Cyanobacterial blooms and what can we do in Lake Hood?

Cyanobacterial blooms & what can we do in Lake Hood?

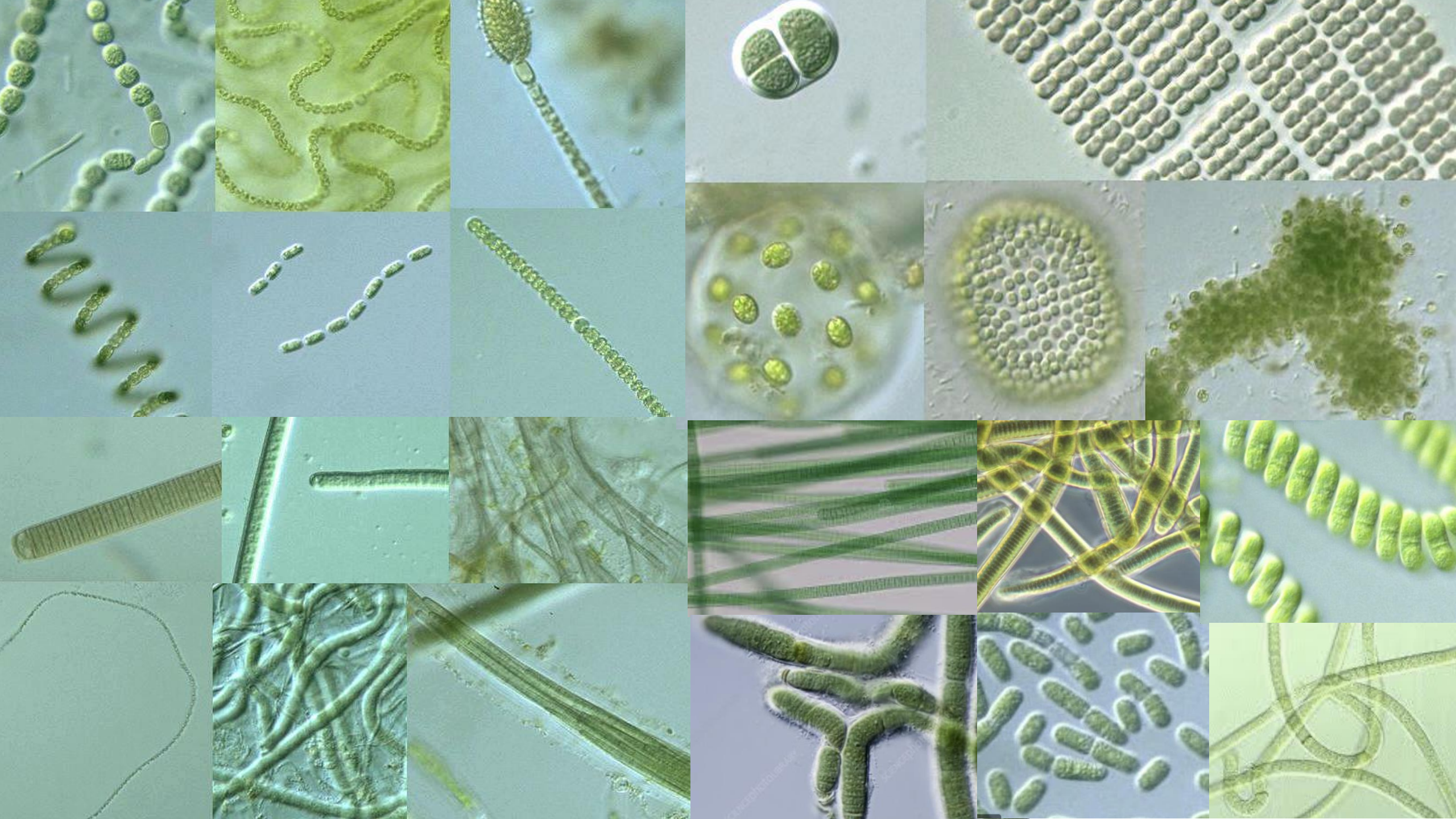
- What are cyanobacteria?
- Why are they a problem?
- Why do they bloom?
- Species in Lake Hood
- Future plans

Cyanobacteria (blue-green algae)

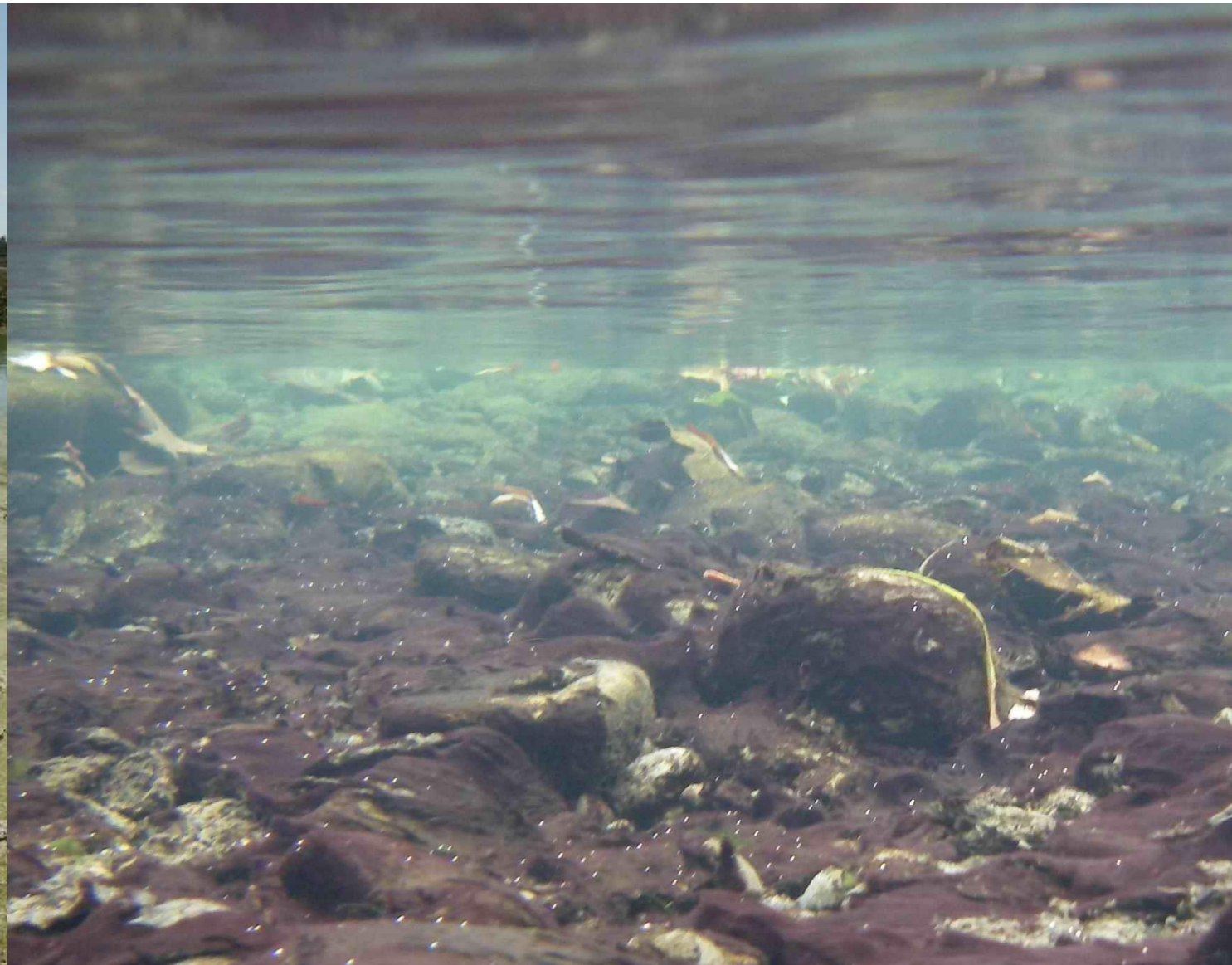
Antarctica

Desert soils

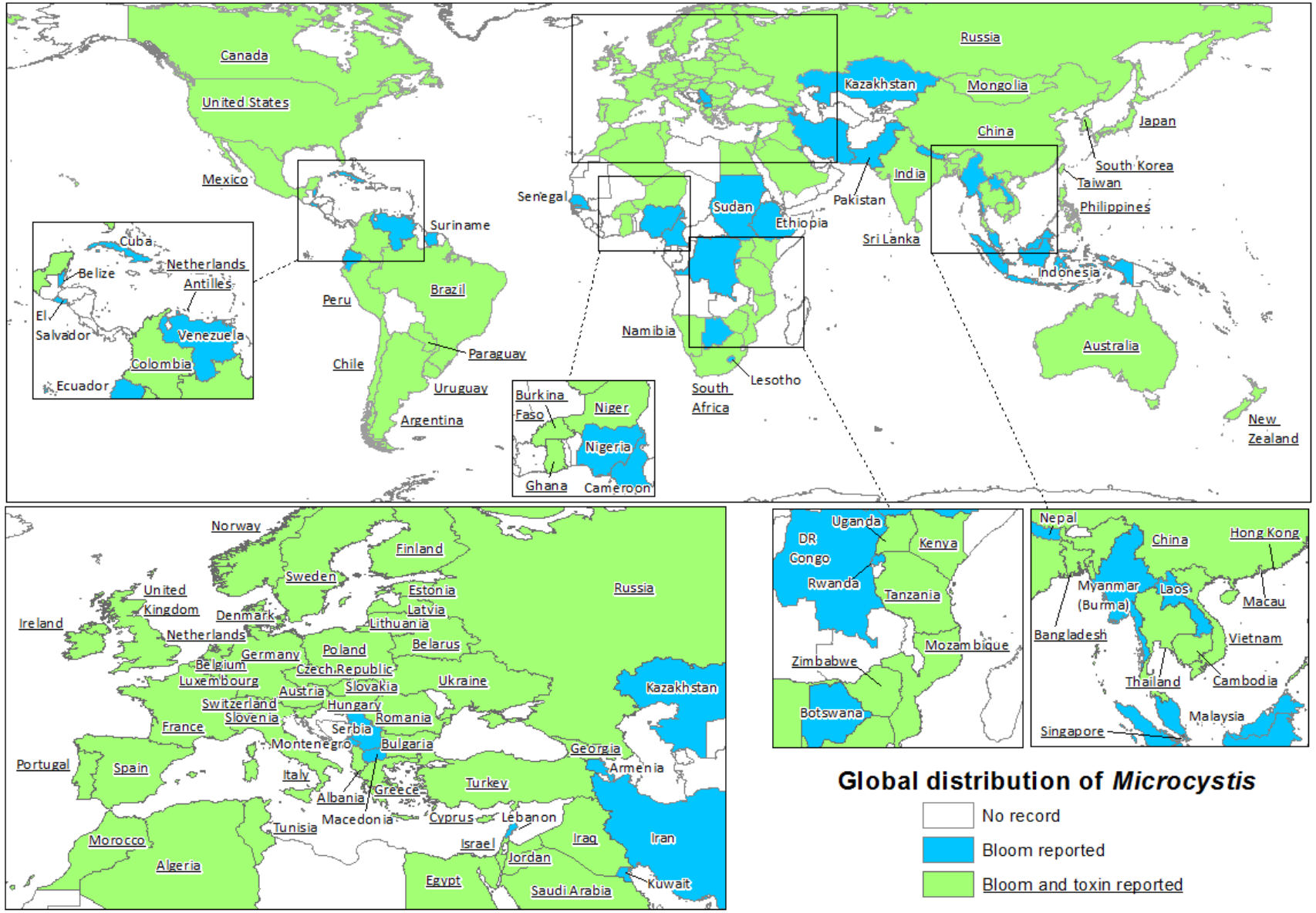
Thermal environments

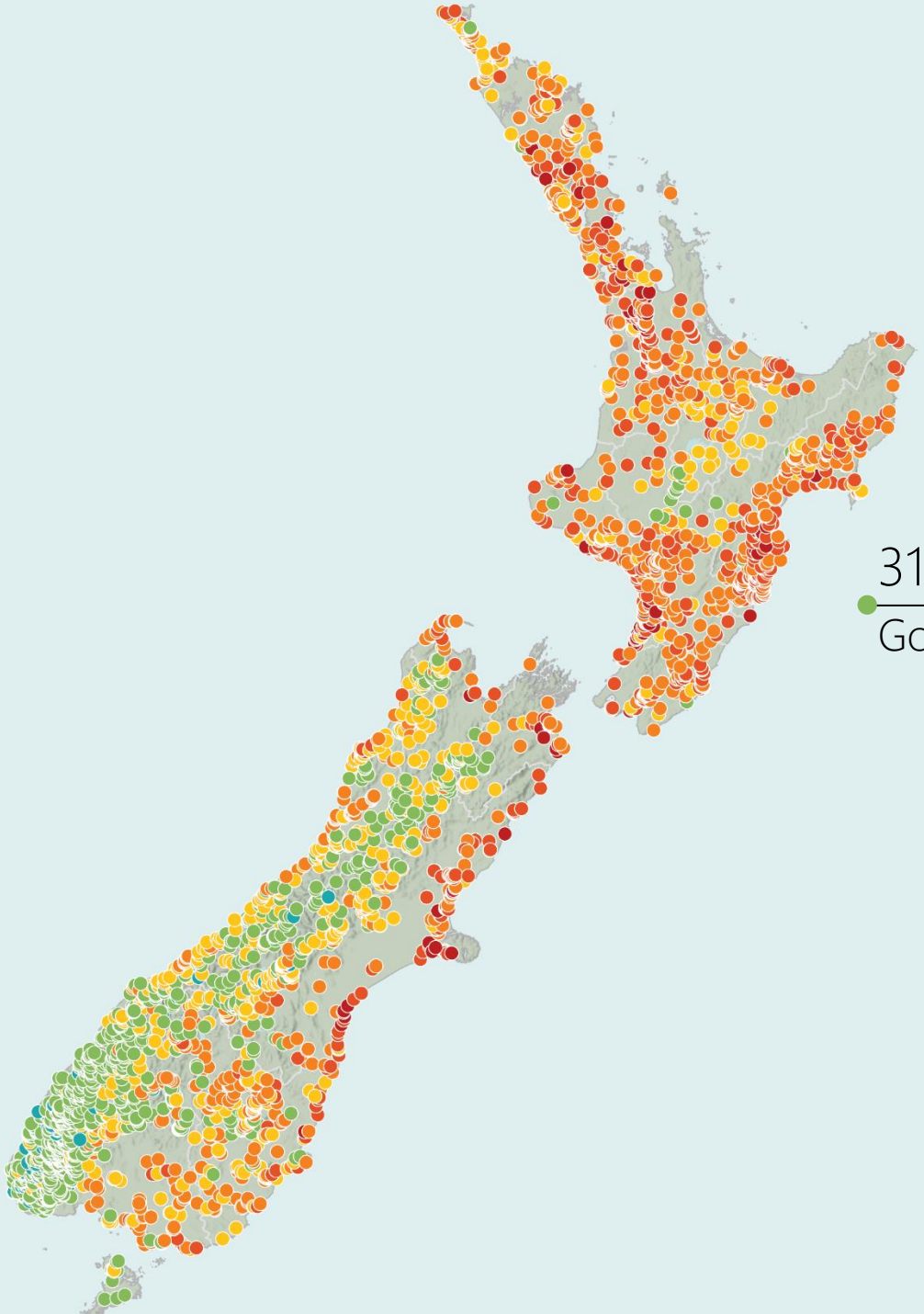


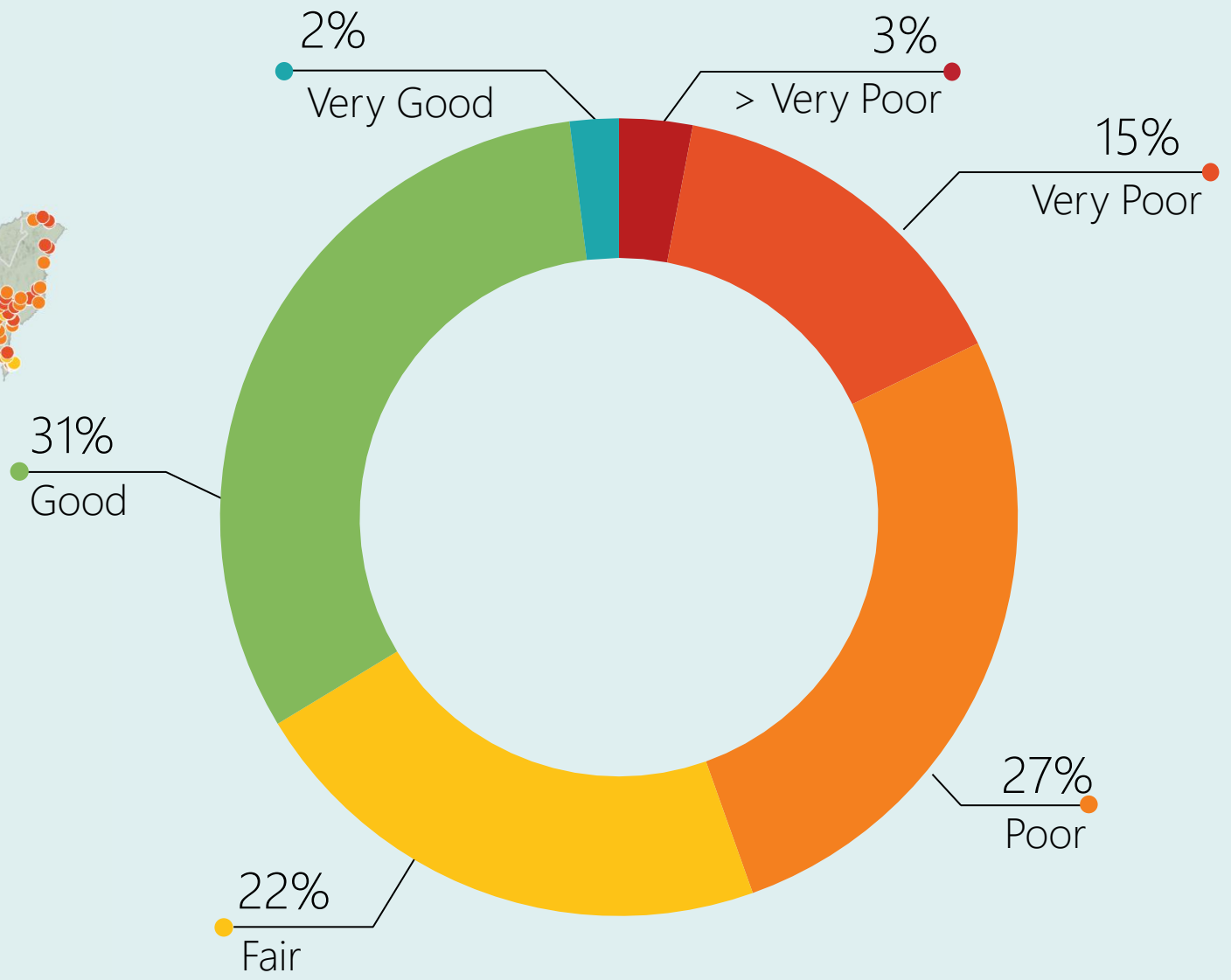
Freshwater – planktonic and benthic

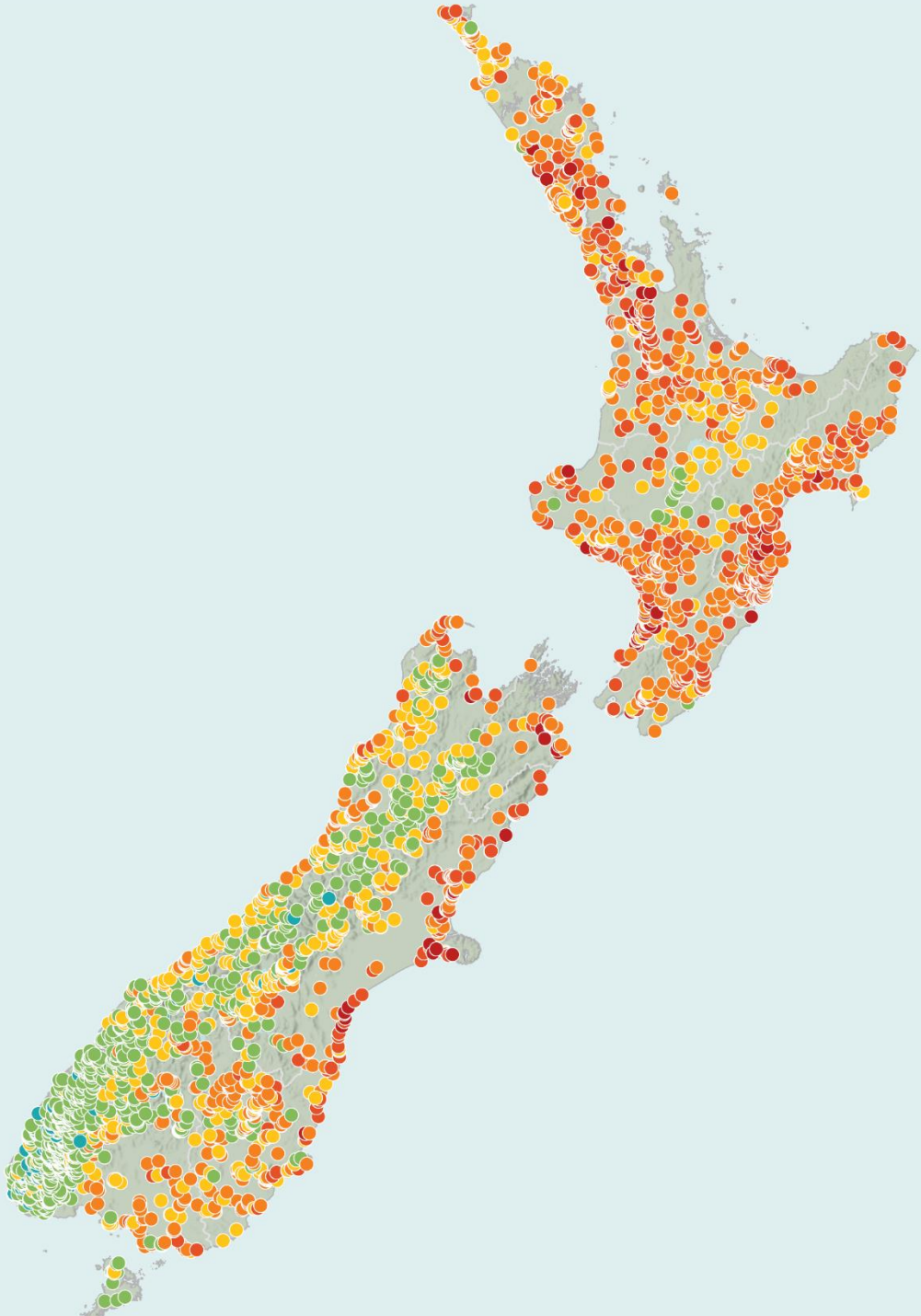


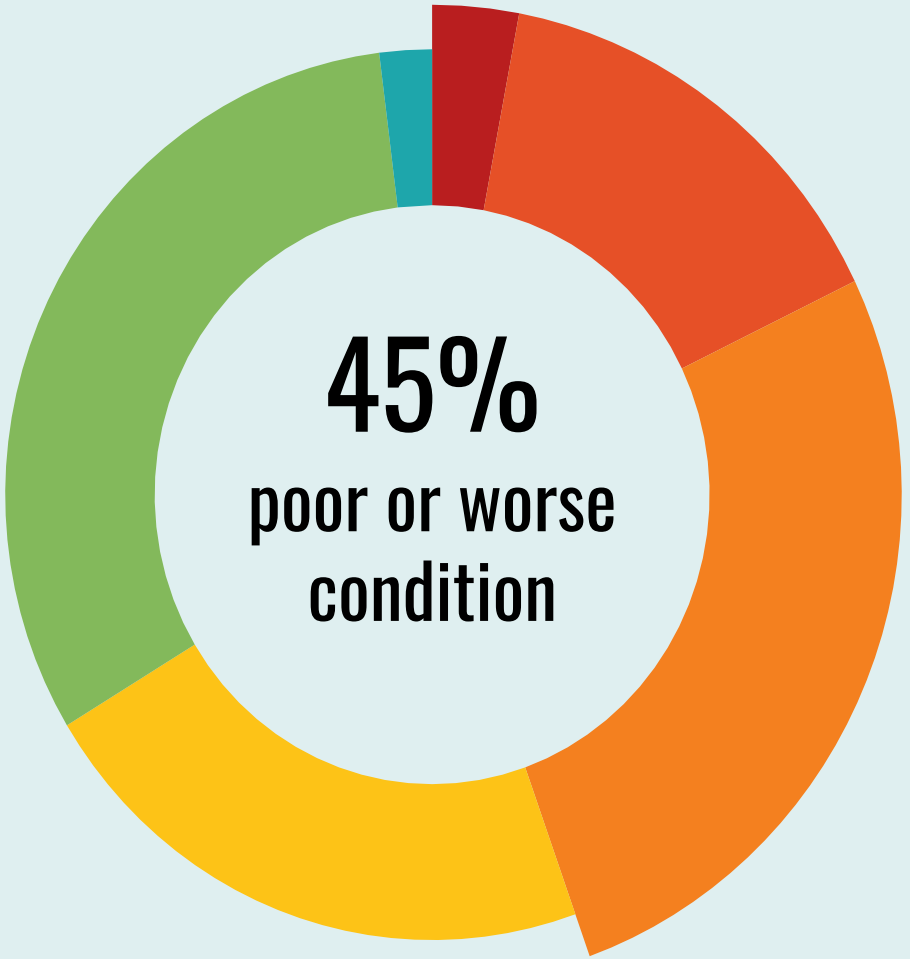
Global issue – *Microcystis* = 107 countries






2%
Very Good
3%
> Very Poor
15%
Very Poor
31%
Good
27%
Poor
22%
Fair




45%
poor or worse
condition

Negative consequences of blooms

- Changes in food webs
- Shading of aquatic plants
- Loss of ecosystem services
- Increased deoxygenation of bottom waters
- Increased nutrient release from sediment
- **Toxins**

Cyanotoxins

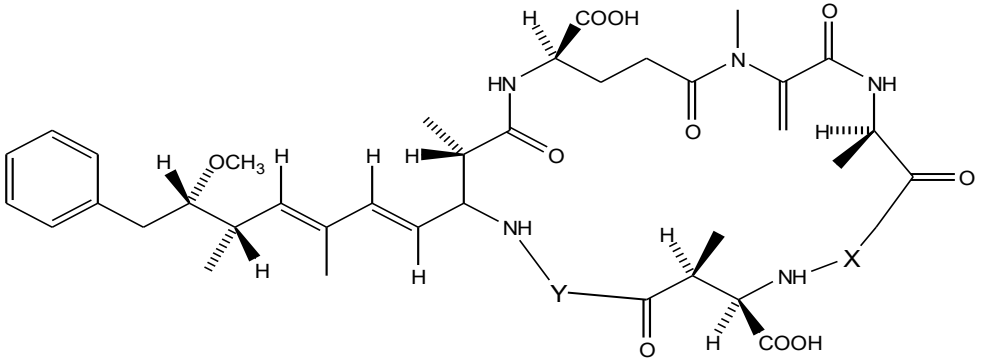
Cyanotoxins

Cyanotoxins fall into three broad classes

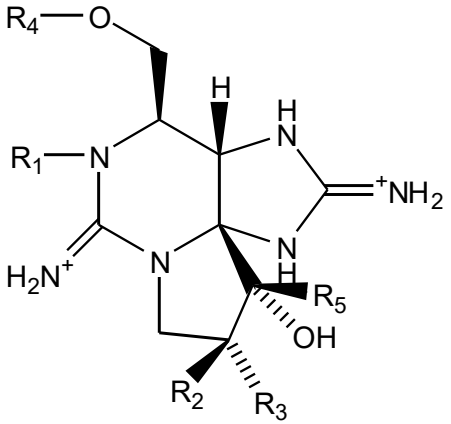
Hepatotoxins
Microcystin (from *Microcystis, Dolichospermum*)
Nodularin (from *Nodularia*)
Cylindrospermopsin (from *Cylindrospermopsis*)

Neurotoxins
Anatoxin-a (from *Aphanizomenon, Dolichospermum*)
Saxitoxin (from *Lyngba, Dolichospermum*)

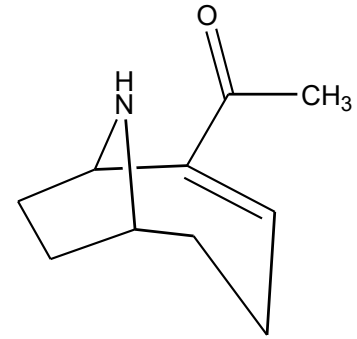
Dermatotoxins
Lyngbyatoxin-a (from *Lyngba, Dolichospermum*)
Lipopolysaccharides (from most cyanobacteria)



General structure of microcystin



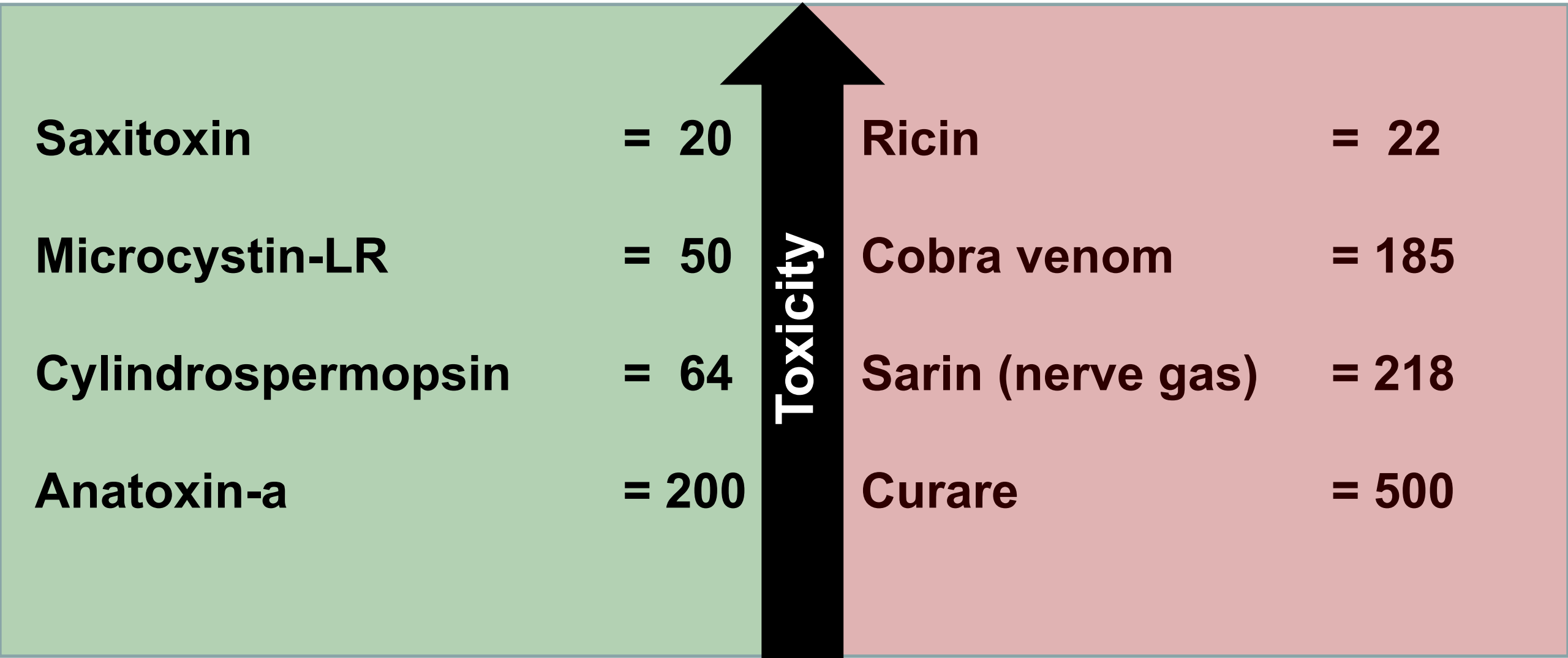
General structure of the saxitoxin



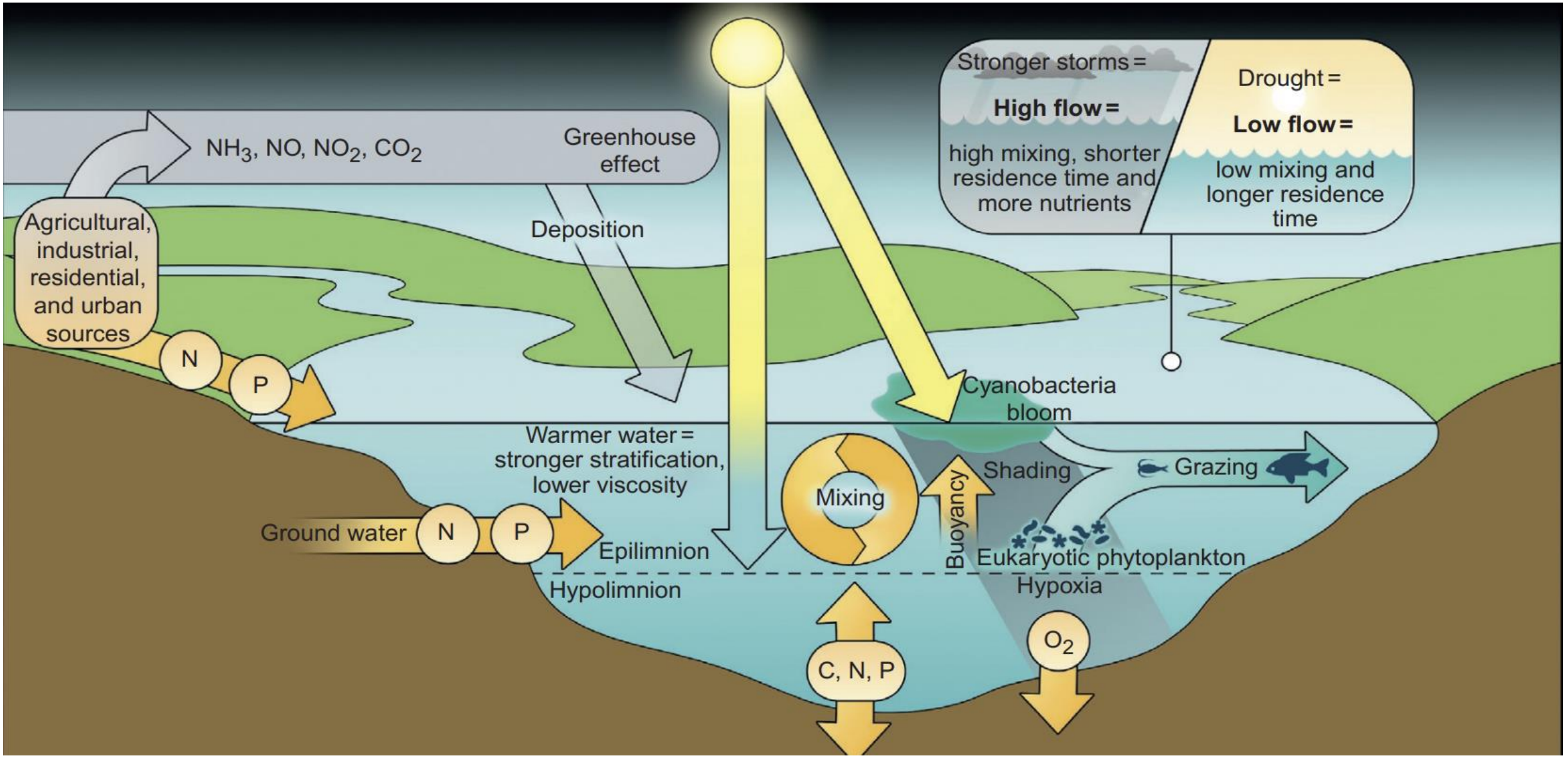
Structure of anatoxin-a

Cyanotoxins – how toxic?

IP LD_{50} (µg/kg)



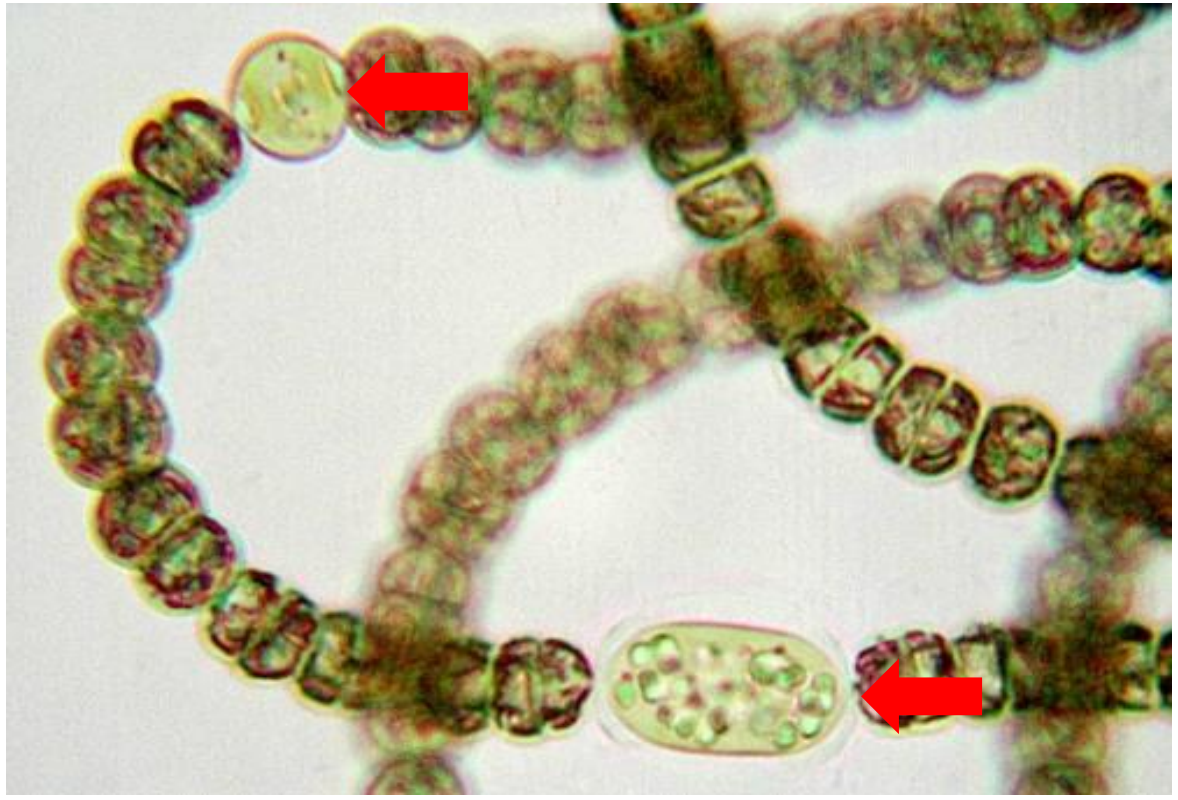
What causes cyanobacterial blooms?



Lake Hood cyanobacteria

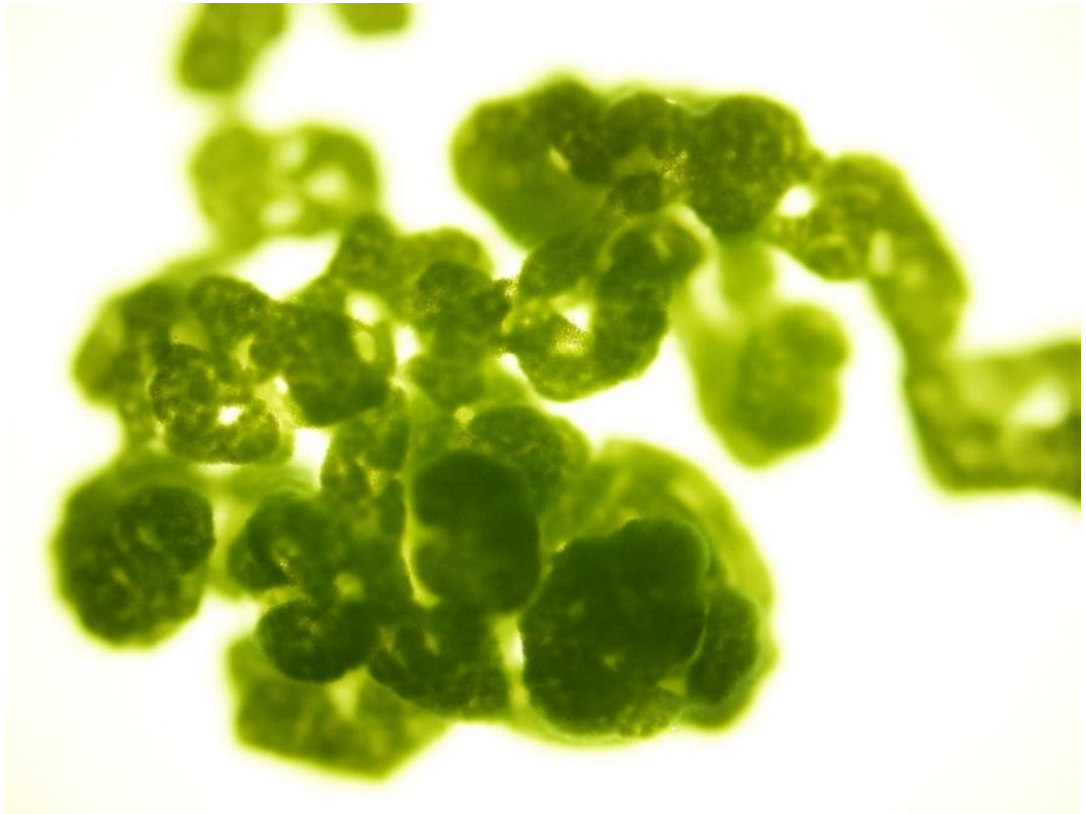
Dolichospermum

- Fix nitrogen
- Resting cell



Microcystis

- Commonly produces toxin

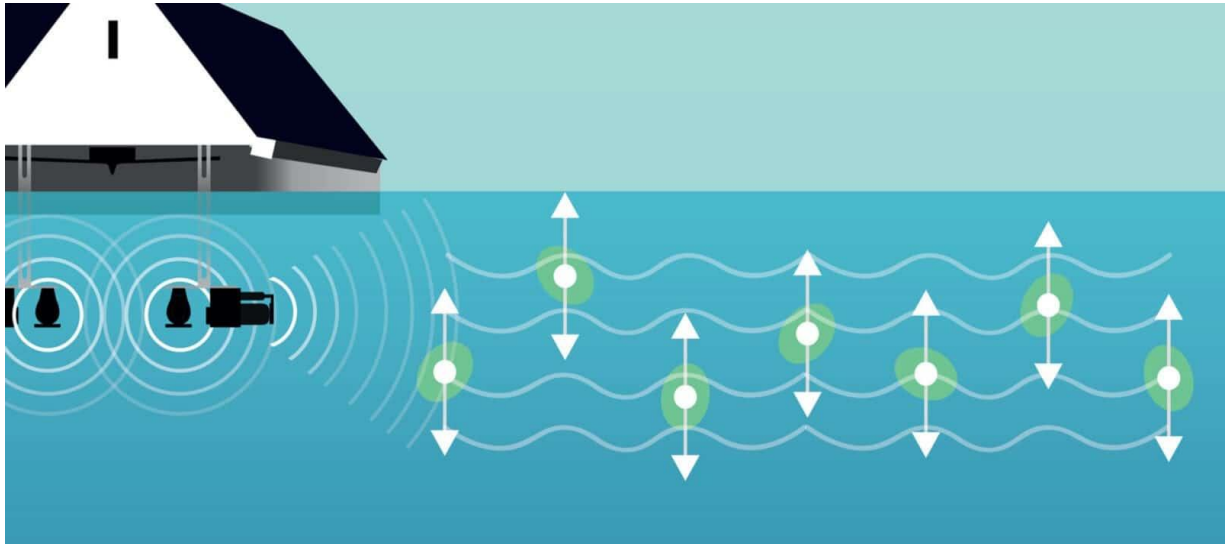


Control options – in lake trials

What are we going to test?

Four to five approaches

- Ultrasound
- Chemical/biological
  - Cupper sulphate based
  - Hydrogen-peroxide based
  - Enzyme/bacteria



Considerations

- Longevity/feasibility
- Cost
- Non-target impacts (H&S, sound, ecology)

Longer term studies

Hydrodynamic model & circulation

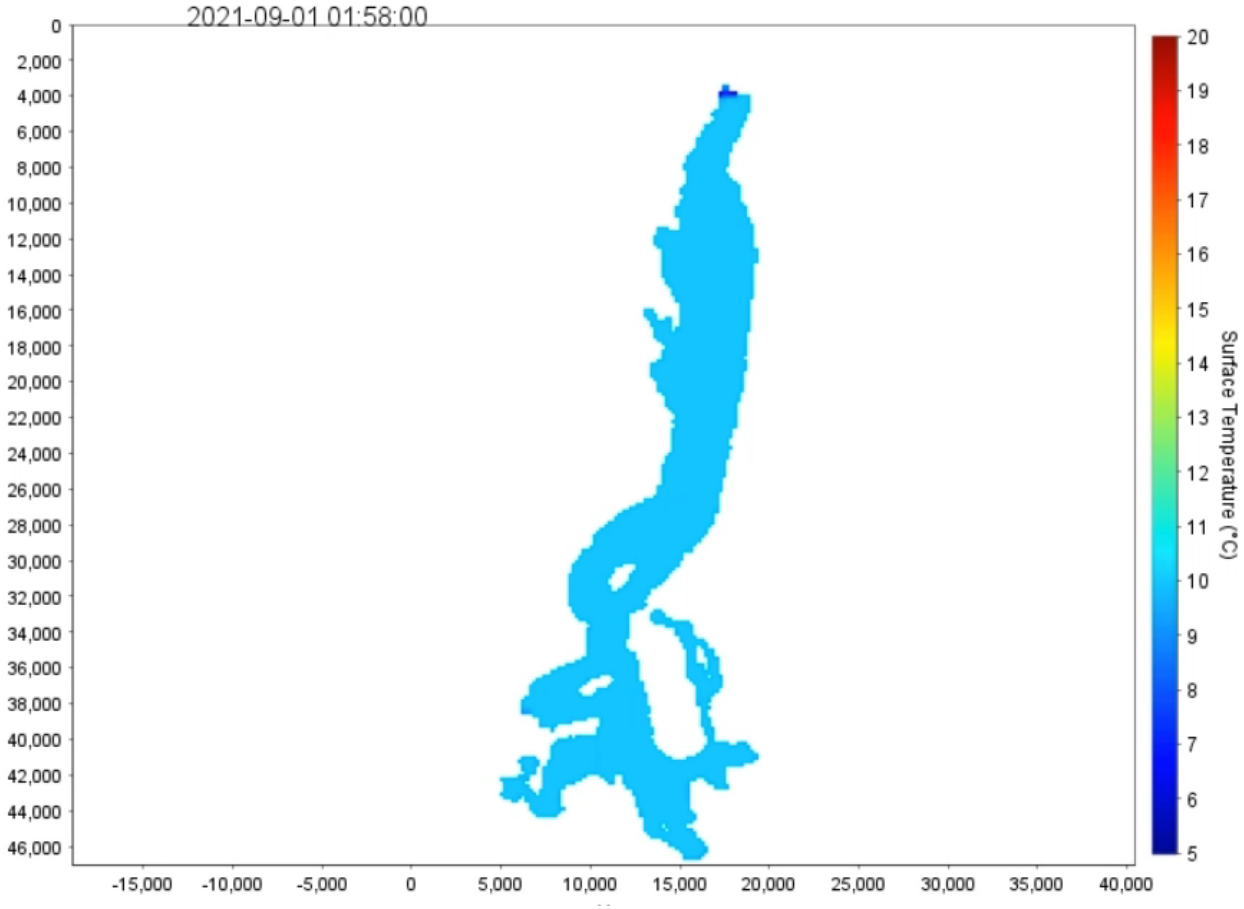
- Can we enhance circulation to reduce blooms
- Where should additional intakes/outlets be positioned
- Would artificial mixing help?

Bloom origin & dynamics

- When and where do cyanobacterial blooms begin?
- What conditions trigger bloom onset?
- Are sediment cells a key source of bloom inoculum?

Nutrients - sources and cycling

- Is the sediment a significant source of nutrients?
- Can we reduce external nutrients?



Model (Lake Wanaka) : Aidin Jabbari – Earth Science NZ

Volunteers

In-lake mesocosms

2-3 times a week (cyanofluro, photos, water sampling)

Lake studies

Cleaning sensors (monthly)

Twice weekly monitoring (cyanofluro)

More to come…