EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

CYANOCOST – ES 1105 Action

www.cyanocost.com

Cyanobacterial blooms and toxins in water resources:
Occurrence, impacts and management.

Short Term Scientific Mission (STSM)

"Tracing toxigenic cyanobacteria from preserved genetic material"

Introduction

Following eutrophication of Lake Gjersjøen (Norway), dense surface blooms of a green-pigmented ecotype of the cyanobacterium *Planktothrix* were observed starting in 1964. After the initial operation of a sewage treatment plant in 1971 the trophic state improved to meso-/eutrophic. With the increasing N/P ratio (Fig. 1) a red-pigmented *Planktothrix* ecotype that formed metalimnetic blooms became dominant (Fig. 2). This red-pigmented variant had first been observed in summer 1970 and seemed to have displaced the green-pigmented ecotype after 1971 (Faafeng&Nilssen).

Objective

It was hypothesized that the changes in the *Planktothrix* population starting in summer 1970, when the red-pigmented ecotype was first observed, would be reflected in changes of the relative abundances of *oci*B genotypes.

Cyanobacteria populations are genetically heterogenous and can be divided into different genotypes (GT) or chemotypes (CH), e.g. according to the presence or absence of toxin synthesis genes or qualitative differences in the intracellular composition of non-ribosomal oligopeptides, respectively. It has been suggested that the relative genotype / chemotype abundance is regulated by local abiotic and biotic factors.

Fig. 1.
Spring overturn concentrations of total-P and total-N (modified from Faafeng & Nilssen 1981)

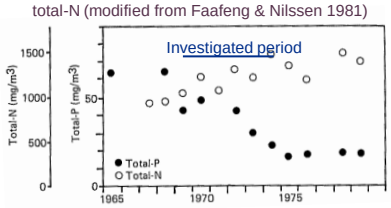

Fig. 2.
Succession of different *Planktothrix* ecotypes distiguished microscopically. Colored bars indicate the pigmentation of the filaments (modified from Faafeng & Nilssen 1981)

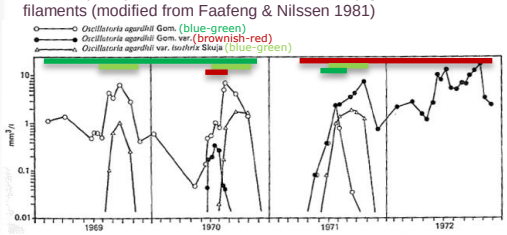

Fig. 3.
Phytoplankton on filters. Filters from 1969 to 1973 were used for DNA extraction. Blue-green and red color is indicative of *Planktothrix*.

Results

The *oci*B genotype composition was dominated by genotype 9 in 1969, with low shares of genotype 5 and 7 (<5% of the total *oci*B containing genotypes). During 1970 and 1971 the share of genotype 9 decreased while genotype 5 increased in abundance.
Genotype 1 was first detected in autumn 1970 in very low amounts. It subsequently increased in abundance until it became dominant from Aug. 1971 onwards. In 1972 the three other *oci*B genotypes were not detected at all, and subsequently never got abundant again (Fig. 4).
The results of this study support the hypothesis of a shift of genotypes with differing oligopeptide profiles during the investigated period.

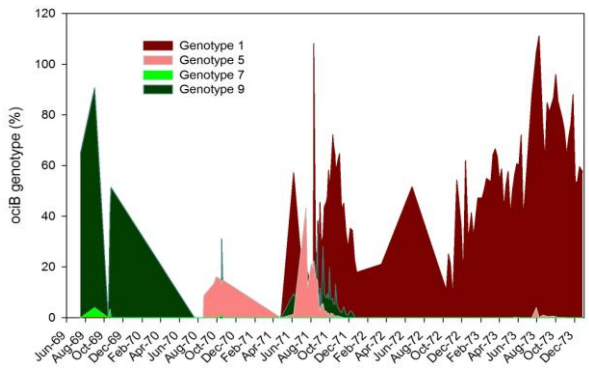

Fig. 4.
Relative abundances of different *oci*B genotypes estimated by qPCR. Share of four different *oci*B genotypes as related to the total abundance of *Planktothrix* genotypes containing the *oci*B gene.

Researcher

Veronika Ostermaier
Research Institute for Limnology
University of Innsbruck, Mondsee, Austria

Molecular ecology and physiology of cyanobacteria
Group leader: Doz. Dr. Rainer Kurmayer

Host Organization

Norwegian Institute for Water Research, Oslo, Norway
Section: Freshwater Biology
Host: Dr. Sigrid Haande
In cooperation with
Prof. Dr. Thomas Rohrlack

Methodology

The DNA was extracted from preserved phytoplankton on filters (Fig. 3) and investigated by quantitative real-time PCR (qPCR) with regard to four different *Planktothrix oci*B (cyanopeptolin synthetase) genotypes. Their relative abundances were estimated in relation to the total abundance of genotypes containing the *oci*B gene (Fig. 4).

The four quantified genotypes that were distinguished on the basis of their genetic differences within the *oci*B gene had been classified as chemotypes earlier, according to differences in their intracellular oligopeptide profile as investigated by LC-MS/MS from strains (Rohrlack *et al* 2008).

The strains used for the differentiation of chemotypes and genotypes also differ in pigmentation:
while strains representing GT/CH 1 and 5 are red-pigmented, strains representing 7 are green-pigmented and strains used for the classification of CH/GT 9 are mostly green-pigmented.

COST is supported by the EU RTD Framework Programme

ESF provides the COST Office through a European Commission contract

References
- Faafeng B.A. and Nilsson P. (1981): A twenty-year study of eutrophication in a deep, soft-water lake. Verh. Internat. Limnol. 21:412-424.
- Rohrlack T, Edvardsen B, Skulberg R, Halstvedt C, Utkilen H.C, Ptacnik R, Skulberg O.M. (2008): Oligopeptide chemotypes of the toxic freshwater cyanobacterium *Planktothrix* can form subpopulations with dissimilar ecological traits. Limnol. Oceanogr. 53:1279-1293.