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Cyanobacterial blooms : toxicity, diversity, modelling and management

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B-BLOOMS

Cyanobacterial blooms in Flanders

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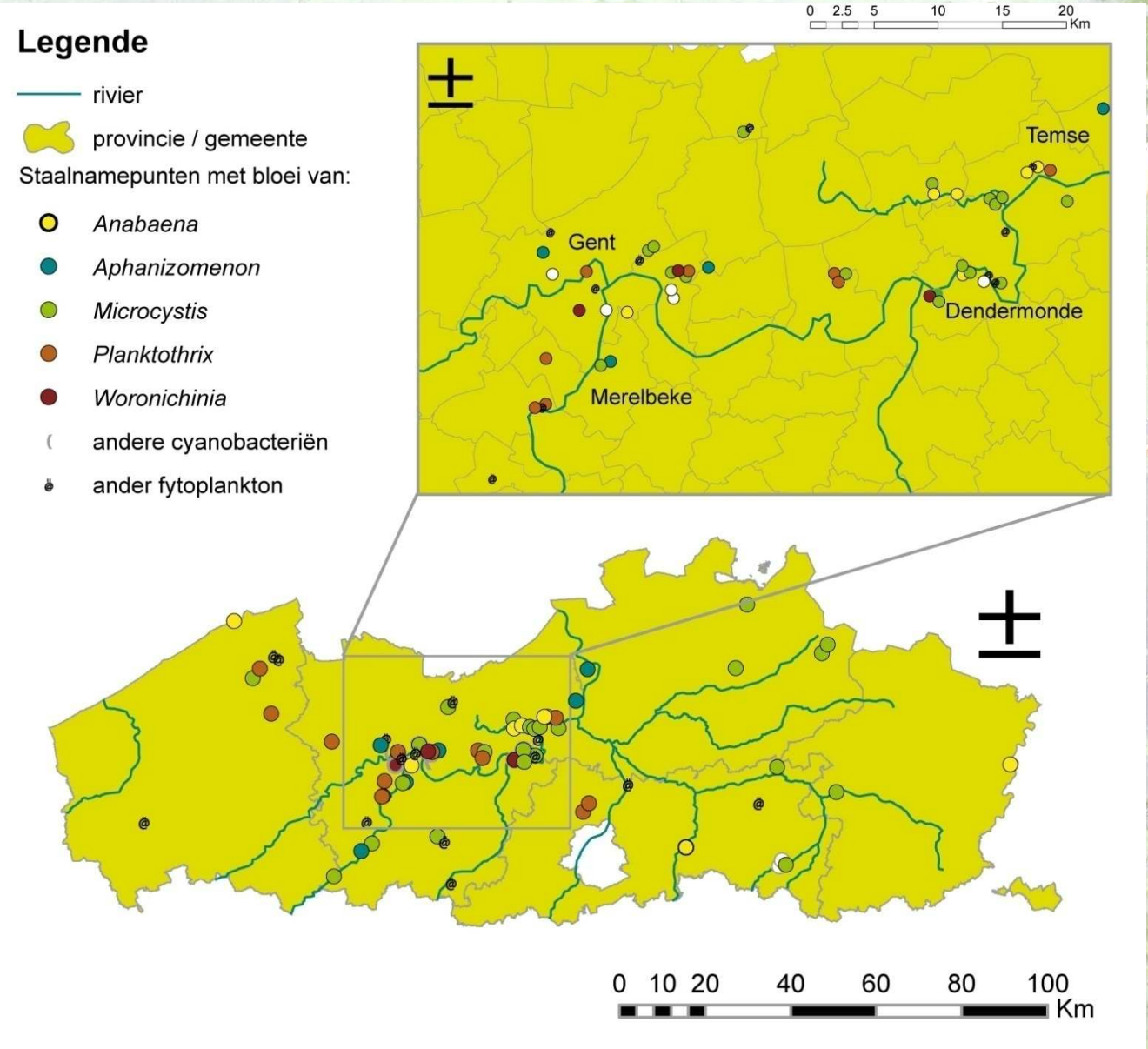
PROTISTOLOGY AQUATIC ECOLOGY

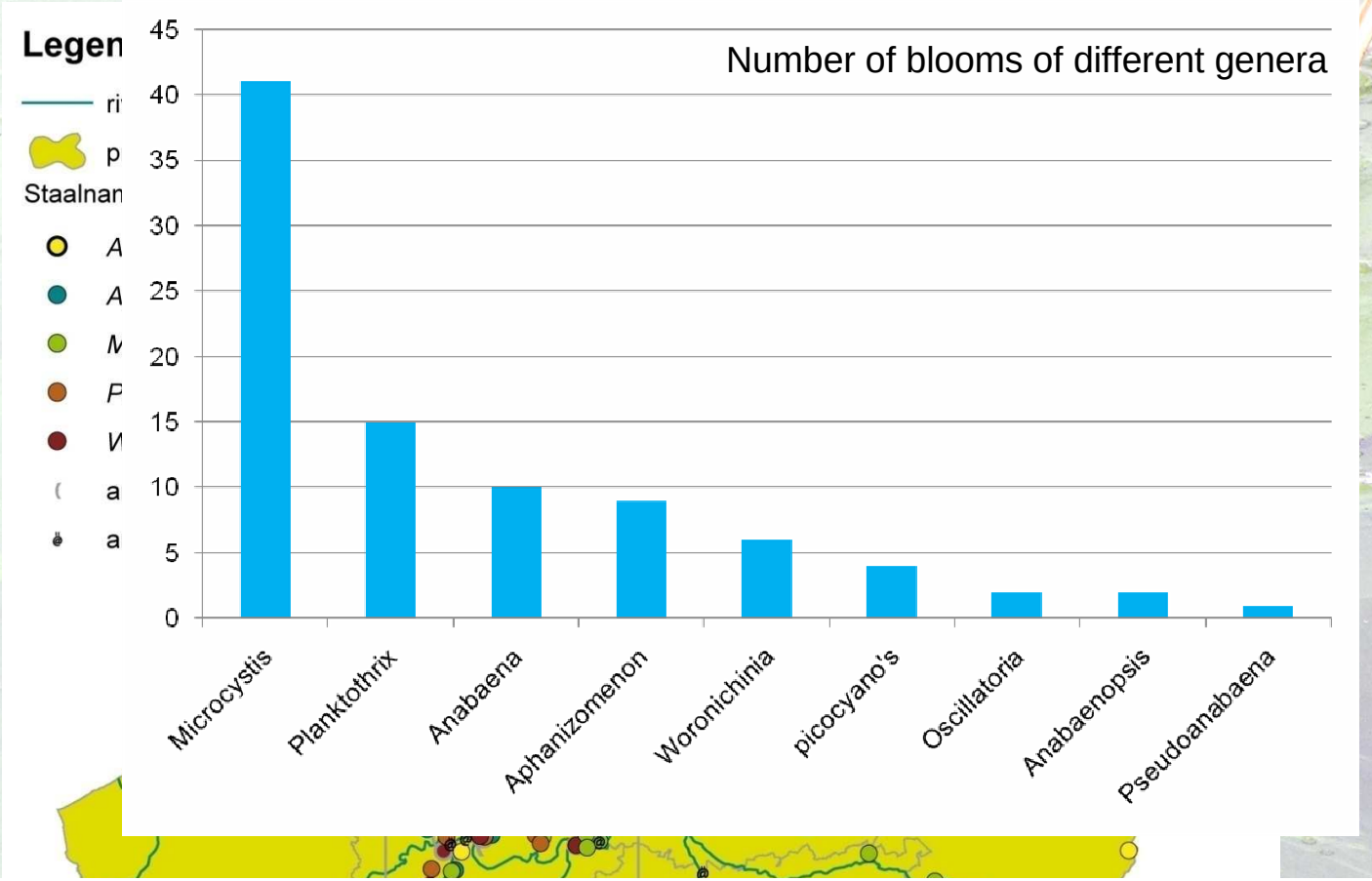
Occurrence and toxicity of cyanobacterial blooms

Grindplas (Kessenich), Augustus 2007

Occurrence and toxicity of cyanobacterial blooms



Occurrence and toxicity of cyanobacterial blooms



Cyanobacterial blooms are widespread in Flanders, especially in summer, and many are toxic. The most common bloom-forming taxa are *Microcystis* and *Planktothrix*.

0 10 20 40 60 80 100 Km

Management implications: temporary closure of recreational waters

De Gavers (Harelbeke), March 2007

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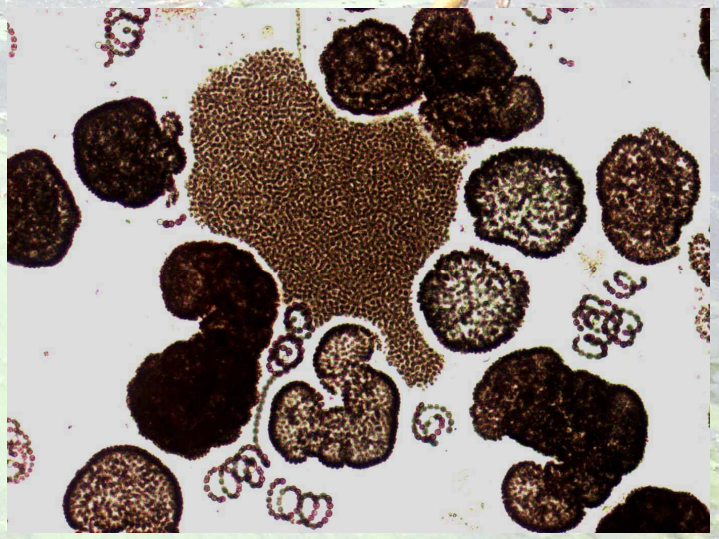
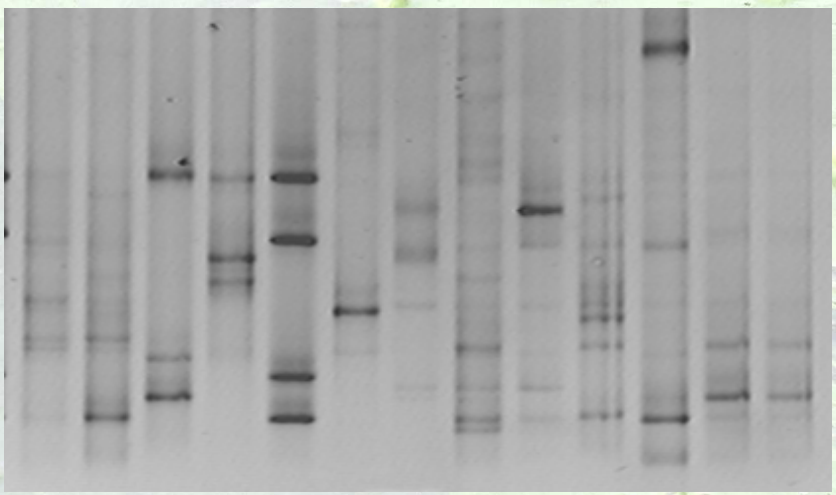
Schulensmeer (Lummen), September 2007



ITS rDNA population structure of the most common bloom-formers, *Microcystis* and *Planktothrix*

Microcystis

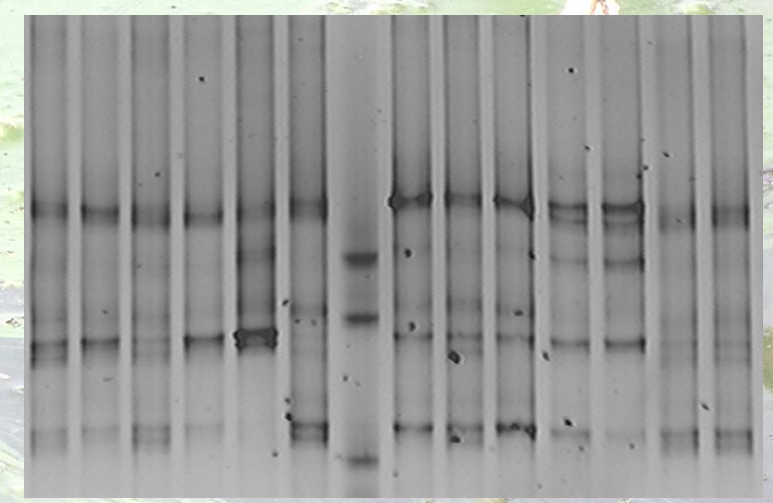
32 blooms



High local and regional ITS diversity of *Microcystis* blooms.
Average number of ITS genotypes per sample: 3.6 (range: 1-10).
No correlation with environmental or spatial variables.

Planktothrix

24 blooms



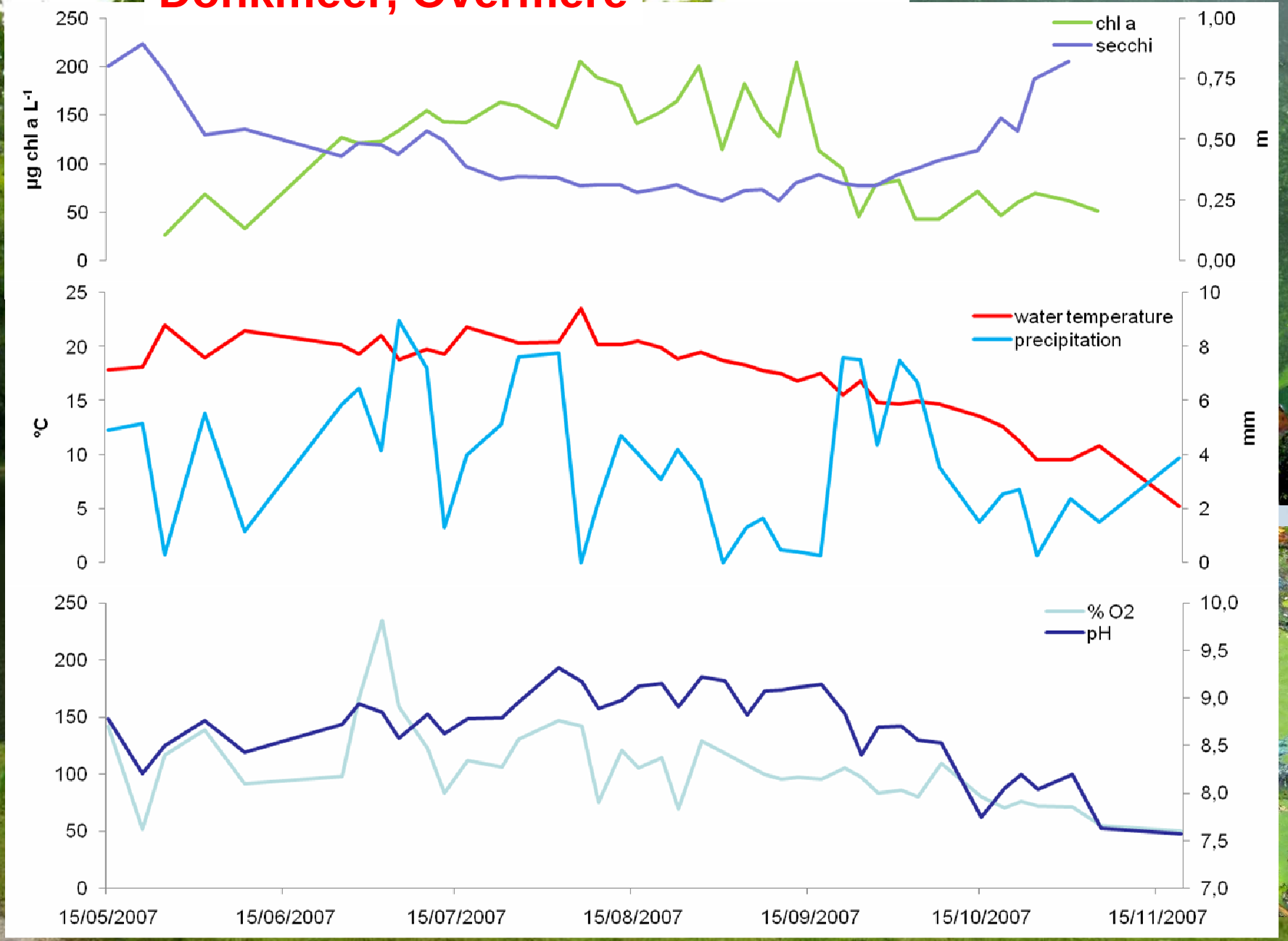
Low local and regional ITS diversity of *Planktothrix* blooms
Average number of ITS genotypes per sample: difficult to know because of intragenomic variation in ITS, around 1-2 genotypes per sample

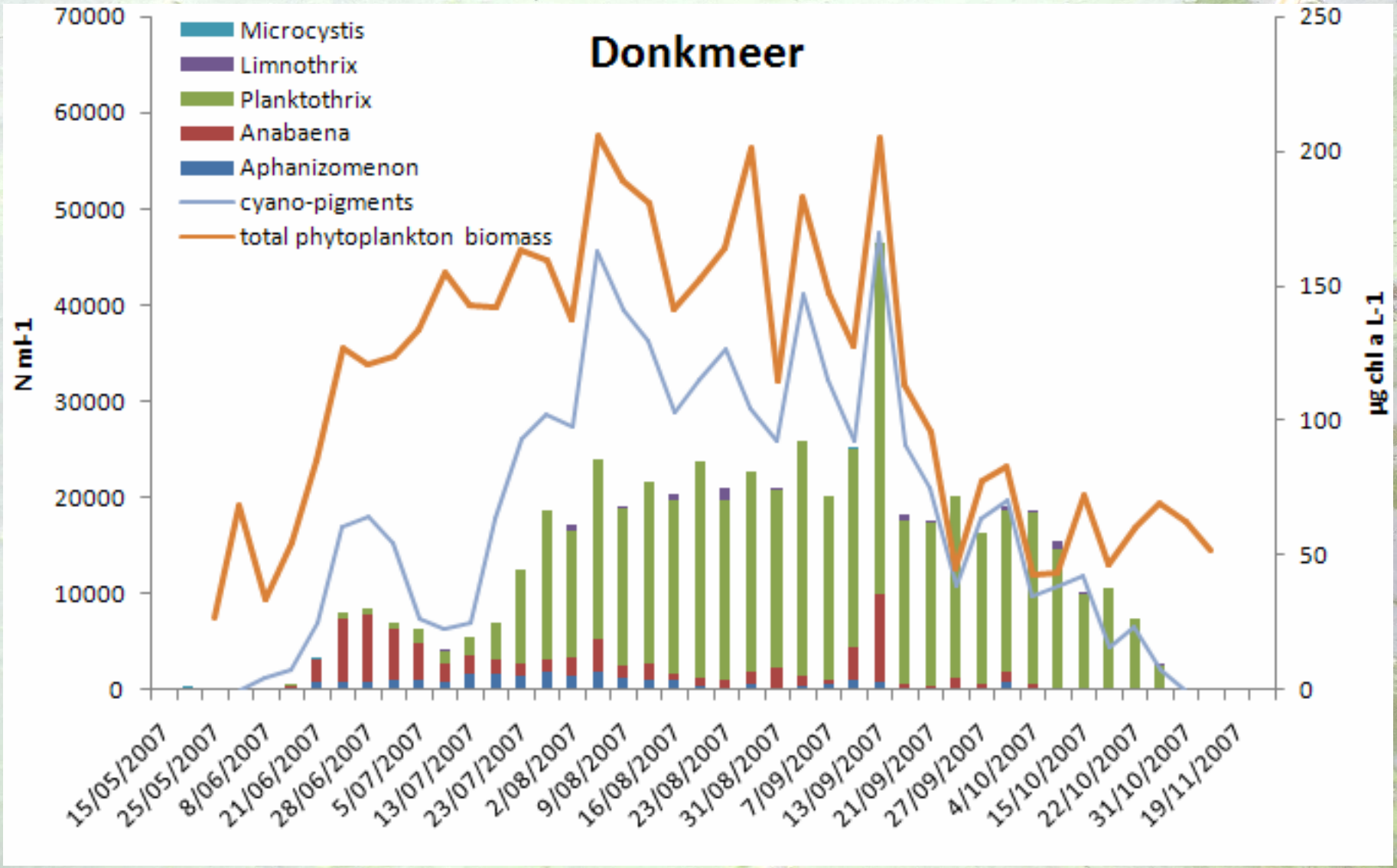
Bloom dynamics

- Monitoring cyanobacterial blooms in reference lakes during two years with a high sampling frequency.
- Measuring important climatic, physicochemical and biotic variables (other phytoplankton, zooplankton).
- *Microcystis* and *Planktothrix* population structure.
- Toxicity measurements.

Donkmeer, Overmere

Donkmeer, Overmere

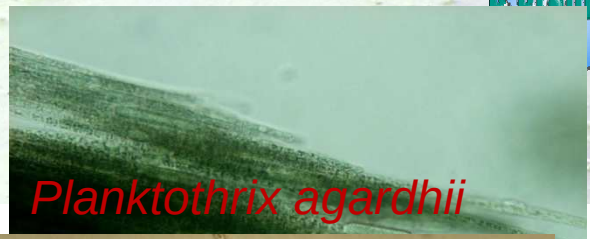



Donkmeer
Microcystis
Limnothrix
Planktothrix
Anabaena
Aphanizomenon
cyano-pigments
total phytoplankton biomass
N ml-1
µg chl a L-1
70000
60000
50000
40000
30000
20000
10000
0
250
200
150
100
50
0
15/05/2007
25/05/2007
8/06/2007
21/06/2007
28/06/2007
5/07/2007
13/07/2007
23/07/2007
2/08/2007
9/08/2007
16/08/2007
23/08/2007
31/08/2007
7/09/2007
13/09/2007
21/09/2007
27/09/2007
4/10/2007
15/10/2007
22/10/2007
31/10/2007
19/11/2007

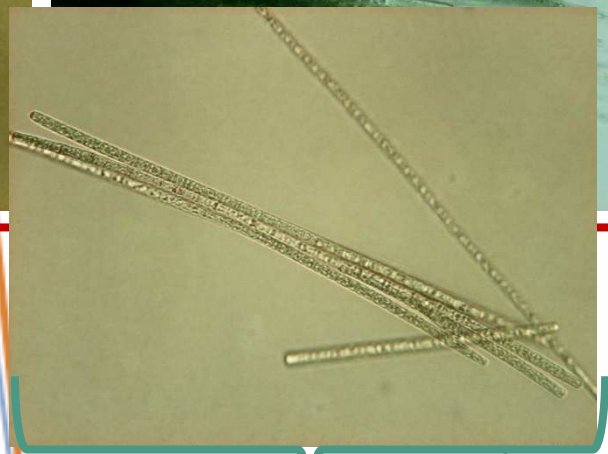
Anabaena flos-aquae

Anabaena subcylindrica

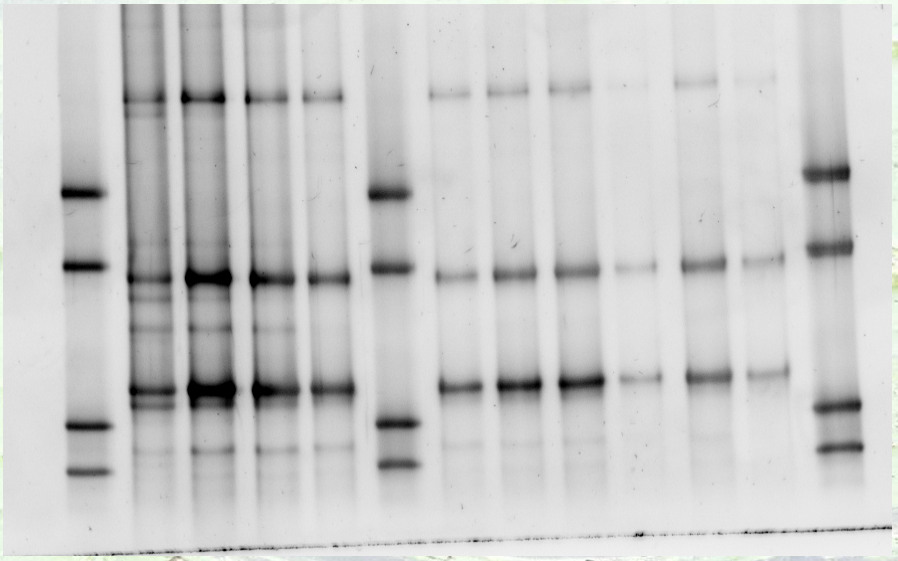
Aphanizomenon flos-aquae



Planktothrix agardhii



ITS rDNA DGGE *Planktothrix*



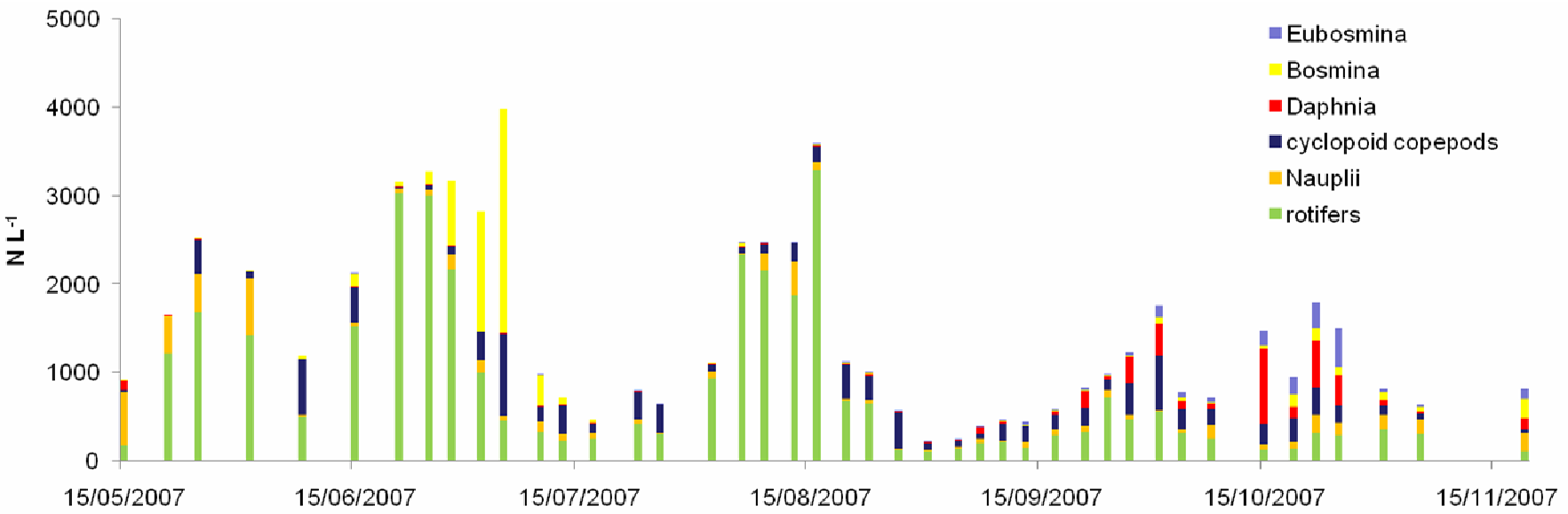
ITS diversity of *Planktothrix agardhii* in Donkmeer. (From left to right: samples from end of July 2007 to end of August 2007. First, sixth and last lane = marker).

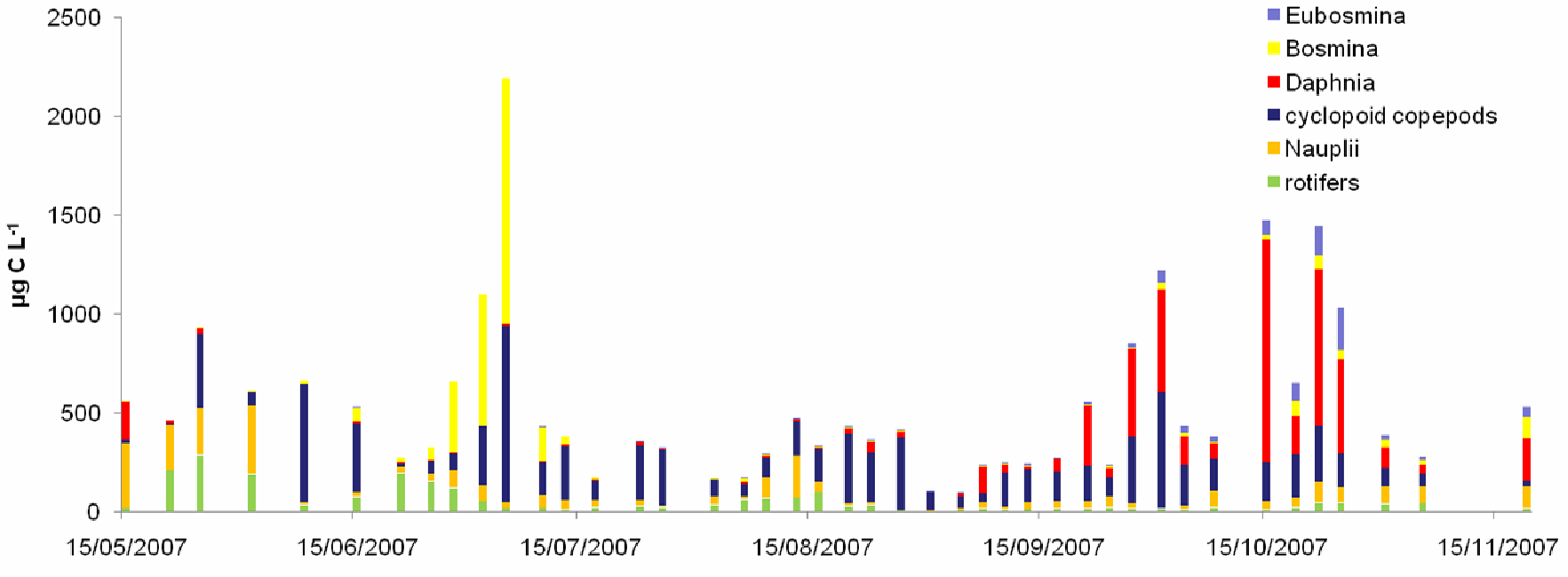
Few temporal changes

Isolation of strains showed intragenomic variation in ITS

Three ITS genotypes were dominant, but in accordance to the isolated strains they probably belong to only one or two strains.

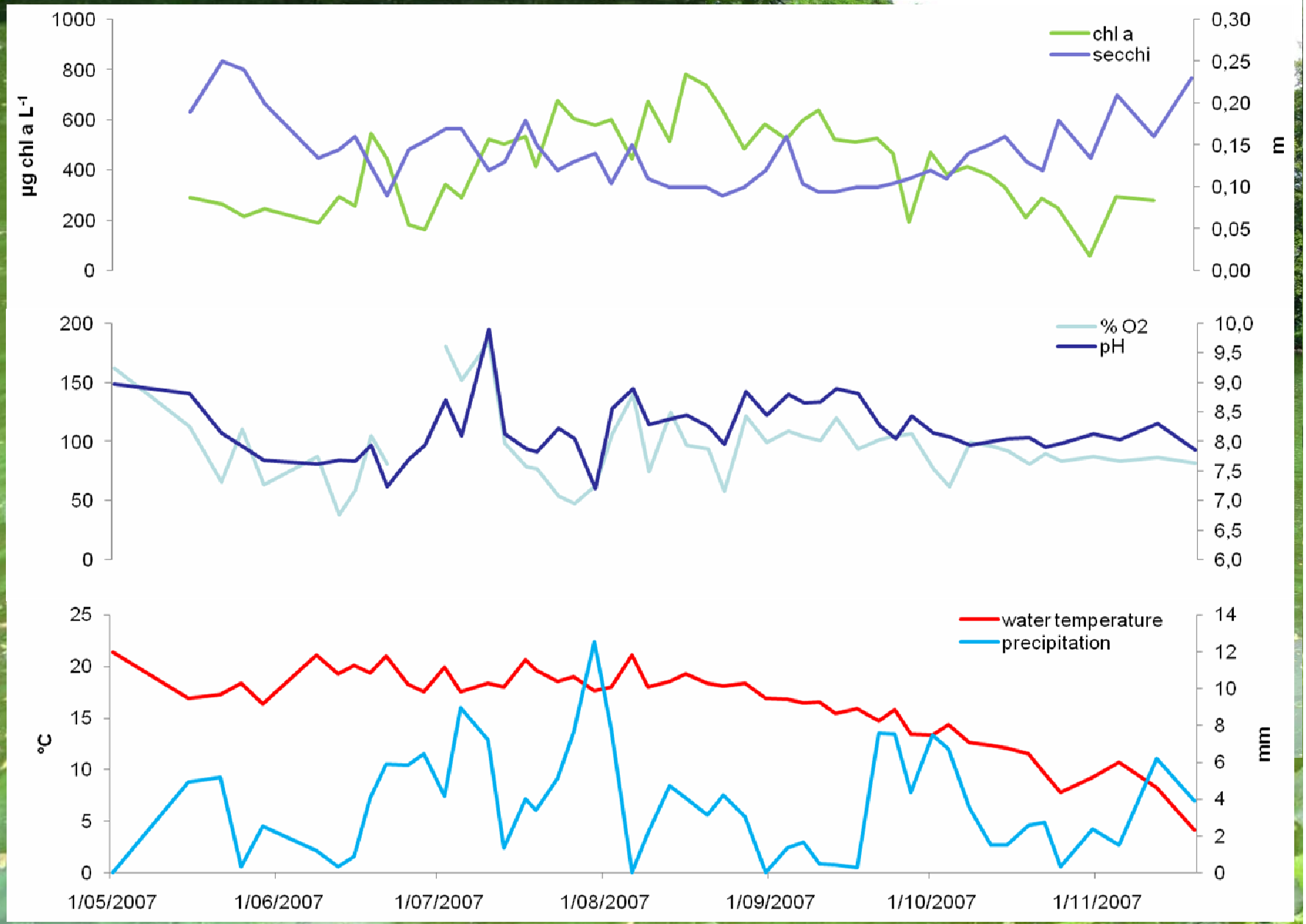
Zooplankton community



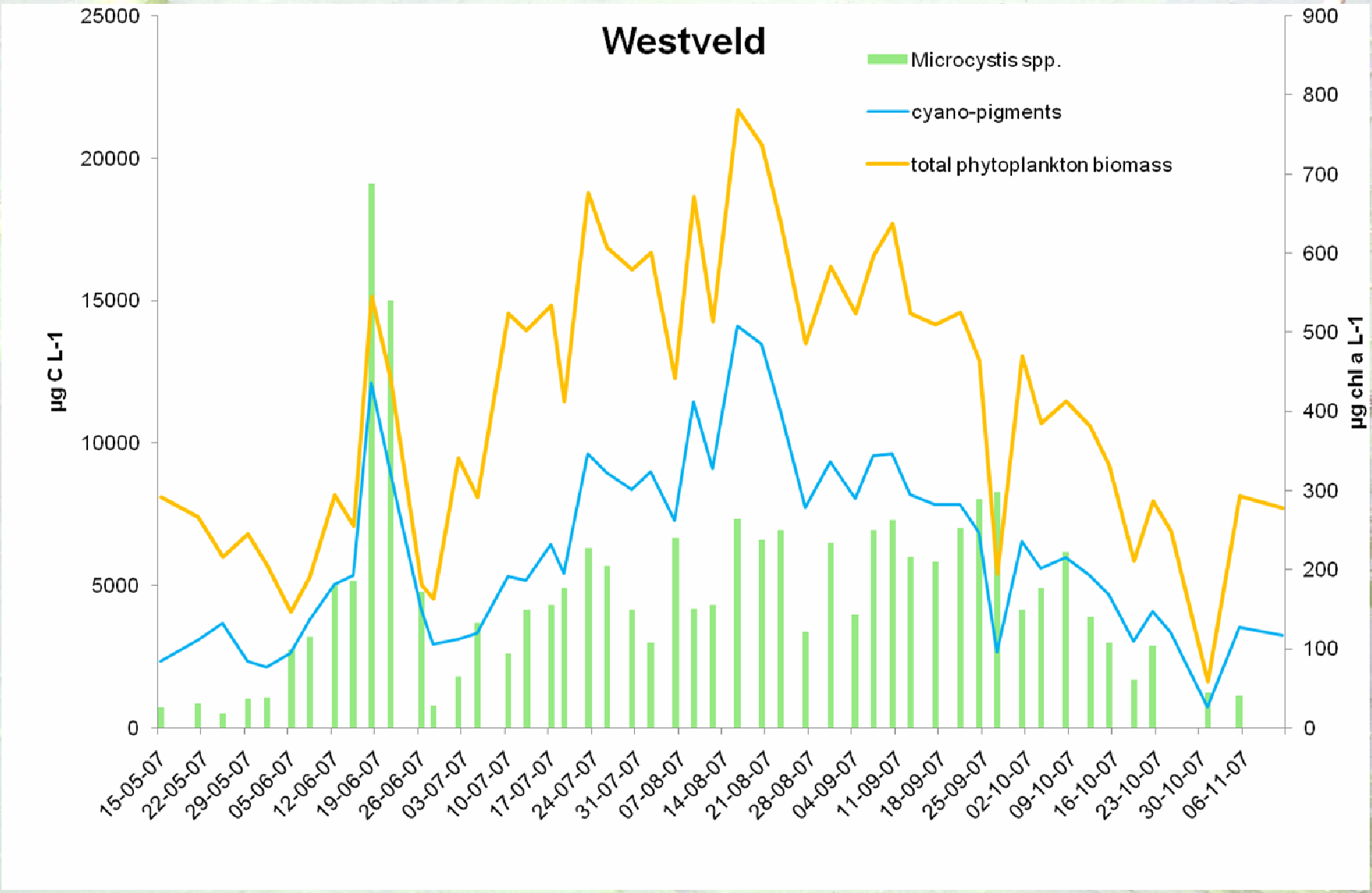


Park Westveld, Sint-Amandsberg

Park Westveld, Sint-Amandsberg

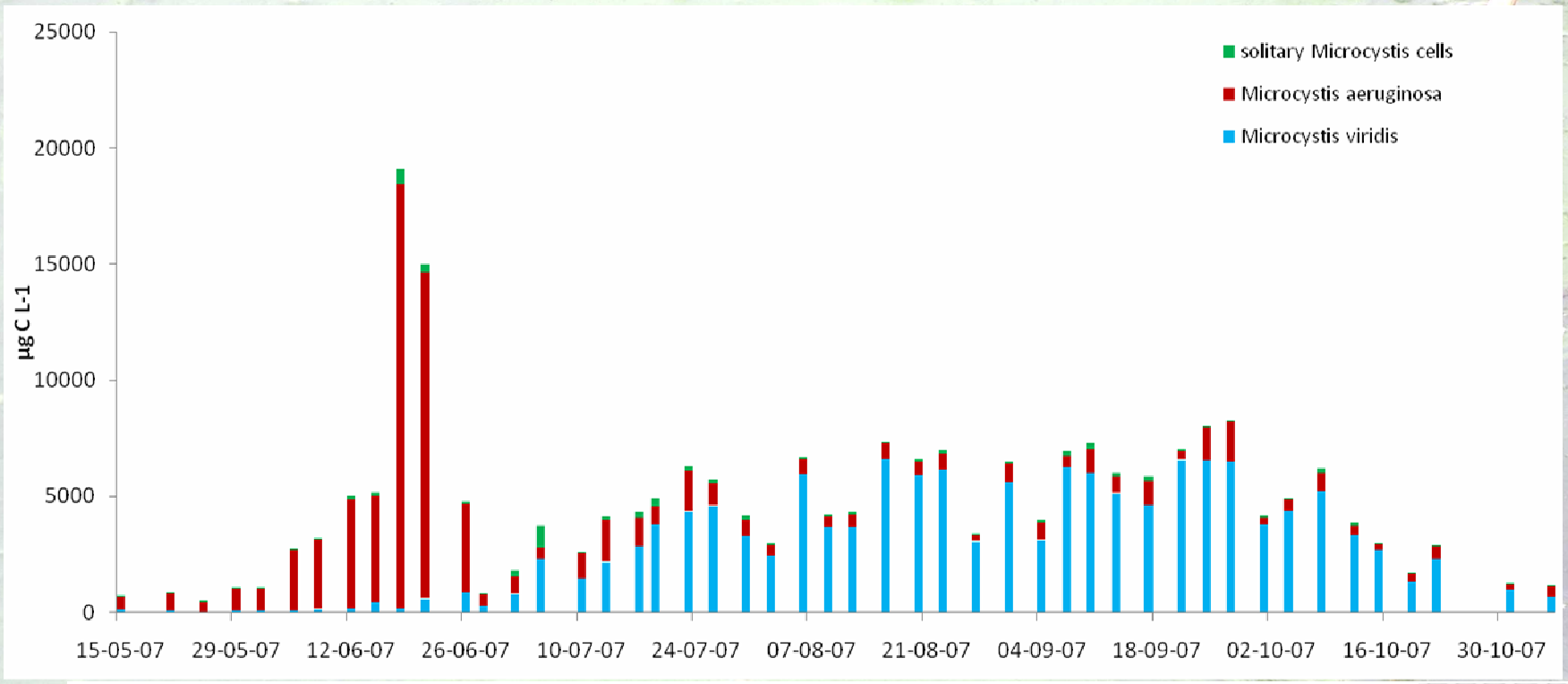


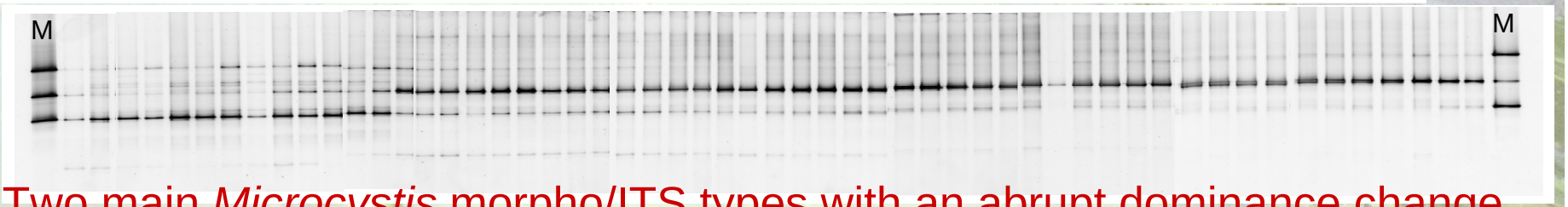
Phytoplankton species composition



Microcystis dominance throughout the growing season

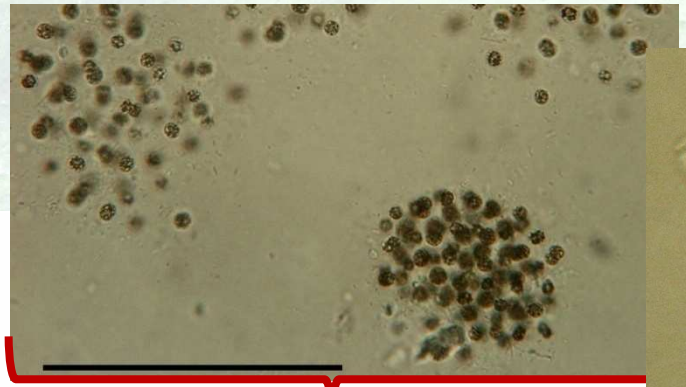
Microscopy and DGGE ITS rDNA *Microcystis*

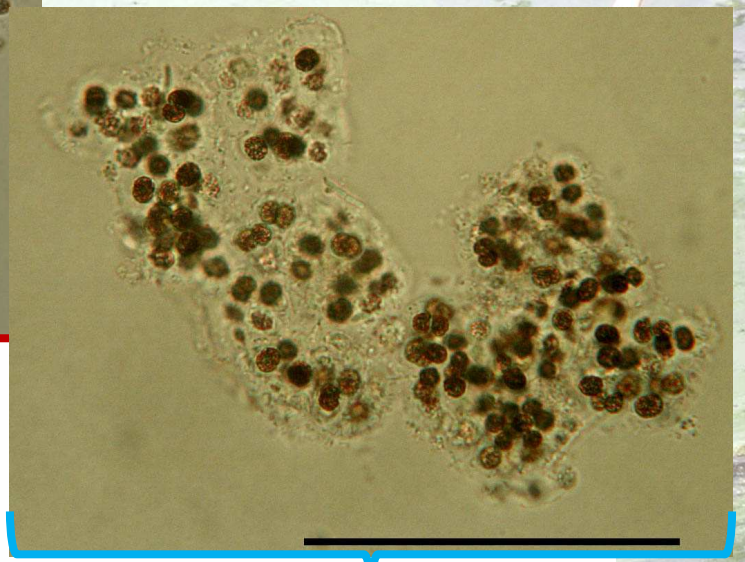


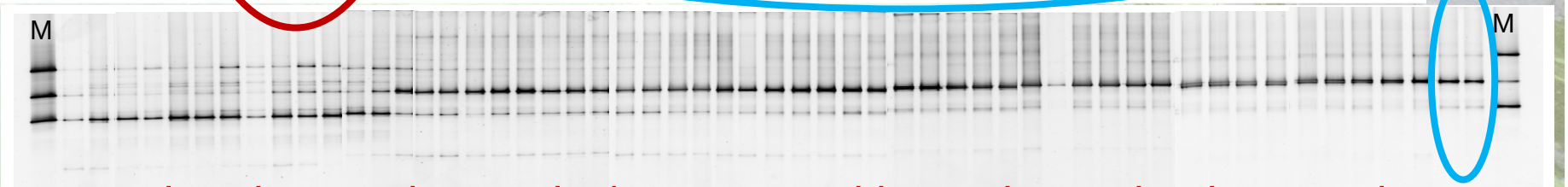


Two main *Microcystis* morpho/ITS types with an abrupt dominance change

Microscopy and DGGE ITS rDNA *Microcystis*

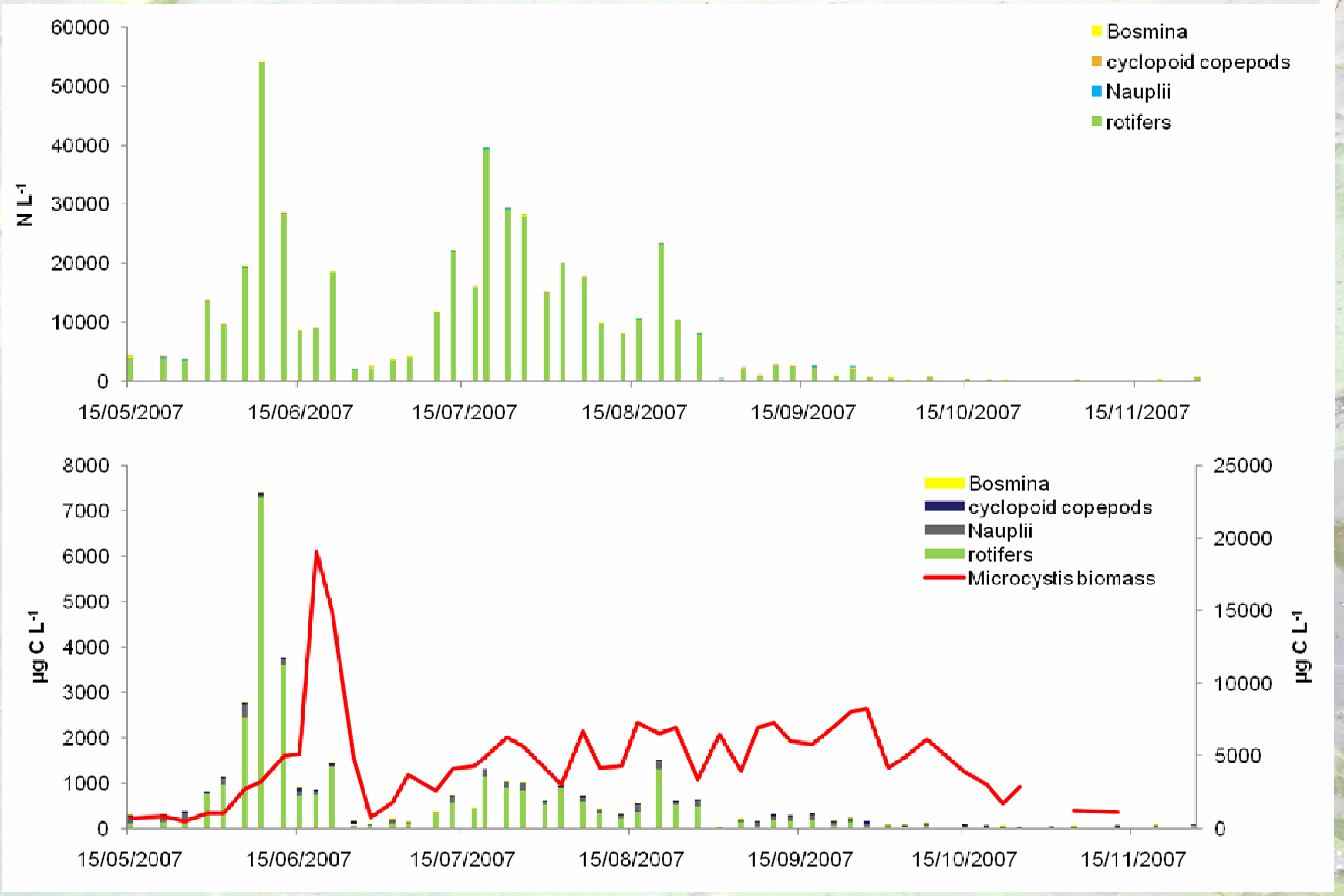




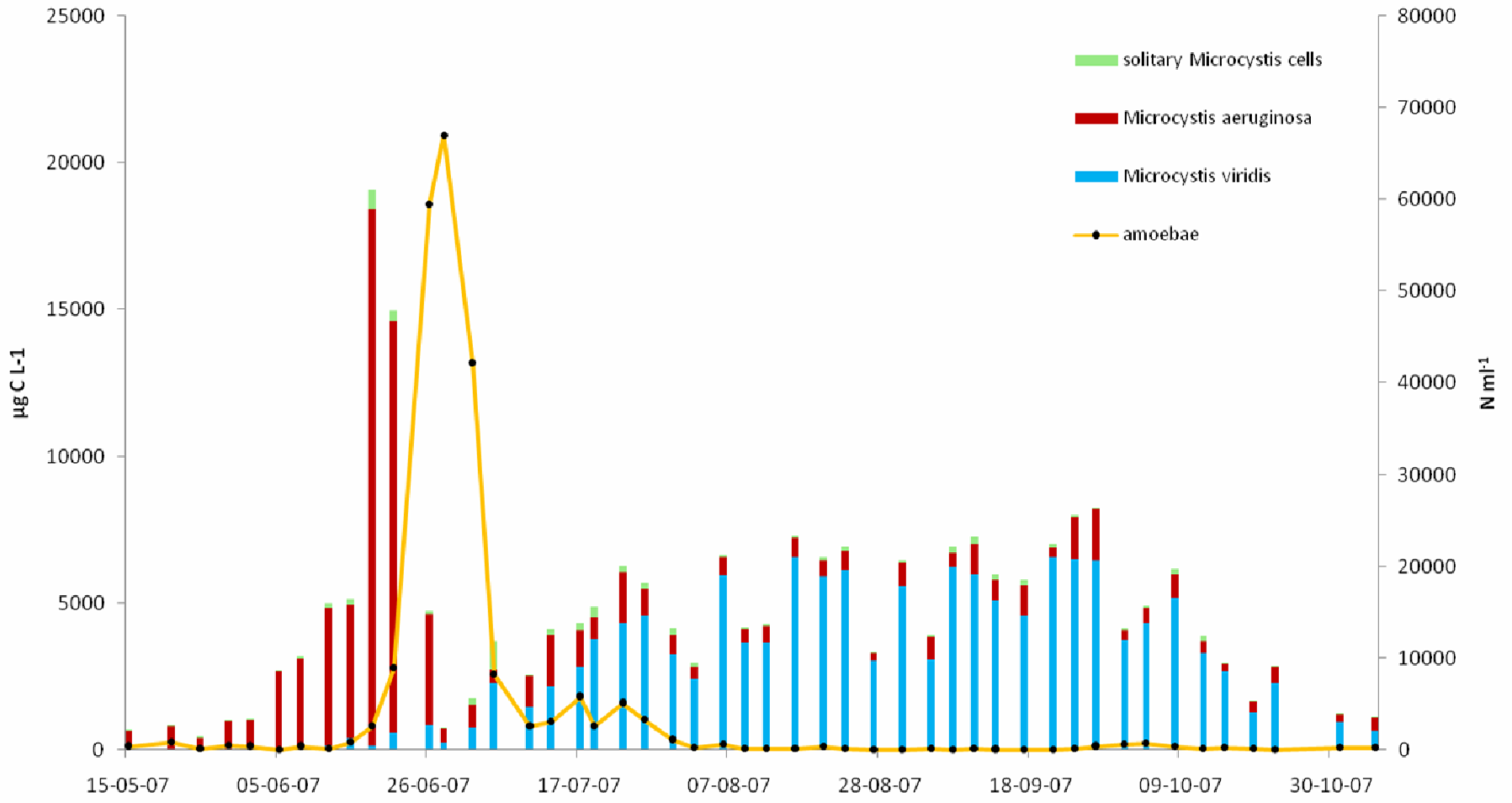


Two main *Microcystis* morpho/ITS types with an abrupt dominance change

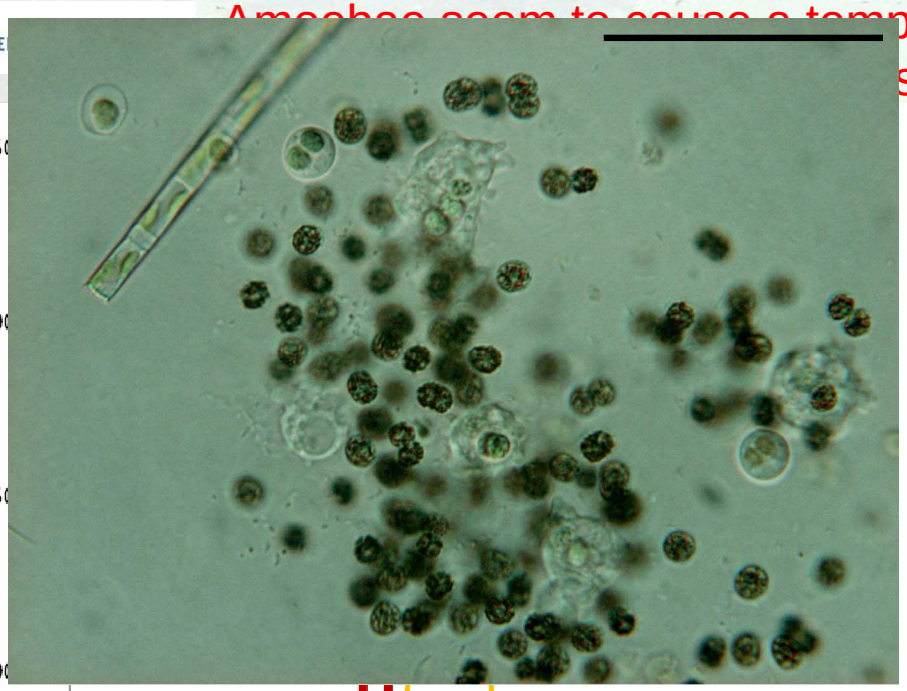
No influence of zooplankton?

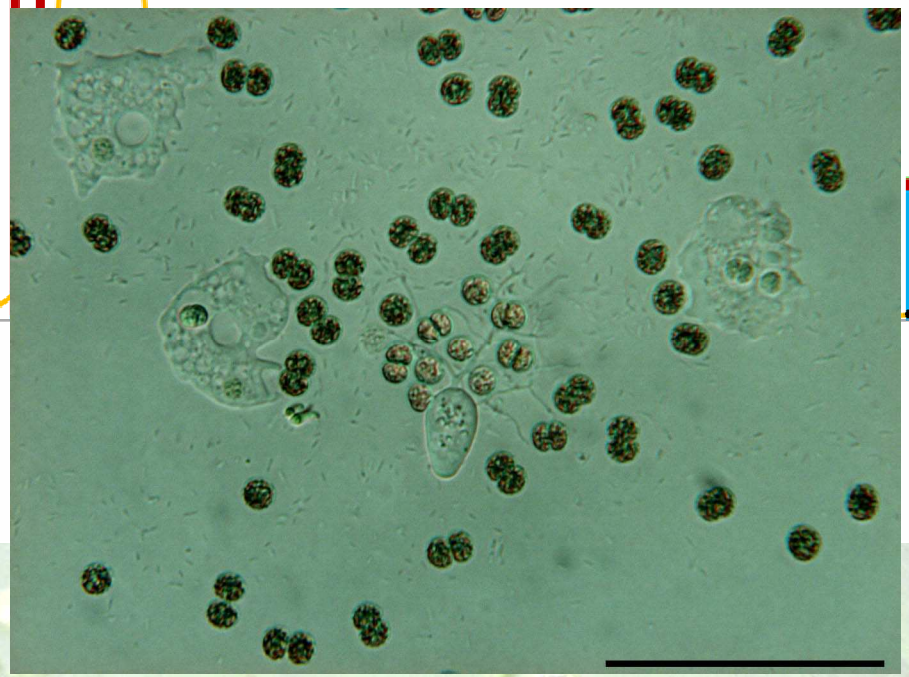


Amoebae seem to cause a temporary bloom collapse and an abrupt change in population structure

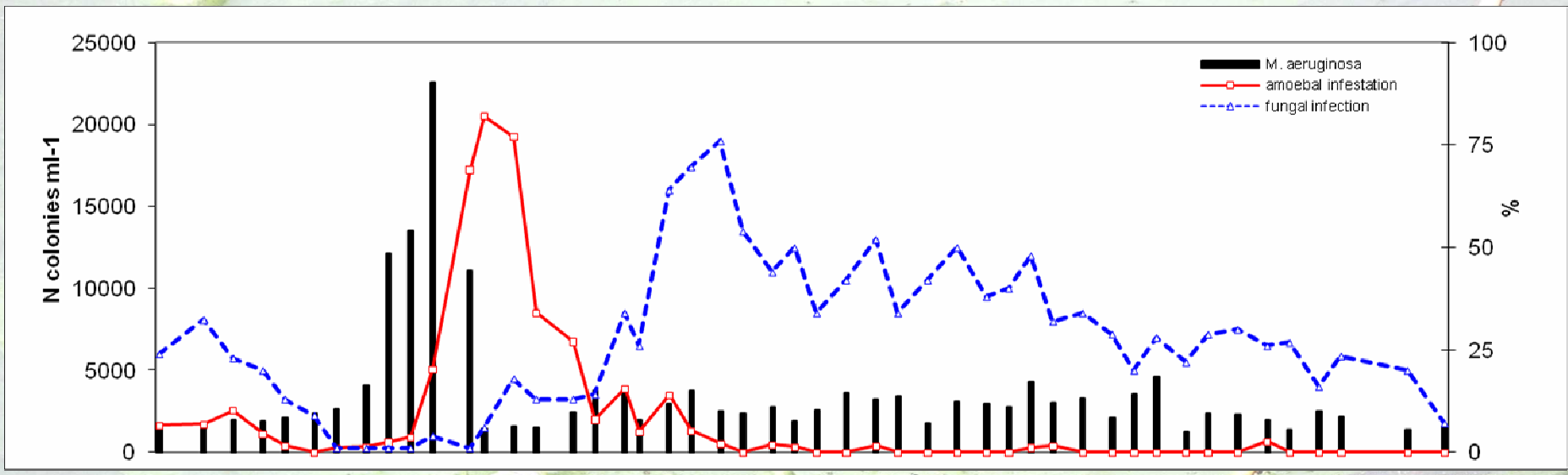


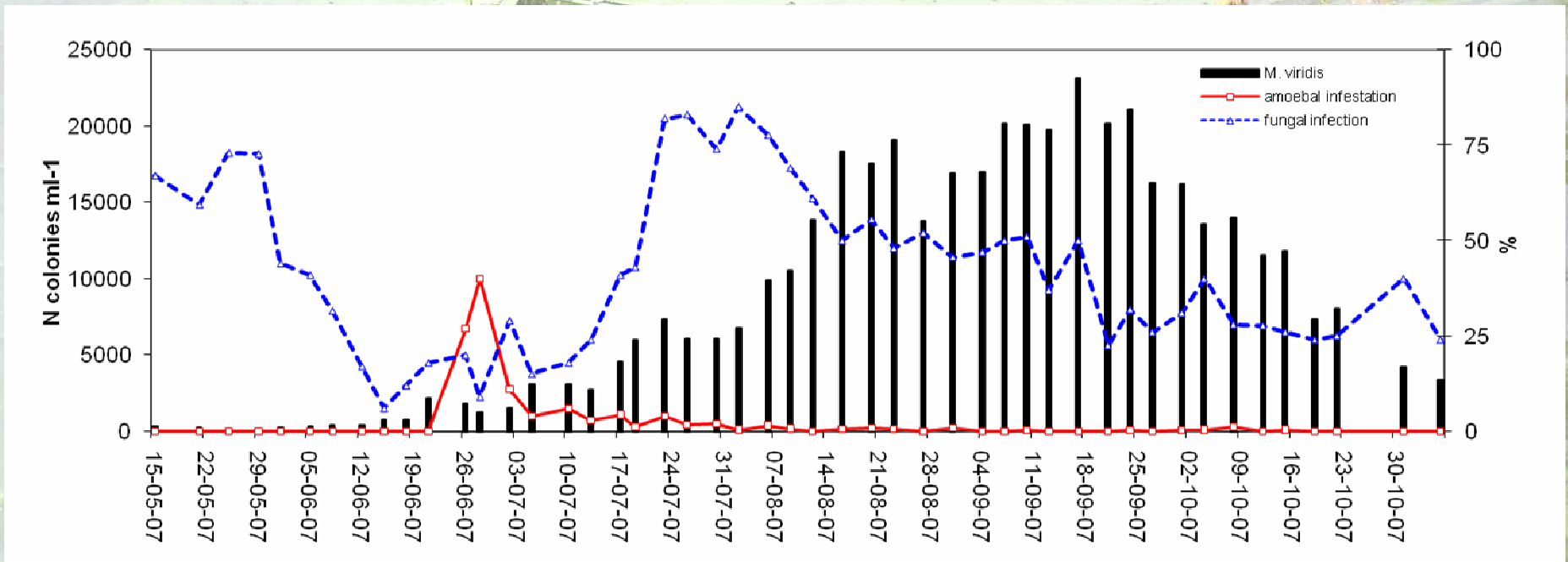
Amoebae seem to cause a temporary bloom collapse and



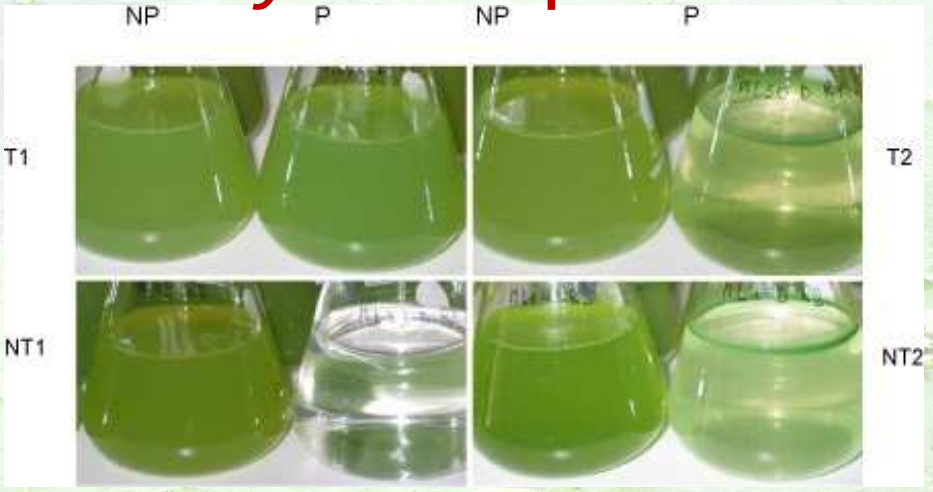


No effects of fungal infections?





Microcystis experiments

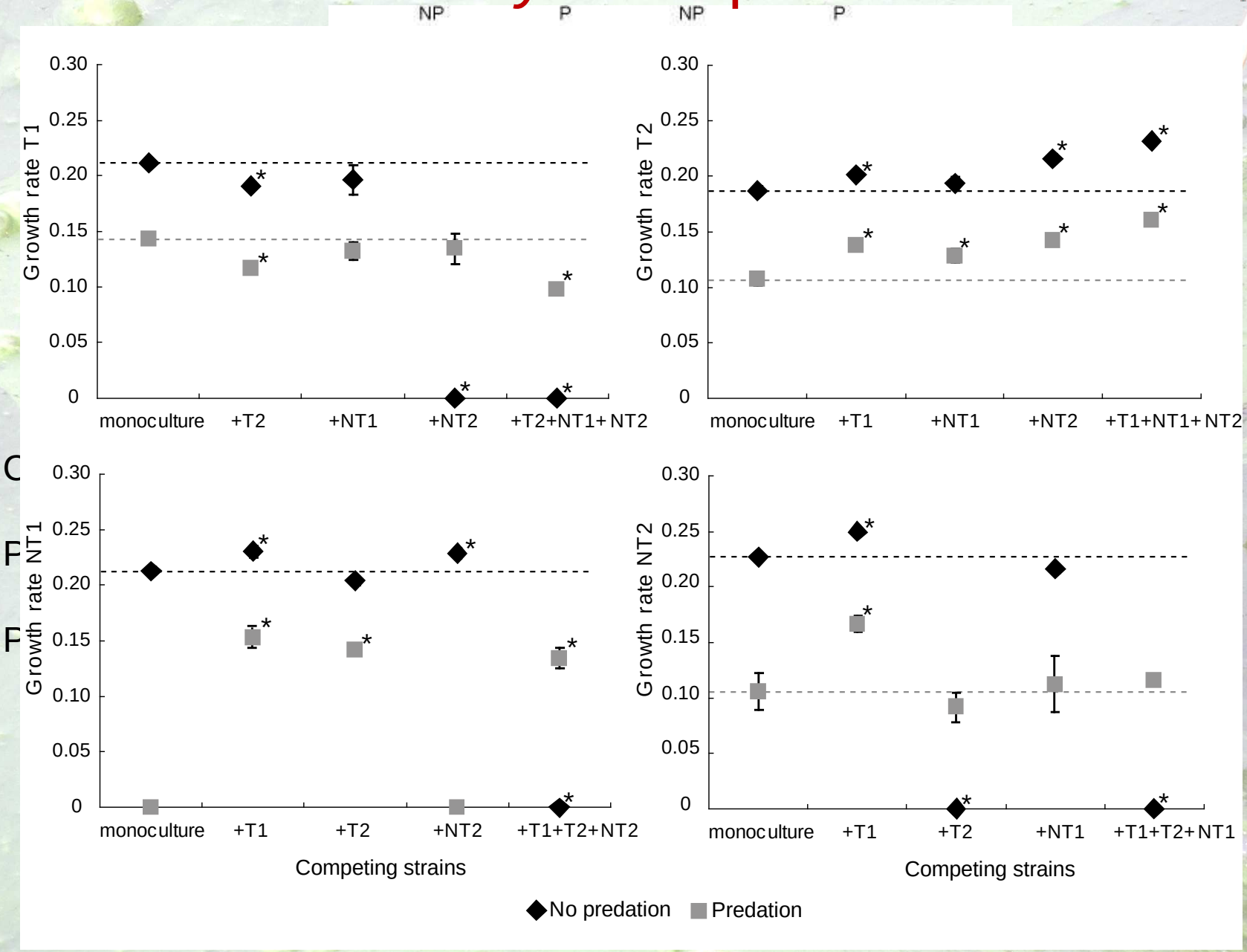


Competitive interactions/facilitation

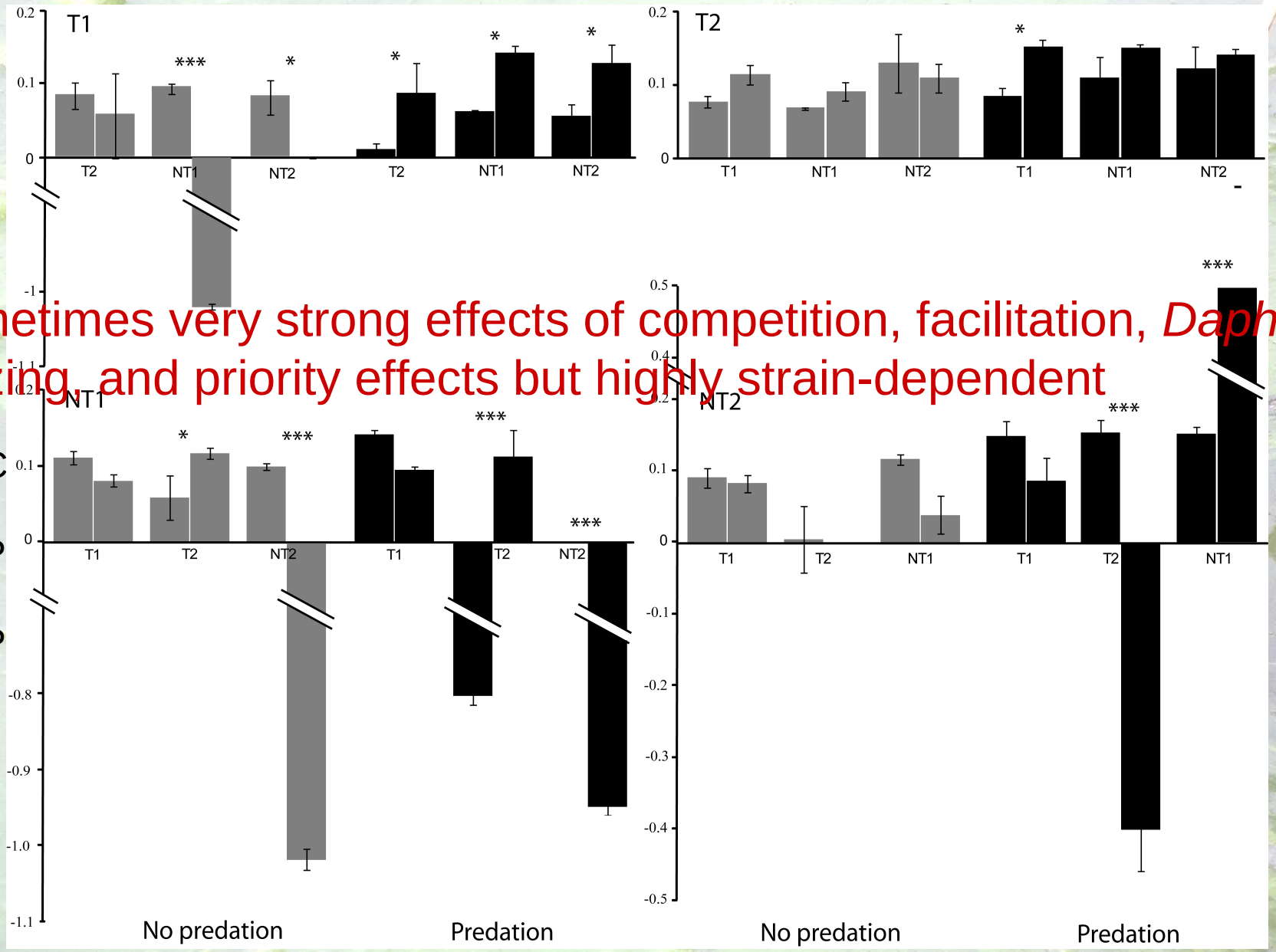
Predation by *Daphnia* and amoebae

Priority effects

Microcystis experiments



Microcystis experiments



Sometimes very strong effects of competition, facilitation, *Daphnia* grazing, and priority effects but highly strain-dependent

Conclusions and prospects

Cyanobacterial blooms are widespread in Flanders and often toxic. The main bloom-forming cyanobacteria are *Microcystis* and *Planktothrix*.

The ITS rDNA population structure of *Microcystis* and *Planktothrix* show large differences as seen by both a bloom field survey and by a study of bloom dynamics in two reference lakes. Environmental factors influencing *Microcystis* population structure were difficult to identify despite large differences between lakes and within lakes.

First results of a study of *Microcystis* bloom dynamics points at predation by amoebae as an important factor in determining *Microcystis* population structure. Laboratory experiments show that competitive interactions, priority effects and grazing by *Daphnia* can determine population composition but effects are highly strain-dependent.

Future work; analysis of bloom dynamics study, amoebae experiments.