



Pesticide monitoring activities in
Finnish surface waters
Quick history and on-going studies

Katri Siimes

Finnish Environment Institute (SYKE)

Uppsala 8.9.2016

Katri.siimes@ymparisto.fi

About the roles of Finnish institutions – (pesticides)

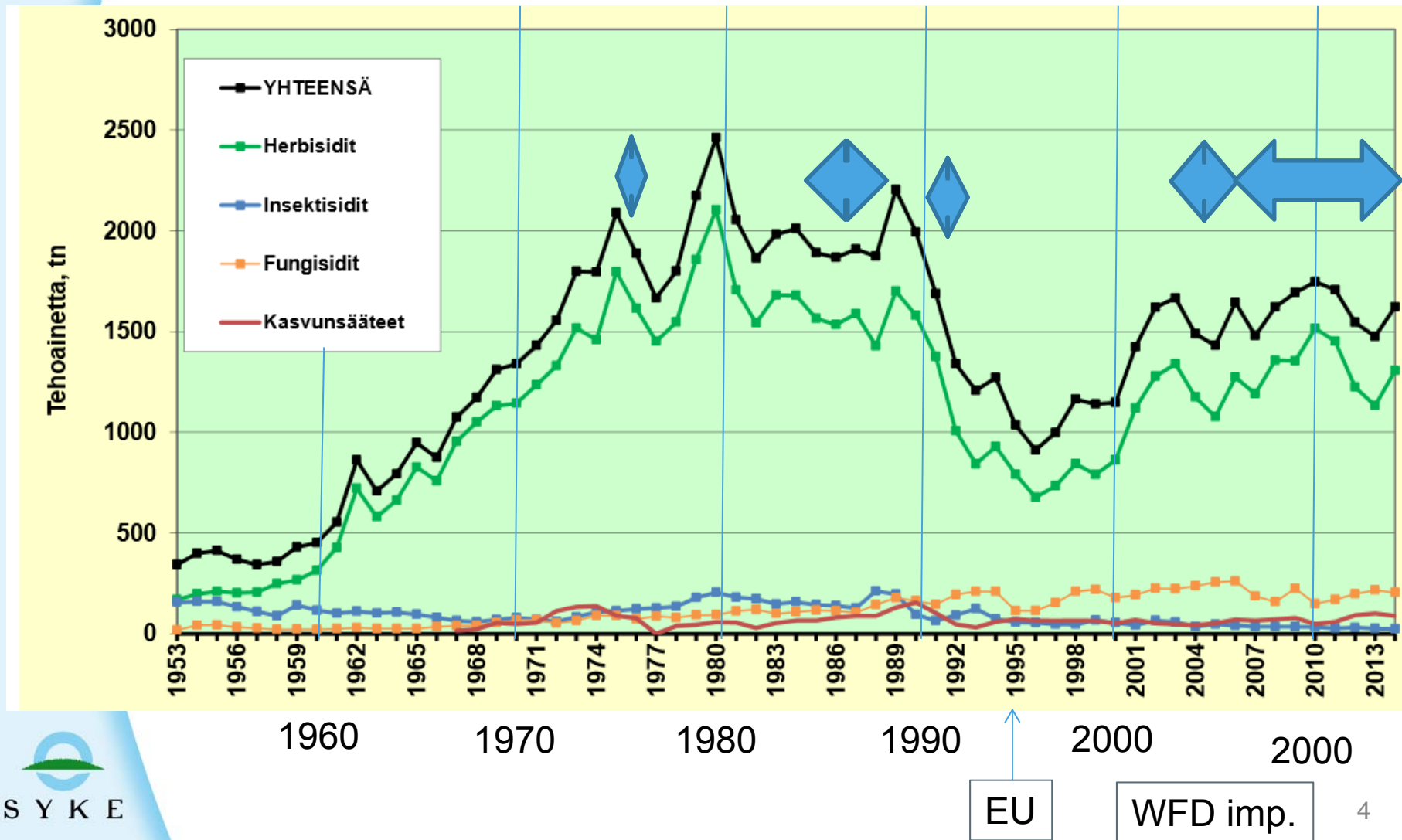
- **Tukes** (The Finnish Safety and Chemical Agency) is the responsible authority in pesticide registration (and in sales statistics).
- **LUKE** (Natural resources institute Finland; previously MTT):
 - Experience in research projects in experimental fields
 - Including "leaching fields", where all surface runoff and drainage water are measured and sampled
 - The authority in pesticide usage statistics for EU (only 2013)
- **SYKE** (Finnish Environmental Institute)
 - Experience in national screenings of hazardous chemicals (but not a responsible authority)
 - => SYKE has carried out / co-ordinated national screenings in project based funding
 - Participating in some research projects

Content

- Short history of pesticide "monitoring" studies before 2000
- Monitoring in 2004 and 2005 to gain experience before later monitoring (required by WFD)
 - Many of the WFD / EU priority substances are (former) pesticides; We studied them + other compounds (tot. 98-> compounds)
 - 2004: temporal resolution in intensive sites + sampling site within the drainage basin
 - 2005: spatial resolution (+sediments)
 - Practicing year 2006 (but different laboratory, and less compounds analysed)
- Monitoring in 2007-2014 (nothing in 2015)
- On-going monitoring in 2016

Ralf Schäfer sampling
in ditches in 2005

Pesticide "monitoring" studied in Finland (on the top of sale statistics)



"Monitoring" before 2000

History - before year 2000

1970's:

- Single grab samples from 19 rivers (big ones) in October 1976
 - Phenoxy acids (and chlorinated phenols) analyzed
 - High concentrations (6 – 8 µg/l) of 2,4-D and 2,4,5-T e.g. in r. Aura, which was used as drinking water supply in that time
 - The airplane sprayed herbicides on young forests the probable reason for high concentrations in Eastern Finland.
 - MCPA detected in 5/19 sites; observed concentrations 0.2 – 1.6 µg/l.
 - Kiviranta & Miettinen 1976.

1980's

- Grab samples from river Aura (n=18) and from a small research catchment Löytäneenoja (n=15) in growing seasons 1985 – 1987.
 - 19 analyzed compounds (LQ 0.001 – 0.1 µg/l depending on chemical)
 - The concentrations of 4 compounds were only 5-100 times lower than LC50 values in literature (malationi, fenitorotioni, propaklori, dinosebi).
 - (+according to current knowledge, the concentrations of dimethoate and terbutylazin were not acceptable.)
 - MCPA the most frequently detected
 - Rekolainen et al. 1988. (In Finnish)

History - before year 2000

1990's

- Monthly grab samples in ten rivers (big ones) in summers 1991 and 1992 (n=54)
 - Analyzed E.g. Phenoxy acids (like MCPA), atrazine, simazine, bentazone (LQ for MCPA 0.1 µg/l)
 - Phenoxy acids frequently detected.
 - Rekolainen and Hirvi suggested that they are not found, if agricultural land use in the catchment area is <15% or the size of the stream > 44 m³/s.
 - Hirvi and Rekolainen 1995.

"Monitoring" before full implementation of water framework directive (WFD)

2004: intensive areas (1+5)

- temporal variation

- where to sample within the catchment

2005: statistically selected sites

- spatial variation

- sediments

2006: How to organize monitoring with regional authorities.

Sites in 2004

- intensively cultivated (expected high load sites)
- analyses of 98 compounds (EU priority substances and other pesticides/metabolites)

Table I. Sampling sites of pesticide screening in Finnish surface waters in 2004

| code | site | catchment area | agricultural land use % | main crops | sampling time | n |
|-------------------------------|---------------------|------------------------|-------------------------|----------------------------------|---------------|----|
| Research catchment (L) | | | | | | |
| L1 | continuous | 5.6 km ² | >50% | cereals, sugar beet, potato, hay | May-Oct. | 21 |
| L2 | manual | 5.6 km ² | | | May-Oct. | 17 |
| L3 | up-stream ditch | ca 2 km ² | | | June, July | 2 |
| Monthly sampling | | | | | | |
| m1 | stream | ca 85 km ² | >35% | cereals, hay, vegetables | June-Oct. | 5 |
| m2 | upstream from m1 | ca 15 km ² | about 20% | | June-Oct. | 5 |
| m3 | big open ditch | ca 5 km ² | >60% | cereals, hay, carrots | June-Oct. | 5 |
| m4 | subsurface drainage | <3 km ² | (100%) | cereals, turnip rape | June-Oct. | 5 |
| m5 | stream | 56 km ² | 13% | hay, potato, cereals | July, Aug. | 2 |
| m6 | ditch/stream | <3 km ² | (?) | strawberries | June, Sep. | 2 |
| Rivers | | | | subcatchments | | |
| r1 | Porvoonjoki | 1 270 km ² | 31% | m1, m2 | Sep. | 1 |
| r2 | Vantaanjoki | 1 680 km ² | 24% | m1, m2 | Sep. | 1 |
| r3 | Paimionjoki | 1 100 km ² | 43% | | Sep. | 1 |
| r4 | Aurajoki | 870 km ² | 37% | | Sep. | 1 |
| r5 | Kokemäenjoki | 27 000 km ² | 13% | L, m3, m4 | Sep. | 1 |
| r6 | Lestijoki | 1 400 km ² | 10% | m5 | Sep. | 1 |

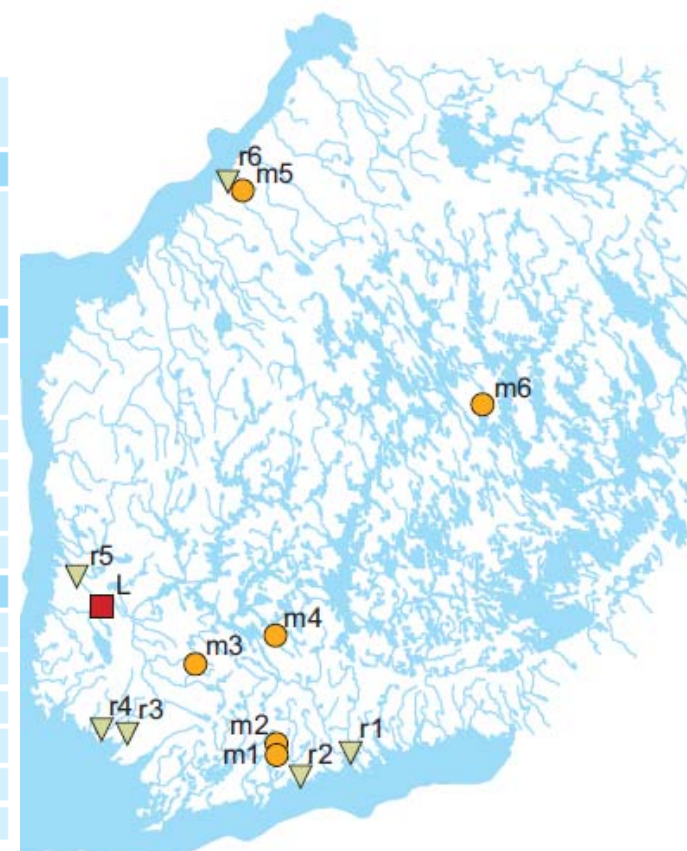


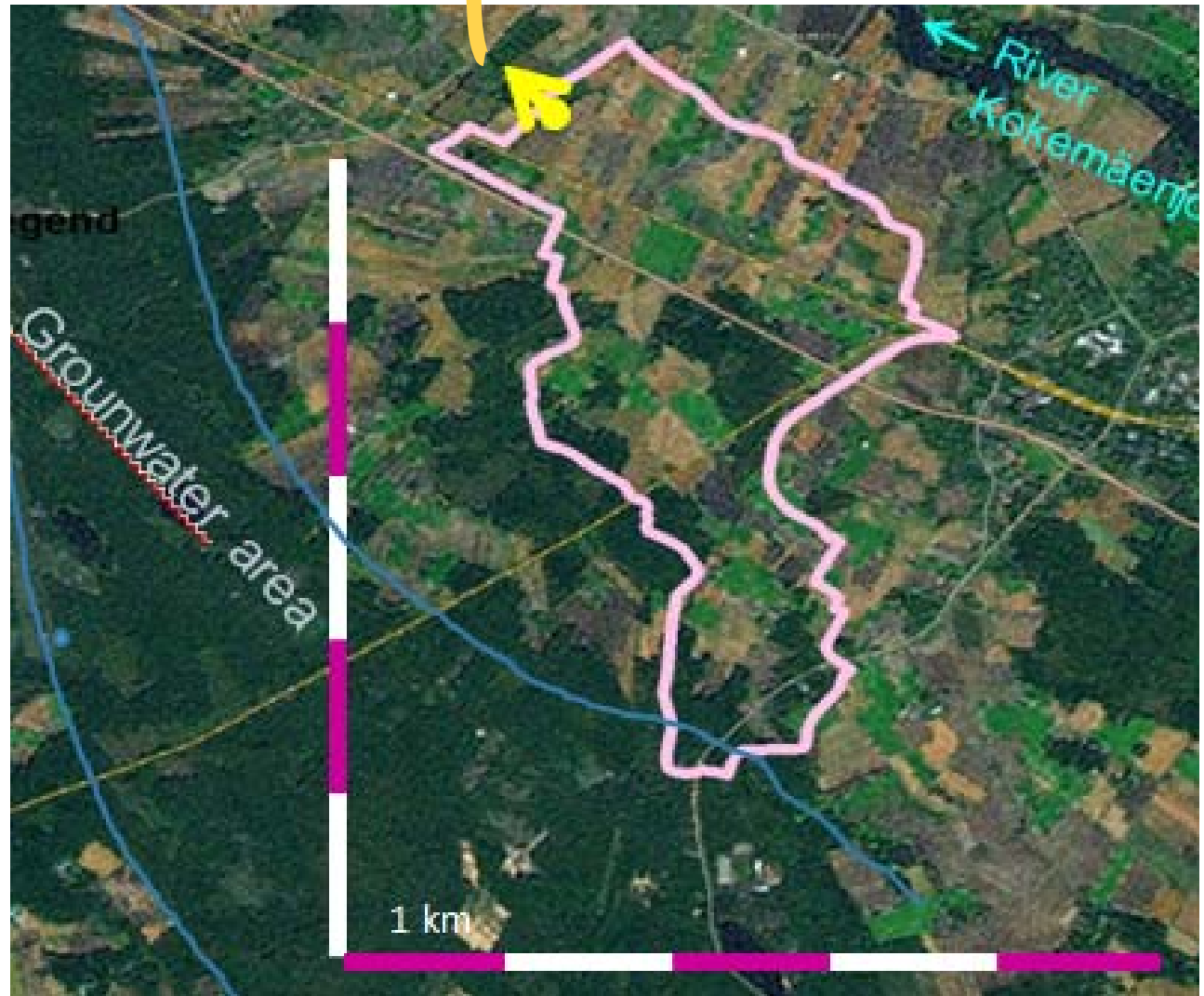
Figure I. Sampling sites in 2004



Lepsämänjoki, a tributary
of river Vantaa
-monthly sampling site in
2004-2005, two sites
Upper (15 km²) and
middle (85 km²)



Löytäneenoja - intensive sampling site 2004-2005:
weekly samples (both time based composite
samples and grab samples)



Results from the monitoring in 2004

- Pesticides are found in water
- Concentrations are at their highest after application period (Log.scale in the figures)
- The level of concentrations was as high / higher in downstream sites (as in upstream sites) (pesticide usage distribution?)

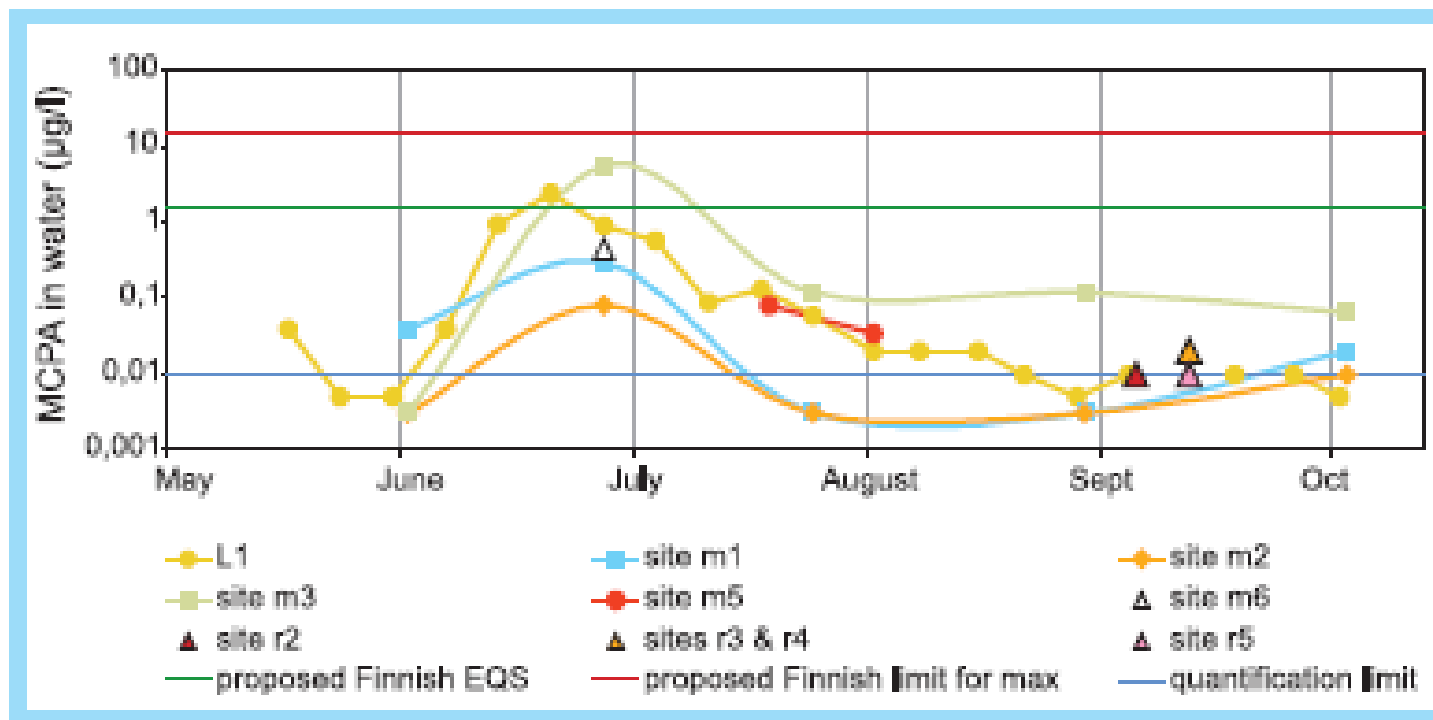
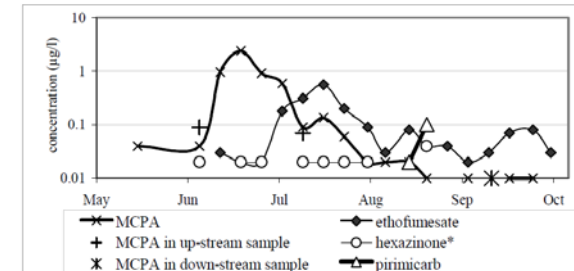
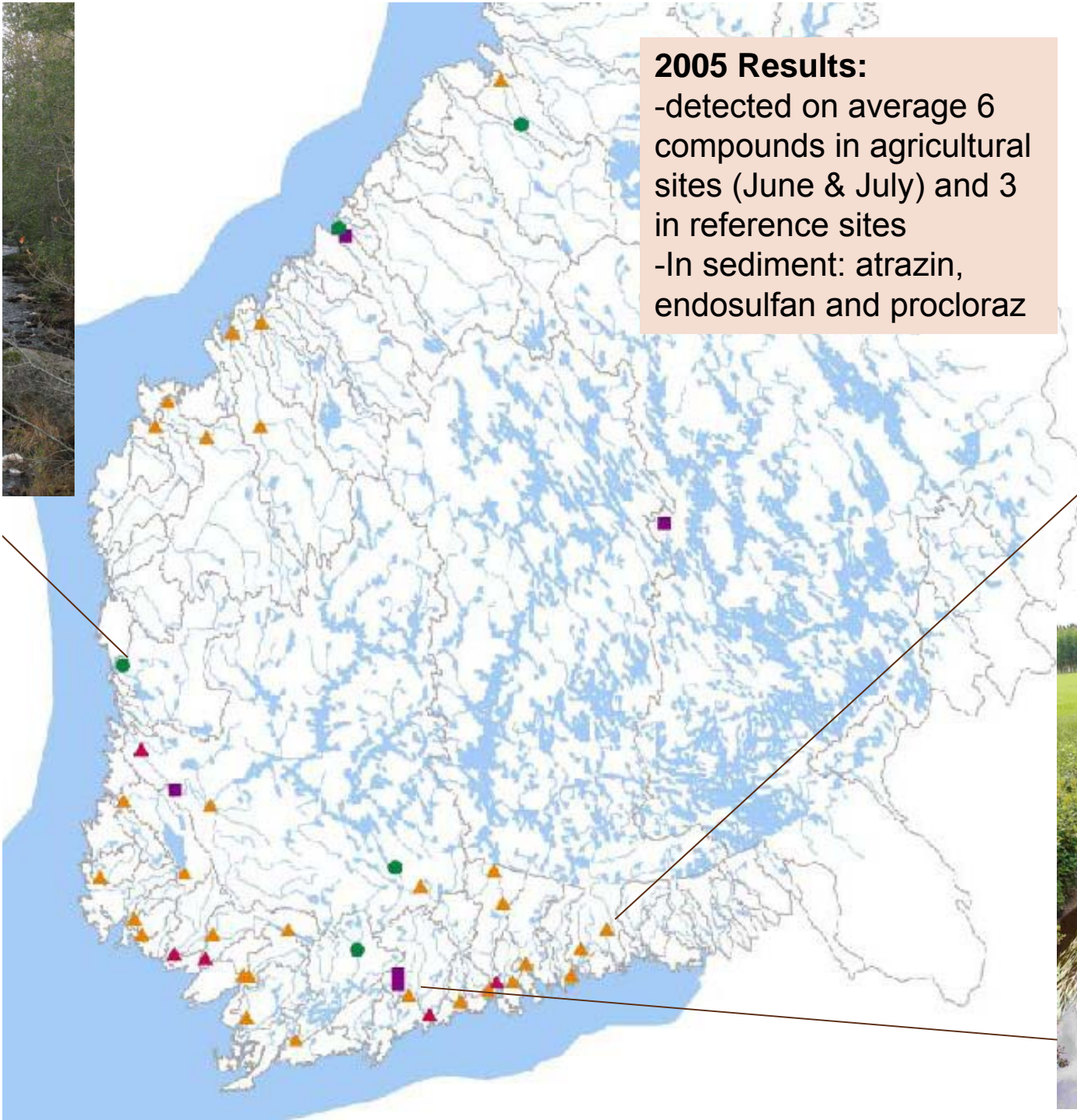


Figure 6. MCPA concentrations in the sampling site

Screening in 2005

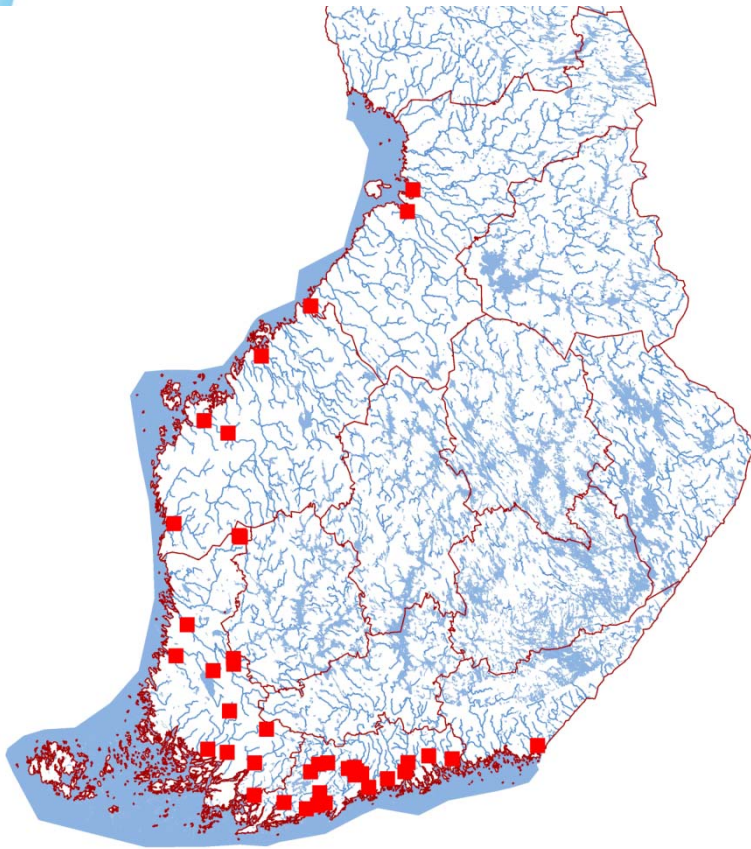
- 35 sites among 2nd order streams
 - agricultural land use
- 5 reference sites (agricultural land use <10%)
- Grab water samples twice per site + sediment





Monitoring within MaaMet-project 2007-2014

Monitoring in 2007 - 2014



- Annually 5 – 15 sites
 - different sites in dif. years
 - 40 sites / 8 year period+ additional samples (<3 sampling times/year)
Sites in “agricultural areas” (in Finnish scale)

Grap surface water samples

- Monthly May 2007 – April 2008
- 1 or 2 times / month in May-Nov. 2008-2014

Multiresidue methods

- Ramboll Analytics in Lahti
 - Increasing number of analysed compounds (150 - >200), decreased LOQ-values
 - A few other analysis, like glyphosate, ETU, tribenuron-methyl
- Results are in the database (open data) in SYKE (but in Finnish)

Results 2007 - 2014

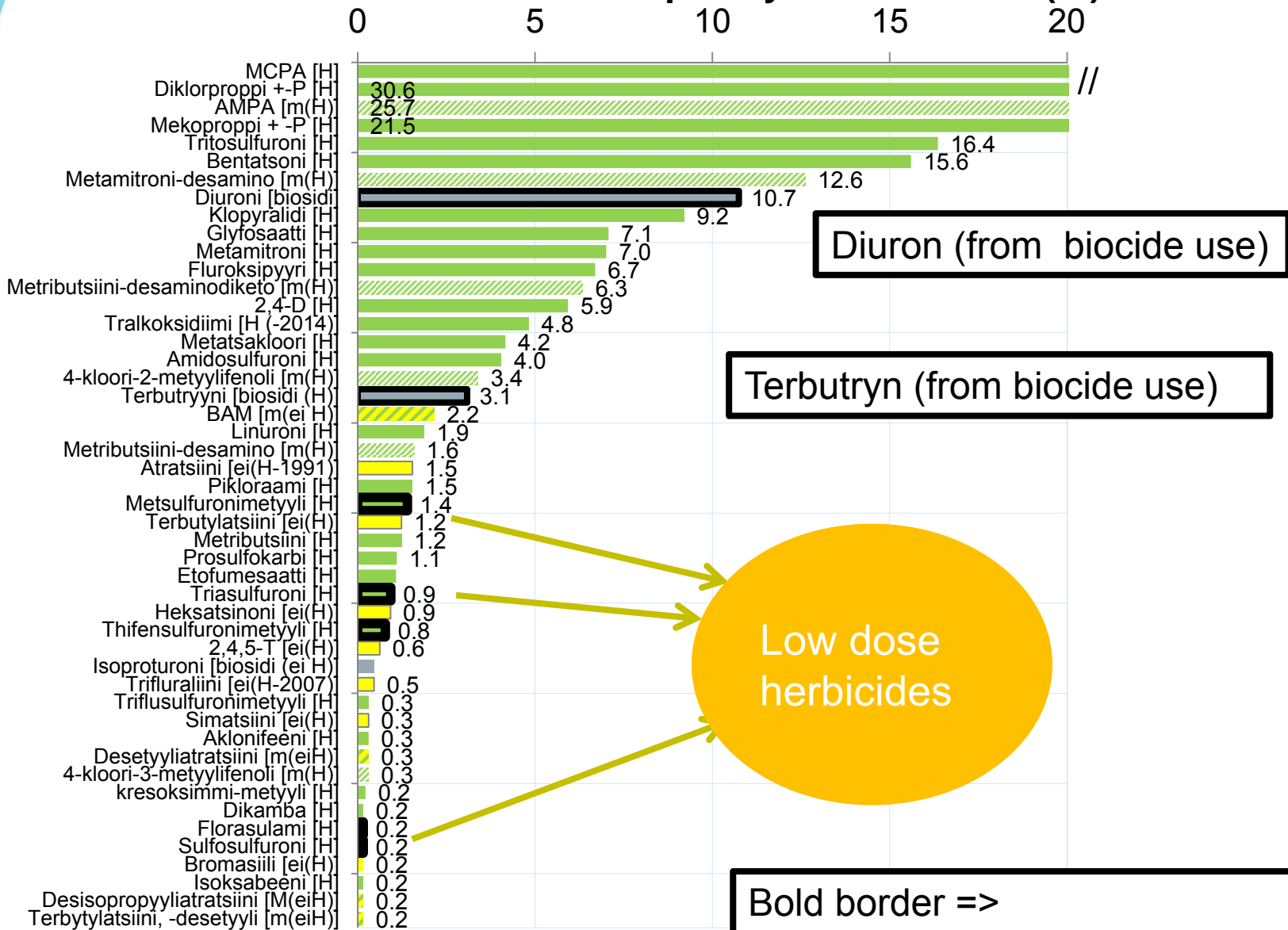
Detection frequency

- No pesticides detected in 1/3 samples
- At least 10 compounds detected in 5% of samples; these sampling sites were in water bodies, which ecological classification was lower than good.
- The most often detected compounds were those having the highest sales
 - except glyphosate (not detected that often) and neonicotinoids (more often)

Concentrations

- Only a few exceedings of EQS-values (Environmental Quality Standard) or similar reference value based on ecotoxicology
- Low-dose herbicides were the only group of compounds, where exceedings were clearly related to agricultural use
- The others exceedings: biocide-use and single detections of legacy compounds

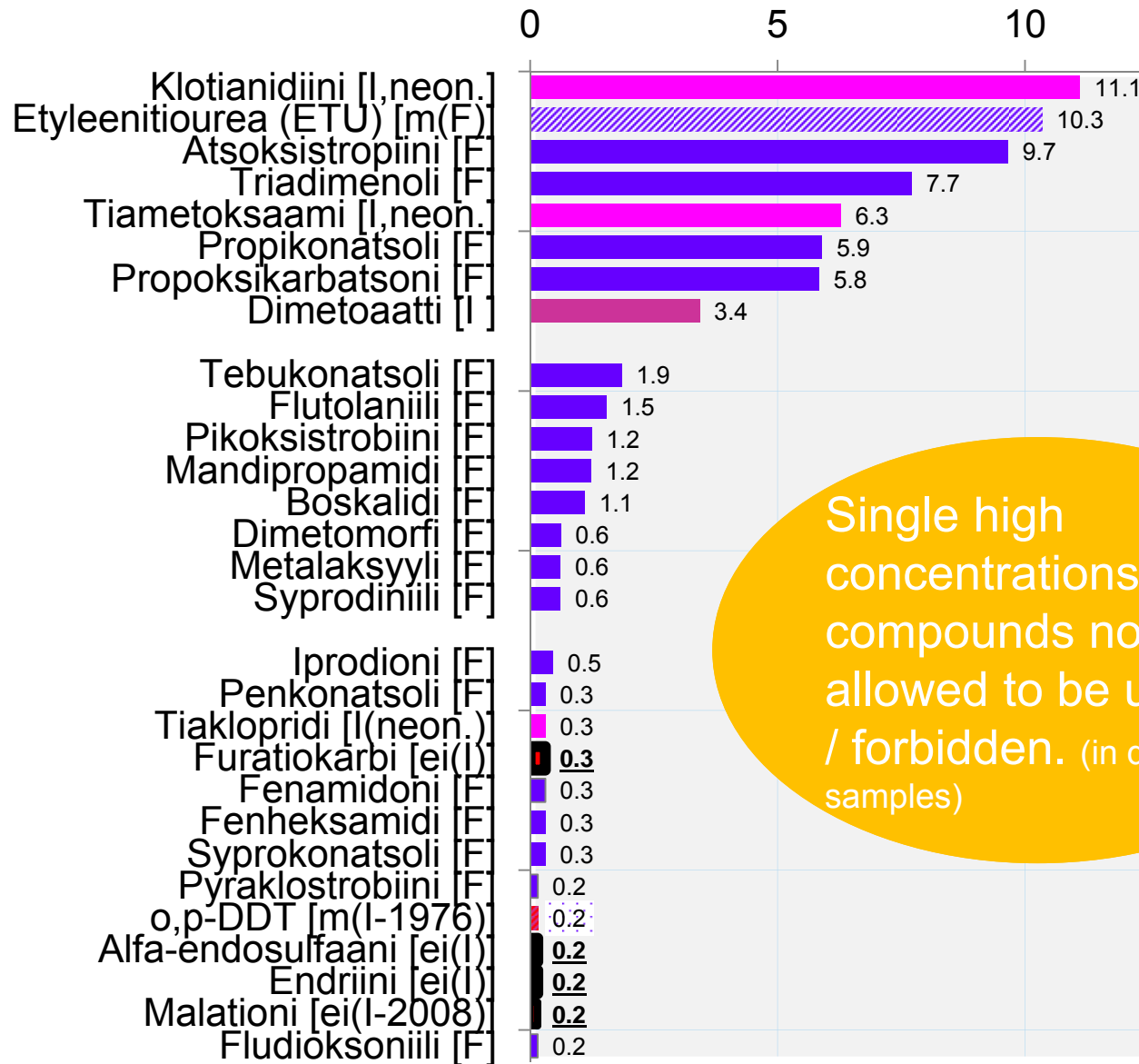
Detection frequency of herbicides (%)



Low dose herbicides

Bold border =>
EQS exceeding at least in one sample

Detection frequency of others (%)



Single high concentrations of compounds not allowed to be used / forbidden. (in different samples)

Differences in surface water monitoring between Nordic countries

- E.g. in Sweden and in Norway
 - monitored in small research catchments with known pesticide usage
 - volume-based / time-based (or more sophisticated) sampling methods.
- In Finland (2007-2014)
 - Part of the sampling sites changed annually
 - Most of the sites had catchment area $>500 \text{ km}^2$
 - Information about pesticide usage in the upper catchment area was not/seldom available

No monitoring in 2015,
but screening of WFD watchlist compounds (candidates for
priority substances)

- This list includes e.g. neonicotinoids
 - But also e.g. hormones and drugs, which concentrations were more often too high.

Monitoring in 2016 in Savijoki (tributary to river Aura)

The stream selected due to other on-going studies

e.g. gypsum study; farmer interviews

Sampling in the two sampling points (upstream and downstream)

water samples every 2 weeks (grab & time-pr. composite samples)

passive samplers; sediment samples



Thank you!

katri.siimes@ymparisto.fi

