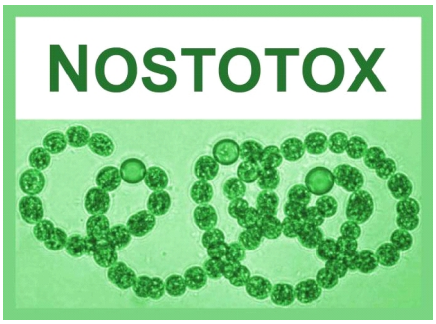
Development of Toxic Nostocales (Cyanobacteria) in the Course of Declining Trophic State and Global Warming

NOSTOTOX

Final Report



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The joint research project
Development of toxic Nostocales (Cyanobacteria) in the course of declining trophic state and global warming
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The project was supported by the Kompetenzzentrum Wasser Berlin (KWB – Berlin Centre of Competence for Water) in the domain of **knowledge transfer / communication:**

The Kompetenzzentrum Wasser Berlin is an international centre for water research and knowledge transfer. The KWB links the capacities of the Berlin universities and research institutes to the Berlinwasser group of companies and Veolia.

The responsibilities for KWB within the project NOSTOTOX were the following:

- inform potential end-users (public authorities, water suppliers) about the project and relevant (intermediate) results,
- involve end-users in the discussion about possible countermeasures as well as in the development of a decision support system,
- organize technical discussions and conferences to present intermediate results,
- act as contact for the Berliner Wasserbetriebe and Veolia Water for topics relating the project progress, the contents of the project and its results,
- assure that the interests of the sponsors BWB and Veolia are considered during project progress, according to the aims of the project.

The research project was accompanied by a steering committee consisting of technical experts from the involved stakeholders and representatives of the funding organizations:

- R. Gnirss (BWB),
- M. Dechesne, E. Soyeux, N. Rampnoux (Veolia Environnement),
- C. Pagotto (Veolia Eau),
- J. Schade (PT Jülich).

Summary

Background

Cyanobacteria of the order Nostocales – native species as well as alien species from tropical regions – were found to increase in many Brandenburg lakes while the formerly dominating microcystin (MC) producing cyanobacteria (*Microcystis* and *Planktothrix*) occurred less often and in lower amounts. As a consequence, lower MC concentrations were observed while the toxin cylindrospermopsin (CYN) that is produced by Nostocales was found to be widely distributed and to exceed sometimes the recommended guideline value for drinking-water of 1 µg L^{-1}. Recent data on the occurrence of further neurotoxins (paralytic shellfish poisoningtoxin, PSP and anatoxin, ATX) produced by cyanobacteria of the order Nostocales did not exist. Nostocales are superior competitors under conditions of high light intensity and nitrogen depletion because they can fix molecular nitrogen. Their germination is regulated by temperature and the temporal starting point of the pelagic population determines the population size (the earlier the larger). Therefore, the following working hypothesis has been put forward: Combined effects of declining trophic state and global warming favor the development of Nostocales and cause a shift in the species composition as well as in the occurrences of cyanobacterial toxins.

Objectives

The NOSTOTOX project aimed to determine the present occurrence and future development of Nostocales and their toxins in waterbodies. Special emphasis was paid to answer the question, which Nostocales species and which toxins can be expected under conditions of a proceeding decline in trophic state and increasing water temperature. The outcome of the project aims to contribute to developing recommendations and guidelines for the management of inland waters and drinking water supplies.

Concept

The occurrence and seasonal dynamics of cyanobacteria and toxins as well as of physical and chemical parameters were studied in 15 lakes in Berlin and Brandenburg. Data were integrated in an existing data base on long-term development of phytoplankton of 33 lakes. These data were analyzed with multivariate statistical approaches to identify main predictor variables of cyanobacteria performance and to evaluate threshold values for cyanobacterial dominance.

For the identification of toxin producers strains of different species from different lakes were isolated and analyzed morphologically (detection of species), genetically (detection of species and toxin encoding genes) and chemically (detection of toxins). Toxin produc-