TE/01

B-BLOOMS2 - Results

Cyanobacterial blooms: toxicity, diversity, modelling and management

DURATION OF THE PROJECT
15/12/2006 - 31/07/2011

BUDGET
1.081.253 €

KEYWORDS
Cyanobacteria, blooms, eutrophic lakes, genetic diversity, monitoring, cyanotoxins, modelling.

CONTEXT

Cyanobacterial blooms, mass developments of cyanobacteria floating at the surface of waterbodies, have become a recurrent and increasingly important phenomenon in freshwaters worldwide over recent decades. The formation of such blooms in surface waters is closely linked to water eutrophication (Chorus, 2001). These nuisance blooms represent major potential hazards for human and animal health, and interfere in various negative ways with the sustainable use of surface waters for e.g. drinking water treatment, recreation, irrigation and fisheries. Between 25 and 70% of the blooms are toxic (Sivonen, 1996). The cyanotoxins are mainly released in the water column during collapse of the blooms. Ingestion of, or contact with water containing cyanobacterial cells or toxins can cause health damage (Bell & Codd 1996; Carmichael et al. 2001; de Figueiredo et al., 2004; Dittmann & Wiegand, 2006).

In view of the lack of knowledge about the situation in Belgium, three of the present partners initiated in 2003 the BELSPO project B-BLOOMS1. Thanks to this work, it has been shown that surface waters in Belgium were also plagued by cyanobacterial blooms, particularly in summer and autumn. Eighty % of the blooms contained taxa with the genetic potential to synthetise microcystins, and the presence of this toxin family in the cyanobacterial biomass was shown by HPLC analysis for 40% of the analysed bloom samples.

OBJECTIVES

The B-BLOOMS2 project aimed to deepen knowledge of cyanobacterial blooms in Belgium, improve the modelling for prediction and early-warning, develop operational monitoring structures and tools, and propose strategies to reduce the impact of cyanobacterial blooms.

From a scientific point of view, the research programme focused on:

- Collection of physical, chemical, biological and meteorological data on selected reference waterbodies plagued by toxic cyanobacterial blooms in Flanders, Brussels and Wallonia;
- Identification and study of the toxigenic cyanobacteria present in the Belgian samples using molecular tools on samples and strains, including genetic diversity and factors regulating their population dynamics;
- Measurement of the major cyanotoxins present in the blooms and water samples by analytical methods;
- Development and test of management scenarios for control or mitigation of cyanobacterial blooms in one reservoir using integrated watershed models;
- Development of a statistical predictive model for a series of urban ponds.

From a practical and science policy point of view, B-BLOOMS2 aimed to:

- Implement a network of samplers based on existing monitoring programmes of surface waters or on collaboration with health authorities or environmental organisations (BLOOMNET);
- Transfer knowledge about methods of monitoring and analysis of blooms to the water/health authorities and environmental organisations by hands-on courses in our laboratories and field sites;
- Reinforce the communication to and with authorities and the general population, to raise public awareness, contribute to future guidelines and risk assessment procedures, and improve monitoring and management.

SSD SCIENCE FOR A SUSTAINABLE DEVELOPMENT

TERRESTRIAL ECOSYSTEMS

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CONCLUSIONS

Among the main results of the study, it can be stressed that most of the cyanobacterial blooms consisted of potentially toxic taxa of the genera *Aphanizomenon*, *Microcystis*, *Planktothrix* and *Anabaena*. Improved molecular approaches demonstrated that genetic diversity within blooms can be high and that changes in strain dominance occur and can be caused by strong and specific trophic interactions. Several genes of the *mcy* cluster were regularly detected in bloom samples. The toxin analyses showed the presence of microcystins in all samples tested, the concentration of which exceeded World Health Organization Guideline Values for drinking- and recreational waters on several occasions. These results will help to understand the factors and mechanisms influencing cyanotoxin production, and, from a management point of view, call for measures for improved cyanobacterial bloom monitoring, bloom reduction and for the reduction of public exposure to harmful blooms.

CONTRIBUTION OF THE PROJECT TO A SUSTAINABLE DEVELOPMENT POLICY

From a management point of view, the project has contributed to the development of measures for improved cyanobacterial bloom monitoring, bloom reduction and for the reduction of public exposure to harmful blooms. Indeed, throughout the project and particularly in the second phase (2009-2010), the teams were actively involved in various information and monitoring activities, in collaboration with water managers and stakeholders throughout the three Belgian regions (Brussels, Flanders and Wallonia). These activities comprised water quality measurements, determination of phytoplankton composition, collection and characterisation of cyanobacterial blooms by different techniques and determination of soluble and particulate microcystins. In the framework of the application of the EU Bathing Water Directive (2006/7/CE), the B-BLOOMS2 teams provided significant help to the authorities in identifying and refining policies and measures related to the risk assessment and management of cyanobacterial blooms.

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