

## Toxicity of coastal water in the Curonian Lagoon, Baltic Sea during autumn HAB, 2013

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### Summary

The effect of raw natural water from the coastal zone of Curonian Lagoon, sampled during toxic autumn hyper-bloom of cyanobacteria (16.09.2013 and 06.10.2013) was tested on *Daphnia magna* Straus (Crustacea, Cladocera). In both data and after 1 month of cool keeping (6-8°C) of October water filtrate, the high level of microcystin concentration was detected by Mycrocystin Strip Tests (Abraxis) at a level  $> 10 \mu\text{g l}^{-1}$ . Evident toxic effect (100% mortality) of September and October water samples, and October samples after one-month keeping in low-temperature condition, was shown. In September samples 100% mortality of cladocerans was recorded after 1-2 days, level of mortality increased gradually during experiment. Water of 06.10.2013 demonstrated sharp neurotoxic effect during first 20 minutes, paralysis was noticed in different dilutions of natural water (from not diluted to 1:10). 100% mortality level in all concentration was occurred not later than in 4 hours, except 1:10 trial, where was recorded after 20 h. Lethal effect of September water samples could be explained by high content of microcystins. The effect of other samples is explained by joined acting of unidentified neurotoxin and high microcystin concentration.

### Introduction

In hyper-trophic Curonian Lagoon harmful algal blooms (HABs) are regular, since late 1990s could occur several times per year and influence strongly lagoon ecology and recreational attractiveness of National Park. HABs, usually dominated by potentially toxic cyanobacteria often result to mass mortality of hydrobionts and sometimes – piscivorous birds. 18 MC congeners were recorded in lagoon water samples (Russkikh et al., 2012). However, cyanotoxin hazard are not recognized yet in the region. Mass fish-kill, observed in the coastal waters of Curonian Lagoon, in the recreational zone of National Park “Curonian Spit” in fall 2013 (16.09 -15.10.2013), was a reason for toxicity tests on model species *Daphnia magna* Straus. (Crustacea, Cladocera).

### Materials and methods

*Daphnia magna* Straus, used for experiments, were taken from laboratory culture in Atlantic Branch of P.P. Shirshov Institute of Oceanology, Russia. Cladocerans originate from one female and were similar in age-size. Several groups of cladocerans were exposed to filtrate of natural raw water, taken in a coastal zone of lagoon during cyanobacterial hyper-bloom: 16.09.13 – *Microcystis* spp. bloom at initial phase of cell lysis, and 06.10.13, at the end of *Microcystis* spp. bloom when large-scale lysis was recorded, water was colored by phycocyanin, but *Aphanizomenon flos-aqua* dominated. Experimental media did not contain microalgae cells, but contain natural mixture of cyanobacterial metabolites. In both dates the level of MC congeners was screened by Microcystin Strip Test Kit for recreational waters (Abraxis Ltd.) as  $> 10 \text{ ppb}$ . Part of 06.10.13 filtrate was keep for 1 month at constant low-temperature conditions (6-8 °C), then used for one more experiment.  $\Sigma\text{MCs}$  was checked after 1 month and was at a level  $> 10 \text{ ppb}$ . September samples tested in 3 dilutions with cultural media: 0 (100 % of

raw filtrate), 1:1 (50 % RF) and 1 (clean cultural media, control). October water samples were tested in 0; 1:1, 1:4; 1:10 dilutions and control. Each dilution was checked in 3 repetitions, 10-15 individuals each, in Petri dishes with 50 ml of media, without feeding. Individuals were monitored after 20, 70, 120, 180, 220 min and 20 h since the beginning of exposure. Stereomicroscope was used. Absence of swimming, character of swimming antenna moving/its immobility, immobility of pectoral legs were marked. Absence of any muscle activity recognized as a death.

## Results and Discussion

In four series of acute tests it was shown, water filtrates, free of microalgae cells, were toxic for *D. magna* in different dilutions and in all cases lead to 100% lethality in experimental trials when survival in control ones was 99.7-100%. Undiluted filtrate and its dilution 1:1 in September slightly effected swimming of some specimens and lead to slowly increasing mortality during 4 h, but 100% lethal effect was recorded after 1 day. Filtrate of October water had acute, fast and un-reversible paralytic effect in all dilutions (0, 1:1, 1:4) except 1:10. For 20 min – 3 h, depend on dilution, immobility appeared, swimming antenna were paralyzed, later paralysis of pectoral legs occurred, blocking the breath movement and leading to 97-100% mortality for 1-4 hrs.  $LT_{50}$  consists 15 min for non-diluted raw filtrate, 1.2 and 1.5 h in trials 1:1 and 1:4 correspondingly. In 1:10 trials only 30% of crustaceans were immobilized during 4 h, paralysis of swimming antennae was reversible in this dilution and recovered after 4 h, however swimming ability didn't recover. Besides on slight neurotoxic effect, the death of 100% individuals was recorded also in 1:10 trial, but after 20 h exposure (Figure 1).

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Lethal effect of September water on daphnia could be explained well by high content of microcystins (Chen et al., 2005). The effect of other samples is explained by joined, possible synergetic effect of unidentified neurotoxin (fast paralysis), high MC-congeners content (death after 1 day exposure in 1:10 trials) and other cyanobacterial metabolites in raw water. (Ibelihgs, Havens, 2008).

## References

- Chen W., Song L., Ou D., Gan N. 2005. Chronic toxicity and responses of several important enzymes in *Daphnia magna* on exposure to sublethal microcystin-LR. *Environ Toxicol.*, 20(3): 323-330.
- Ibelihgs B.W., Havens K.E. 2008 Cyanobacterial toxins: a qualitative meta-analysis of concentrations, dosage and effects in freshwater, estuarine and marine biota. *Adv Exp Med Biol.*, 619: 675-732.
- Russkikh J., Ezhova E., Lange E., Zhakovskaya Z., Chernova E. 2012. Harmful Algal Bloom and cyanotoxins content in waters of the Curonian and Vistula lagoon. *Abstr. of ECSA 51th Int. Symp. "Research and Management of Transitional waters "23-27 Sept. 2012, Klaipeda: p.93.*

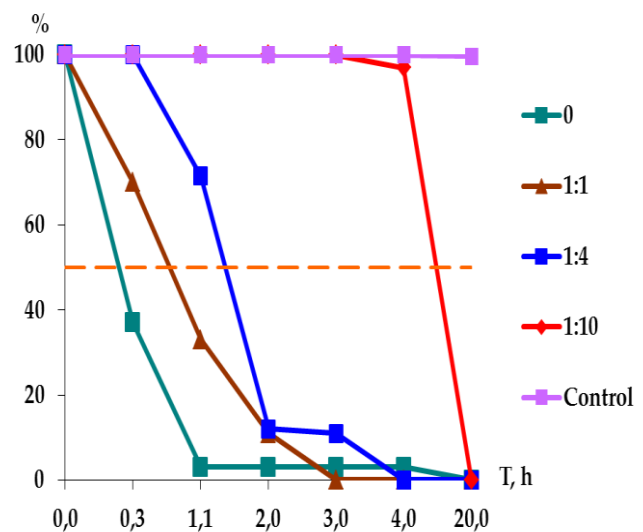


Figure. 1 Survival of *Daphnia magna* in different dilution of raw water samples filtrate, Curonian Lagoon, 06.10.2013