Long-term monitoring of pesticides in Sweden

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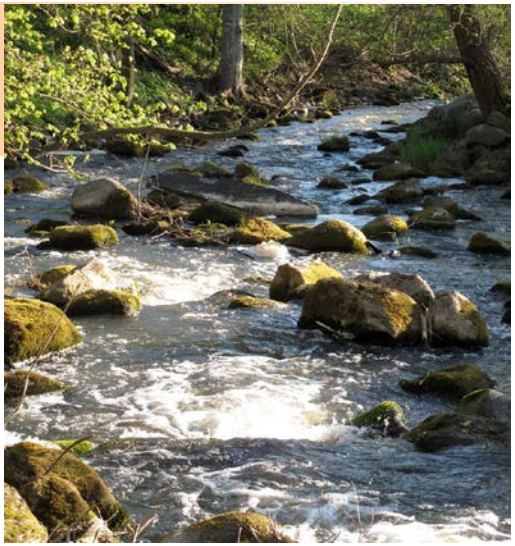
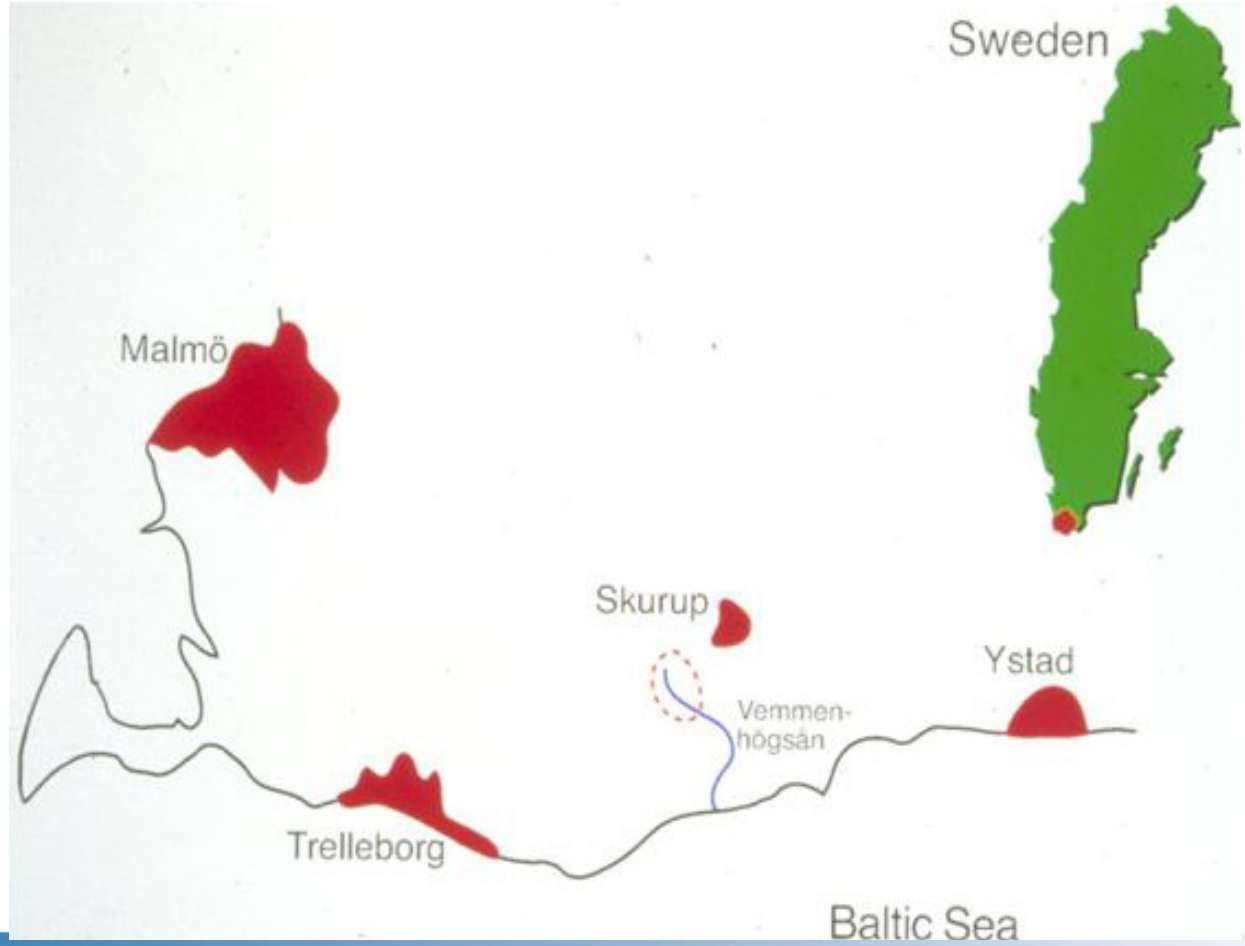
Pesticide monitoring – many different reasons



- To investigate pesticide fate in the actual field situation
  - Go beyond the the well-controlled conditions common for most environmental fate studies
- Investigate the development over time
  - Follow-up on regulatory decisions (eg drinking water directive, WFD)
  - Follow-up on the registration process and policy changes
- Develop scientific understanding
  - Calibration/validation of exposure models (regional/catchment scale)

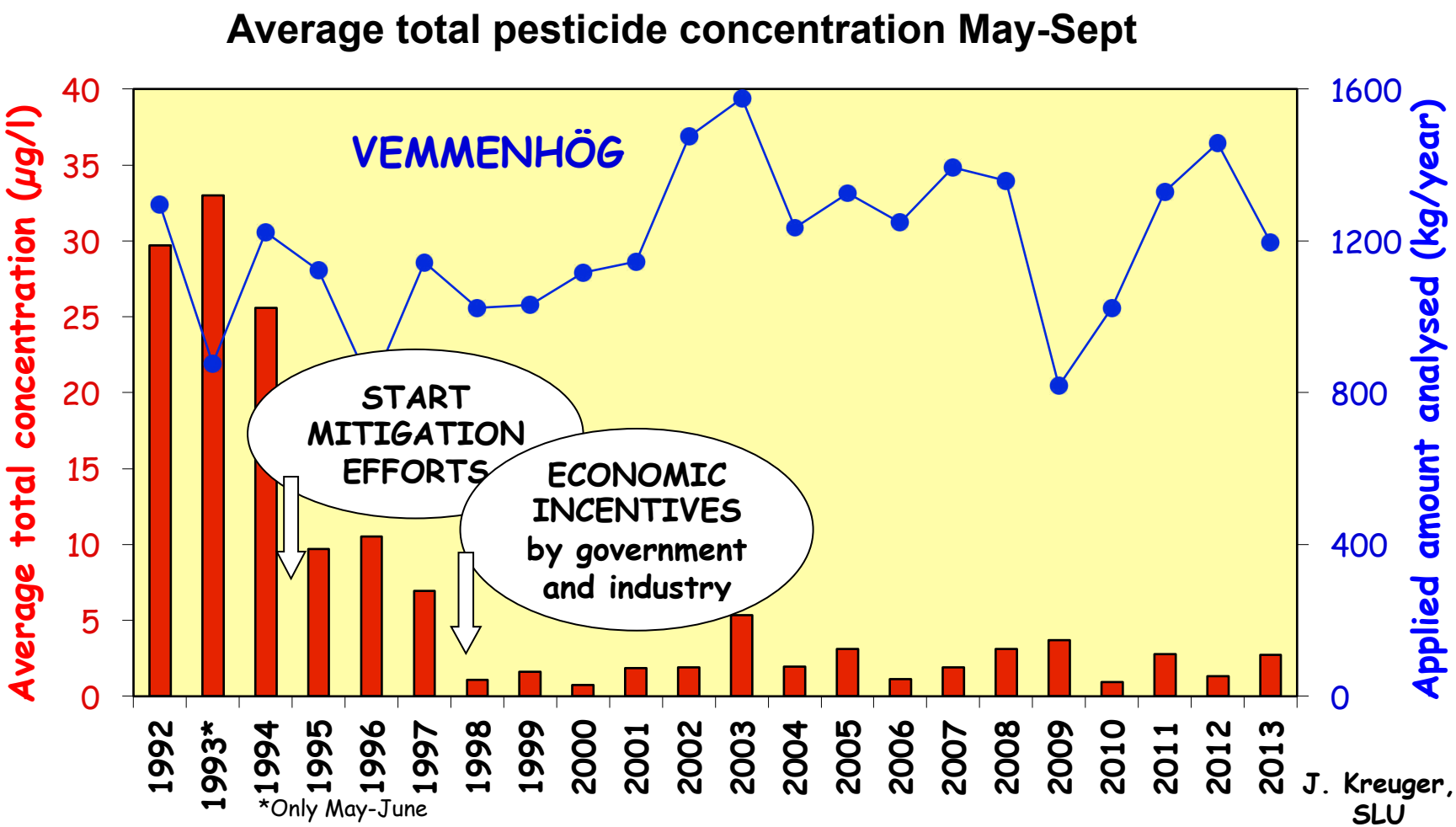
Swedish monitoring experiences
The Vemmenhög catchment

- Monitoring of pesticides in stream water from an agricultural catchment in southern Sweden
- Started in 1990, now >20 years of data



Results long-term monitoring 1992-2013

A 90% reduction in pesticide concentrations



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Avoid point sources –
education of farmers

- Safe storage of pesticides
- Safe places for filling and cleaning spraying equipment
- No ”beauty-treatment” on farmyards

One mitigation option applied was the use of safe places for filling and cleaning spraying equipment (e.g. biobeds)

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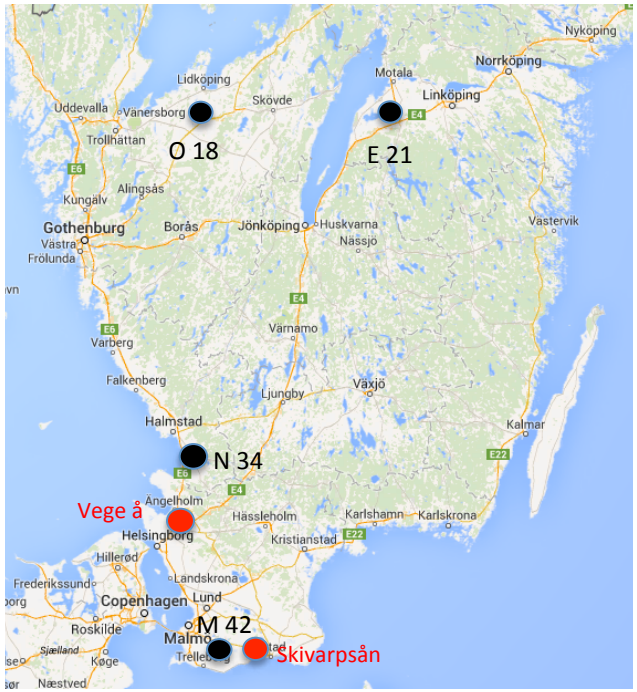
Current pesticide monitoring program



Program started in 2002

- **Surface water:**
- Västergötland (O18)
- Östergötland (E21)
- Halland (N34)
- Skåne (M42)

Streams *draining small catchments 8-16 km²*
continuous, automatic sampling

- Skivarpsån
- Vege å

Rivers
100 - 500 km²
manual grab sampling 9 times/y

- **Groundwater:**

In the catchments — *4 times/y*

Objective: Feed-back on the national risk-reduction program and the regulatory process, as well as the basis for information to the farming community

Stream water sampling in catchments

- Automatic water sampling
- Time paced weekly composite samples (1 sub-sample each 90 min during the week) during main growing season
- During later years also bi-weekly composite samples during winter season in 2 catchments
- Continuous water flow measurements

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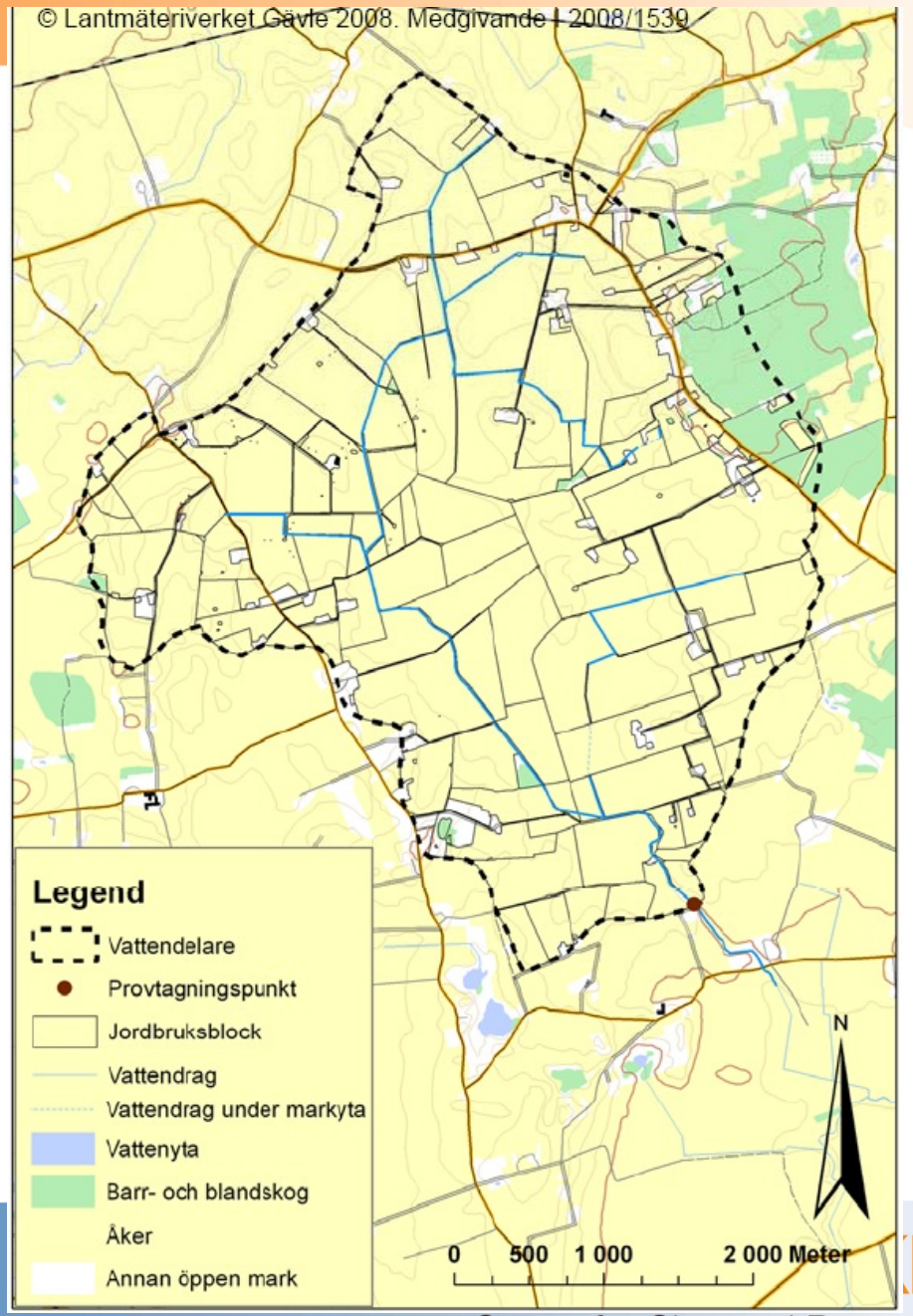
Catchment inventory

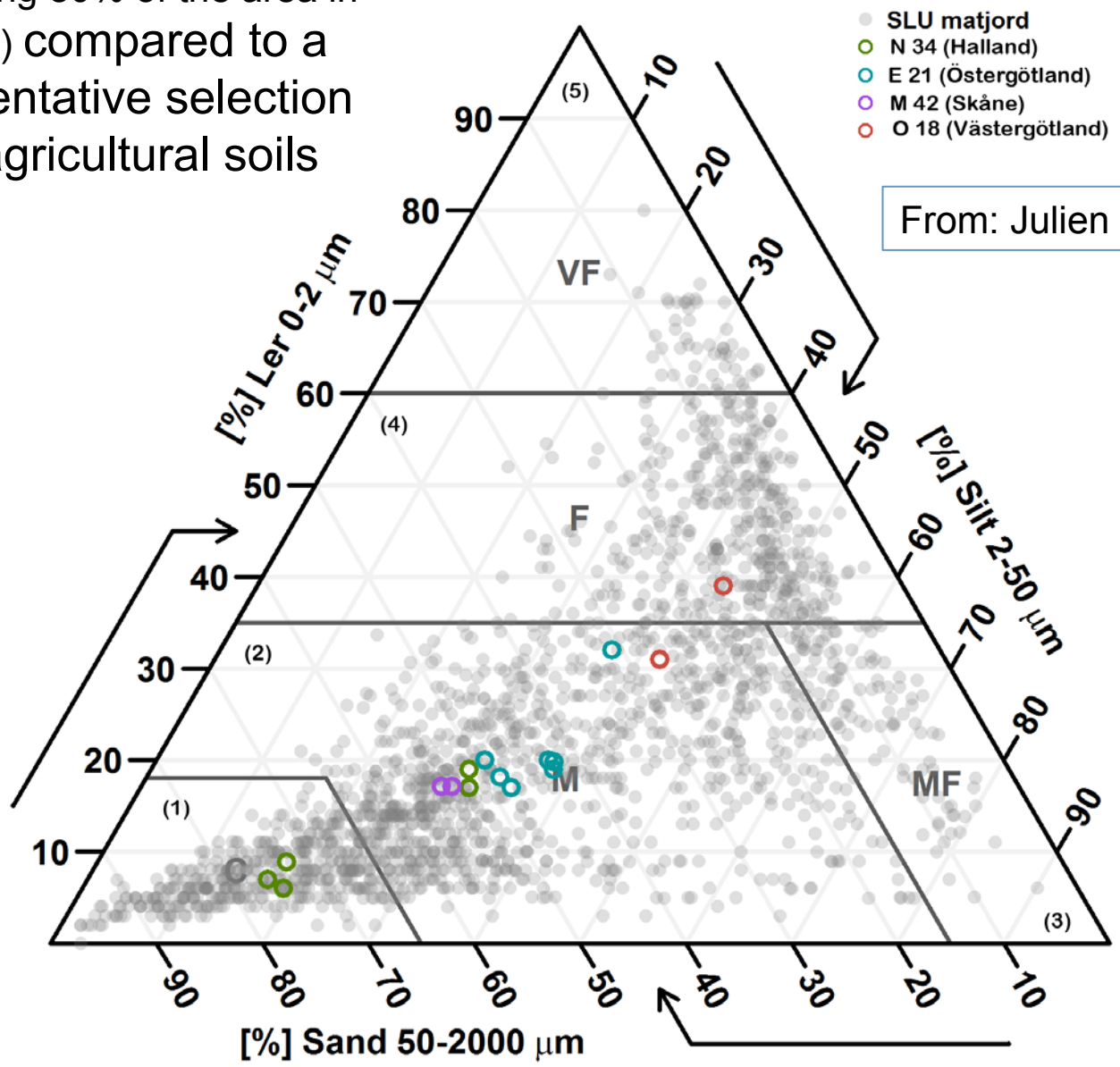
- Yearly interviews with farmers in the catchments on the use of pesticides (& crops and nutrients) – which pesticides, when, where and how much – at a field level



Analytical program development

- New pesticides enter the market, old ones disappear
- The analytical program needs to be flexible
  - Pesticides included has increased from ca 80 to 130
  - LOD/LOQ levels are at the ng/l-level for most pesticides
- Selection criteria:
  - Most heavily used (corresponds to ca. 90% of sold amounts in Sweden) and sprayed on large acreages
  - Superseded though still frequently detected
  - Included in Water Framework Directive (WFD)
  - Aquatic toxicity
  - List updated each year in co-operation with regulatory authorities and feedback from farmer interviews

Top soil texture in the four monitoring catchments
(top soils covering 80% of the area in each catchment) compared to a large representative selection of Swedish agricultural soils



From: Julien Moeys, CKB

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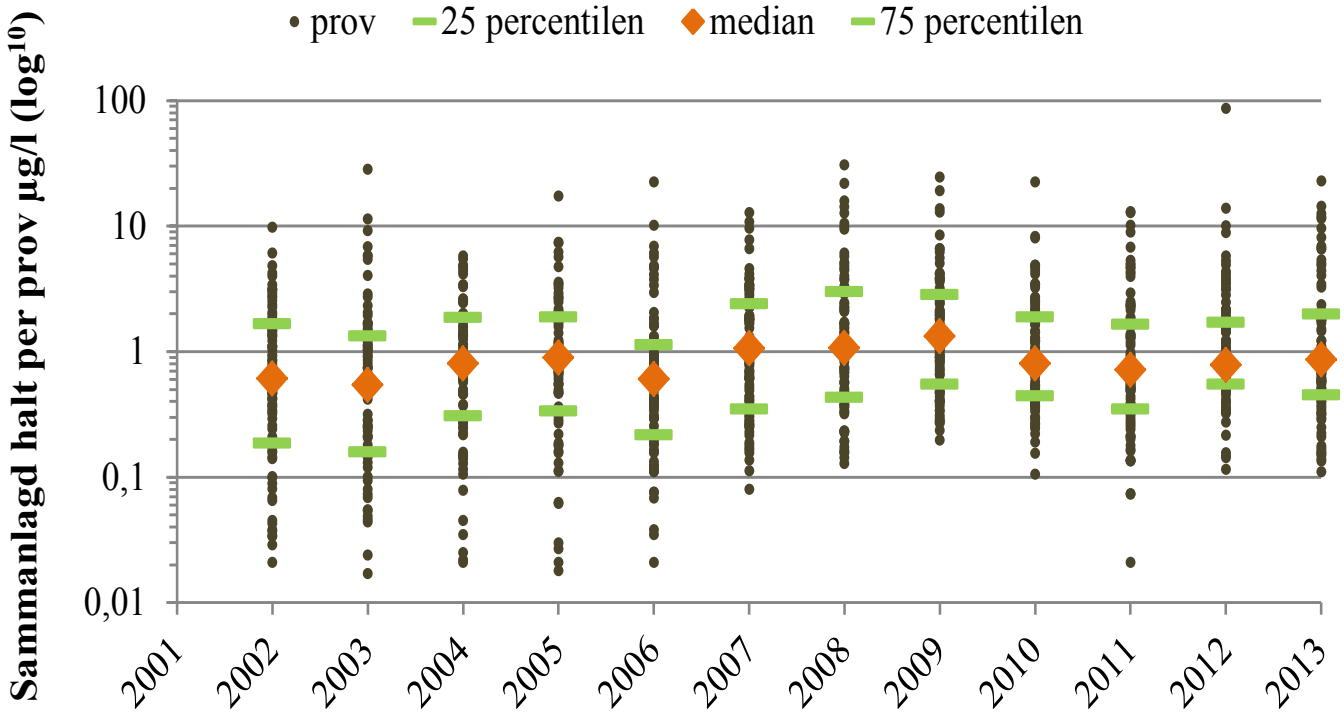
Total pesticide concentrations 2002-2013 (catchments)



No trend in annual median total concentration during the past 12 years

Concentration levels in streams

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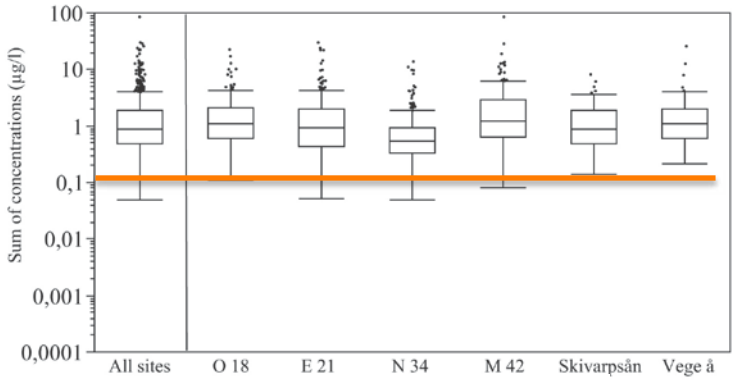

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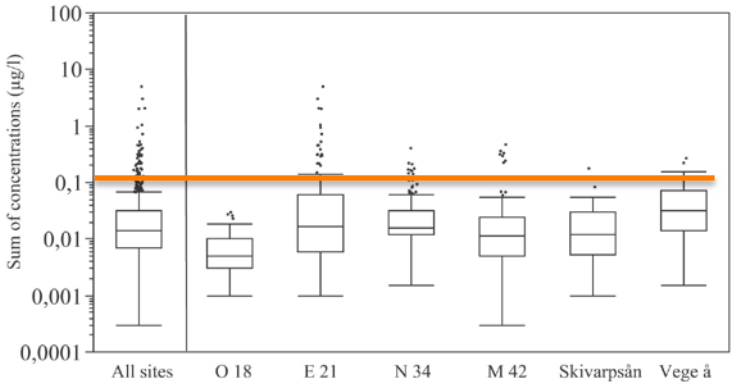

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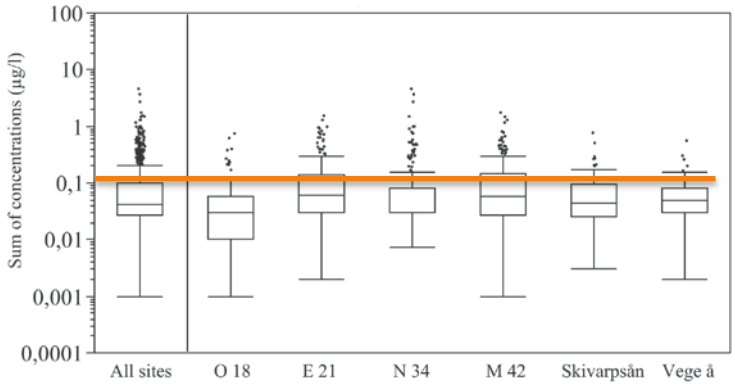

- Roughly a 10-fold difference in concentration levels between each pesticide type – reflecting a difference in application rates
- Concentration levels in rivers (based on grab samples) does not differ substantially from the smaller streams

Data from 2002-2012

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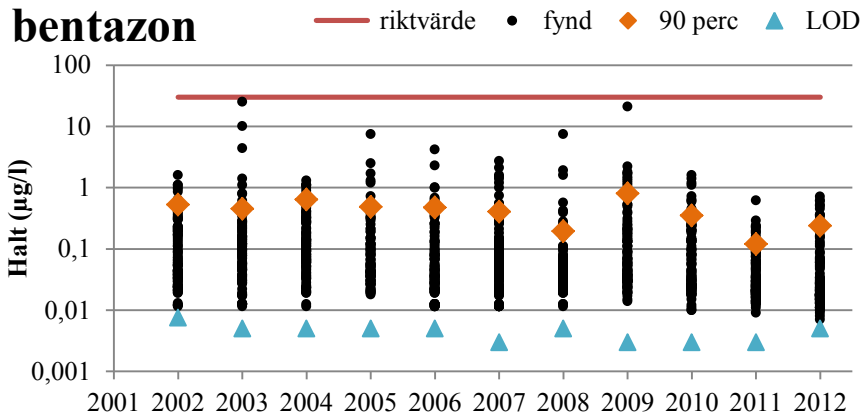

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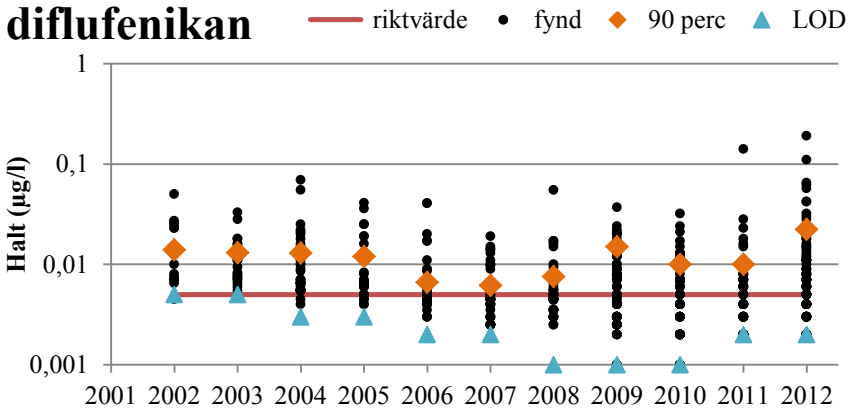

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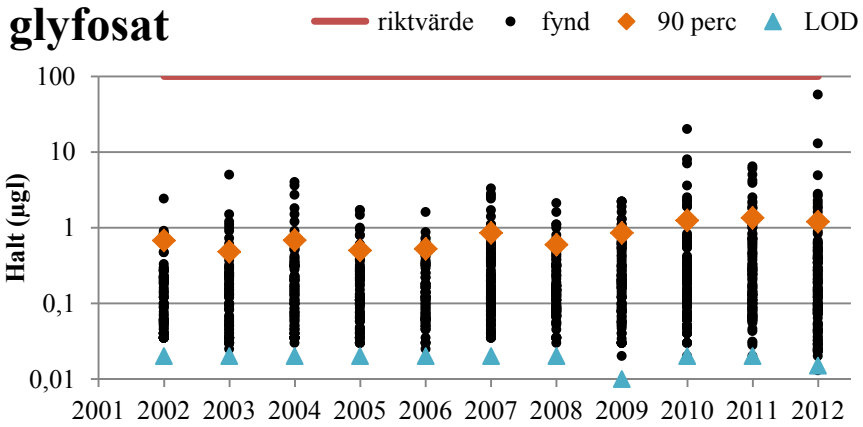
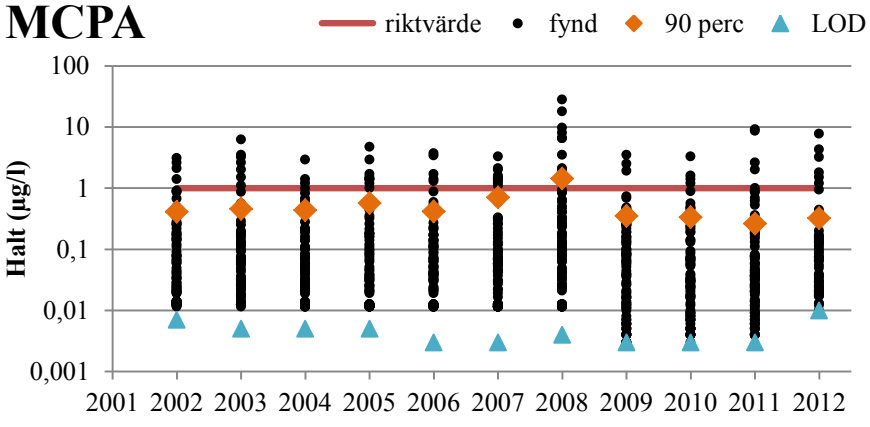


MCPA



Risk-index based on monitoring data - using a modified version of the US Pesticide Toxicity Index (PTI)

$$PTI = \sum_{i=1}^{n} \frac{Conc_i}{EQS_i}$$

- $Conc_i$ = Pesticide concentration $_i$
- EQS_i = EQS or national EQO for the pesticide $_i$
- n = Number of pesticides

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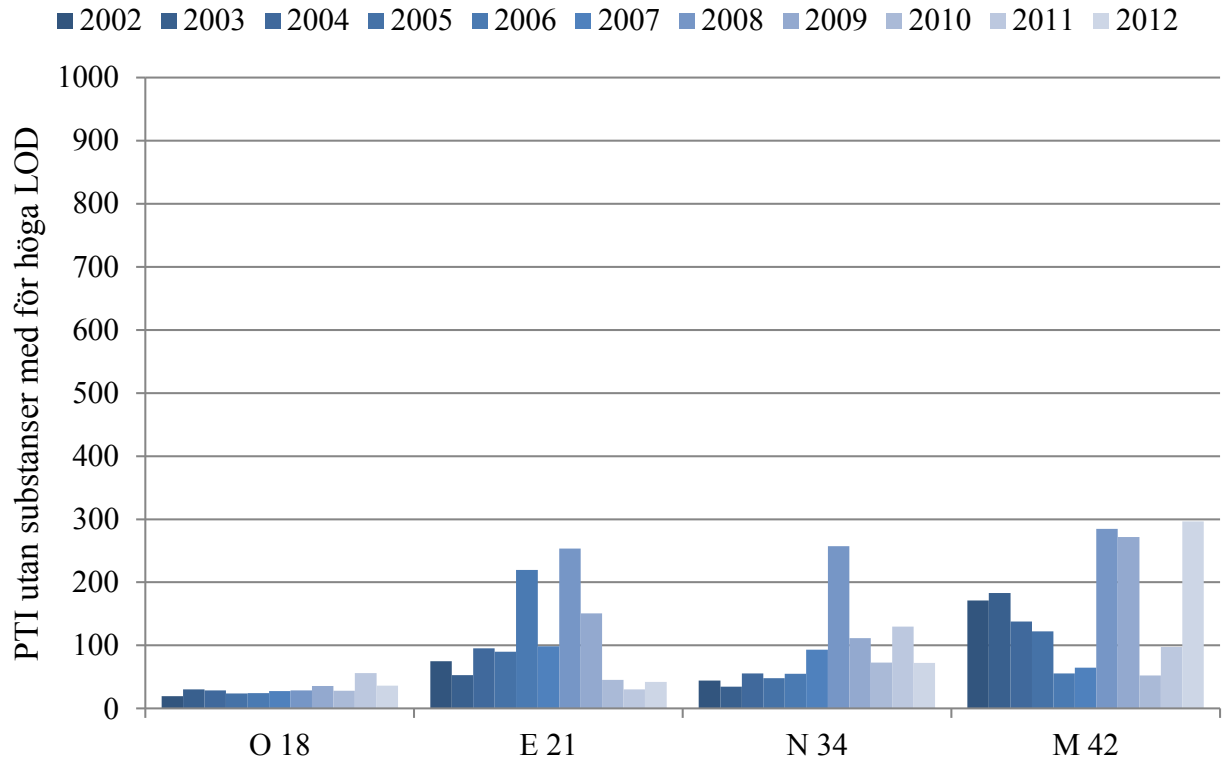
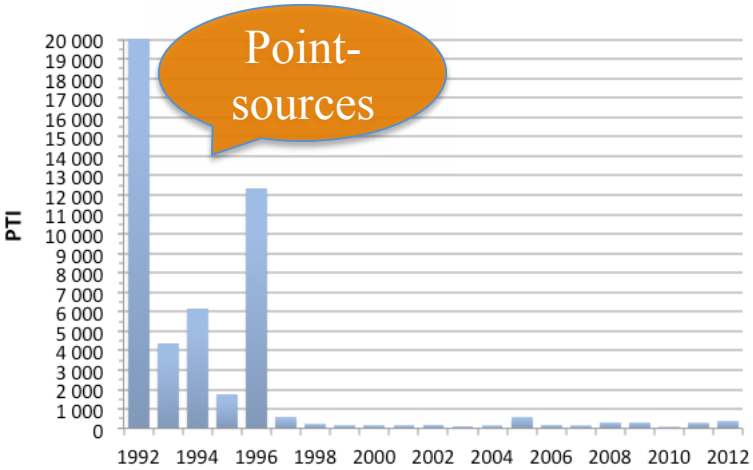
Development of PTI in the four monitoring catchments 2002-2012



Including only pesticides with LOD below EQO during 2002-2012

No particular trend

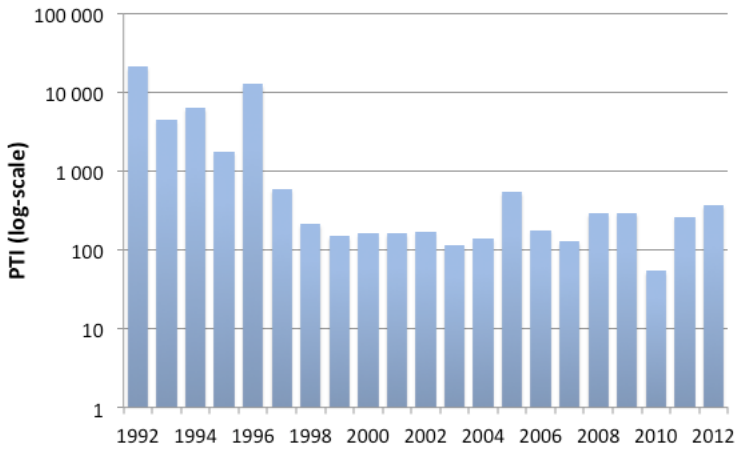
Development of PTI in the Vemmenhög catchment 1992-2012



PTI - absolute values

Following a 90 % decrease of measured pesticide concentrations in the stream, also the potential ”risk” for aquatic organisms (measured as PTI) has decreased since mitigation measures started in the mid-90’s - by 1-2 orders of magnitude!

PTI – log-scale



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Conclusions

- A 90% decline in pesticide concentrations in surface waters when handling point sources
- No decline in absolute concentrations or in toxicity during later years
- Most pesticides detected below EQO values, though some frequently detected above the 0.1 µg/l and/or above the EQO
- Much more difficult to reduce non-point source pollution – the importance of transport pathways in the agricultural landscape varies between different regions
  - i.e. mitigation options varies between regions and include a number of different options (e g buffer zones, drift reduction nozzles, timing of application, doses, IPM…)

Thank you!

Acknowledgement:

- The national pesticide monitoring programme is funded by the Swedish Environmental Protection Agency