

Daphnia Tests in the Rhine Water Control Station Worms

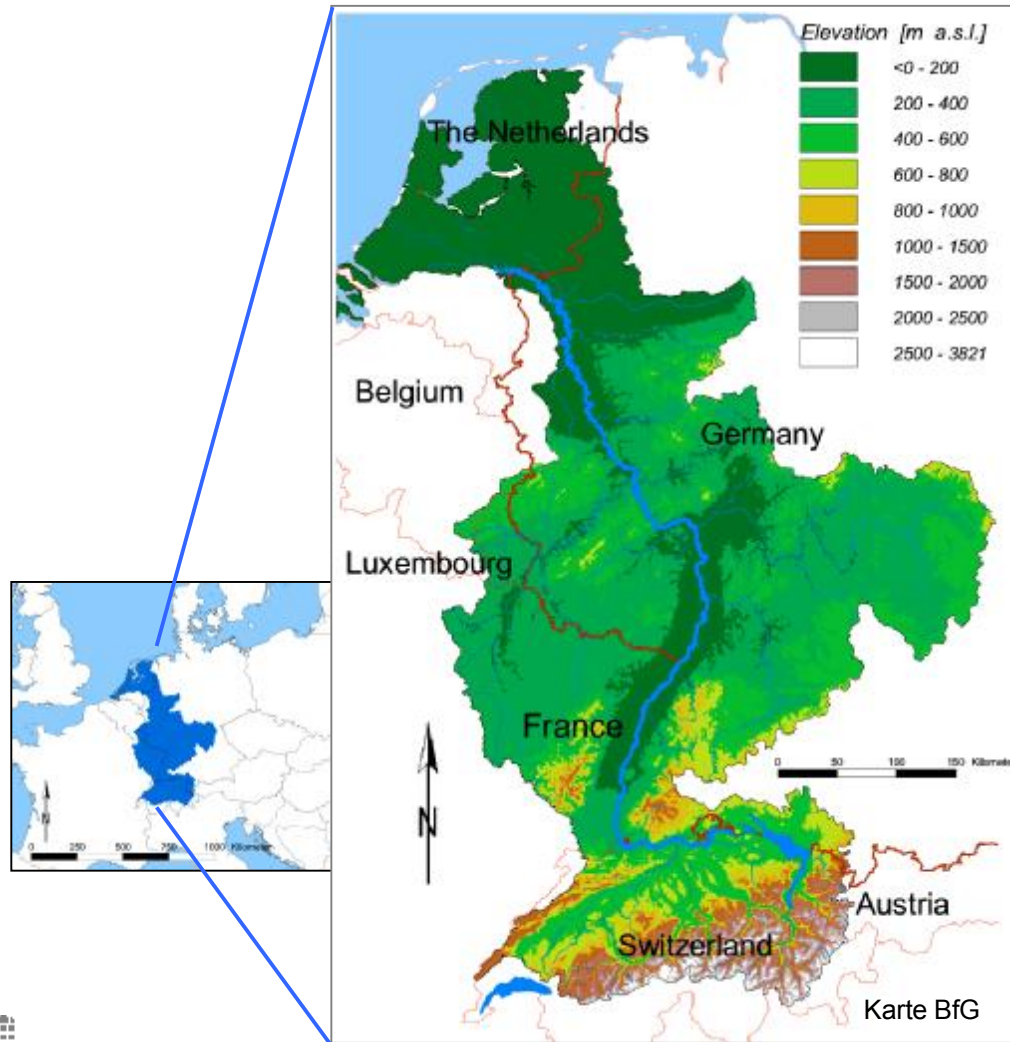
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Rhine Water Control Station Worms
of the State Environmental Agency
Rhineland-Palatinate (Germany)

Structure of the Presentation

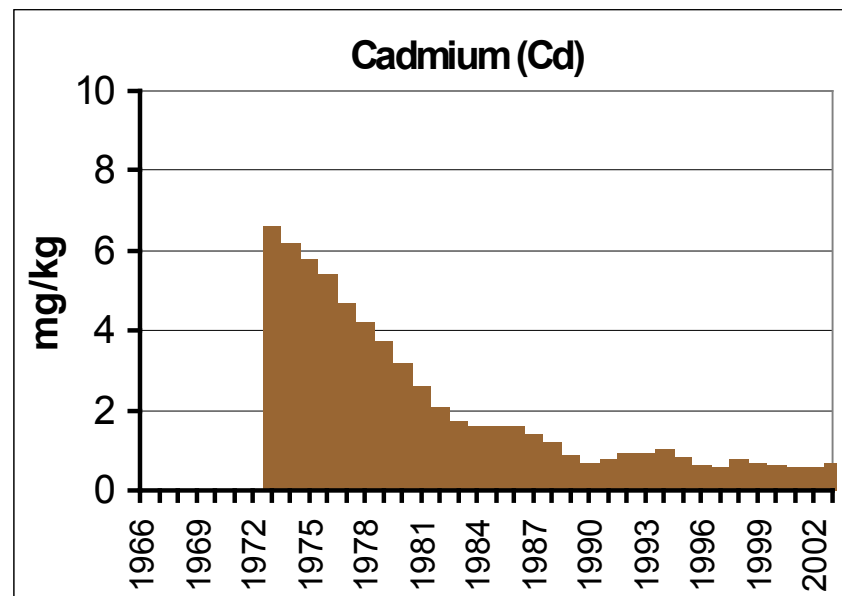
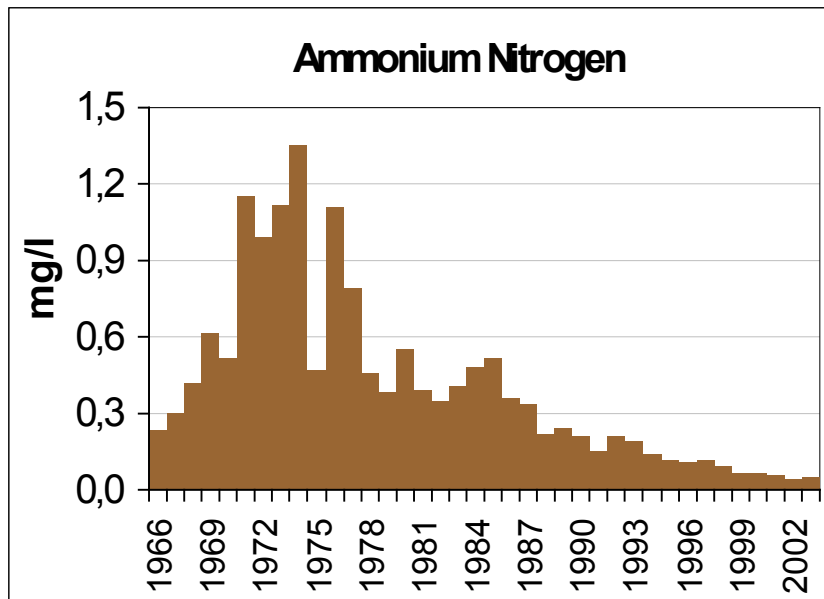
- geography and historical background
- monitoring stations
- alarm monitoring
 - continuous biotests (biomonitors)
 - Dynamic Daphnia Test
 - structure of the WAP Rhine
 - alarm sampling

The River Rhine



- length: 1,320 km
- draining off: 2,290 m³/s (D/NL border)
- inhabitants: > 50 Mio.
- drinking water for 5.5 Mio inhab.
- shipping: ca. 200 Mio. t/y
25% dangerous goods
- 50 % of whole of Europe's chemical industry in catchment area

Evidence for Success of Water Management



Sandoz (CH), 1986

November 1st, 1986:

Fire-brigade report: stockroom 956 of the chemical company SANDOZ near Basel (Switzerland) burnt down.

30 tons of pesticides discharged into the river Rhine.



During the passing of the poisoned wave, the intakes for drinking water for 5,000,000 people were closed for 18 days.

Targets of the Rhine Action Programme

- to improve water quality
- to reduce number of accidents with water hazardous substances
- to improve and recover natural habitats

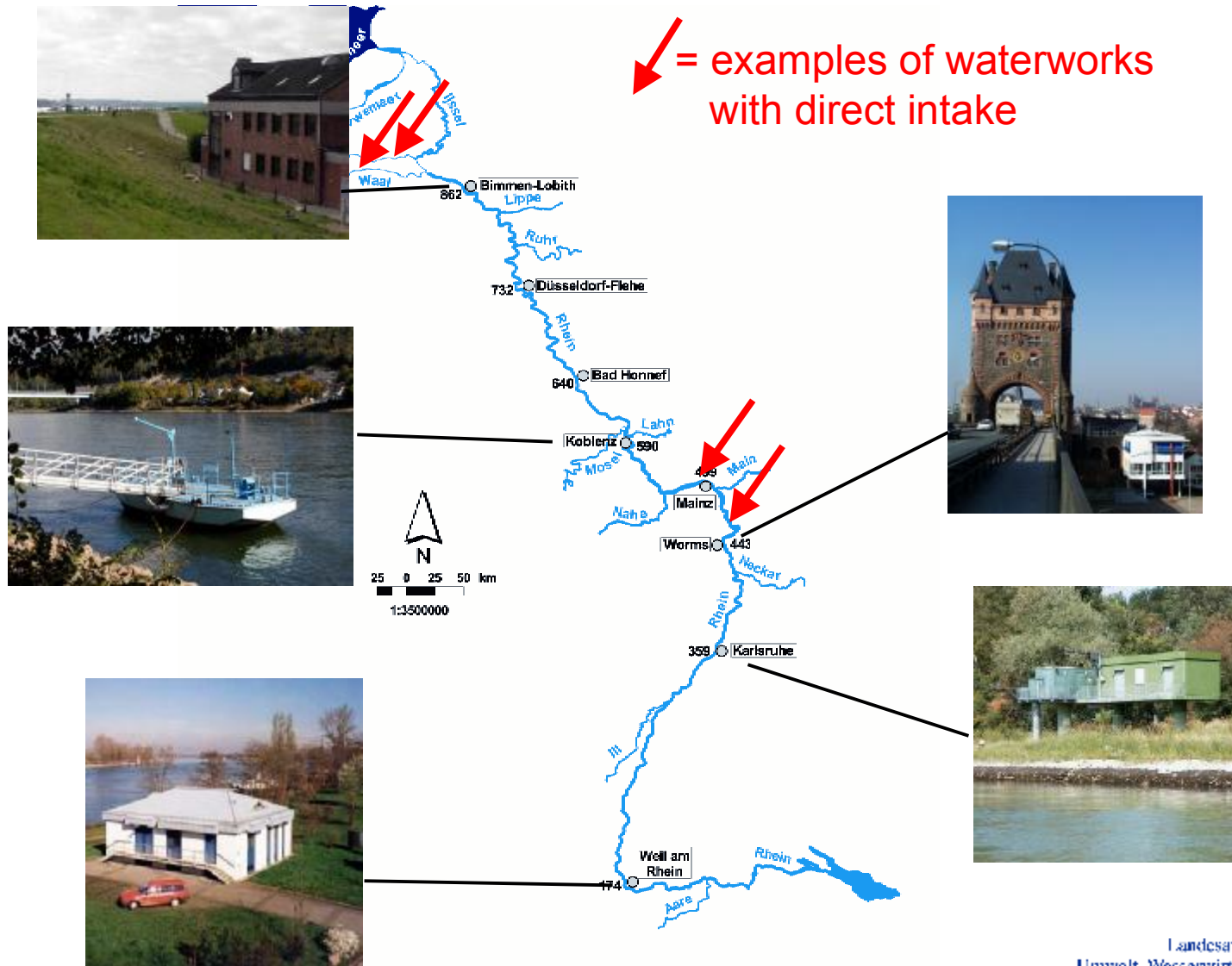
Alarm Monitoring Rhine

“Alarm Monitoring” with extra effort at 8 monitoring stations.

Elements of Alarm Monitoring:

- online monitoring of chemical-physical parameters
- search for hazardous industrial compounds and pesticides (“screening”)
- continuous registration of toxicity with continuous biotest methods (“biomonitoring”)

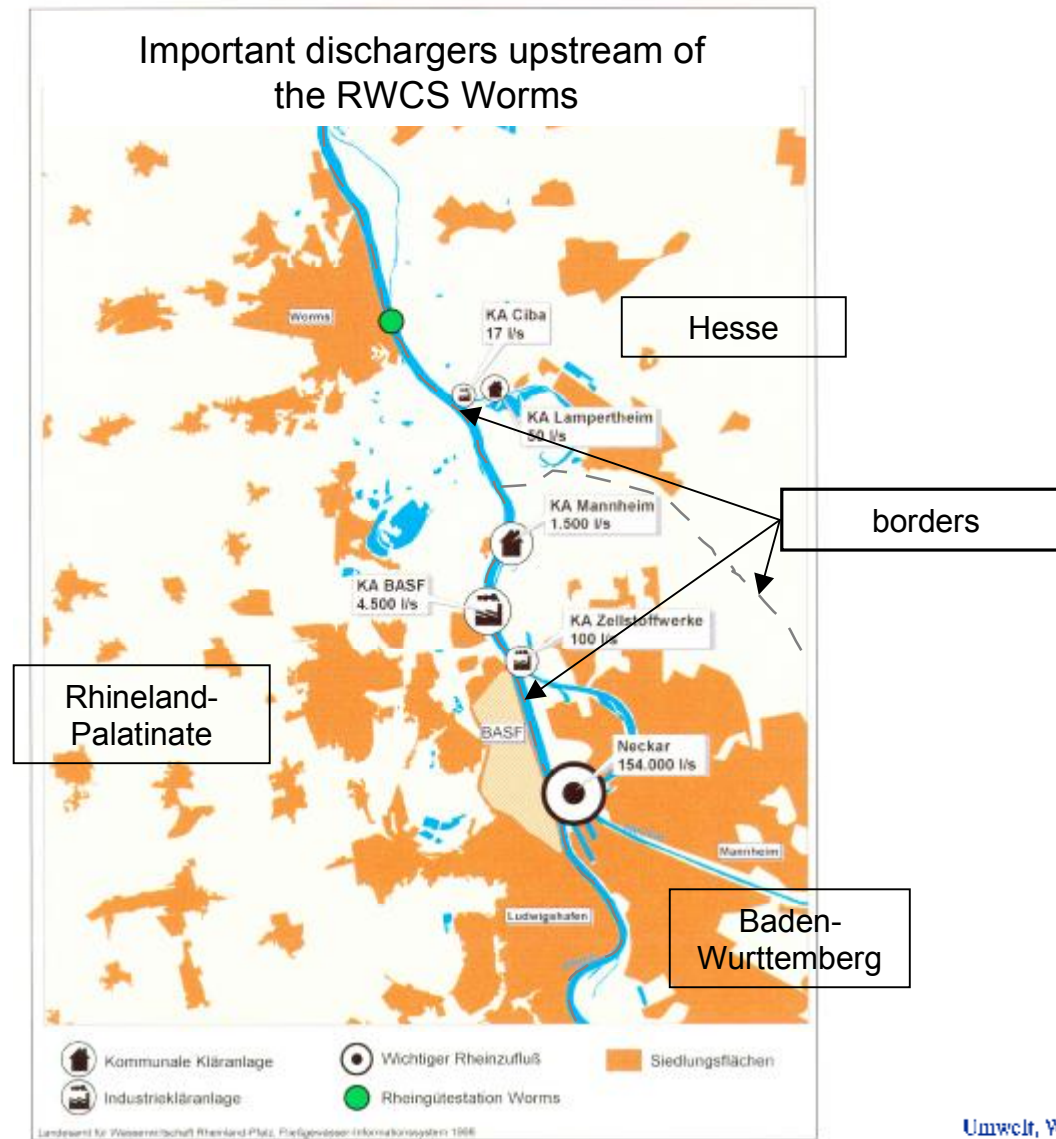
Alarm Monitoring Network "Rhine"



↘ = examples of waterworks with direct intake



Impacts in the Rhine-Neckar Region



Detection:

- the type of products the different companies are producing
- list of substances which are allowed to be discharged by the different companies
- our own chemical library
- water police

Technical Equipment of the RWCS

Sampling:

- 4 routine samplers
- 4 event samplers
- 1 alarm sampler

Biomonitoring

- 2 Dynamic Daphnia Tests
- 1 DF-Algae Test

Chemical Monitoring

- GC/MS Screening

Continuous Measurement:

- water temperature
- oxygen
- pH
- electric conductivity
- turbidity
- fluorescence
- SAK 254

Continuous Biotests (Biomonitors)

- Goal:
rapid detection of impact by hazardous compounds
- Method:
continuous registration of changes in behavioural and/or physiological changes in living organisms.

Continuous Biotests in the RWCS

DF-Algae Test

The fluorescence of microalgae (e.g. *Chlorella vulgaris*) in a water sample is compared with that in a control sample.

Biotest-Alarm (instrumental alarm) at significant differences between the fluorescence curves.

Dynamic Daphnia Test

The activity of water fleas (*Daphnia magna*) is measured by means of light barriers.

Biotest-Alarm (instrumental alarm) at significant changes in activity.

Continuous Biotests

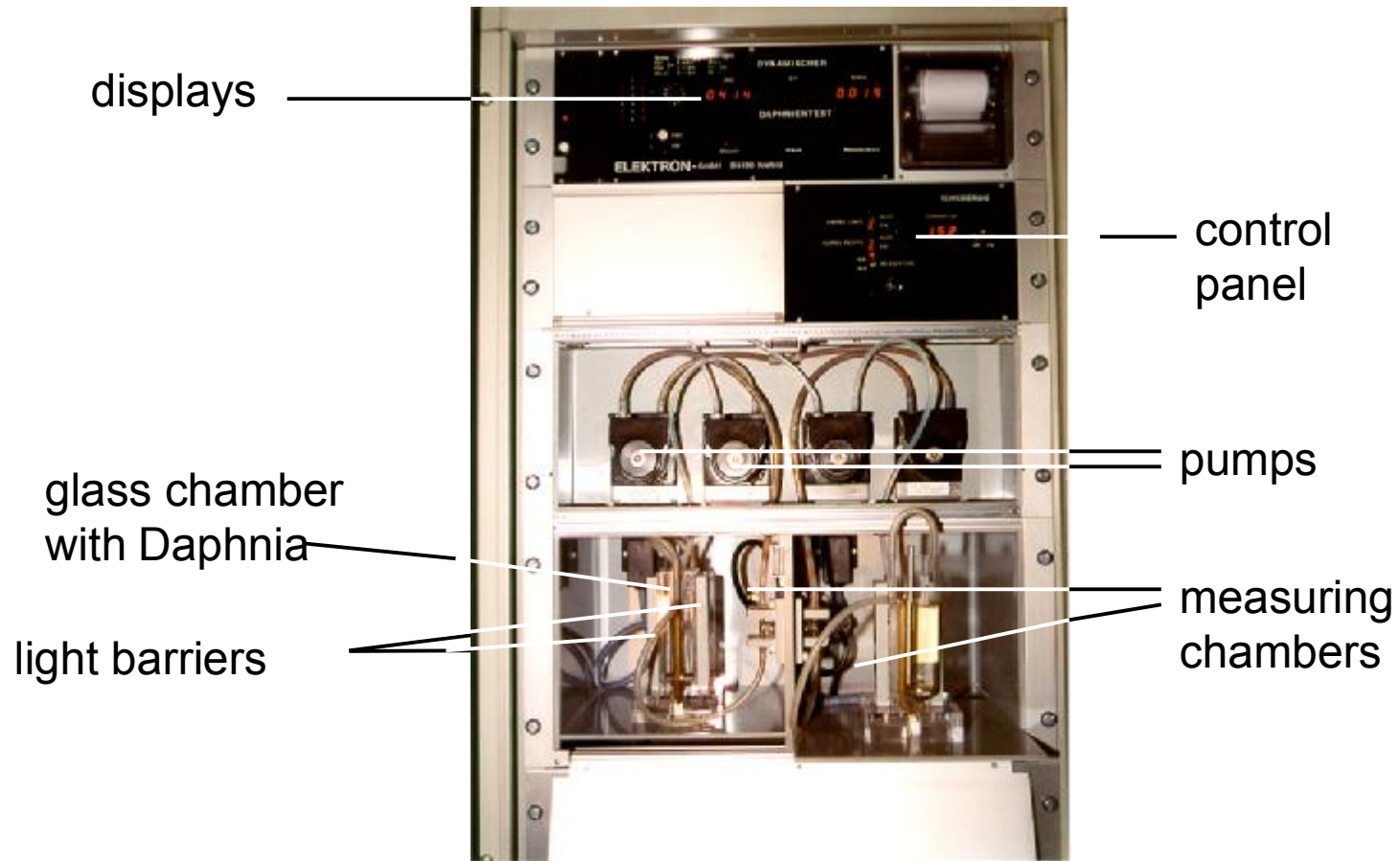
DF - Algae Test



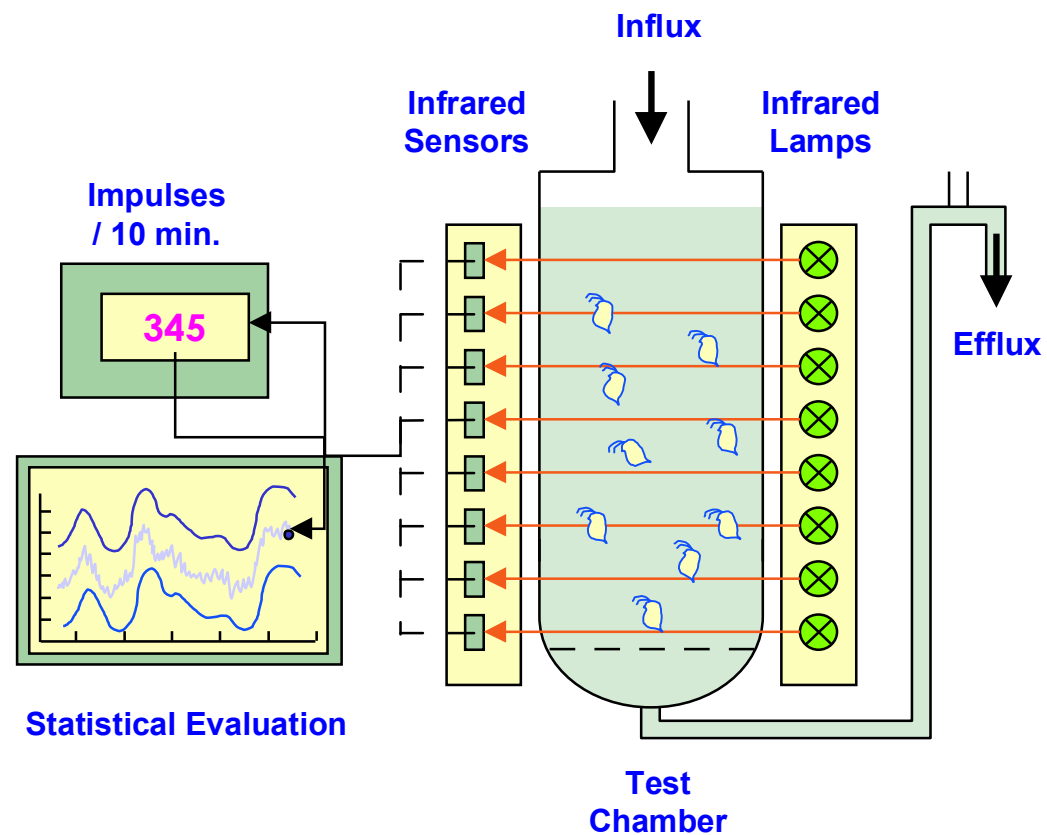
Dynamic Daphnia Test



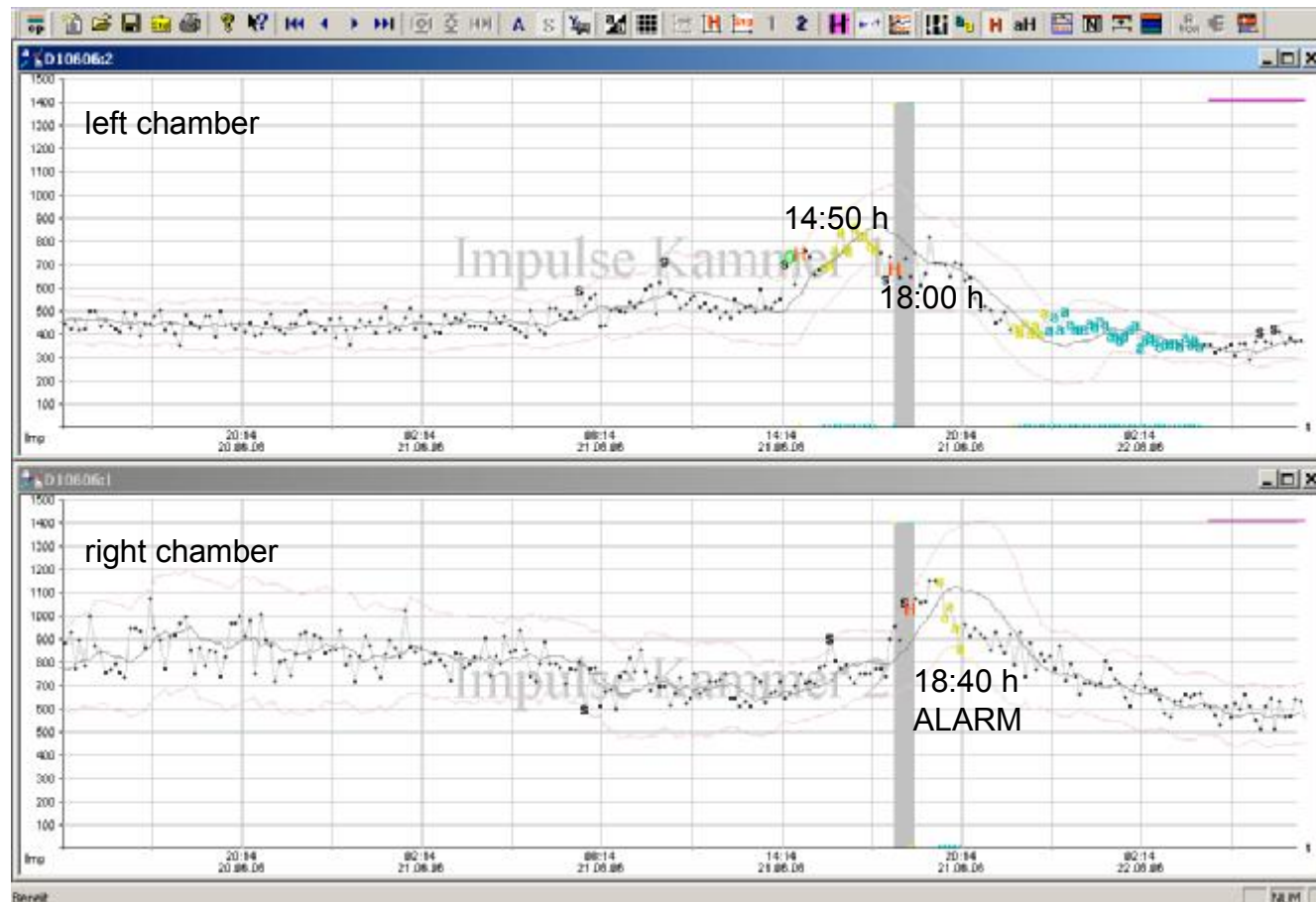
Dynamic Daphnia Test



Principle of the Dynamic Daphnia Test



Detection of Alarms with the bbe Hinkley-Detector



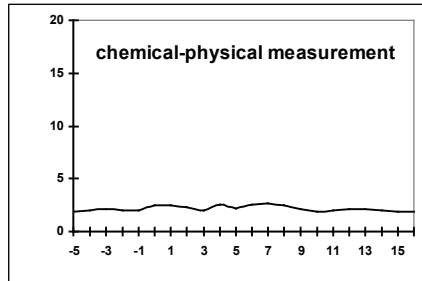
Consequences of Daphnia Alarm

- **Alarm sampler** starts automatically
- “Pager” alarms colleague who is **on-call**, even at night or weekend
- On-call colleague has to check in the station:
 - technical equipment of the biomonitor
 - physical/chemical parameters
 - optical analysis of the daphnia curvesleading to **classification of the daphnia alarm**

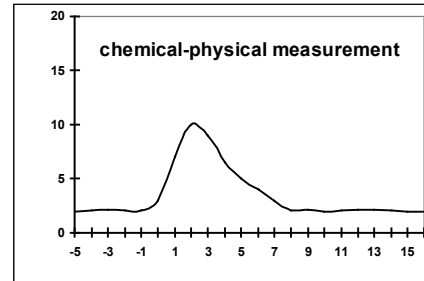
Continuous Biotest Methods

Alarm Classes

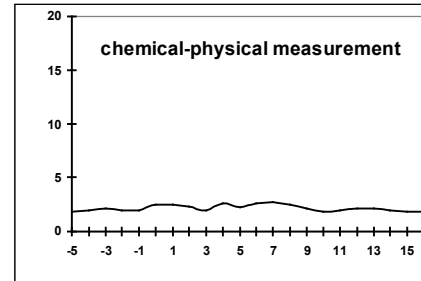
Irregularity



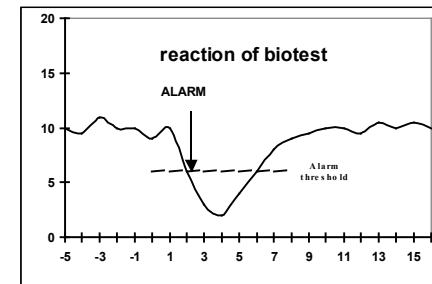
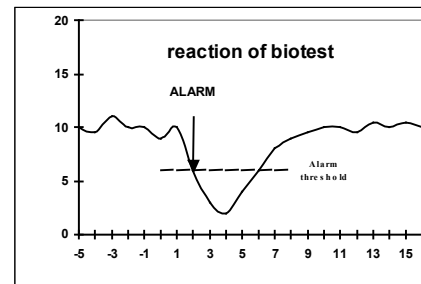
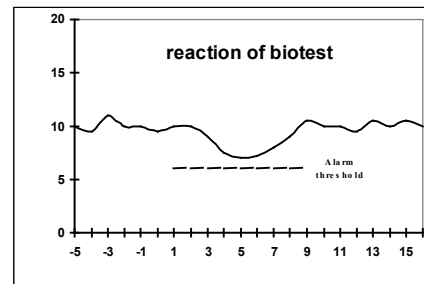
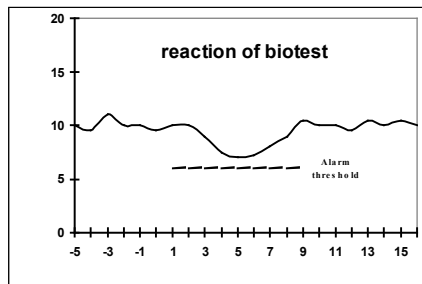
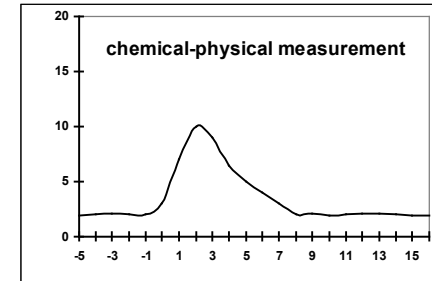
Indication



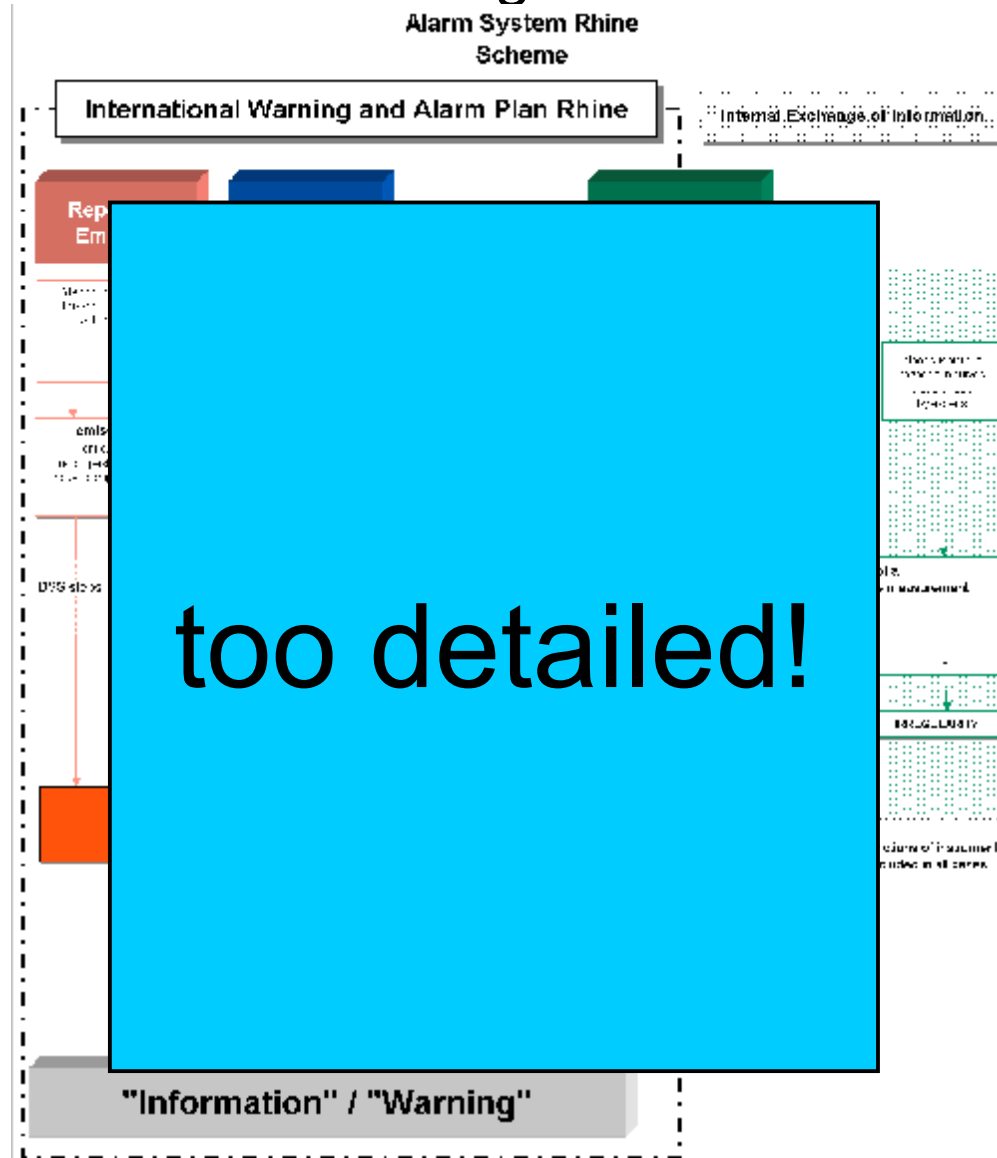
Event



Messaging Level



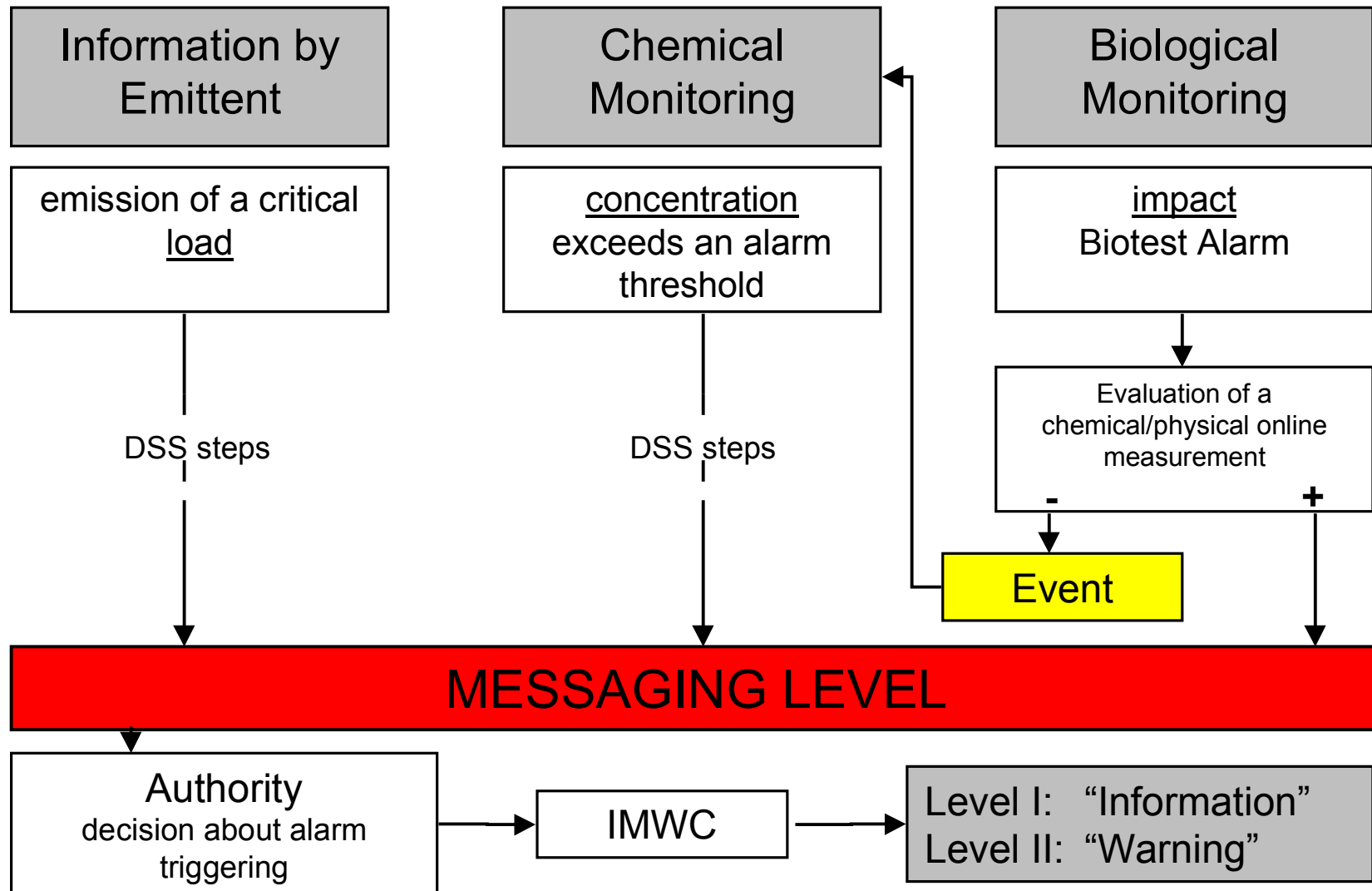
International Warning and Alarm Plan Rhine



DSS = Decision Support System



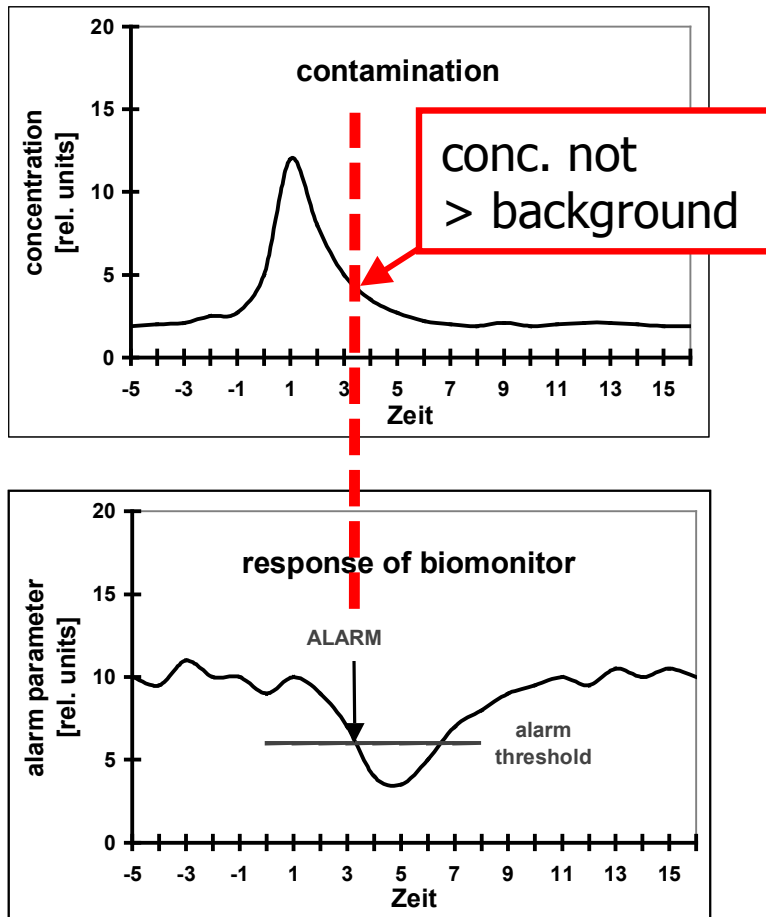
International Warning and Alarm Plan Rhine



International Main Warning Centers (IMWC)



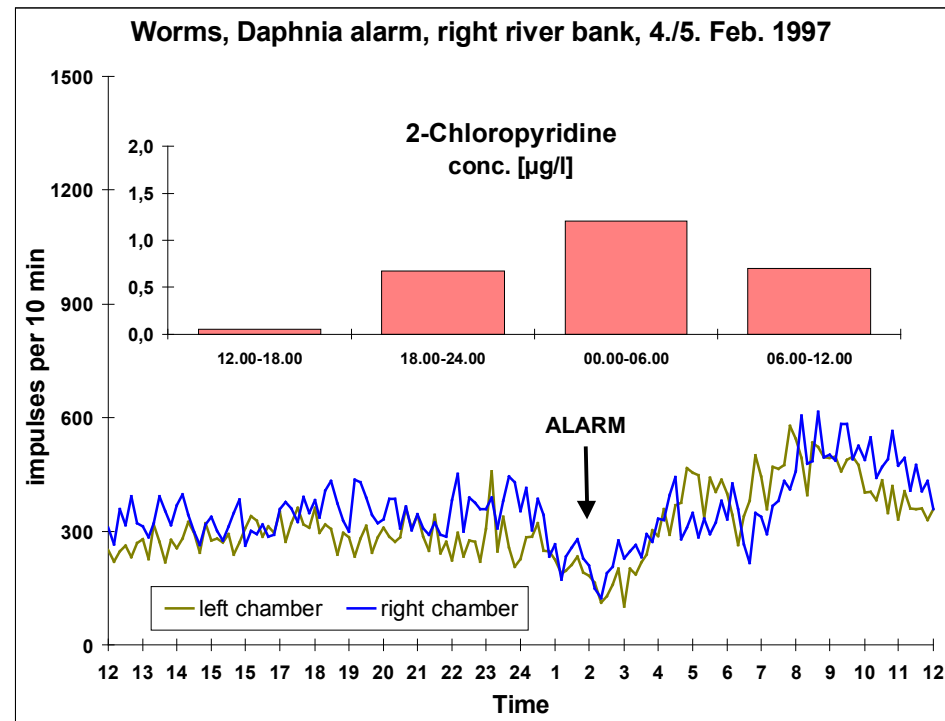
Alarm Monitoring: Alarm Sampling



Alarm Monitoring: Event Sampling

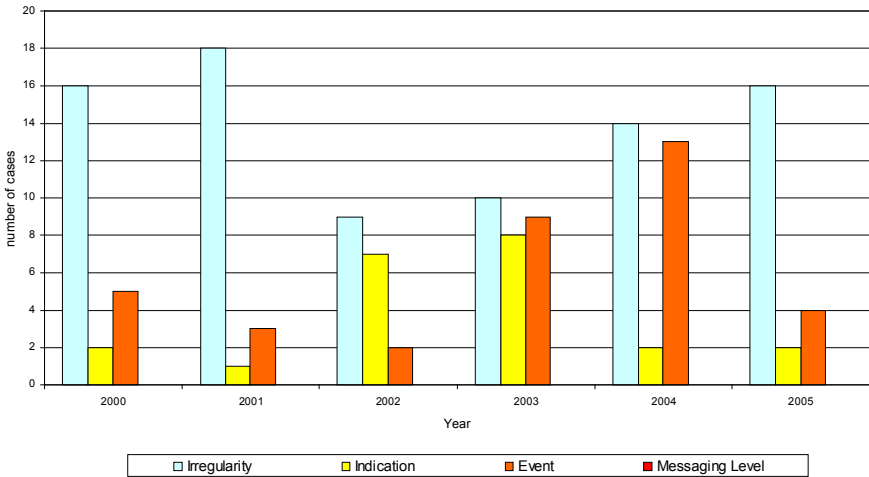


Self-emptying water sampler

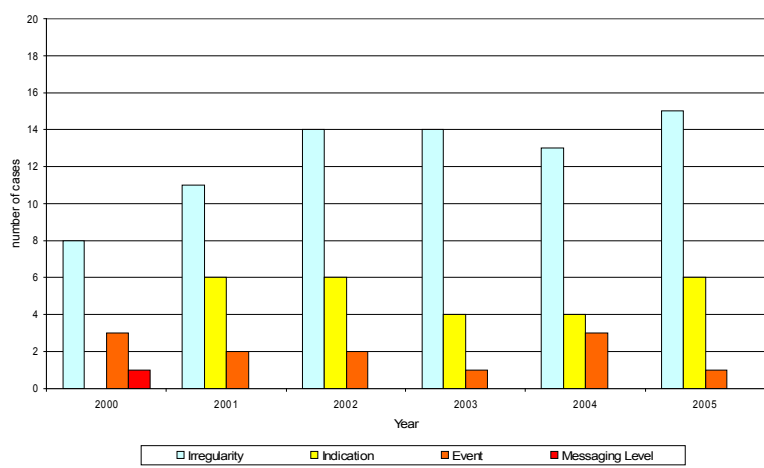


Number of Daphnia Alarms

left riverside



right riverside





Thank you!