A natural phenomenon turned nasty: Where, when, and why will cyanobacterial blooms be toxic?

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Cyanobacterial bloom-forming species

Microcystis spp.

Aphanizomenon flos-aquae

Anabaena spp.

Planktothrix agardhii
Algal blooms
Cyanotoxins toxic to humans when found in drinking water

Health Impacts of Cyanotoxins

Note: Not all cyanotoxins lead to all of these health impacts. These listed impacts are caused by microcystins or cylindrospermopsin, the two cyanotoxins that EPA has issued Health Advisories for.

### IN HUMANS

**Brain**
*Source:* Ingestion  
*Symptoms:*  
- Headache  
- Incoherent speech  
- Drowsiness  
- Loss of coordination

**Respiratory System**  
*Source:* Inhalation  
*Symptoms:*  
- Dry cough  
- Pneumonia  
- Sore throat  
- Shortness of breath  
- Loss of coordination

**Digestive System**  
*Source:* Ingestion, drinking contaminated water, or eating contaminated fish  
*Symptoms:*  
- Abdominal pain  
- Nausea  
- Vomiting  
- Diarrhea  
- Stomach cramps

**Body**
*Source:* Contact, e.g. swimming  
*Symptoms:*  
- Irritation in eyes, nose, and throat  
- Blistering around the mouth  
- Skin rash, including tingling, burning and numbness  
- Fever  
- Muscle aches (from ingestion)  
- Weakness (from ingestion)

**Organs**
*Source:* Ingestion  
*Symptoms:*  
- Kidney damage  
- Abnormal kidney function  
- Liver inflammation

**Nervous System**
*Source:* Ingestion  
*Symptoms:*  
- Tingling  
- Burning  
- Numbness

### IN PETS

**Symptoms:**  
- Vomiting  
- Fatigue  
- Shortness of breath  
- Difficulty breathing  
- Coughing  
- Convulsions  
- Liver failure  
- Respiratory paralysis leading to death
What we know:

• **Nutrients** stimulate cyanobacterial blooms
• **Warmer waters** favor cyanobacterial blooms
• We know which species produce toxins (e.g. *Microcystis*)
• Cyanobacterial blooms are increasing world-wide
Don’t know where and when blooms will be toxic
Due to intraspecific variability – not all strains are toxic!
Don’t know why toxic
Not certain why cyanobacteria produce toxins (microcystin)

- role in carbon uptake & photosynthesis
- functions as grazer/parasite deterrent
Overall aim

- understand temporal and spatial patterns of toxic and non-toxic *Microcystis botrys* populations
- investigate the underlying function of toxicity
- Develop an early-warning detection tool of toxic *Microcystis* blooms optimized for Swedish conditions.
Stakeholder collaboration

• Information stakeholders – symposium for organizations responsible for water management (HAV, länsstyrelse, SMHI, Livsmedelsverket etc)

• Tool stakeholders – continuous contact with company, LU innovation, and waterworks (ie Sydvatten)
about this grant proposal

• Worked and reworked (third time’s a charm)
• Environmental problem is urgent and relevant
• Solid theoretical basis
• New approach
• Novel technology
• Competitive group (track record, competence)