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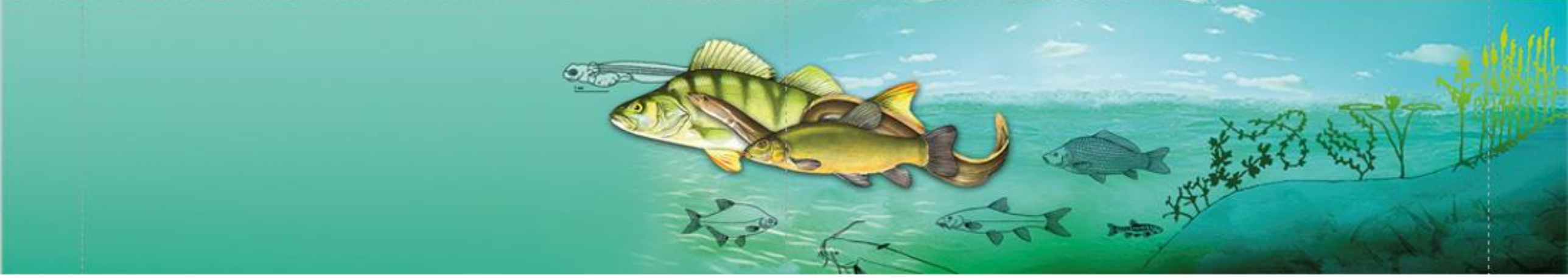
CENAKVA

South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses

Fate and effects of micropollutants in aquatic environment



Tomáš Randák et al.

University of South Bohemia in České Budějovice, Faculty of Fisheries and Protection of Waters, Laboratory of Environmental Chemistry and Biochemistry

trandak@frov.jcu.cz

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Laboratory of Environmental Chemistry and Biochemistry (LECHB)

- ✓ development of new progressive detection methods of wide spectra of relevant pharmaceuticals, illicit drugs, UV filters, PFAS, pesticides, etc. in environmental samples
- ✓ detection of wide spectra of contaminants esp. in water, fish tissues and passive samplers
- ✓ investigation of effect of pollution on exposed organisms (field and laboratory studies, biomarkers)
- ✓ cooperation with companies interested in development of water treatment technologies and with waste water treatment plants

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Laboratory of Environmental Chemistry and Biochemistry (LECHB)

Micropollutants = compounds of anthropogenic origin occurring in the environment in relatively low concentrationsng -µg/l, kg

- many of them are used by humans in their daily lives and in agriculture - e.g., **medicines and personal care products, pesticides...**

- present in surface and groundwater

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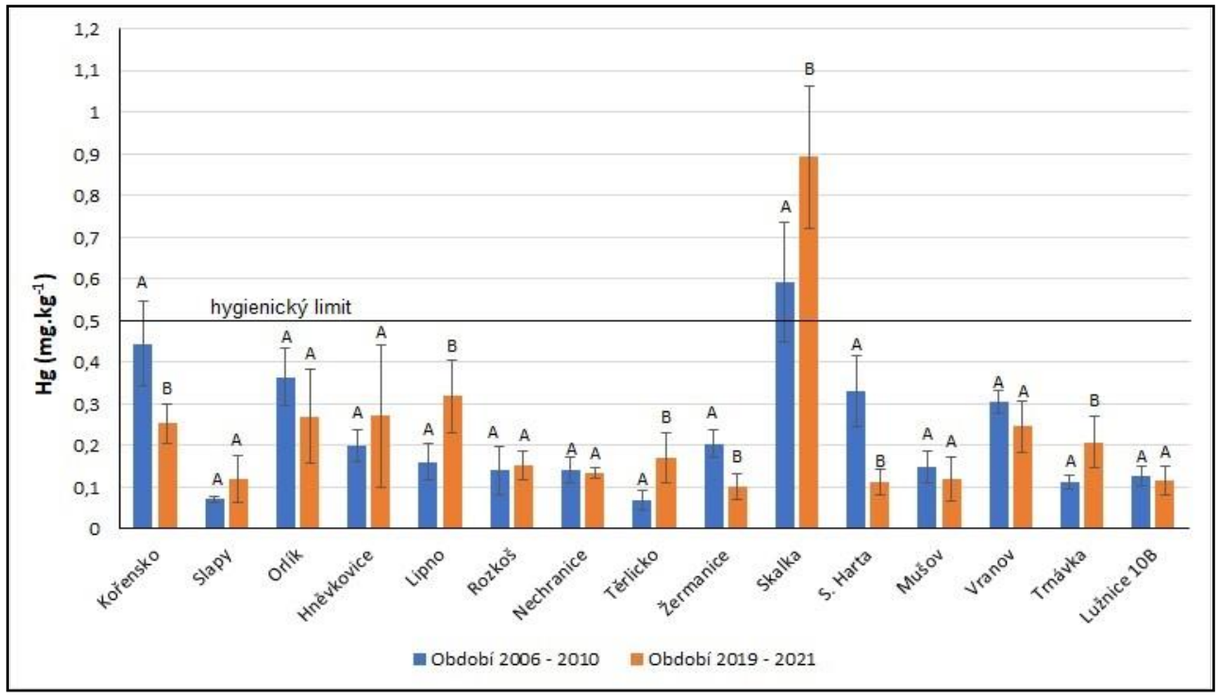
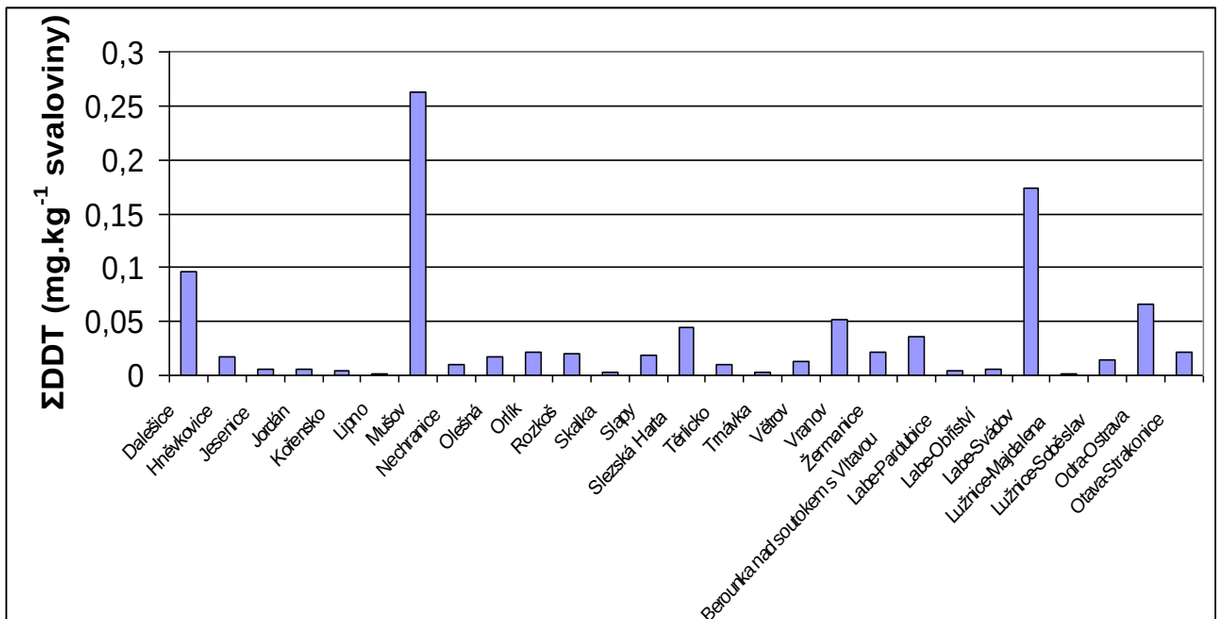
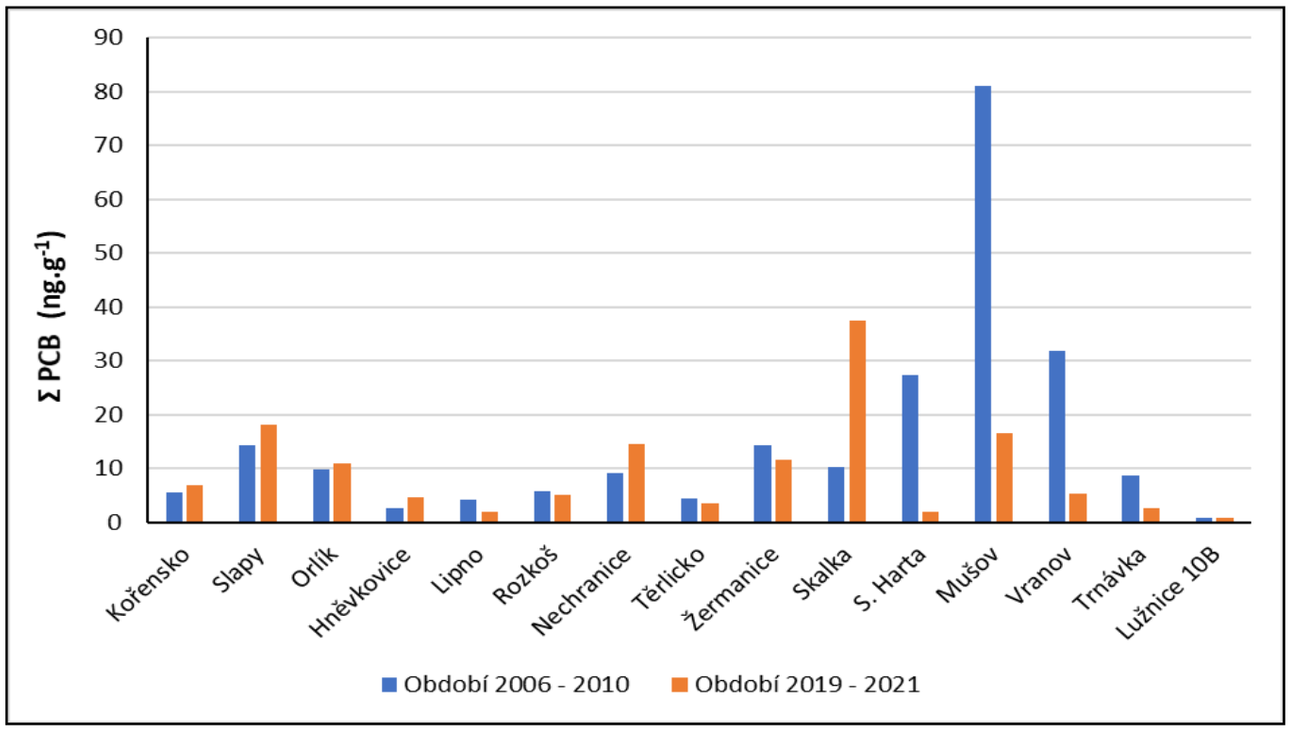
The main sources of pollution of aquatic environment

Industry – toxic metals (Hg, Cd, Pb), PCBs, dioxins, HCB, etc.

Comparison of the content of extraneous substances in the muscle of bream in the Czech Republic







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Agriculture - flushing and leakage of organic substances, water pollution, and eutrophication

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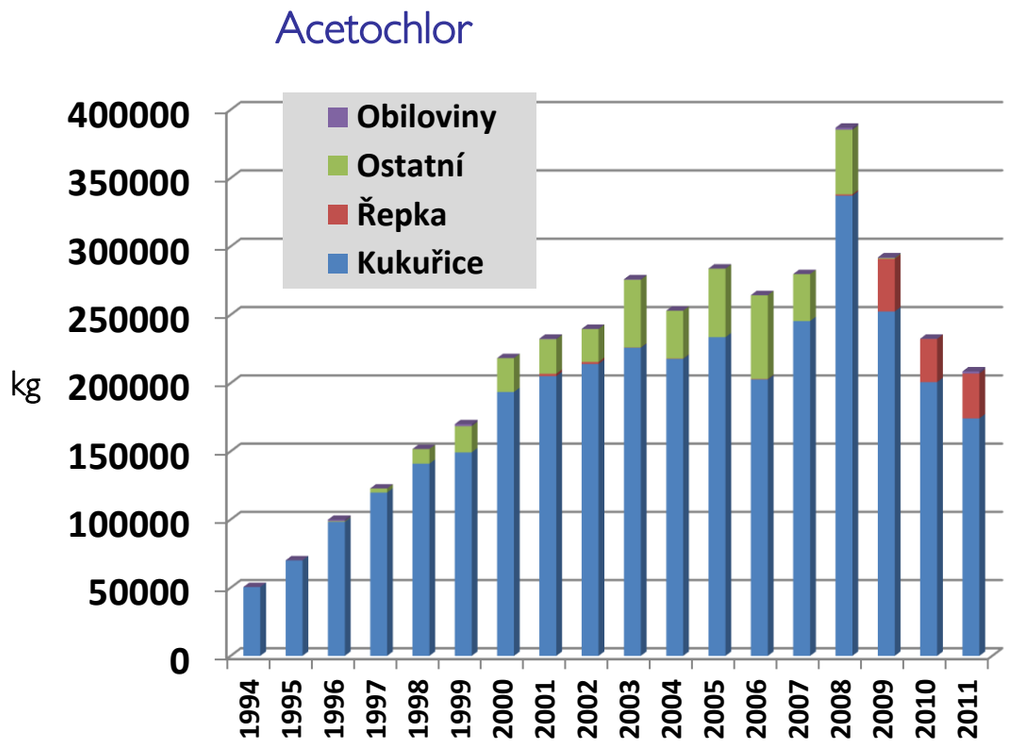
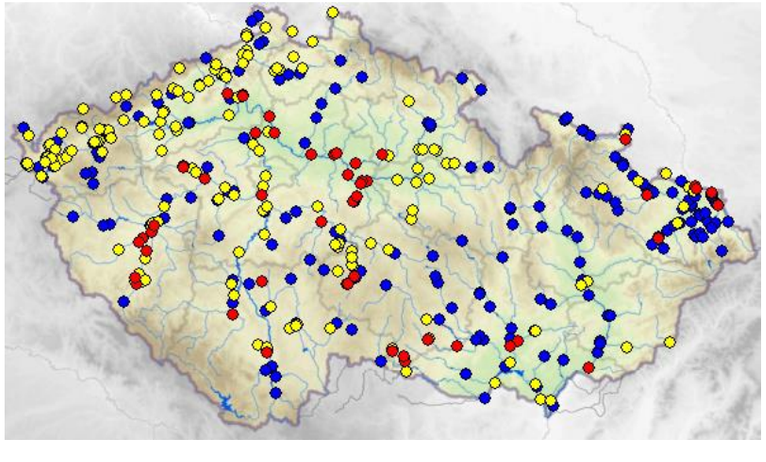
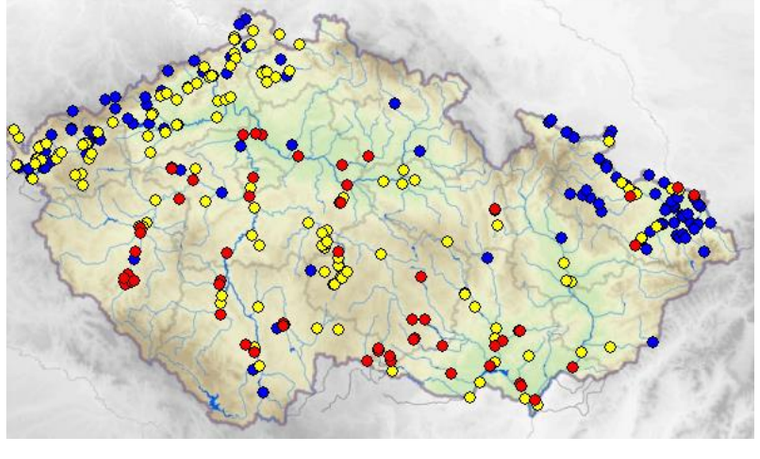
Agriulture - pesticides



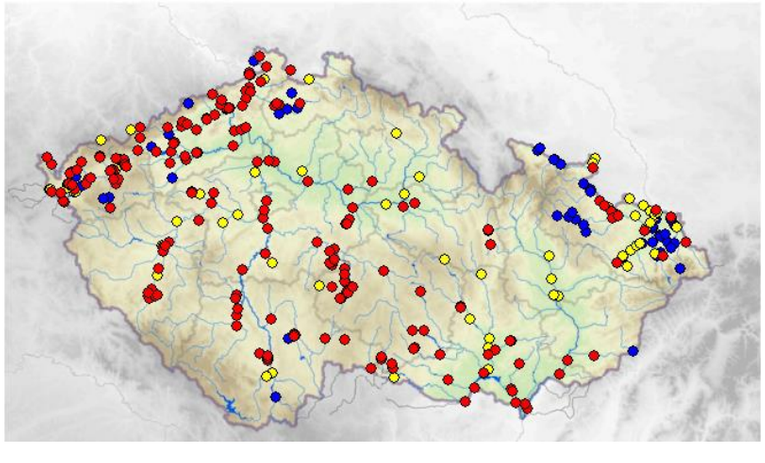
Acetochlor



Acetochlor OA



Acetochlor ESA



- 1- koncetrace pod mezí stanovitelnosti
- 2 - koncentrace nad mezí stanovitelnosti
- 3 - koncentrace nad 0,1 µg/l

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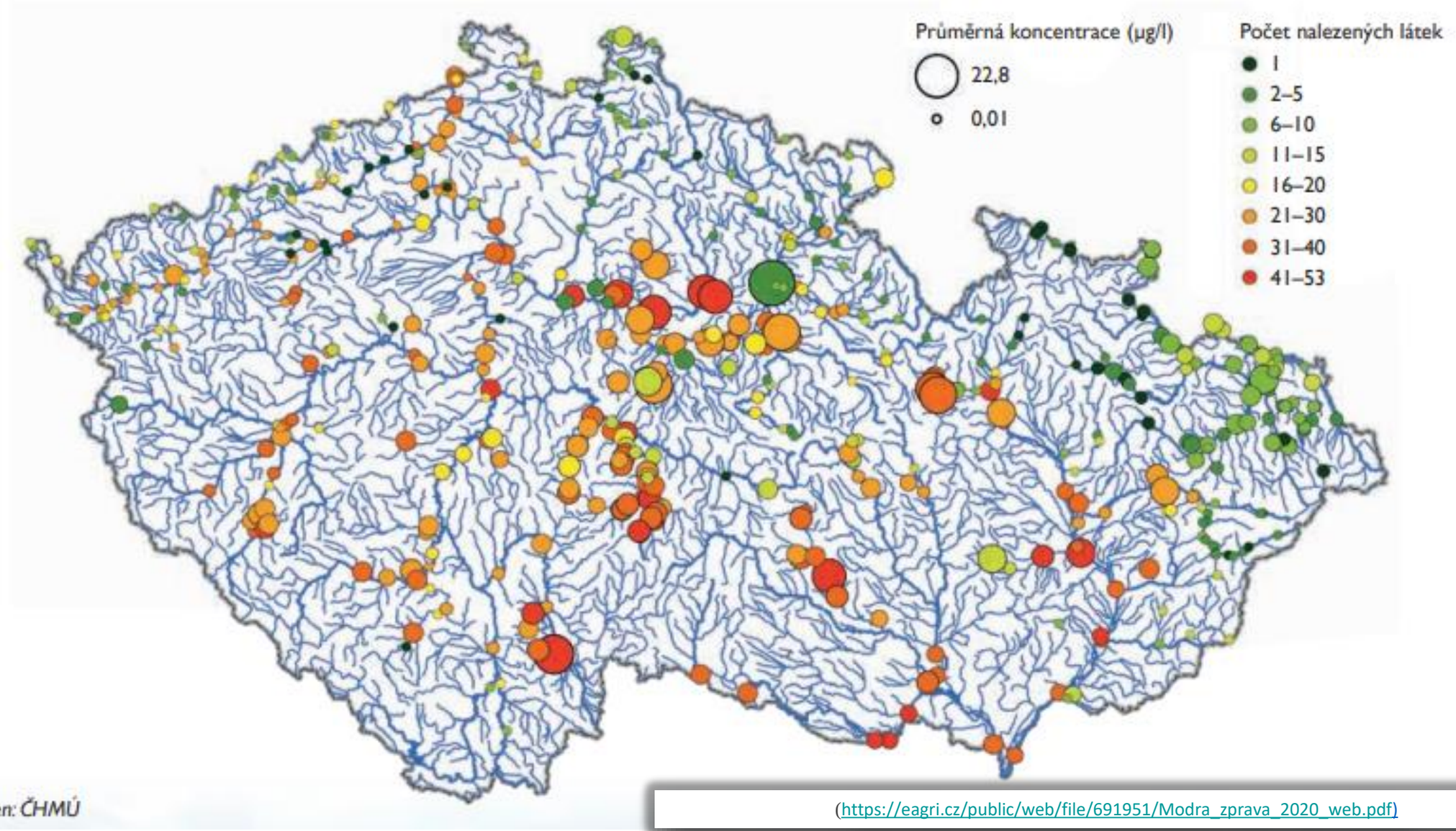
Pesticides in surface waters in the Czech Republic - 2020



(https://eagri.cz/public/web/file/691951/Modra_zprava_2020_web.pdf)

Municipal pollution – municipal waste water, including „treated" in WWTP

many extraneous substances persist (e.g. drugs, perfumes, cosmetics detergents and their degradation products, pesticides, etc.).

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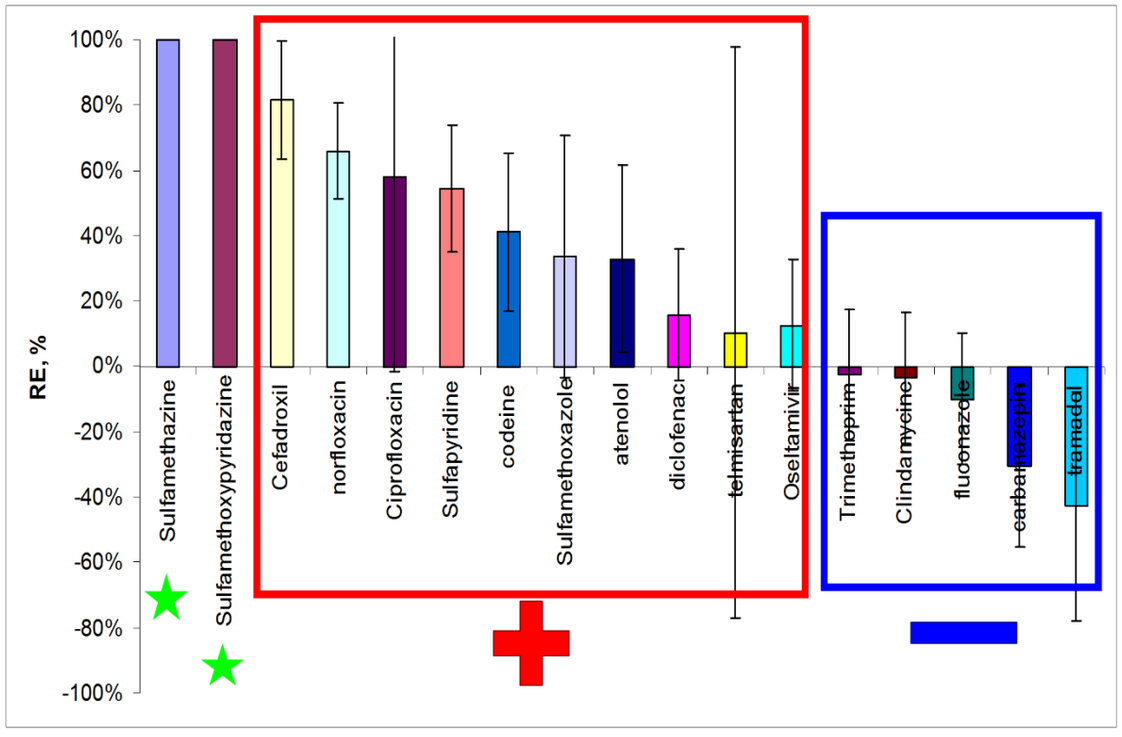
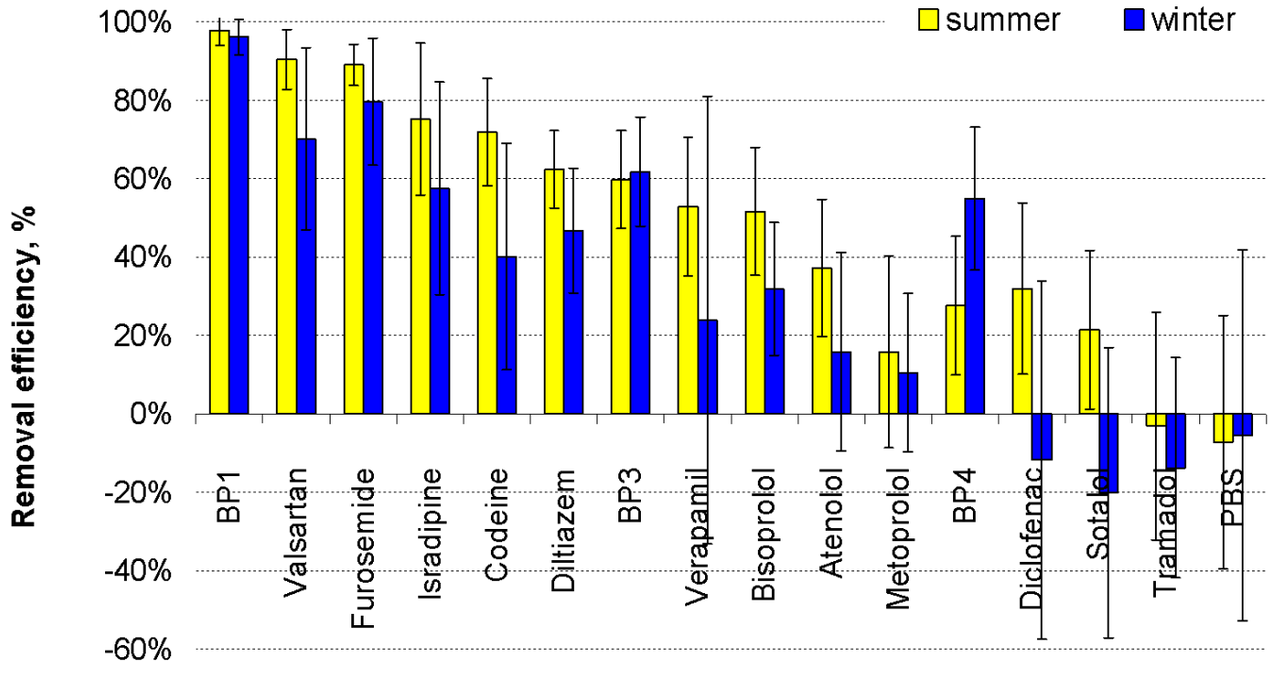
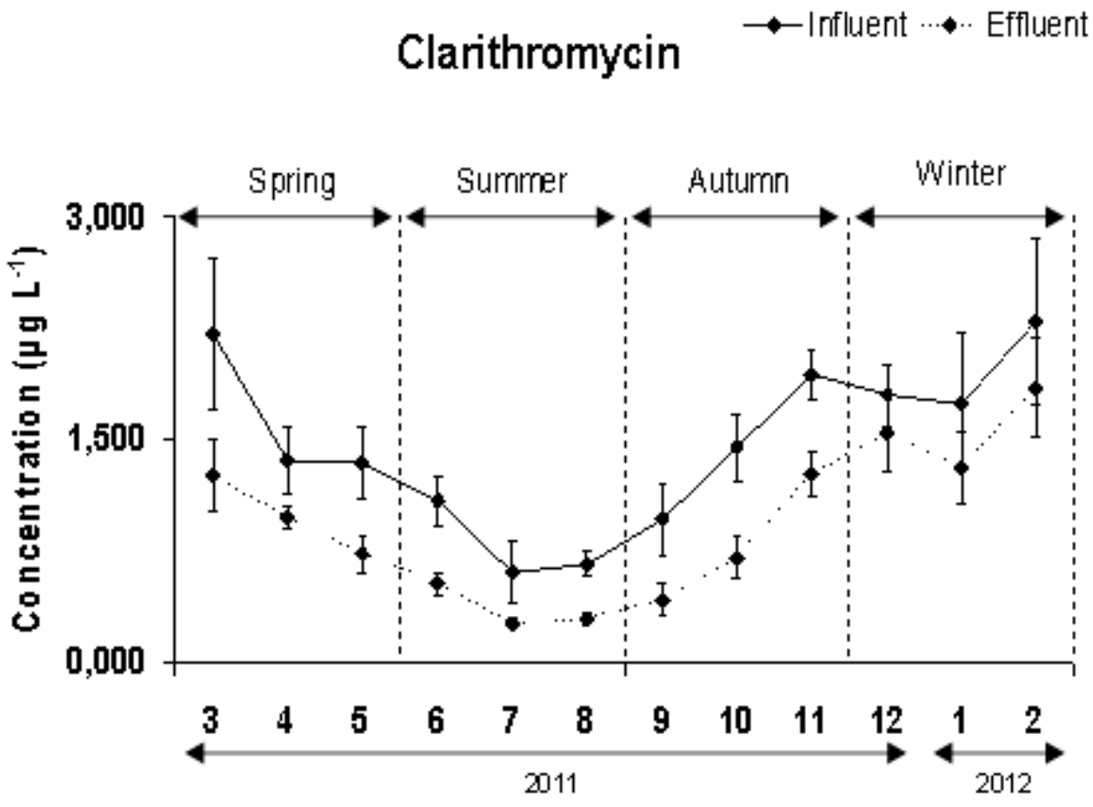
Municipal pollution

Concentration and efficiency of removing pharmaceuticals during the year at the Ceske Budejovice WWTP







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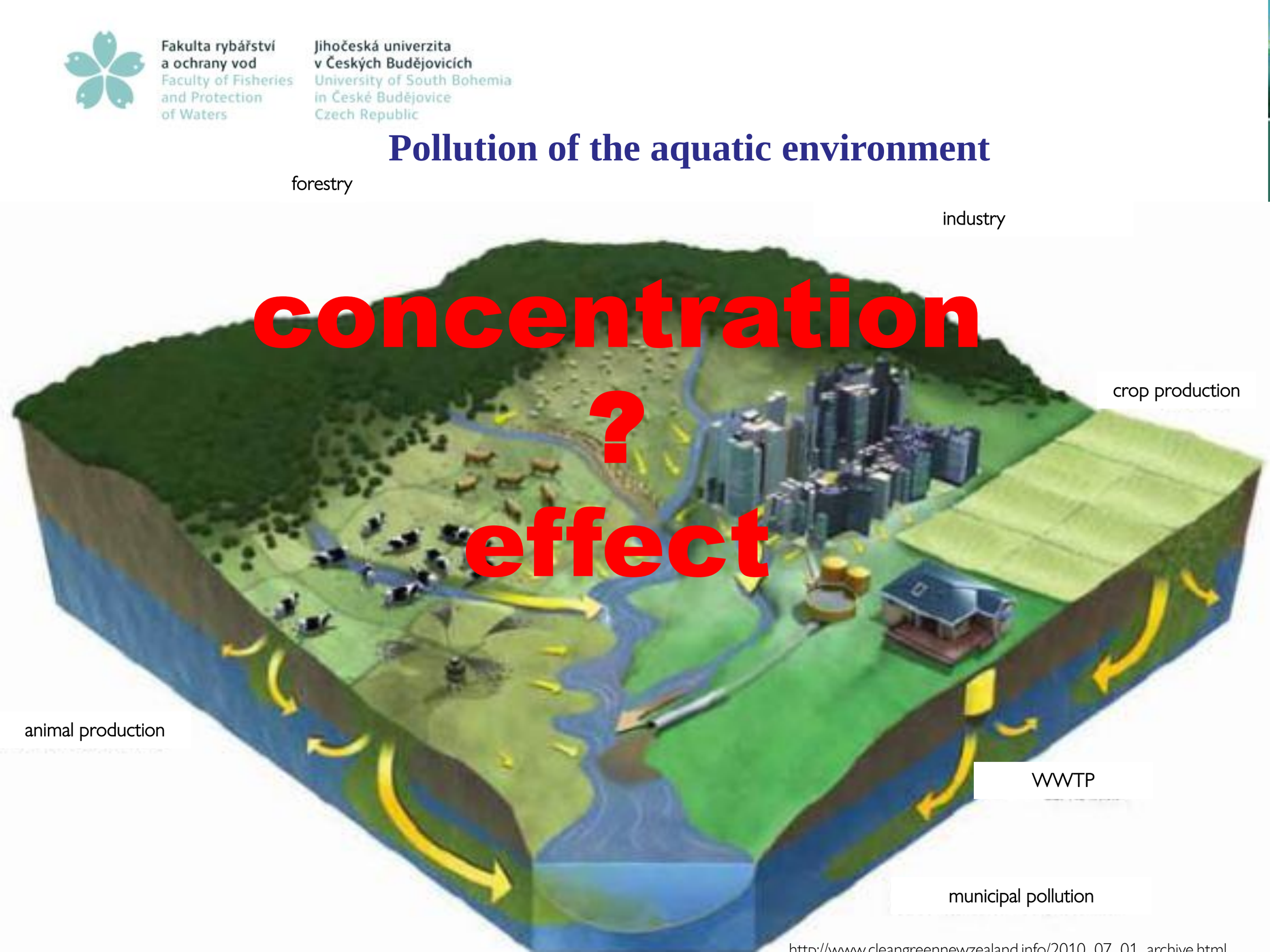
Pollution of the aquatic environment



http://www.cleangreennewzealand.info/2010_07_01_archive.html

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Where are aquatic organisms most affected by pollution?

Prachatice?

Prague?

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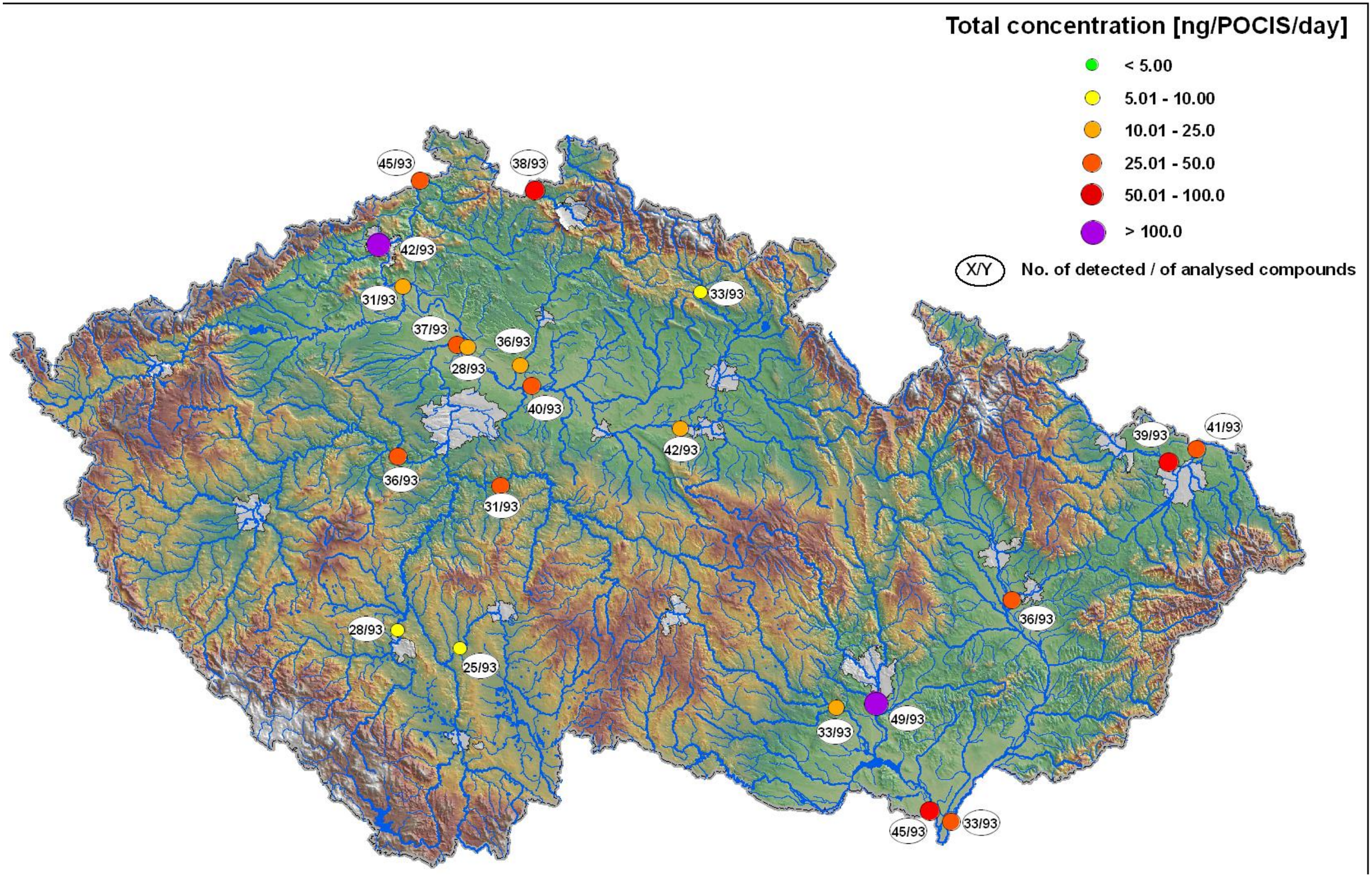
Occurrence of drug residues in important streams of the Czech Republic



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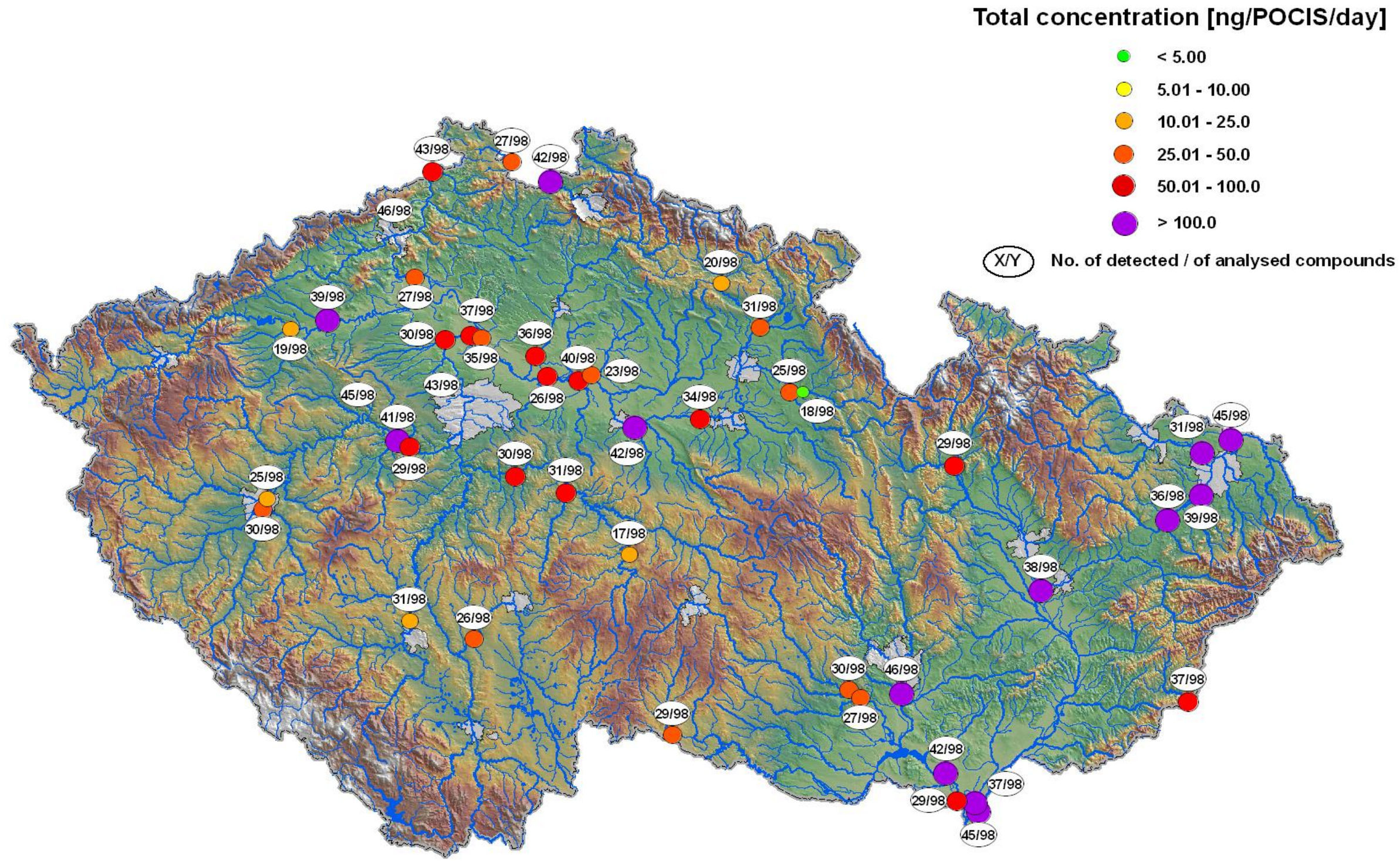
Occurrence of drug residues in small streams of the Czech Republic



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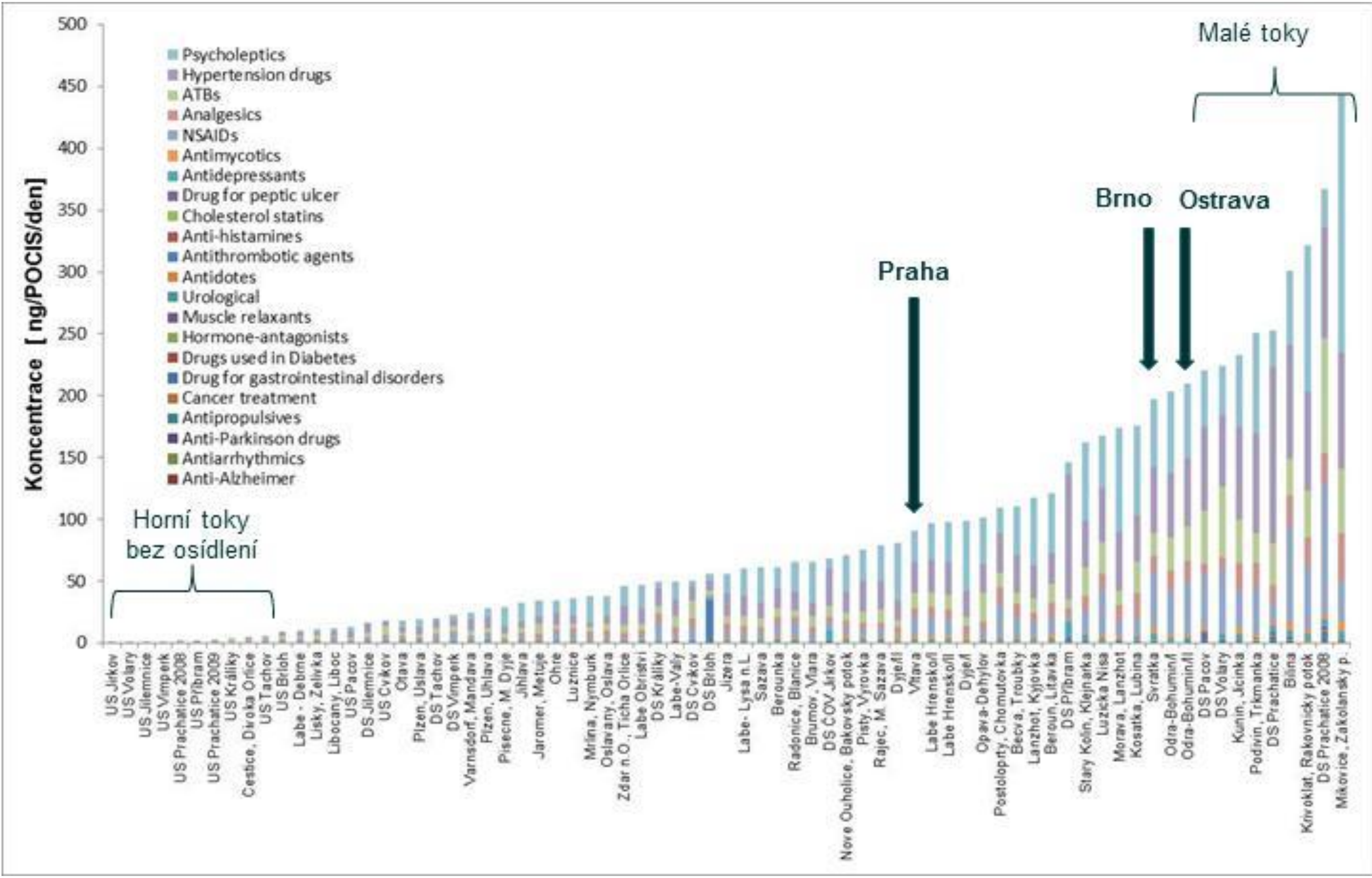
Occurrence of pharmaceuticals in streams of the Czech Republic



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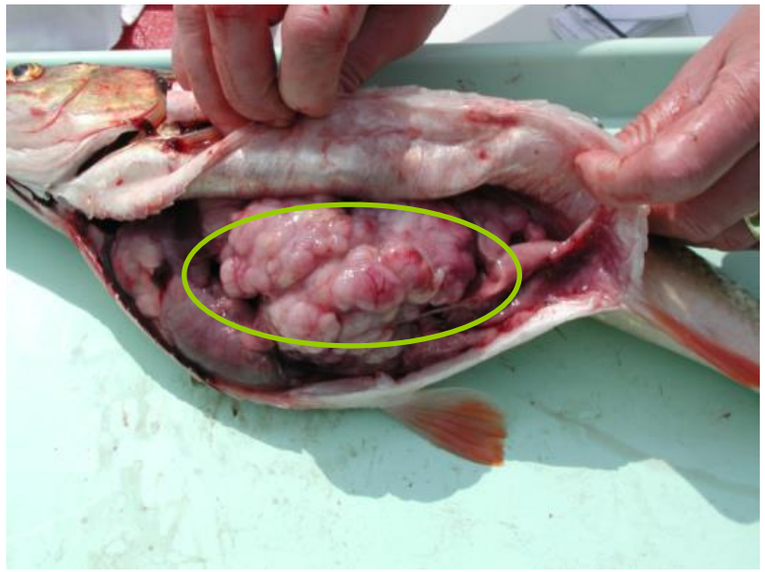
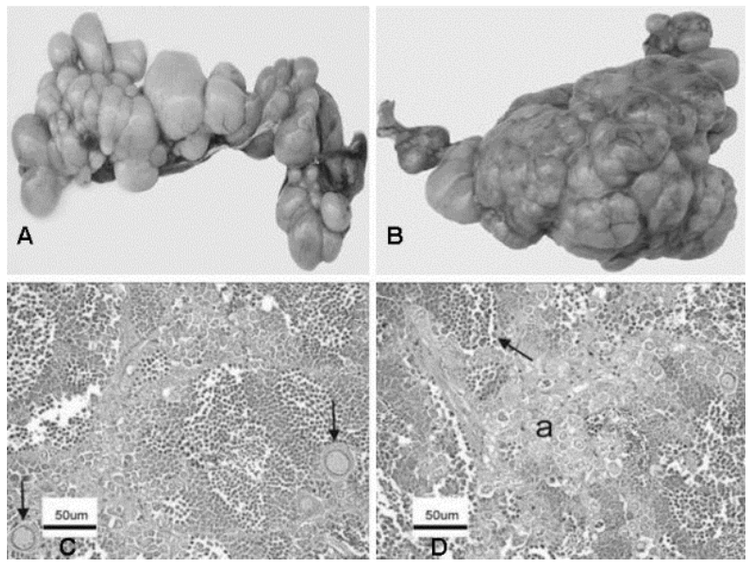
Pharmaceuticals in the aquatic environment

- for drugs, direct toxic effects are not significant, but others:
- the presence of antibiotics or antivirals in ŽP causes the development of resistance of bacteria and viruses
- the presence of drug residues induces chemical stress and can cause physiological and histopathological changes in organisms exposed to this pollution
- affect the sex of fish - hormones and synthetic hormones used both as contraception and for the treatment of cancer or osteoporosis
- analgesics, antidepressants, and other psychologically active substances (potentially also drugs) affect the behavior of fish





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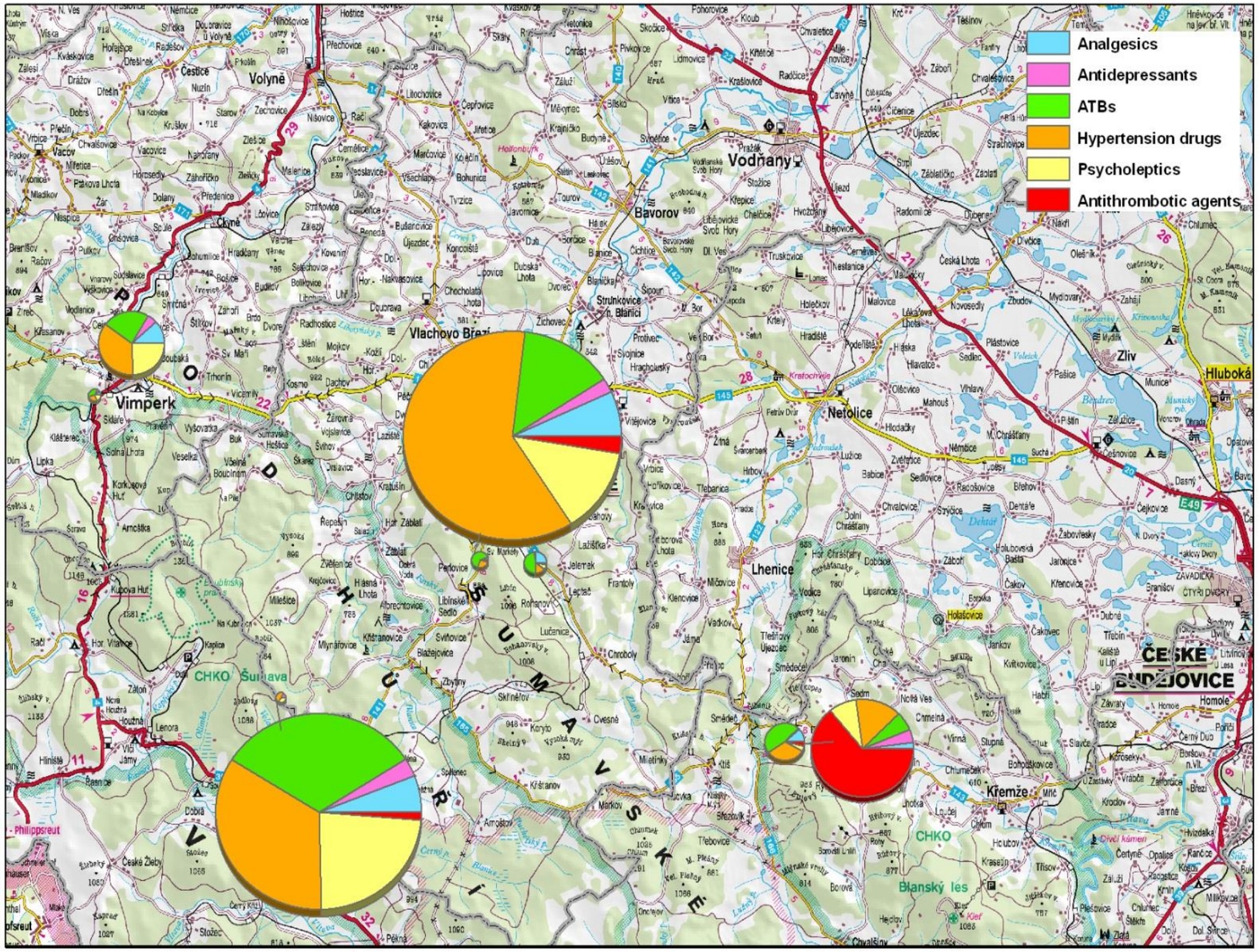
The impact of settlement on small watercourses



- **high concentrations of pharmaceuticals downstream relatively small towns**
- **highly represented psychoactive drugs**

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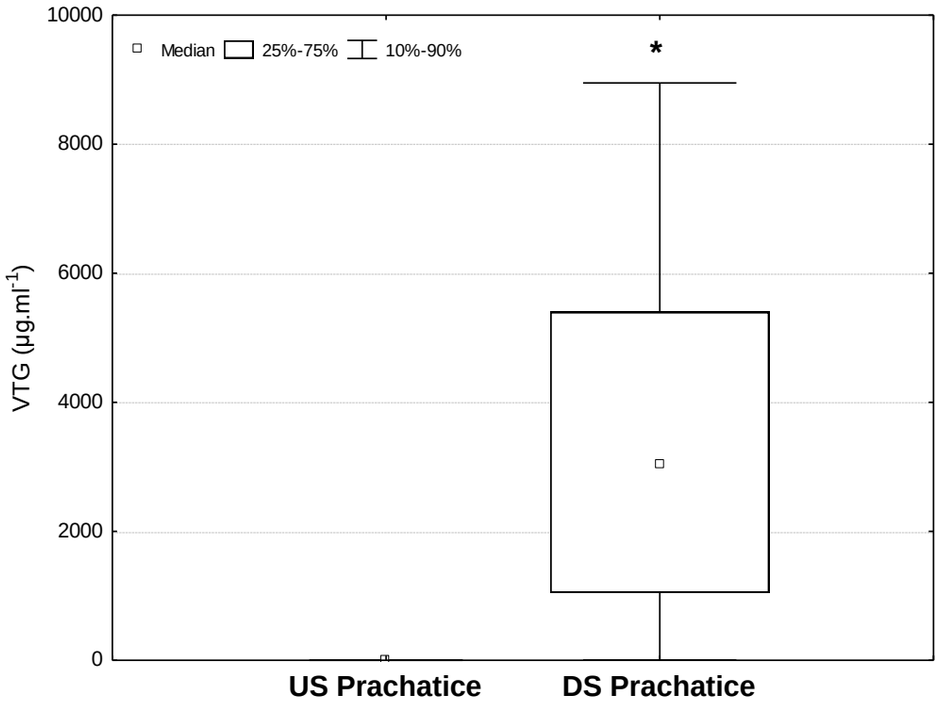
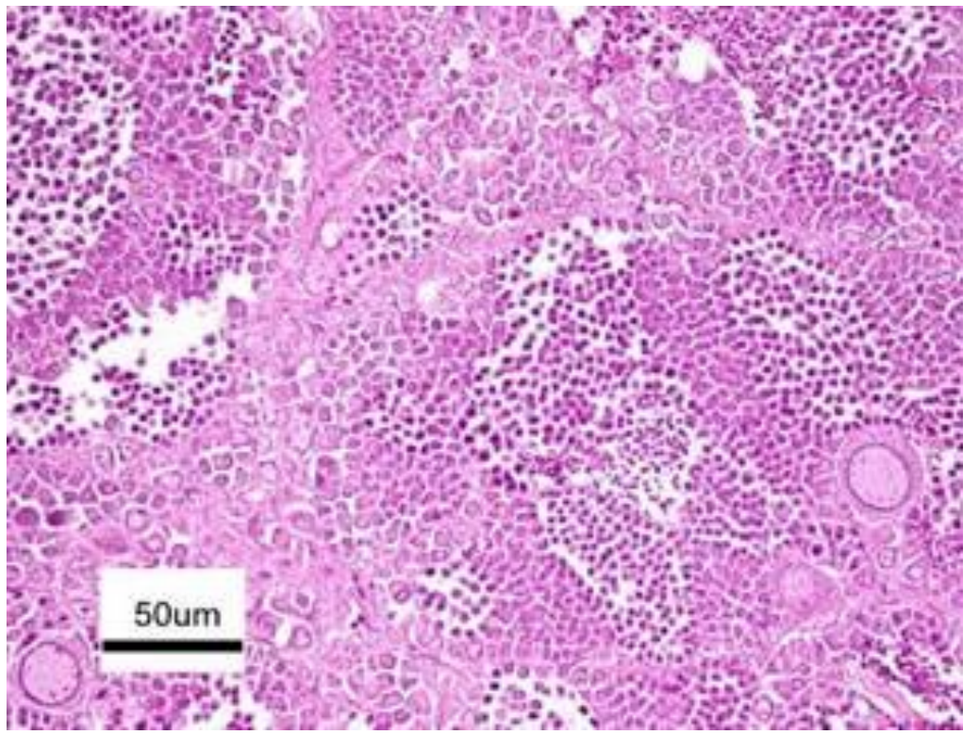
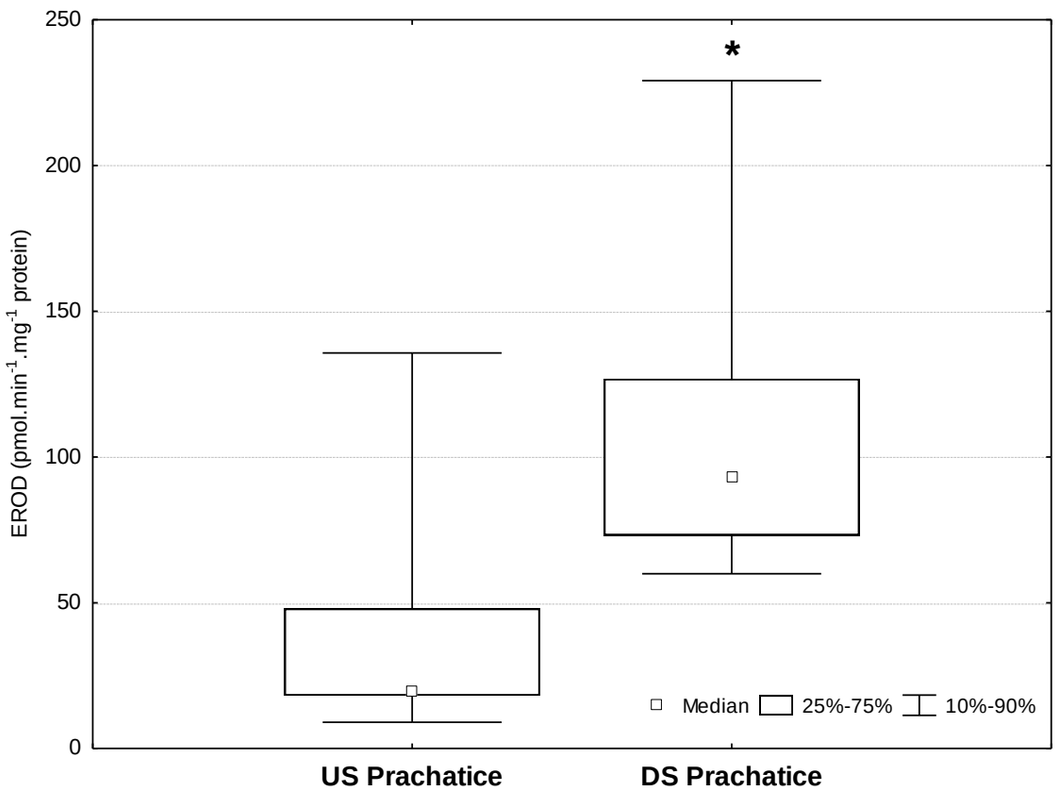
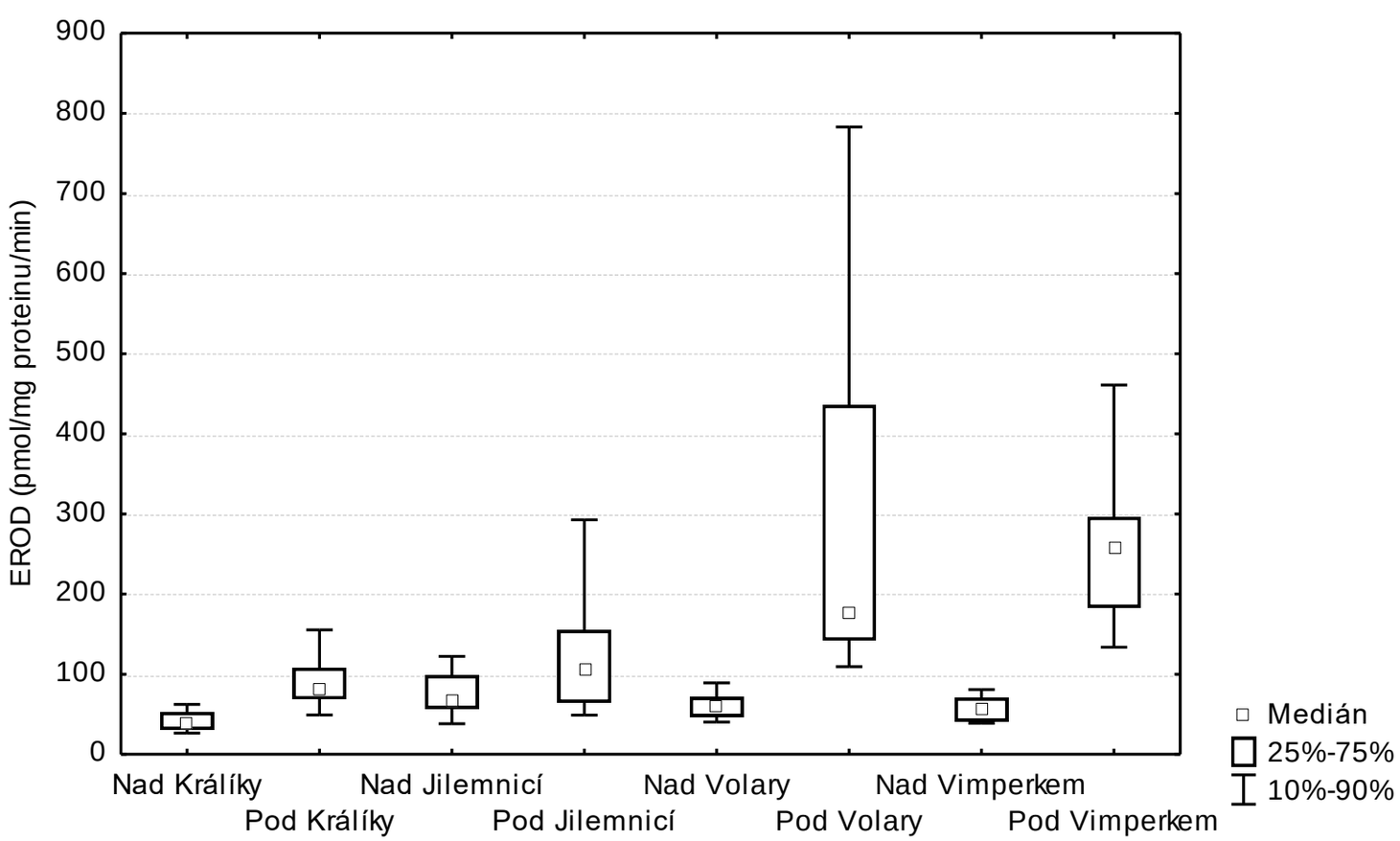
Effect of municipal pollution on fish









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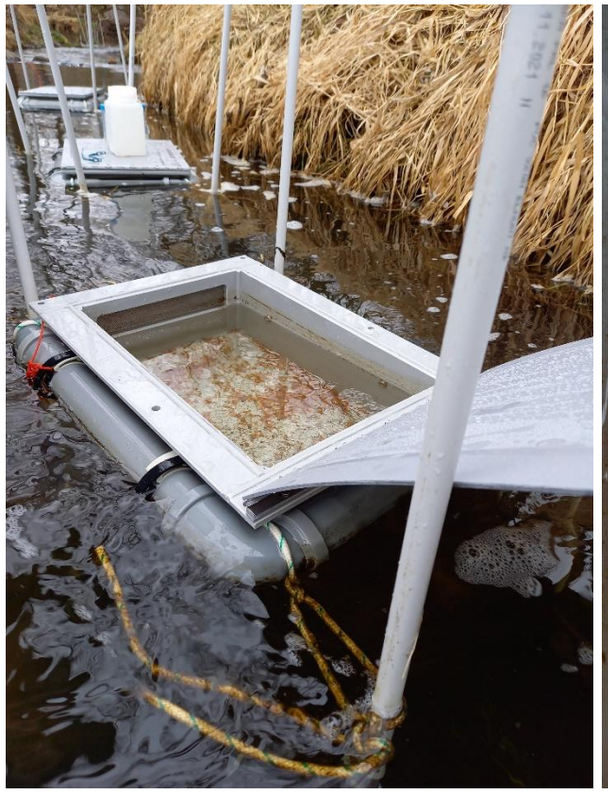
Floating incubators of fish eggs = FIELD lab

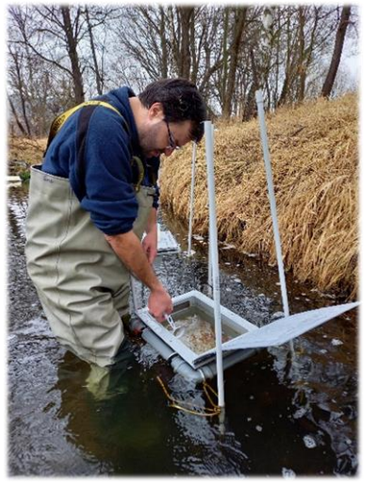


The floating incubators (380 × 250 × 145 mm) The sides and bottom are meshed (2 x 1.35 mm)

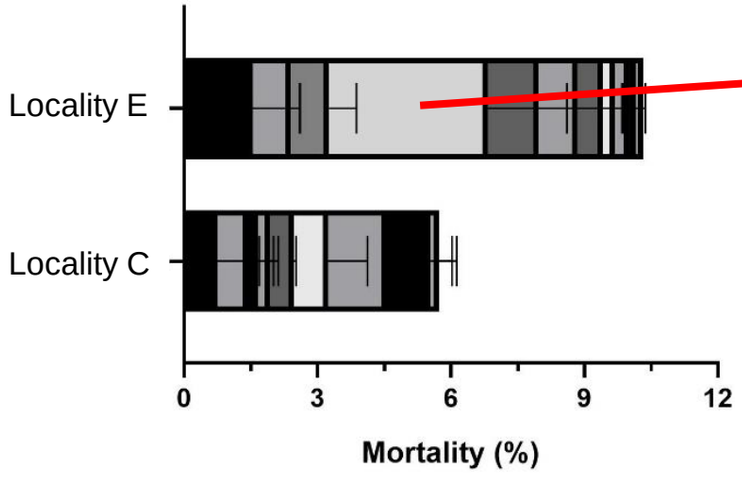
Producer: Michal Blaha, Czech Republic

Incubators - results

Mortality

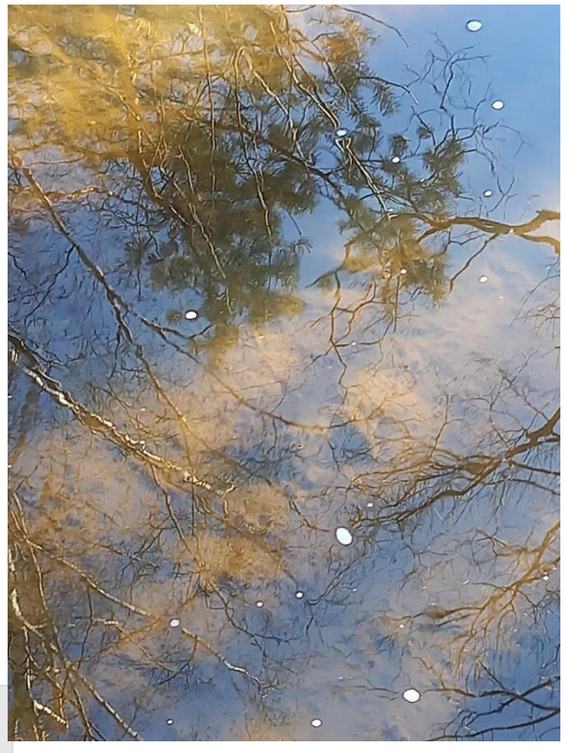


Mortality checking



- 28th day, the remarkably high mortality in the E group —caused by heavier rain, which washed out the sewers in the town + STP „relieving“

locality C	locality E
5.5% ± 2.5%	10.3% ± 1.5%



❖ The combined effects of water quality parameters, temperature, PPCPs, sludge and other pollutants may be responsible for the significantly higher mortality in the E group than that of the C group.

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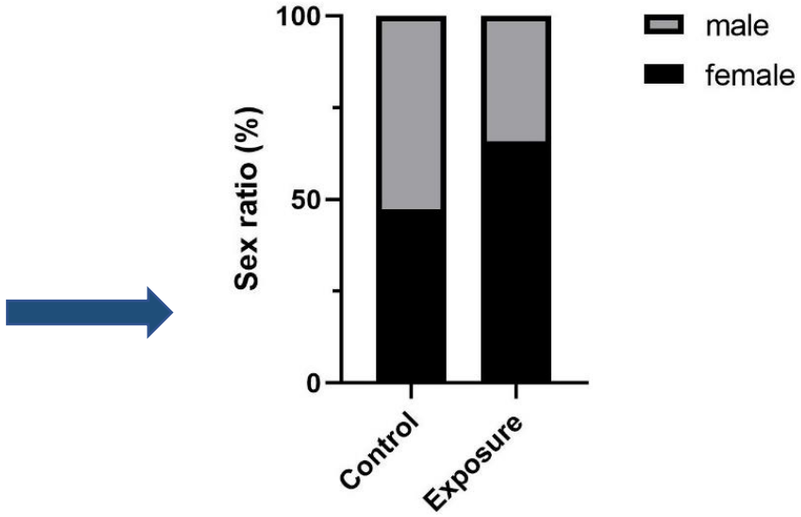
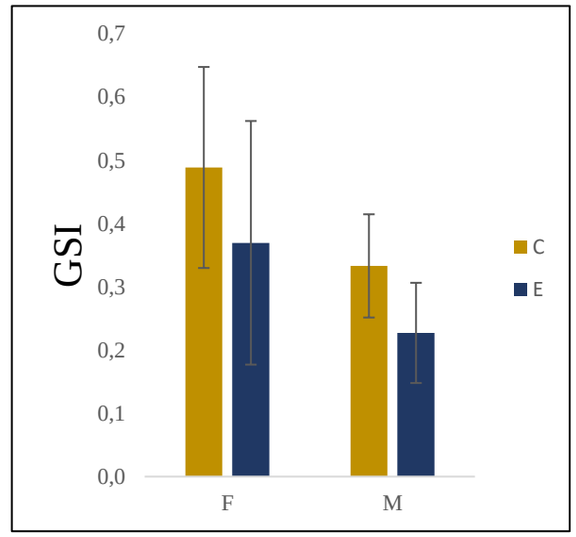
Incubators - results

Sex ratio and GSI





	C	E
Sex ratio (M:F)	1: 0.9	1: 1.9

❖ **negative effect of STP´s effluent on the sex ratio and gonadal development of brown trout**

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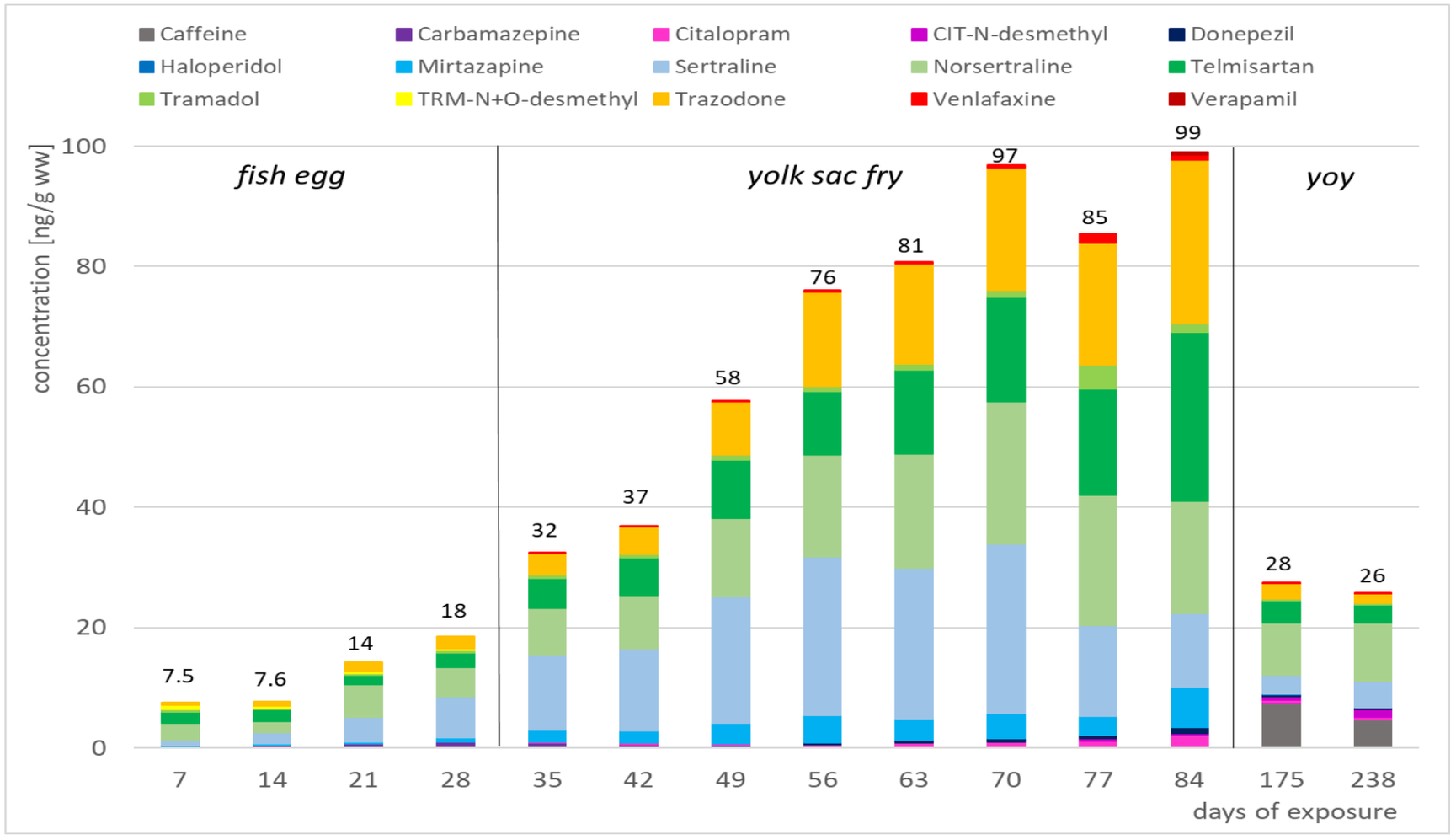
Incubators - results

Bioaccumulation of PPCPs – E group (90 PPCPs analysed)



- 15 PPCPs
- different PPCPs in different developmental stages (caffeine, haloperidol, venlafaxine)
- total concentration is increasing with time exposure – during fish egg and endogenous feeding stages
- bioaccumulation factor >2000 … sertraline (and norsertraline)

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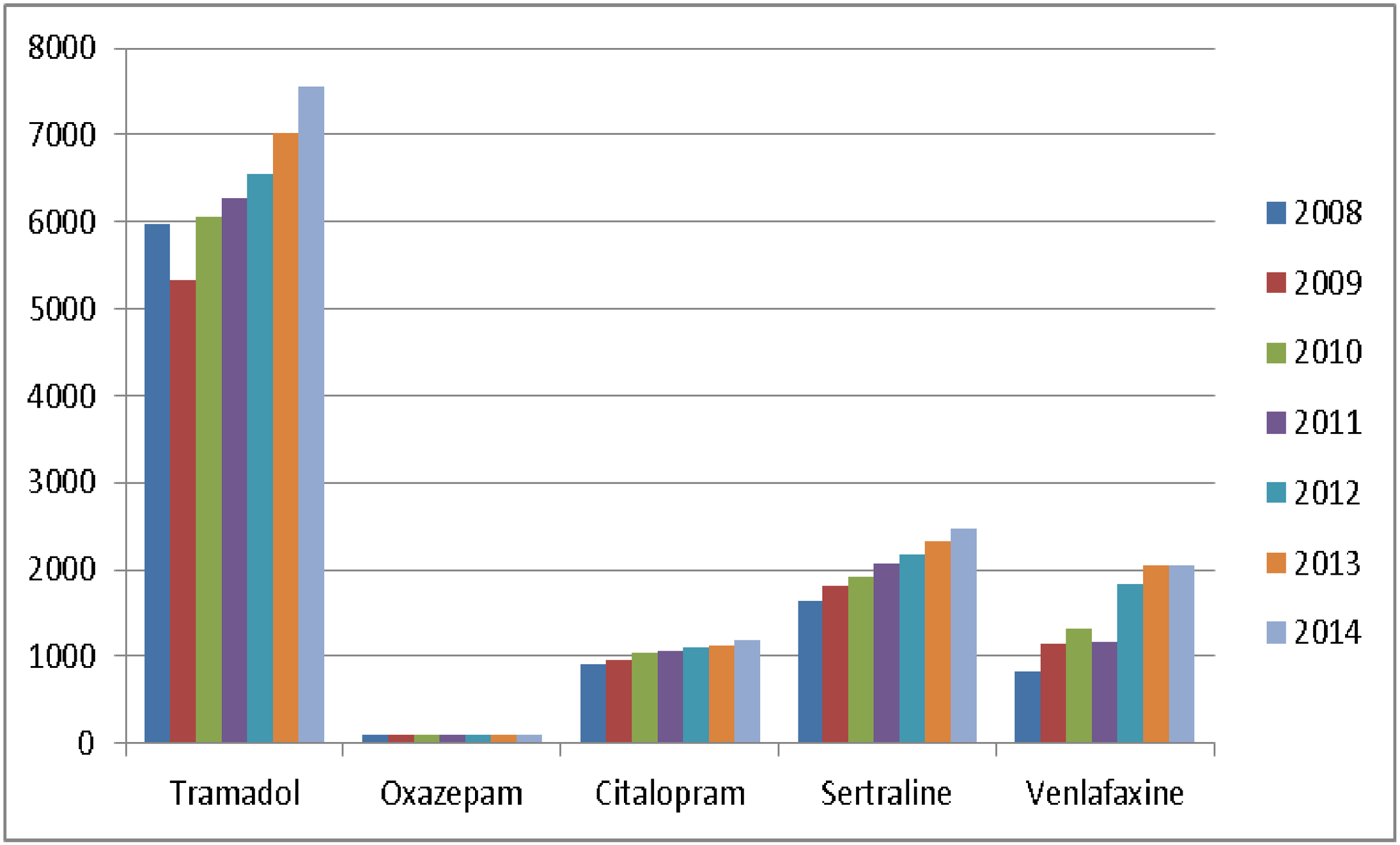
Psychoactive compounds in the aquatic environment in the Czech Republic

Consumption of selected psychotropic drugs in the Czech Republic (source SUKL) (in kg of active substance)



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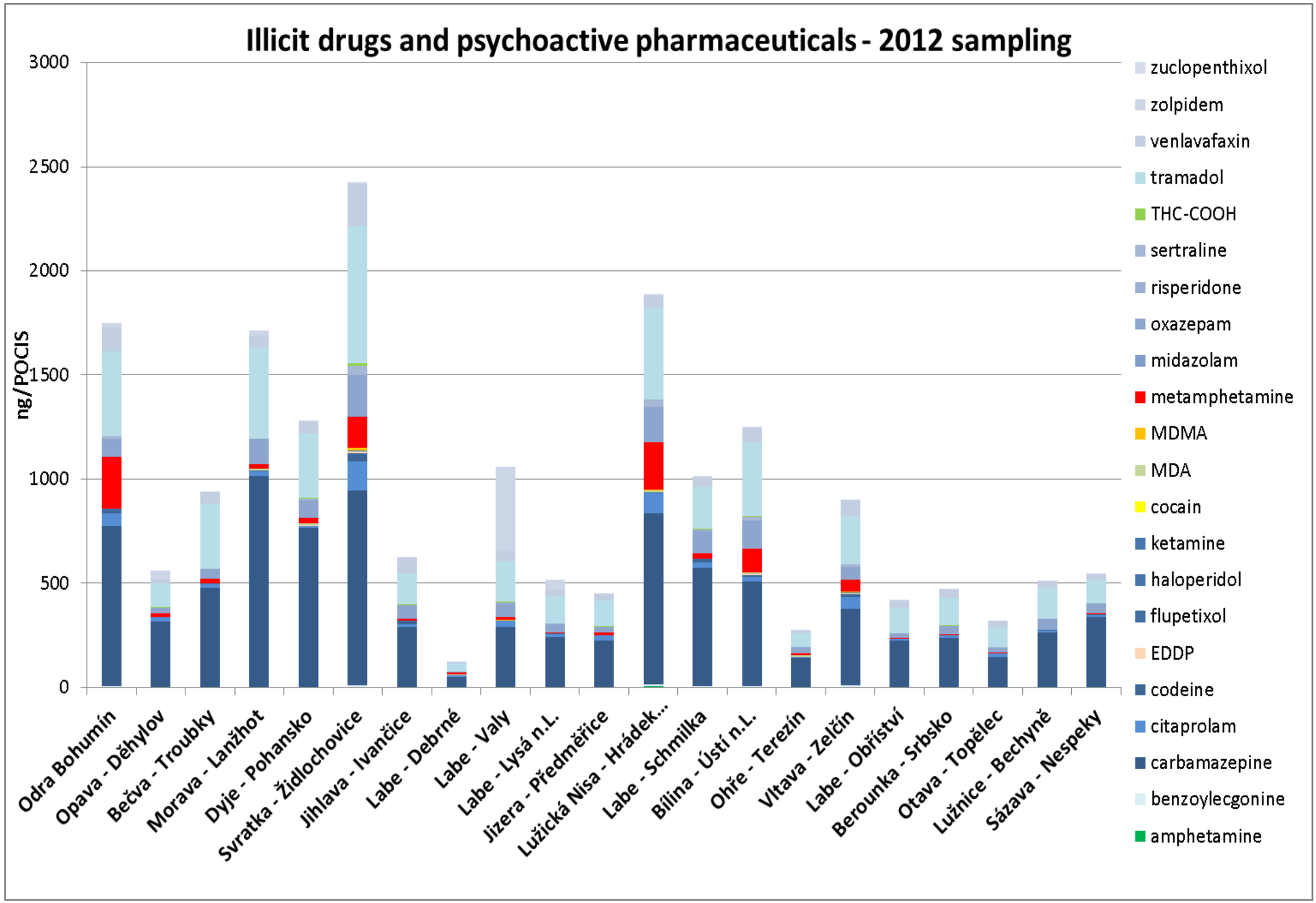
Occurrence of psychoactive substances in streams of the Czech Republic



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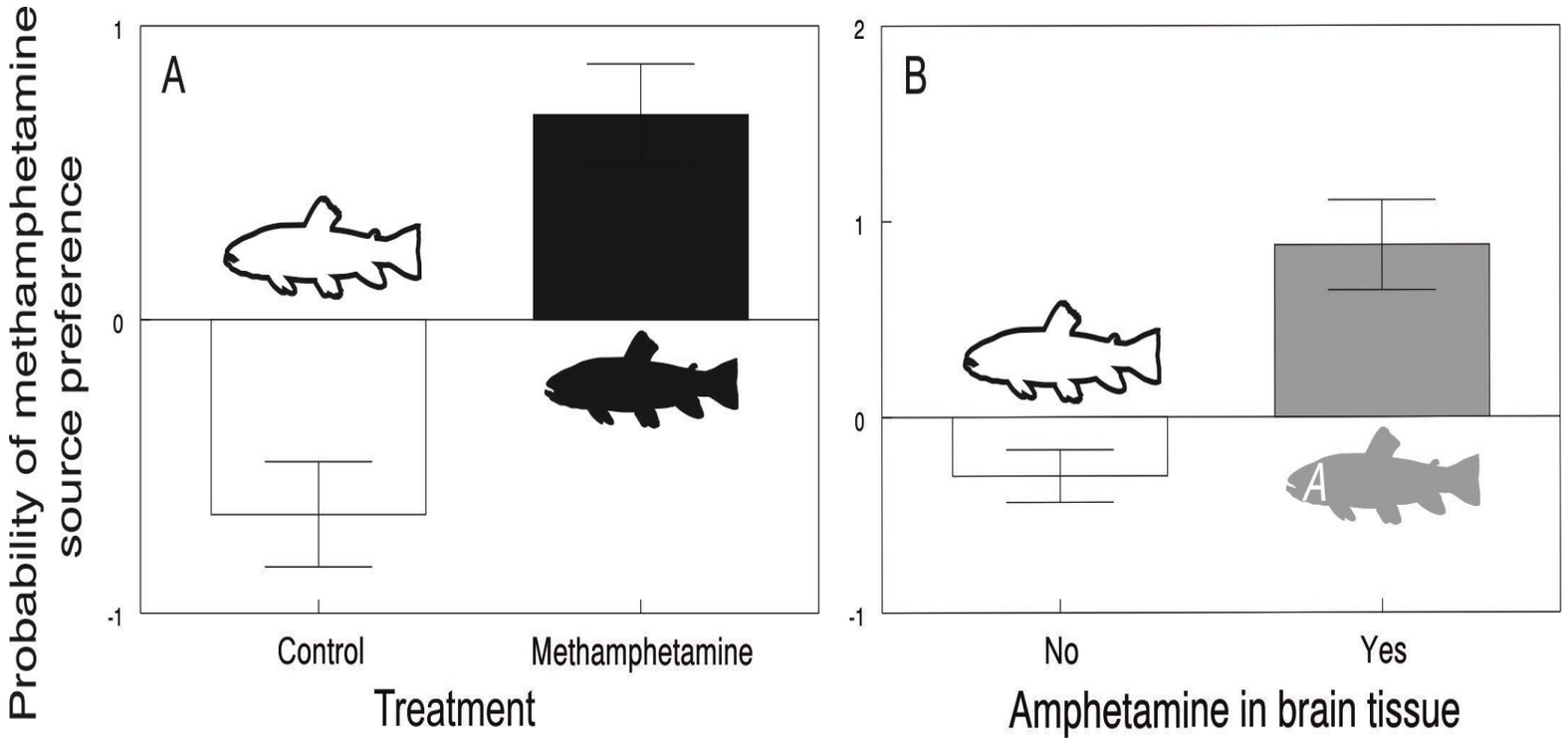
Effect of methamphetamine on fish



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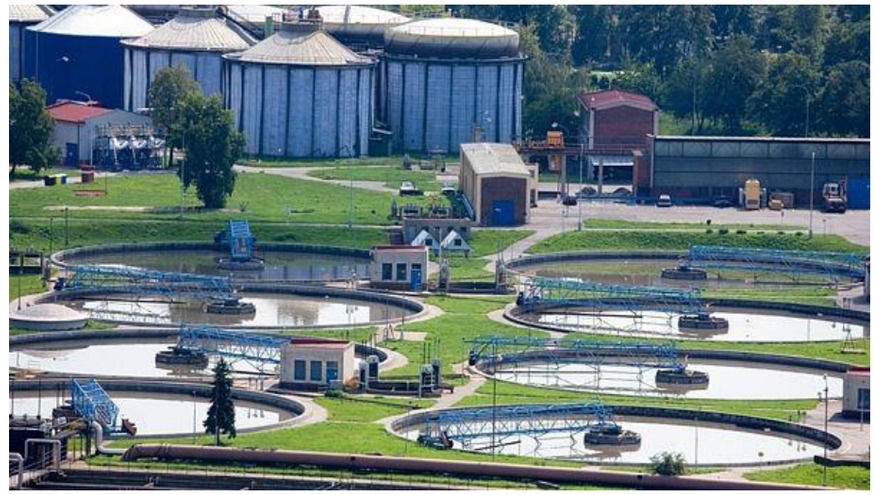
Summary

In some localities, the concentration of extraneous substances present in the aquatic environment negatively affects aquatic organisms. The worst situation is in small streams - recipients of water from WWTPs - where there is only a slight dilution of these "cleaned" waters.



All contaminants present in the given environment contribute to the effect on the exposed organisms - the so-called "cocktail effect" arises; this overall effect cannot be predicted under laboratory conditions.

The effect of micropollutants on ecosystems is still largely unknown. They can likely influence the biodiversity and then basic ecosystem functions. On the other hand, in the case of long-term exposed organisms, their adaptation to this situation is obvious.

As a result of bad management of the use of the landscape, there has recently been a reduction in biodiversity, intensive degradation of the soil fund, rapid drainage of water from the landscape, drying, and contamination of drinking water sources.

Can we change anything?

- Fundamental changes in the field of agriculture and landscape management - reducing the application of pesticides - limiting the production of energy crops, consistent compliance with basic agrotechnical rules and sowing procedures, greater diversity of the agricultural output, support for biodiversity in the landscape, improved management of the protection of water resources, etc.

- Optimizing the content of active substances in newly developed drugs - lower concentration while maintaining the therapeutic effect

- Limiting the consumption of medicines and other chemicals used in households, education regarding the disposal of unused substances and preparations

- Development and application of new technologies for the final treatment of waste and drinking water; prioritization of WWTPs for the installation of final-treatment technologies

- Effective monitoring of the occurrence and research of the impact of MP in the environment - development and use of new effective analytical methods for the detection of MP, including degradation products in environmental components; identification of new pollutants; comprehensive ecotoxicological studies

Thank you for your attention!

contact: trandak@frov.jcu.cz