Northern Ontario School of Medicine
École de médecine du Nord de l'Ontario
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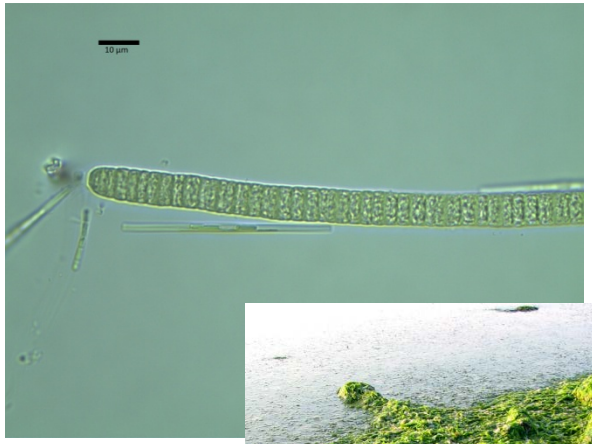
Northern Ontario School of Medicine Research into Cyanobacteria Blooms in the West Nipissing

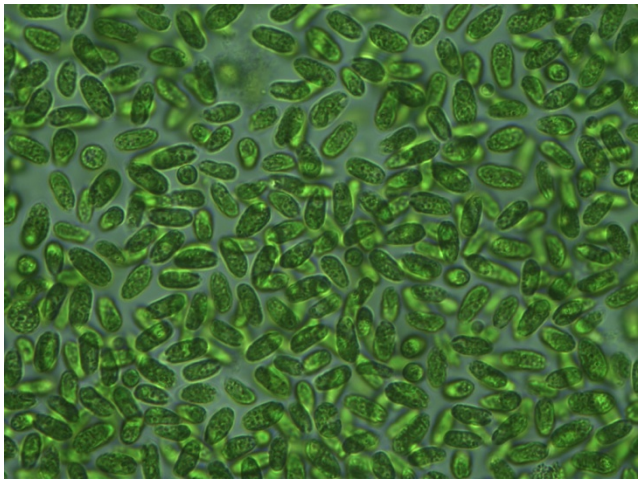
Presented by:

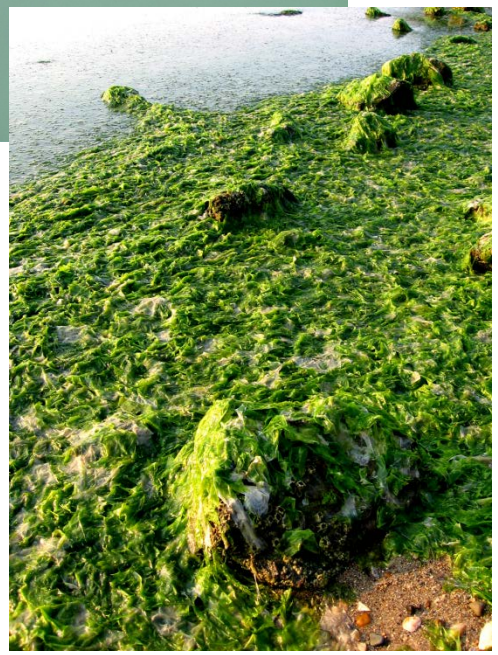
Greg Ross, PhD
Associate Dean, Research

November 22, 2013

What are algae?







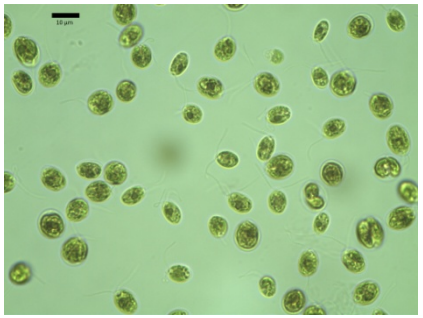
Ubiquitous organisms

commons.wikimedia.org/lichen

chemistry.about.com/chlamydomonas

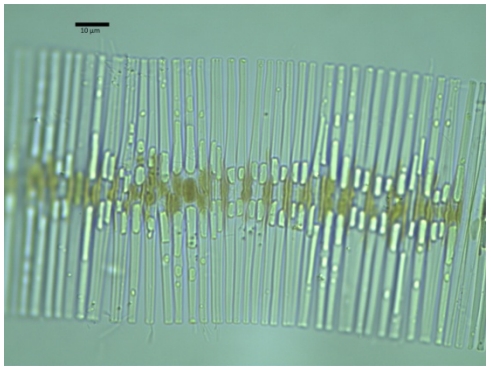
photoblog.nbcnews.com/yellowstones

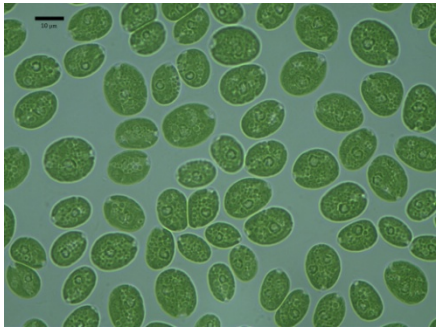
Taxonomy

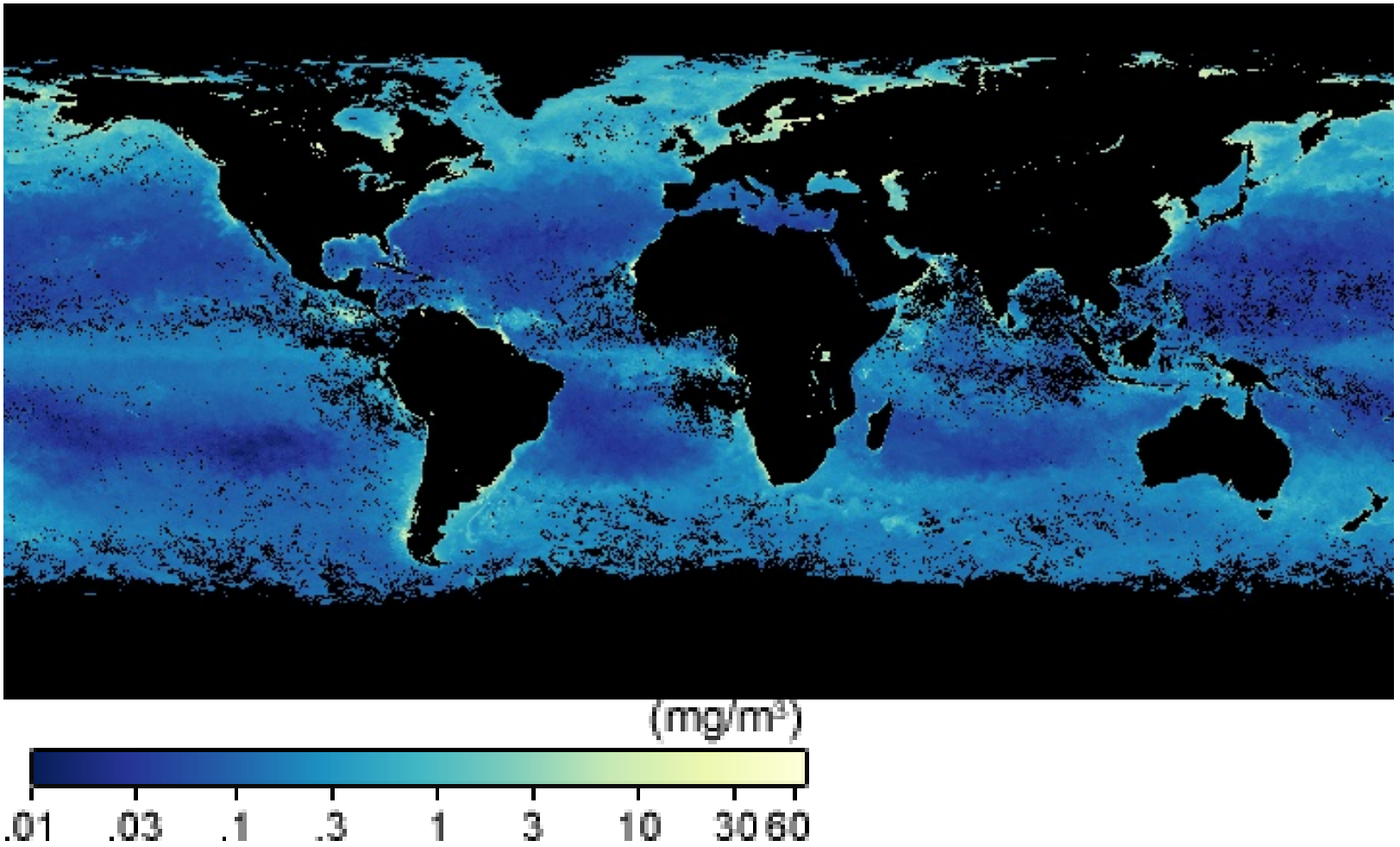


Division (or Phyla)

- Cyanophyta (blue-green algae)
- Glaucophyta
- Rhodophyta (red algae)
- Heterokontophyta (brown algae)
- Haptophyta
- Cryptophyta
- Dinophyta
- Euglenophyta
- Chlorarachniophyta
- Chlorophyta (green algae)





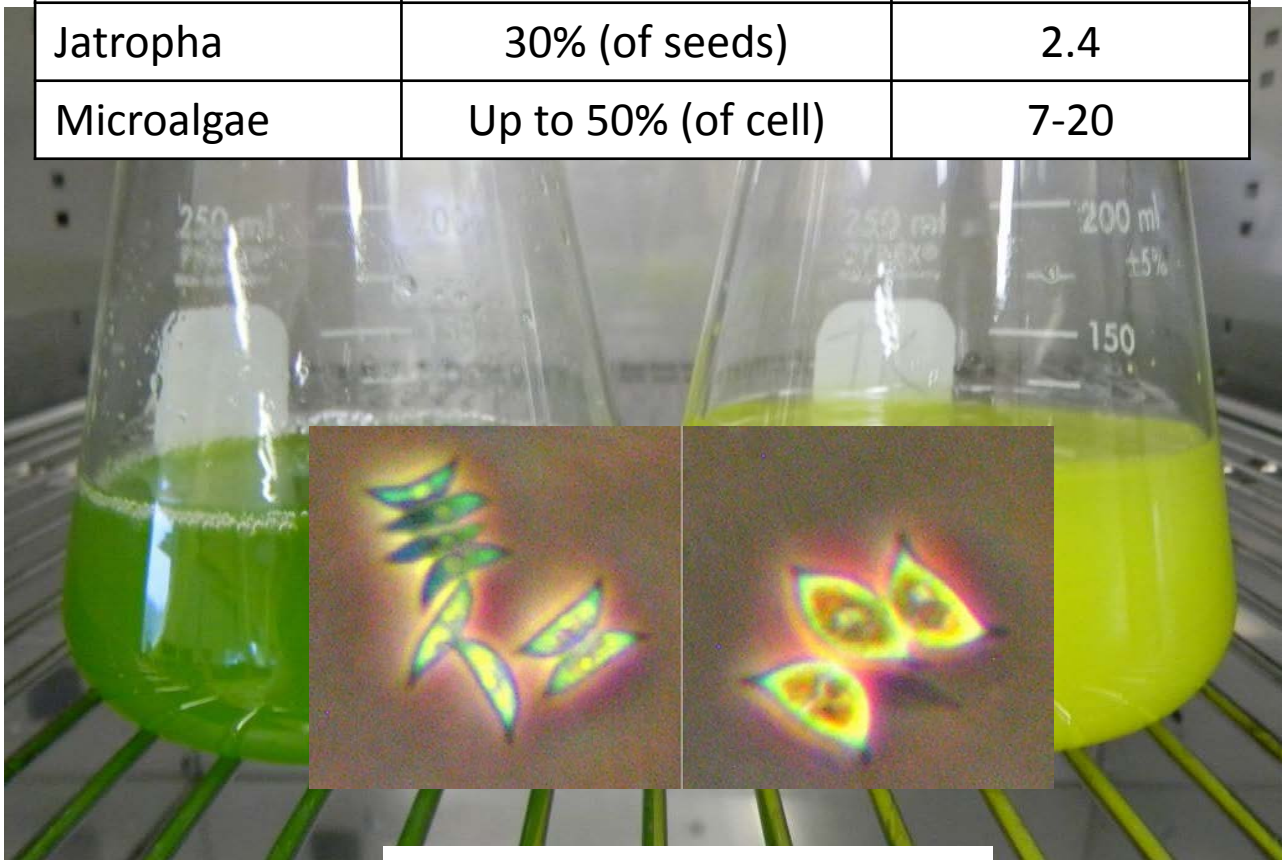


More than half oxygen we breath comes from microalgae

http://neo.sci.gsfc.nasa.gov

Microalgae – the growth in interest

Crop	Oil content (wt % of dry mass)	Oil production (T/ha/year)
Rapeseed	40-44% (of seeds)	1.4
Soya	20% (of seeds)	0.48
Jatropha	30% (of seeds)	2.4
Microalgae	Up to 50% (of cell)	7-20

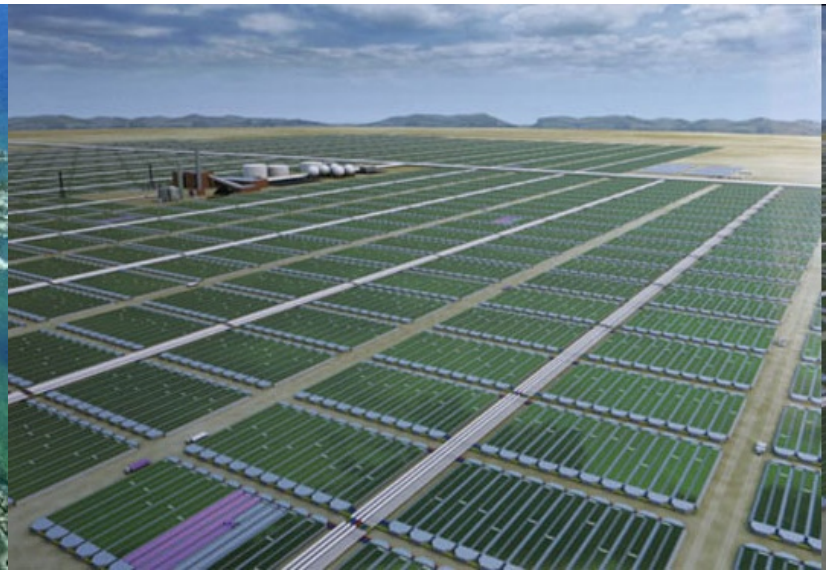


Scenedesmus dimorphus

Algal Mass Production

- Mass algal cultivation has become common place

- Most algal production facilities are located in warm climates
  - Hawaii, California, etc.



Tackling likely process conditions

- Water source (Process Water) extracted from a local reservoir – low on nutrients
- Bubbled in process off-gas contains SO_2 – will reduce water pH

Instigated a "local" sampling regime:

So far have assessed microalgae in over 300 selected northern lakes and tailing ponds.

Looking for:

- high lipid production;
- low pH tolerance;
- good metal tolerance;
- water temperature range.

Industrial Based Economy:

- produce enormous amounts of heat and CO_2

Algae Detection: Synopsis of Current Activities

Problem:

- Random sampling is proving to be ineffective and time consuming

Goal:

- Use aerial based platform to detect specific strands of algae
- Increase efficiency and resource allocation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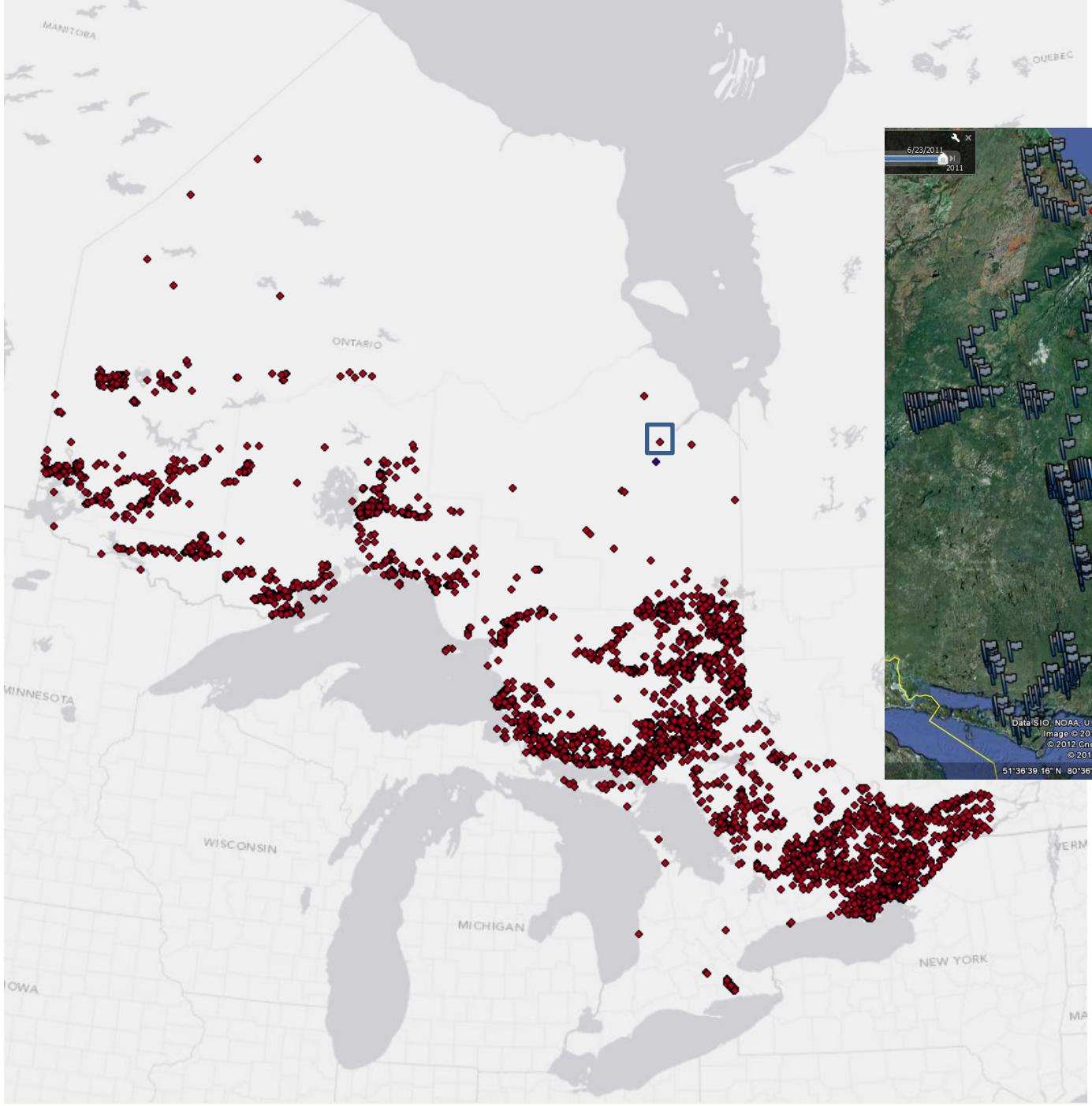

MANITOBA
ONTARIO
QUEBEC
MINNESOTA
WISCONSIN
MICHIGAN
NEW YORK
6/23/2011
2011
0271
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2012 TerraMetrics
© 2012 Cnes/Spot Image
© 2012 Google
51°36'39.16" N 80°36'30.72" W elev 12 ft


Notice
An algae bloom has made this area potentially unsafe for water contact. Avoid direct contact with visible surface scum.

Algae vs. Cyanobacteria

Green Algae

- Photosynthetic
- Membrane-bound nuclei; specialized organelles
- Bloom formation with low concentration of toxins (in freshwater)
- Toxic potency low

Cyanobacteria

- Photosynthetic
- No membrane-bound nuclei; no specialized organelles
- Accumulate via bloom / scum formation (high cell number / high toxin concentration)
- Toxic potency high

Cyanobacterial Blooms

- Crucial to cyanobacterial toxicity
- Form in shallow, warm, slow-moving (still) waters
  - Typically form at night
- Blooms form based on several physical, chemical, and biological factors
- Increase the biomass of cyanobacteria and, the concentration of the toxins

http://www.mfe.govt.nz/publications/ser/snapshot-lake-water-quality-nov06/html/page6.html

First Evidence of Cyanotoxicity

Lake Alexandrina, South Australia, 1878

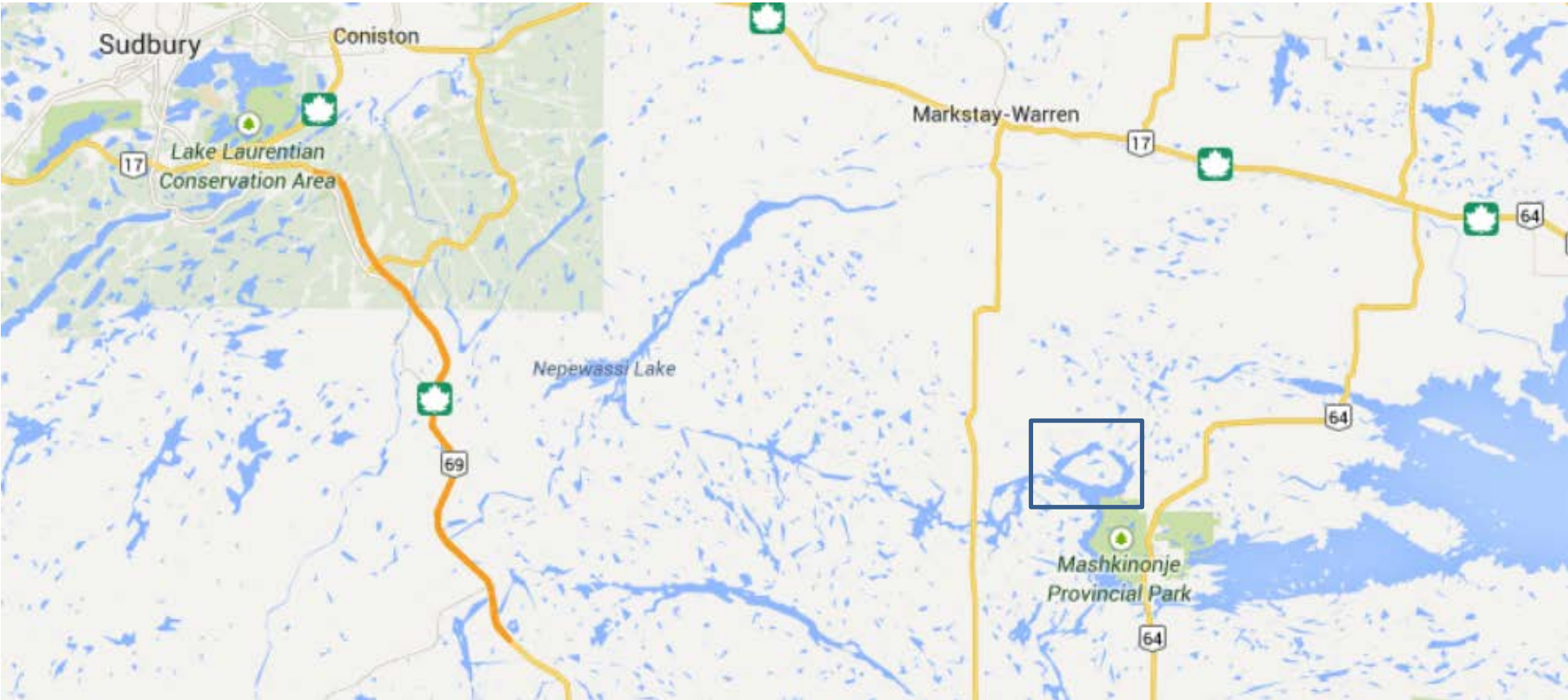
- Livestock poisoning
- Drinking from *Nodularia spumigenia* scum
  - *"…symptoms – stupor and unconsciousness, falling and remaining quiet, as if asleep, unless touched, when convulsions come on, with head and neck drawn back by rigid spasm, which subsides before death. Time – sheep, from one to six or eight hours; horses, eight to twenty-four hours; dogs, four to five hours; pigs, three or four hours…" (Francis, 1878)*

Potomac Rivers, Ohio, 1931

- First evidence of mass human toxicity
- Drinking water treated with copper sulphate (destroy algal blooms) – caused death and lysis of cyanobacteria, released toxins into water
- Bloom of *Microcystis aeruginosa*

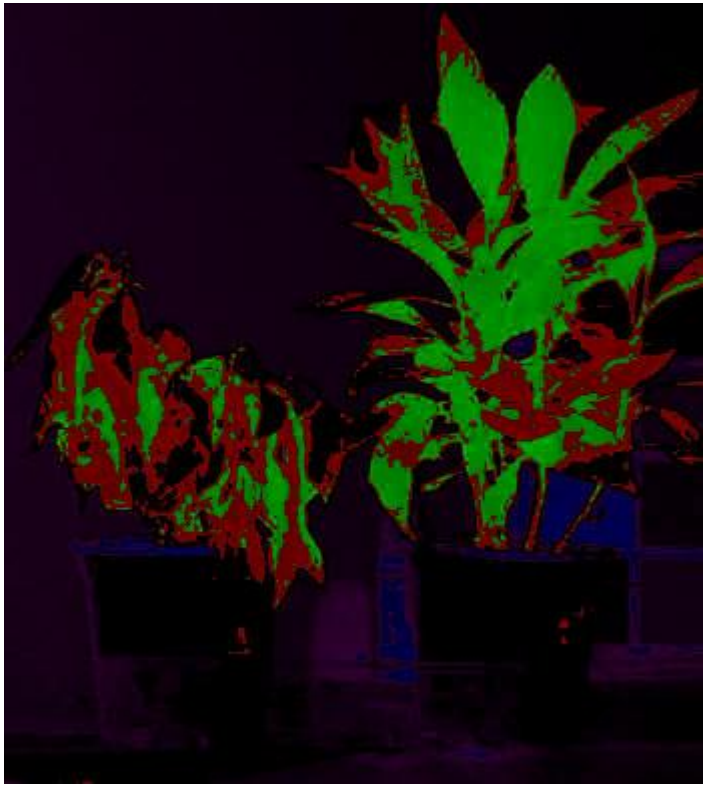
Musky Bay
Environmental Sampling

July 24, 2013

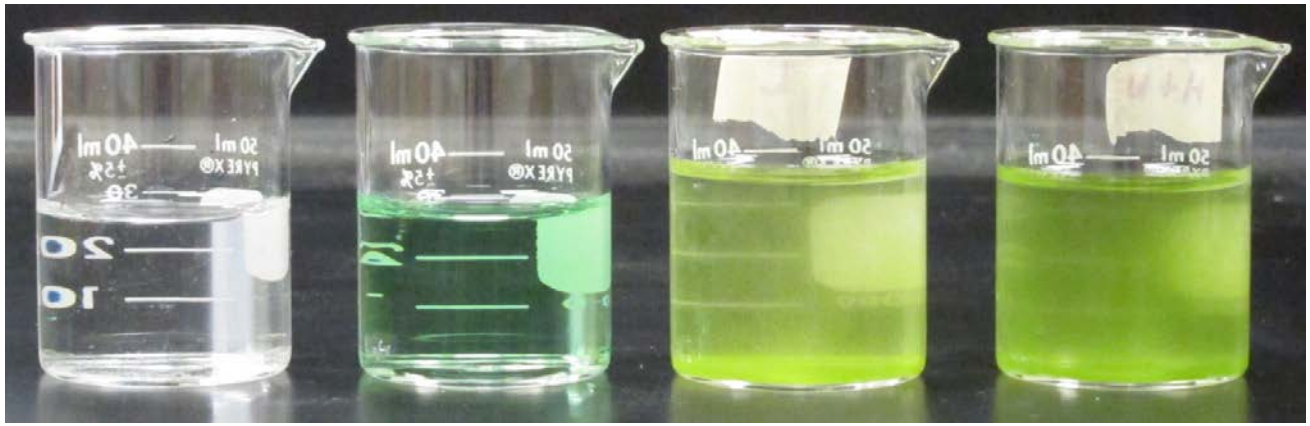


Normalized Difference Vegetative Index

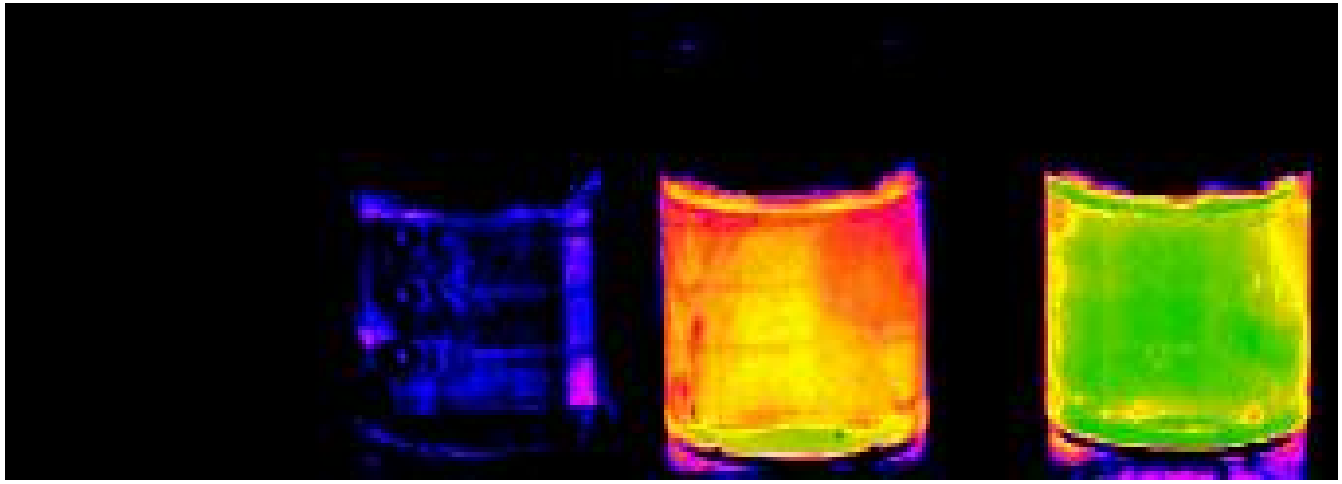
- Technology developed to monitor the photosynthetic capacity of plants
  - Developing the technology to monitor batch stress level



Camera Processing



Water | Green Food Colouring | Sample 1 | Sample 2



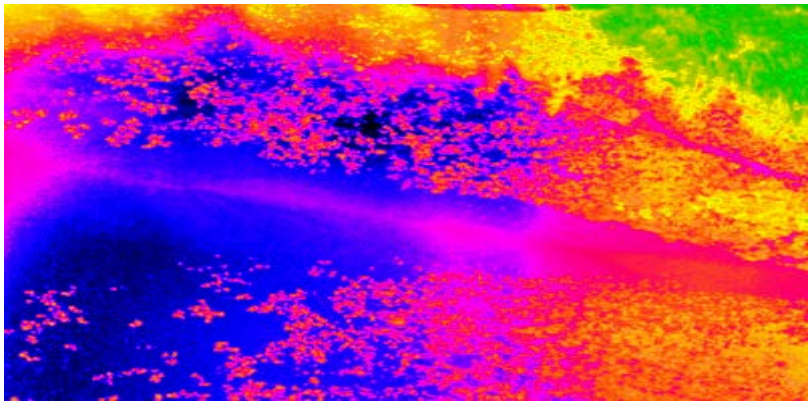
Processing Scale

Healthy

Stressed

Background


Victoria Lodge
& Trailer Park



Thanks!

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Canadian Shield Consultants Agency Inc.
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