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landsbygdsutveckling: Europa  
investerar i landsbygdsområden



Lokalt ledd utveckling

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&*

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REGITO

Research Center on Water and Health



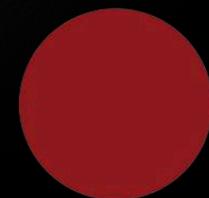
OSBY  
KOMMUN



# *On Cyanobacteria*



**REGITO**  
Research Center on Water and Health



# We fish – We get improvements in water quality But we still get blooms of cyanobacteria!!!



2013-10-13

Photo: Johan Forssblad

Sometimes – and some years – we have no cyanobacteria!



BJÖRQVIKEN, FINJASJÖN, 2012-08-19

*Photo: Johan Forssblad*

But sometimes the cyanobacteria are swimming to the public swimming place!



BJÖRKVIKEN 2017-07-19

*Photo: Johan Forssblad*

Let us dive into the world of cyanobacteria  
500 genera, 2000 species



Photo: © Gertrud Cronberg

Cyanobacteria can be aquatic and terrestrial  
Aquatic cyanobacteria can be planktonic or benthic  
Consequently, these different species occupy different  
ecological niches



Photo: © Johan Forsblad  
Foto: Johan Forsblad

Photo: © Helène Annadotter

**Woronichinia naegeliana - was present in the bloom of Lake Immeln  
in 2012**

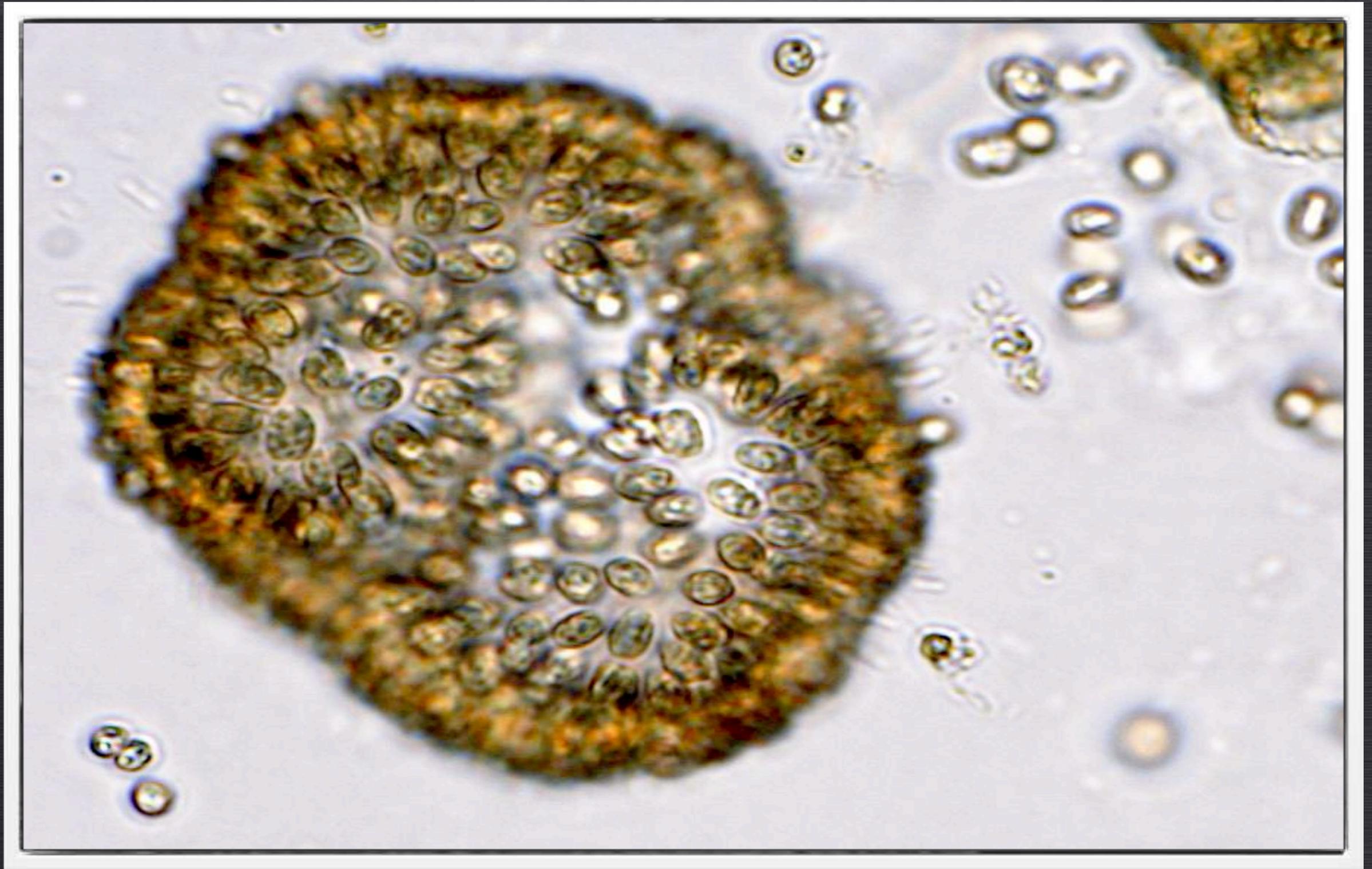


Photo: © Gertrud Cronberg

# Microcystis botrys - was present in the bloom of Lake Immeln in 2012

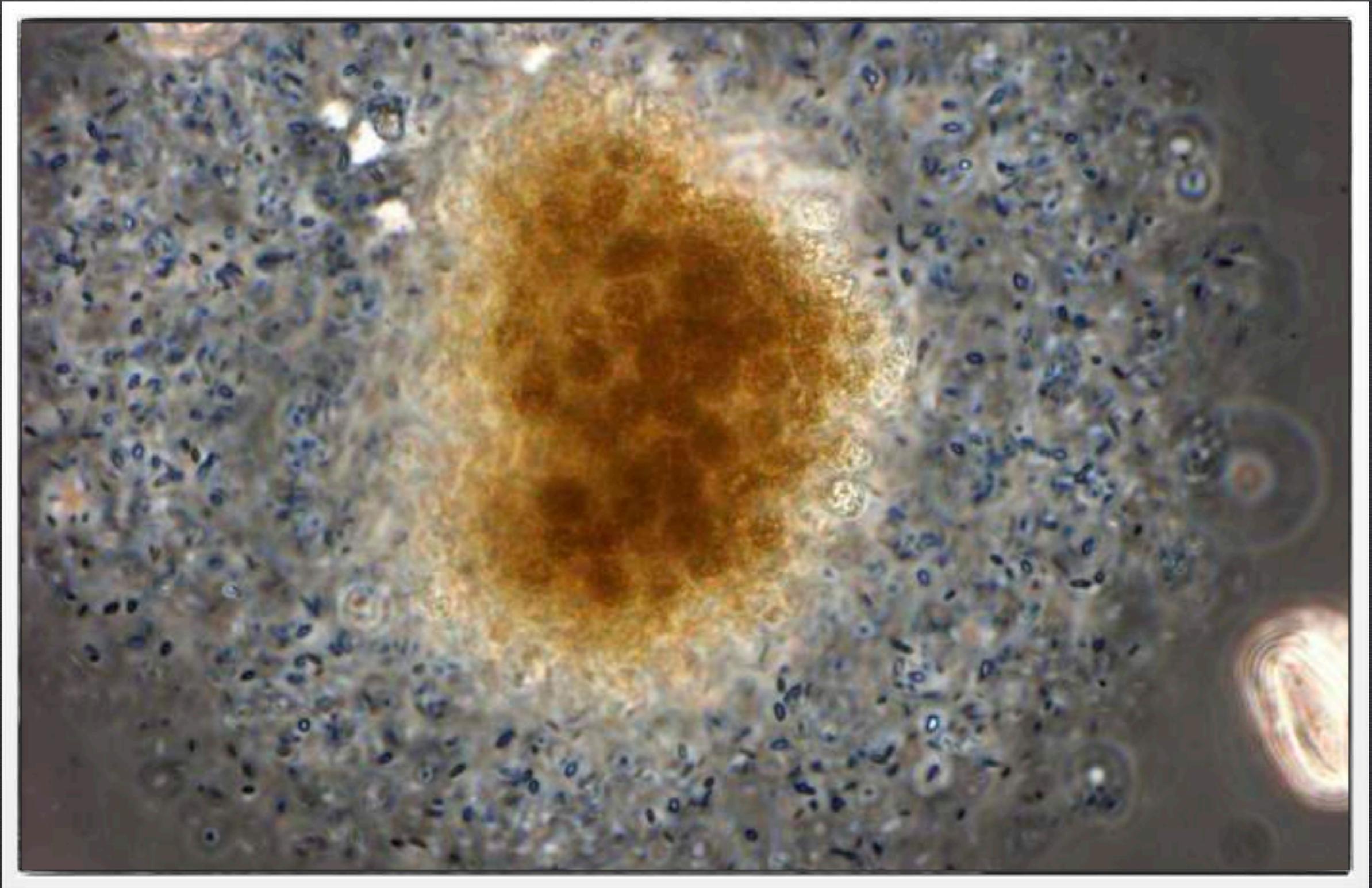


Photo: © Gertrud Cronberg

# Oscillatoria at the bottom of Lake Immeln

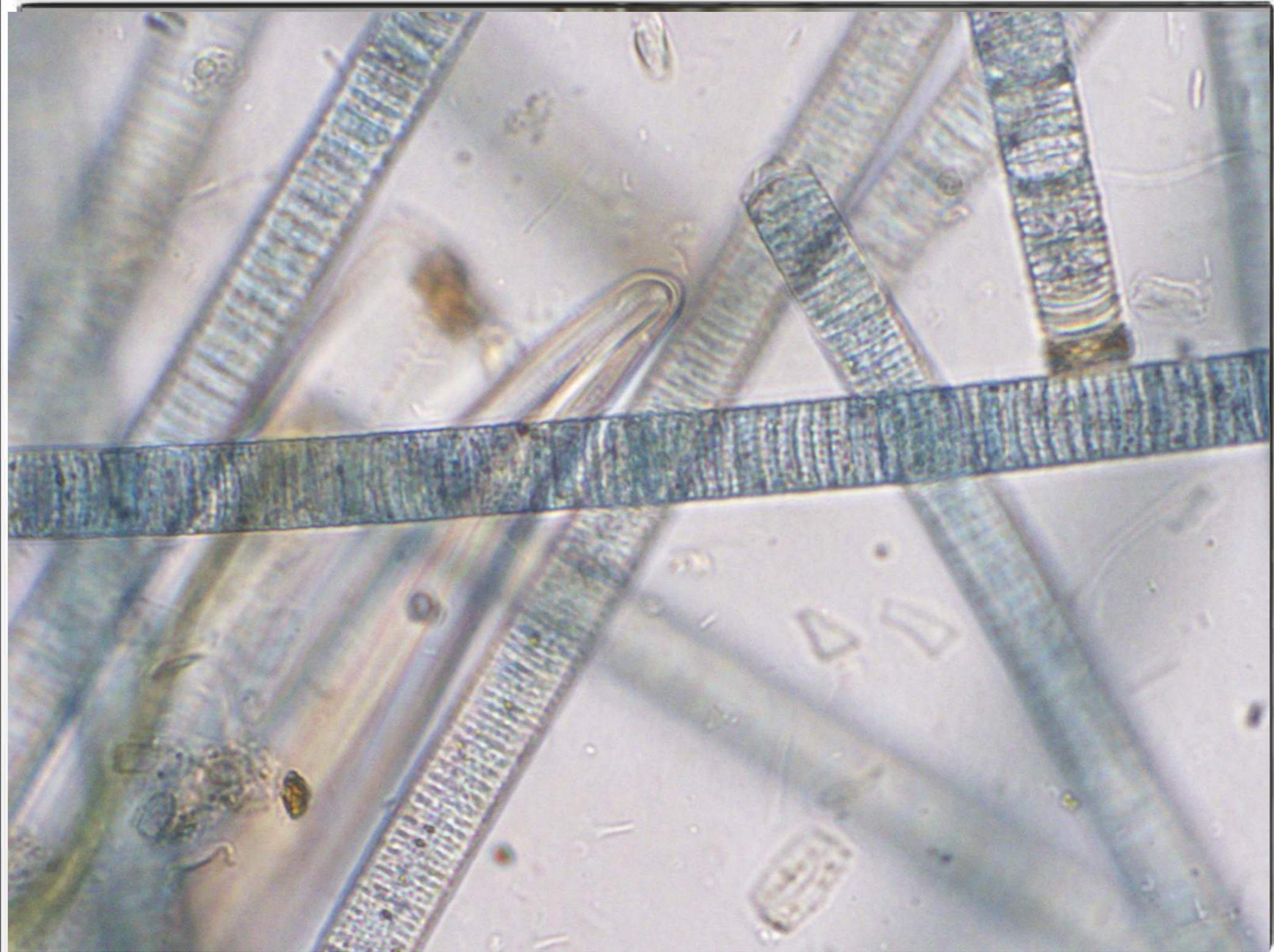


Photo: ©Johan Forsslad



The cyanobacterium  
*Oscillatoria limosa*  
at the bottom of the River  
Almaån

2017-06-22

Photo: Johan Forsblad

# Anabaena lemmermannii - was present in the bloom of Lake Osbysjön in 2018



Photo: © Gertrud Cronberg

**Nodularia spumigena - distributed worldwide  
Forms water blooms in the Baltic Sea**



Photo: © Gertrud Cronberg

# A bloom of *Nodularia* attacks an island close to Öland



KALMARSUND, SWEDEN, 2003

*Foto: Johan Forsblad*

# Arthrospira platensis from the bottom of Lake Immeln

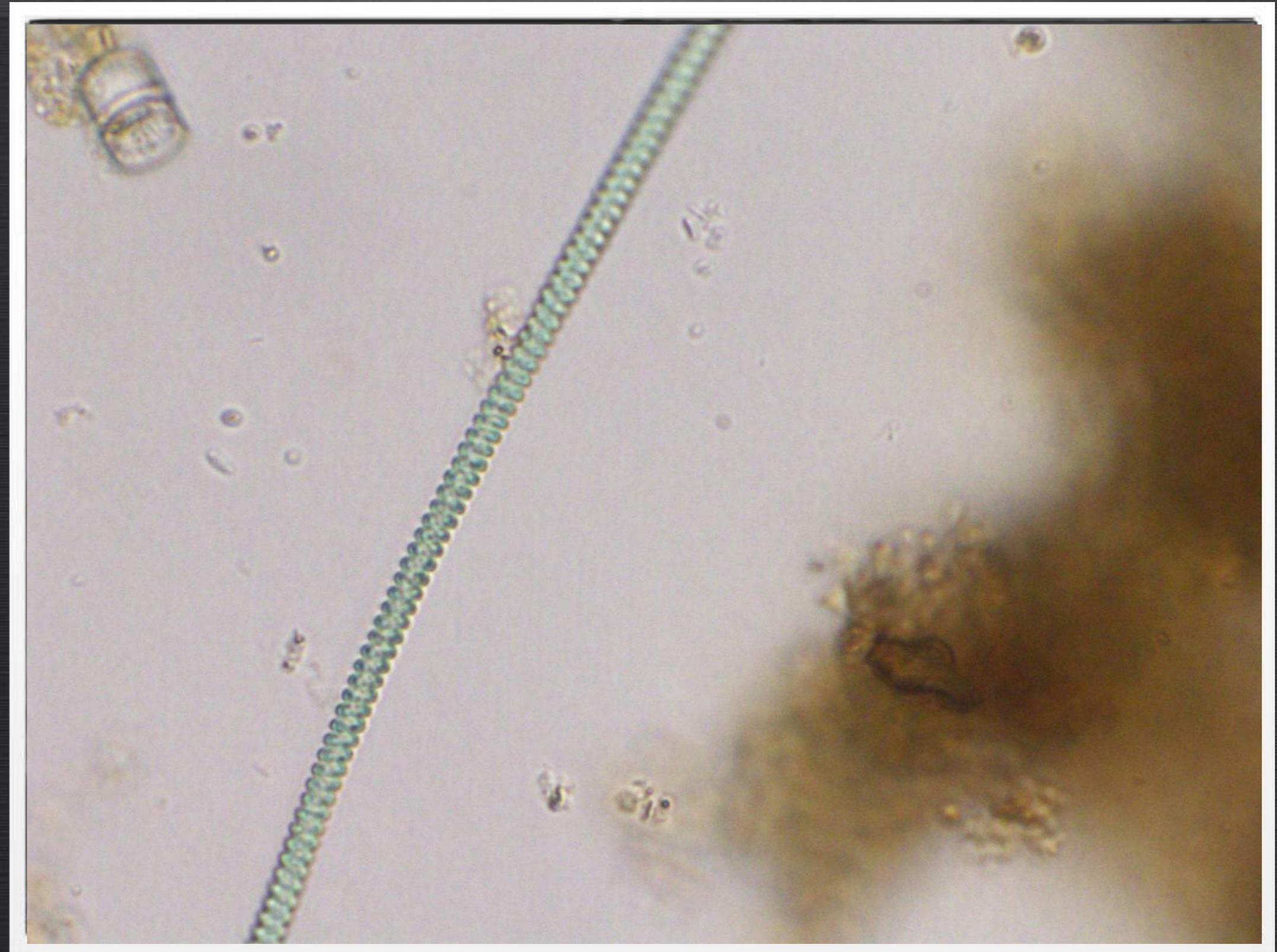


Photo: ©Johan Forsblad

# Arthrospira platensis

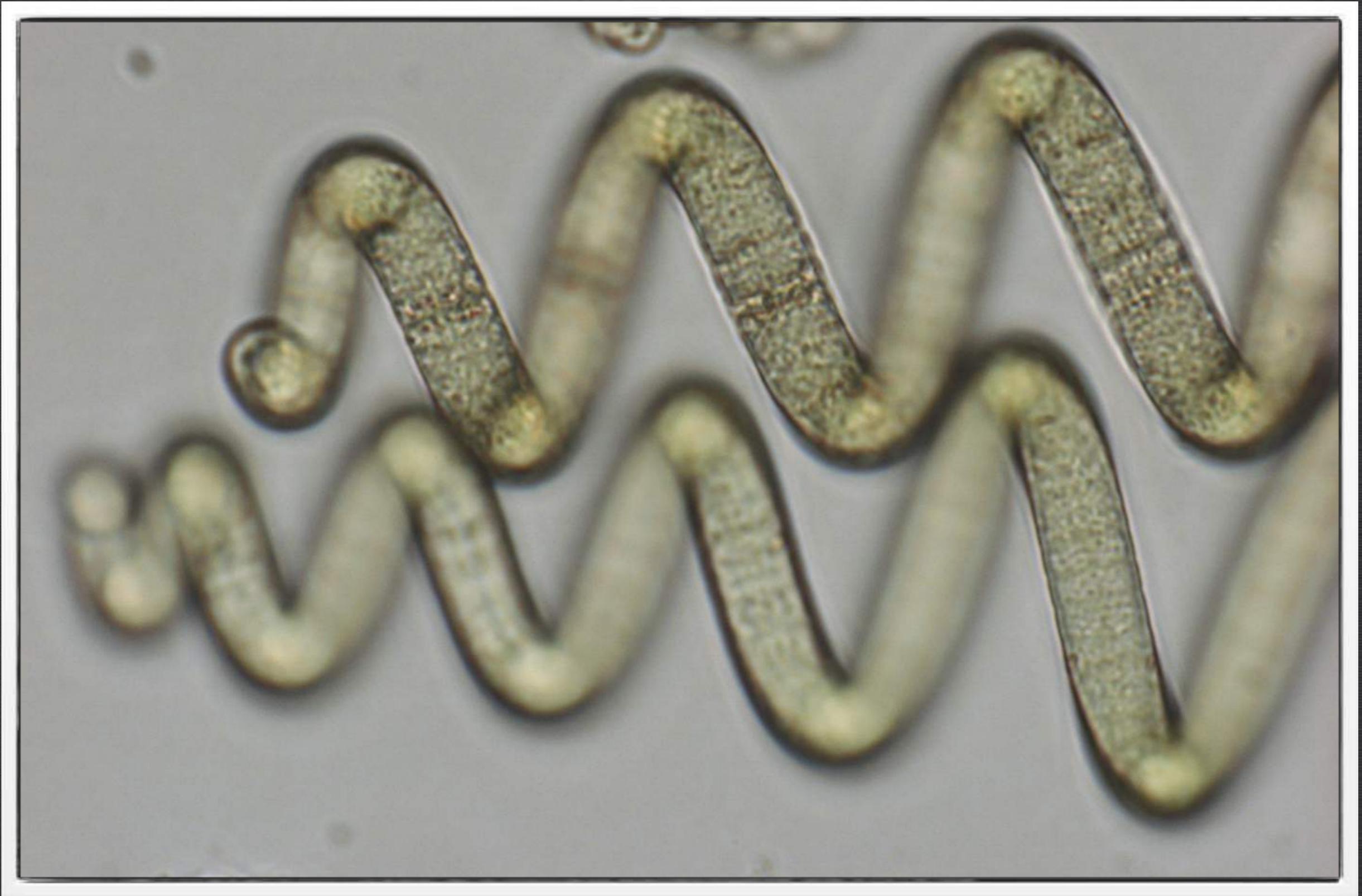


Photo: © Gertrud Cronberg

Arthrospira platensis is cultivated as health food  
- and an important food for flamingos in the soda lakes of Rift Valley

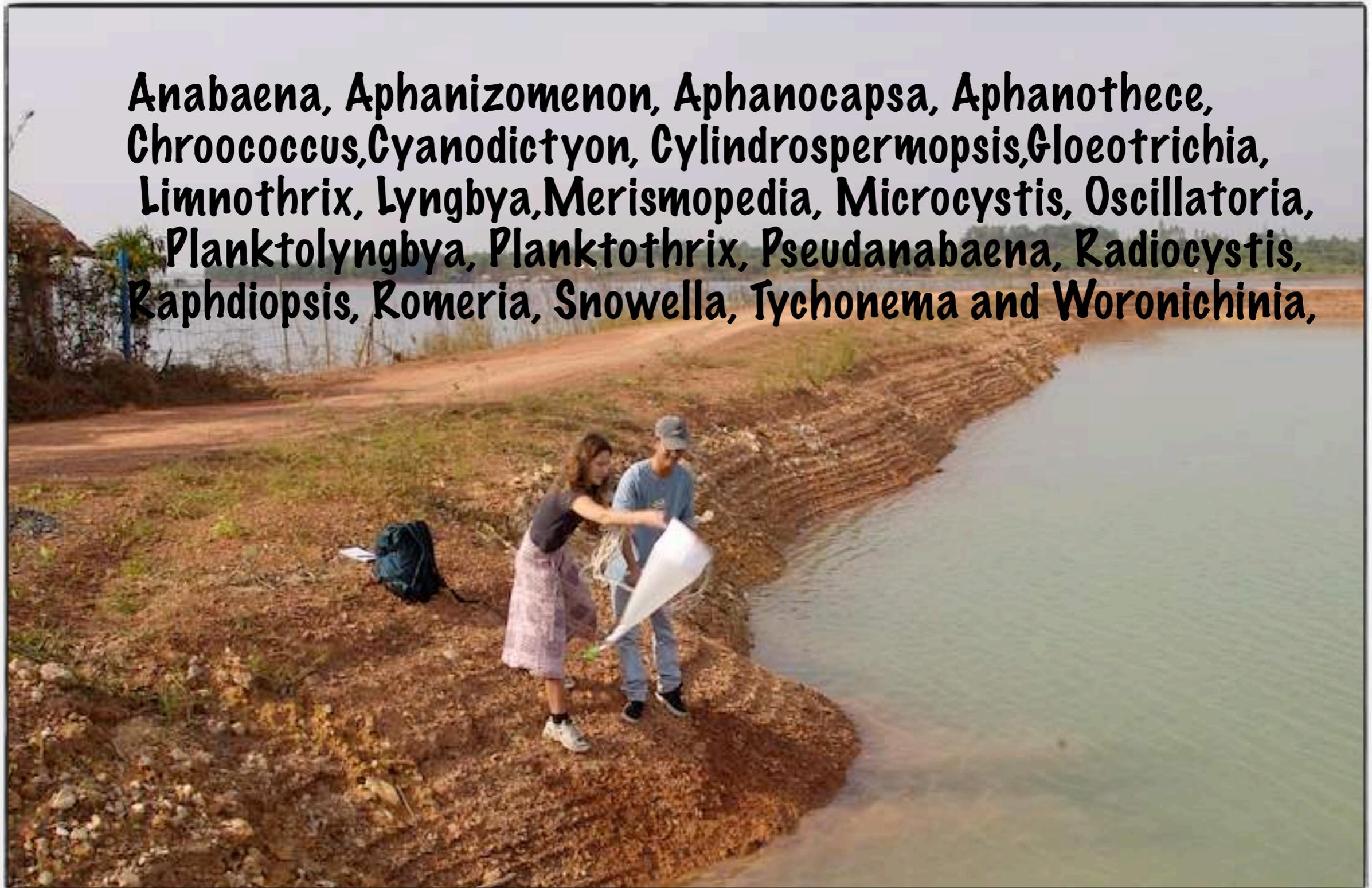


NAKURU, KENYA

*Foto: Johan Forsblad*

**A large number of cyanobacterial genera occur in freshwater  
such as:**

**Anabaena, Aphanizomenon, Aphanocapsa, Aphanothece,  
Chroococcus, Cyanodictyon, Cyndrospermopsis, Gloeotrichia,  
Limnothrix, Lyngbya, Merismopedia, Microcystis, Oscillatoria,  
Planktolyngbya, Planktothrix, Pseudanabaena, Radiocystis,  
Raphdiopsis, Romeria, Snowella, Tychonema and Woronichinia,**

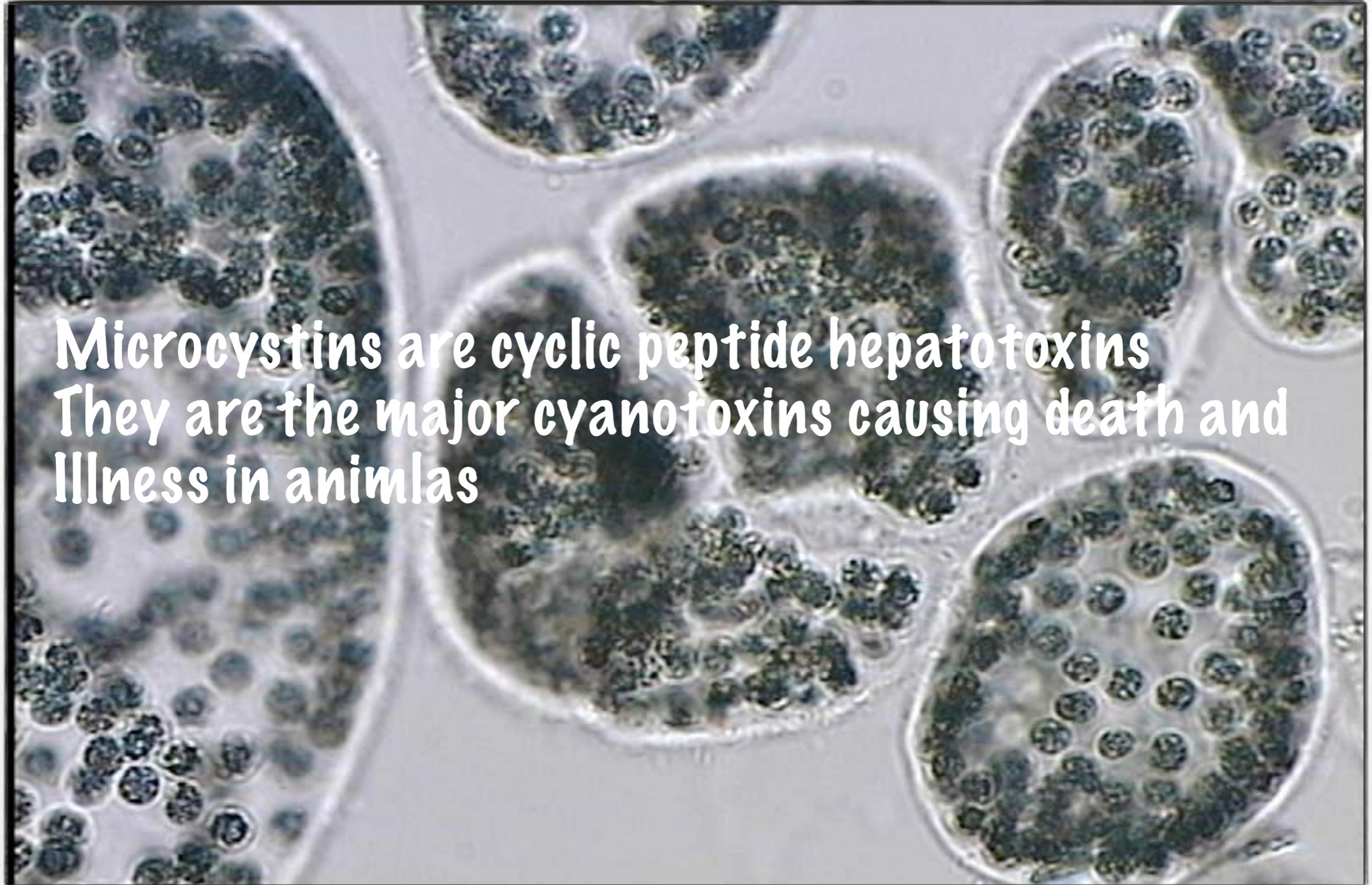


Cyanobacteria that can form blooms in marine waters include *Trichodesmium*, *Synechococcus*, *Synechocystis*, *Aphanizomenon* and *Nodularia*



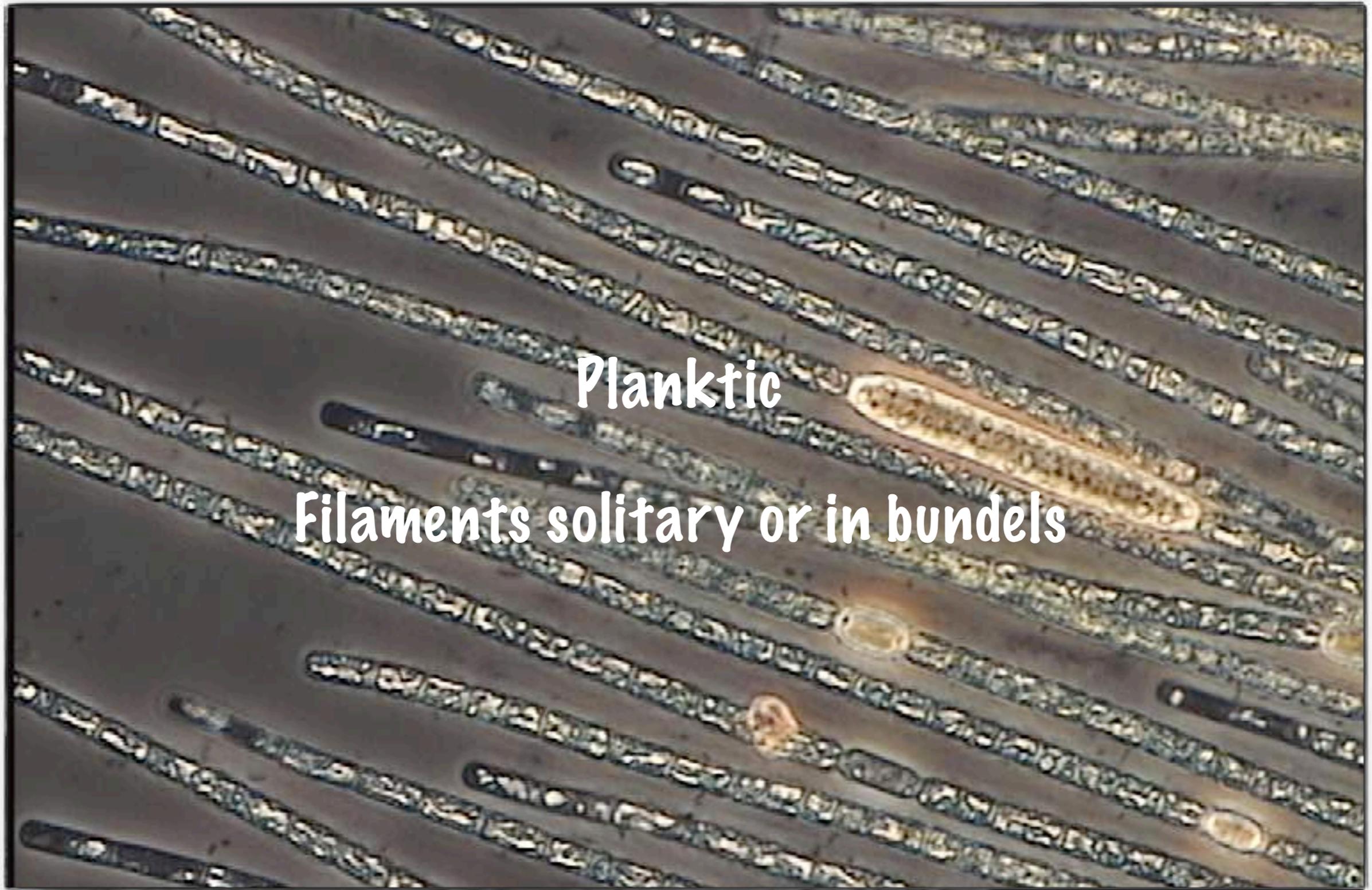
Photo: © Helène Annadotter

# Microcystis



**Microcystins are cyclic peptide hepatotoxins  
They are the major cyanotoxins causing death and  
illness in animals**

# Aphanizomenon



Planktic

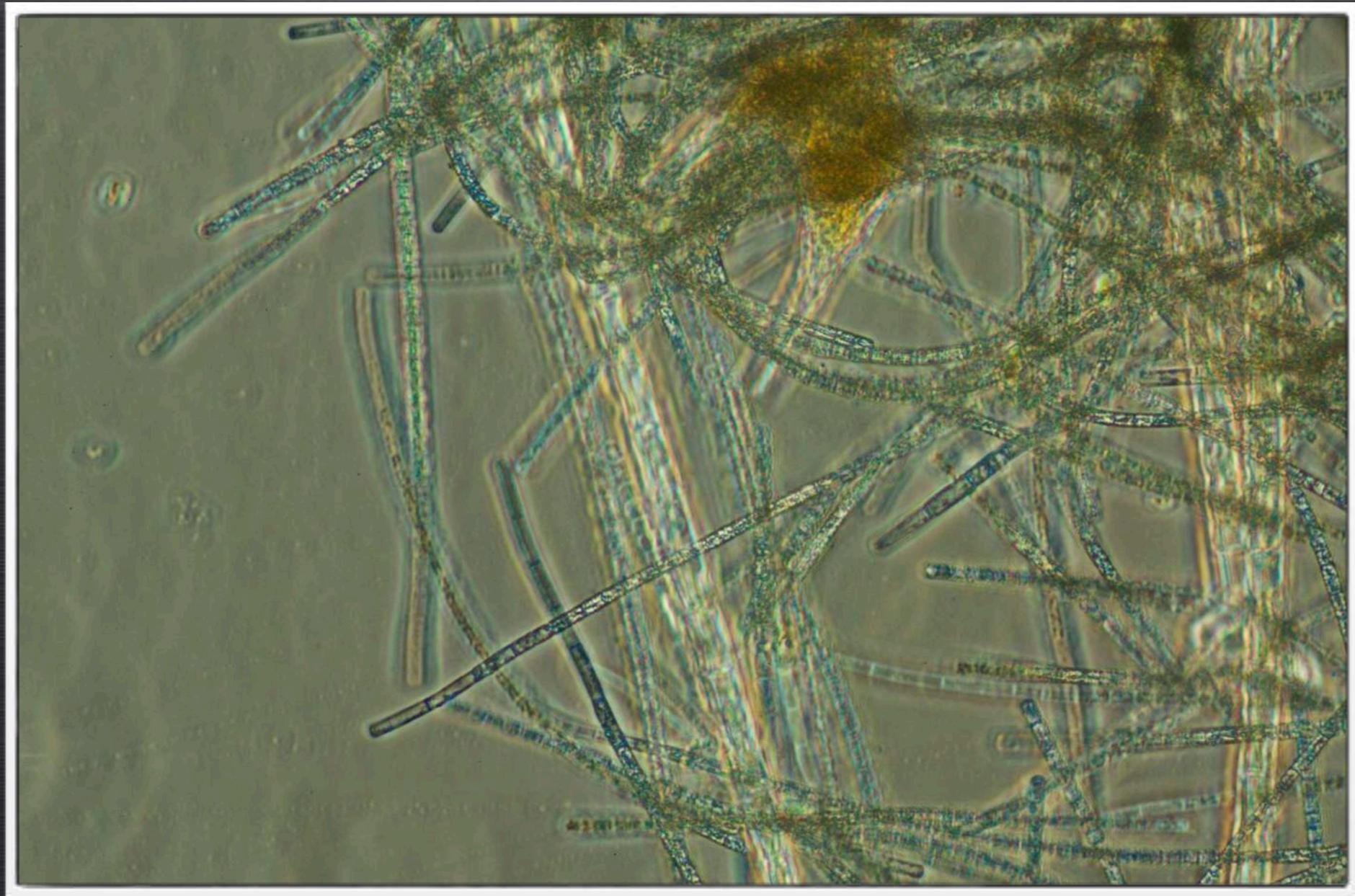
Filaments solitary or in bundles

# A mass development of *Aphanizomenon yezoense* in Lake Finjasjön September 2017



Photo: ©Johan Forsblad

The bloom was dominated by the cyanobacterium *Aphanizomenon yezoense*!



MICROSCOPE PHOTO FROM LAKE FINJASJÖN WATER 2017-08-21

*Photo: Johan Forsblad*

At the end of the 20<sup>th</sup> century, mass developments of cyanobacteria were observed with increasing frequency in most parts of the world  
(Hoeger et al., 2005)



LAKE EAST RINGSJÖN, SWEDEN, 1985

*Photo: ©Gertrud Cronberg*

# What is causing the blooms of cyanobacteria?



Photo: © Gertrud Cronberg

The Swedish lakes will (?), in 2027, reach  
"Good ecological status"

That is, eliminate cyanobacteria mass developments!  
HOW?

The water authorities is focusing on reducing the  
external load of phosphorus



# Information from Havs- och Vattenmyndigheten on algal blooms.

► Är algblooming giftigt?

► Hur ser algblooming ut?

► Vad är orsaken till algbloomingarna?

► Vad ska man göra vid algblooming?

▼ Hur kan vi minska algbloomingen?

Viktigt för att minska algbloomingarna är att minska näringstillförseln till våra vatten, något som måste minska både nationellt och internationellt.

Till exempelvis försöker östersjöländerna tillsammans minska näringstillförseln till Östersjön. Tillförseln av fosfor ska minska med nästan 15 200 ton, varav Sverige ska minska tillförseln med 530 ton. Om detta arbete lyckas, förväntas blomningarna av den giftiga cyanobakterien att minska inom 10 till 15 år.

Vad kan jag göra?

Som privatperson kan du bidra till att minska näringsbelastningen på flera sätt. Det kan tyckas litet, men många små källor blir sammanlagt till ett stort problem. Några exempel:

- **Töm båttoa i land.** Detta är särskilt viktigt eftersom båttoaletter används under sommaren, när algerna växer mest.
- **Kissa inte i vattnet.** Den mängd som en person normalt kissar under ett dygn ger gödning till ett kilo alger.
- **Avgaser har en gödande effekt, tanka därför gräsklipparen och utombordaren med alkylatbensin, inte den vanliga från bensinmacken.**
- **Välj fosfatfria hushållskemikalier om ditt avlopp inte är anslutet till ett reningsverk.**

► Var hittar jag aktuell information om algblooming vid min badplats?

Informationscentralen för Västerhavet

Informationscentralen för Bottniska viken - ICBV

Badplatsen

**Miljöpåverkan**

- Avlopp ►
- Fritidsbåtar ►
- Fysisk påverkan ►
- Försurning av sjöar och vattendrag ►
- Havsförsurning ►
- Jordbruk
- Klimat
- Marint skräp ►
- Miljöfarliga ämnen ►
- Oljeutsläpp ►
- Sjöfart
- Vattenbrist ►
- Vrak ►
- Övergödning ▼
- Algblooming
- Vad gör vi åt övergödningen?

# Advices from "Havs- och vattenmyndigheten



Don't pee in the water  
Use alkylatpetrol for your lawnmower  
Empty your boattoilet in the harbor

Sweden will decrease the load of phosphorus with 530 tons. If we succeed with this, we will reduce the toxic algal blooms in the Baltic Sea within 10-15 years  
"Havs- och vattenmyndigheten"

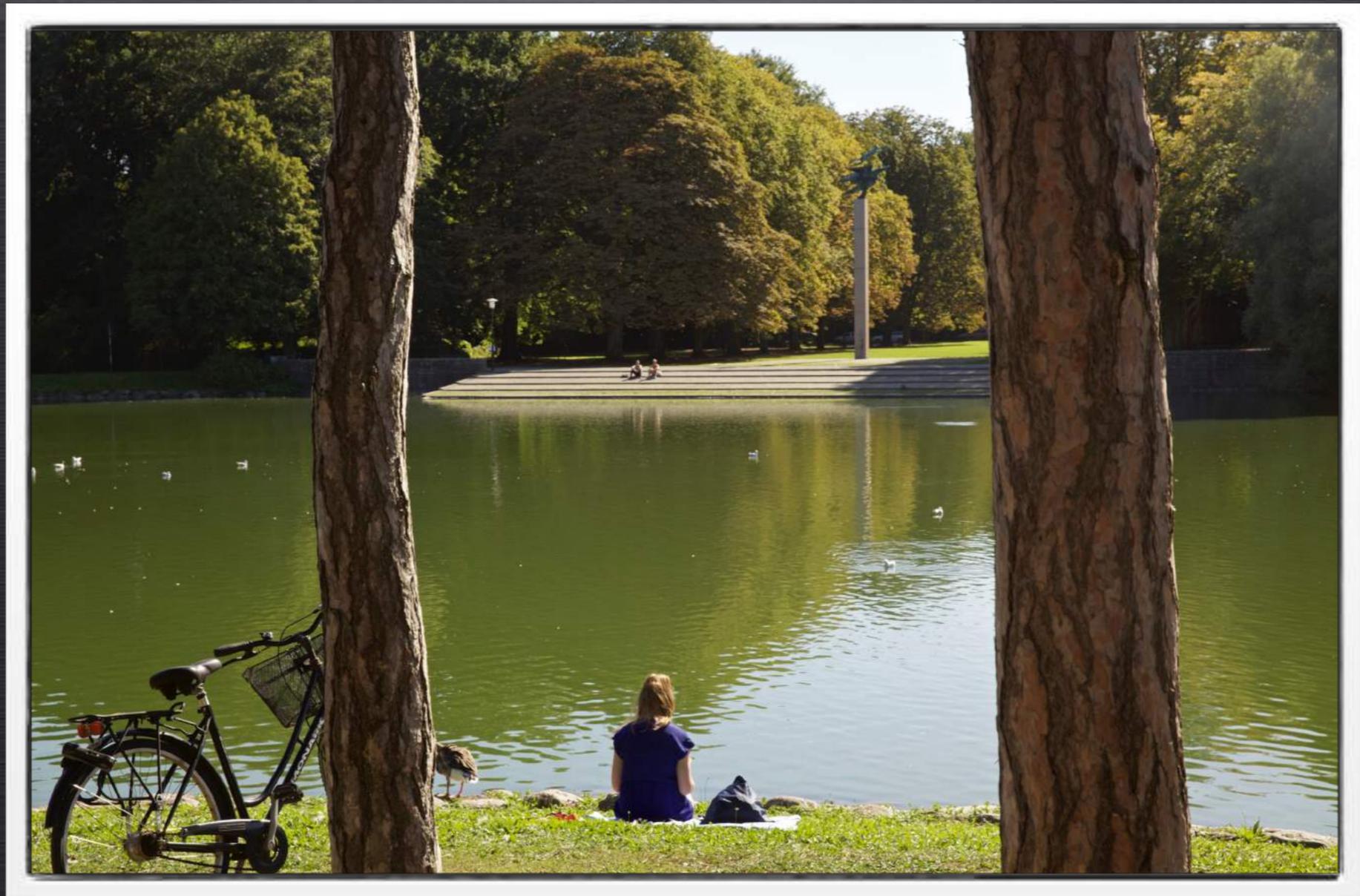


Photo: ©Johan Forssblad

Which scientific facts is this calculation based on?  
Is it really that simple? Is there a  
dose-response relationship between total phosphorus  
and algal biomass?



Photo: ©Johan Forsblad

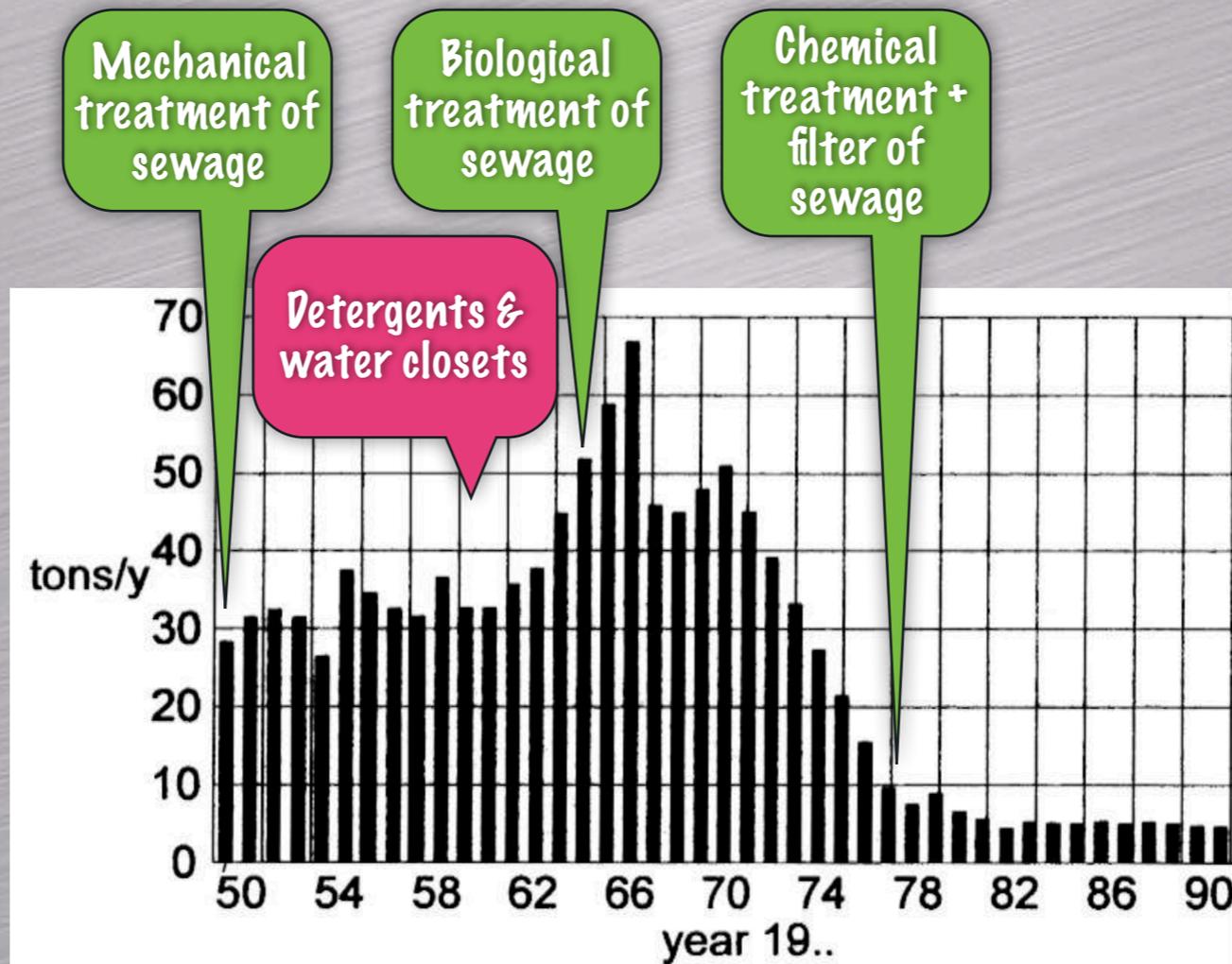
We have plenty of data from Lake Finjasjön



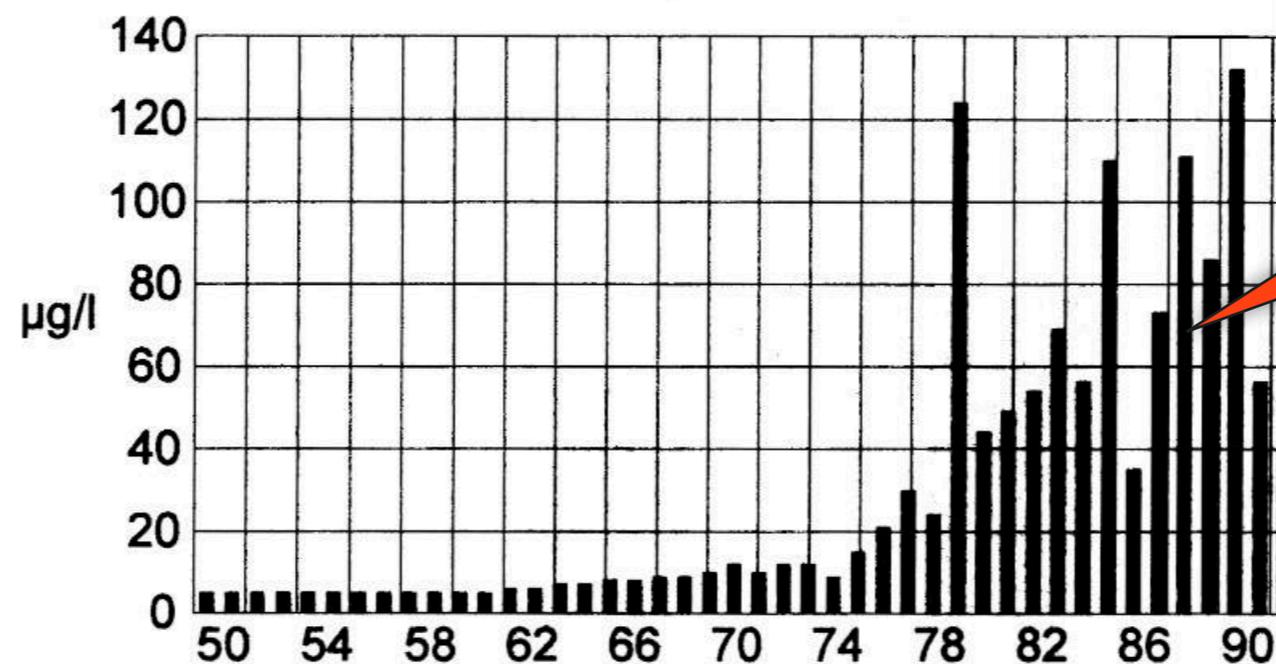
LAKE FINJASJÖN, HÄSSLEHOLM, SWEDEN

# The total P load was reduced to 7% Despite this, the algae increased

Phosphorus  
to the lake:



Chlorofyll a  
in the lake:



... the  
chlorofyll  
level  
exploded ...

A Swedish study on the response of reduced external P load showed that 50% of the recipient lakes did not show any improved water quality after installation of phosphorus precipitation in Swedish sewage treatment plants



ALMA Å –THE WATER INTAKE TO HÄSSLEHOLM 1989

*Photo: ©Heléne Annadotter*

The relationship between loading of external phosphorus and cyanobacteria occurrence is generally regarded as an axiom.  
But we have to question it !!!



LAKE FINJASJÖN 2007-06-08

*Photo: ©Johan Forssblad*

We want to get rid of cyanobacteria blooms in our lakes!  
That is what matters!



THE DAM 2017-08-21

*Photo: Johan Forsblad*



*Photo: ©Johan Forsblad*

**Dramatically reduced P loading did not  
diminish algal biomass in many lakes  
In several oligo–mesotrophic lakes  
heavy and toxic blooms of develop occasionally**

Lake Immeln is a nutrient-poor lake

Aug 2015 10  $\mu\text{g TP/l}$



*Foto: Johan Forsblad*

A bloom of *Anabaena lemmermanni* developed in the nutrient poor drinking water reservoir Andträsket in July 2017  
No explanation why!



Alger. (Bilden är ej tagen i det aktuella Andträsket.)

**Varningen: Drick inte vattnet i Råneå**

**LULFA** Algblomning har upptäckts i Andträsket. Råneås råvattentäkt. Därför avråds

# A bloom of *Anabaena lemmermanni* in Lake Osbysjön



Photo: © Agne Andersson

Lake Kallsjön is another nutrient poor lake where autumn blooms of cyanobacteria develop.



2010-10-29

Foto: Anders Lundquist

Lake Bosarpasjön is the only lake in the Hässleholm community with a swimming school. Blooms of cyanobacteria can, however, develop, especially in the autumn



2012-10-11

Foto: Johan Forsblad

A mass development of Microcystis in the clear water Lake Luhrsjön.  
This lake is considered as the best lake in Scania.



PÅARP

# Different hypotheses behind mass development of cyanobacteria - none of these is about external P load

TN/TP

Low light

Aerotops

Zooplankton-grazing

Warm water

Trace element

The phosphorus storage

Inorganic nitrogen

If we act quickly when we get unexpected blooms, we may get some clues about the triggering factors, that may vary from lake to lake



STORA SLOTTSPARKSDAMMEN, MALMÖ

Photo: ©Johan Forssblad

# What caused this bloom?



2012-11-19

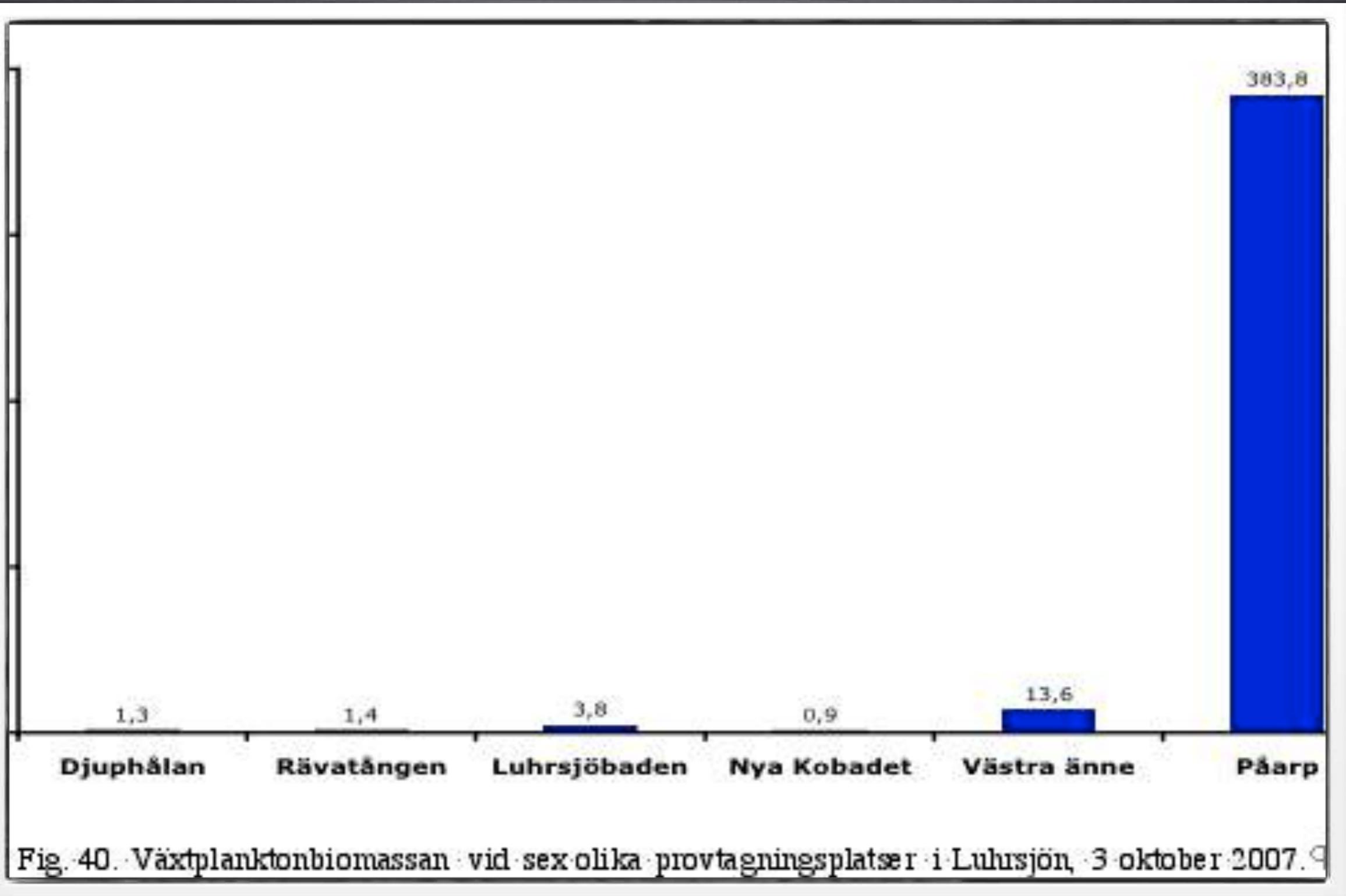
*Photo: Agne Andersson*

# What caused this bloom in Lake Osbysjön ?



Photo: ©Agne Andersson

# The patchiness of cyanobacteria biomass in the mesotrophic Lake Luhrsjön



The toxic cyanobacterium *Cylindrospermopsis raciborskii* is spreading northwards in Europe! Warming?



CYLINDROSPERMOPSIS RACIBORSKII

Photo: ©Gertrud Cronberg

The variation of cyanobacteria occurrence in time and space may give us clues what is causing the development



LAKE FINJASJÖN, 2008

Photo: ©Johan Forssblad

In Lake Finjasjön, it can quickly change between clear water and algal blooms



FINJASJÖN 2007-06-08

Photo: ©Johan Forssblad

In some parts of the lake, (Skyrup) the water is clear more och less permanently during the summer



Photo: ©Johan Forssblad

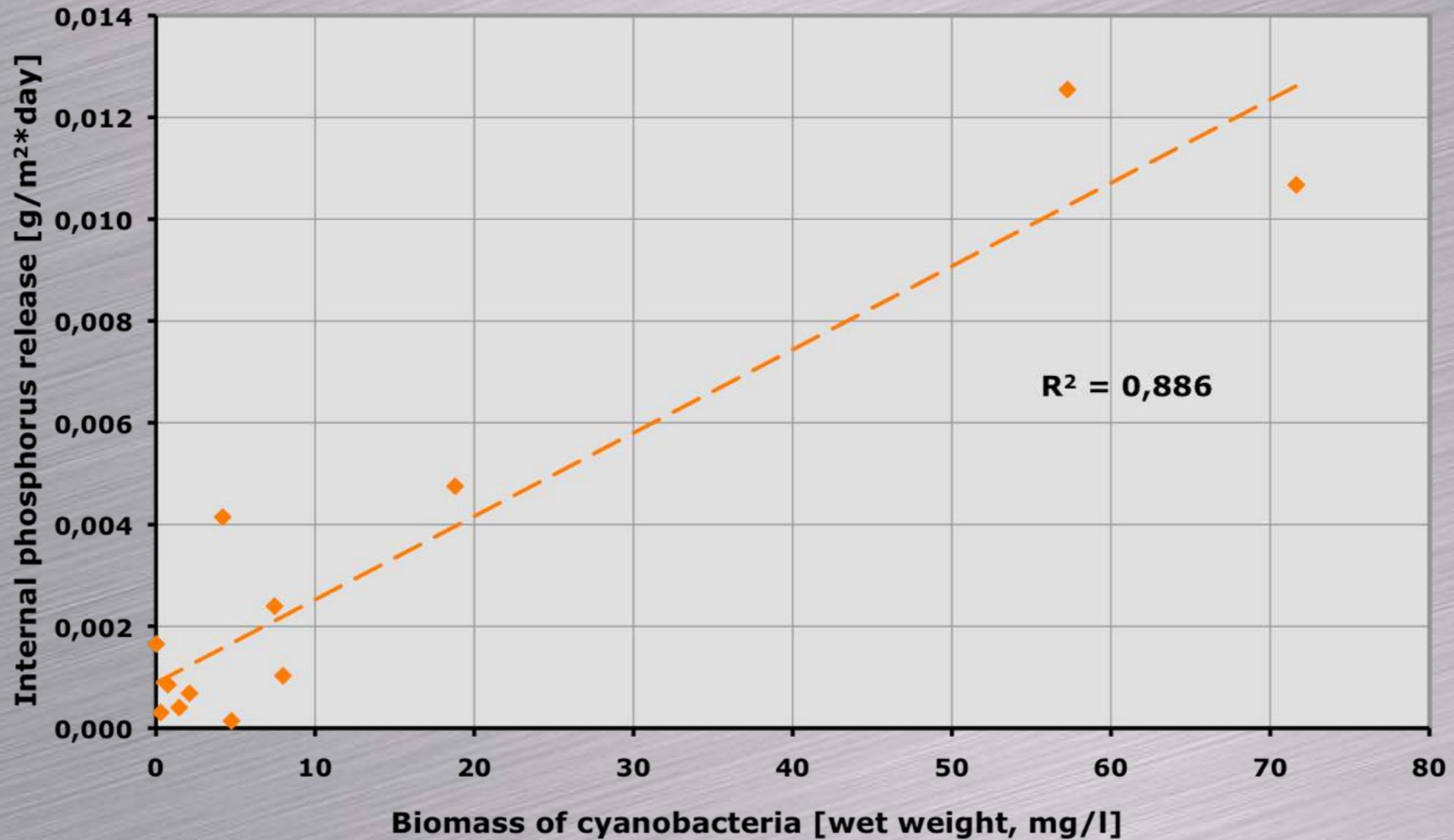
....while in other parts, blooms of cyanobacteria develops frequently



Photo: ©Johan Forsblad

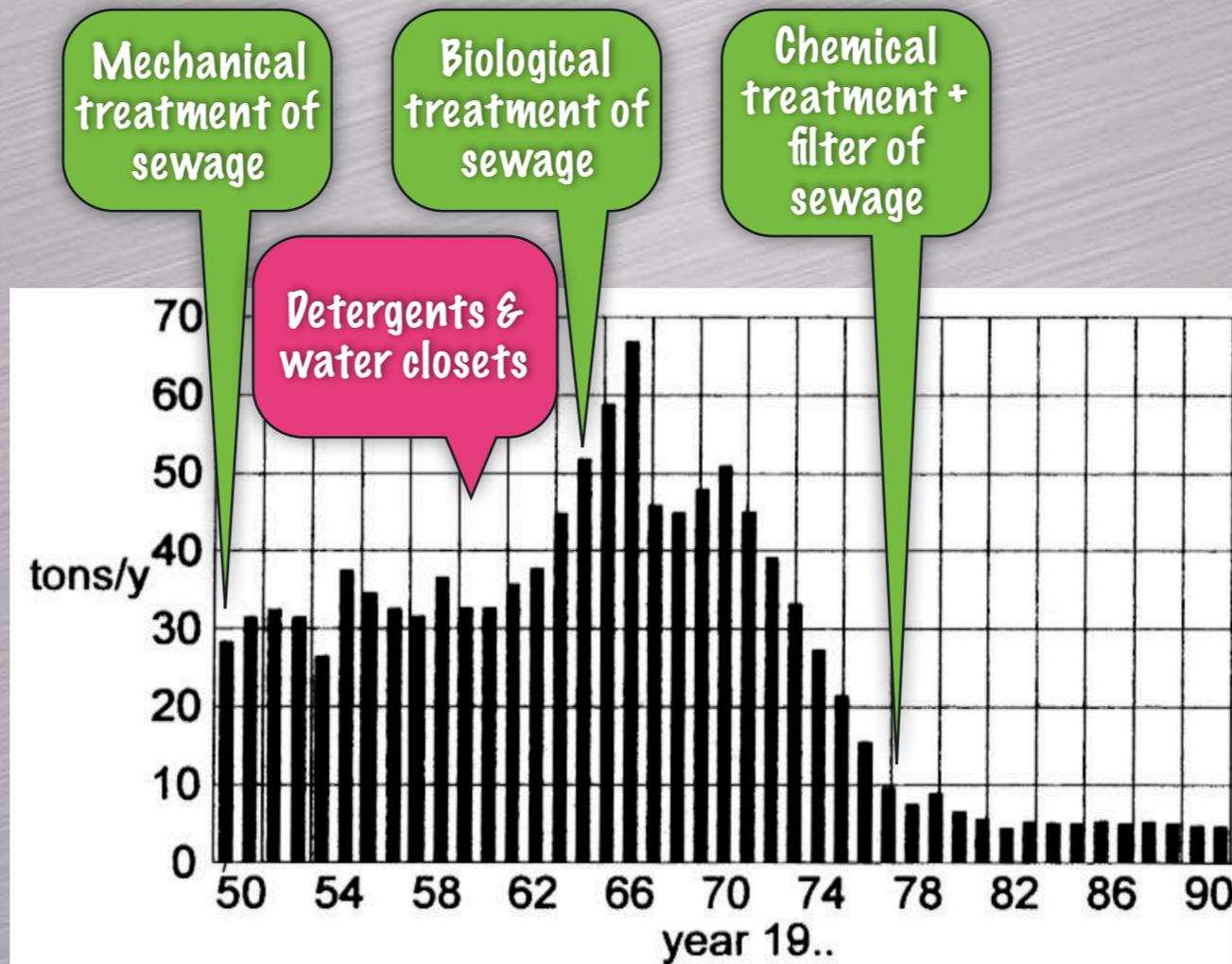
# Internal phosphorus release and biomass of cyanobacteria

Finjasjön 1992-1997  
(Annadotter, 2006)

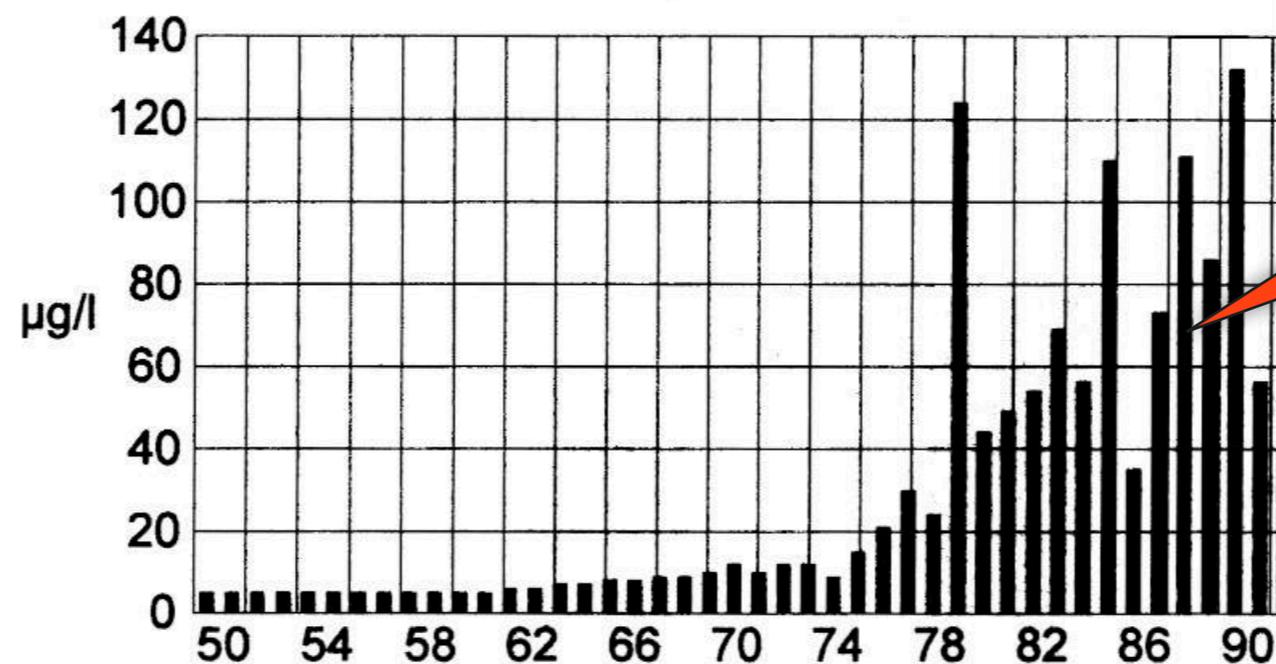


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Phosphorus  
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Chlorofyll a  
in the lake:



... the  
chlorofyll  
level  
exploded ...

## Take home messages

When we talk about cyanobacteria, remember that we talk about 2000 different species with different ecological niches

In our study of Lake Finjasjön, the biomass of cyanobacteria correlated with the internal P loading.

Consequently, all activities that inhibits the processes that triggers internal P loading, may reduce the occurrence of cyanobacterias blooms

## Take home messages

In large number of lakes, there seems to be no dose-response relationship between external P load and cyanobacterial biomass

The patchiness of cyanobacteria in lakes may give us clues to why and how they develop

How will we achieve the goal of having lakes with good ecological status in 2027?

We must emphasise our efforts in understanding the factors that trigger blooms of cyanobacteria and internal loading of phosphorus



*Photo: ©Johan Forsblad*

**Let the lakes and ponds, again, become the clear eyes of the earth!**