

# Harmful Algal Blooms

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November 1, 2018

# Outline

Harmful Algal  
Blooms

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Introduction

Survey

References

## 1 Introduction

## 2 Survey

# Harmful Algal Blooms

## Harmful Algal Blooms

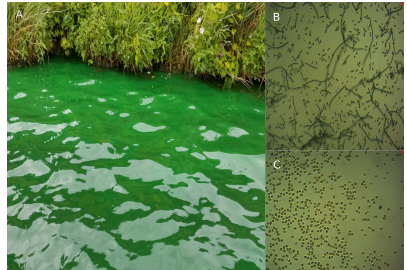
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## References

- Increase in primary productivity and
- Explosive growth of microspopic algae and cyanobacteria
- Toxin-producing genera
- Decrease biodiversity
- Anoxic environment



# HAB

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- Naturally occurring
- Exacerbate from anthropogenic causes<sup>1</sup>
- Worldwide issue
- Coastal environments
- Freshwater lakes

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<sup>1</sup>Rastogi, Sinha, and Incharoensakdi, "The cyanotoxin-microcystins: current overview".

# Lake Erie 2014

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# Possible causes

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# Toxicity

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- Irritant
  - Lipolysacharides<sup>2</sup>
- Toxins
  - Microcystin and nodularin <sup>1</sup>
  - Cylindrospermopsin<sup>3</sup>
  - Anatoxin<sup>4</sup>
  - Saxitoxin <sup>1</sup>

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<sup>2</sup>Moore, Richard and Ohtani, Ikuko, "Cyanobacterial Toxins".

<sup>3</sup>Dittmann, Fewer, and Neilan, "Cyanobacterial toxins".

<sup>4</sup>Codd et al., "Cyanobacterial toxins, exposure routes and human health".

# Microcystin

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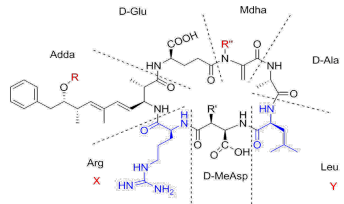
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- Cyclic peptide
- 1000 Da
- Hepatoxin and carcinogenic
- Inhibits protein phosphatase
- Diverse structures
- Intra-peritoneal LD<sub>50</sub> ranging from 25-150  $\mu\text{g}/\text{kg}^a$



<sup>a</sup>Dittmann, Fewer, and Neilan, "Cyanobacterial toxins".



# Cylindrospermopsin

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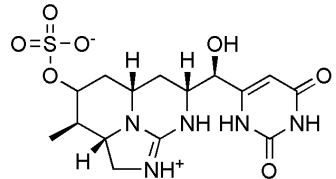
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- Polycyclic uracil derivative<sup>a</sup>
- Toxicity not fully understood
  - Covalently binds to DNA/RNA<sup>b</sup>
  - Inhibits protein synthesis<sup>3</sup>
- LD<sub>50</sub> of 2.1 mg/kg over 24 h<sup>c</sup>
  - Health Advisory of 8  $\mu\text{g/L}$  over one day<sup>a</sup>



<sup>a</sup>Moreira et al., "Cylindrospermopsin".

<sup>b</sup>Kittler et al., "1. The mystery of the metabolic activation of cylindrospermopsin".

<sup>c</sup>Shaw et al., "Cylindrospermopsin, A Cyanobacterial Alkaloid".

# Anatoxin

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# Saxitoxin

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# Exposure Route

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- Direct contact
- Aerosols
- Ingestion
  - Seafood/Fish
  - Drinking water
  - Algal supplements

# Law and Regulation

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- Safe Drinking Water Act
- Maximum Contaminant Level
  - Regulated and enforced
- Contaminant Candidate List
  - “More like guidelines”

# Objectives

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# Surveyed Lakes

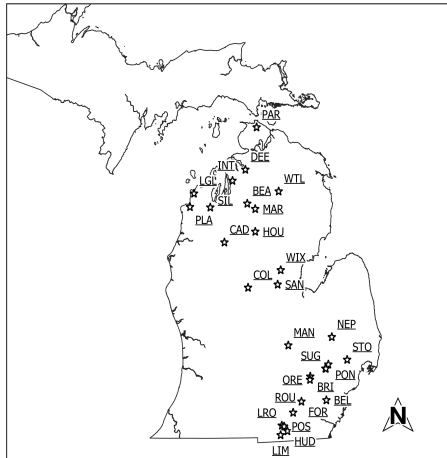
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# Water Sampling

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- Sampled each lake once a month
- Collected water
- Quickly transported back
- Analyzed ASAP



# SPATT

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- Solid phase adsorbent toxin tracking
  - Sachet filled with resin
  - Left for one month
- test

# Analysis

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# Nutrients

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- Orthophosphate-P
- Nitrate+nitrite-N
- Ammonia-N
- Total Kjeldahl nitrogen
- Total Phosphorus

<++>

# LC-MS/MS

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- Freeze/Thaw
- Filter

# SPATT

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- Solid phase adsorbent toxin tracking
- Similar to the stationary phase

# ELISA

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# Geospatial Analysis

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# Results

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# Could we predict HABs?

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# Acknowledgment

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References

- My lab partners Brian Spies and Andrew Herrpich
- Jason Sckrabulis, Ryan Mcwhinnie, Melissa Ostrowski
- Dr. David Szlag and Dr. Thomas Raffel
- Michigan Department Environmental Quality
- Oakland University and the Chemistry Department

# References I

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# References II

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# References III

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