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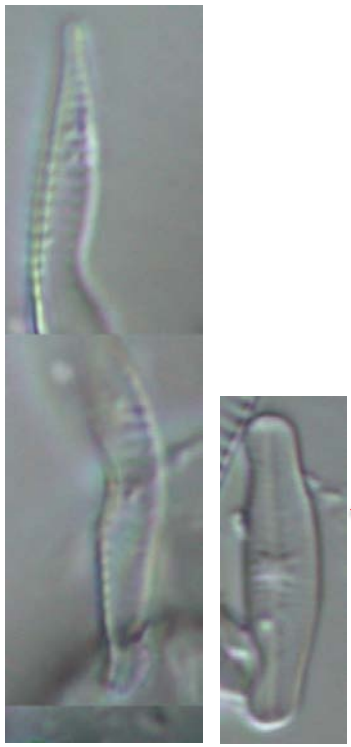
Utveckling av en biologisk miljögiftsindikator – kiselalger

Påverkan av tungmetaller och organiska miljögifter

Presenterat även på 6TH CENTRAL EUROPEAN DIATOM MEETING (CE-DIATOM) 22.-25.3.2012, Innsbruck, Austria

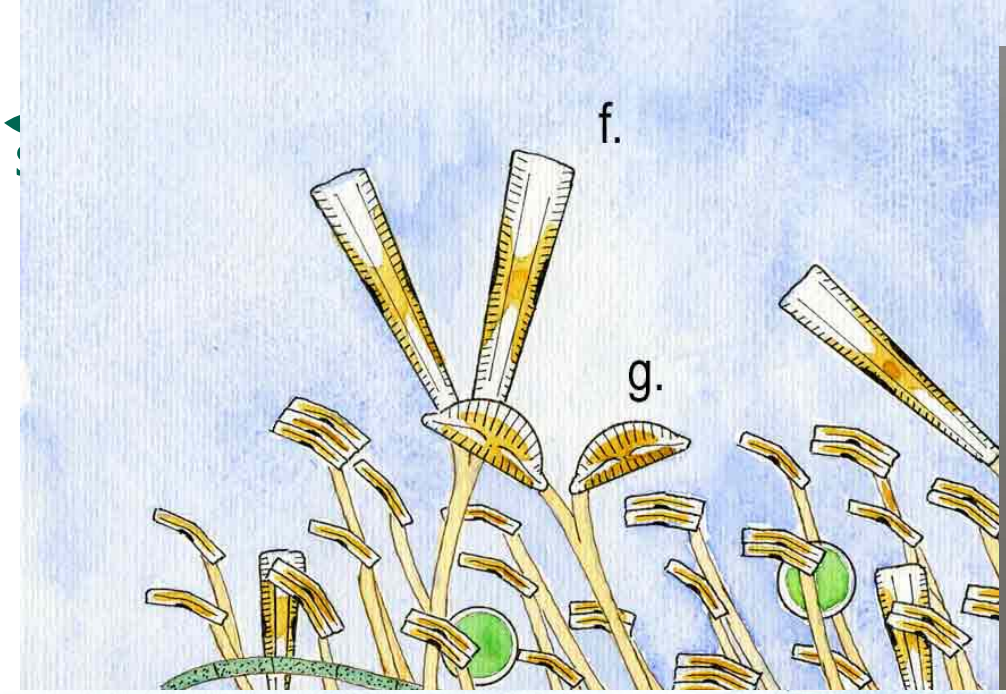
Kiselalgsmetoden måste utvecklas så att även giftpåverkan indikeras

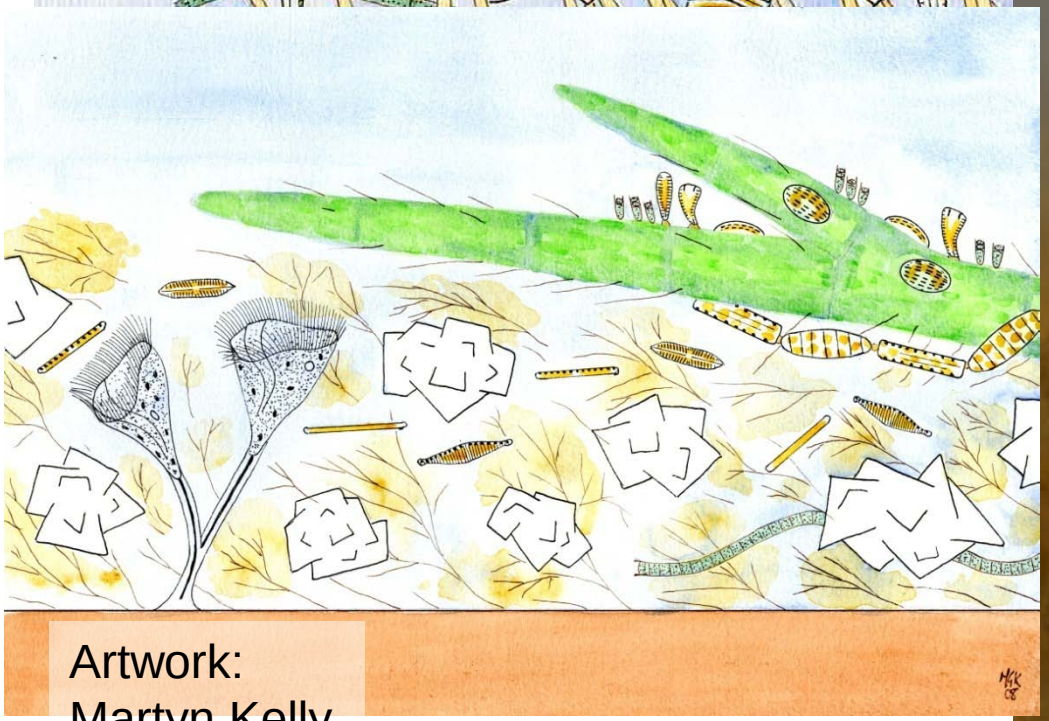
- **Tröskelvärde för missbildningar** (ofta < 1%)
  kanske olika typer vid olika gifter
- **Låg diversitet & artantal**
- **Toleranta kiselalgstaxa**
  Vissa kiselalger kan utveckla en gifttolerans och sedan en massutveckling
  (t.ex. *Achnanthidium minutissimum)*
- **Speciella levnadsformer / ekologiska grupper**
  Kiselalger som är skyddad från giftpåverkan ökar sin abundans (exempel: mobila, lågprofilerade, slembildande)



ofta < 1%

➡ Pågående projekt





Artwork:
Martyn Kelly

SLU WATERS

Fortlöpande miljöanalys

Tack till

Hans Olofsson, Länsstyrelsen i Dalarna

Marie Eriksson, Pardis Pirzadeh, Hillevi Hägnesten, Vibeke Lirås,
Länsstyrelsen i Skåne
Amelie Jarlman, Jarlman Konsult AB

och många fler, särskild på alla Sveriges länsstyrelser

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Första resultat

SLU WATERS *Fortlöpande miljöanalys*

Diatoms of Dalarna and Norrbottens County – impact of mining industry

- 25 streams Dalarna
- 6 streams Norrbotten
- Heavy metal gradient:
  - Cu 0,05 - 790 µg/l
  - Zn 0,6 - 56000 µg/l
  - Cd 0,001 - 231 µg/l
  - Pb 0,01 - 2100 µg/l

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Swedish Classification of the Heavy Metal Gradient - Concentration

Class	Description	Cu	Zn	Cd	Pb
1	Very low conc.	≤ 0,5	≤ 5	≤ 0,01	≤ 0,2
2	Low conc.	0,5 - 3	5 - 20	0,01 - 0,1	0,2 - 1
3	Mod. to high conc.	3 - 9	20 - 60	0,1 - 0,3	1 - 3
4	High conc.	9 - 45	60 - 300	0,3 - 1,5	3 - 15
5	Very high conc.	> 45	> 300	> 1,5	> 15

Swedish Environmental Agency – Environmental Quality Criteria for Lakes and Streams (report 4913) 1999

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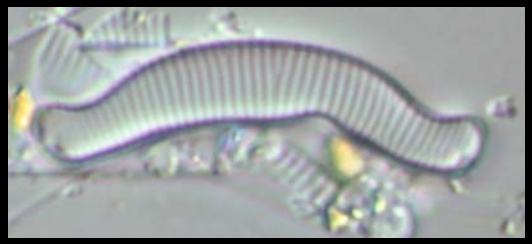
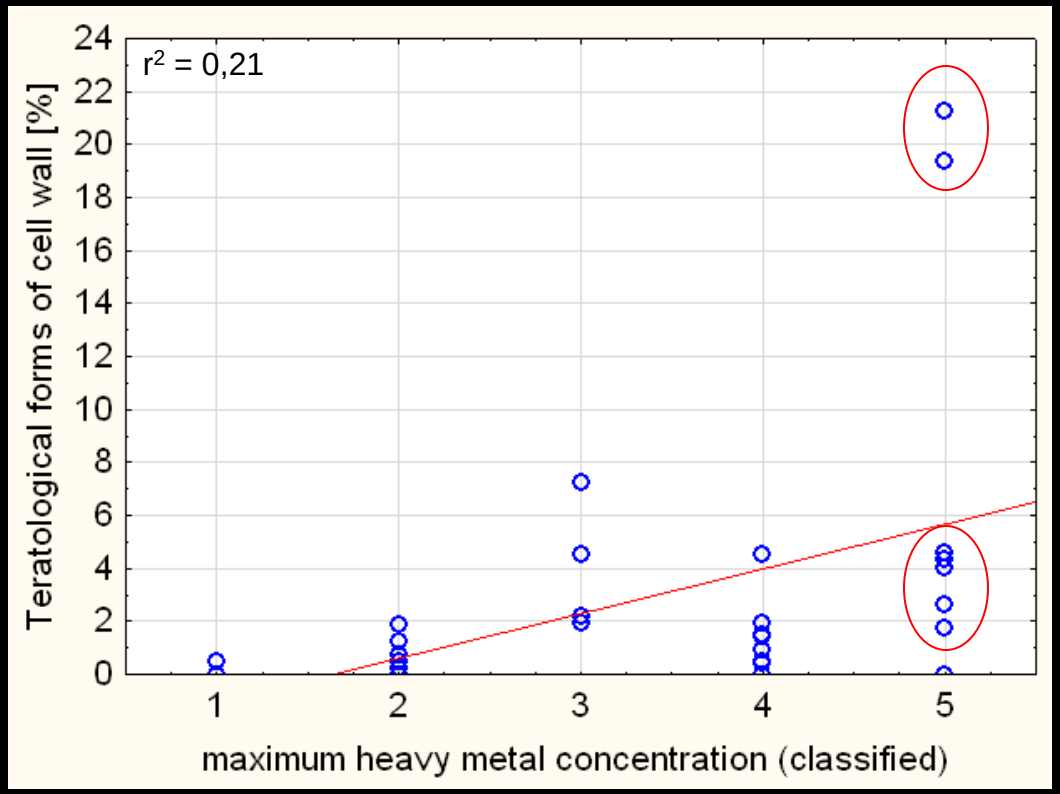
Most teratological forms under maximum heavy metal concentration

Metals measured:
Cu, Zn, Cd, Pb,
Cr, Ni, As, Co, V

Classification:
Highest concentration class (1-4 metals)





4 metals in class 5, highest conc.

less metals in class 5

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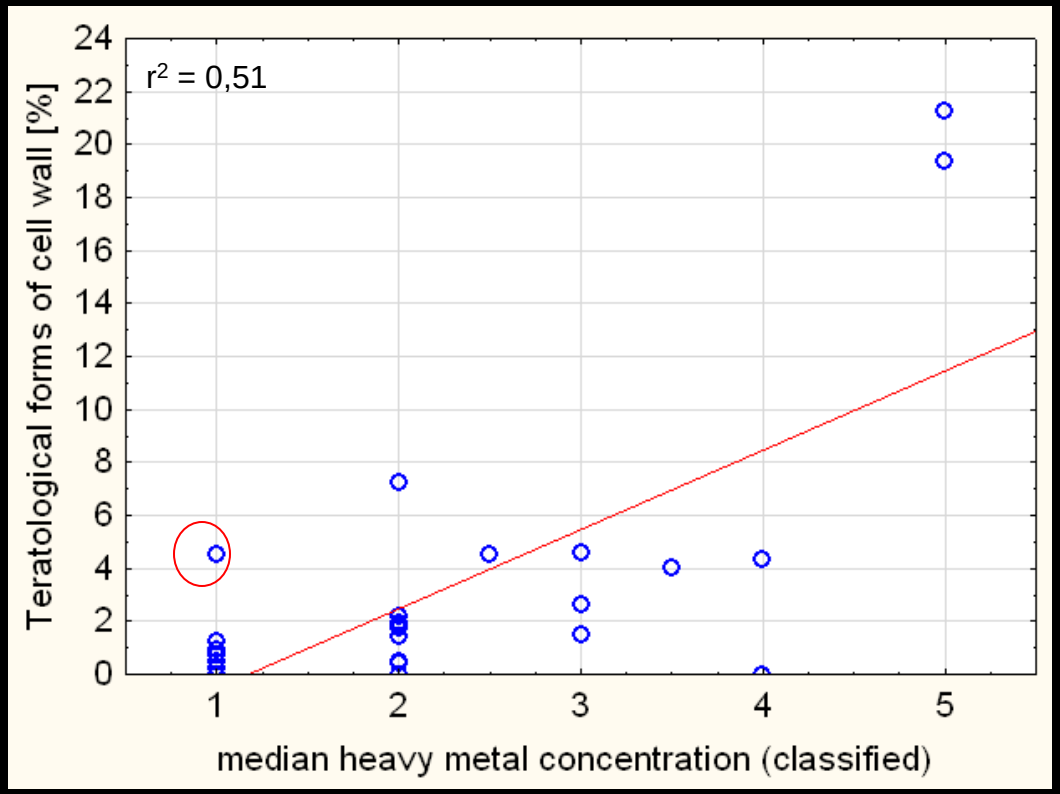
Better correlation of teratological forms including all heavy metals (median class)

Classification: Median of all nine concentration classes



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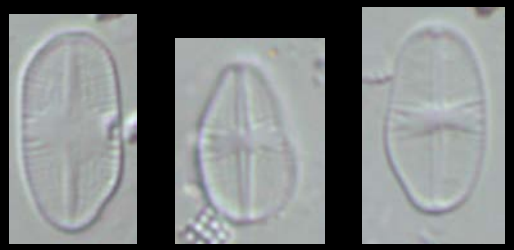
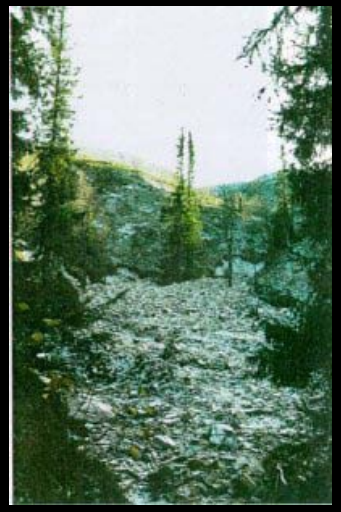
Fortlöpande miljöanalys

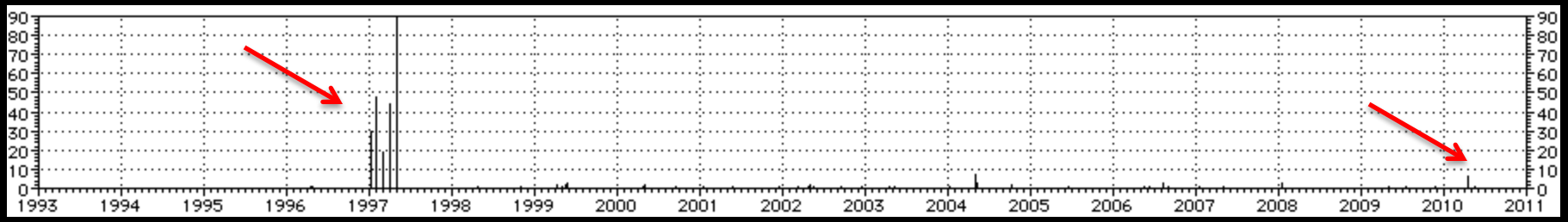


Psammothidium subatomoides Bukhtiyarova & Round, 1996

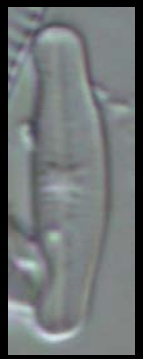
Exception 1: Göljån

- Göljån:
  ”too high” % of teratological valves - why?
- Naturally copper rich bedrock
- Flash flood August 1997 – since then regular spring floods with enhanced copper levels up to moderate concentrations

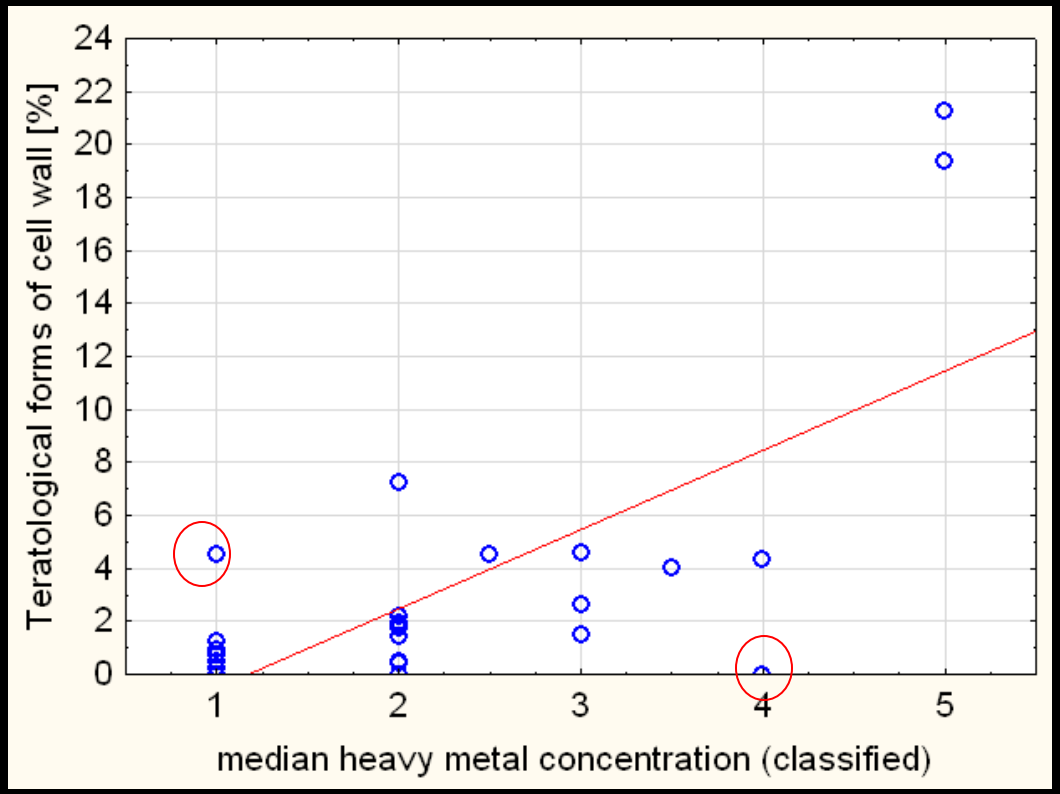




Exception 2: Södra bäck Skyttgruva



Classification: Median of all nine concentration classes

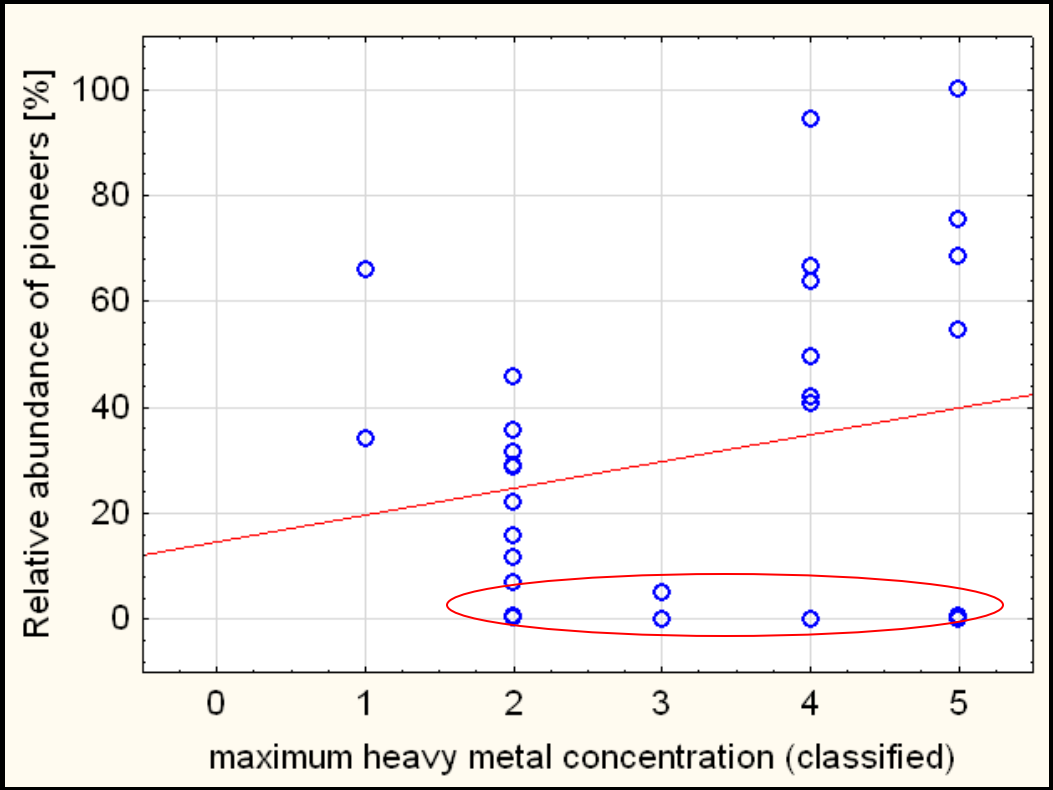


Exception 2: Södra bäck Skyttgruva

- S. bäck Skyttgruva: No teratological valves at all despite Cu, Zn and Cd being in class 5 ?
- Only one taxon:
  Achnanthidium minutissimum group
- Known to develop tolerance to heavy metals
- Also known as pioneer taxon (early colonizer after disturbances)*

Pioneers increase in a heavy metal gradient

Pioneers in present dataset: *Achnanthidium minutissimum* group* and *Amphora pediculus* s.l.



Dominance (> 60%) of Eunotia – not classified as pioneers

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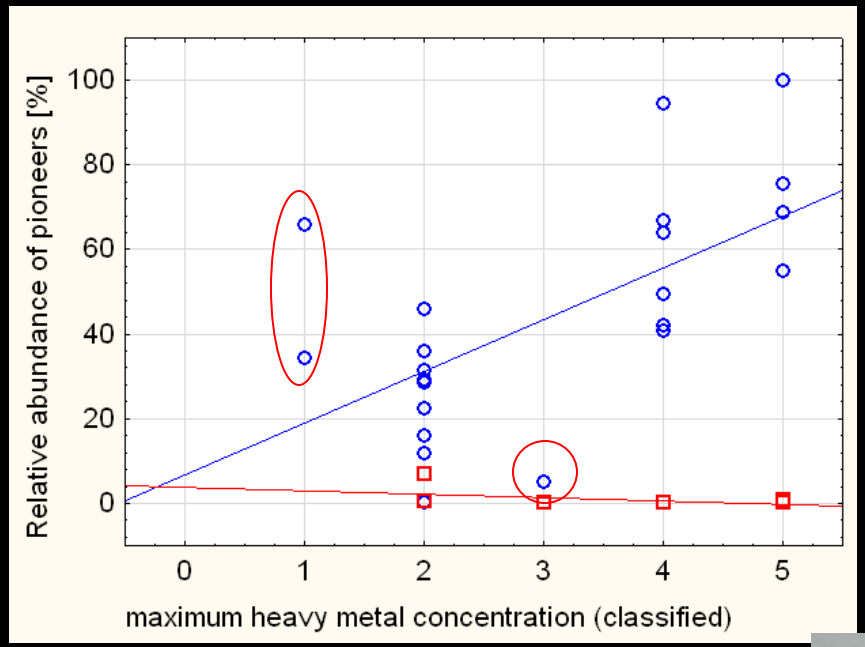
Pioneers increase in a heavy metal gradient

Luossajoki, outlet Ala Lombolo
impacted by **mercury** (old mining reservoir, high mercury concentration in sediments)



Göljån again
40 % Psammothidium subatomoides
Not (yet?) classified as pioneer

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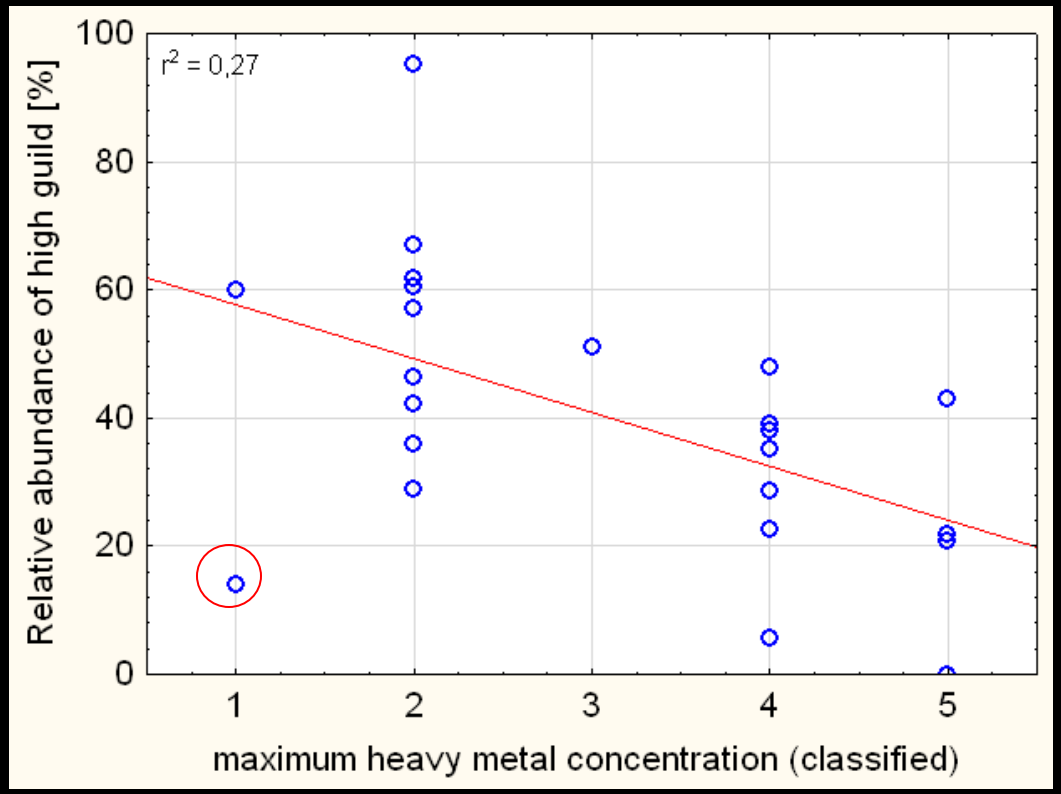
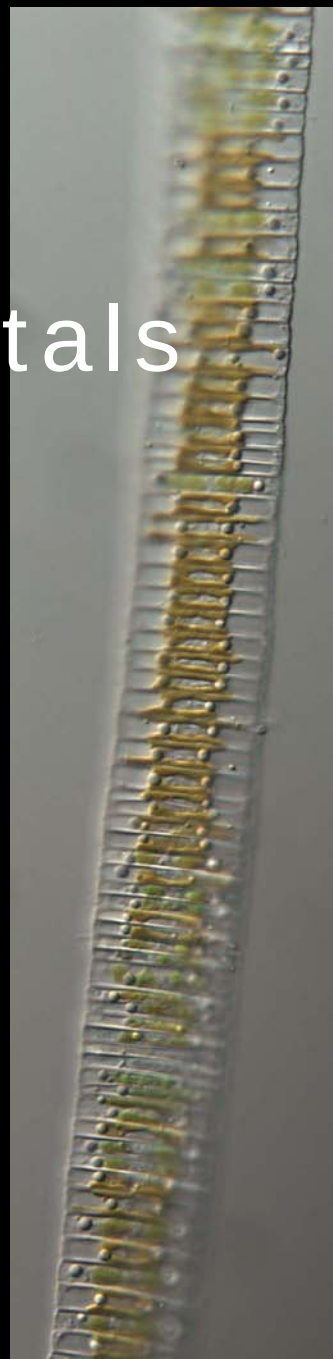
High guild taxa vs. heavy metals

High guild taxa (here for example *Aulacoseira, Tabellaria, Gomphonema, Brachysira*) do decrease with increasing metal toxicity in the present study.



Luossajoki, outlet Ala Lombolo impacted by **mercury**



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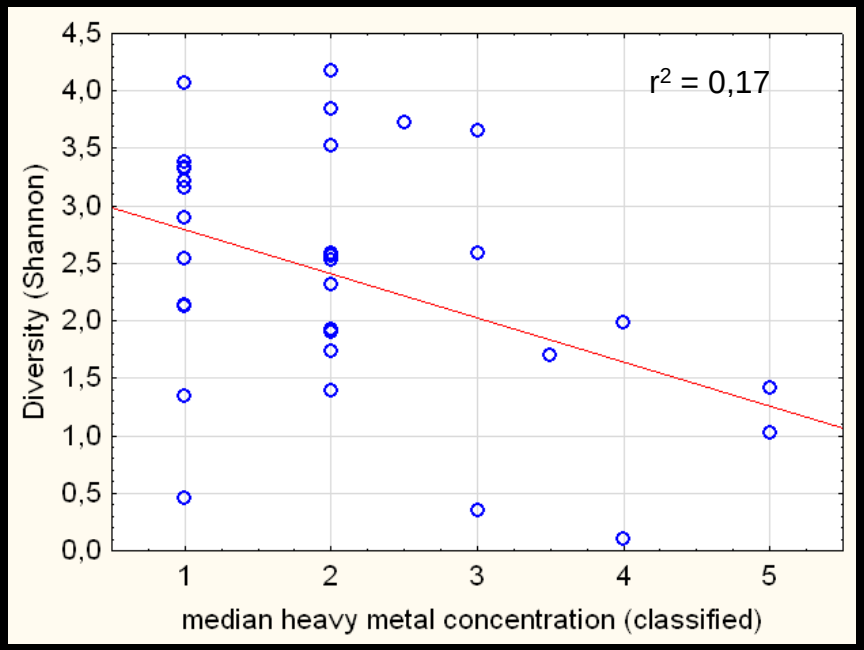
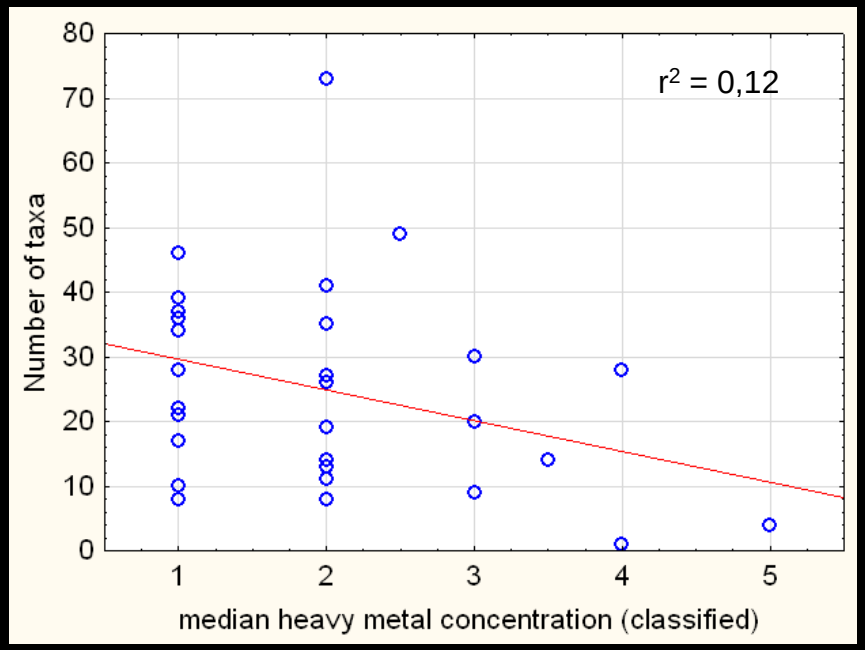
Diversity and taxa richness vs. heavy metals





Both diversity and number of taxa decrease with increasing heavy metal concentration, but correlation is weak.

Sammanfattning

Metallpåverkan

- Tröskelvärde för missbildningar:
  > 2% troligtvis påverkat ü
- Låg diversitet & artantal ü
- Toleranta kiselalgstaxa ?
- Speciella levnadsformer / ekologiska grupper ü
  pionjärtaxa é
  högväxande taxa ê

Pågående arbete

- Påverkan av organiska miljögifter
- Orsaker för den höga variationen av alla olika faktorer
- In med mera data
- Skapa index!
  Måste vara multimetriskt, eftersom ingen parameter för sig är tillräckligt säkert

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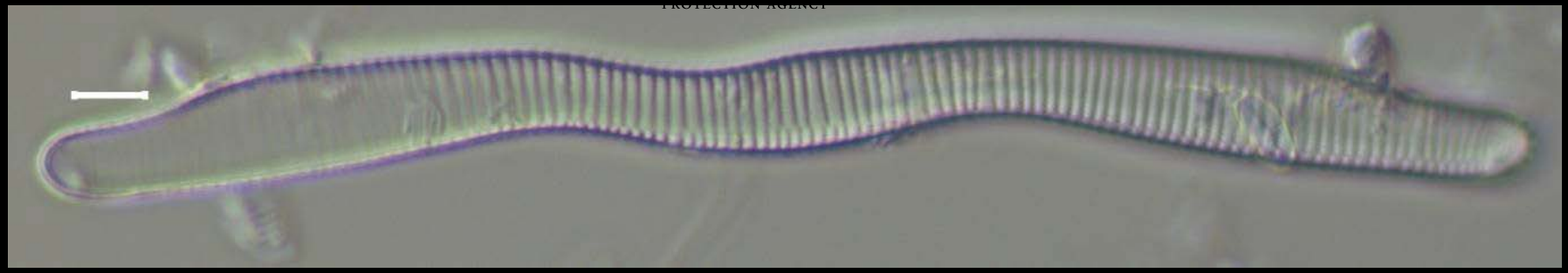
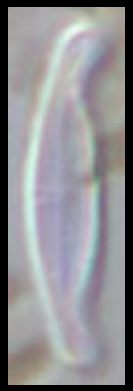
NATUR VÅRDS VERKET

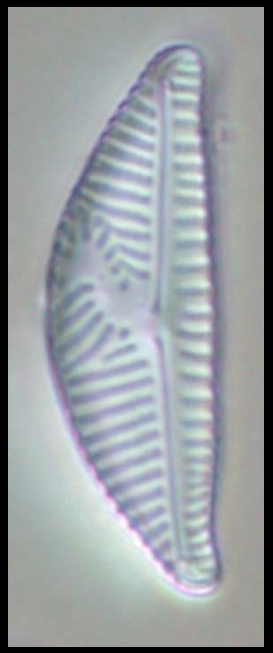
Swedish Agency for Marine and Water Management

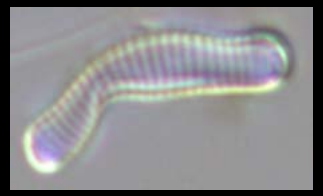
Fortlöpande miljöanalys



Tack

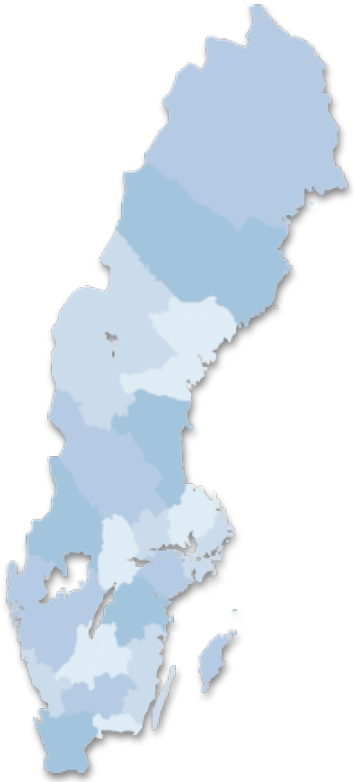






Back to the teratological valves...

Diatoms of Skåne County – impact of agriculture



- 30 streams
- Toxin measurement of **EUs priority substances** both in **water samples** and with **passive samplers**

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Toxins found in Sweden in present study

- **Toxins > 10 x AA-EQS**

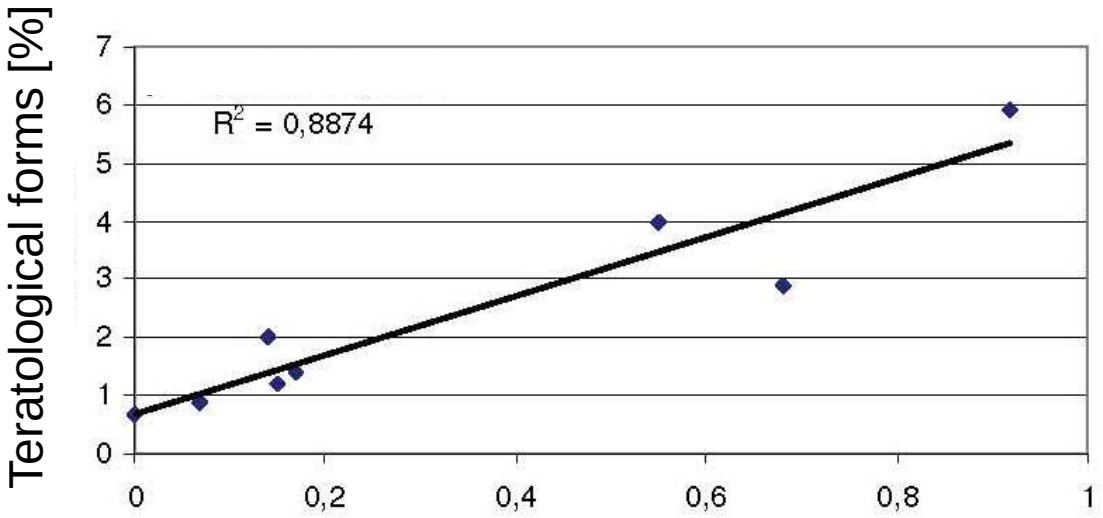
  Imidakloprid (insecticide)
  Brominated diphenylethers (industrial applications, often flame retardant)
  Tributyltin (biocide, anti-fouling)
  Octylphenols (industrial applications, in rubber, pesticides and paints)
  Diflufenican (herbicide)

- **Toxins > 1 x AA-EQS**

- Terbutylazin (herbicide)
  Propoconazol (fungicide)
  Glyfosat (herbicide)
  Isoproturon (herbicide)

EU directive priority substances 2012
AA: annual average value
EQS: environmental quality standard

Teratological forms in a toxin gradient

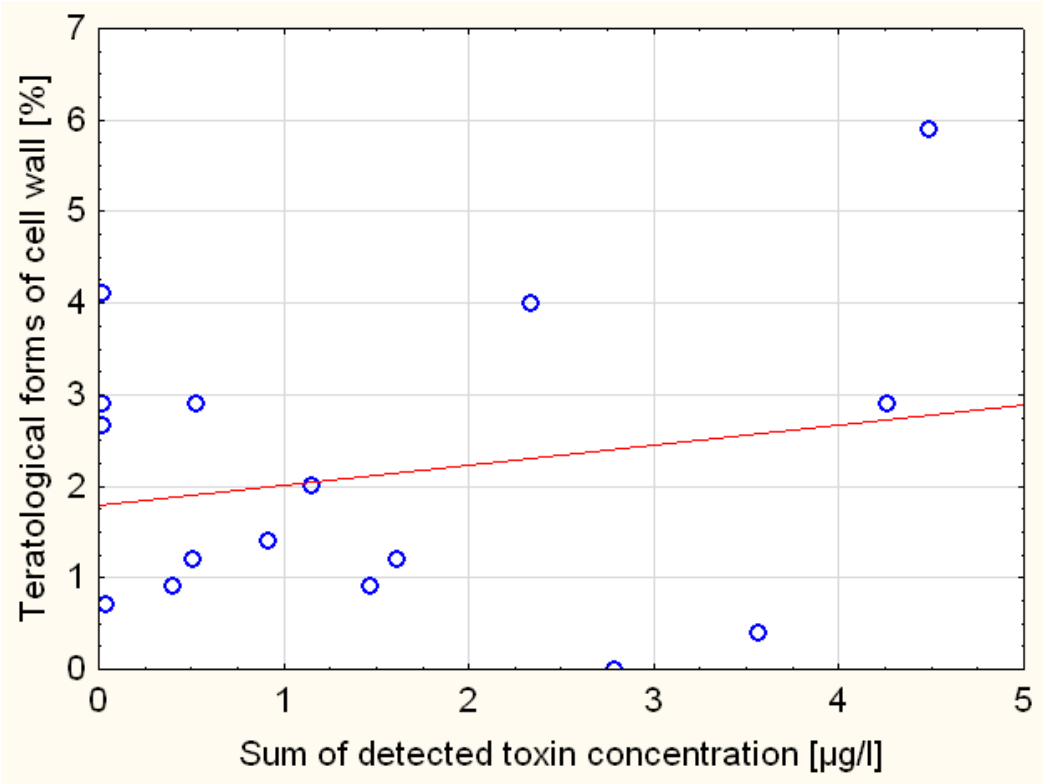


Sum of detected toxin concentration [µg/l]
2-3 months before diatom sampling
(pilot study sept 2010, n=8)

Strongest correlations with **sum of the detected toxin concentrations**.
Not with number of detected toxins or with **Toxindex** (according to priority substance EU directive 2012).

Strongest correlation with concentrations **2-3 months before diatom sampling**.

Adding more sites makes picture complicated…



Unfortunately, data not always available for period 2-3 months before sampling…

Diatoms, toxins and metals

Further work:

- more streams with seasonal information available for both toxins and diatoms will be included
- test of only herbicide impact
- detailed analysis of toxicity indices – maybe signal now vanishes in noise?
- different taxa sensitive to different toxins or metals?
- other traits/guilds?
- Al? Hg?
- Teratological valves: Diatoms only sensible during sexual reproduction?

Funding

- Swedish Environmental Protection Agency, via the ”Common regional sub-programs”
  1. WFD prioritized toxins (“PRIO program”)
  2. Regional environmental monitoring
  Project leader: County Administrative Board Blekinge
- Swedish Environmental Protection Agency via Environmental Object Projects (Miljömålsprojekt)
- Swedish Environmental Protection Agency via Research Department (Waterbody Assessment Tools for Ecological Reference conditions and status in Sweden (WATERS))
- Swedish University of Agricultural Sciences via research program Environmental Monitoring and Assessment (Fortlöpande miljöanalys (FoMA) och miljöövervakning)

Finansiering

Fortlöpande miljöanalys

Kemiska provtagningar
- -Passiva provtagningar
- -Vattenkemiska analyser

PRIO-projektet

Kiselalgsprovtagningar
- -fältprovtagning
- -taxonomisk analys
- -räkna deformerade skal

Delprogrammet kiselalger i rinnande vatten (Ny kompletterande ansökan för 2011)
Enskilda länsstyrelser (?)
Ev stöd från PRIO-projektet (?)

Statistisk analys och framtagande av index

Miljömålsprojekt (ansöker om pengar för 2011)

?

Förändring i befintliga bedömningsgrunder
(för att ta hänsyn till ev effekt av miljögifter om sådana framkommer av analyserna)

Waters

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