Chemical monitoring in biota: the current practice

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Why we do biotamonitoring ?

Because we want to know something about the well-being of biota or ecosystem

We take samples and look at:

- species composition
- abundance of individuals
- age groups in the populations

- Chemical load in biota

Chemical load in water, sediment or a passive sampling medium gives no direct information about well-being of biota

Chemical monitoring in aquatic biota in Bavaria

- fish (passive monitoring) since 1995
- mussels (active monitoring) since 2000
- Bavarian biota sample bank since 2004

- aims:
  - find responsible source of pollution
  - documentation of a sucessful restauration
  - description of trends
  - complience of limiting values (EQS)

- examples for analysed pollutants:
  - anorganic substances: Cr, Ni, Co, Cu, Zn, As, Se, Cd, Sb, Pb, Ag, Hg…
  - organic substances: chlorobenzene, HCB, HCBD, PCB, lindane, DEHP, methyl-triclosan (biozid-metabolit), synthetic musk …

Why is fish or mussel used for monitoring of pollutants?

– detection limit (water concentration too low)
– accumulation in food chain
– accumulation via water and food
– interpretation of biological effects
– secondary poisoning
– temporal integration
– load in a distinct site (mussel)
– spatial integration (fish)
– concentrations in food (fish)

Mussel-Pollutant-Montoring

- mussels from poorly influenced sites (also analysed for comparison)
- one size group

exposition in spring and autumn for 6 month (active monitoring)

- defined sampling site
- defined period of time

pooled samples

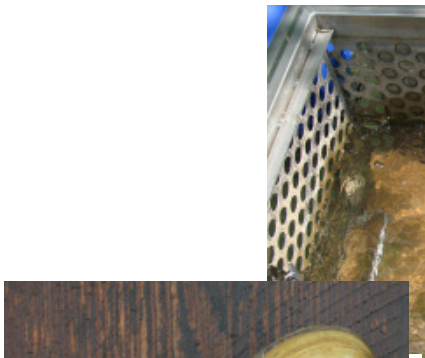
- quickly results

Mussel-Pollutant-Monitoring (Dreissena polymorpha)

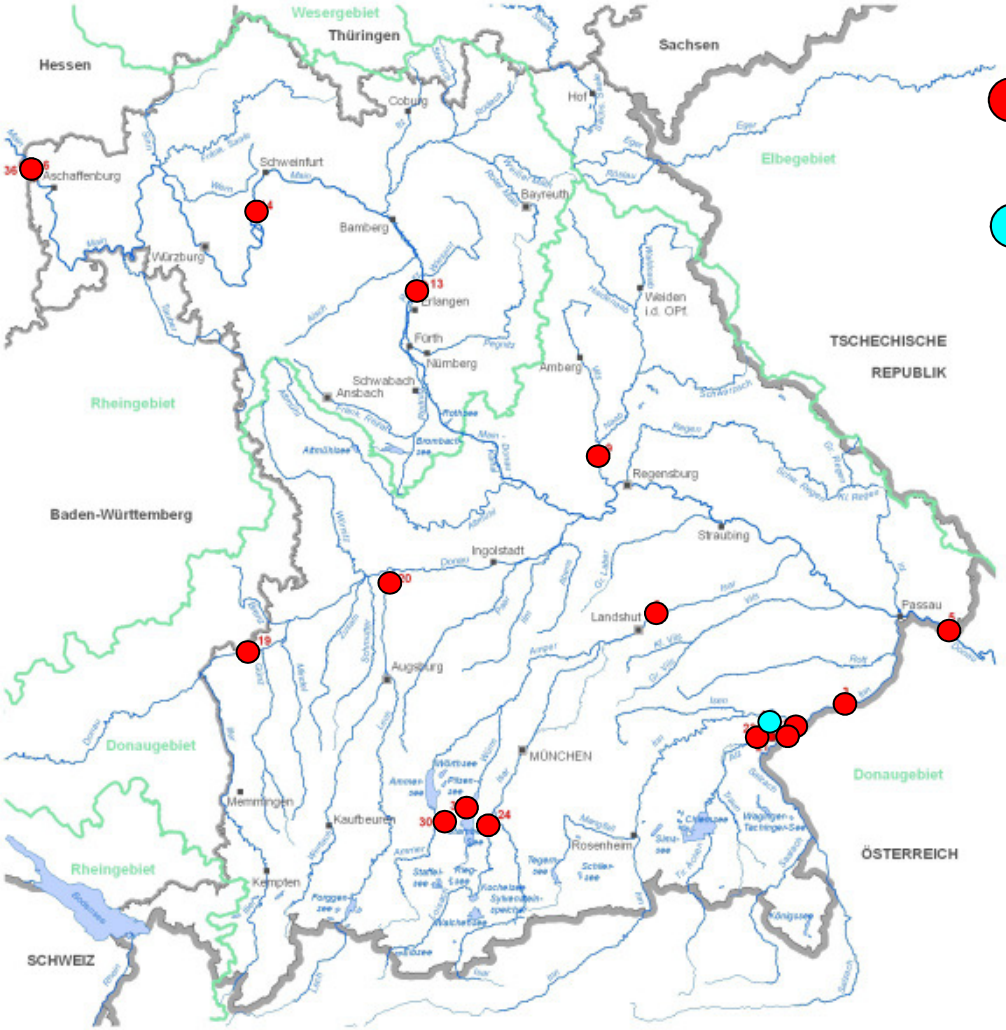
- exposition of 200 mussles
- pooled samples of 50 – 100 mussels

Mussel-Pollutant-Monitoring (Anodonta sp.) or (Unio pictorum)

- exposition of 10 mussels
- pooled samples of 10 mussels



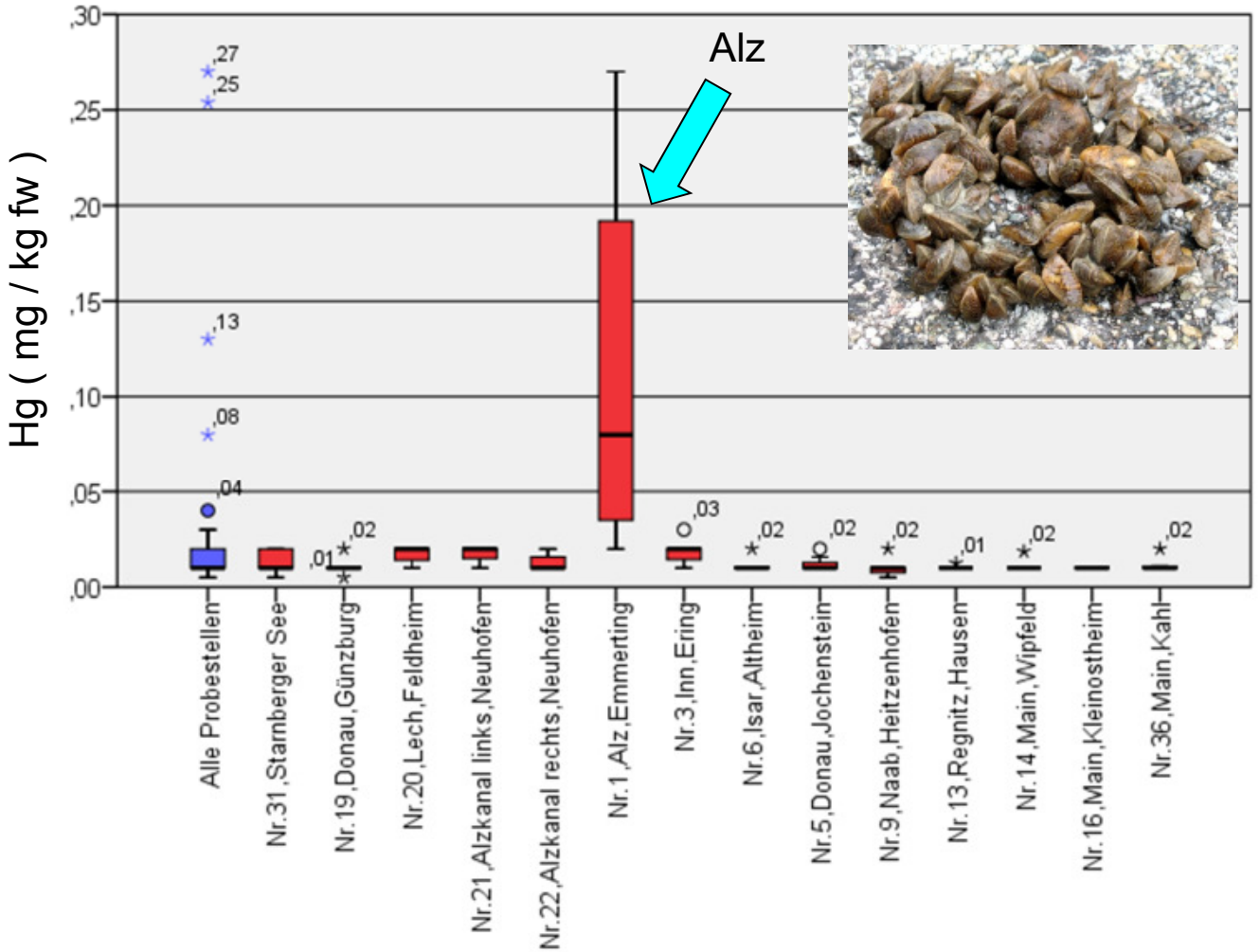
Sampling sites of Mussel-Pollutant-Montoring



- sampling sites
- Alz, Emmerting

Mercury in Dreissena polymorpha (years 2008 – 2011)

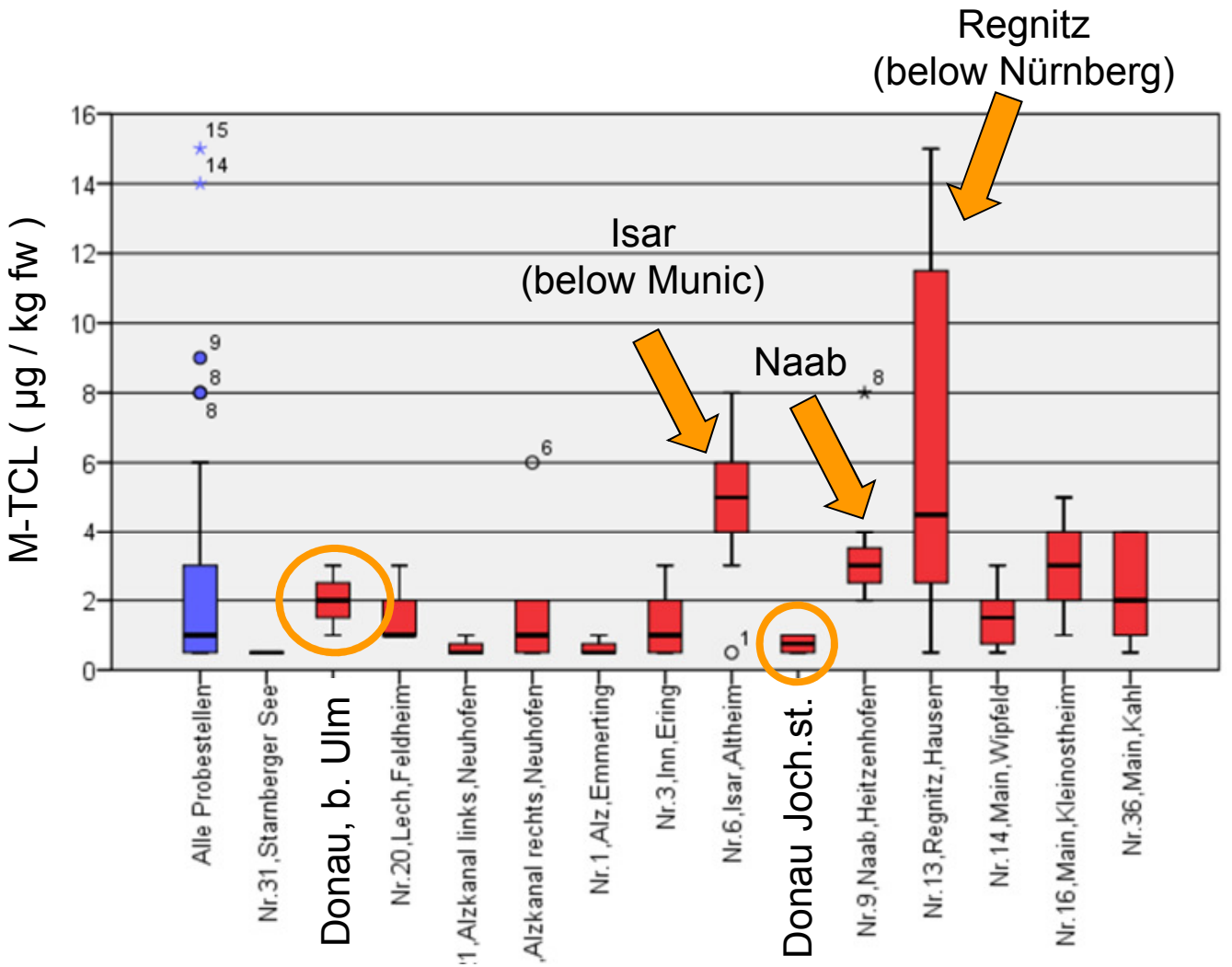
Alz, Emmerting



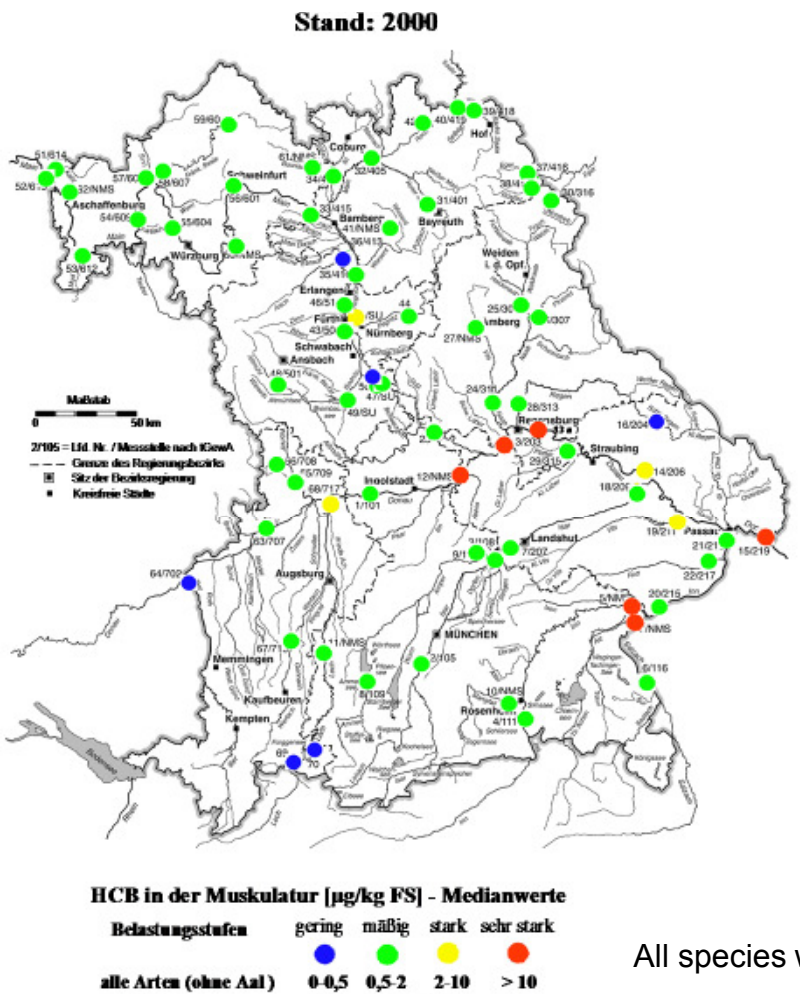
Methyl-Triclosan in Dreissena polymorpha (years 2008 – 2011)

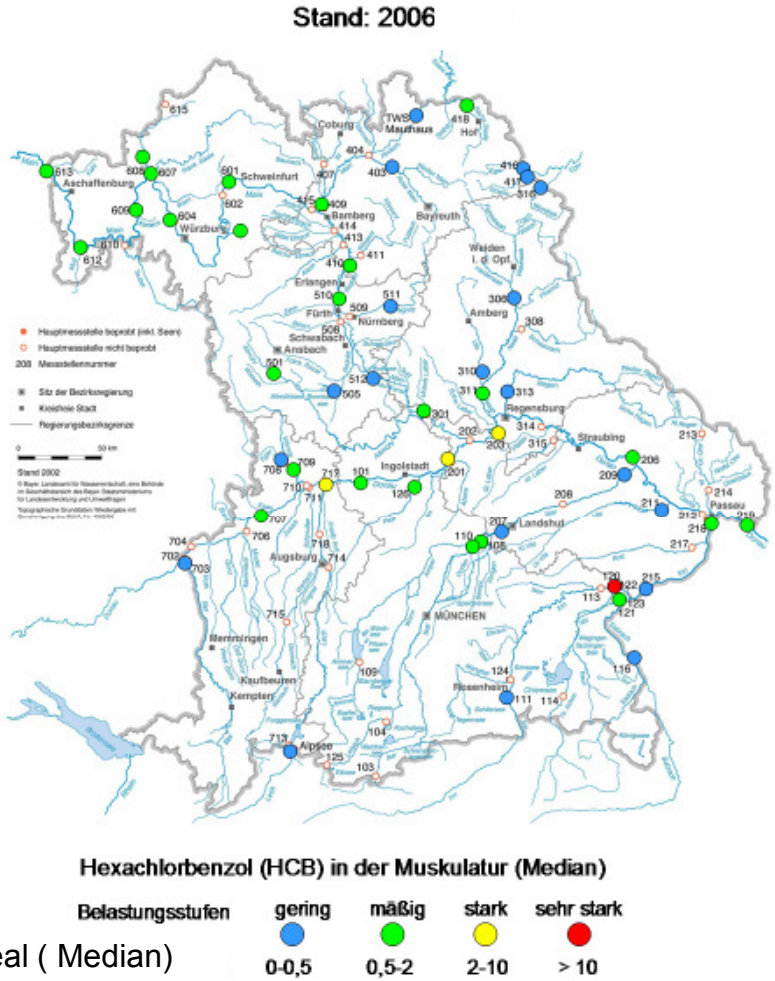
Danub, Günzburg
(below Ulm)

Danub, Jochenstein
(border to Austria)



HCB (µg / kg fw) in muscle of fish in the Bavarian sampling sites





All species without eal (Median)

Which sampling site and method?

How many individuals and which species?

Decisions you have to make are:

- take a bottom living or an open water species
- predator or not
- how many individuals are needed for staisical analysis

Which investigation period (season) and age?

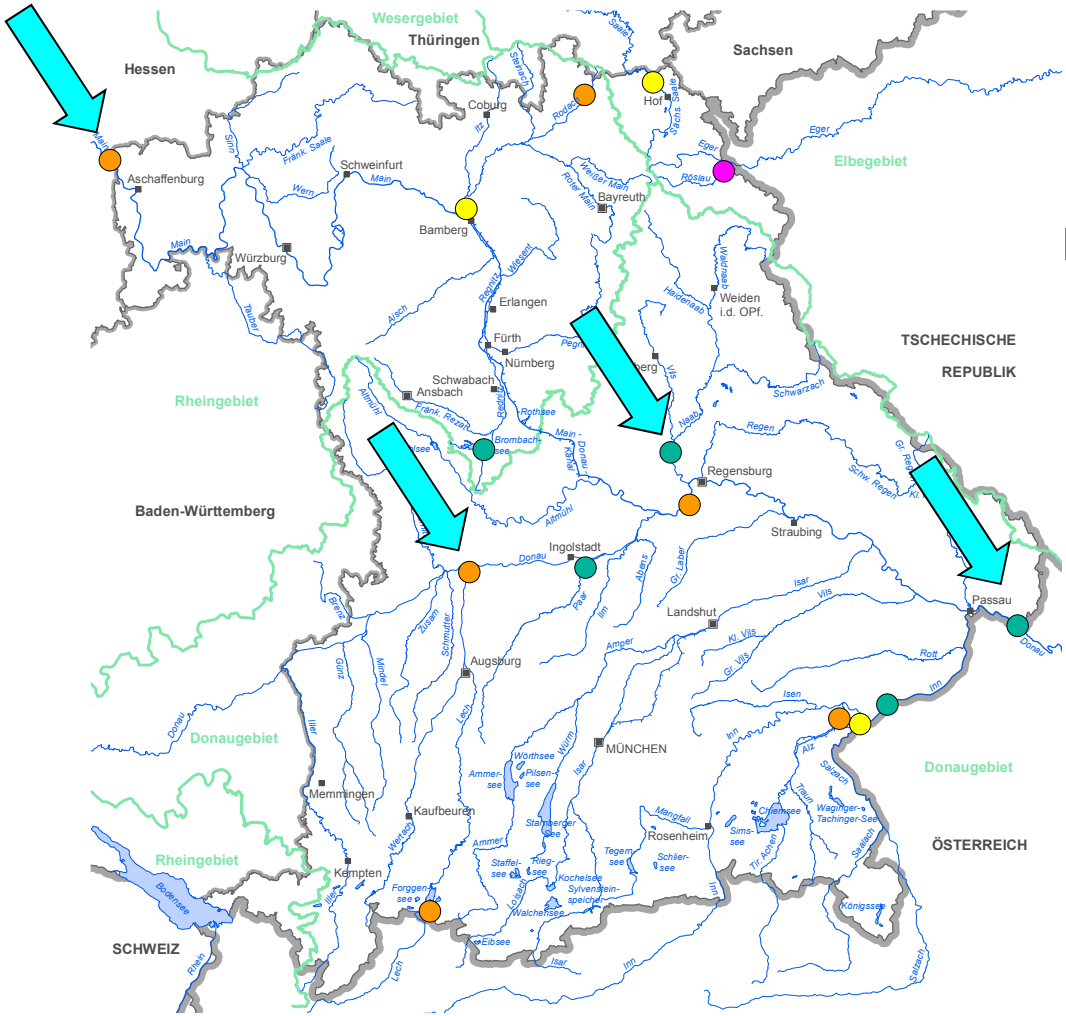
Which tissue?

How to mix and conservate the samples?

Fish-Pollutant-Montoring since 2011

- 50 sampling sites
- sampling every 3 years
- 10 individuals
- standardised weight
- annually in autumn
- *Leuciscus cephalus* (chub) in rivers
- *Perca fluviatilis* (perch) or *Esox lucius* (pike) in lakes
- muscle, liver
- homogenated samples
- no pool samples
- frozen or lyophylisated for conservation
- 10 years stored for retrospective study

Mercury in muscle of fish in 2011



Mercury in muscle of chub (rivers) and perch or roach (lakes)

in µg / kg fw (mean value)

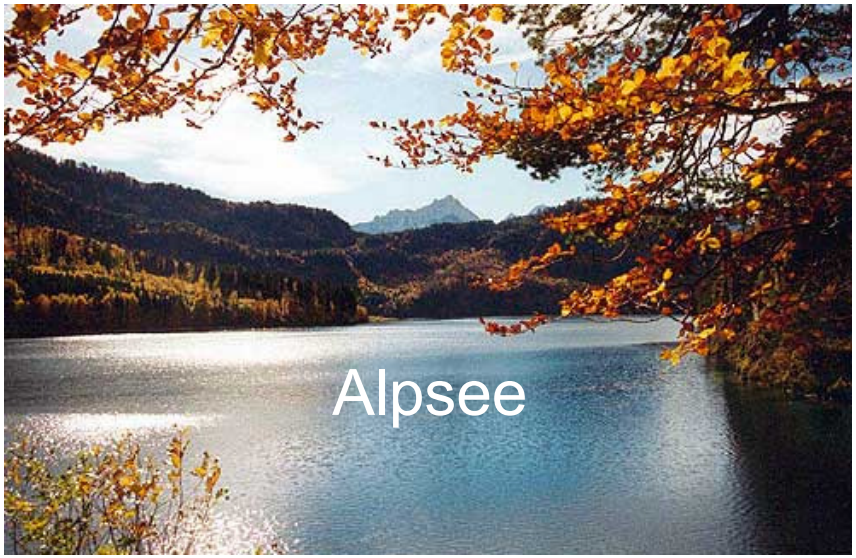
Mercury also analysed in Dreissena

EQS: < 20 µg/kg fw

- 20 – 100 µg/kg fw
- 100 – 200 µg/kg fw
- 200 – 500 µg/kg fw
- > 500 µg/kg fw

Mercury in muscle of fish, Median 2000 – 2008, (Min - Max)

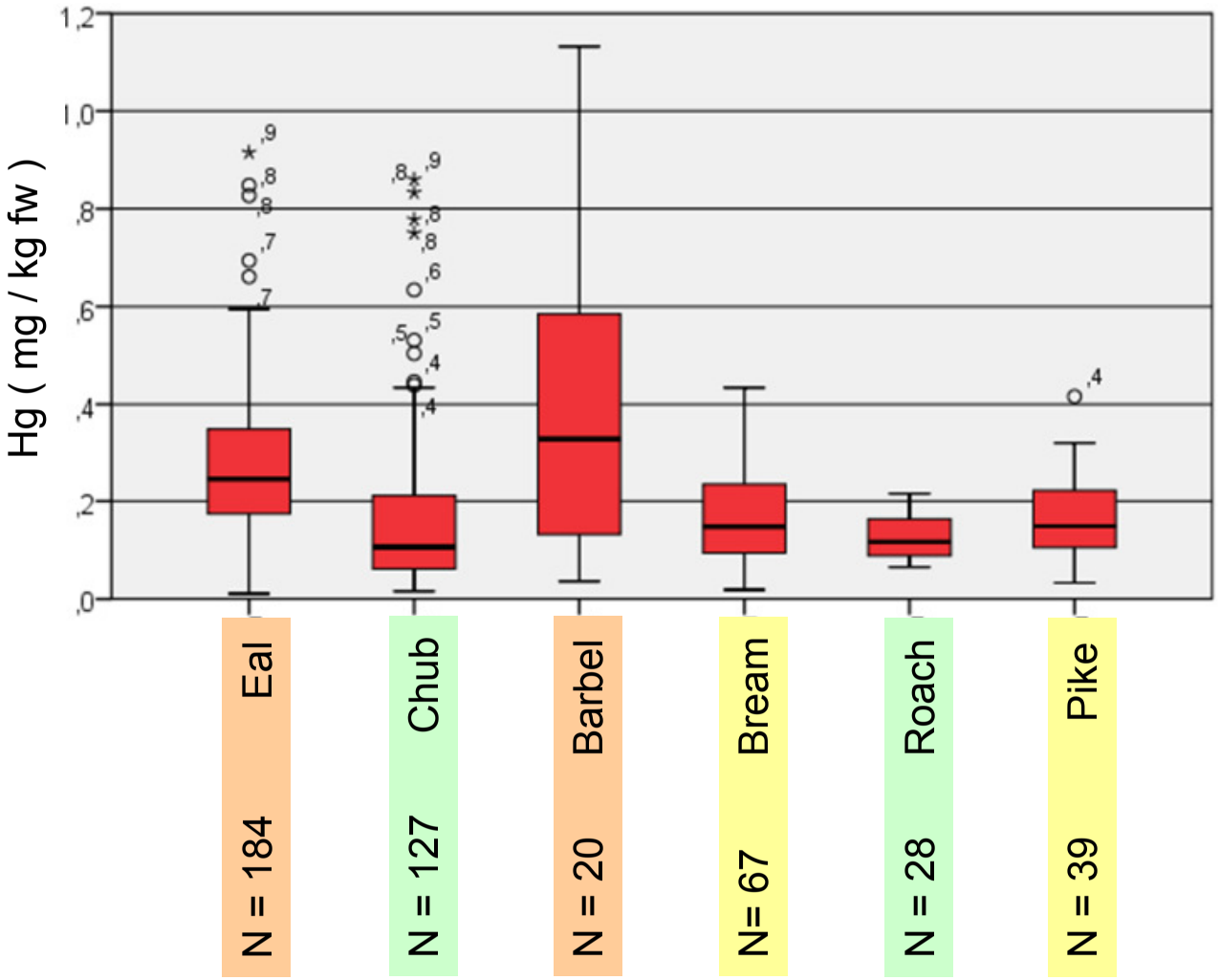
Hg (mg/kg fw)	species	number	Hg (mg/kg fw)
0,08 (0,02 – 0,13)	trout	7	
0,41 (0,14 – 0,65)	perch	13	
	eal	7	0,24 (0,13 – 0,39)
	roach	23	0,25 (0,11 – 0,49)



Mercury in Biota, Median 2000 – 2008, (Min - Max)

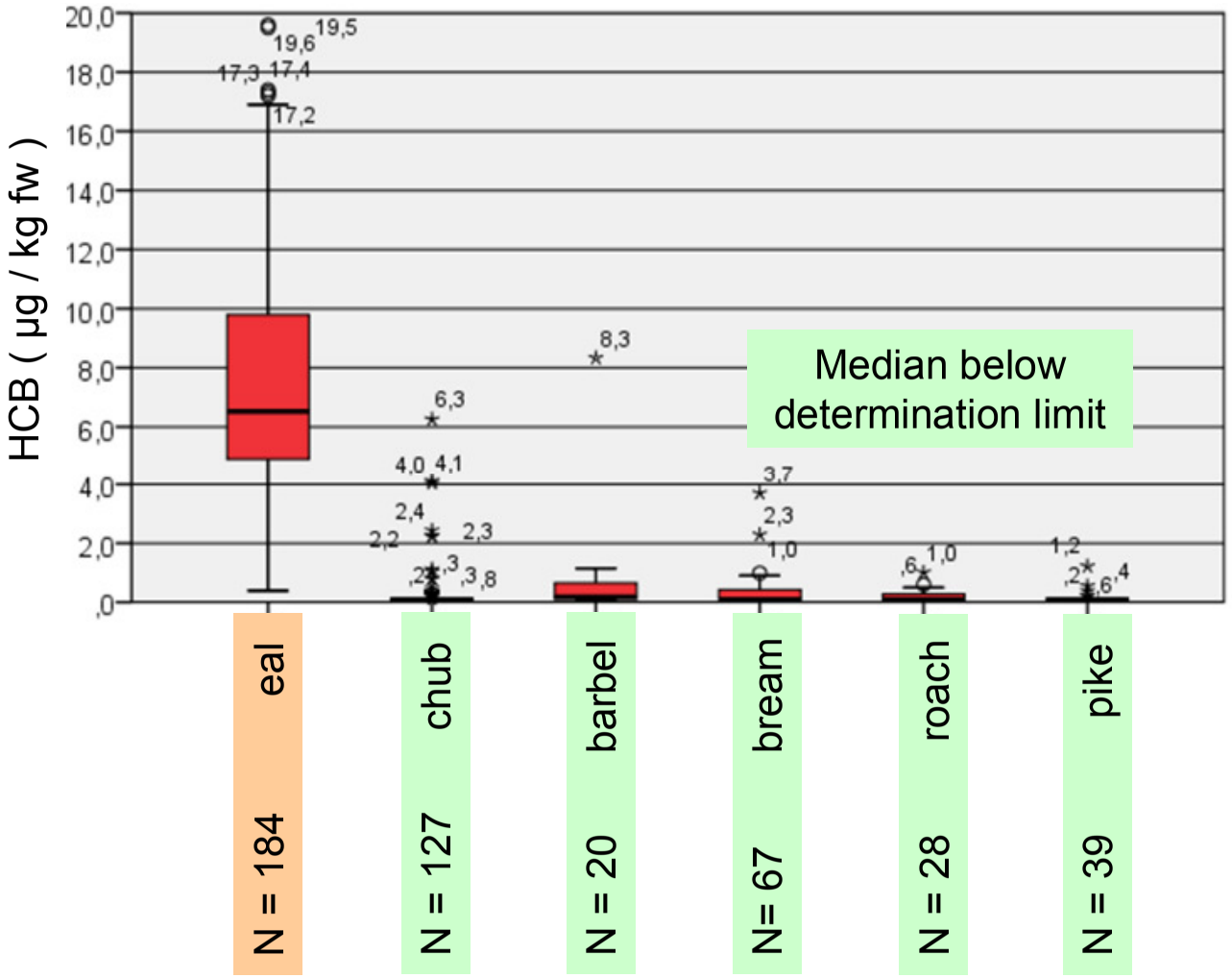
river, site	species	Hg (mg/kg fw)	number
Danub, Dillingen	chub (muscle)	0,07 (0,04 – 0,27)	17
Danub, Dillingen	eal (muscle)	0,20 (0,11 – 0,59)	28
Danub, Günzburg	Dreissena	0,01 (pooled samples)	
Lech, Feldheim	chub (muscle)	0,29 (0,10 – 0,78)	24
Lech, Feldheim	eal (muscle)	0,53 (0,24 – 1,68)	19
Lech, Feldheim	Dreissena	0,02 (pooled samples)	

Mercury in muscle of fish (2007 – 2009)



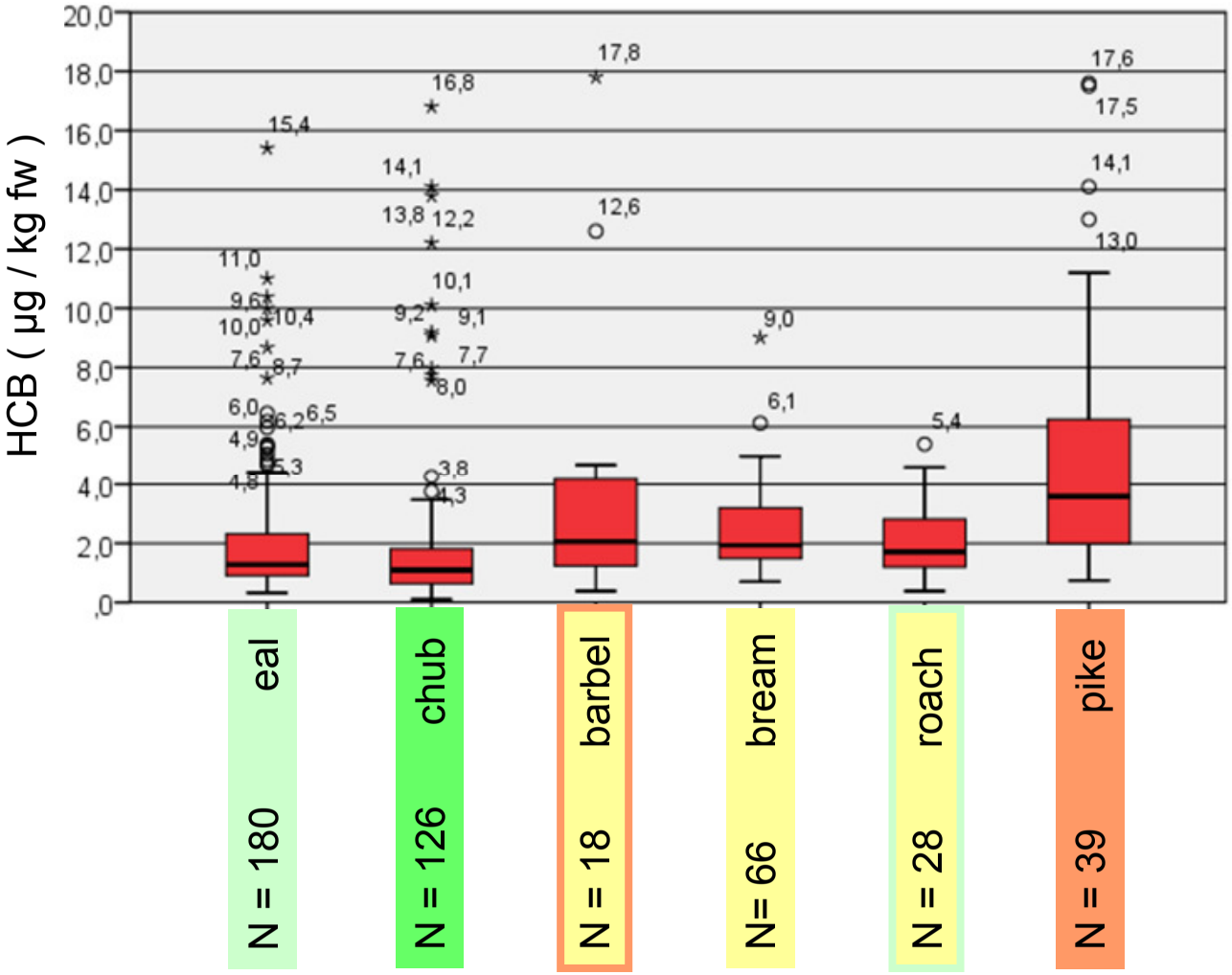
fish of all sites

Hexachlorbenzene in muscle of fish (2007 – 2009)

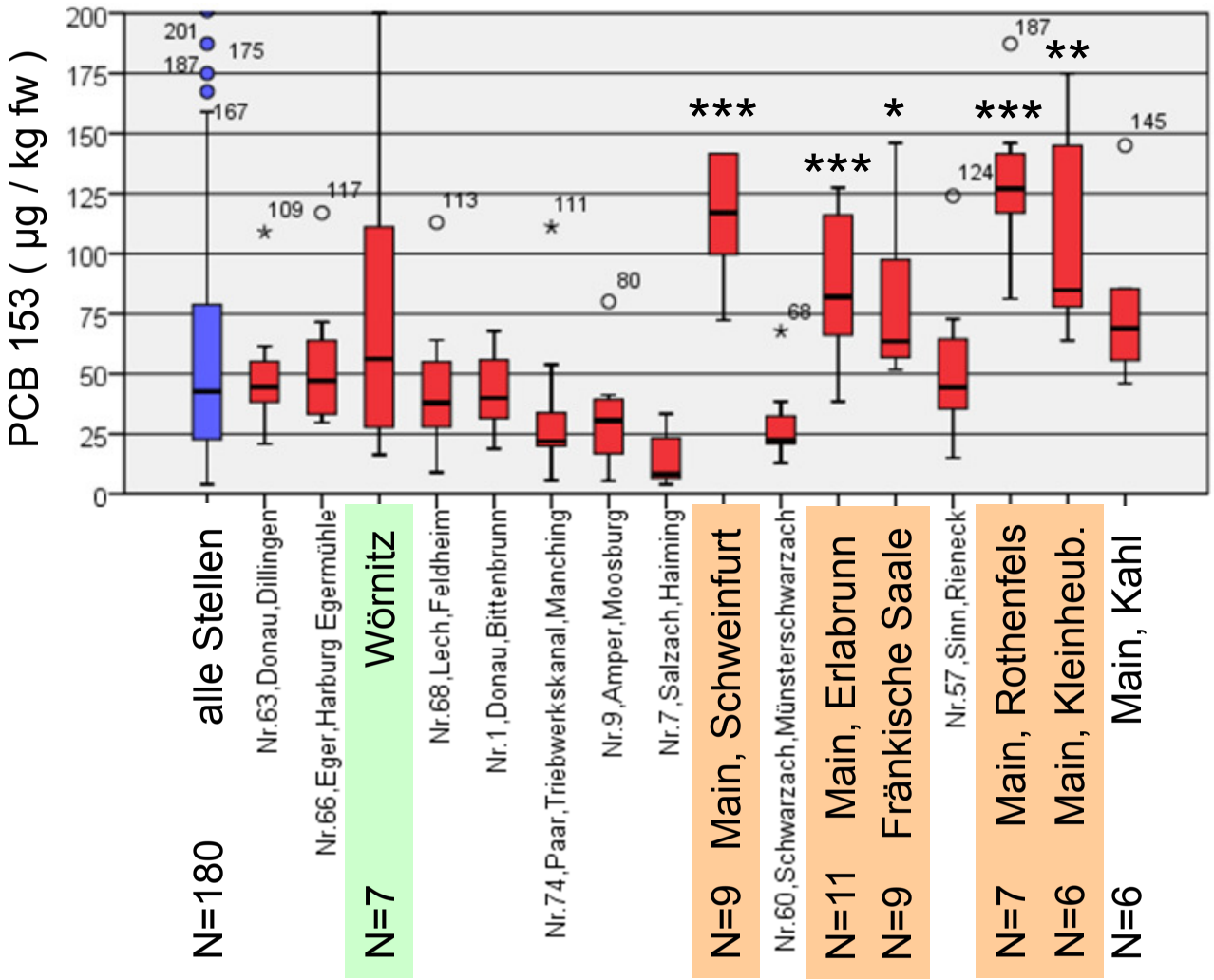


fish of all sites

Hexachlorbenzene in liver of fish (2007 – 2009)

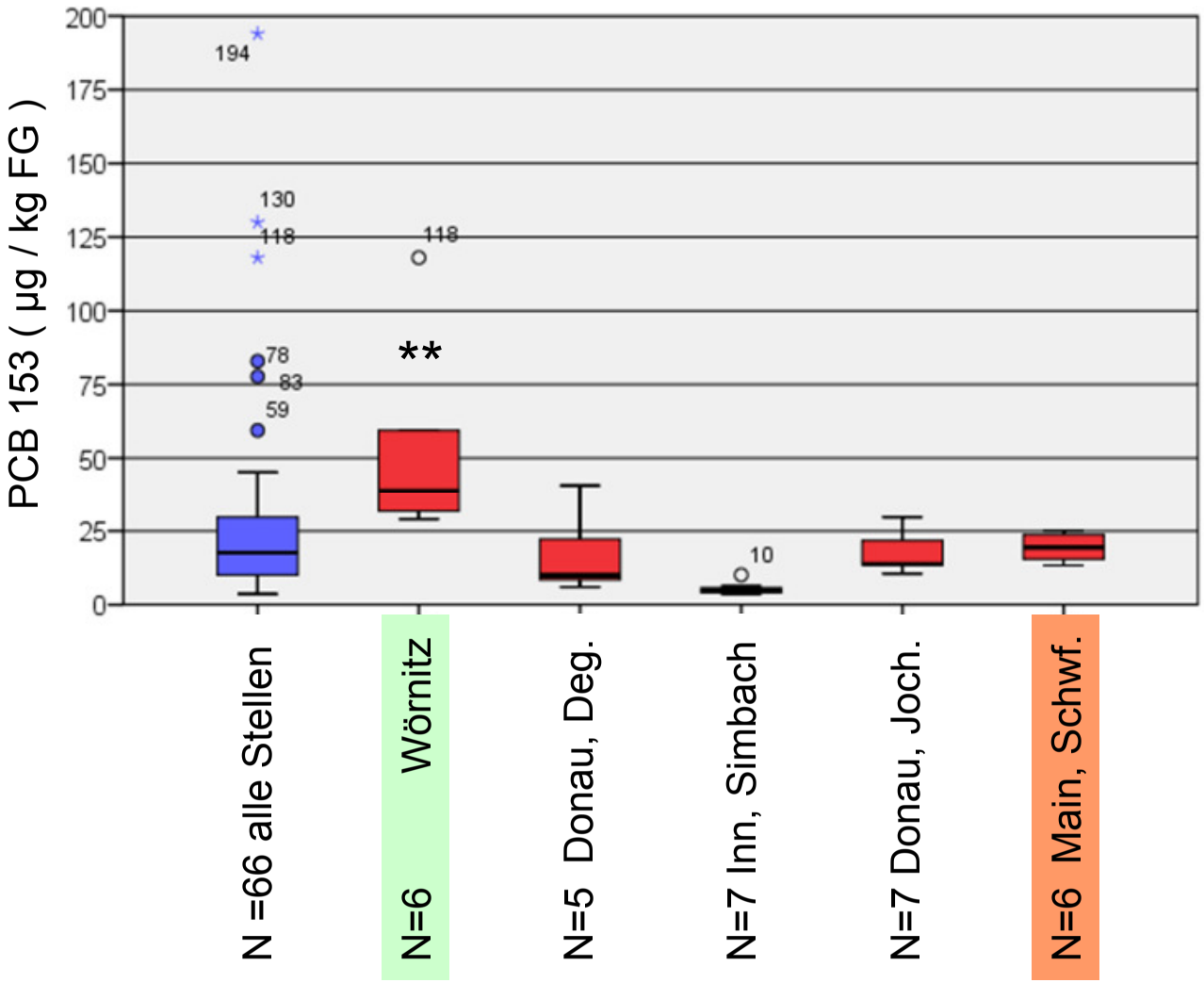


PCB 153 in liver of eal (2007 – 2009)



* p < 0,05
** p < 0,01
*** p < 0,001

PCB 153 in liver of barbel (2007 – 2009)



** p < 0,01

Conclusions

Biotamonitoring is a good instrument
for assesment of ecosystems

- Biota incorporate pollutants from water and from food
- Biota integrate over a time period

- Showing differences between monitoring sites
- Showing differences between species
- Showing trends

- Biota-samples have to be standardised
  as good as possible in a sampling-programm
- Biota-samples should be described
  (age, fat, weight…) for interpretation of data