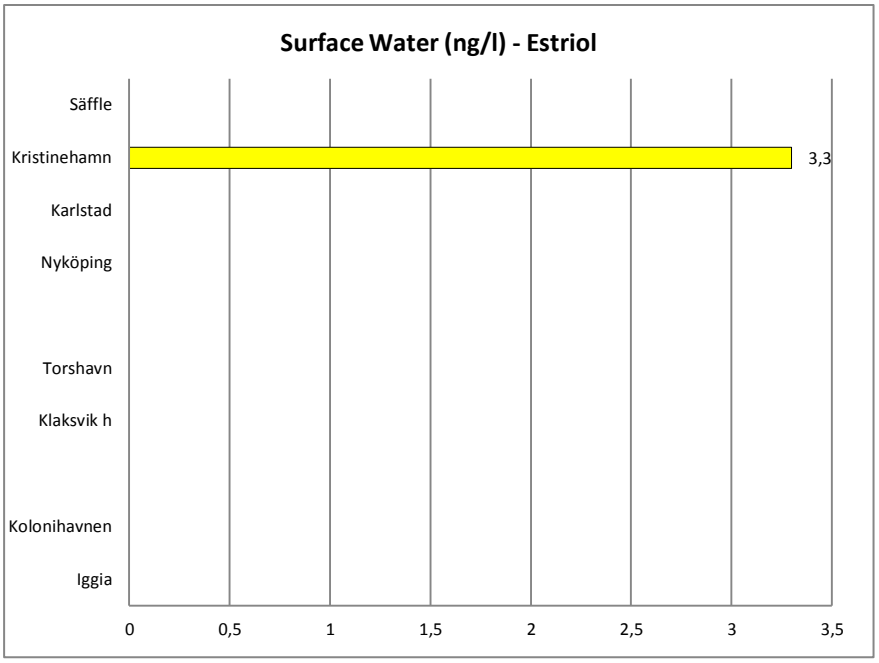
4.2.2 Estriol

CAS nr.: 50-27-1
Info: Extrogen hormone antagonist for estradiol
Toxicity data: LOEL (Oryzias latipes) induced intersex (testis-ova), exposure from hatching, 90 days = 0.75 µg/l
(Andersson, et al., 2006)
PNEC = 0,00075 µ/l (Schlabach, et al., 2007)




Sludge (µg/kg dw) - Estriol
Oslo
Alvesta
Avesta
Berg
Bollnäs
Borlänge
Bräcke
Eskilstuna
Eslöv
Flen
Gällivare
Hallstahammar
Hede
Helsingborg
Hudiksvall
Hultsfred
Hässleholm
Hörby
Karlshamn
Karlskrona
Karlstad
Katrineholm
Kristianstad
Kristinehamn
Krokom
Landsbro
Landskrona
Lessebo
Ljungby
Luleå
Lund
Lycksele
Malmö
Mariefred
Markaryd
Norberg
Olofström
Piteå
Ragunda
Ronneby
Sandviken
Skellefteå
Skövde
Strängnäs
Strömsund
Svedala
Sölvesborg
Tingsryd
Trelleborg
Trosa
Uppvidinge
Vetlanda
Virserum
Västerås
Växjö
Ystad
Älmhult
Östersund
Åre
Ängelholm
Torshavn
Kolonihavnen
Akureyri
Reykjavik
4,00
80,00
130,00
36,00
41,00
14,00
3900
6,01
118,33
6,73
19,12
0,00
1000,00
2000,00
3000,00
4000,00
5000,00


STP Effluent Water (ng/l) - Estriol
Oslo
3,00
Arvika
Avesta
Bollnäs
Borlänge
Bräcke
Eskilstuna
Eslöv
Falun
Flen
Gällivare
Hallstahammar
Hede
50
Helsingborg
Hudiksvall
10
Hultsfred
Hässleholm
Hörby
Karlshamn
Karlskrona
Katrineholm
Kristianstad
Krokom
Landsbro
36
Landskrona
Luleå
Lund
Lycksele
Malmö
Mariefred
Norberg
Nyköping
Olofström
Piteå
60
Ronneby
Sandviken
Skellefteå
20
Skövde
Strängnäs
10
Strömsund
Svedala
Sölvesborg
Trelleborg
Trosa
Vetlanda
Vingåker
Virserum
Ystad
Ängelholm
20
Östersund
Åre
50
Torshavn
75,90
Kolonihavnen
25,39
Reykjavik
53,94
Hveragerdi
55,61
Akureyri
22,80
0,00
20,00
40,00
60,00
80,00



Estriol	Norway (a)		Sweden(b)		Faroe Islands (c)		Greenland (c)		Iceland (c)	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota (µg/kg ww)			nd	3						
STP sludge (µg/kg dw)	nd 4 4	7	nd 3900 700,17	61	5,59 6,42 6,01	2	26,7 210 118	2	nd 19,1 12,93	3
Sediment (µg/kg dw)			nd	8	nd	3	nd	2		
Landfill leachates, water (ng/l)			nd 20 20	7						
Surface water (ng/l)			nd 3,3 3,3	19	nd	5	nd	5		
STP Influent (ng/l)			nd 24 24	19	58,8 58,8 58,8	2			nd 98,7 85,9	5
STP effluent (ng/l)	nd 3 3	7	nd 60 32	60	75,9 75,9 75,9	1	25,4 25,4 25,4	1	nd 53,9 47,0	5
Manure (µg/kg dw)			nd 180 180	4						
Hospital WW (ng/l)			nd 50 50	7	31 198 114,6	2	135 140 137	2		

References:

a) (Thomas, et al., 2007)
b) (Andersson, et al., 2006)
c) (Fick, et al., 2011)
d) (Huber, et al., NA)

Conclusion:

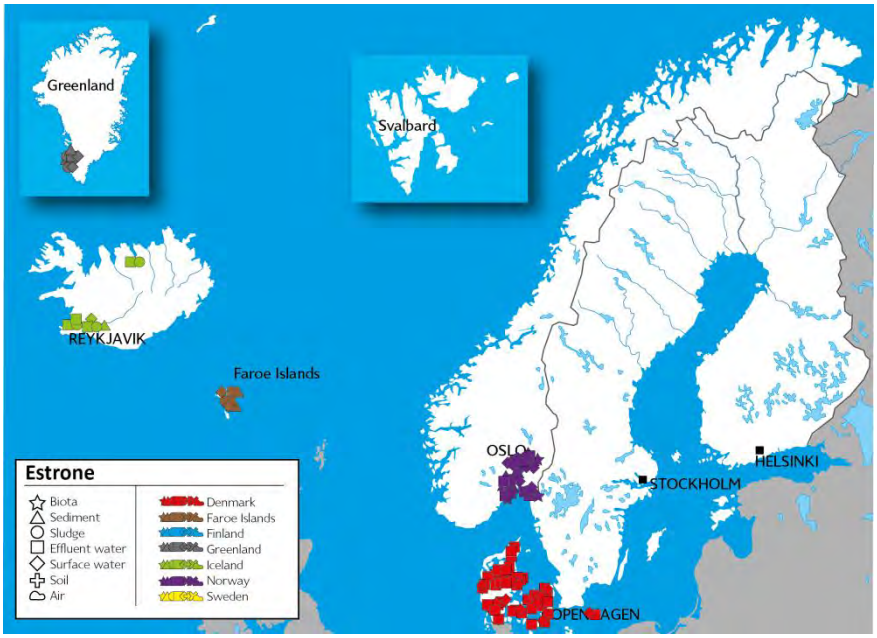
The compound was investigated in one study in Norway, one in Sweden and one in Faroe Islands, Greenland and Iceland.

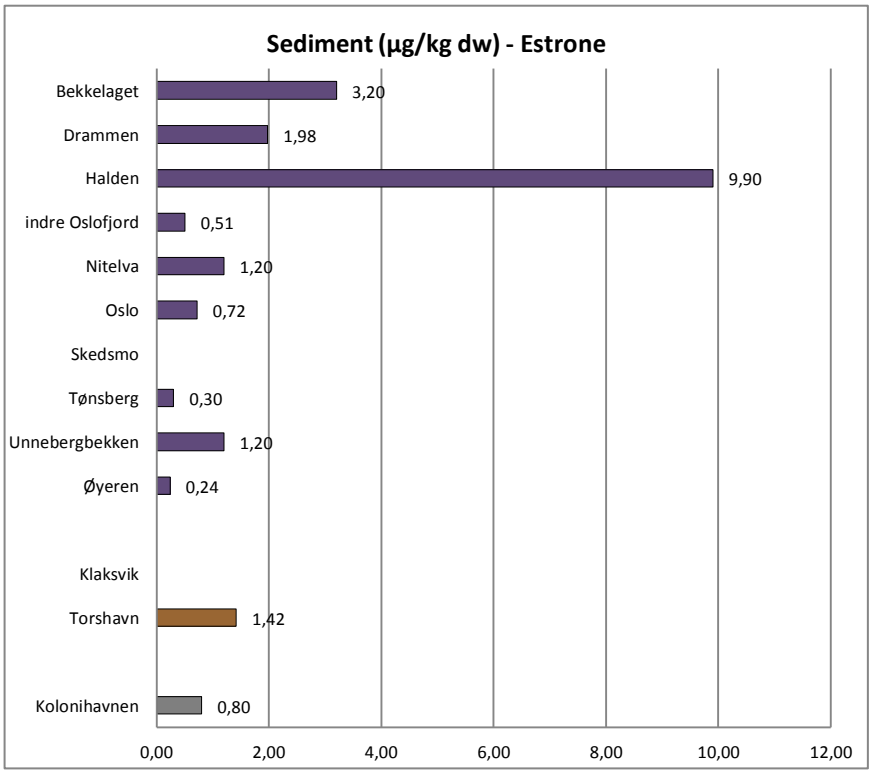
It was detected in several matrices:

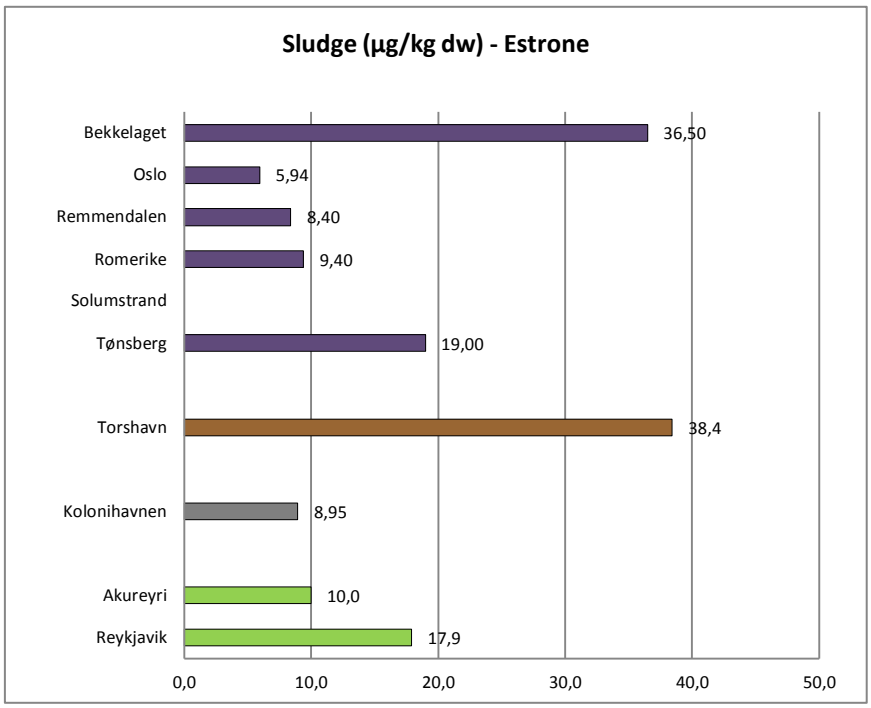
- STP sludge in Sweden, Faroe Islands, Greenland and Iceland. Results from the different countries show a high variability. The concentration detected in Sweden are above twenty times higher than in Greenland and two hundred times higher than in Iceland
- STP effluent water in all countries. The lowest concentration was detected in Norway. High values were detected in Greenland. All the detected values were above the PNEC
- STP influent water in Sweden (lowest concentrations), Faroe Islands (two times higher than Sweden) and in Iceland (four times higher than Sweden)
- Surface water only in Sweden in values were above the PNEC
- Hospital waste water in Faroe Islands and Greenland. The highest values were detected in Greenland
- Landfill leachate and manure in Sweden

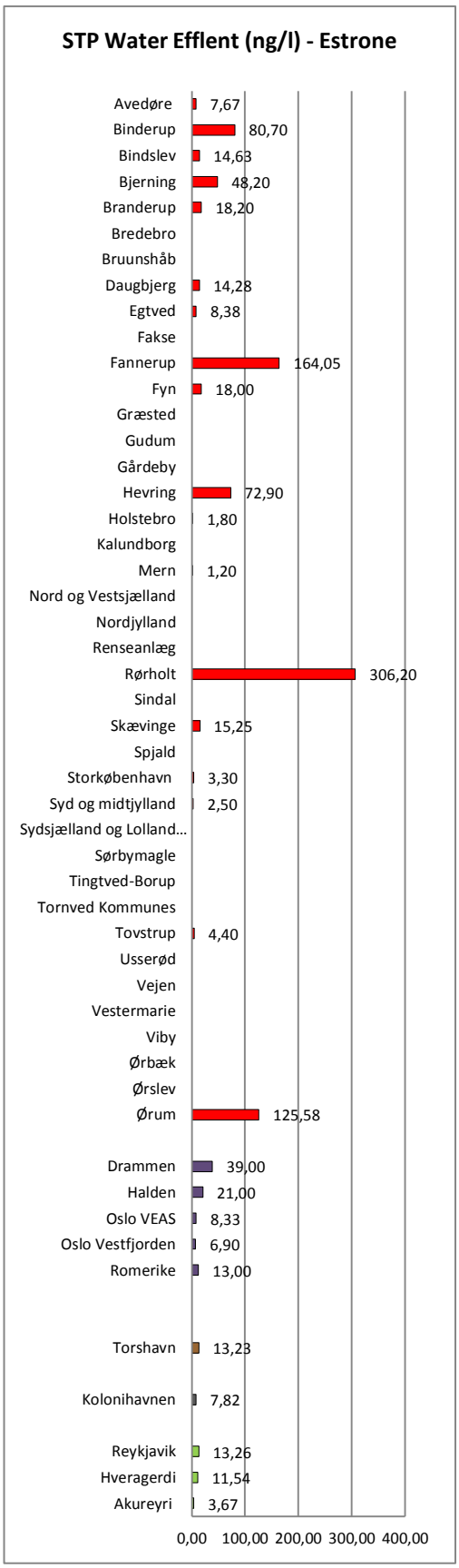
4.2.3 Estrone

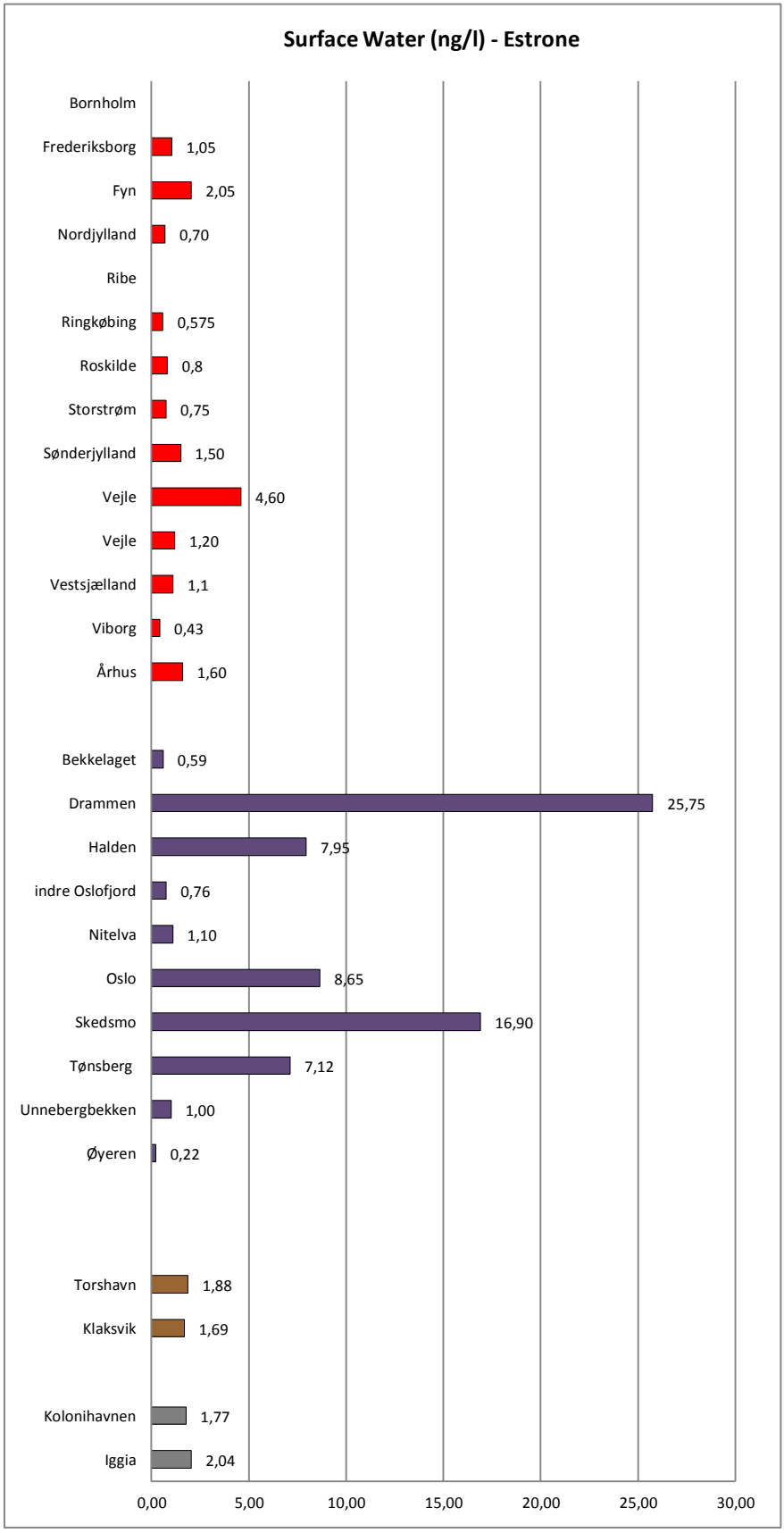
CAS nr.: 53-16-7
Info: Estrogenic hormone
Toxicity data: NA
PNEC = NA






Sludge (µg/kg dw) - Estrone
Bekkelaget
Oslo
Remmendalen
Romerike
Solumstrand
Tønsberg
Torshavn
Kolonihavnen
Akureyri
Reykjavik
36,50
5,94
8,40
9,40
19,00
38,4
8,95
10,0
17,9
0,0
10,0
20,0
30,0
40,0
50,0


STP Water Efflent (ng/l) - Estrone
Avedøre 7,67
Binderup 80,70
Bindslev 14,63
Bjerning 48,20
Branderup 18,20
Bredebro
Bruunshåb
Daugbjerg 14,28
Egtved 8,38
Fakse
Fannerup 164,05
Fyn 18,00
Græsted
Gudum
Gårdeby
Hevring 72,90
Holstebro 1,80
Kalundborg
Mern 1,20
Nord og Vestsjælland
Nordjylland
Renseanlæg
Rørholt 306,20
Sindal
Skævinge 15,25
Spjald
Storkøbenhavn 3,30
Syd og midtjylland 2,50
Sydsjælland og Lolland...
Sørbymagle
Tingtved-Borup
Tornved Kommunes
Tovstrup 4,40
Usserød
Vejen
Vestermarie
Viby
Ørbæk
Ørslev
Ørum 125,58
Drammen 39,00
Halden 21,00
Oslo VEAS 8,33
Oslo Vestfjorden 6,90
Romerike 13,00
Torshavn 13,23
Kolonihavnen 7,82
Reykjavik 13,26
Hveragerdi 11,54
Akureyri 3,67
0,00 100,00 200,00 300,00 400,00


Surface Water (ng/l) - Estrone
Bornholm
Frederiksborg
1,05
Fyn
2,05
Nordjylland
0,70
Ribe
Ringkøbing
0,575
Roskilde
0,8
Storstrøm
0,75
Sønderjylland
1,50
Vejle
4,60
Vejle
1,20
Vestsjælland
1,1
Viborg
0,43
Århus
1,60
Bekkelaget
0,59
Drammen
25,75
Halden
7,95
indre Oslofjord
0,76
Nitelva
1,10
Oslo
8,65
Skedsmo
16,90
Tønsberg
7,12
Unnebergbekken
1,00
Øyeren
0,22
Torshavn
1,88
Klaksvik
1,69
Kolonihavnen
1,77
Iggia
2,04
0,00
5,00
10,00
15,00
20,00
25,00
30,00

Estrone	Norway		Denmark		Faroe Islands (f)		Greenland (f)		Iceland (f)	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota (µg/kg ww)	nd	6 (a)								
STP sludge (µg/kg dw)	nd 36,50 10,7	13 (ab)			15,4 61,4 38,4	2	6,89 11 8,95	2	1,1 18,8 12,6	3
Sediment (µg/kg dw)	nd 9,90 1,64	12 (a)			nd 1,42 1,42	3	nd 0,80 0,80	2		
Landfild leachate sediment (µg/kg dw)	nd 4,9 2,07	4 (a)								
Untreated landfill leachates (ng/l)	4,3 50 16,08	5 (a)								
Treated landfill leacha-tes (ng/l)	6,3 26 14,32	4 (a)								
Surface water (ng/l)	0,22 50 7	8 (ab)	nd 6,4 1,25	124 (c)	nd 2,01 1,83	5	nd 2,09 1,91	5		
STP Influent (ng/l)	10 52 31,5	8 (a)	nd 131 42	14 (c)	8,95 11,6 10,2	2			2,04 20,9 9,91	5
STP effluent (ng/l)	nd 39 14,98	11 (ab)	nd 310 40	100 (cde)	13,2 13,2 13,2	1	7,82 7,82 7,82	1	3,6 13,3 8,7	5
Hospital WW (ng/l)					7,44 18,5 12,97	2	18,9 21 19,95	2		
Miscellaneous[68] (ng/l)			nd 112,4 4,84	106 (c)						

References:

a) (Møskeland, et al., 2006)
b) (Thomas, et al., 2007)
c) (Stuer-Lauridsen, et al., 2005)
d) (Kjølholt, et al., 2003)
e) (Ingerslev, et al., 2003)
f) (Huber, et al., NA)

[68] Samples where distinction between upstram/downstream and influent/effluent makes no sense

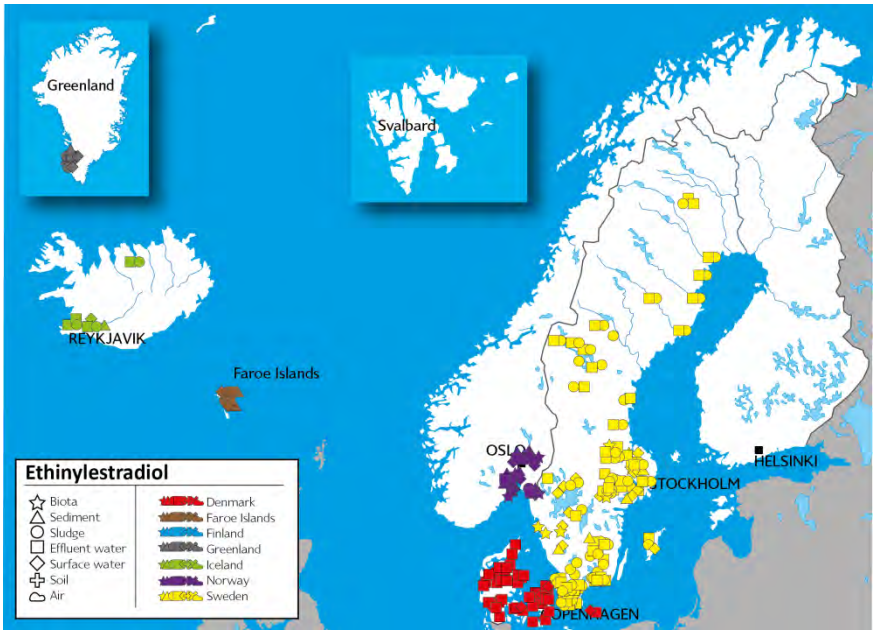
Conclusion:
Estron has been monitored in two studies in Norway, three studies in Denmark and one study in Faroe Islands, Greenland and Iceland.

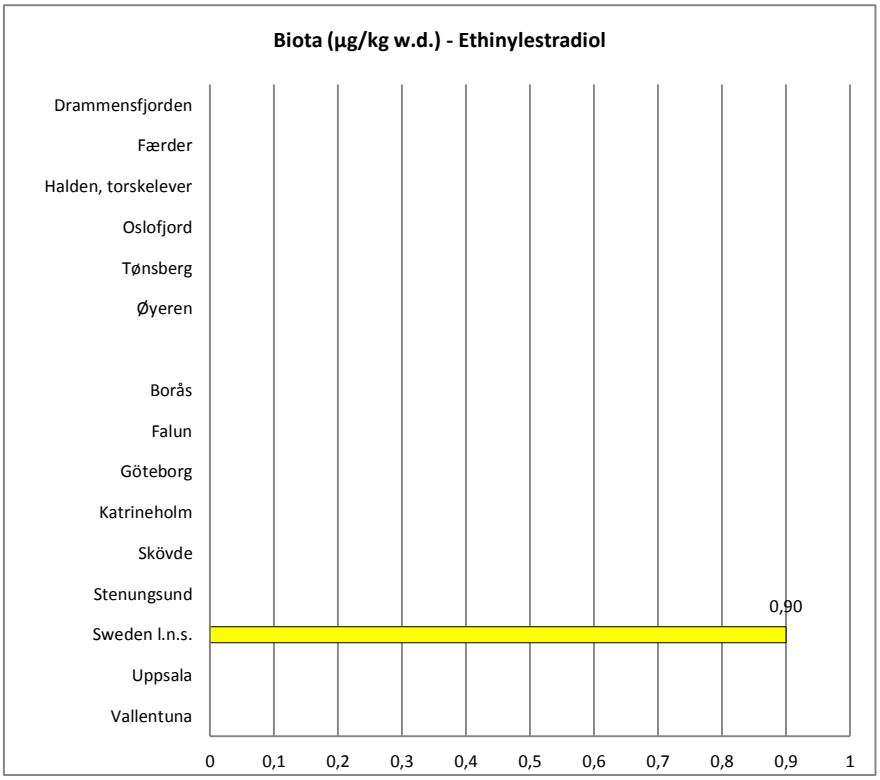
The compound were detected in several matrices:

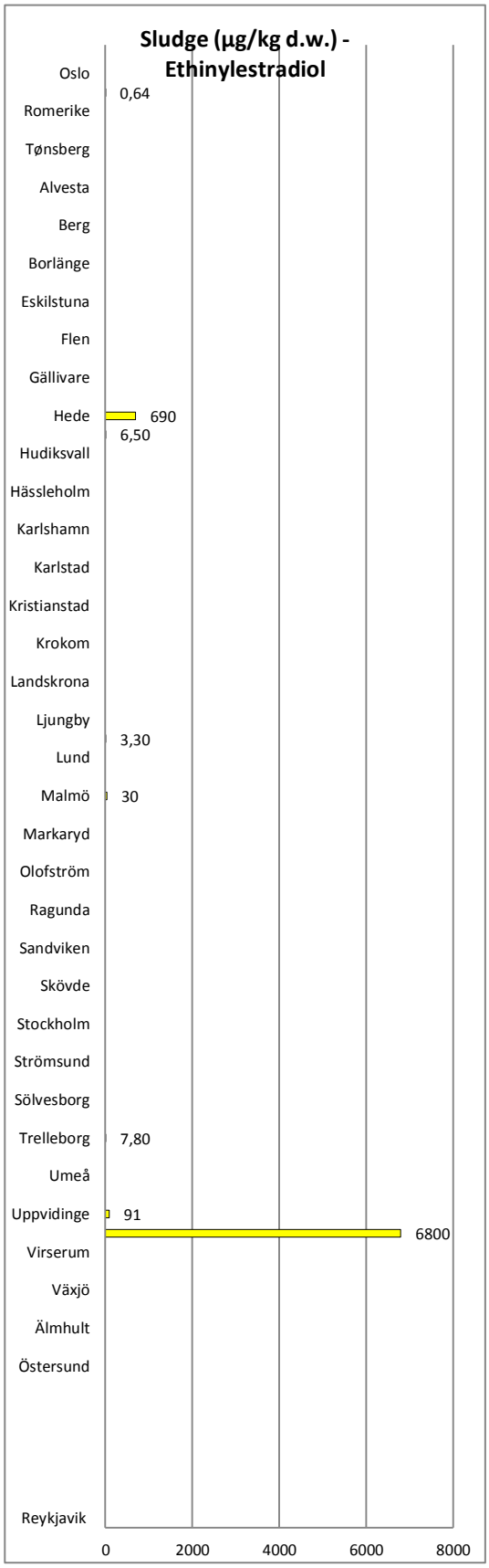
- STP sludge in Norway, Faroe Islands, Greenland and Iceland. The highest values were detected in Faroe Islands
- Sediment in Norway, Faroe Islands and Greenland. The lowest concen-trations were detected in Faroe Island and Greenland whilst the highest were detected in Norway (ten times higher than in the other countries)
- Surface water in Denmark, Faroe Islands and Greenland. Highest values were detected in Norway
- STP effluent water in all the countries. The highest values were detected in Denmark (about ten times higher than in the other countries)
- In STP influent water in Norway, Denmark, Faroe Islands and Iceland. The highest concentration was detected in Denmark
- In hospital waste water in Faroe Islands and Greenland.
- In landfill leachate in Norway
- In miscellaneous samples of water in Denmark

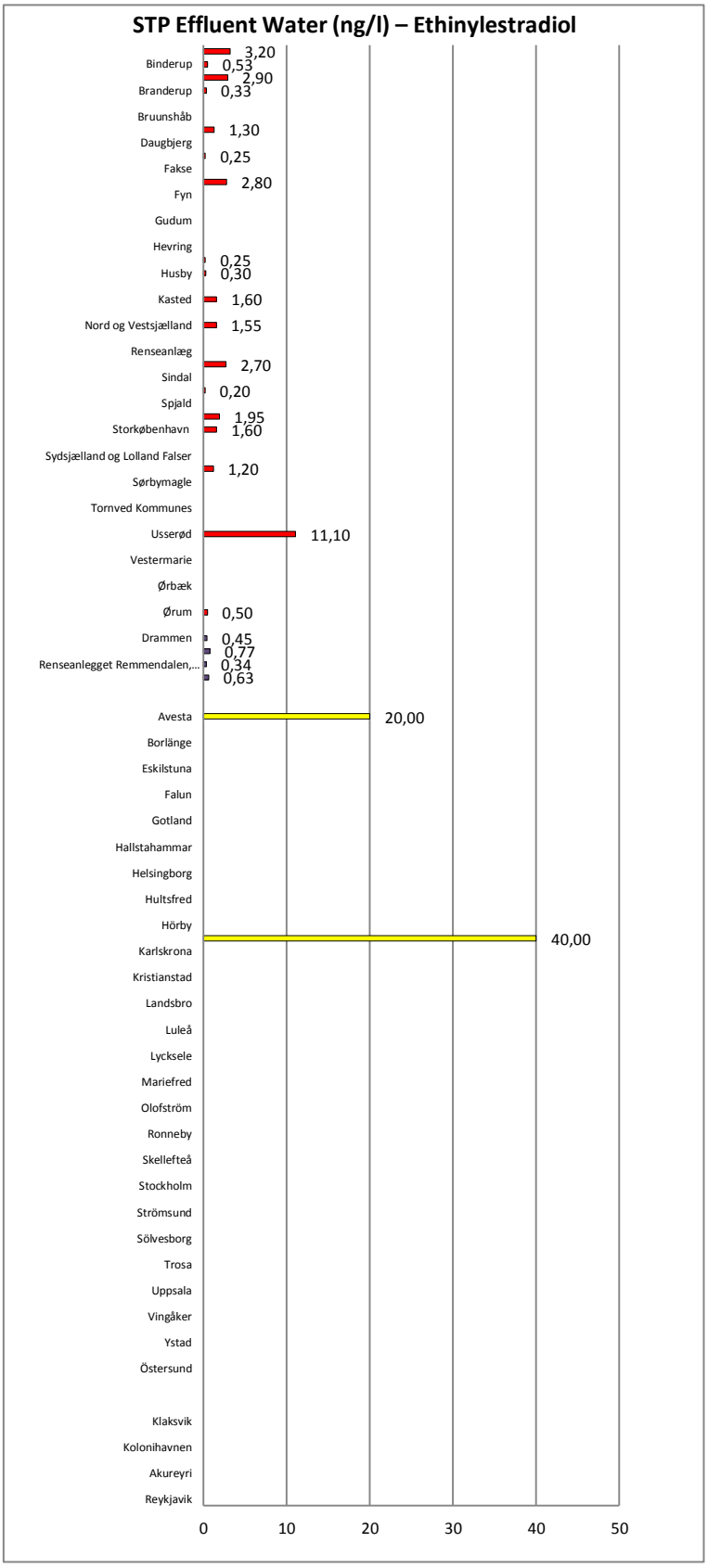
4.2.4 Ethinylestradiol (17α-ethinylestradiol)

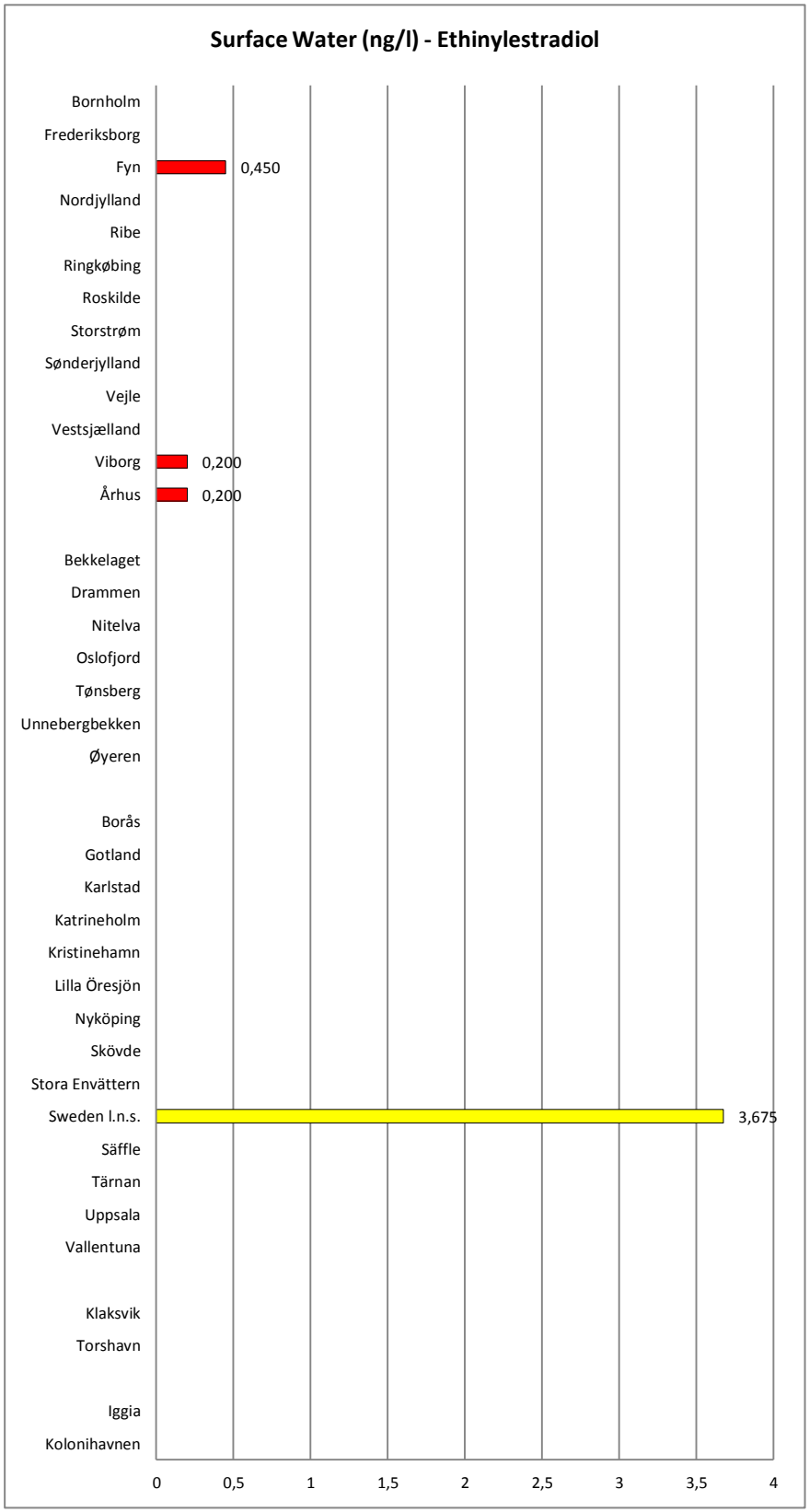
CAS nr.: 57-63-6
Info: Derivative of estradiol used as orally bio-active estrogen used in almost all modern formulations of combined oral contraceptive pills.
Toxicity d*ata: LOEL (Oryzias latipes)> 0,01 µg/l*
(Andersson, et al., 2006)
PNEC = 0,00002 ng/l (Schlabach, et al., 2007)


Greenland
Svalbard
REYKJAVIK
Faroe Islands
OSLO
HELSINKI
TOCKHOLM
COPENHAGEN
Ethinylestradiol
Biota
Sediment
Sludge
Effluent water
Surface water
Soil
Air
Denmark
Faroe Islands
Finland
Greenland
Iceland
Norway
Sweden


Biota (µg/kg w.d.) - Ethinylestradiol
Drammensfjorden
Færder
Halden, torskelever
Oslofjord
Tønsberg
Øyeren
Borås
Falun
Göteborg
Katrineholm
Skövde
Stenungsund
Sweden l.n.s.
Uppsala
Vallentuna
0,90
0
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1


Sludge (µg/kg d.w.) - Ethinylestradiol
Oslo
Romerike
Tønsberg
Alvesta
Berg
Borlänge
Eskilstuna
Flen
Gällivare
Hede
Hudiksvall
Hässleholm
Karlshamn
Karlstad
Kristianstad
Krokom
Landskrona
Ljungby
Lund
Malmö
Markaryd
Olofström
Ragunda
Sandviken
Skövde
Stockholm
Strömsund
Sölvesborg
Trelleborg
Umeå
Uppvidinge
Virserum
Växjö
Älmhult
Östersund
Reykjavik
0,64
690
6,50
3,30
30
7,80
91
6800
0
2000
4000
6000
8000


STP Effluent Water (ng/l) – Ethinylestradiol
Binderup
Branderup
Bruunshåb
Daugbjerg
Fakse
Fyn
Gudum
Hevring
Husby
Kasted
Nord og Vestsjælland
Renseanlæg
Sindal
Spjald
Storkøbenhavn
Sydsjælland og Lolland Falser
Sørbymagle
Tornved Kommunes
Usserød
Vestermarie
Ørbæk
Ørum
Drammen
Renseanlegget Remmendalen,...
Avesta
Borlänge
Eskilstuna
Falun
Gotland
Hallstahammar
Helsingborg
Hultsfred
Hörby
Karlskrona
Kristianstad
Landsbro
Luleå
Lycksele
Mariefred
Olofström
Ronneby
Skellefteå
Stockholm
Strömsund
Sölvesborg
Trosa
Uppsala
Vingåker
Ystad
Östersund
Klaksvik
Kolonihavnen
Akureyri
Reykjavik
3,20
0,53
2,90
0,33
1,30
0,25
2,80
0,25
0,30
1,60
1,55
2,70
0,20
1,95
1,60
1,20
11,10
0,50
0,45
0,77
0,34
0,63
20,00
40,00
0
10
20
30
40
50


Surface Water (ng/l) - Ethinylestradiol
Bornholm
Frederiksborg
Fyn
0,450
Nordjylland
Ribe
Ringkøbing
Roskilde
Storstrøm
Sønderjylland
Vejle
Vestsjælland
Viborg
0,200
Århus
0,200
Bekkelaget
Drammen
Nitelva
Oslofjord
Tønsberg
Unnebergbekken
Øyeren
Borås
Gotland
Karlstad
Katrineholm
Kristinehamn
Lilla Öresjön
Nyköping
Skövde
Stora Envättern
Sweden l.n.s.
3,675
Säffle
Tärnan
Uppsala
Vallentuna
Klaksvik
Torshavn
Iggia
Kolonihavnen
0
0,5
1
1,5
2
2,5
3
3,5
4

Ethinylestradiol	Norway		Denmark		Sweden		Faroe Islands		Greenland		Iceland	
Matrix	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Biota (µg/kg ww)	nd	6 (a)			nd 0,90 0,90	18 (fg)						
STP sludge (µg/kg dw)	nd 0,64 0,64	13 (ab)			nd 6800 1090	53 (f)	nd	2 (h)	nd	2 (h)	nd	3 (h)
Sediments (µg/kg dw)	nd	12 (a)			nd	7 (f)	nd	3 (h)	nd	2 (h)		
Landfild leachate sediments (µg/kg dw)	nd	4 (a)										
Untreated landfill leachates, water (ng/l)	nd 2,80 2,80	4 (a)			nd 35 30	7 (f)						
Treated landfill leachates, water (ng/l)	nd 5 5	5 (a)										
Surface water (ng/l)	nd	8 (a)	nd 0,70 0,30	124 (ce)	nd 10 3,69	34 (fg)	nd	5 (h)	nd	5 (h)		
STP Influent (ng/l)	nd 1,70 0,81	8 (a)	nd 2,60 1,49	11 (c)	nd 50 50	74 (fg)	nd	2 (h)			nd	5 (h)
STP effluent (ng/l)	nd 0,77 0,55	11 (ab)	nd 11,10 1,53	103 (cde)	nd 40 40	73 (fg)	nd	1 (h)	nd	1 (h)	nd	5 (h)
Drinking water (ng/l)												
Manure (µg/kg dw)					nd 82 82	5 (f)						
Drinking water (ng/l)					nd	8 (g)						
Hospital WW (ng/l)					nd 20 15	7 (f)	nd	2 (h)	nd	2 (h)		
Miscellaneous[69] (ng/l)			nd 3,70 2,57	107 (c)								

References:

a) (Møskeland, et al., 2006)
b) (Thomas, et al., 2007)
c) (Stuer-Lauridsen, et al., 2005)

[69] Samples where distinction between upstram/downstream and influent/effluent makes no sense

d) (Kjølholt, et al., 2003)
e) (Ingerslev, et al., 2003)
f) (Andersson, et al., 2006)
g) (Fick, et al., 2011)
h) (Huber, et al., NA)

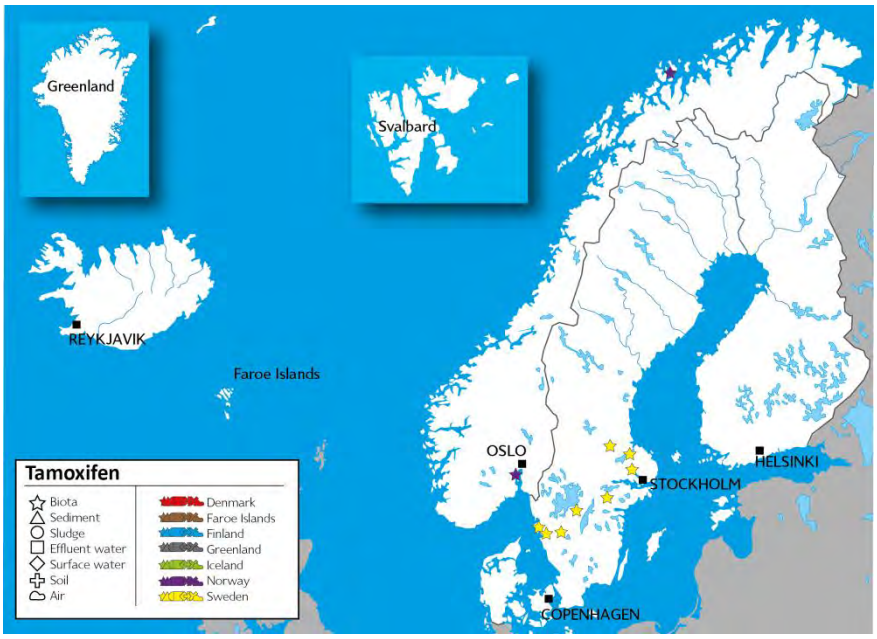
Conclusion:
Ethinylestradiol was monitored in two studies in Norway, three studies in Denmark, two studies in Sweden, and one study in Faroe Islands, Greenland and Iceland.

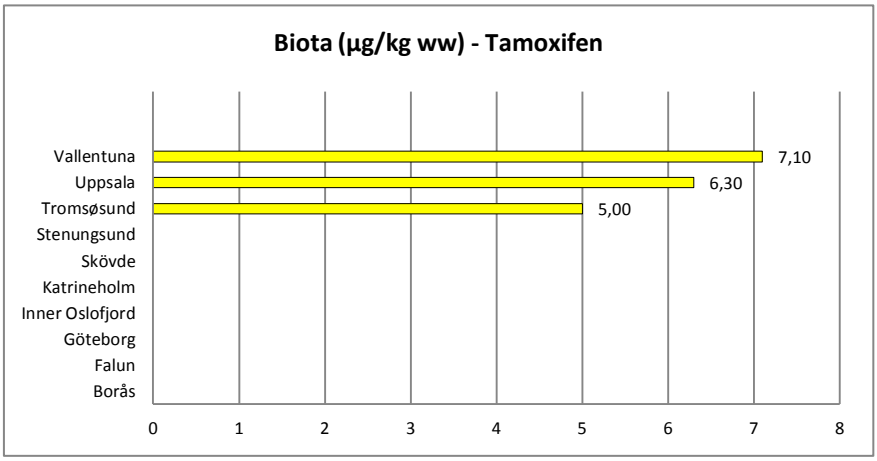
The compound were detected in several matrices:

- Biota in Sweden
- STP sludge in Norway and Sweden
- Surface water in Denmark and Sweden. The highest concentrations were detected in Sweden. All the detected values were above the PNEC
- STP effluent water in Norway, Denmark and Sweden. High variation amongst the three countries. The lowest values were detected in Norway. Highest values were detected in Sweden. All the detected values were above the PNEC
- STP influent water in Norway, Denmark and Sweden. The highest values were detected in Sweden and fill leachates in Norway
- Miscellaneous sample of water in Denmark

4.2.5 Tamoxifen

CAS nr.: 10540-29-1
Info: Used for the treatment of both early and advanced ER+ (estrogen receptor positive) breast cancer in pre- and post-menopausal women. Additionally, it is the most common hormone treatment for male breast cancer.
Toxicity data:
LOEC 5600 ng/l (Schlabach, et al., 2009)
PNEC = 0,49 µg/L (Stuer-Lauridsen, et al., 2011)





Tamoxifen	Norway (a)		Sweden (b)	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota (µg/kg ww)	nd 5 5	3	nd 7,10 6,70	15
STP sludge (µg/kg dw)	nd 2,10 1,50	4	6,70 13 8,76	5
Sediment (µg/kg dw)	nd	6		
Surface water (ng/l)	nd	12	nd 13 10	15

Tamoxifen	Norway (a)		Sweden (b)	
STP Influent (ng/l)			nd 930 208,96	12
STP effluent (ng/l)	nd	10	nd 210 51,68	13
Drinking water (ng/l)			nd	6

References:

a) (Schlabach, et al., 2009)
b) (Fick, et al., 2011)

Conclusion

The compound was monitored in one Norwegian and one Swedish study. It was detected in several matrices:

- Biota in both countries
- STP sludge both in Norway and, in highest consentrations, in Sweden
- STP effluent in Sweden
- Surface water in Sweden
- STP influent in Sweden

4.3 Compounds monitored in one study

	Norethindrone (68-22-4)	Progesterone (57-83-0)	
Matrix	*min* *max* *AD*	*min* *max* *AD*	*Nr.S*
Biota	nd	nd	3
Sediment (µg/kg dw)	nd 12,00 12,00	nd 32 32	7
STP sludge (µg/kg dw)	nd 6100 446,67	nd 1900 141,1	61
STP effluent (ng/l)	nd 10 9	nd 110 29,26	55
Influent water (µg/l)	nd 20 13,83	nd 22 13,12	19
Leachate (ng/l)	nd 40 17,5	nd 20 13,8	7
Surface water (ng/l)	nd 10 7,5	nd 32 13,50	17

	Norethindrone (68-22-4)	Progesterone (57-83-0)	
Hospital WW (ng/l)	nd 30 23,5	nd 20 11,25	7
Manure (µg/kg dw)	nd 66 54	nd 200 112,7	5

Reference:

- (Andersson, et al., 2006)

	Etonogestrel (54048-10-1)	Finasteride (98319-26-7)	Flutamide (13311-84-7)	Levonorgestrel (797-63-7)	
Matrix	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*Nr.S*
Biota (µg/kg)	nd	nd	nd	nd	15
STP sludge (µg/kg dw)	nd	nd	nd	nd	5
Effluent (ng/l)	nd	nd 20 16,6	nd 64 49	nd	13
Surface water (ng/l)	nd	nd 42 27	nd	nd	15
STP influent (ng/l)	nd	nd 28 17,6	nd 110 48,3	nd	12
Drinking water (ng/l)	nd	nd	nd	nd	6

Reference:

- (Fick, et al., 2011)

	17α-estradiol (57-91-0)	
Matrix	min max AD	Nr.S
Surface water (ng/l)	nd 1,8 0,71	124
Influent water (µg/l)	nd 19,5 5,36	14
STP effluent (µg/l)	nd 51,9 5,89	74
Miscellaneous (ng/l)	0,10 17,00 2,32	106[70]

Reference:

- (Stuer-Lauridsen, et al., 2005)

[70] Samples where distinction between upstream/downstream or influent/effluent makes no sense

5. Cardiac and blood pressure medicine and diuretics

5.1 Scope and definition

Cardiac medication includes drugs which treat heart diseases.

Blood pressure medicine is defined as drugs that aim to treat hyper- or hypotension.

Cardiac and blood pressure medication includes beta-blockers, ACE inhibitors, angiotensin II receptor blockers, calcium channel blockers, alpha blockers, alpha-2 receptor agonist, combined alpha and beta-blockers, central agonists, peripheral adrenergic inhibitors, blood vessel dilators, or vasodilators.

Diuretics increase the amount of sodium and water excreted into the urine by the kidneys, one effect is to lower blood pressure mainly by reducing the volume of fluid in the blood vessels. In this manner, there is a large overlap between diuretics and blood pressure medicine, as most drugs classified as "diuretics" are often also used in the treatment of hypertension. Consequently, diuretics are included in this category.

Antithrombotics were not include in this category.

Table 4 presents compounds belonging to this category and identified in monitoring studies in the Nordic countries.

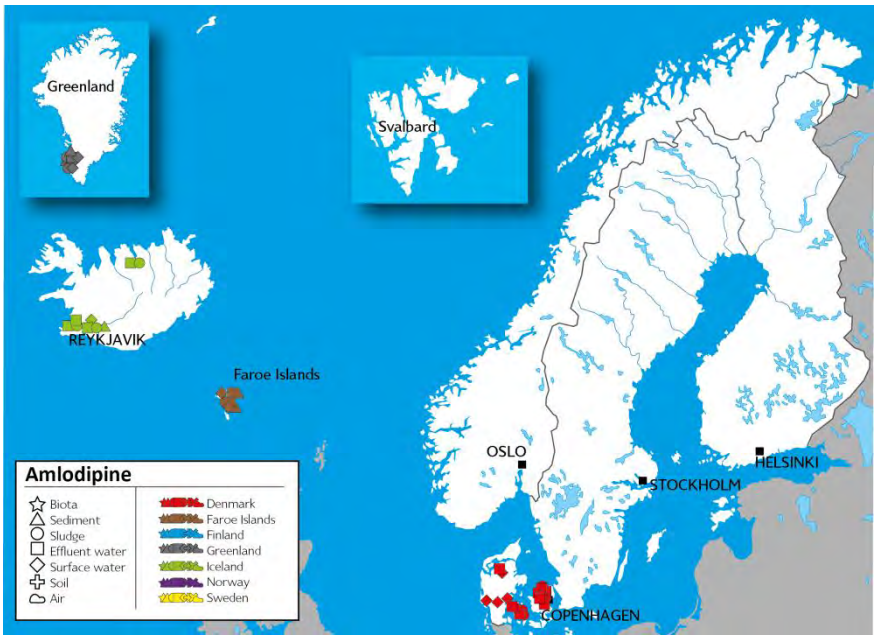
Table 4: Cardiac, blood pressure and diuretics identified in monitoring studies in the Nordic countries

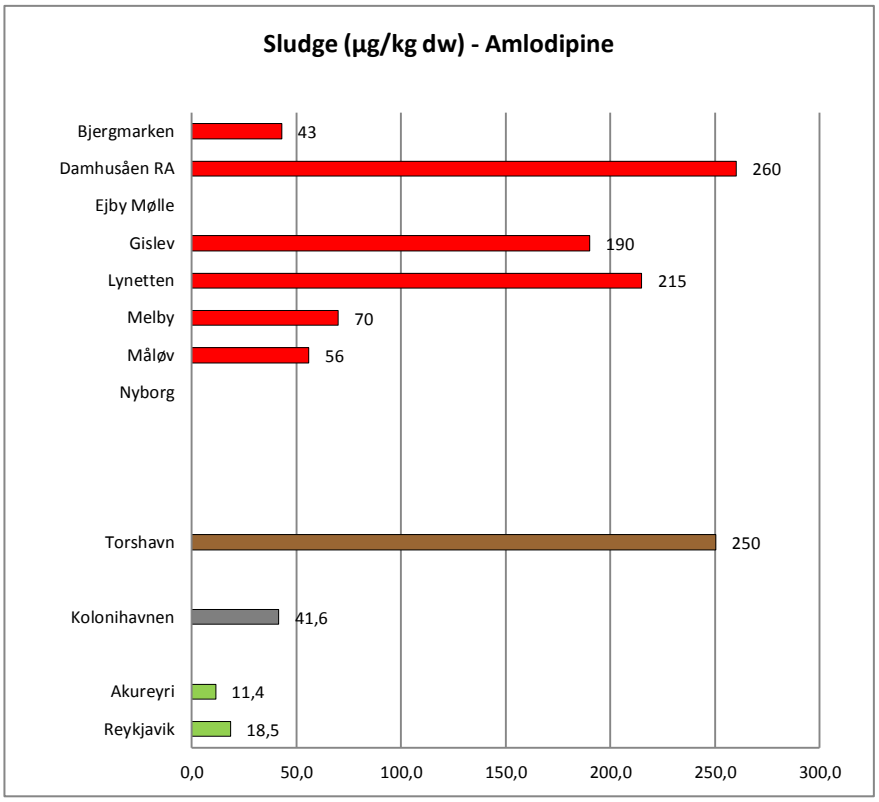
Compounds Monitored	CAS nr
Acebutolol (betablocker)	37517-30-9
Alfuzosin (alfa blocker, diuretic)	81403-80-7
Amiloride (diuretic, used for hypertension)	2016-88-8
Amlodipin (used for hypertension)	88150-42-9
Atenolol (betablocker)	29122-68-7
Bendroflumethiazid (used for hypertension)	73-48-3
Bisoprolol (betablocker)	66722-44-9
Candesartan (angiotensin II receptor antagonist)	139481-59-7
Cilazapril (ACE inhibitor)	88768-40-5
Diltiazem (anti-hypertension)	42399-41-7
Enalapril (angiotensin converting enzyme (ACE inhibitor)	75847-73-3
Eprosartan (used for hypertension)	133040-01-4
Felodipine (used for hypertension)	72509-76-3
Furosemide(diuretic, used for hypertension)	54-31-9
Hydrochlorothiazide (diuretic used for hypertension and congestive heart faillure)	58-93-5
Irbesartan (anti-hypertension)	138402-11-6
Losartan	124750-99-8
Metoprolol (betablocker)	51384-51-1
Propanolol (Beta blocker)	525-66-6
Sotalol (betablocker)	3930-20-9
Telmisartan (used for hypertension)	144701-48-4
Verapamil (calcium channel blocker)	52-53-9

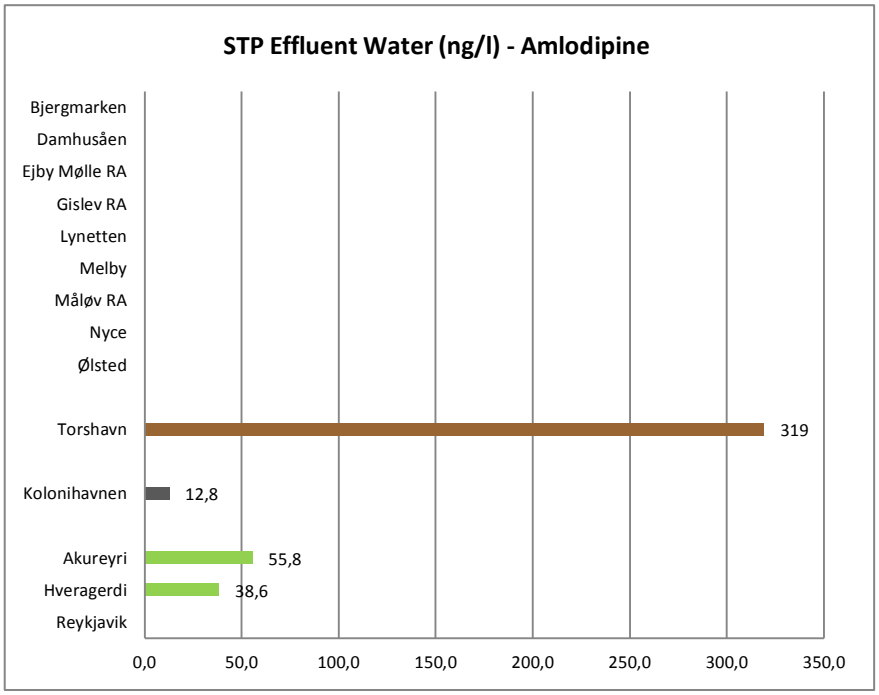
5.2 Compounds mapped

5.2.1 Amlodipine

CAS nr.: 88150-42-9
Info: Cardioselective beta blocker with ISA (intrinsic sympathomimetic) activity. Long-acting calcium channel blocker (dihydropyridine (DHP) class) used as an anti-hypertensive and in the treatment of angina.
Toxicity data: NA
PNEC = NA




Sludge (µg/kg dw) - Amlodipine
Bjergmarken
Damhusåen RA
Ejby Mølle
Gislev
Lynetten
Melby
Måløv
Nyborg
Torshavn
Kolonihavnen
Akureyri
Reykjavik
43
260
190
215
70
56
250
41,6
11,4
18,5
0,0
50,0
100,0
150,0
200,0
250,0
300,0


STP Effluent Water (ng/l) - Amlodipine
Bjergmarken
Damhusåen
Ejby Mølle RA
Gislev RA
Lynetten
Melby
Måløv RA
Nyce
Ølsted
Torshavn
Kolonihavnen
Akureyri
Hveragerdi
Reykjavik
319
12,8
55,8
38,6
0,0
50,0
100,0
150,0
200,0
250,0
300,0
350,0

Amlodipine	Denmark		Faroe Islands		Greenland		Iceland	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota (µg/kg ww)								
STP sludge (µg/kg dw)	nd 310 163,63	10 (a)	214 286 250	2 (b)	37,5 45,7 41,6	2 (b)	9,6 18,5 13,7	3 (b)
Sediment (µg/kg dw)			nd	3 (b)	nd 1,47 1,47	2 (b)		
Surface water (ng/l)	nd	18[71] (a)	nd	5 (b)	nd	5 (b)		
Groundwater (ng/l)	nd	3[72]						
STP Influent (ng/l)	nd	10 (a)	nd 247 247	2 (b)			nd 11,4 11,4	5 (b)
STP effluent (ng/l)	nd	10 (a)	319 319 319	1 (b)	12,8 12,8 12,8	1 (b)	nd 72,9 47,2	5 (b)
Hospital WW (ng/l)			98,1 448 273	2 (b)	nd 121 121	2 (b)		
Pig slurry (ng/l)	nd	4 (a)						
Warning system for pesticide leaching to groundwater (ng/l)	nd	9 (a)						

References:

a) (Mogensen, et al., 2008)
b) (Huber, et al., NA)

Conclusion:

The compound was monitored in Denmark, Faroe Islands, Greenland and Iceland. It was detected in several matrices:

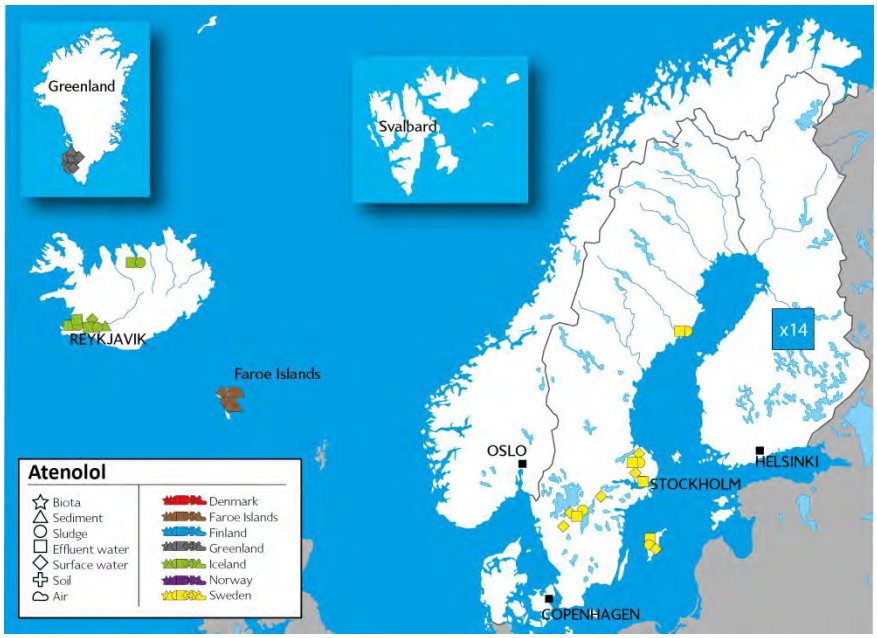
- STP sludge in all countries, in most samples analysed. Values detected in Denmark and the Faroe Island were significantly higher than in the other countries
- In only one sediment sample in Greenland
- Not detected in surface water in any country monitored
- STP effluent in Faroe Islands, Greenland and Iceland but not Denmark. High concentrations were detected in Faroe Islands
- Hospital waste water in Faroe Islands, in one sample in Greenland
- STP influent in Faroe Islands and Iceland, not in Denmark

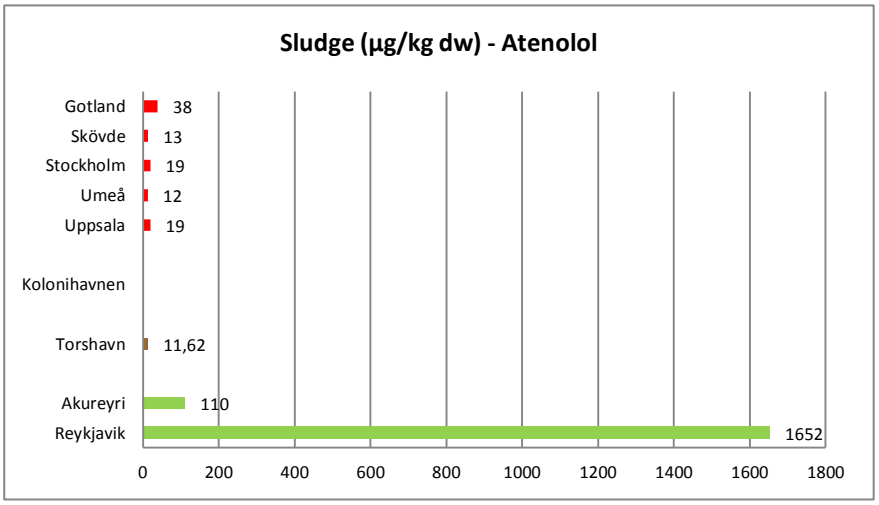
[71] Upstream and downstream of fish farms

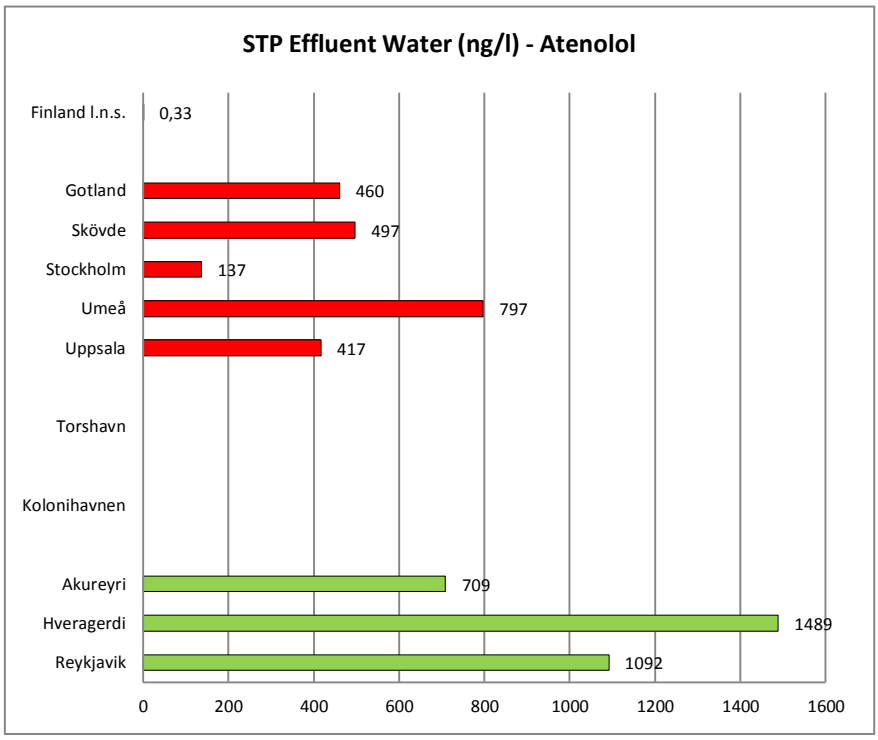
[72] Including 2 measurements in groundwater at proximity of a hospital

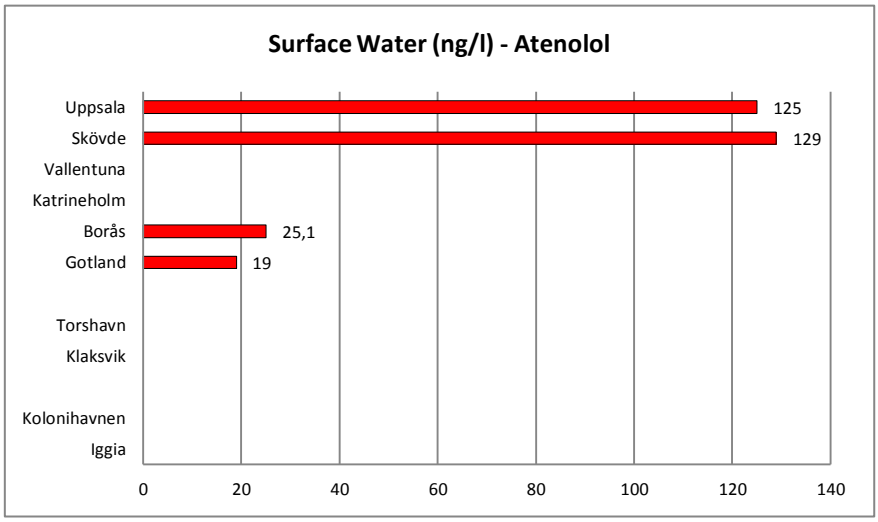
5.2.2 Atenolol

CAS nr.: 29122-68-7
Info: Selective beta-1 receptor antagonist
Toxicity data: NA
PNEC = 77,7 µg/l









Atenolol	**Finland**		**Sweden**		**Faroe Islands**		**Greenland**		**Iceland**	
Matrix	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Biota (µg/kg ww)			nd	15 (c)						
STP sludge (µg/kg dw)			12 38 20,2	5 (c)	9,82 13,4 11,62	2 (d)	nd	2 (d)	58,6 1651,6 623,8	3 (d)
Sediment (µg/kg dw)					nd	3 (d)	nd	2 (d)		

Atenolol	Finland		Sweden		Faroe Islands		Greenland		Iceland	
Surface water (ng/l)			nd 390 74	15 (c)	nd	5 (d)	nd	5 (d)		
Groundwater (µg/l)										
STP Influent (ng/l)	NA NA 800	11 (a)	330 4900 1160	12 (c)	nd 36 36	2 (d)			500 2230 1120	5 (d)
STP effluent (ng/l)	NA NA 330	14 (a)	130 920 460	13 (c)	nd	1 (d)	nd	1 (d)	706,9 1729,2 1097,4	5 (d)
Hospital WW (ng/l)					nd 120 120	2 (d)	310 470 390	2 (d)		
Drinking water			nd	6 (c)						
Settleable particulate material	nd	11 (b)								

References:

a) (Vieno, 2008)
b) (Lahti & Oikari, 2011)
c) (Fick, et al., 2011)
d) (Huber, et al., NA)

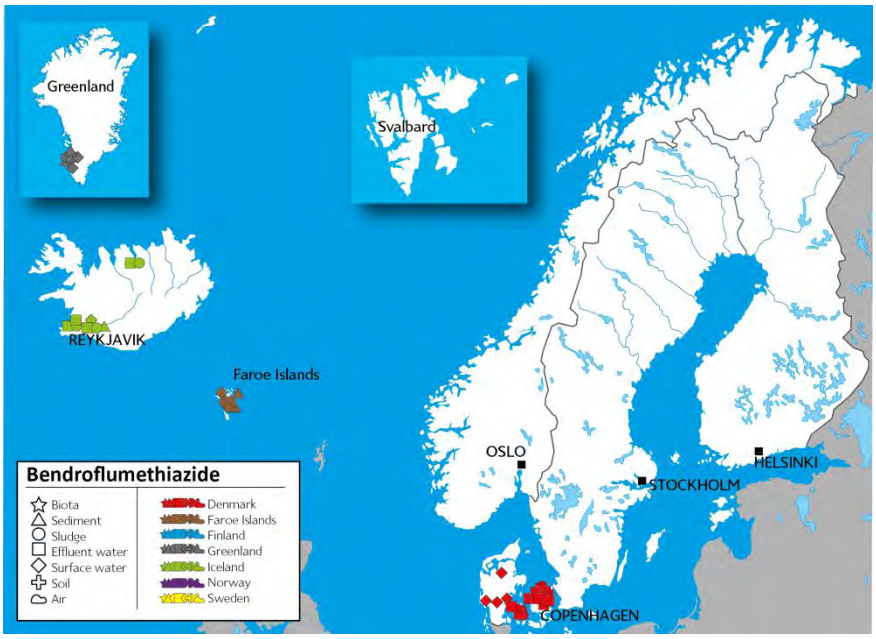
Conclusion:

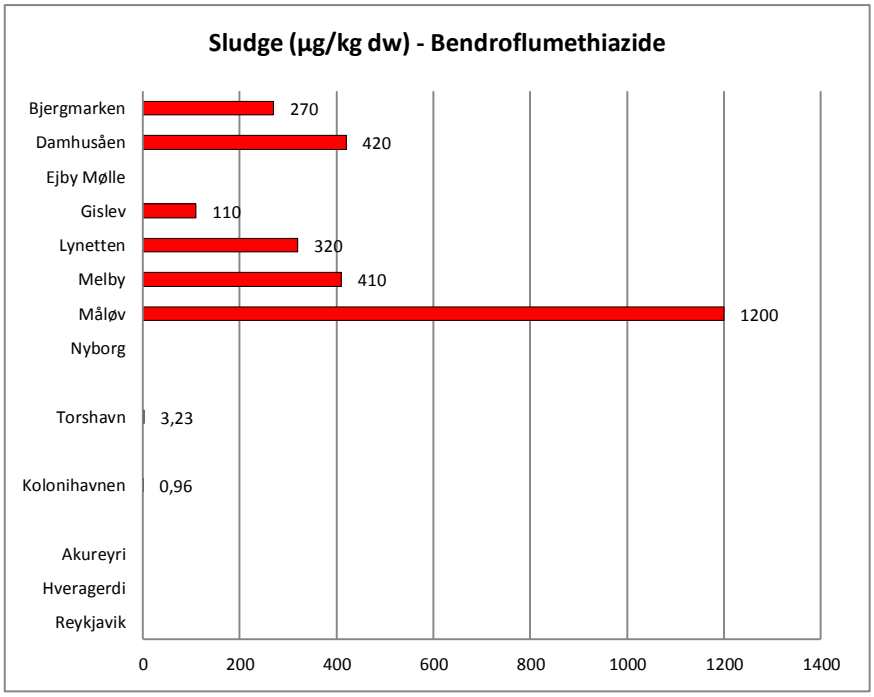
The compound was monitored in two studies in Finland, one study in Sweden and one study throughout Faroe Islands, Greenland and Iceland. The compound was detected in several matrices:

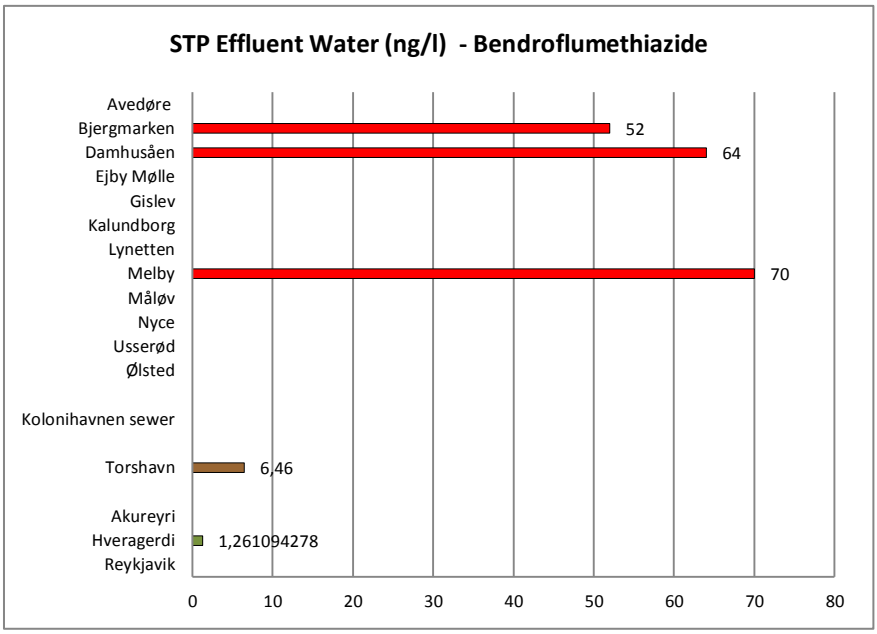
- STP sludge in Sweden, Faroe Islands and Iceland, not in Greenland. Values detected in Iceland were much higher than in the other countries
- Surface water only in Sweden
- STP effluent in Finland, Sweden and Iceland, not in Faroe Islands and Greenland
- Hospital waste water in all countries monitored.
- STP influent in all countries monitored

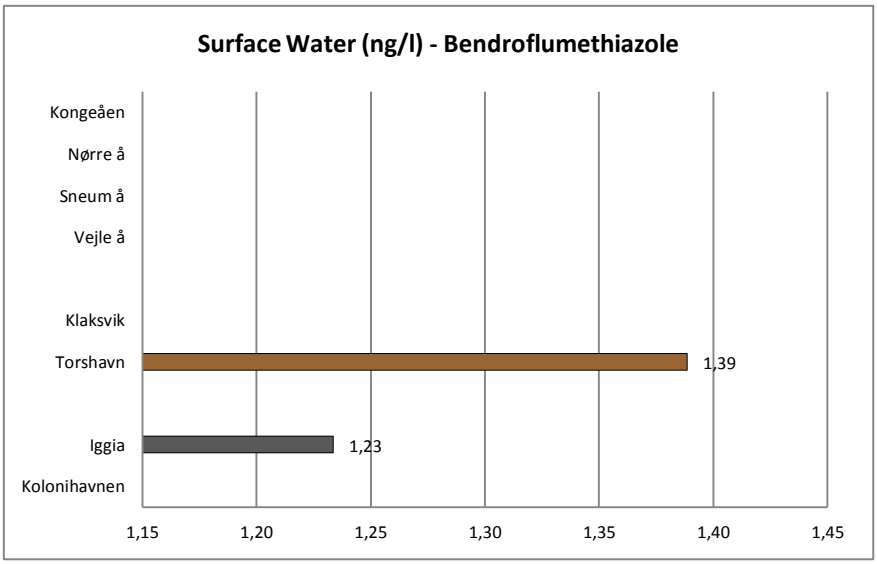
5.2.3 Bendroflumethiazide

CAS nr.: 73-48-3
Info: Diuretic, also used in the treatment of hypertension
Toxicity data: NA
PNEC = NA









Bendroflumethiazide	**Denmark**		**Faroe Islands**		**Greenland**		**Iceland**	
Matrix	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*
STP sludge (µg/Kg dw)	nd 1200 430	10 (a)	nd 3,23 3,23	2 (c)	0,96 0,97 0,965	2 (c)	nd nd nd	4 (c)

Bendroflumethiazide	Denmark		Faroe Islands		Greenland		Iceland	
Sediment (µg/kg dw)			nd 1,32 1,32	3 (c)	nd	2 (c)		
Surface water (ng/l)	nd	16[73] (a)	nd 1,39 1,39	5 (c)	nd 1,23 1,23	5 (c)		
Groundwater (ng/l)	nd	3[74] (a)						
STP Influent (ng/l)	nd 112 111	9 (a)	nd	2 (c)			nd	5 (c)
STP effluent (ng/l)	nd 70 60	22 (ab)	6,46 6,46 6,46	1 (c)	nd	1 (c)	nd 1,3 1,3	5 (c)
Pig slurry (ng/l)	nd	3 (a)						
Warning system for pesticide leaching to groundwater (ng/l)	nd	8 (a)						
Drain water (ng/l)	nd	1 (a)						
Hospital WW (ng/l)			1,38 7,00 4,19	2 (c)	nd	2 (c)		

References:

a) (Mogensen, et al., 2008)
b) (Kjølholt, et al., 2003)
c) (Huber, et al., NA)

Conclusion:

The compound was monitored in Denmark, Faroe Islands, Greenland and Iceland. It was detected in several matrices:

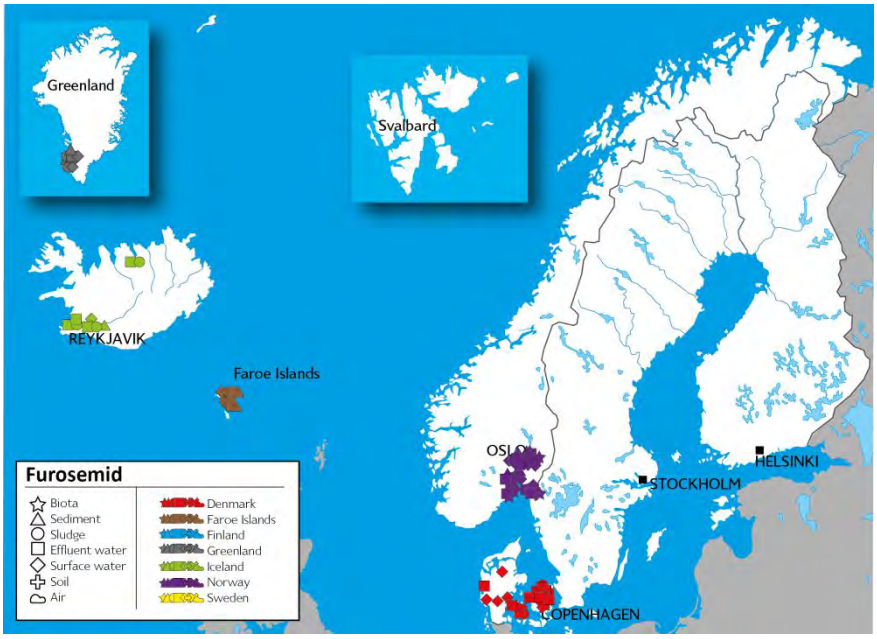
- STP sludge in Denmark, Faroe Island and Greenland, not in Iceland. The value detected in one location in Denmark was much higher than all other values detected
- In one sample in sediment in Faroe islands
- Surface water in Faroe Islands and in Greenland
- STP effluent water in Denmark and Faroe Island, not in the other countries. The values detected in Denmark were higher
- Hospital waste water only in Faroe Islands
- STP influent only in Denmark

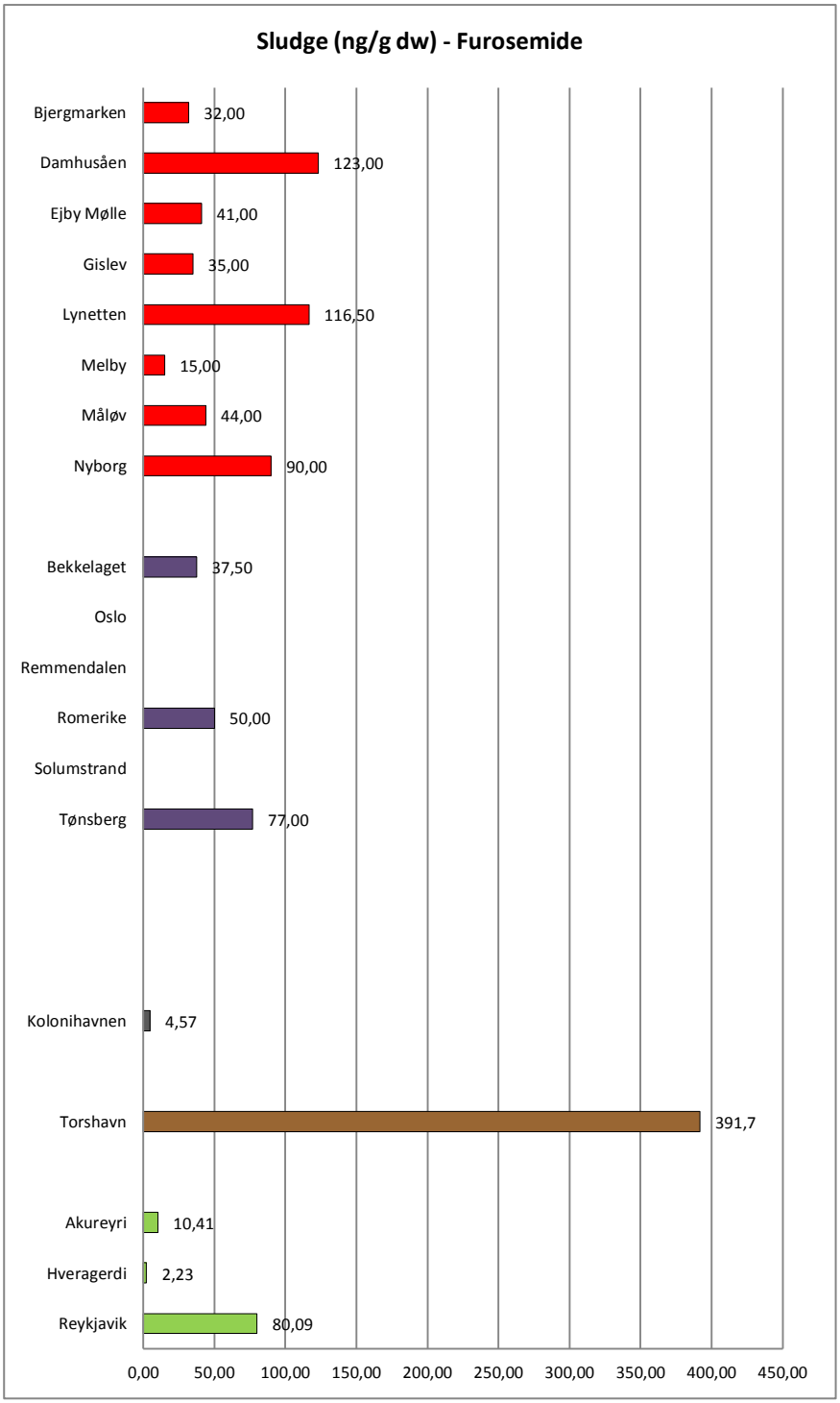
[73] Upstream and downstream of fish farms

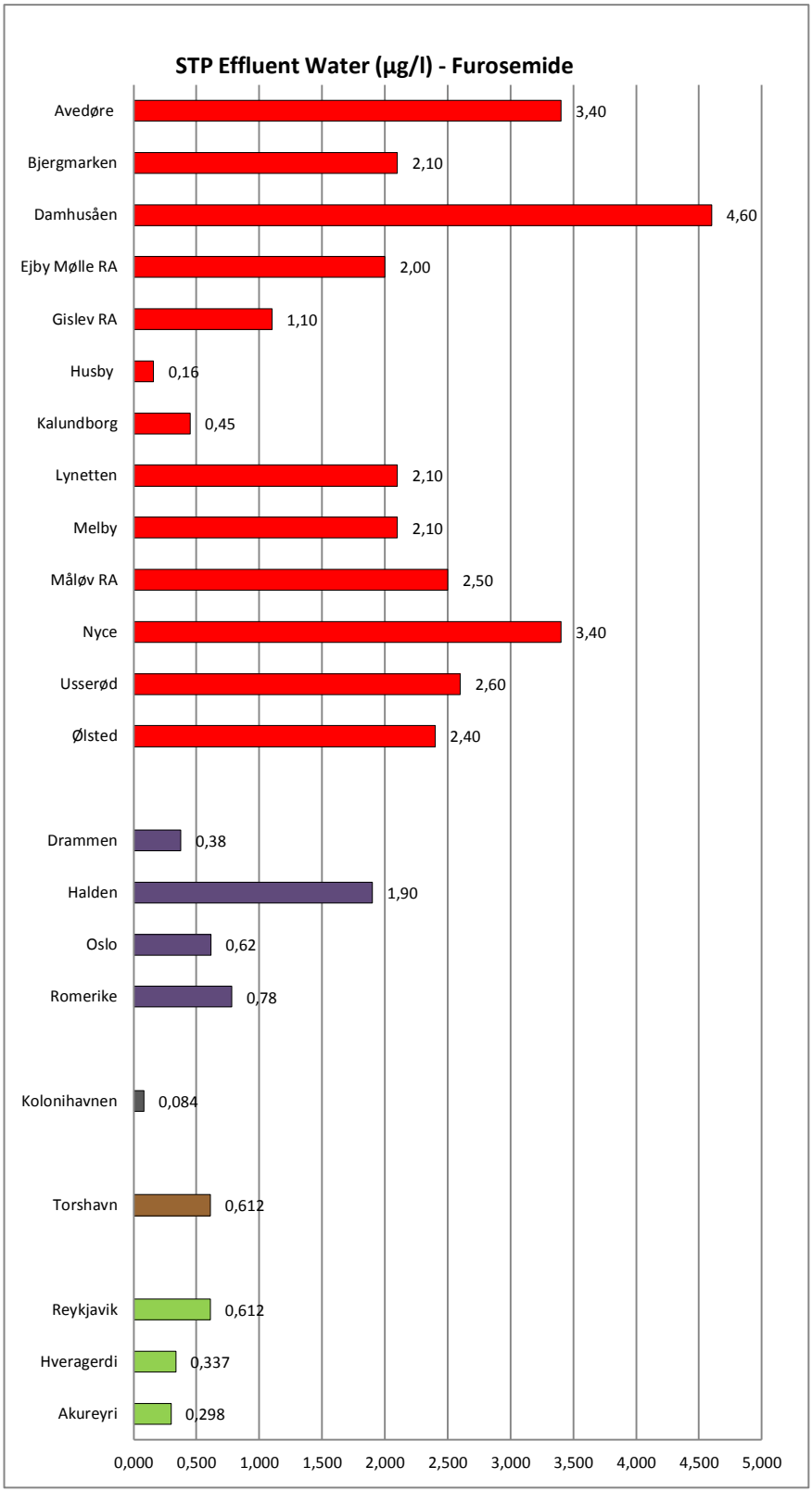
[74] Including 2 measurements in groundwater at proximity of a hospital

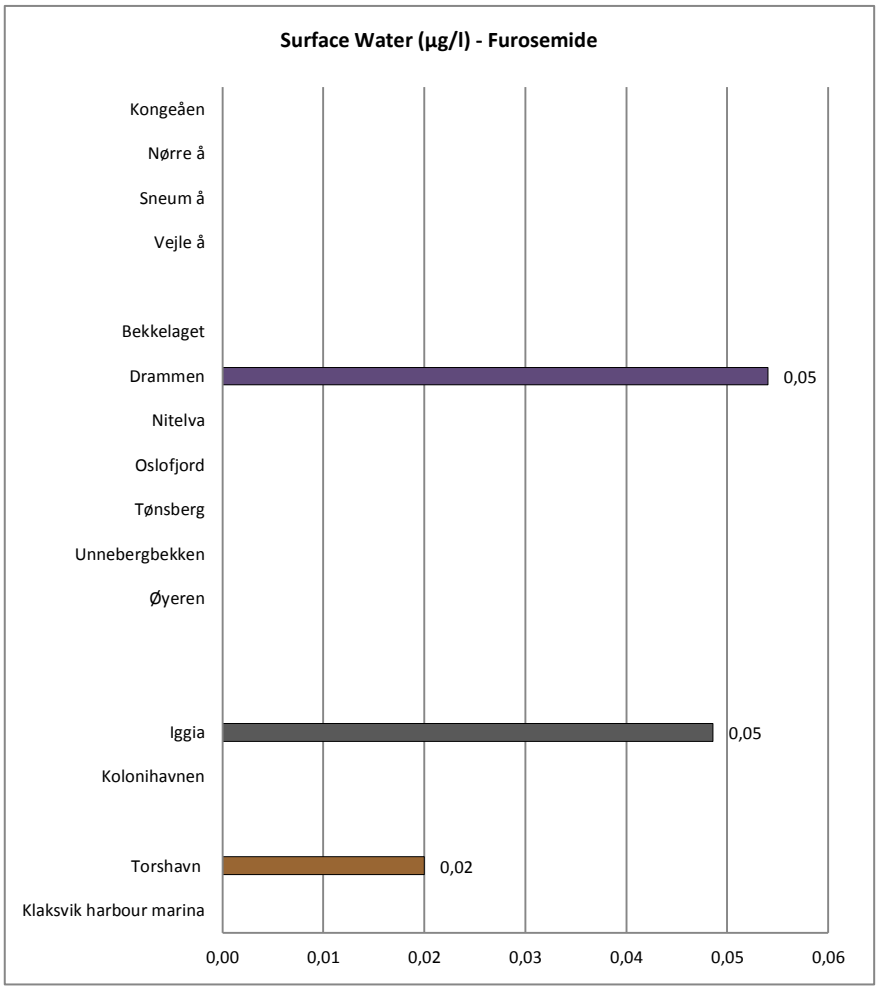
5.2.4 Furosemide

CAS nr.: 54-31-9
Info: Diuretic, also used in the treatment of hypertension
Toxicity data: NA
PNEC = 45,14 µg/l (Stuer-Lauridsen, et al., 2011)




Sludge (ng/g dw) - Furosemide
Bjergmarken
32,00
Damhusåen
123,00
Ejby Mølle
41,00
Gislev
35,00
Lynetten
116,50
Melby
15,00
Måløv
44,00
Nyborg
90,00
Bekkelaget
37,50
Oslo
Remmendalen
Romerike
50,00
Solumstrand
Tønsberg
77,00
Kolonihavnen
4,57
Torshavn
391,7
Akureyri
10,41
Hveragerdi
2,23
Reykjavik
80,09
0,00
50,00
100,00
150,00
200,00
250,00
300,00
350,00
400,00
450,00


STP Effluent Water (µg/l) - Furosemide
Avedøre
Bjergmarken
Damhusåen
Ejby Mølle RA
Gislev RA
Husby
Kalundborg
Lynetten
Melby
Måløv RA
Nyce
Usserød
Ølsted
Drammen
Halden
Oslo
Romerike
Kolonihavnen
Torshavn
Reykjavik
Hveragerdi
Akureyri
3,40
2,10
4,60
2,00
1,10
0,16
0,45
2,10
2,10
2,50
3,40
2,60
2,40
0,38
1,90
0,62
0,78
0,084
0,612
0,612
0,337
0,298
0,000
0,500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000



Furosemide	**Denmark**		**Norway**		**Faroe Islands**		**Greenland**		**Iceland**	
Matrix	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*
Biota (µg/kg ww)			nd	6 (c)						
STP sludge (µg/kg dw)	15 180 73,6	10 (a)	nd 77 54,8	6 (c)	97,7 686 391,7	2 (d)	2,96 6,18 4,57	2 (d)	2,2 80,1 25,8	4 (d)
Sediment (µg/kg dw)			nd	12 (c)	nd	3 (d)	nd	2 (d)		
Landfild leachates sediments (µg/kg dw)			nd	4 (c)						
Untreated landfill leachates (µg/l)			nd	4 (c)						
Treated landfill leachates (µg/l)			nd	5 (c)						

Furosemide	Denmark		Norway		Faroe Islands		Greenland		Iceland	
Surface water (µg/l)	nd	16 [75](a)	nd 0,05 0,006	8 (c)	nd 0,03 0,02	5 (d)	nd 0,048 0,048	5 (d)		
Groundwater (µg/l)	nd	3[76] (a)								
STP Influent (µg/l)	2,1 6,3 4,2	9 (a)	nd 5,75 2,21	8 (c)	0,071 0,52 0,30	2 (d)			0,24 1,25 0,57	5 (d)
STP effluent (µg/l)	0,16 4,6 2,5	16 (ab)	nd 1,90 0,92	4 (c)	0,61 0,61 0,61	1 (d)	0,084 0,084 0,084	1 (d)	0,12 0,91 0,42	5 (d)
Pig slurry	nd	3 (a)								
Warning system for pesticide leaching to groundwater (µg/l)	nd	8 (a)								
Drain water (µg/l)	0,64 0,64 0,64	1 (a)								
Hospital WW (µg/l)					1,14 11,42 6,28	2 (d)	nd 0,047 0,047	2 (d)		

References:

a) (Mogensen, et al., 2008)
b) (Kjølholt, et al., 2003)
c) (Møskeland, et al., 2006)
d) (Huber, et al., NA)

Conclusion:

The compound was monitored in Denmark, Norway, Faroe Islands, Greenland and Iceland. It was detected in several matrices:

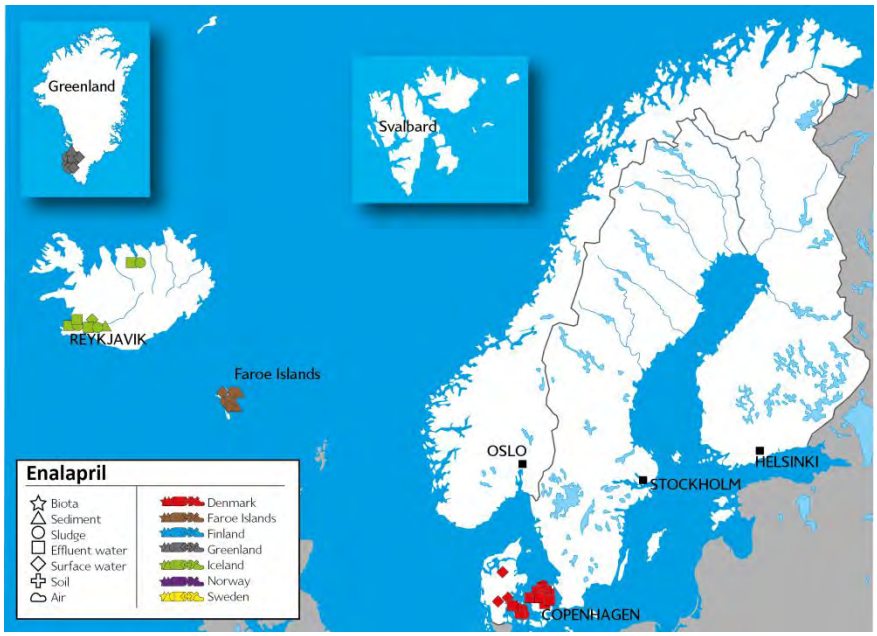
- Surface water in Norway, Greenland and Faroe Island
- STP sludge in all countries and in the large majority of all locations monitored. The values detected were higher in Greenland
- STP effluent water in all countries and in most samples analysed. Higher variations were observed in Denmark, the values detected were generally higher in Denmark than in the other countries
- Hospital waste water in all countries monitored. Values detected in Greenland were lower than in the other countries
- STP influent in all countries monitored

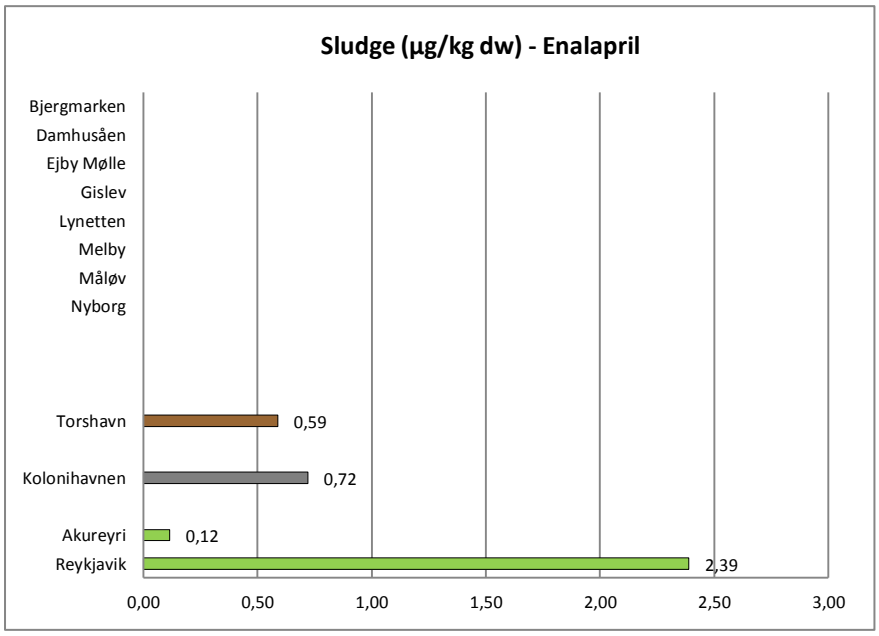
[75] Upstream and downstream of fish farms

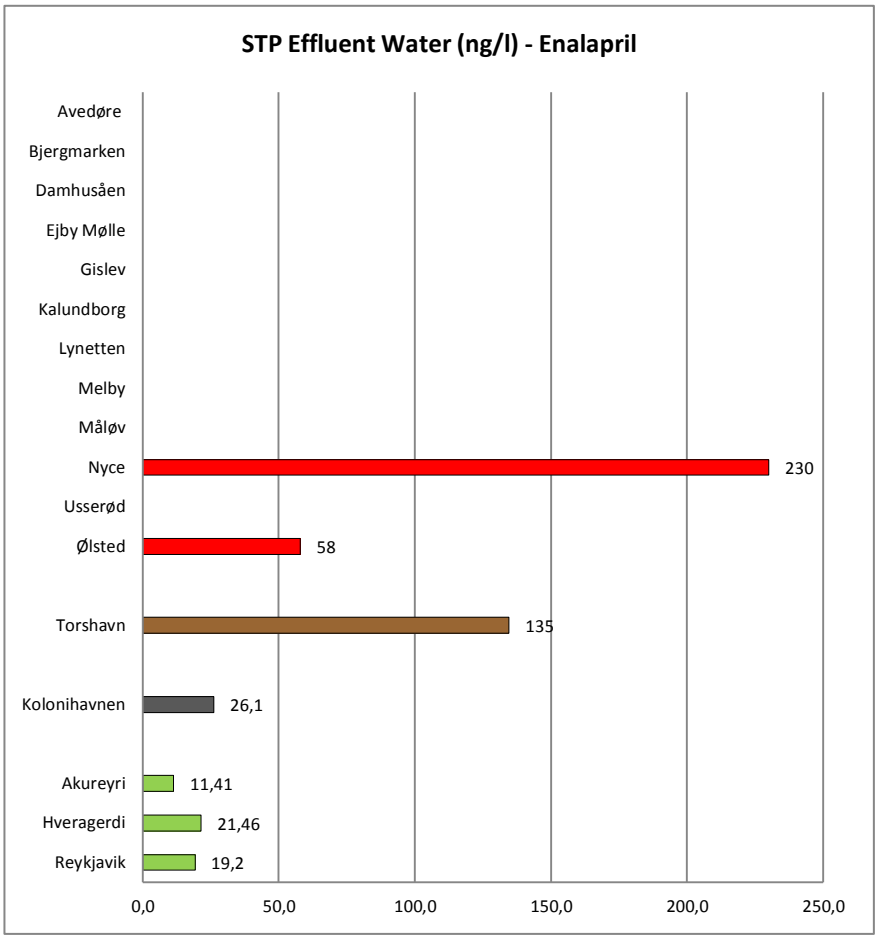
[76] Including 2 measurements in groundwater at proximity of a hospital

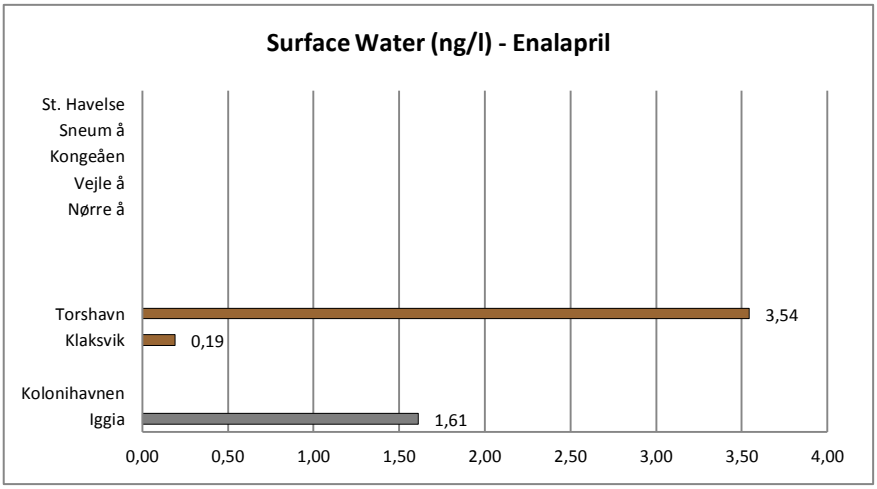
5.2.5 Enalapril

CAS nr.: 75847-73-3
Info: Angiotensin converting enzyme (ACE) inhibitor used in the treatment of hypertension and some types of chronic heart failure
Toxicity data: NA
PNEC = NA






STP Effluent Water (ng/l) - Enalapril
Avedøre
Bjergmarken
Damhusåen
Ejby Mølle
Gislev
Kalundborg
Lynetten
Melby
Måløv
Nyce
Usserød
Ølsted
Torshavn
Kolonihavnen
Akureyri
Hveragerdi
Reykjavik
230
58
135
26,1
11,41
21,46
19,2
0,0
50,0
100,0
150,0
200,0
250,0


Surface Water (ng/l) - Enalapril
St. Havelse
Sneum å
Kongeåen
Vejle å
Nørre å
Torshavn
Klaksvik
Kolonihavnen
Iggia
3,54
0,19
1,61
0,00
0,50
1,00
1,50
2,00
2,50
3,00
3,50
4,00

Enalapril	Denmark		Faroe Islands		Greenland		Iceland	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
STP sludge (µg/kg dw)	nd	10 (a)	0,13 1,05 0,59	2 (c)	0,37 1,07 0,72	2 (c)	nd 2,39 1,25	3 (c)
Sediment (µg/kg dw)			nd	3 (c)	nd	2 (c)		
Surface water (ng/l)	nd	16[77] (a)	0,19 5,87 2,71	5 (c)	nd 2,98 1,61	5 (c)		
Groundwater (ng/l)	nd	3[78] (a)						
STP Influent (ng/l)	170 680 370	9 (a)	32,1 112 72,3	2 (c)			5,88 26,9 15,93	5 (c)
STP effluent (ng/l)	nd 250 140	15 (ab)	135 135 135	1 (c)	26,1 26,1 26,1	1 (c)	11,4 22,7 17,0	5 (c)
Pig slurry	nd	4 (a)						
Warning system for pesticide leaching to groundwater (ng/l)	nd	8 (a)						
Drain water (ng/l)	nd	1 (a)						
Hospital WW (ng/l)			57,4 120 88,9	2 (c)	113 322 217	2 (c)		

References:

a) (Mogensen, et al., 2008)
b) (Kjølholt, et al., 2003)
c) (Huber, et al., NA)

Conclusion:

The compound was monitored in two studies in Denmark and one study in Faroe Islands, Greenland and Iceland. It was detected in several matrices:

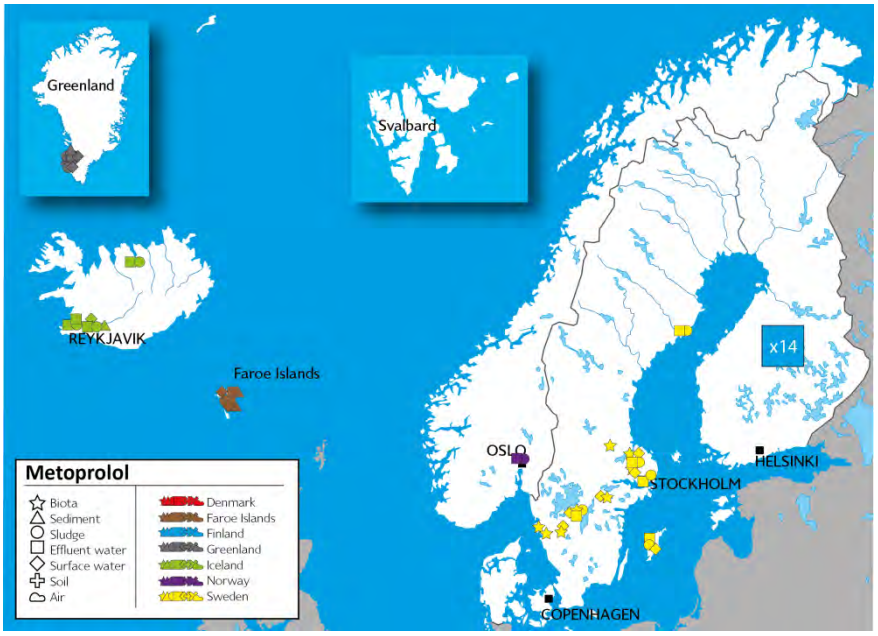
- STP sludge in Faroe Islands, Greenland and Iceland, not in Denmark
- Surface water in Faroe Islands and Greenland, not in Denmark.
- STP effluent water in all countries. The values detected in Denmark and Faroe Islands were higher than in the other countries
- Hospital waste water in all countries monitored
- STP influent in all countries monitored

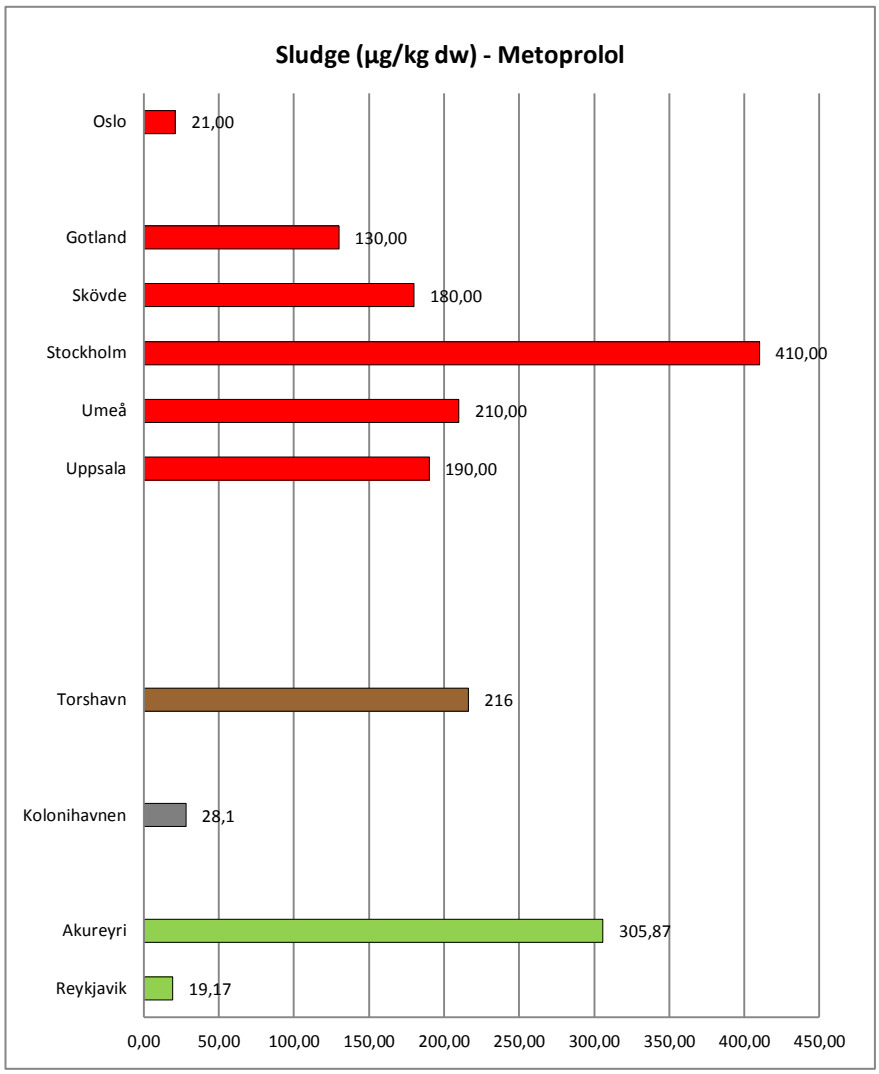
[77] Upstream and downstream of fish farms

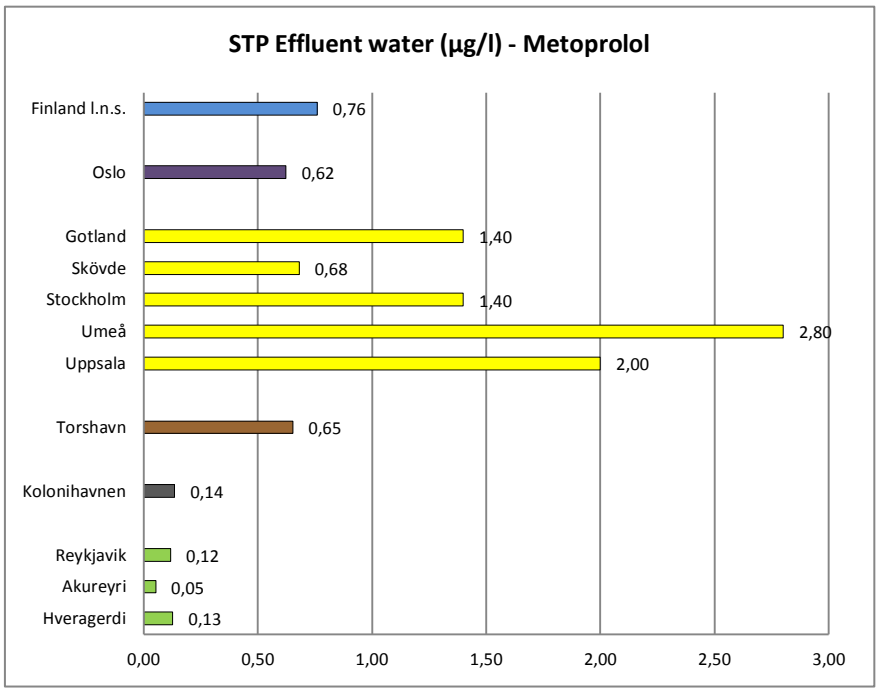
[78] Including 2 measurements in groundwater at proximity of a hospital

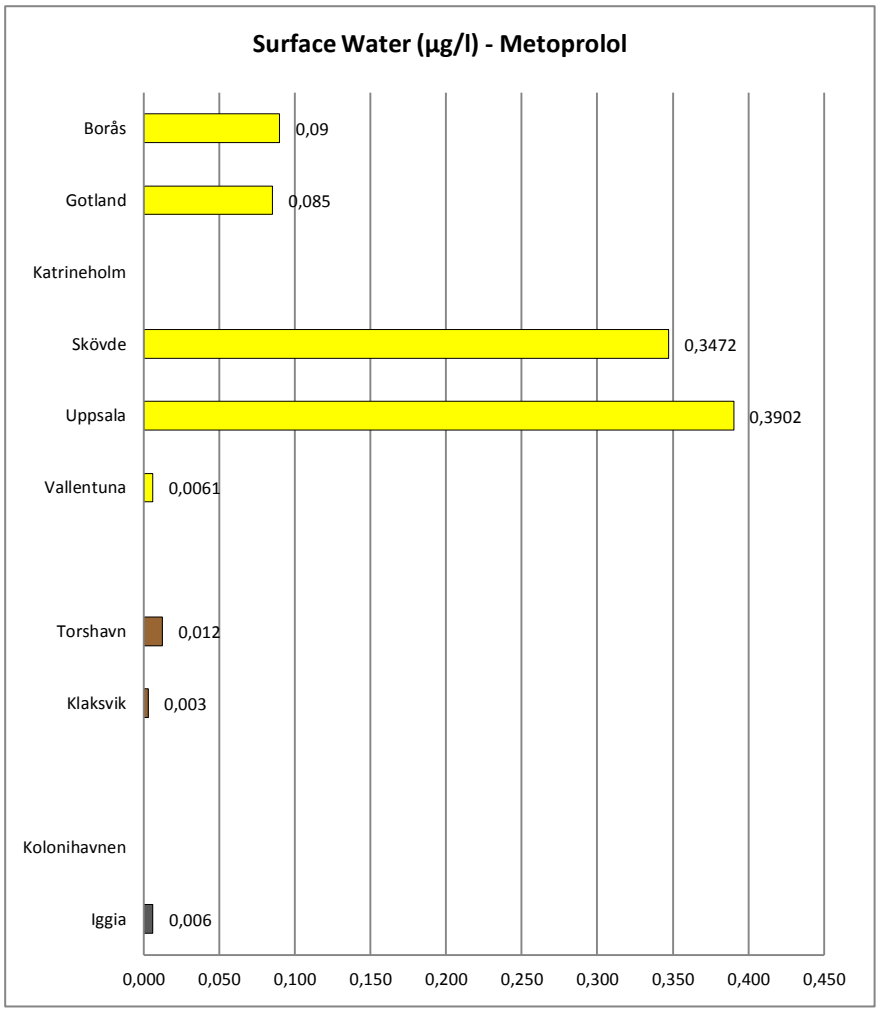
5.2.6 Metoprolol

CAS nr.: 51384-51-1
Info: Selective beta-1 receptor blocker used in treatment of several diseases of the cardiovascular system, especially hypertension
Toxicity data: NA
PNEC = 8,8 µg/l (Schlabach, et al., 2007)




Sludge (µg/kg dw) - Metoprolol
Oslo
21,00
Gotland
130,00
Skövde
180,00
Stockholm
410,00
Umeå
210,00
Uppsala
190,00
Torshavn
216
Kolonihavnen
28,1
Akureyri
305,87
Reykjavik
19,17
0,00
50,00
100,00
150,00
200,00
250,00
300,00
350,00
400,00
450,00


STP Effluent water (µg/l) - Metoprolol
Finland l.n.s.
0,76
Oslo
0,62
Gotland
1,40
Skövde
0,68
Stockholm
1,40
Umeå
2,80
Uppsala
2,00
Torshavn
0,65
Kolonihavnen
0,14
Reykjavik
0,12
Akureyri
0,05
Hveragerdi
0,13
0,00
0,50
1,00
1,50
2,00
2,50
3,00


Surface Water (µg/l) - Metoprolol
Borås
0,09
Gotland
0,085
Katrineholm
Skövde
0,3472
Uppsala
0,3902
Vallentuna
0,0061
Torshavn
0,012
Klaksvik
0,003
Kolonihavnen
Iggia
0,006
0,000
0,050
0,100
0,150
0,200
0,250
0,300
0,350
0,400
0,450

Metoprolol	Finland		Norway		Sweden		Faroe Islands		Greenland		Iceland	
Matrix	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*
Biota (µg/kg ww)					nd	15 (d)						
STP sludge (µg/kg dw)			nd 21 21	7 (c)	130 410 220	5 (d)	108 324 216	2 (e)	14,7 41,4 28,1	2 (e)	19,2 548,9 210,3	3 (e)
Sediment (µg/kg dw)							nd	3 (e)	0,67 7,39 4,03	2 (e)		
Surface water (µg/l)					nd 1,20 0,30	15 (d)	nd 0,02 0,01	5 (e)	nd 0,01 0,006	5(e)		
STP Influent (µg/l)	NA NA 1,06	14 (a)			1,20 6,80 2,58	12 (d)	0,32 0,40 0,36	2 (e)			0,014 0,18 0,11	5 (e)
STP effluent (µg/l)	NA NA 0,76	14 (a)	0,37 0,77 0,59	6 (c)	0,13 2,80 1,62	14 (d)	0,65 0,65 0,65	1 (e)	0,14 0,14 0,14	1 (e)	0,05 0,13 0,09	5 (e)
Settleable particulate material (ng/g dw)	8,9 104 49,9	11 (b)										
Drinking water (ng/l)					nd 0,016 0,010	6 (d)						
Hospital WW (µg/l)							0,35 0,81 0,58	2 (e)	nd 0,25 0,25	2 (e)		

References:

a) (Vieno, 2008)
b) (Lahti & Oikari, 2011)
c) (Thomas, et al., 2007)
d) (Fick, et al., 2011)
e) (Huber, et al., NA)

Conclusion:

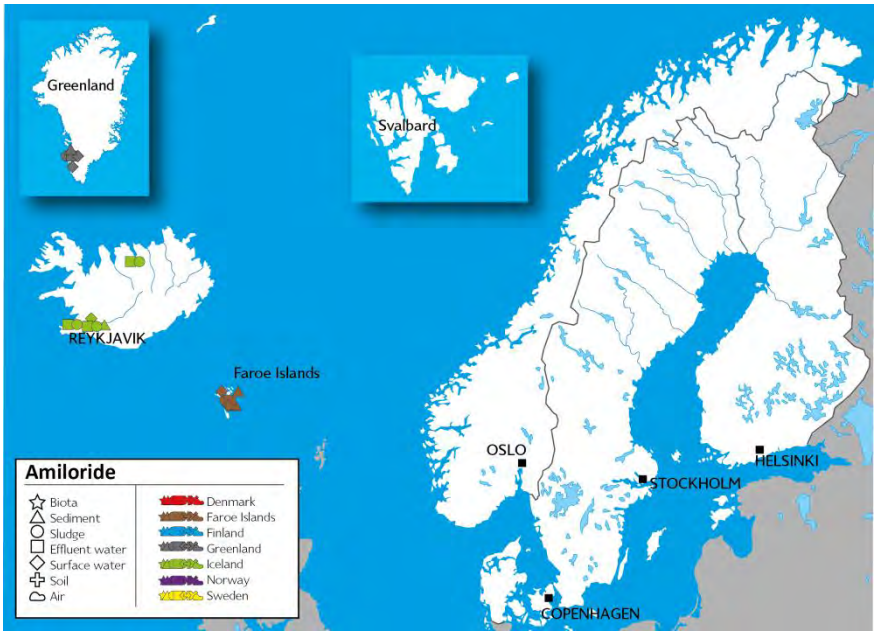
The compound was monitored in Finland, Norway, Faroe Islands, Greenland and Iceland. It was detected in several matrices:

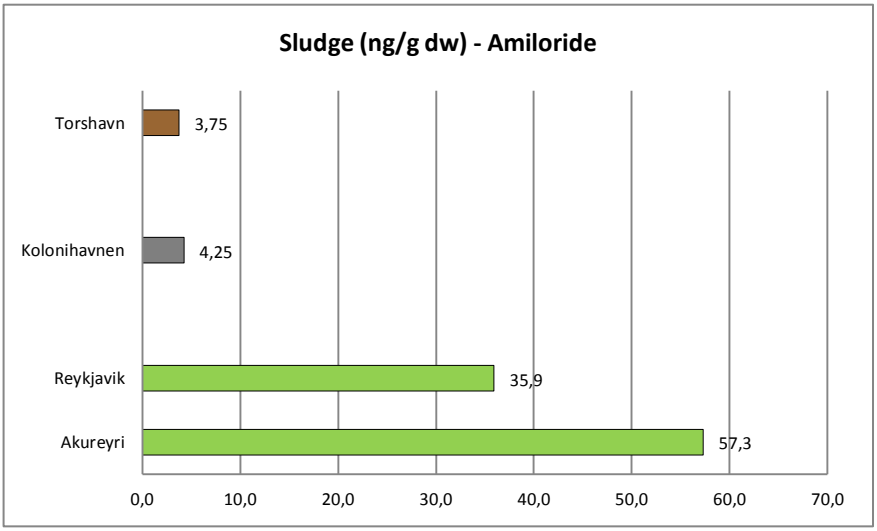
- STP sludge in one sample in Norway, in Sweden, Faroe Islands, Greenland and Iceland. Lower values were detected in Norway and Greenland
- Sediment in Greenland, not Faroe Islands
- STP effluent in all countries. Lower values were detected in Iceland and Greenland

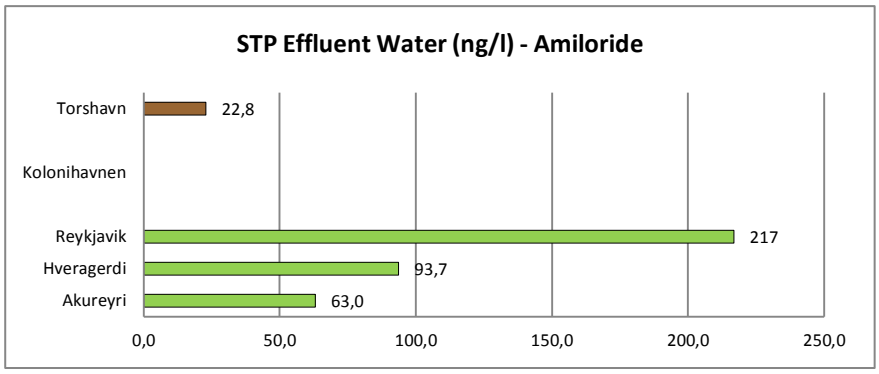
- Surface water in all countries monitored. High variations were observed in values detected in Sweden
- STP influent in all countries monitored

5.2.7 Amiloride

CAS nr.: 2016-88-8
Info: Potassium-sparing diuretic
Toxicity data: NA
PNEC = NA







Amiloride	Faroe Islands (a)		Greenland (a)		Iceland (a)	
Matrix	*Min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
STP sludge (ng/g dw)	0,93 6,56 3,75	2	1,83 6,67 4,25	2	21,0 93,6 50,2	3
Sediment (ng/g dw)	nd 1,3 0,94	3	0,60 0,79 0,69	2		
Surface water (ng/l)	53 552,26 301	5	238 397,6 332	5		
STP Influent (ng/l)	18,9 25,6 22,2	2			30,6 287,18 149,4	5
STP effluent (ng/l)	22,8 22,8 22,8	1	nd	1	40,9 216,8 106,0	5
Hospital WW (ng/l)	nd 8,27 8,27	2	nd	2		

References:

a) (Huber, et al., NA)

Conclusion:

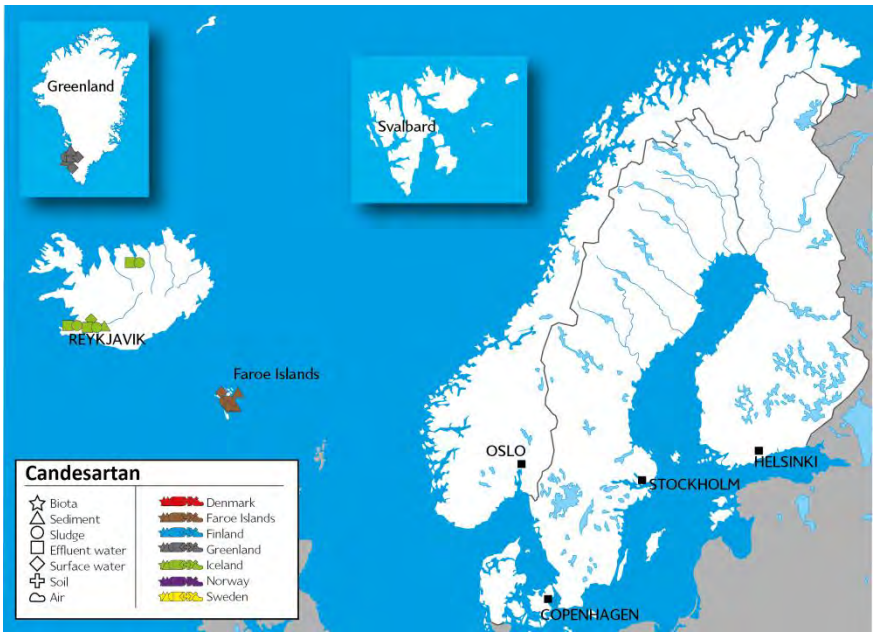
The compound was monitored in Faroe Islands, Greenland and Iceland. It was detected in several matrices:

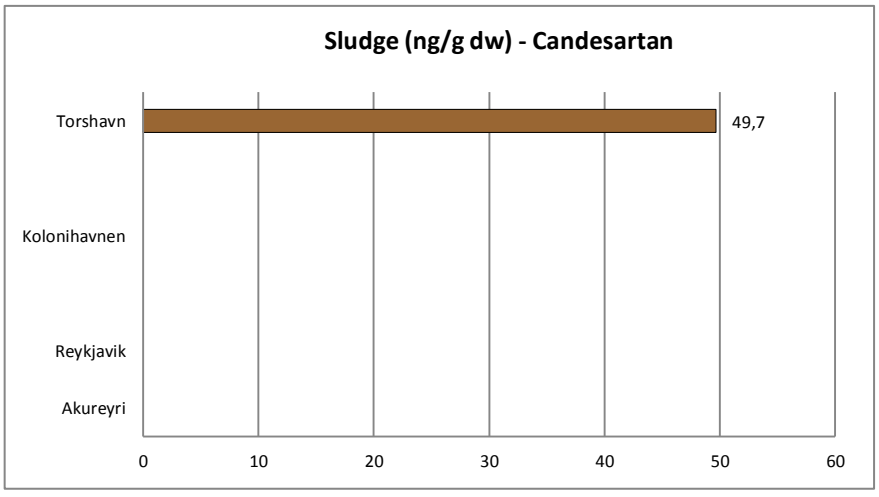
- STP sludge in all three countries. While concentrations were similar in Faroe Islands and Greenland, Iceland showed values which were ten times higher
- Sediment in Faroe Islands and Greenland.
- Surface water in Faroe Islands and Greenland
- Effluent water in Faroe Islands and Iceland

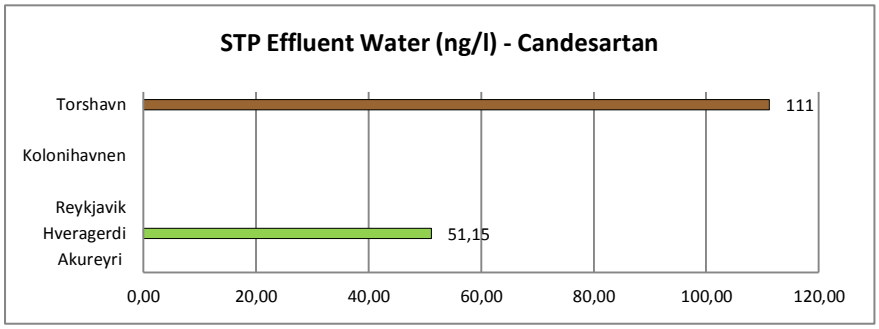
- STP influent in Faroe Islands and Iceland
- Hospital waste water in Faroe Islands

5.2.8 Candesartan

CAS nr.: 139481-59-7
Info: Angiotensin II receptor antagonists indicated for the treatment of hypertension
Toxicity data: NA
PNEC = NA







Candesartan	Faroe Islands (a)		Greenland (a)		Iceland (a)	
Matrix	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
STP sludge (ng/g dw)	nd 49,7 49,7	2	nd	2	nd	3
Sediment (ng/g dw)	nd	3	nd	2		
Surface water (ng/l)	nd 5,34 4,63	5	nd	5		
STP Influent (ng/l)	53,8 60,3 57	2			nd 36,6 30,7	5
STP effluent (ng/l)	111 111 111	1	nd	1	Nd 54,3 51,1	4
Hospital WW (ng/l)	142 251 196	2	nd	2		

References:

a) (Huber, et al., NA)

Conclusion:

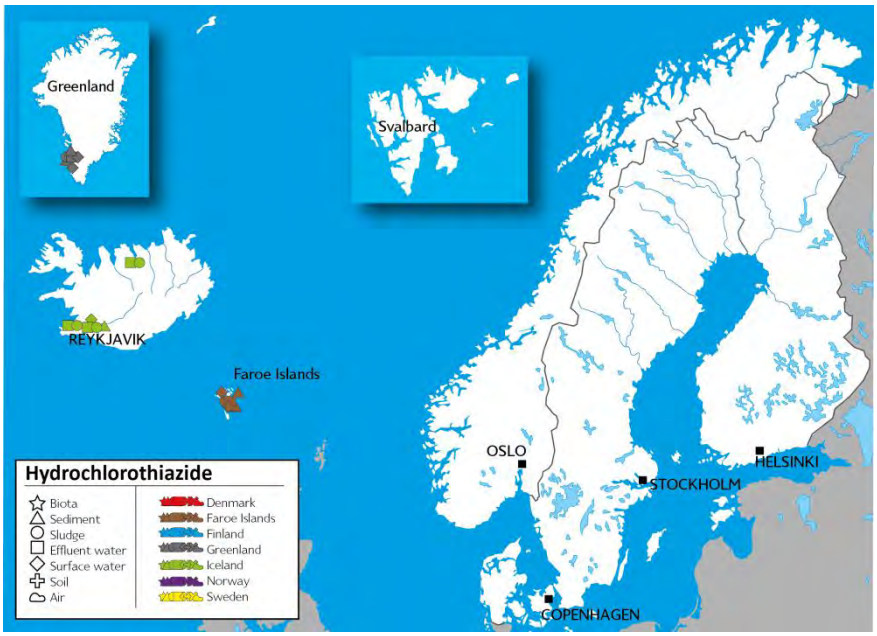
The compound was monitored in Faroe Islands, Greenland and Iceland.

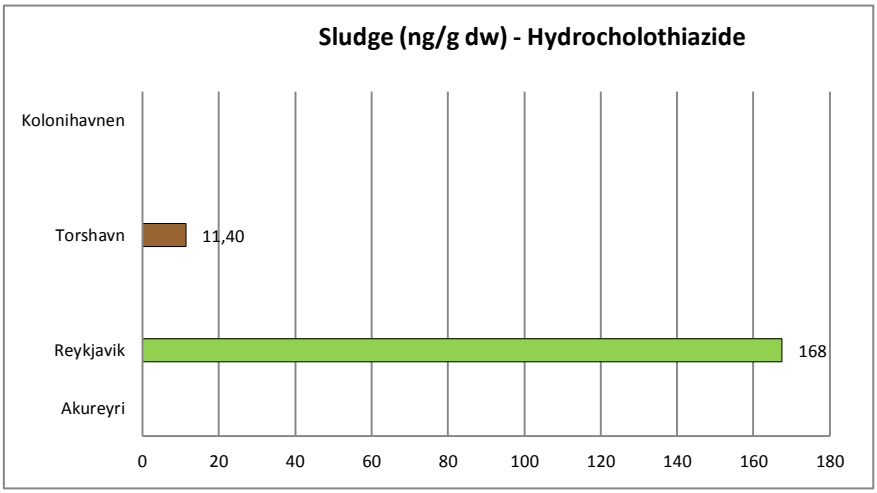
It was detected in several matrices in Faroe Islands and Iceland but it was never detected in Greenland:

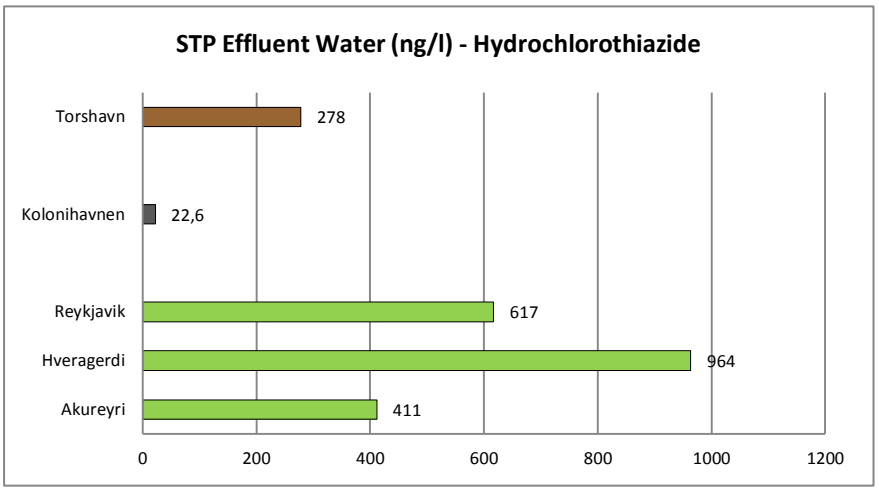
- STP sludge in Faroe Islands
- Surface water in Faroe Islands
- STP effluent in Faroe Islands and Iceland. Concentrations in the Faroe Islands were higher.
- STP influent in Faroe Islands and Iceland
- Hospital waste water in Faroe Islands

5.2.9 Hydrochlorothiazide

CAS nr.: 58-93-5
Info: Diuretic
Toxicity data: NA
PNEC = NA







Hydrochlorothiazide	Faroe Islands (a)		Greenland (a)		Iceland (a)	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*	*min* *max* *AD*	*Nr.S* *(ref)*	*min* *max* *AD*	*Nr.S* *(ref)*
STP sludge (ng/g dw)	7,52 15,3 11,40	2	nd	2	nd 167,5 167,5	3
Sediment (ng/g dw)	nd	3	nd	2		
Surface water (ng/l)	nd	5	nd	5		
STP Influent (ng/l)	87,9 90,4 89,1	2			258 1258 616	5
STP effluent (ng/l)	278 278 278	1	22,6 22,6 22,6	1	410 983,9 673,5	5
Hospital WW (ng/l)	345 345 345	2	6,26 6,42 6,34	2		

References:

a) (Huber, et al., NA)

Conclusion:

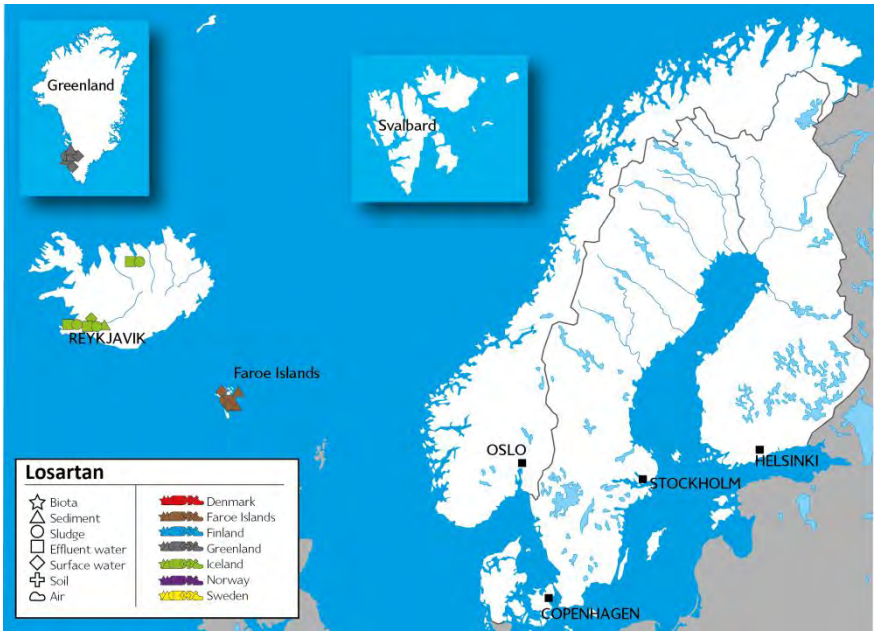
The compound has been monitored in one international study covering Faroe Islands, Greenland, and Iceland. It has been detected in several matrices:

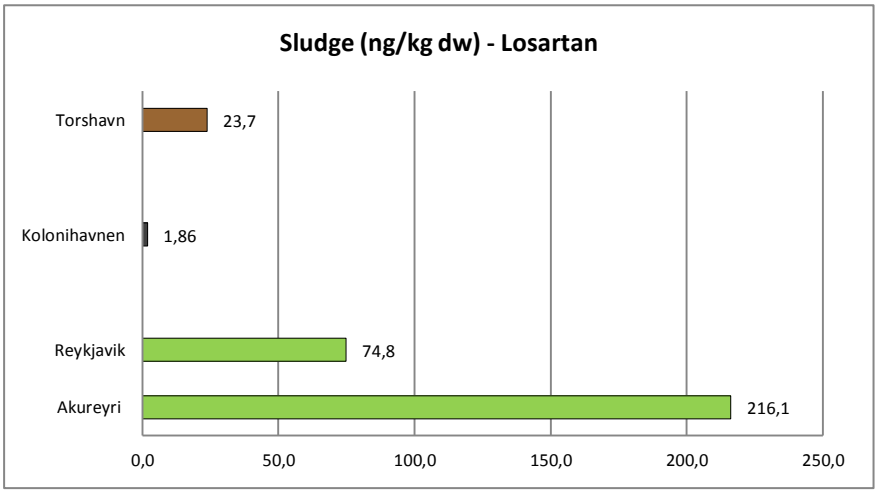
- STP sludge in Faroe Islands and Iceland. Highest values were detected in Iceland
- STP effluent water in all three countries. The lowest concentrations were detected in Greenland

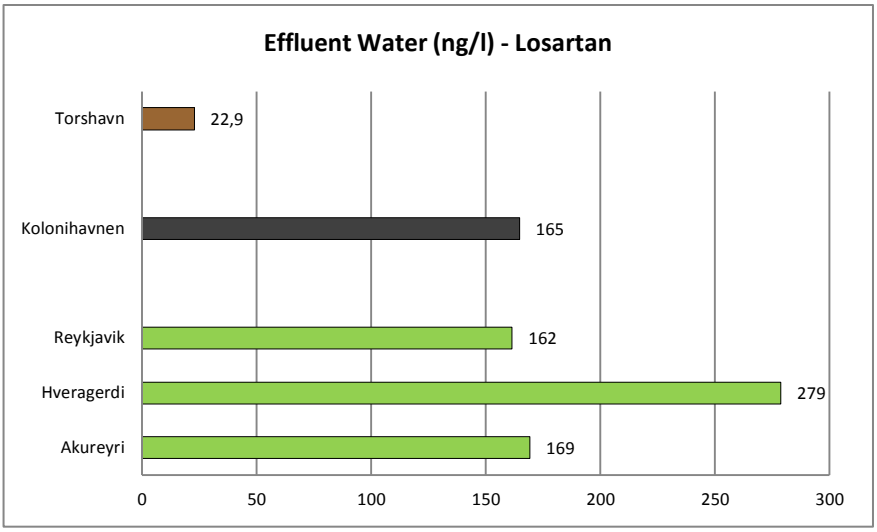
- STP influent in Faroe Islands and Iceland
- Hospital waste water in the Faroe Islands and Greenland

5.2.10 Losartan

CAS nr.: 124750-99-8
Info: Angiotensin II receptor antagonist used to treat hypertension
Toxicity data: NA
PNEC = NA







Losartan	Faroe Islands (a)		Greenland (a)		Iceland (a)	
Matrix	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*
STP sludge (ng/g dw)	14,4 33 23,7	2	1,80 1,92 1,86	2	39,9 392,4 169,0	3
Sediment (ng/g dw)	nd	3	nd	2		
Surface water (ng/l)	nd 4,60 4,33	5	nd 5,03 5,03	5		
STP Influent (ng/l)	25,8 98,5 62,2	2			189 586,3 298	5
STP effluent (ng/l)	22,9 22,9 22,9	1	165 165 165	1	161,5 281,2 211,6	5
Hospital WW (ng/l)	159 292 226	2	21,5 74,3 47,9	2		

References:

a) (Huber, et al., NA)

Conclusion:

The compound has been monitored in one international study covering Faroe Islands, Greenland, and Iceland. It has been detected in several matrices:

- STP sludge in all three countries. Highest values were detected in Iceland
- Surface water in all the countries. monitored

- STP effluent water in all three countries. The lowest concentrations were detected in Faroe Islands
- STP influent in Faroe Islands and Iceland. The highest values were detected in Iceland
- Hospital waste water in Greenland and the Faroe Islands

5.3 Compounds monitored in at least two studies

5.3.1 Acebutol

CAS nr.: 37517-30-9
Info: Cardioselective beta blocker with ISA (intrinsic sympathomimetic) activity
Toxicity data: NA
PNEC = NA

Acebutol	Finland	
Matrix	min max AD	Nr.S (ref)
STP effluent (µg/l)	NA NA 0,14	14 (a)
Influent water (µg/l)	NA NA 0,34	14 (a)
Settleable particulate material (ng/g dw)	nd 53,8 25,22	11 (b)

References:
a) (Vieno, 2008)
b) (Lahti & Oikari, 2011)

Conclusion:
The compound was monitored in two studies in Finland and was detected in all matrices monitored: STP influent and effluent and settleable particulate matter.

5.3.2 Bisoprolol

CAS nr.: 66722-44-9
Info: Selective type beta-1 adrenergic receptor blocker
Toxicity data: NA
PNEC = NA

Bisoprolol	**Finland**		**Sweden**	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg dw)			nd	15 (b)
STP sludge (µg/kg dw)			2,80 10 5,36	5 (b)
Surface water (ng/l)			nd 150 20	15 (b)
STP Influent (ng/l)			80 560 200	12 (b)
STP effluent (ng/l)			40 250 110	13 (b)
Drinking water water (ng/l)			nd	6 (b)
Settleable particulate material (ng/g dw)	nd 325 131,3	11 (a)		

References:
a) (Lahti & Oikari, 2011)
b) (Fick, et al., 2011)

Conclusion:
The compound was monitored in Finland and Sweden. It was detected in Sweden in surface water, STP sludge, effluent and influent as well as in settleable particulate material in Finland.

5.3.3 Felodipine

CAS nr.: 72509-76-3
Info: Calcium channel blocker (calcium antagonist) used to control hypertension
Toxicity data: NA
PNEC = NA

Felodipine	Norway (a)		Sweden (b)	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg ww)	nd	6	nd	20
STP sludge (µg/kg dw)	25 62 37,7	6	nd	18
Sediment (µg/kg dw)	nd	12	nd	3
Landfild leachate sediment (µg/kg dw)	nd	4		
Surface water (ng/l)	nd	8	nd	23
STP Influent (ng/l)	nd	8	nd	21
STP effluent (ng/l)	nd	4	nd	30
Drinking water (ng/l)			nd	8
Untreated landfild leachates (ng/l)	nd	4		
Treated landfild leachates (ng/l)	nd	5		

References:

a) (Møskeland, et al., 2006)
b) (Kjølholt, et al., 2003)

Conclusion:

The compound was monitored in Norway and Sweden. It was only detected in STP sludge in Norway. The compound was not detected in any other matrice in either country.

5.3.4 Sotalol

CAS nr.: 959-24-0
Info: Used in individuals with rhythm disturbances (cardiac arrhythmias) of the heart, and to treat hypertension
Toxicity data: NA
PNEC = NA

Sotalol		**Finland**
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*
STP Influent (µg /l)	nd 0,83 0,83	14 (a)
Effluent water (µg /l)	nd 0,28 0,28	14 (a)
Settleable particulate material (ng/g dw)	nd	11 (b)

References:
a) (Vieno, 2008)
b) (Lahti & Oikari, 2011)

Conclusion:
The compound was monitored in two studies in Finland and was detected in one STP influent sample and one STP effluent sample.

5.4 Compounds monitored in one study

	Alfuzosin (81403-80-7	**Cilazapril (88768-40-5)**	**Diltiazem (42399-41-7)**	**Eprosartan (133040-01-4)**	**Irbesartan (138402-11-6)**	**Telmisartan (144701-48-4)**	**Verapamil (52-53-9)**	
Matrix	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*Nr.S*
Biota (ng/g ww)	nd 0,2 0,14	nd	nd	nd	nd 1,3 0,91	nd	nd	15
STP sludge (ng/g dw)	10 34 21,20	1,10 2,6 1,54	nd 0,80 0,80	nd 14 12,67	8,70 280 93,54	nd 1400 540	nd 18 18	5
STP effluent (ng/l)	18 110 55,23	nd 28 8,7	11 100 42,69	12 870 239,7	19 1100 416,1	nd 250 113,8	nd 29 17,33	13
STP influent (ng/l)	16 220 64,42	nd 42 11,32	31 270 84,50	27 1700 446,33	150 2600 766,67	nd 1400 410	14 110 28,08	12

	Alfuzosin (81403-80-7	Cilazapril (88768-40-5)	Diltiazem (42399-41-7)	Eprosartan (133040-01-4)	Irbesartan (138402-11-6)	Telmisartan (144701-48-4)	Verapamil (52-53-9)	
Surface water (ng/l)	0,45 33 7,98	nd 4 2,75	nd 20 6,12	nd 35 13,74	2 430 62,10	nd 110 110	nd 20 19,50	10
Drinking water (ng/l)	nd	nd	nd 7,90 7,90	nd 5,10 5,10	nd 2,80 1,65	nd	nd	6

Reference:

- (Fick, et al., 2011)

	Propanolol (525-66-6)	
Matrix	*min* *max* *AD*	*Nr.S*
Biota	nd	3
Sediment	nd	6
STP sludge (ng/g dw)	12,3 30,3 19,6	4
Effluent (ng/l)	nd 77,7 39,9	10
Surface water (ng/l)	nd 3 1,66	12

Reference:

- (Schlabach, et al., 2009)

6. Complexing compounds

Complexing forms are defined as chelant compounds, which form complexes with calcium, magnesium, and iron, allowing better foaming and cleaning performance of cosmetics and personal care products. By binding with metal ions, these ingredients prevent the metals from deposition on hair, scalp and skin.

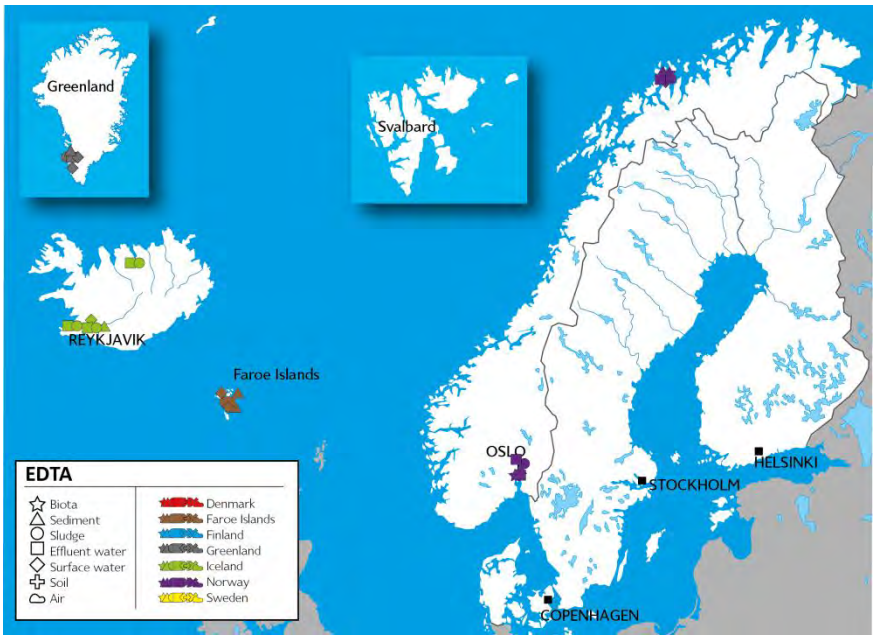
Chelante compounds are heterocyclic chemicals with a central metallic ion attached by covalent bonds to two or more non-metallic atoms in the same molecule.

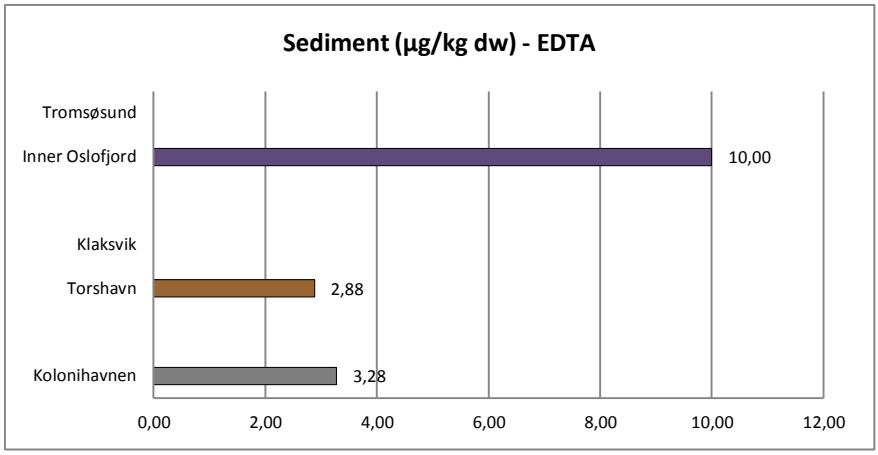
Disodium EDTA and the related ingredients bind to metal ions which inactivates them. The binding of metal ions helps prevent the deterioration of cosmetics and personal care products. It also helps to maintain clarity, protect fragrance compounds, and prevent rancidity.

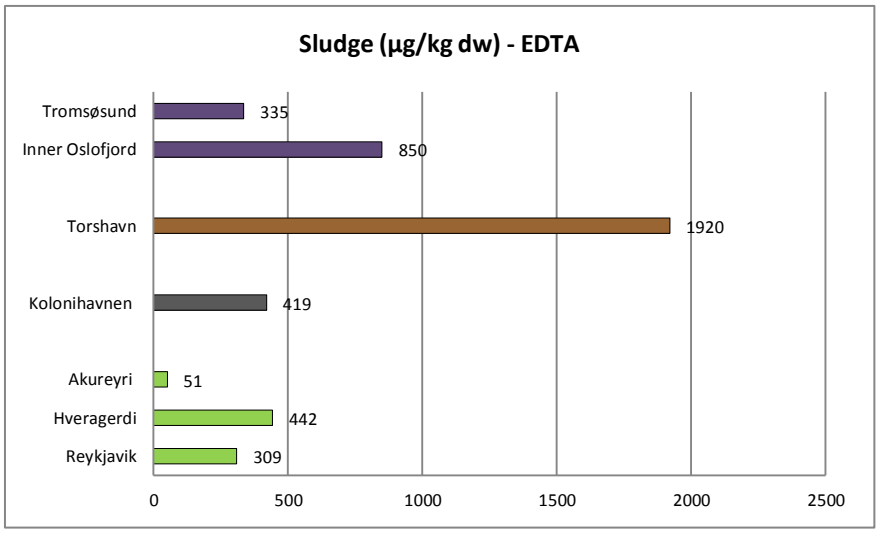
Ethylenediaminetetraacetic acid (EDTA) is the only complexing compound that has been monitored in the Nordic countries.

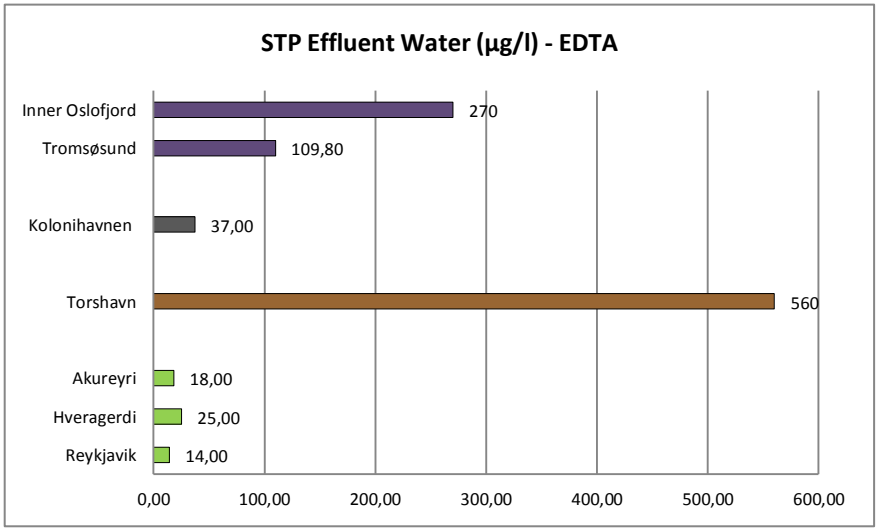
6.1.1 Ethylenediaminetetraacetic acid (EDTA)

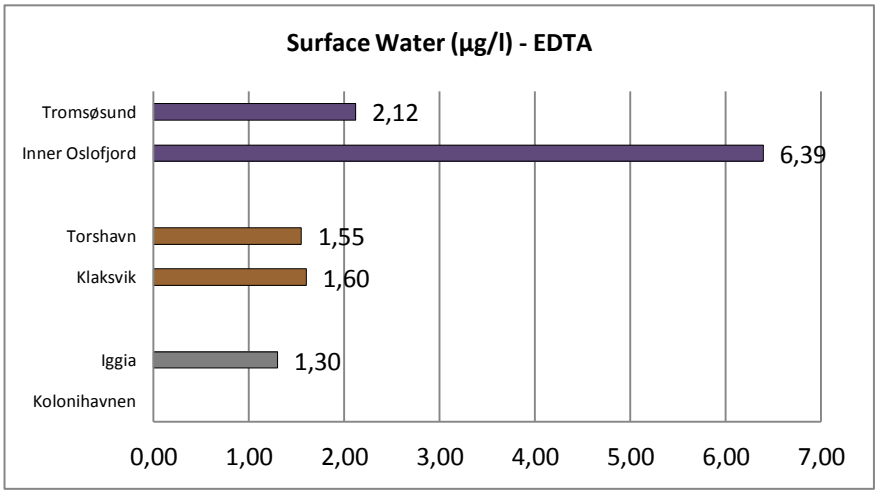
CAS nr.: 60-00-4
Info: Ligand and chelating agent, i.e. its ability to "sequester" metal ions
Toxicity data: LD50 (Lepomis macrochirus)=24 000 000 ng/L *(Schlabach, et al., 2009)*
PNECaqua = 2,2 mg/l (Schlabach, et al., 2009)




Sediment (µg/kg dw) - EDTA
Tromsøsund
Inner Oslofjord
Klaksvik
Torshavn
Kolonihavnen
10,00
2,88
3,28
0,00
2,00
4,00
6,00
8,00
10,00
12,00


Sludge (µg/kg dw) - EDTA
Tromsøsund
Inner Oslofjord
Torshavn
Kolonihavnen
Akureyri
Hveragerdi
Reykjavik
335
850
1920
419
51
442
309
0
500
1000
1500
2000
2500


STP Effluent Water (µg/l) - EDTA
Inner Oslofjord
Tromsøsund
Kolonihavnen
Torshavn
Akureyri
Hveragerdi
Reykjavik
270
109,80
37,00
560
18,00
25,00
14,00
0,00
100,00
200,00
300,00
400,00
500,00
600,00



EDTA	Norway		Faroe Islands		Greenland		Iceland	
Matrix	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*	*min max AD*	*Nr.S (ref)*
Biota (µg/kg ww)	nd	4 (a)						
STP sludge (µg/kg dw)	280 1100 592,50	4(a)	73 3767 1920	2 (b)	0,38 1,11 0,75	2 (b)	nd 442,1 267,1	4 (b)
Sediment (µg/kg dw)	nd 10 10	6 (a)	nd 4,4 4,4	3 (b)	231 608 419	2 (b)		
Surface water (µg/l)	0,1 7,9 4,25	6 (a)	nd 1,8 1,57	5 (b)	nd 1,3 1,3	6 (b)		
STP Influent (µg/l)			11 16 14	2 (b)			9 27 17,33	3 (b)
STP effluent (µg/l)	79,39 310 189,9	6 (a)	560 560 560	1 (b)	37 37 37	1 (b)	14 25 19	3 (b)
Hospital WW (µg/l)			11 630 320,5	2 (b)	420 420 420	1 (b)		

References:

a) (Schlabach, et al., 2007)
b) (Huber, et al., NA)

Conclusion:

The compound was monitored in Norway, Faroe Islands, Greenland and Iceland. It was detected in several matrices:

- STP sludge in all countries and all samples analysed. The values detected were high for all countries. The highest average detected value is observed in the Faroe Islands
- Sediment in Faroe Islands and Greenland, not in Norway.
- Surface water in Faroe Islands, Greenland and Norway, in the large majority of samples monitored. Higher values were detected in Norway. All values detected were below the PNEC
- STP effluent in all countries. Values detected in Faroe Islands were higher. All values detected were below the PNEC
- Hospital waste water in all countries monitored, in values below the PNEC. Lower values were observed in Greenland
- STP influent in all countries monitored, values detected were below the PNEC

7. Fragrances

7.1 Scope and definition

Fragrances are defined as compounds that participate in giving a "pleasant scent" to a product.

The compounds listed in Table 5 are fragrances that have been monitored in at least one Nordic country.

Table 5: Fragrances identified in monitoring studies in the Nordic countries

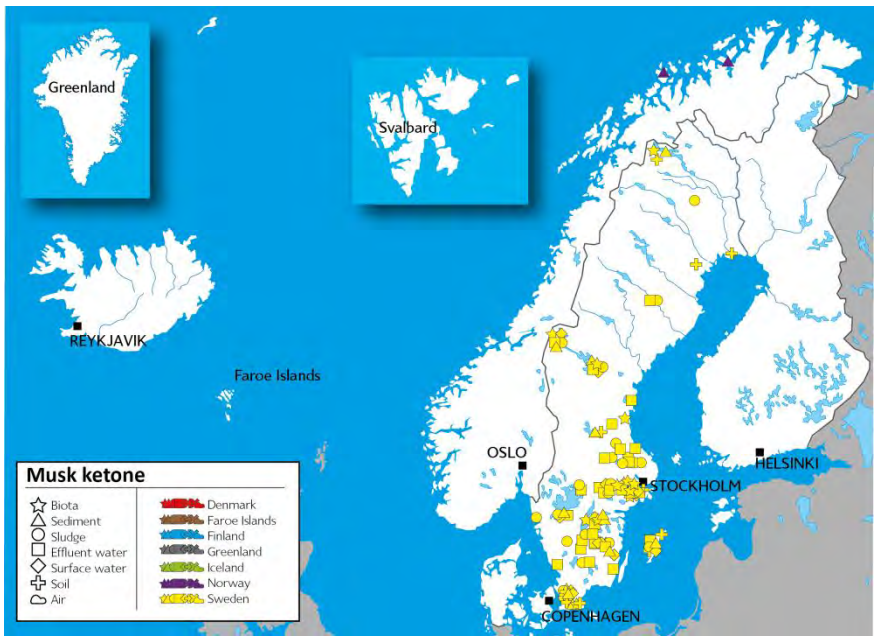
Compounds monitored	CAS nr
d-limonene,	5989-27-5
l-limonene,	5989-54-8
Ethylenebrassylat	105-95-3
Cashmeran, 6,7-Dihydro-1,1,2,3,3-pentamethyl-4(5H)indanone	33704-61-9
Musk moskene, 4,6-dinitro-1,1,3,3,5-pentamethylindane	116-66-5
Phantolide, 6-Acetyl-1,1,2,3,3,5-hexamethyldihydroindene	15323-35-0
Musk xylene, 5-tert-butyl-2,4,5-trinitro-m-xylene	81-15-2
Musk tibetene, 1-tert-butyl-2,6-dinitro-3,4,5-trimethylbenzene	145-39-1
Traseolide, 5-Acetyl-1,1,2,6-tetramethyl-3-isopropyl-dihydroindene	68140-48-7
Tonalide, 7-Acetyl-1,1,3,4,4,6-hexamethyltetrahydro-naphtlene	1506-02-1
Galaxolide, 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta[g]-2-benzopyrane	1222-05-5
Celestolide, 4-Acetyl-1,1-dimethyl-6-tertbutyldihydroindene	13171-00-1
Musk ambrette, 1-tert-Butyl-2-methoxy-4-methyl-3,5-dinitrobenzene	83-66-9
Musk ketone, 1-tert-Butyl-3,5-dimethyl-2,6-dinitrobenzene	81-14-1

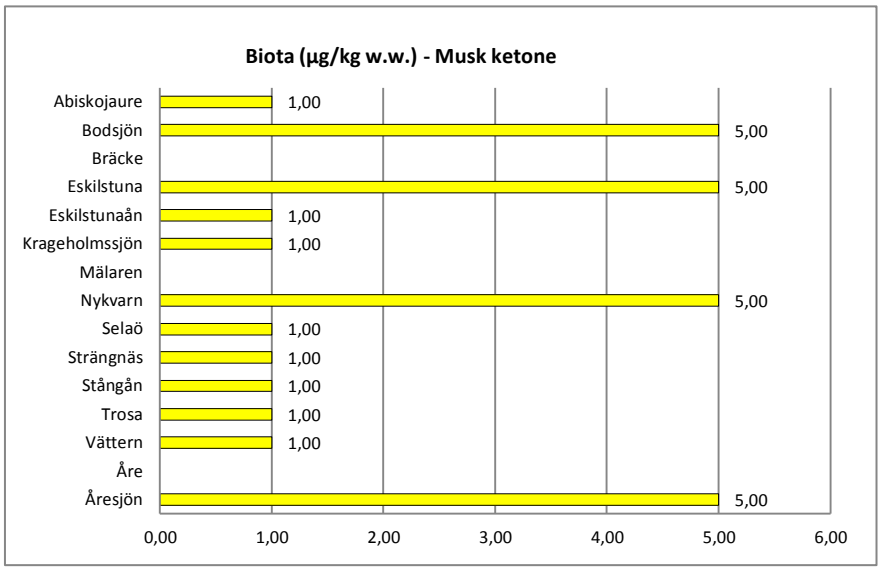
7.2 Compounds mapped

7.2.1 Musk ketone

CAS nr.: 81-14-1
Info: Used as fragrances in soaps, perfumes, air fresheners, detergents, fabric softeners and other household cleaning products

Toxicity data:
Minimum NOEC and LOEC = 0,010 mg/l
(Törneman, 2008)
PNEC =
PNEC aqua = 1 µg/l
PNEC sediment = 220 µg/kg
(Törneman, 2008)


Greenland
Svalbard
REYKJAVIK
Faroe Islands
OSLO
STOCKHOLM
HELSINKI
COPENHAGEN
Musk ketone
Biota
Sediment
Sludge
Effluent water
Surface water
Soil
Air
Denmark
Faroe Islands
Finland
Greenland
Iceland
Norway
Sweden


Biota (µg/kg w.w.) - Musk ketone
Abiskojaure
Bodsjön
Bräcke
Eskilstuna
Eskilstunaån
Krageholmssjön
Mälaren
Nykvarn
Selaö
Strängnäs
Stångån
Trosa
Vättern
Åre
Åresjön
1,00
5,00
5,00
1,00
1,00
5,00
1,00
1,00
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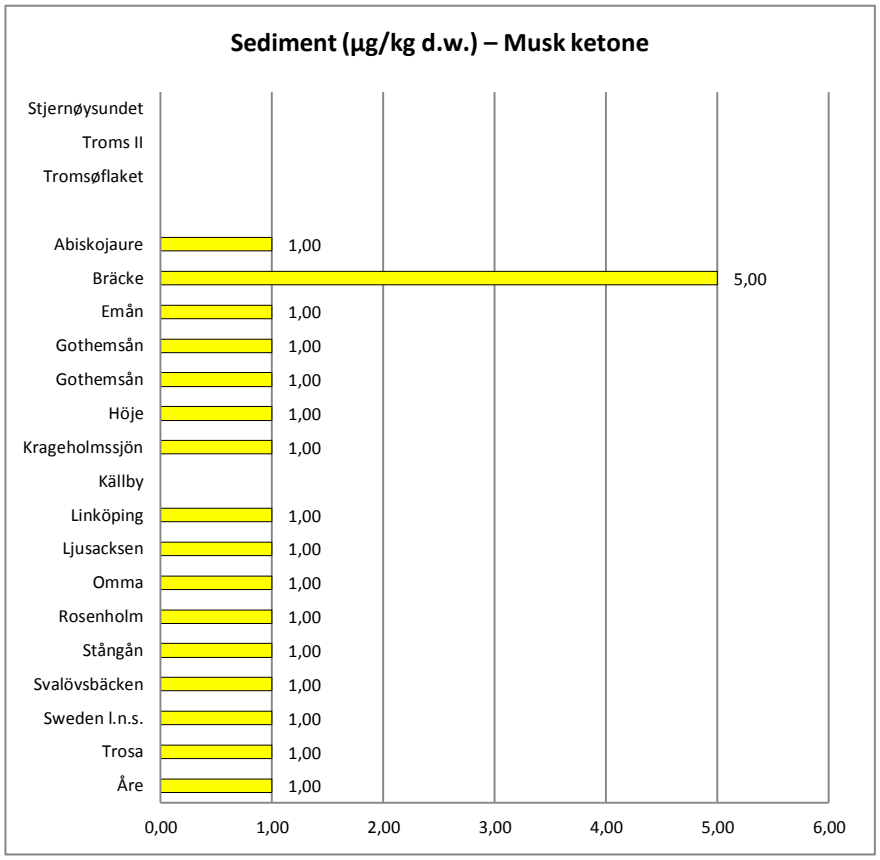
5,00
0,00
1,00
2,00
3,00
4,00
5,00
6,00



Musk ketone	Norway		Sweden	
Matrix	min max AD	Nr.S (ref)	min max AD	Nr.S (ref)
Biota (µg/kg ww)			nd 5,00 2,60	23 (bc)
Sediment (µg/kg dw)	nd	11 (a)	nd 5,00 1,29	42(bc)
STP sludge (µg/kg dw)			nd 84,50 6,96	36(bc)
Soil (µg/kg dw)			nd 5,00 1,19	35(bc)
STP effluent (ng/l)			nd 41,60 3,81	51(bc)
Ground water (ng/l)			1,00 1,00 1,00	3(b)
STP Influent (ng/l)			nd 11 5,48	27(bc)

Musk ketone	Norway	Sweden	
Leachate (ng/l)		1,00 5,00 2,33	4(bc)
Storm water (ng/l)		1,00 1,00 1,00	4(bc)
Surface water (ng/l)		1,00 3,7 1,37	34(bc)

References:

a) (Bakke, et al., 2008)
b) (Törneman, 2008)
c) (Törneman, 2010)

Conclusion:

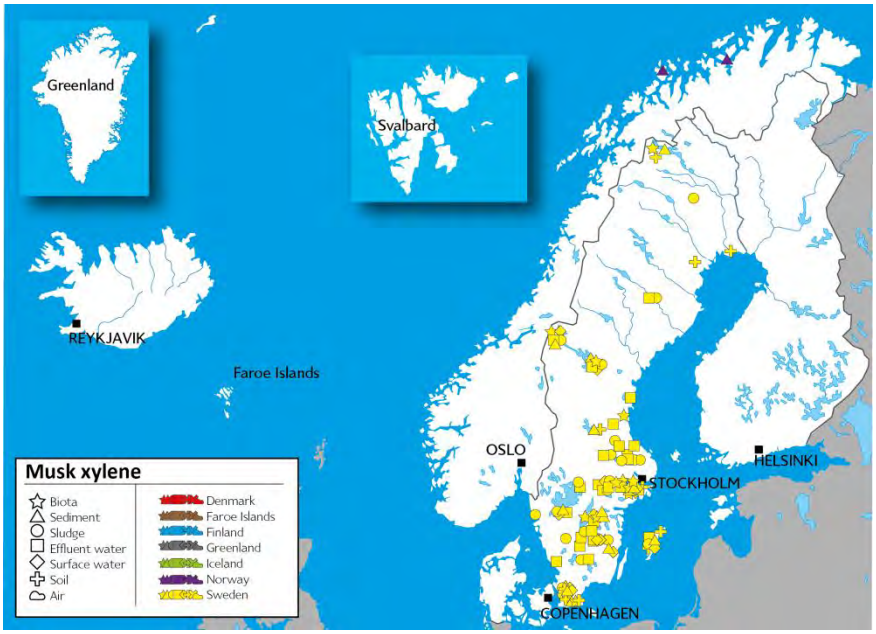
The compound was monitored in throughout Sweden and in Norway. It was not detected in Sediment in Norway, but was detected in all matrices monitored in Sweden:

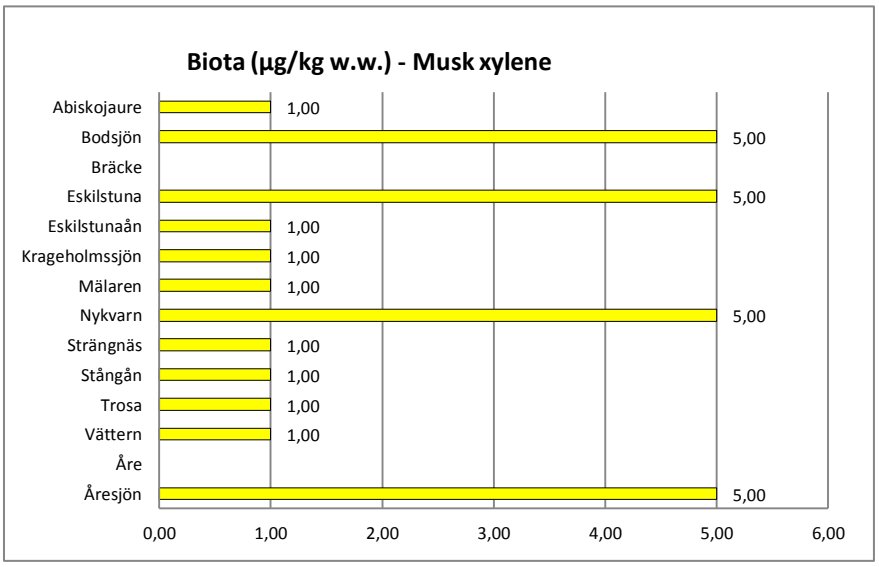
- Biota, in almost all locations monitored, the results varied.
- Sediment, in almost all locations monitored,in values below the PNEC
- Soil in all locations monitored, one higher value was detected in one location
- Surface water, in almost all locations monitored, below the PNEC
- STP sludge, in all locations monitored
- STP effluent, in all locations monitored, below the PNEC

7.2.2 Musk xylene

CAS nr.: 81-15-2
Info: was the most widely used of the “nitro-musks", a synthetic musk fragrance, which mimics natural musk. It has been used as a perfume fixative in a wide variety of consumer products, and is still used in some cosmetics and fragrances
Toxicity data: NOEC and LOEC min 0,056 mg/l
(Törneman, 2008)
PNEC =

- PNEC aqua 1,1 µg/l
- PNEC sediment 300 µg/kg¨
- PNEC soil 260 µg/kg
  (Törneman, 2008)


Greenland
Svalbard
REYKJAVIK
Faroe Islands
OSLO
HELSINKI
STOCKHOLM
COPENHAGEN
Musk xylene
Biota
Sediment
Sludge
Effluent water
Surface water
Soil
Air
Denmark
Faroe Islands
Finland
Greenland
Iceland
Norway
Sweden


Biota (µg/kg w.w.) - Musk xylene
Abiskojaure
Bodsjön
Bräcke
Eskilstuna
Eskilstunaån
Krageholmssjön
Mälaren
Nykvarn
Strängnäs
Stångån
Trosa
Vättern
Åre
Åresjön
1,00
5,00
1,00
1,00
1,00
5,00
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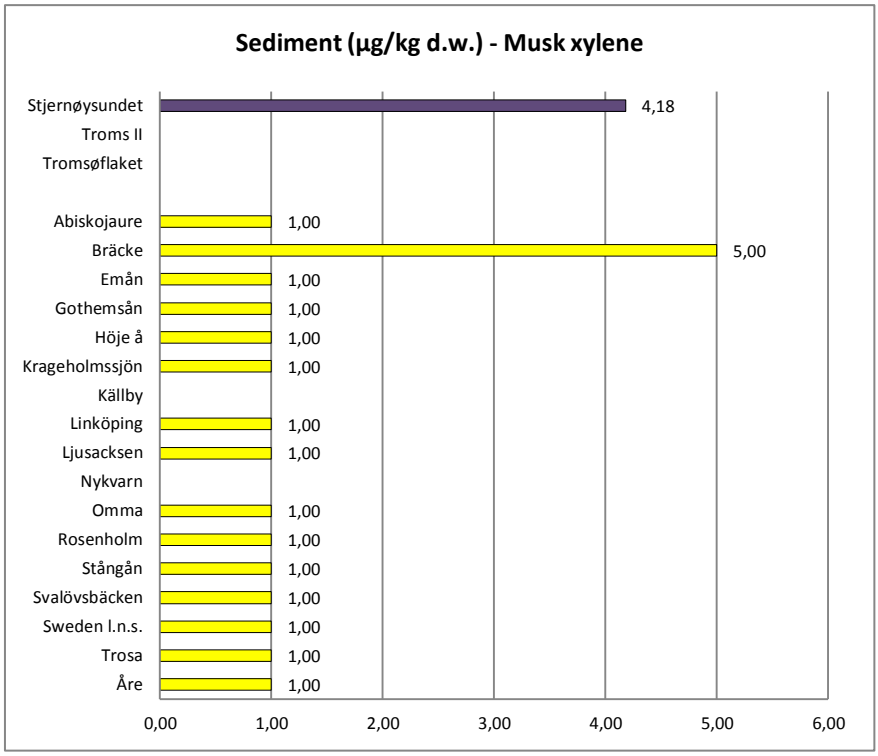
1,00
2,00
3,00
4,00
5,00
6,00



Musk xylene	Norway		Sweden	
Matrix	*min* *max* *AD*	*Nr.S (ref)*	*min* *max* *AD*	*Nr.S (ref)*
Biota (µg/kg ww)			nd 5,00 2,6	23 (bc)
Sediment (µg/kg dw)	nd 4,18 4,18	11 (a)	nd 5,00 1,29	42 (bc)
STP sludge (µg/kg dw)			nd 5,00 1,15	36 (bc)
Soil (µg/kg dw)			nd 5,00 1,19	35 (bc)
STP effluent (ng/l)			nd 10 1,54	48 (bc)
Ground water (ng/l)			1,00 1,00 1,00	3 (b)
STP Influent (ng/l)			nd 340 68	24 (bc)
Leachate (ng/l)			nd 5,00 2,33	4 (bc)

Musk xylene	Norway	Sweden	
Storm water (ng/l)		1,00 1,00 1,00	4 (b)
Surface water (ng/l)		nd 8,70 2,29	34 (bc)

References:

a) (Bakke, et al., 2008)
b) (Törneman, 2008)
c) (Törneman, 2010)

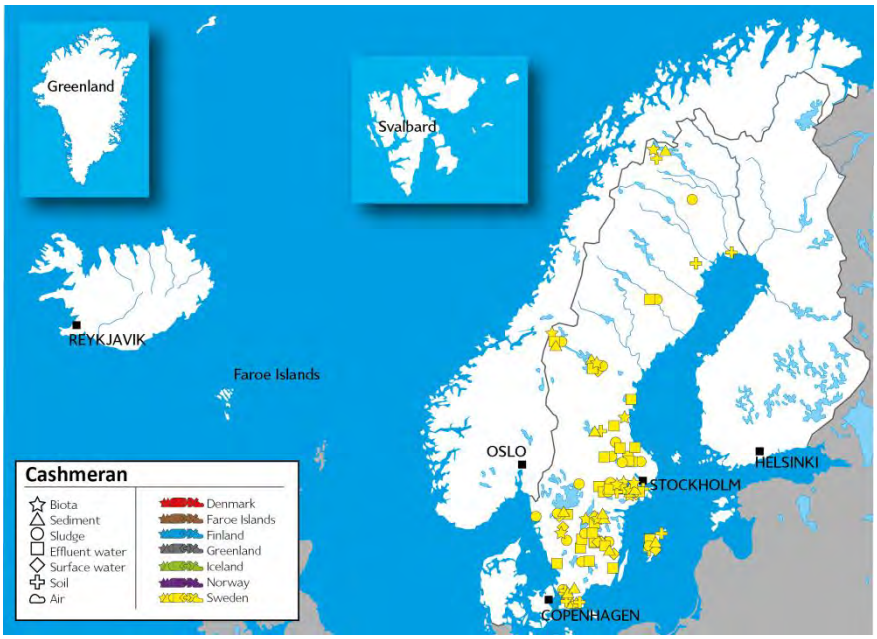
Conclusion:

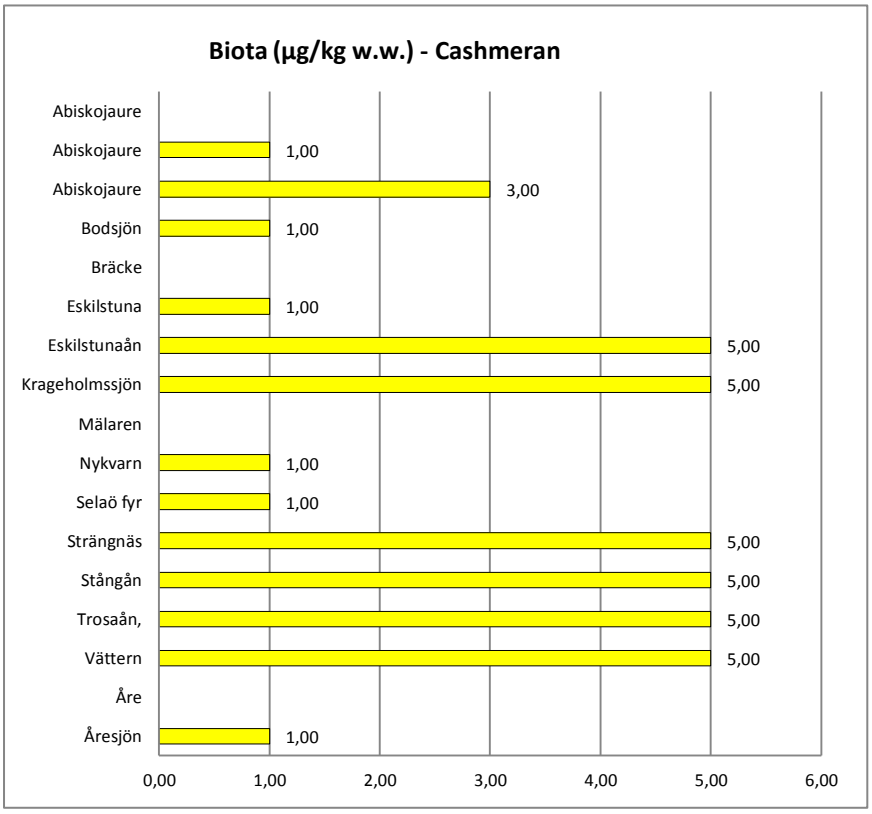
The compound was monitored in Norway and Sweden. It was not detected in sediment in Norway, but was detected in all matrices monitored in Sweden:

- Biota, in almost all locations monitored
- Sediment, in almost all locations monitored, below the PNEC
- Soil, in all locations monitored, below the PNEC
- Surface water , in all locations monitored, below the PNEC
- STP sludge , in all locations monitored
- STP effluent, in all locations monitored, below the PNEC

7.2.3 Cashmeran

CAS nr.: 33704-61-9
Info: Synthetic fragrance in cosmetic, known to bioaccumulateand be a potential hormone disruptor.
Toxicity data: LD50 oral = 2900 mg/kg
(Törneman, 2008)
PNEC = NA


Greenland
Svalbard
REYKJAVIK
Faroe Islands
OSLO
HELSINKI
STOCKHOLM
COPENHAGEN
Cashmeran
Biota
Sediment
Sludge
Effluent water
Surface water
Soil
Air
Denmark
Faroe Islands
Finland
Greenland
Iceland
Norway
Sweden


Biota (µg/kg w.w.) - Cashmeran
Abiskojaure
Abiskojaure
Abiskojaure
Bodsjön
Bräcke
Eskilstuna
Eskilstunaån
Krageholmssjön
Mälaren
Nykvarn
Selaö fyr
Strängnäs
Stångån
Trosaån,
Vättern
Åre
Åresjön
1,00
3,00
1,00
1,00
5,00
5,00
1,00
1,00
5,00
5,00
5,00
5,00
1,00
0,00
1,00
2,00
3,00
4,00
5,00
6,00

Cashmeran	Sweden	
Matrix	min max AD	Nr.S (ref)
Biota (µg/kg ww)	nd 5,00 2,87	23 (ab)
Sediment (µg/kg dw)	1,00 12,20 2,01	42 (ab)
STP sludge (µg/kg dw)	nd 2510 119,94	36 (ab)
Soil (µg/kg dw)	nd 20,00 2,76	35 (ab)
Influent (ng/l)	1,00 150,00 53,81	27 (ab)
STP effluent (ng/l)	1,00 308,00 19,11	51 (ab)
Groundwater (ng/l)	1,00 1,00 1,00	3 (a)
Surface water (ng/l)	1,00 1,00 1,00	4 (ab)
Surface water(ng/l)	nd 26,00 6,21	34 (ab)
Leachate (ng/l)	nd 5,00 2,33	4 (ab)
Storm water (ng/l)	1,00 1,00 1,00	4 (a)

References:

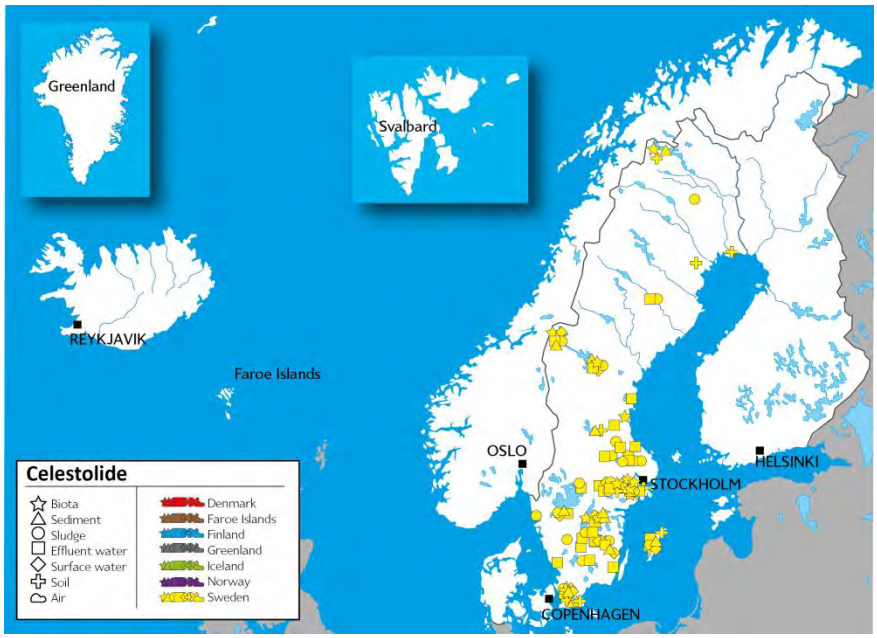
a) (Törneman, 2008)
b) (Törneman, 2010)

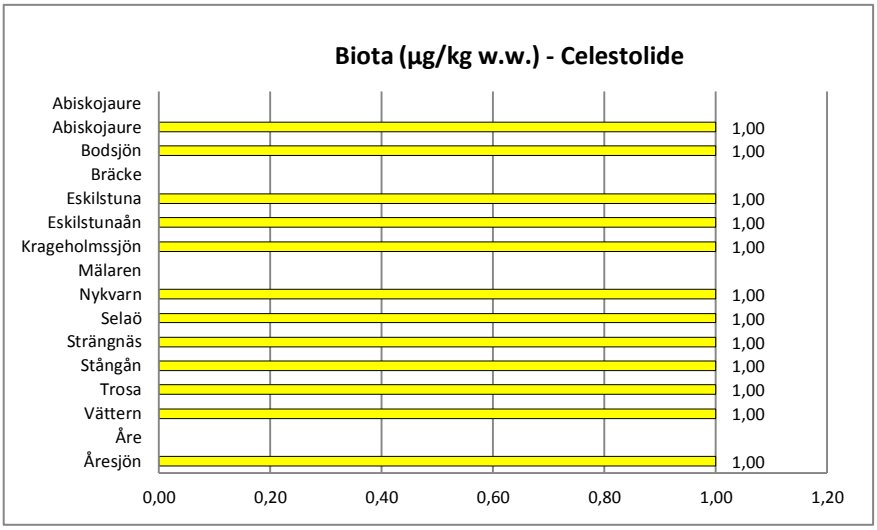
Conclusion:

The compound was only monitored in Sweden and was detected in all locations monitored.

7.2.4 Celestolide

CAS nr.: 13171-00-1
Info: Celestolide is a polycyclic musk commonly used as a fragrance ingredient in a wide variety of personal care and other everyday products, including cosmetics, cleaning agents, detergents, air fresheners, and perfumes
Toxicity data: LD50 oral = 2900 mg/kg
(Törneman, 2008)
PNEC = NA





Celestolide	Sweden	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg ww)	nd 1,00 1,00	23 (ab)
Sediment (µg/kg dw)	nd 5,00 1,28	42 (ab)
STP sludge (µg/kg dw)	nd 124,00 23,22	36 (ab)
Soil (µg/kg dw)	nd 5,10 1,55	28
Influent (ng/l)	nd 17,00 5,48	27 (ab)
STP effluent (ng/l)	nd 4,00 1,47	52 (ab)
Groundwater (ng/l)	1,00 1,00 1,00	3 (ab)
Surface water (ng/l)	nd 3,00 1,15	33 (ab)
Leachate (ng/l)	nd 5,00 2,33	4 (ab)
Storm water (ng/l)	1,00 1,00 1,00	4 (a)

References:

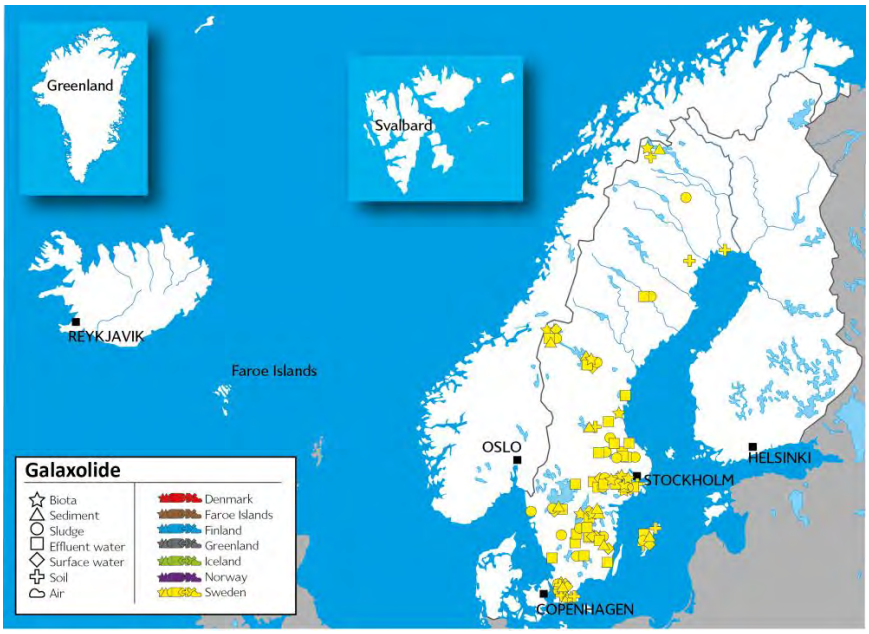
a) (Törneman, 2008)
b) (Törneman, 2010)

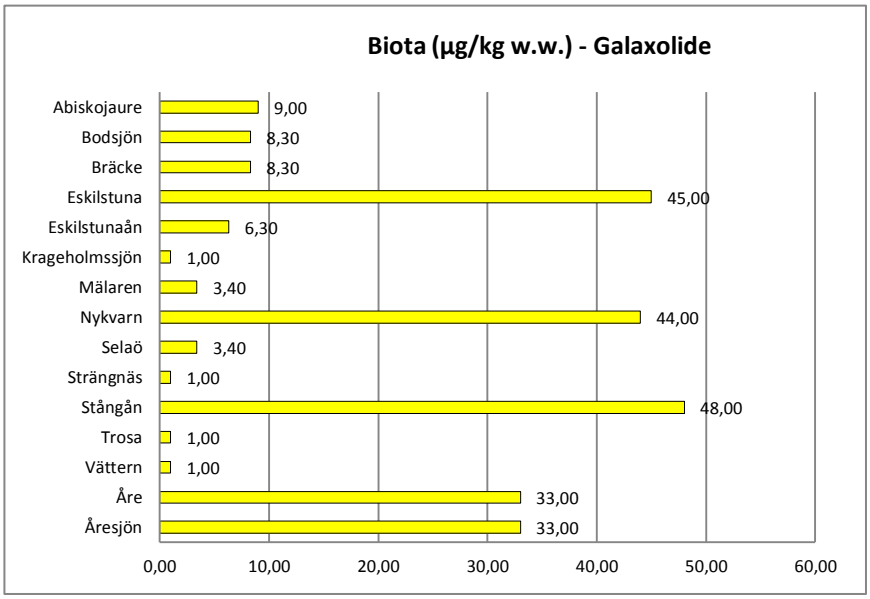
Conclusion:

The compound was only monitored in Sweden, however it was monitored in two studies in biota and in this manner the compound was mapped and graphed for biota. The compound was detected in all matrices sampled and in all locations monitored.

7.2.5 Galaxolide

CAS nr.: 80450-66-4
Info: polycyclic musk commonly used as a fragrance ingredient in a wide variety of personal care and other everyday products, including cosmetics, cleaning agents, detergents, air fresheners, and perfumes
Toxicity data: NOEC and LOEC max = 0,14 mg/l
(Törneman, 2008)
PNEC =
PNEC aqua = 6,8 µg/l
PNEC sediment = 320 µg/l
(Törneman, 2008)





Galaxolide	Sweden	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg ww)	1,00 48,00 18,09	23 (ab)
Sediment (µg/kg dw)	nd 100 18,12	42 (ab)
STP sludge (µg/kg dw)	8,70 29400 6116,91	36 (ab)
Soil (µg/kg dw)	nd 870 68,01	35 (ab)
Influent (ng/l)	53,70 3800 1469,93	27 (ab)
STP effluent (ng/l)	1,00 20300 891,71	51 (ab)
Groundwater (ng/l)	1,00 1,00 1,00	3 (a)
Surface water (ng/l)	nd 800 109,76	34 (ab)
Leachate (ng/l)	1,00 16,00 8,50	4 (ab)
Storm water (ng/l)	1,00 1,00 1,00	4 (a)

References:

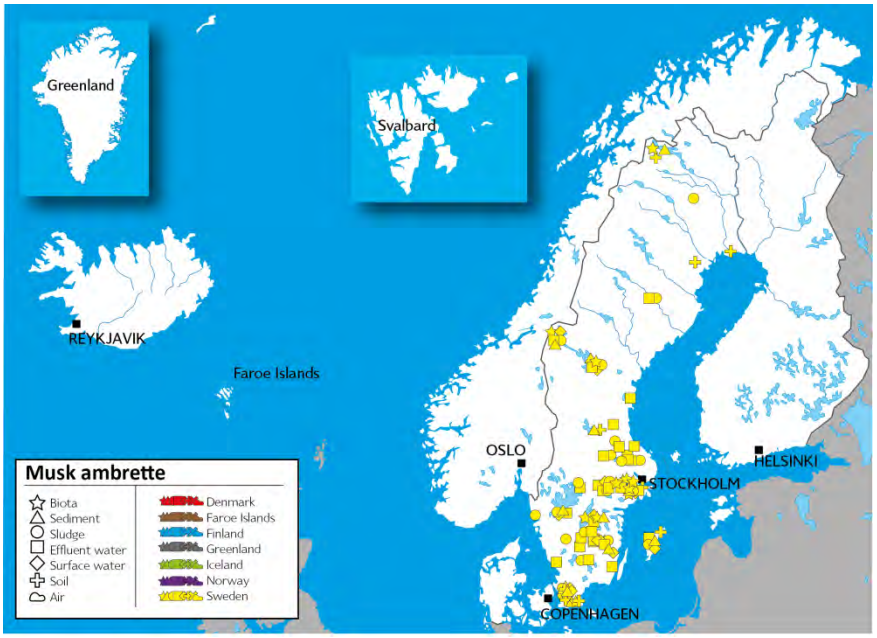
a) (Törneman, 2008)
b) (Törneman, 2010)

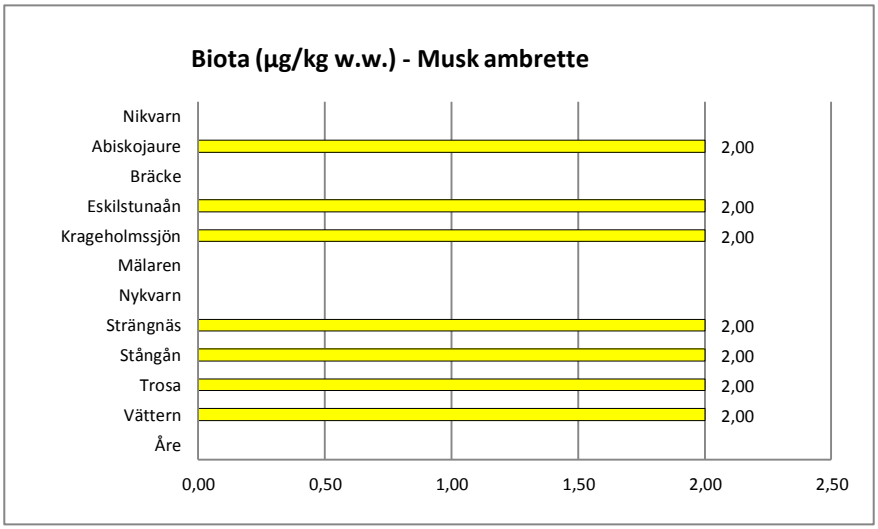
Conclusion:

The compound was only monitored in Sweden and was detected in all locations monitored. High values were detected in STP sludge and effluent. In sediment it was detected in values below the PNEC. High values were detected in STP sludge and effluent, the values detcetd in effluent were above the PNEC. The values detected in surface water were below the PNEC.

7.2.6 Musk ambrette

CAS nr.: 83-66-9
Info: Musk ambrette is a nitro-musk compound widely used as a fixative in fragrance formulations and found to a lesser degree in flavor compositions
Toxicity data: NA
PNEC = NA





Musk ambrette	Sweden	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg ww)	nd 2,00 2,00	23 (ab)
Sediment (µg/kg dw)	nd 49 5,98	42 (ab)
STP sludge (µg/kg dw)	nd 110 16,69	36 (ab)
Soil (µg/kg dw)	nd 23 5,89	35 (ab)
Influent (ng/l)	nd 61 14,85	27 (ab)
STP effluent (ng/l)	nd 10 1,25	51 (ab)
Groundwater (ng/l)	1,00 1,00 1,00	3 (a)
Surface water (ng/l)	nd 3 1,10	34 (ab)
Leachate (ng/l)	nd 5 2,33	4 (ab)
Storm water (ng/l)	1,00 1,00 1,00	4 (a)

References:

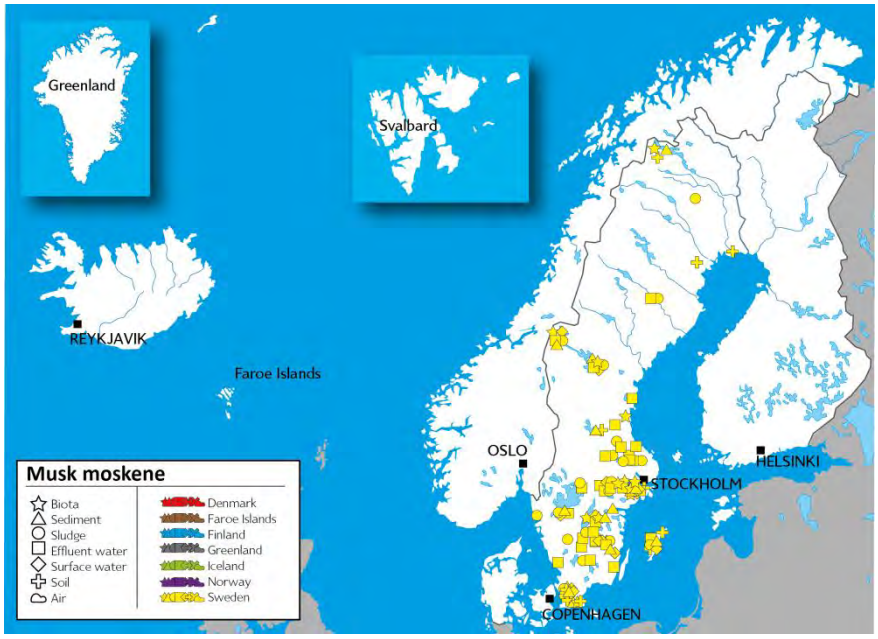
a) (Törneman, 2008)
b) (Törneman, 2010)

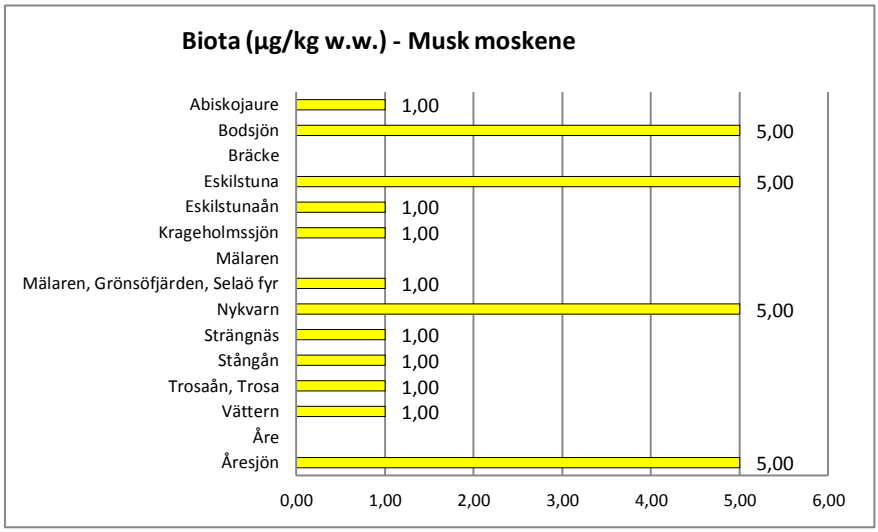
Conclusion:

The compound was only monitored in Sweden and was detected in all locations monitored.

7.2.7 Musk moskene

CAS nr.: 116-66-5
Info: Synthetic fragrance in perfumes and cosmetics
Toxicity data: NA
PNEC = NA





Musk moskene	Sweden	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg ww)	nd 5,00 2,60	23 (ab)
Sediment (µg/kg dw)	nd 5,00 1,31	42 (ab)
STP sludge (µg/kg dw)	nd 5,00 1,15	36 (ab)
Soil (µg/kg dw)	nd 16 3,79	35 (ab)
STP effluent (ng/l)	nd 10 1,25	51 (ab)
Ground water (ng/l)	1,00 1,00 1,00	3 (ab)
STP Influent (ng/l)	nd 10 3,88	27 (ab)
Leachate (ng/l)	nd 5,00 2,33	4 (ab)
Storm water (ng/l)	1,00 1,00 1,00	4 (a)
Surface water (ng/l)	nd 3,00 1,11	34 (ab)

References:

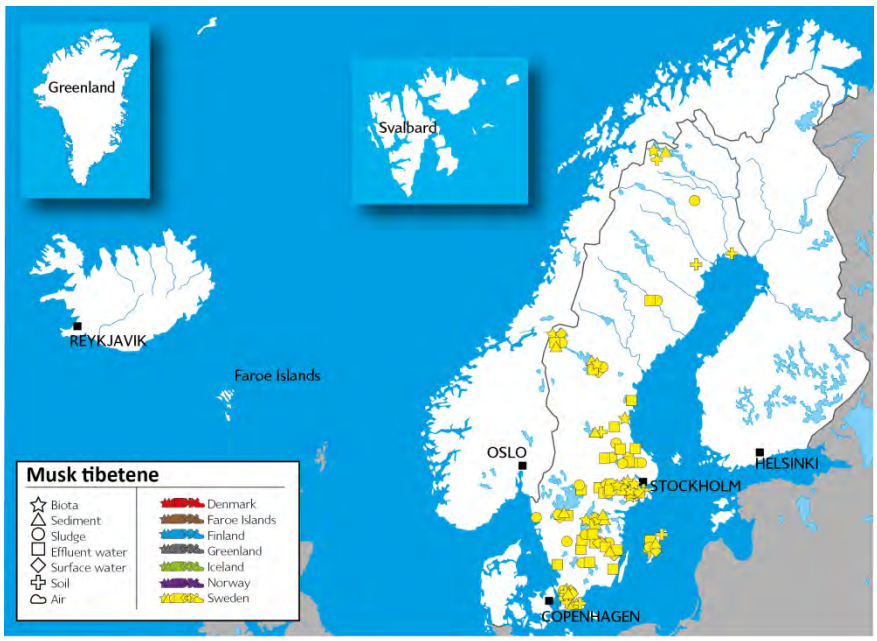
a) (Törneman, 2008)
b) (Törneman, 2010)

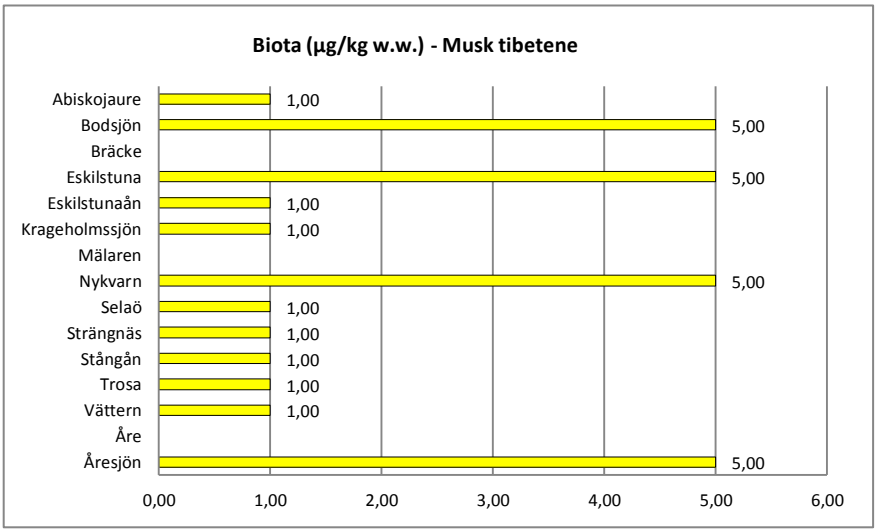
Conclusion:

The compound was only monitored in Sweden and was detected in all locations monitored.

7.2.8 Musk tibetene

CAS nr.: 145-39-1
Info: Synthetic fragrance in perfumes and cosmetics
Toxicity data: NA
PNEC = NA





Musk tibetene	Sweden	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg ww)	nd 5,00 2,60	23 (ab)
Sediment (µg/kg dw)	nd 5,00 1,29	42 (ab)
STP sludge (µg/kg dw)	nd 5,00 1,15	36 (ab)
Soil (µg/kg dw)	nd 5 1,19	35 (ab)
STP effluent (ng/l)	nd 640 17,25	51 (ab)
Ground water (ng/l)	1,00 1,00 1,00	3 (a)
STP Influent (ng/l)	nd 1100 125,61	27 (ab)
Leachate (ng/l)	nd 5,00 2,33	4 (ab)
Storm water (ng/l)	1,00 1,00 1,00	4 (a)
Surface water (ng/l)	nd 640 75,68	34 (ab)

References:

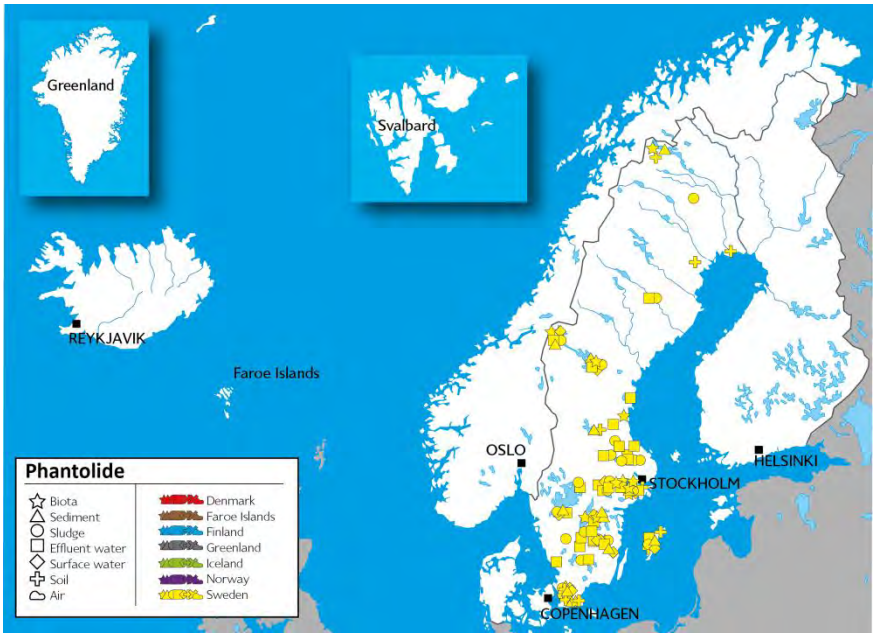
a) (Törneman, 2008)
b) (Törneman, 2010)

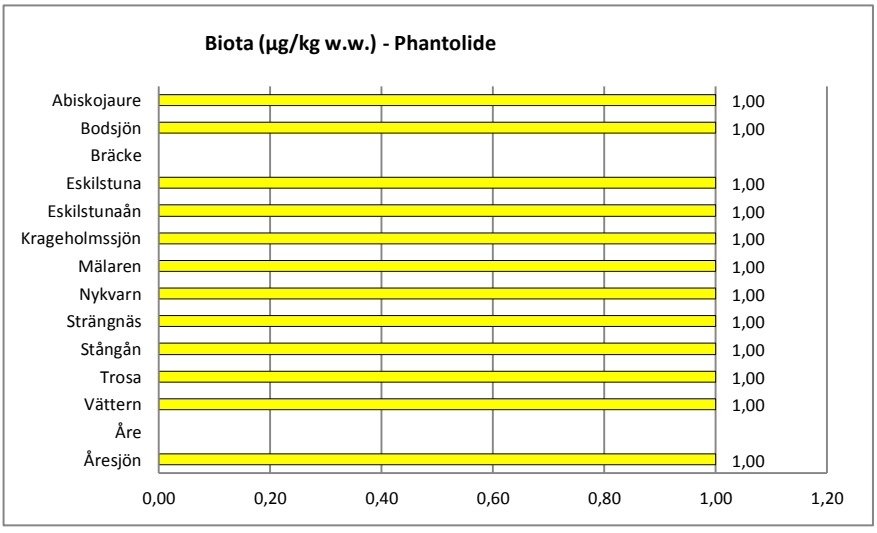
Conclusion:

The compound was only monitored in Sweden and was detected in all locations monitored.

7.2.9 Phantolide

CAS nr.: 15323-35-0
Info: Phantolide is a polycyclic musk, a group of synthetic fragrance chemicals typically used in cosmetics, perfumes, air fresheners, cleaning products, detergents, soap, and many other everyday products with artificial scents
Toxicity data: NOEC and LOEC min 0,044 mg/l, max 0,90 mg/l (Törneman, 2010)
PNEC = NA





	Sweden	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg ww)	nd 1,00 1,00	23 (ab)
Sediment (µg/kg dw)	nd 5,00 1,29	42 (ab)
STP sludge (µg/kg dw)	nd 29,9 4,81	36 (ab)
Soil (µg/kg dw)	nd 5,00 1,19	35 (ab)
STP effluent (ng/l)	nd 2,00 1,04	51 (ab)
Ground water (ng/l)	1,00 1,00 1,00	3 (a)
STP Influent (ng/l)	nd 10 3,36	27 (ab)
Leachate (ng/l)	nd 5,00 2,33	4 (ab)
Storm water (ng/l)	1,00 1,00 1,00	4 (a)
Surface water (ng/l)	nd 3,00 1,10	34 (ab)

References:

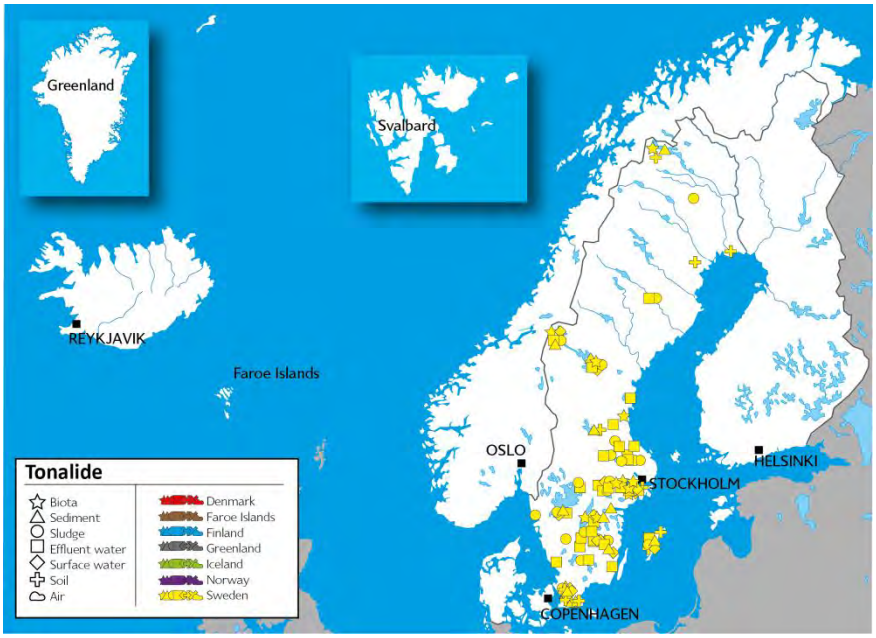
a) (Törneman, 2008)
b) (Törneman, 2010)

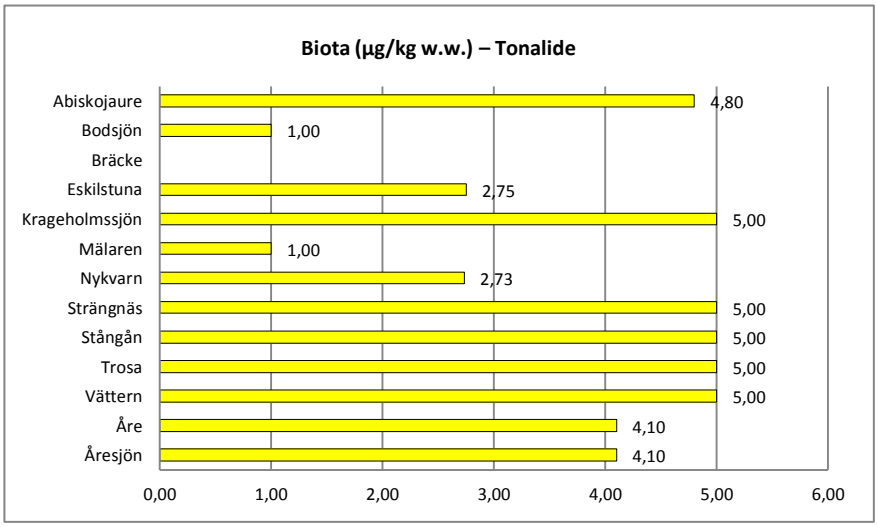
Conclusion:

The compound was only monitored in Sweden and was detected in all locations monitored.

7.2.10 Tonalide

CAS nr.: 21145-77-7
Info: Synthetic fragrance in cosmetics, detergents, toiletries, cigarettes
Toxicity data: NOEC and LOEC max 0,14 mg/l (Törneman, 2010)
PNEC =
PNEC aqua 0,35 µg/l
PNEC sediment 200 µg/l
(Törneman, 2010)





Tonalide	Sweden	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg ww)	nd 5,00 3,49	23 (ab)
Sediment (µg/kg dw)	nd 28 5,18	42 (ab)
STP sludge (µg/kg dw)	1,00 2560 538,15	36 (ab)
Soil (µg/kg dw)	nd 97 11,41	35 (ab)
STP effluent (ng/l)	1,00 1570 67,28	51 (ab)
Ground water (ng/l)	1,00 1,00 1,00	3 (a)
STP Influent (ng/l)	nd 380 146,46	27 (ab)
Leachate (ng/l)	nd 5,00 2,33	4 (ab)
Storm water (ng/l)	1,00 1,00 1,00	4 (a)
Surface water(ng/l)	nd 32 5,94	34 (ab)

References:

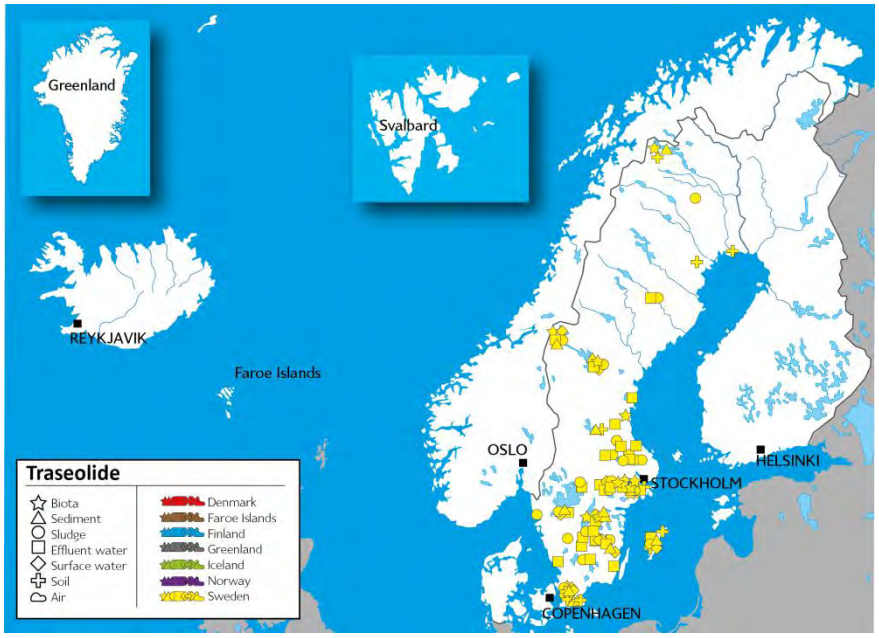
a) (Törneman, 2008)
b) (Törneman, 2010)

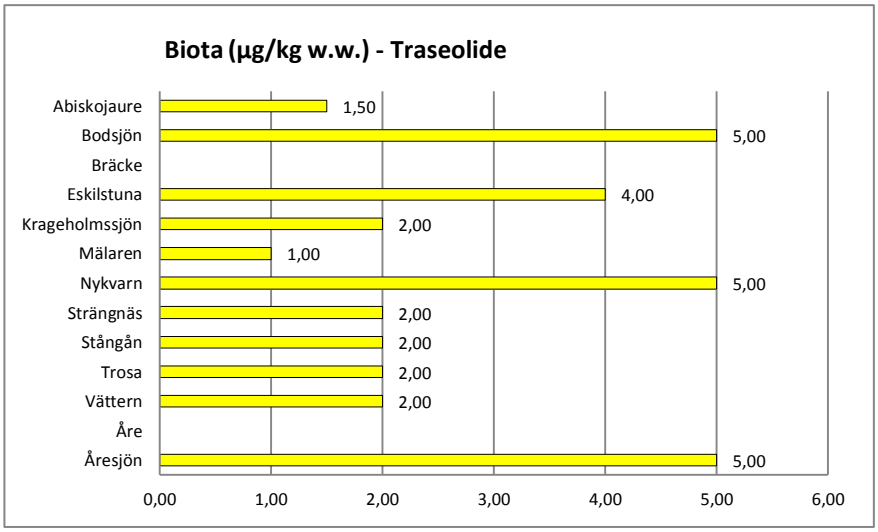
Conclusion:

The compound was only monitored in Sweden and was detected in all locations monitored. The values detected in STP effluent and surface water were above the PNEC. The value detected in sediment was below the PNEC.

7.2.11 Traseolide

CAS nr.: 68140-48-7
Info: Synthetic fragrance in cosmetics, detergents, toiletries, and toys
Toxicity data: NA
PNEC = NA





Traseolide	Sweden	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg ww)	nd 5,00 3,07	23 (ab)
Sediment (µg/kg dw)	nd 5,00 1,29	42 (ab)
STP sludge (µg/kg dw)	nd 112 23,73	36 (ab)
Soil (µg/kg dw)	nd 5,00 1,19	35 (ab)
STP effluent (ng/l)	nd 12 1,93	51 (ab)
Groundwater (ng/l)	1,00 1,00 1,00	3 (a)
STP Influent (ng/l)	nd 10 4,18	27 (ab)
Leachate (ng/l)	nd 5,00 2,33	4 (ab)
Storm water (ng/l)	1,00 1,00 1,00	4 (a)
Surface water (ng/l)	nd 5,5 1,32	34 (ab)

References:

a) (Törneman, 2008)
b) (Törneman, 2010)

Conclusion:

The compound was only monitored in Sweden and was detected in all locations monitored.

7.3 Compounds monitored in one study

	Ethylenbrassylat (105-95-3)	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg ww)	nd	6
Sediment (µg/kg dw)	nd	12
Landfild leachate sediemnts (µg/kg dw)	nd	4
STP sludge (µg/kg dw)	nd	6
STP effluent (µg/l)	nd	4
STP Influent (µg/l)	nd 0,4 0,4	8
Untreated landfild leachate (µg/l)	nd	4
Treated landfild leachate (µg/l)	nd	5
Surface water (µg/l)	nd	8

Reference:

- (Møskeland, et al., 2006)

	D-limonene (5989-27-5)		L-limonene (95327-98-3)	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (µg/kg ww)	nd nd nd	2	nd	2
Sediment (ng/kg dw)	nd 100 100	6	nd 260 98	6
STP sludge (ng/kg dw)	nd 2600 699,3		nd 16000 1840,3	21
STP effluent	nd	2	nd	2
Leachate	nd	1	nd	1
Surface water (µg/l)	nd 0,18 0,18	2	nd 0,51 0,51	2
Air (µg/m3) d-limonene and l-limonene	2,10 2,80 2,33			3

Reference:

- (Potter, et al., 2004)

8. UV-filter compounds

8.1 Scope and definition

UV-filters are defined as compounds used to prevent UV light from getting through various materials. Within the PPCPs, UV-filters are used as sun-screen to protect the skin, by reducing the amount of UV light that reaches the skin, in order to prevent the negative health impacts of these rays.

UV-filters used in PPCPs are believed to emit to the environment primarily from losses due to washing and bathing.

Table 6: UV-filter compounds monitored in the Nordic countries

Compound	CAS
3-Benzylidene camphor (3-BC)	15087-24-8
2-Ethylhexyl 4-dimethylaminobenzoate (EPABA ,ODPABA)	21245-02-3
Diethylaminohydroxybenzoyl hexyl benzoate (DBENZO,)	302776-68-7
Ethylhexylmethoxycinnamate	5466-77-3
Butylmethoxydibenzoylmethane (Avobenzone – Eusolex 9020 – BMDB)	70356-09-1
Isoamyl p-methoxycinnamate (IMC – IAMC)	71617-10-2
Homosalate (HMS – 3,3,5-trimehtylcyclohexylsalicylate)	118-56-9
2-Ethylhexyl salicylate (EHS)	118-60-5
4-Methyl benzylidene camphor (Eusolex 6300)	36861-47-9/ 38102-62-4
Octocrylene (2-ethylhexyl 2-cyano-3,3-di(phenyl)prop-2-enoate)	6197-30-4
2,4-Dihydroxybensophenone	131-56-6
2,2´-Dihydroxy-4-metoxybensophenone (DHMB)	131-53-3
Benzophenone-3, Eusolex 4360	131-57-7

8.2 Compounds monitored in at least two studies

8.2.1 Butylmethoxydibenzoylmethane, Avobenzone Eusolex 9020 (BMDB)

CAS nr.: 70356-09-1
Info: Oil soluble ingredient used in sunscreen products to absorb the full spectrum of UVA rays
Toxicity data: NA
PNEC = NA

BMDB	Norway		Sweden	
Matrix	*min* *max* *AD*	*Nr.S* *(ref)*	*min* *max* *AD*	*Nr.S* *(ref)*
Biota (ng/g ww)	nd	10 (ab)	nd	5 (c)
Sediment (ng/g dw)	nd	17 (ab)	nd	7 (c)
Landfild leachate sediments (ng/g dw)	nd	4 (a)		
STP sludge (ng/g dw)	nd	10 (ab)	nd	8 (c)
STP effluent (ng/l)	nd	4 (b)	nd 14 4,67	8 (c)
STP influent	nd	8 (b)		
Untreated landfill leachates (ng/l)	nd	4 (b)		
Treated landfill leachates (ng/l)	nd	5 (b)		
Urban run-off			nd	6 (c)
Surface water (ng/l)	nd	8 (b)	nd 9,90 6,14	18 (c)

References:
a) (Schlabach, et al., 2009)
b) (Møskeland, et al., 2006)
c) (Remberger, et al., 2011)

Conclusion:
The compound was monitored in Norway and Sweden. It was not detected in any matrix in Norway, but was detected in STP effluent water and surface water in Sweden.

8.3 Compounds monitored in one study

	Octocrylene (6197-30-4)	3-Benzyl-idene camphor (15087-24-8)	4-Methyl benzylidene camphor, (36861-47-9)	Benzo-phenone-3, Eusolex 4360 (131-57-7)	Ethylhexyl-methoxy-cinnamate (5466-77-3)	Diethylamino-hydroxy-benzoylhexyl benzoate (302776-68-7)	Ethylhexyl salicylate (118-60-5)	2-Ethylhexyl 4-(dimethyl-amino) benzoate (21245-02-3)	Isoamyl pmethoxy-cinnamate (71617-10-2)	2,4-Di-hydroxy-benso-phenone (131-56-6)	Homosalate (118-56-9)	2,2´-Dihydroxy-4- metoxyben-sophenone (131-53-3)	
Matrix	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*min* *max* *AD*	*Nr.S*
Biota (ng/g ww)	nd 6,80 4,33	nd	nd 1,20 1,20	nd	nd 0,80 0,60	nd	nd	nd	nd 0,12 0,12	nd	nd	nd	5
Sediment (ng/g dw)	nd 350 125,25	nd 62 35,50	nd 29 17,90	nd 11 8,75	nd 45 27,33	nd	nd 23 23	nd 1,20 1,20	nd 1,80 1,21	nd 4,3 2,72	nd 32 9,76	nd	7
STP sludge (ng/g dw)	2700 9100 6287,5	nd 64 64	320 1300 762,5	14 82 39,38	31 410 160,4	nd 2500 1635,7	nd	nd 39 13,86	nd 7,9 3,98	nd 89 28	140 950 577,5	nd 2,8 1,2	8
STP effluent (ng/l)	nd 600 189,80	nd 19 19	nd 230 62	14 360 131,2	nd 49 21,50	nd 270 96,70	nd 12 12	nd 160 81,35	nd 2 2	nd 68 37,32	nd 25 6,97	nd 3,3 2,35	8
Urban run-off (ng/l)	nd 14 8,84	nd	nd 430 129,1	2,50 13 4,77	nd 1,6 1,60	nd 11 8	nd	nd 38 13,46	nd	nd 3,50 3,40	nd 25 6,97	nd 0,54 0,52	6
Surface water (ng/l)	nd 1200 156,64	nd	nd 35 14,49	0,60 34 7,21	nd 15 6,44	nd 960 136,5	nd 89 32,15	nd 46 9,81	nd 0,84 0,82	nd 11 4,27	nd 46 7,84	nd 2,3 0,8	18

Reference:

a) (Remberger, et al., 2011)

9. Mosquito repellents

This category is defined as pesticides for human consumption (skin application), used specifically to repel mosquitos. No other pesticides are included.

N,N-dietyl-m-toluamid (DEET) is the only mosquito repellant monitored in the Nordic countries.

DEET has been found to inhibit the activity of a central nervous system enzyme, acetylcholinesterase, in both insects and mammals.

9.1.1 N,N-diethyl-m-toluamid (DEET)

CAS nr.: 134-62-3
Info: It is the most common active ingredient in insect repellents
Toxicity data: NA
PNEC aqua = 43 µg/l (Törneman , 2011b)
Reference: (Törneman , 2011b)

DEET	**Sweden**	
Matrix	Min max AD	Nr.S (ref)
Sediment (mg/kg dw)	nd 3,80 3,80	4
STP sludge (mg/kg dw)	nd	4
STP effluent (µg/l)	0,01 0,70 0,17	14
STP influent (µg/l)	nd 0,58 0,33	6
Groundwater (µg/l)	nd 0,06 0,03	8
Surface water (µg/l)	nd 1,10 0,25	11

Conclusion:
The compound has only been monitored in one study in Sweden. It has been detected in sediment, groundwater, surface water, STP effluent and STP influent. All water samples are below the PNEC value.

10. Observations

This report has given an overview of monitoring data for certain PPCPs in the Nordic countries. The scope of the report has not been to draw any conclusions, but the authors would like to present some observations made during the research phase:

- The number of reports produced on this subject was small, compared to several other niches of environmental monitoring. However, the amount of data was very high
- The majority of all data is provided by studies carried out in Sweden. Data for Finland, the Faroe Islands, Greenland and Iceland are scarcer
- Most of the monitoring for these compounds is carried out in STPs and STP recipients. Results from biota and abiotic matrices from more distant location to large human settlements are scarce

Even if this report provides a unique overview of PPCPs in the Nordic environment – it also provides insight into obvious knowledge gaps. This project could therefore be extended in several ways:

- A second step to this report could be to prioritize these compounds by identifying those that have been detected in the environment in concentrations above PNEC values. This could be interesting to assess which compounds could require further monitoring and possibly more regulation relative to their use
- The monitoring reports reviewed include many other PPCPs, that belong to other categories than those considered in this report. It could be of interest to process the monitoring data as done in this report
- During the production of this report, the authors have observed numerous studies from outside of the Nordic countries covering PPCPs. It could be interesting to assess which compounds are monitored in other regions of the world and not in the Nordic region and correlate the latter with sales statistics for those products in the Nordic area

Having an overview such as this report on monitoring data in neighboring countries is of interest for environmental authorities and law makers. In this manner, it could be of interest for the Nordic council to create

an online database, where each country could enter their monitoring data available for environmental pollutants of interest. Throughout time, this would allow countries to also follow trends, and observe the effect of contingency actions in each country.

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PPCP monitoring in the Nordic Countries – Status Report

The Nordic Screening group is pleased to present a compilation of pharmaceuticals and personal care products (PPCPs) monitoring data from the Nordic countries. The report has been prepared by Bergfald miljørådgivere and founded by the Nordic Council of Ministers via the Aquatic Ecosystems Group and the Nordic Chemicals Group.

In recent years, there has been an increased awareness of environmental effects from our use of PPCPs. In order to examine the occurrence of PPCPs in the environment, the Nordic countries have conducted several regional and national environmental surveys. The Nordic screening group saw the need for a compilation of these studies. The objective of this report was therefore to present the existing Nordic environmental data on PPCPs, by identifying which compounds have been analysed, in which countries and if there are obvious variations of levels detected in each country.

The Nordic screening is run by a steering group with representatives from the Danish Centre for environment and Energy, Aarhus University, the Finnish Environment Institute, the Environment Agency of Iceland, the Environment Agency of the Faroe Islands, the Norwegian Climate and Pollution Agency and the Swedish Environmental Protection Agency.

TemaNord 2012:519
ISBN 978-92-893-2346-8
http://dx.doi.org/10.6027/TN2012-519