

Algal Blooms: Cyanobacteria, Toxins, and Nutrients

**Dominique Derminio
and Greg Boyer**

**State University of New York
College of Environmental Science
and Forestry, Syracuse, NY**



Q1. What are cyanobacteria?



Blue-green algae (BGA)

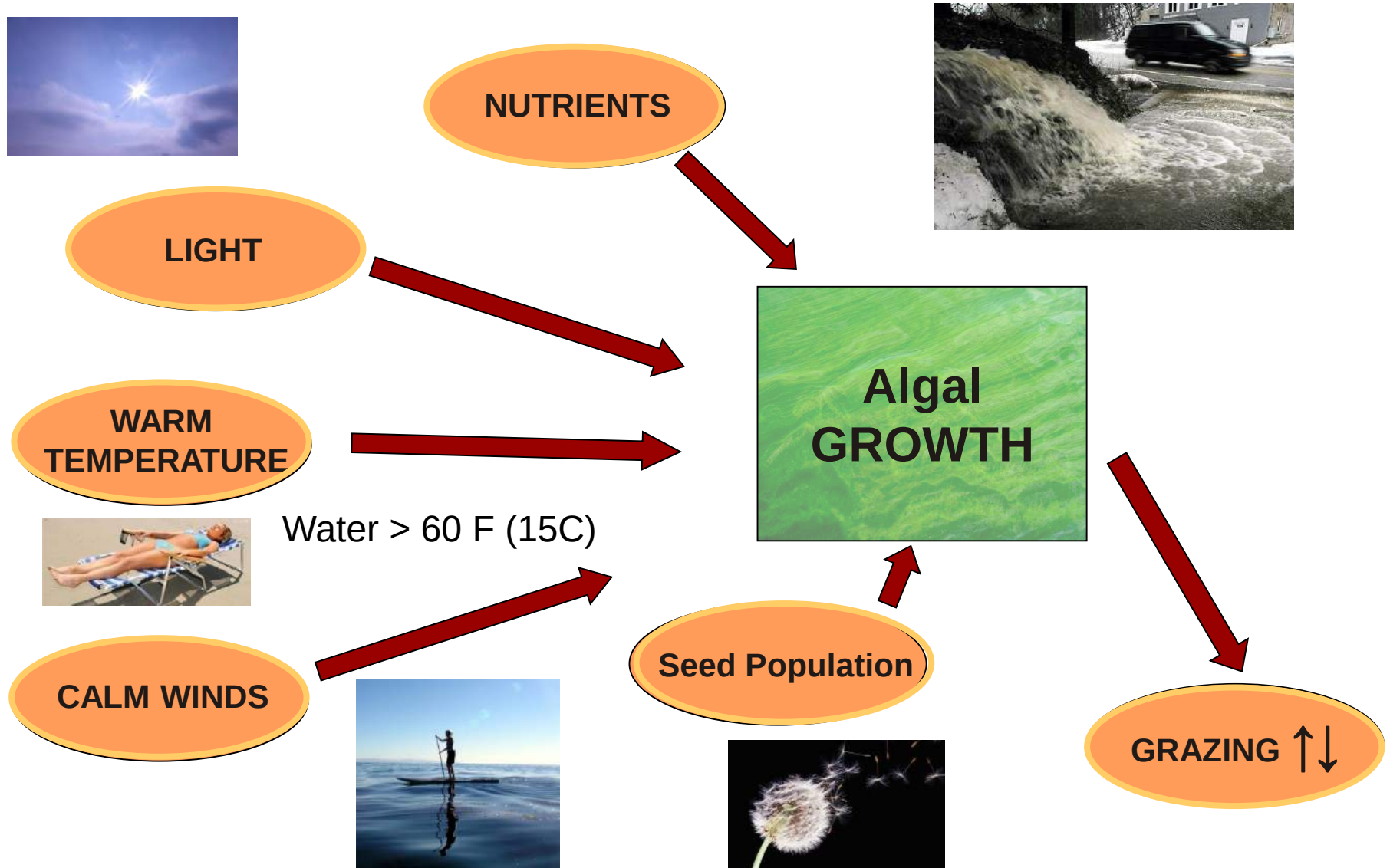
- Approximately 8000 species
- 3 billion years of evolution
 - Well adapted to life
- Humans: 6 million years

Very diverse plant-like group

- Some float
- Some fix nitrogen
- Some forms blooms
- Some are toxic; some not
- Grow slow: peak in August

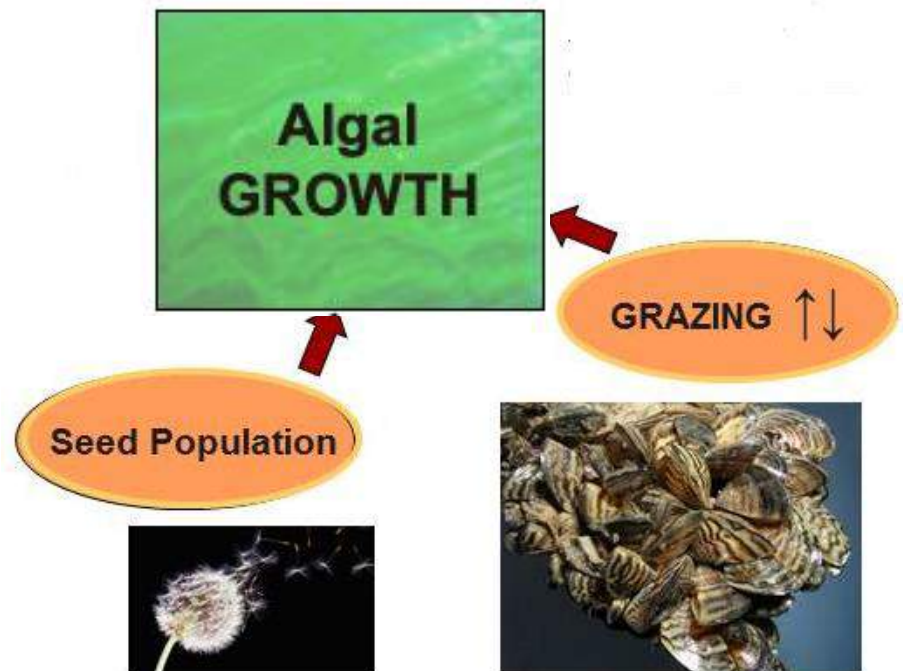


Q2. Why do blooms form?



Q3. How do we prevent blooms?

- Seed population is there
- Zebra mussels may promote blooms or “harvest blooms



Q3. How do we prevent blooms?



LIGHT

**WARM
TEMPERATURE**



Water > 60 F

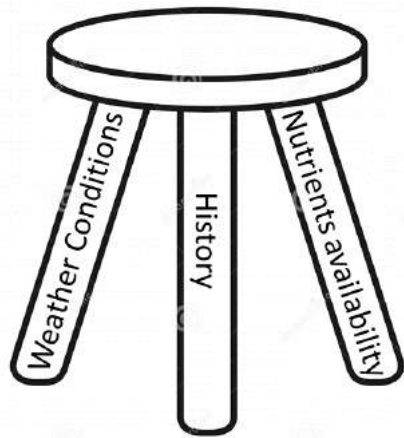
CALM WINDS



Not much we can do about
light, temperature, and winds

**Algal
GROWTH**

Q3. How do we prevent blooms?



Nutrients (N,P)
usually come from
the land as run-off



That brings us to
nutrients.....

It is not the only thing
important, it is **the only**
thing we can control

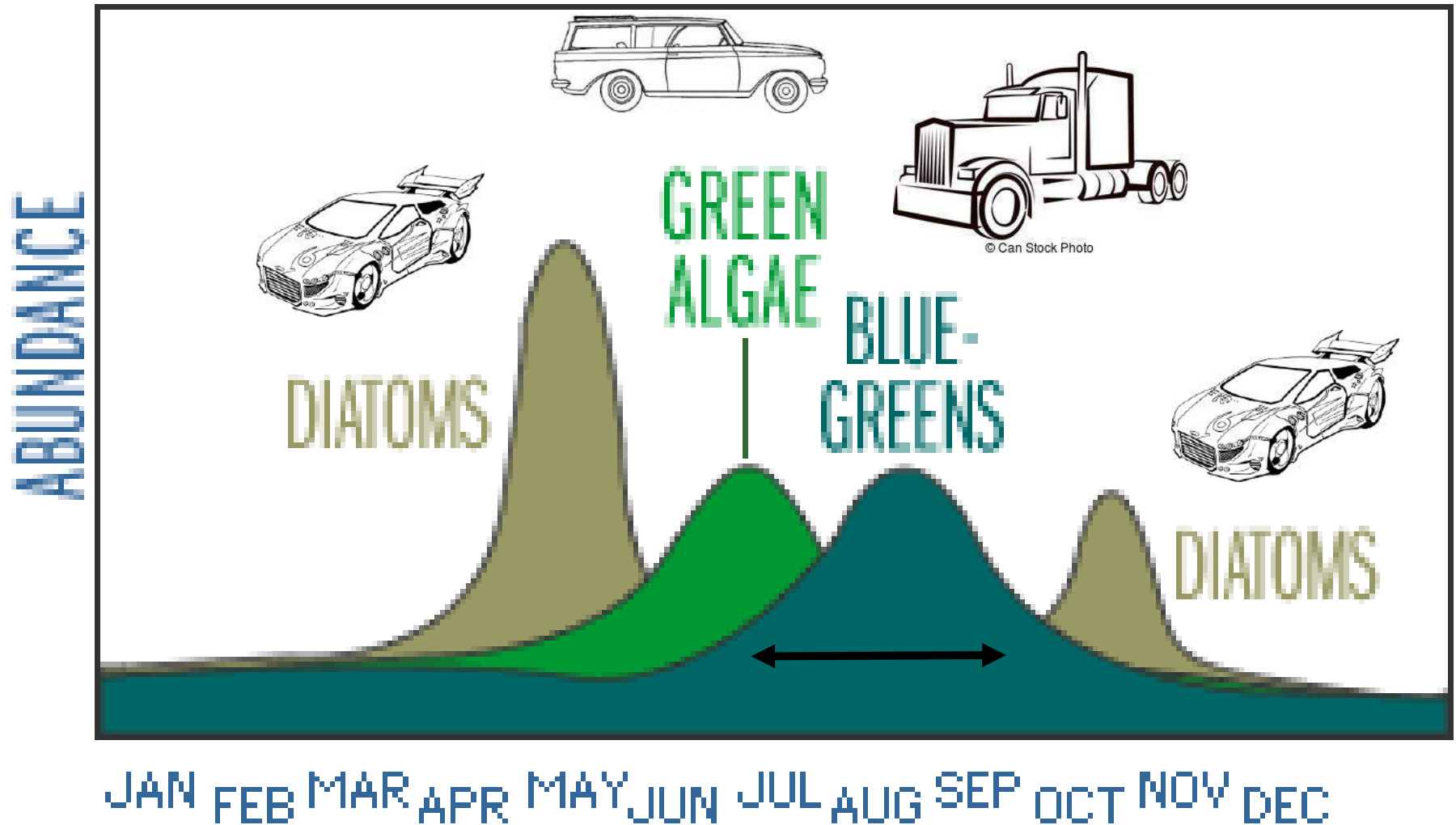


Cyanobacteria don't care what is the source of nutrients.

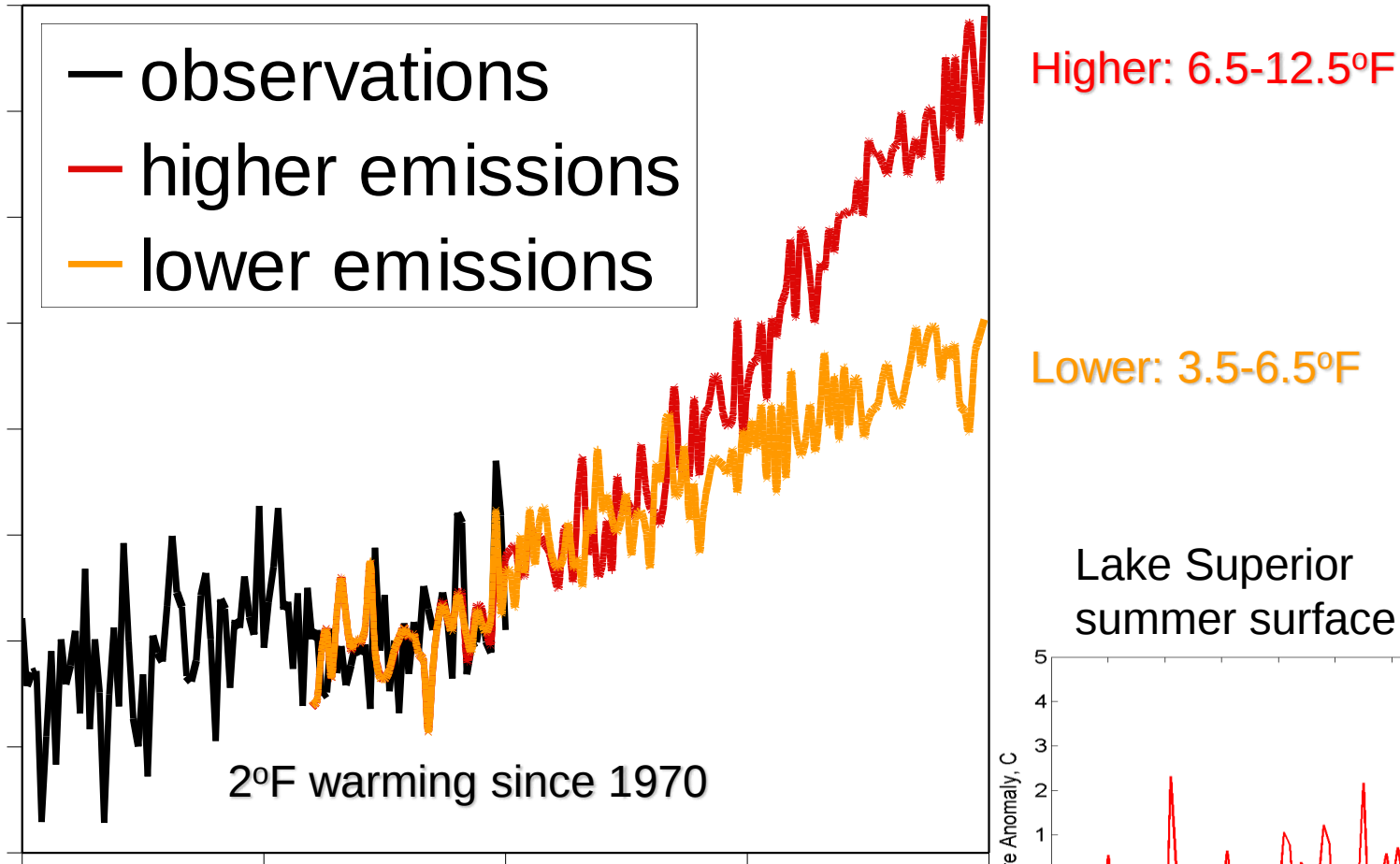
-Control both episodic and continual inputs

Q4. How does climate change fit in?

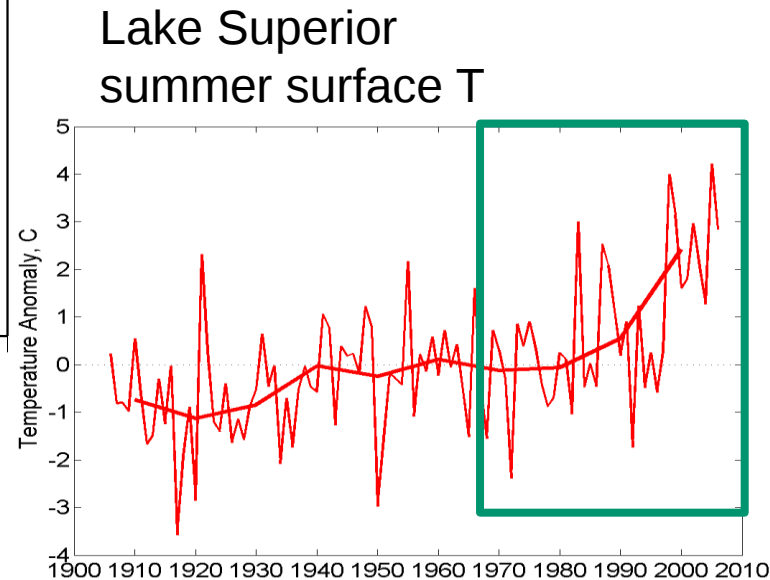
Its useful to understand lake ecology



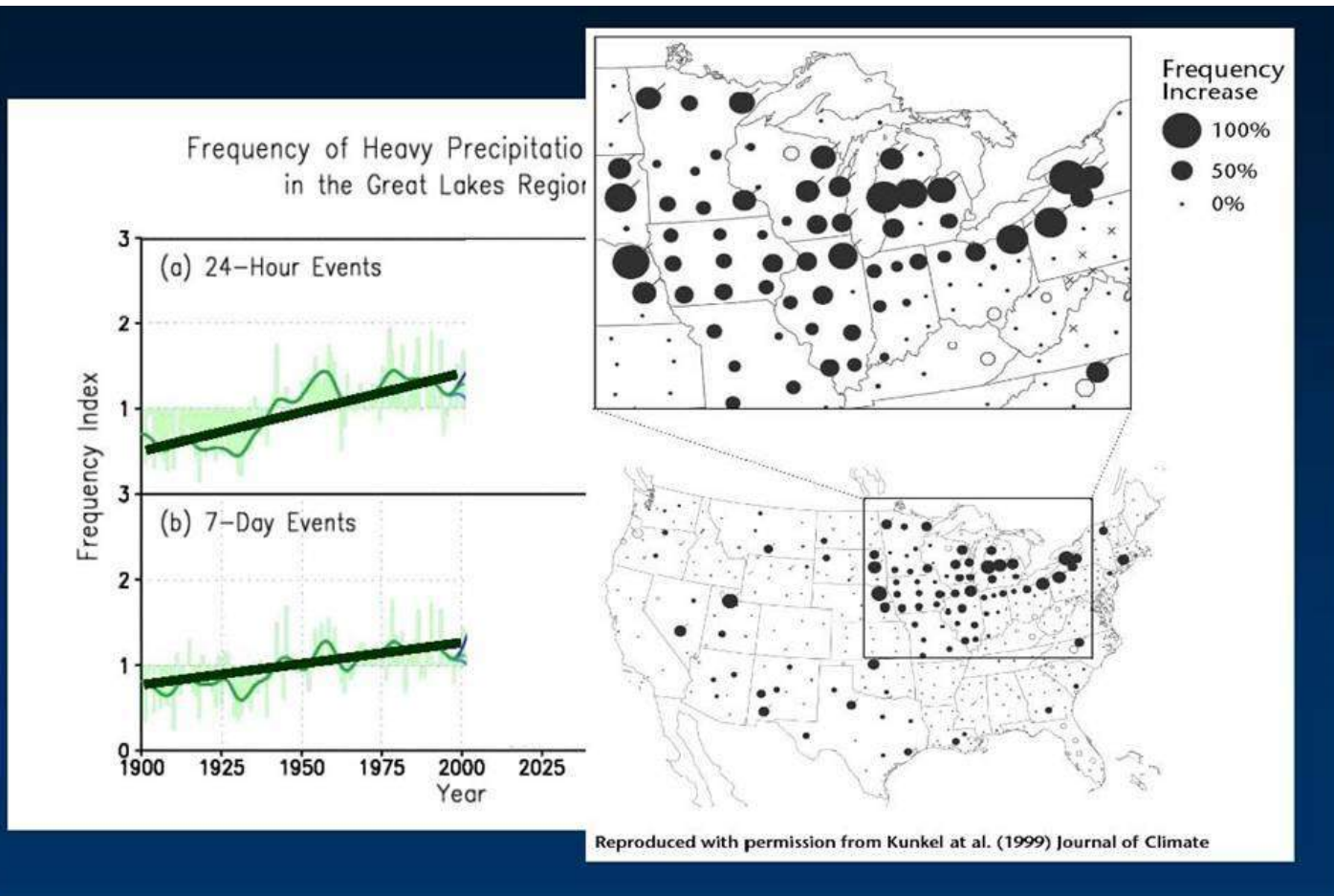
Q4. How does climate change fit in?



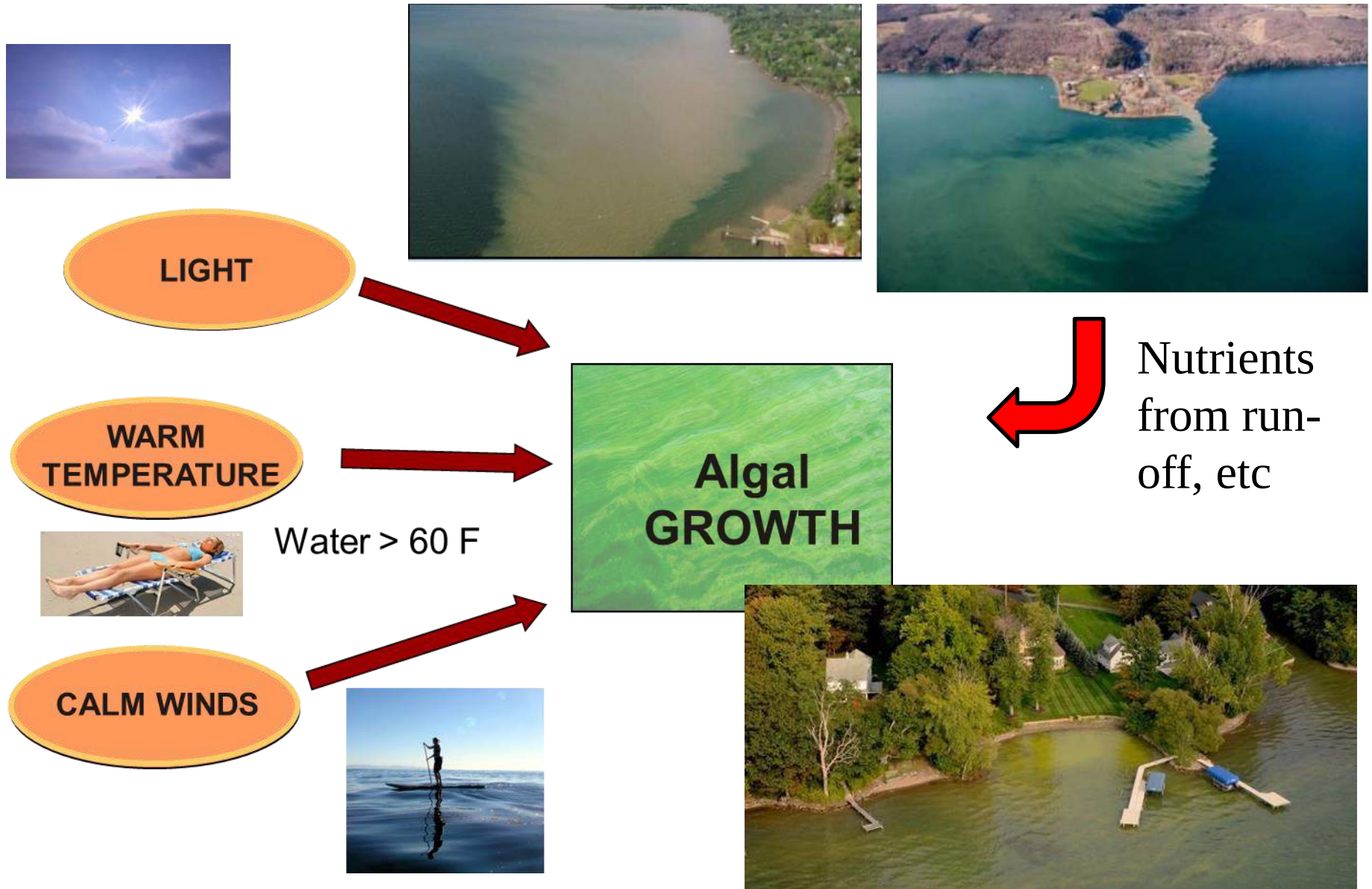
Lake Erie growing season
is increasing by 1.9 days
per year for the last decade



2nd: More frequent extreme rain extreme rain events

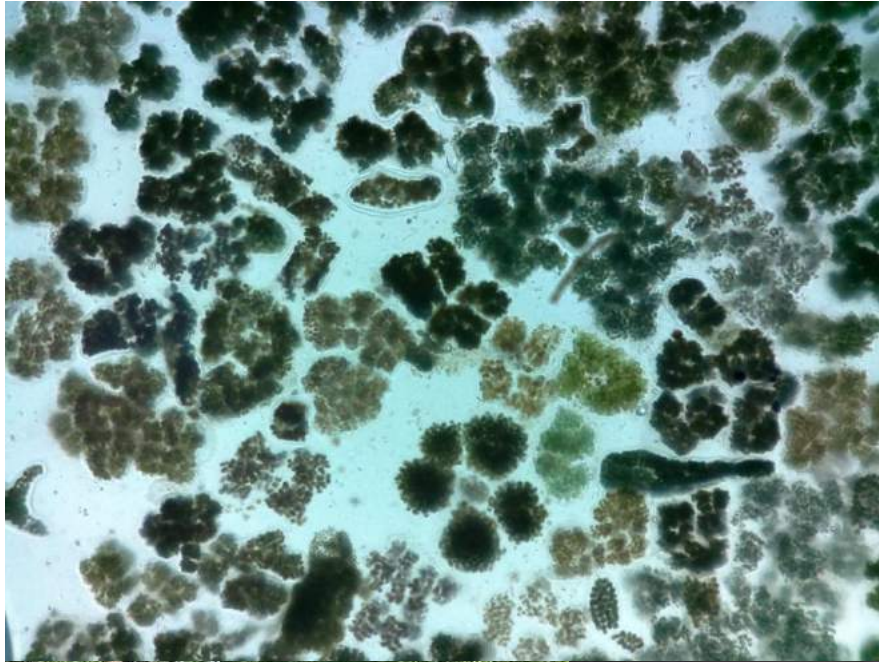


Q5. How this all play out?



Q6. Why are they called harmful?

Microcystis vs. microcystins



- *Microcystis aeruginosa*
 - Non-N fixer
 - Likes organic N
 - Forms surface blooms
- Very common genera
 - Found in every water body
 - First reported in the Finger Lakes in 1800s
- Can exist in toxic, non-toxic and potentially toxic forms.
 - Liver toxin (microcystins)
 - “Fast Death Factor”
 - Responsible for drinking water advisories

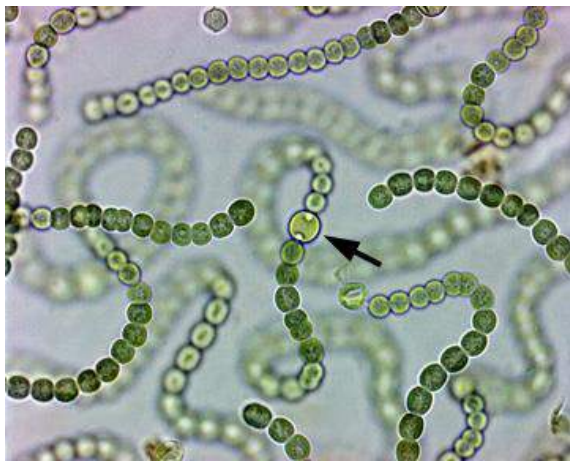


Toledo 2014

A wee bit of history on HABS in the Finger Lakes

% of samples with detectable Microcystins (n); maximum value in ug/L												
2004	2006	2007	2010	2011	2012	2013	2014	2015	2016	2017	2018	
0% (3)		10% (10) 0.1					0% (2)			4% (52) 0.56	5% (42) 2.1	Otisco Lake
15% (7) 0.2										57% (82) 214	21% (47) 205	Skaneateles Lake
33% (6) 0.2		0% (26)		100% (3) 2500		100% (2) 40	33% (9) 75	73% (26) 800	80% (40) 2000	32% (59) 1803	20% (45) 1355	Owasco Lake
0% (5)		0% (18)			0% (1)		0% (5)	0% (4)	85% (7) 150	9% (43) 730	25% (96) 1060	Cayuga Lake
0% (3)			0% (2)				0% (9)	11% (9) 70	20% (10) 33	72% (70) 390	(108) 620	Seneca Lake
20% (5) 0.1										19% (21) 623	(108) 620	Keuka Lake
40% (5) 0.4	0% (2)		100% (1) 40			0% (2)		93% (15) 50	0% (8)	30% (27) 632	2% (47) 246	Canandaigua Lake
42% (9) 1			100% (2) ????			95% (25) ????	7% (57) 3	4% (71) 80	12% (80) 5	10% (104) 5	7% (9) 0.4	Honeoye Lake
0% (4)										10% (19) 0.2	0% (14)	Canadice Lake
0% (4)										0% (54)	0% (96)	Hemlock Lake
33% (6) 0.1									0% (1)	5% (36) 1	0% (44)	Conesus Lake

We really did not see a lot of toxic HABs in the finger lakes 15 years ago



Cyanobacteria are rich chemical factories

- Beneficial pharmaceuticals
- Liver toxins
- Skin toxins
- Neurotoxins
- Allergenic agents

■ Anatoxin-a

“Very fast death factor”

- Very unstable
- Responsible for a number of animal fatalities.

Three reports

“And all the waters that were in the river turned to blood. And the fish that were in the rivers died; and the river stank, and the Egyptians could not drink the water of the river, . . .”

Exodus 7:20-21

.....Thank you for the report of the cattle poisoning around Payne's Lake.... The state laboratory has examined the water samples from this lake and.... and it is reasonable to assume a water bloom was responsible for the death of these animals.

NY State Vet Records, July 24; 1938

*..... The sample collected on August 1, 2019 consisted of a dense bloom of the cyanobacterium *Microcystis aeruginosa*..... by all estimates this would represent an extreme bloom and be cause for alarm..... Contained high levels of neurotoxin anatoxin-a....*

Response to 3 cow deaths near Lowville NY August 2019

Questions?

dsdermin@syr.edu

glboyer@esf.edu



**OCEANS & HUMAN
HEALTH INITIATIVE**



MERHAB-LGL

Harmful Algal Bloom



Monitoring and Event Response in the Lower Great Lakes