

Blooms, nutrients and climate change: what's in the future for Florida lakes and estuaries?

KARL HAVENS

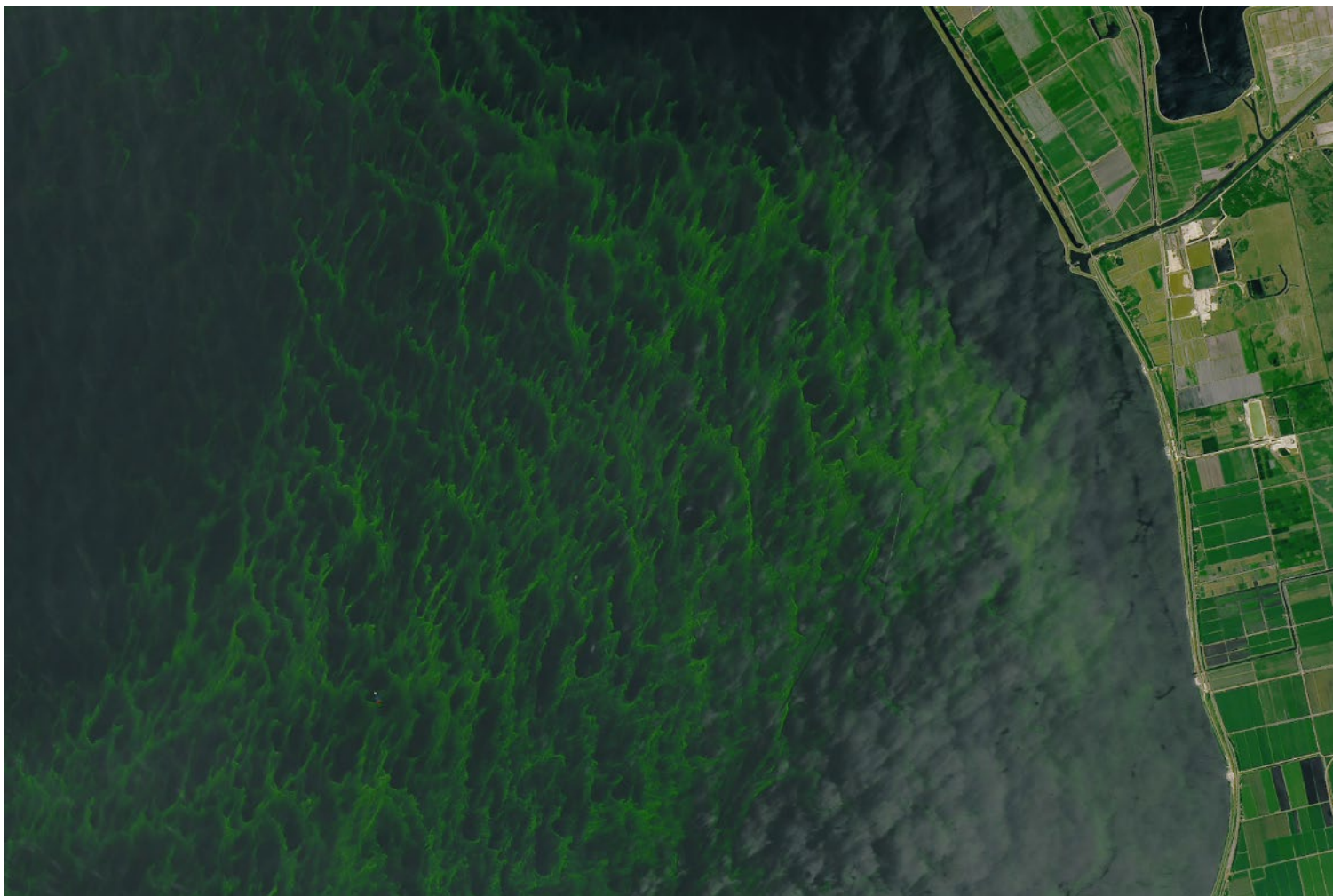
FLORIDA SEA GRANT, UNIVERSITY OF FLORIDA / IFAS



Outline

- Harmful algal blooms
- The events of summer 2018
- What precipitated this outbreak of blooms?
- What has changed in the last 25 years?
- The role of nitrogen vs phosphorus
- What could happen with climate change?
- Impacts and solutions

Harmful Algae Blooms



NASA satellite imagery – summer 2016

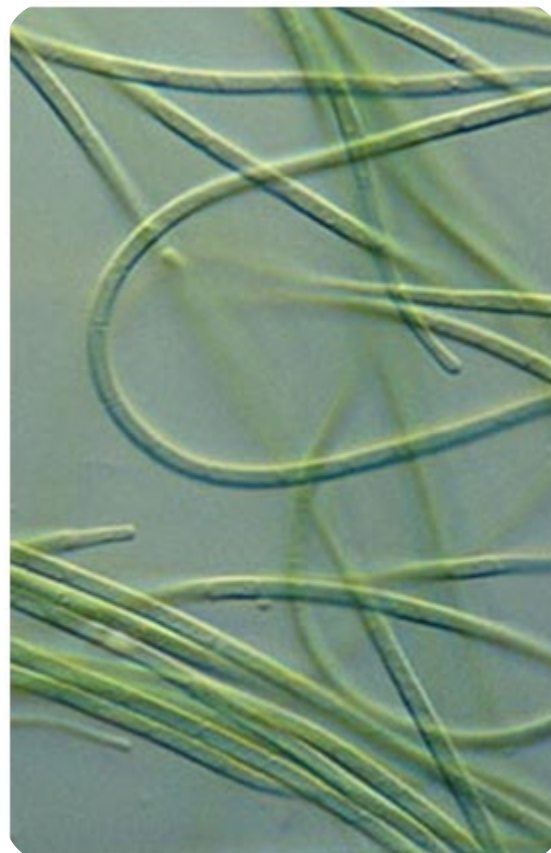
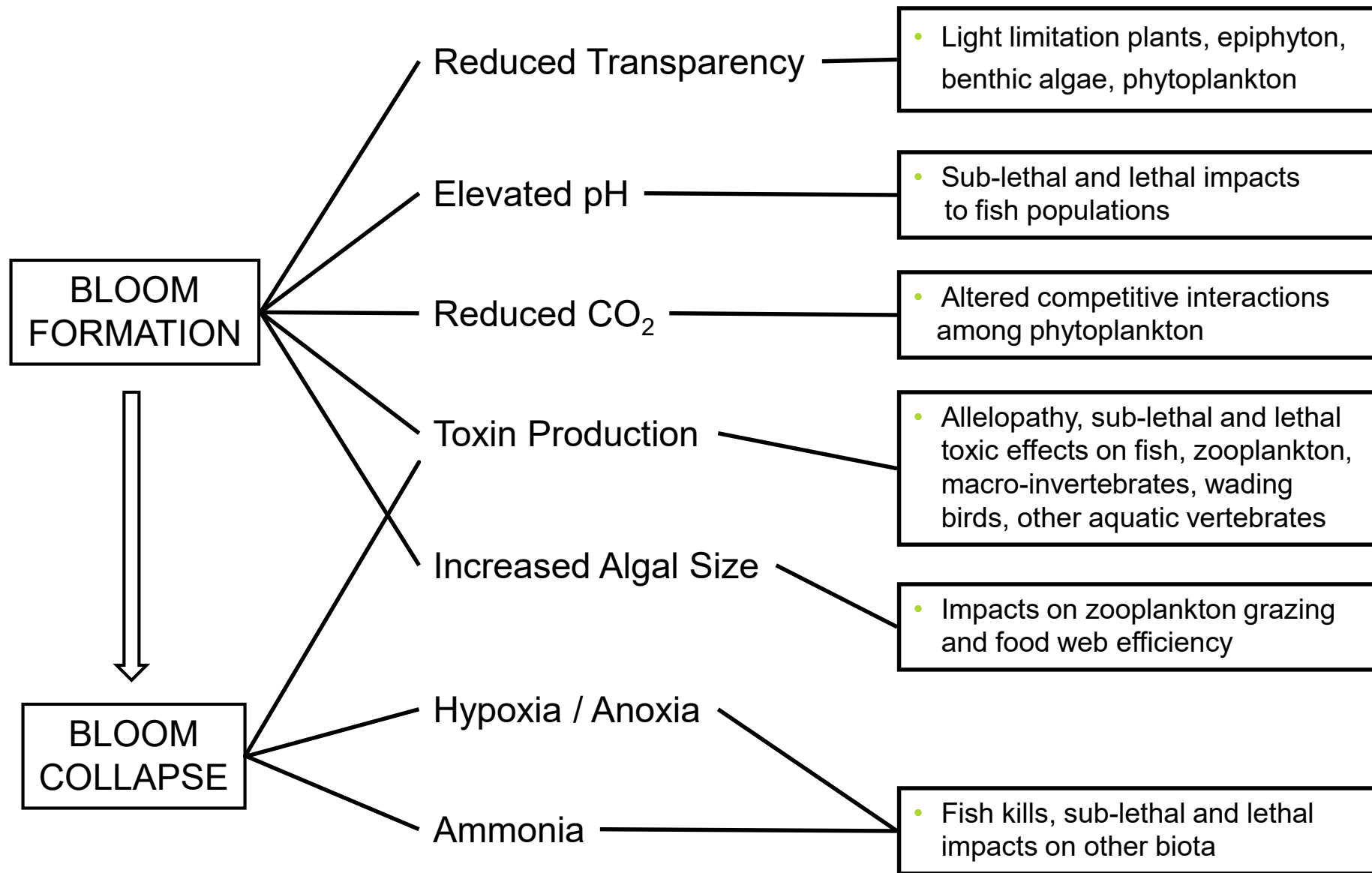






Photo: Ed Philips, UF/IFAS – summer 2016



+ economic and human health effects

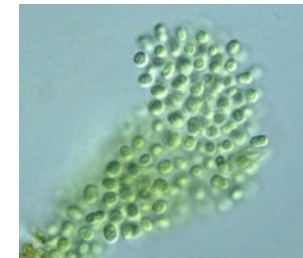
Source: Havens, 2008

Socioeconomic and human health impacts



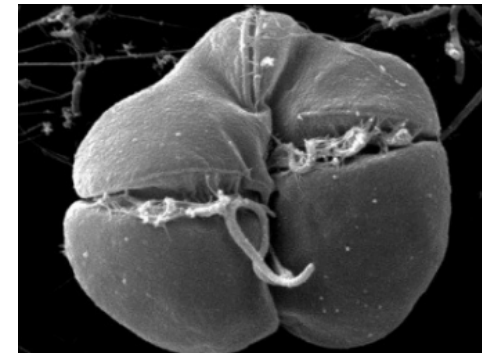
Cyanobacteria (blue-green algae)

Freshwater to slightly saline, lakes, ponds, rivers and estuaries,
Some species produce hepato and neuro-toxins, fish kills linked
mainly with decomposition and oxygen depletion, can cause
contact dermatitis, human health effects not well-understood,
blooms are stimulated by man-made nutrient sources (N and P)



Red Tide (*Karenia brevis*)

Marine, form offshore naturally, produce brevetoxins that cause respiratory distress, fish / marine mammal kills, maybe stimulated by man-caused nutrient sources along the near-shore coastal waters



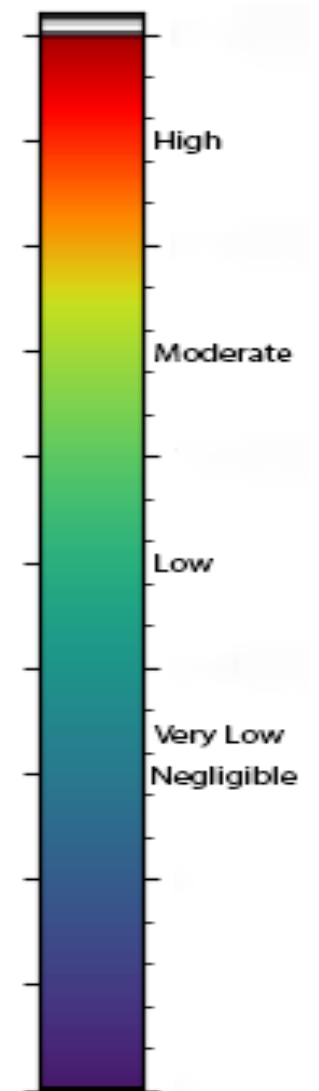
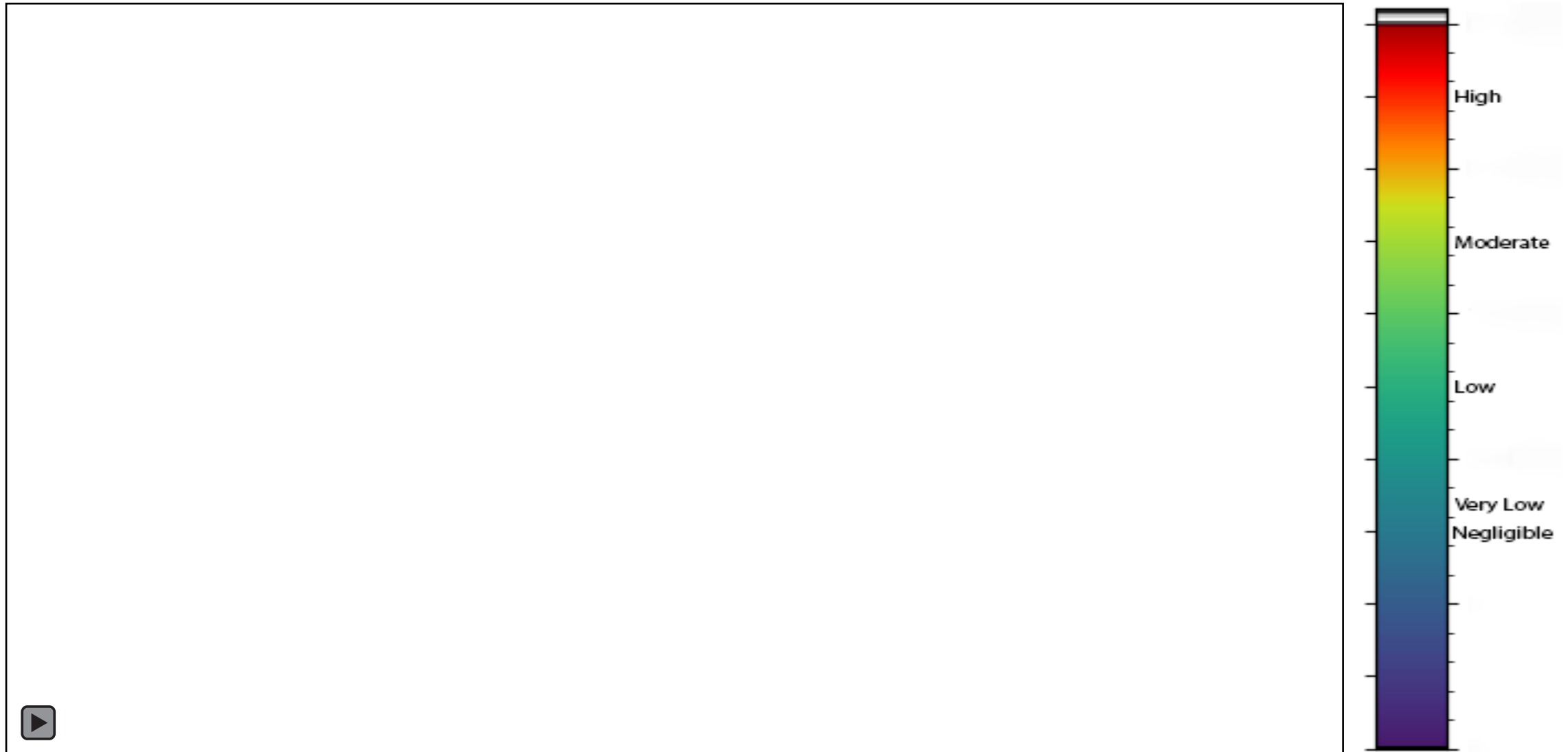
Source: Florida Fish and Wildlife Research Institute

Summer 2018

Lake Okeechobee, Summer 2018

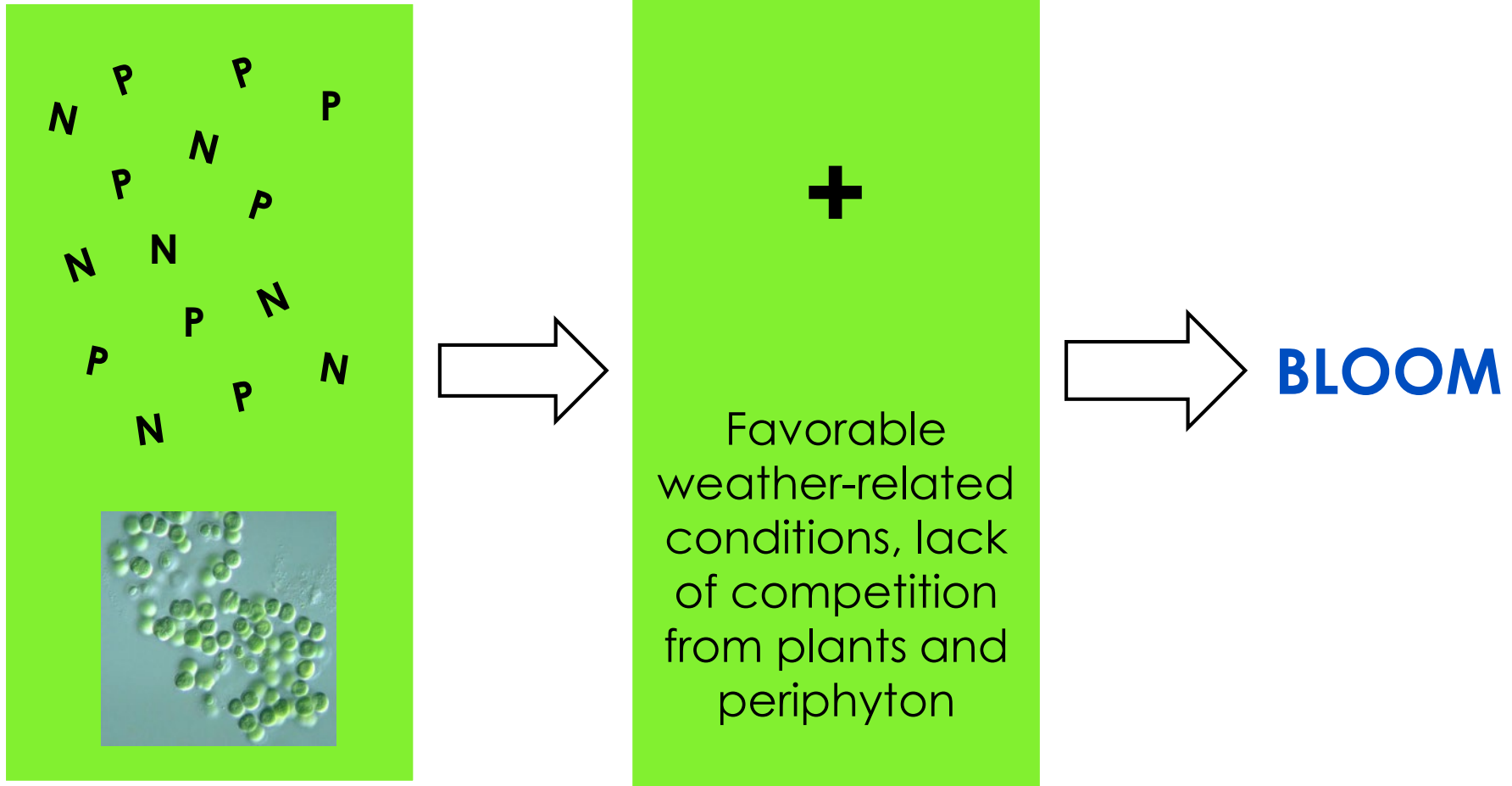


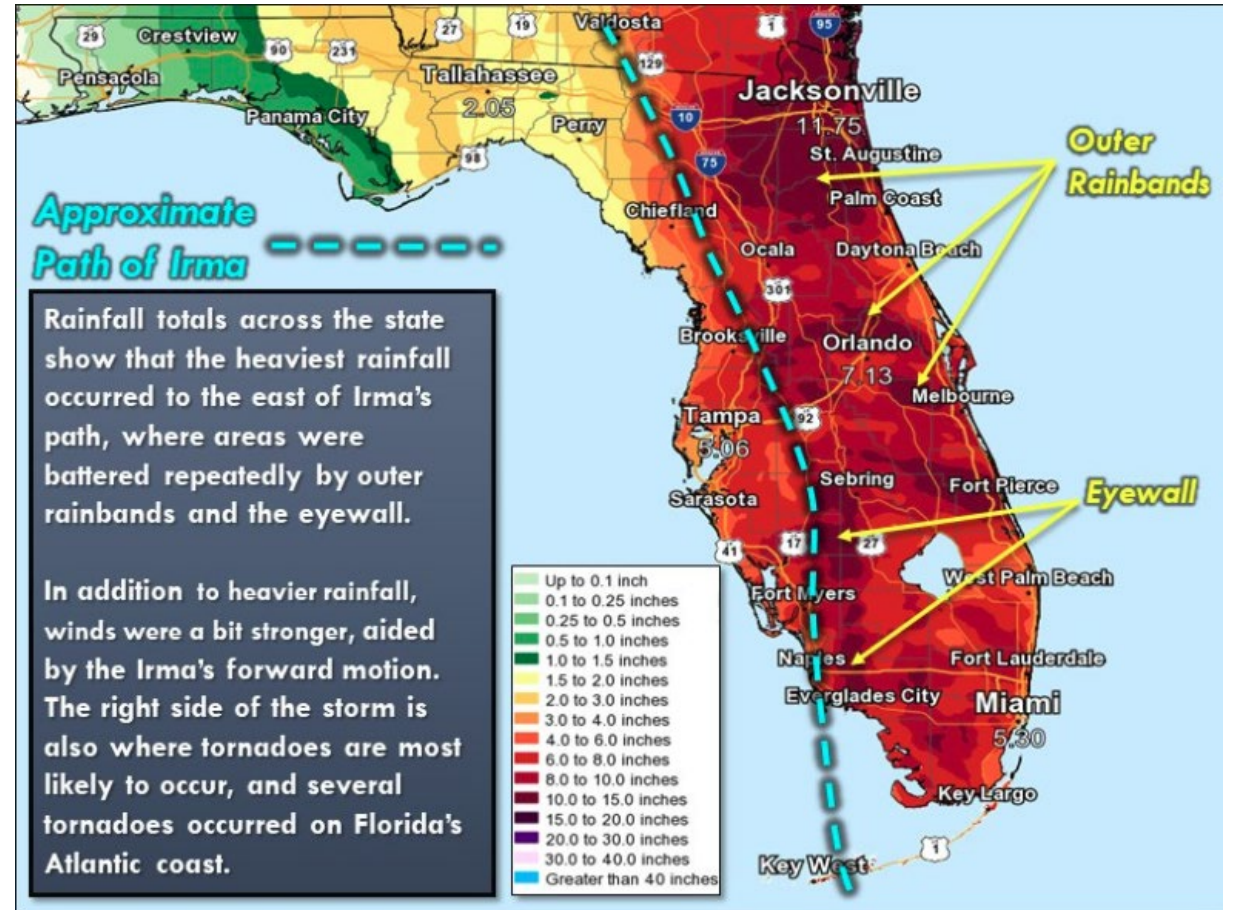
Gulf Coastal Waters, Summer 2018



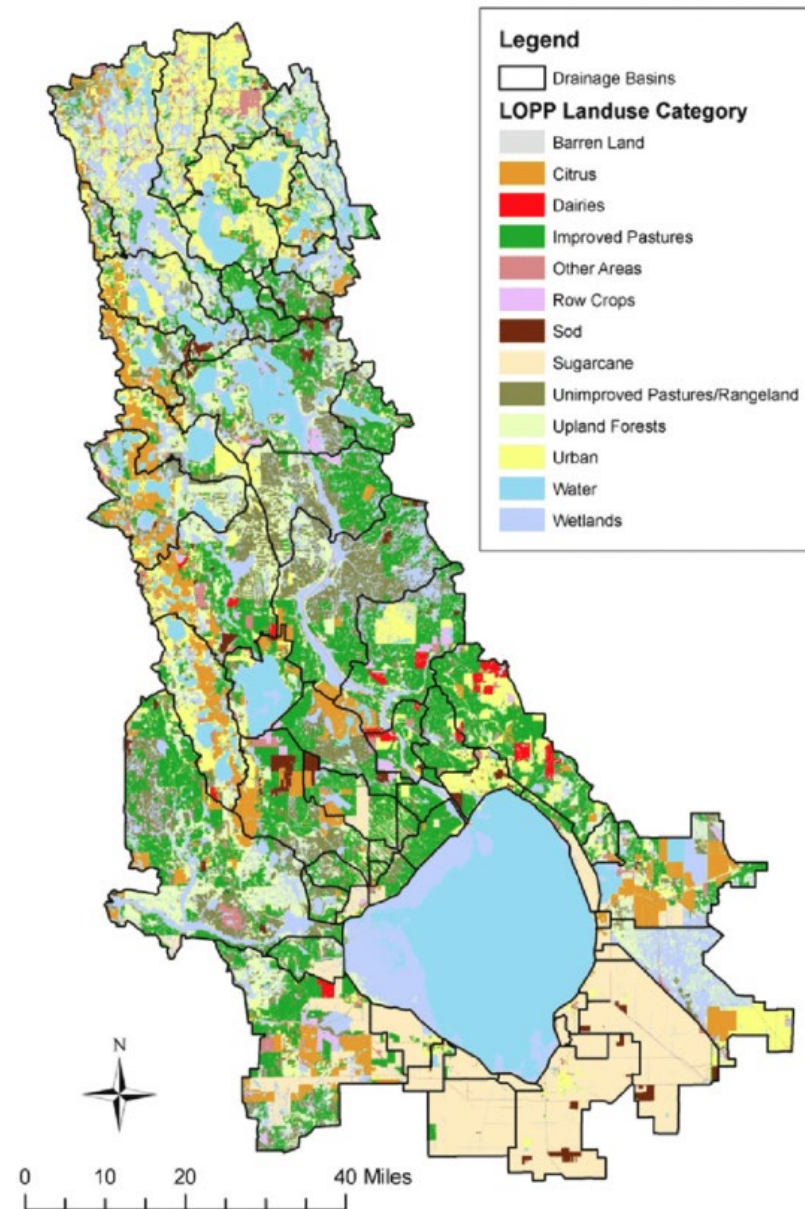
Contributing Factors

Cyanobacteria bloom dynamics

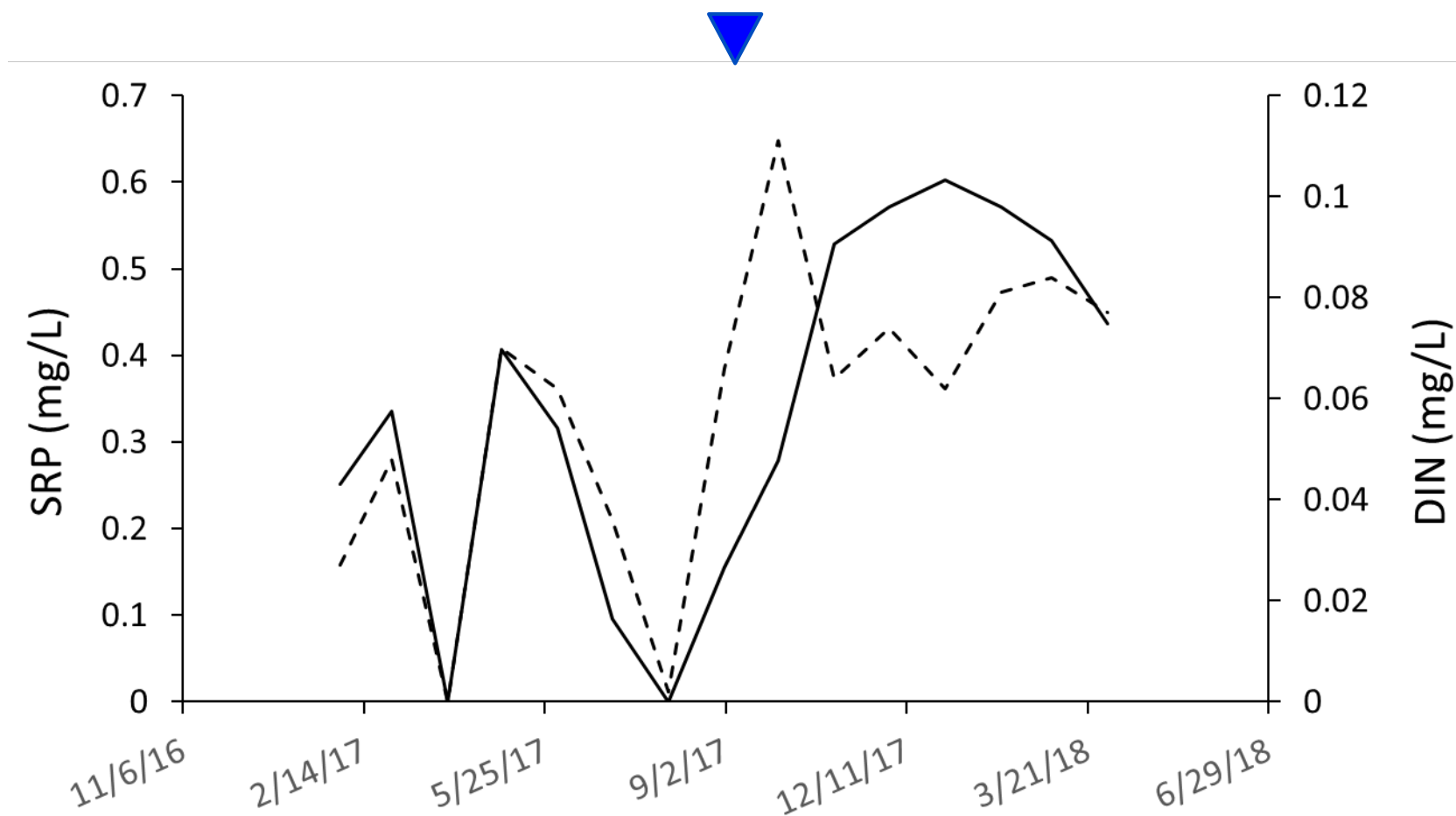




Source: NOAA National Weather Service – Sept 2017

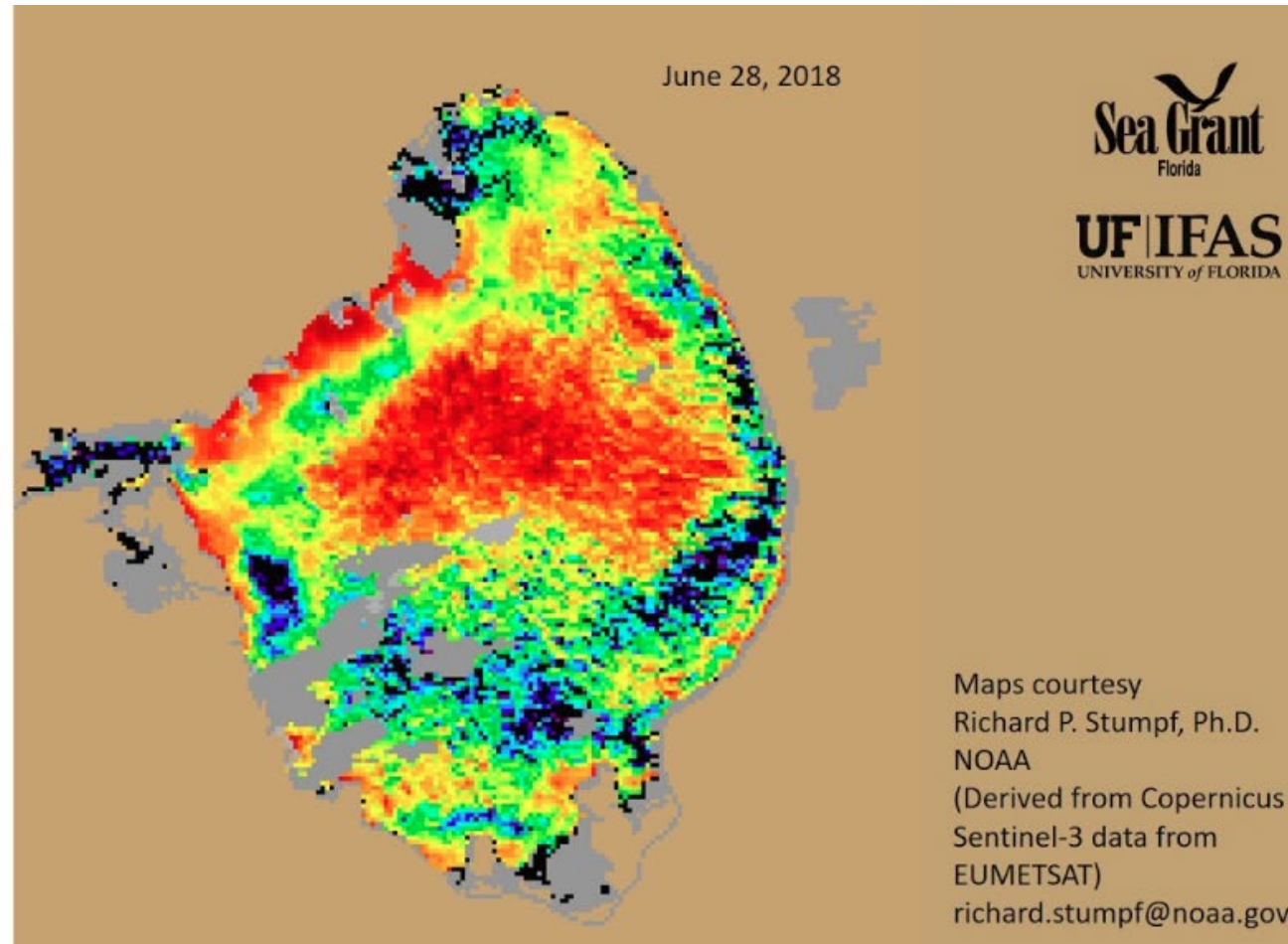
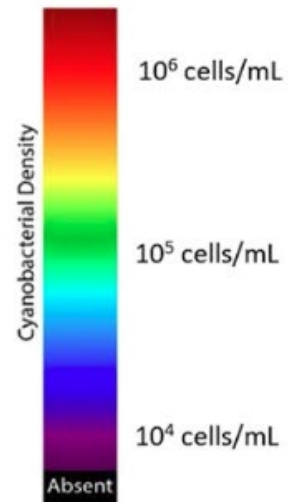


Source: SFWMD



Unpublished Data Source: SFWMD

Lake Okeechobee



The Coastal Connection

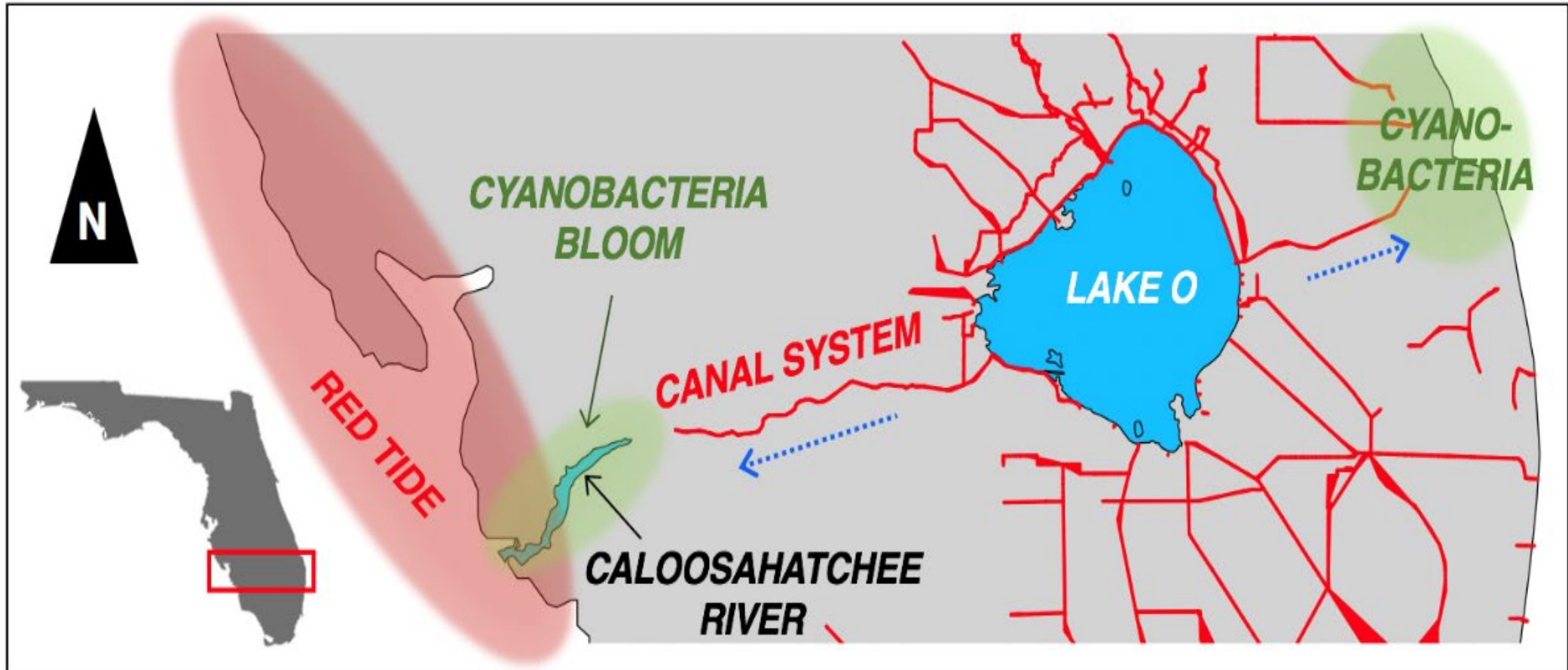
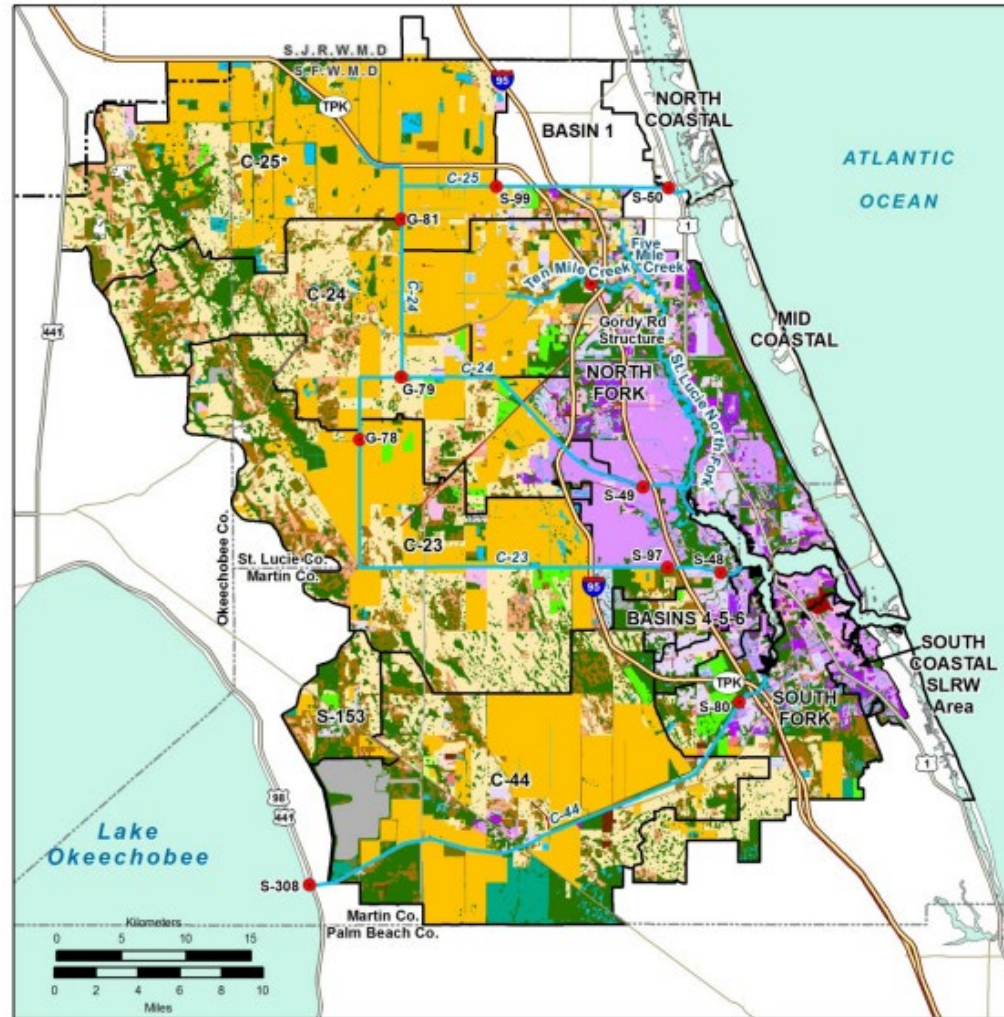


Image courtesy Ed Philips, UF/IFAS Fisheries & Aquatic Sciences



Photo: Ed Phlips, UF/IFAS – Summer 2016

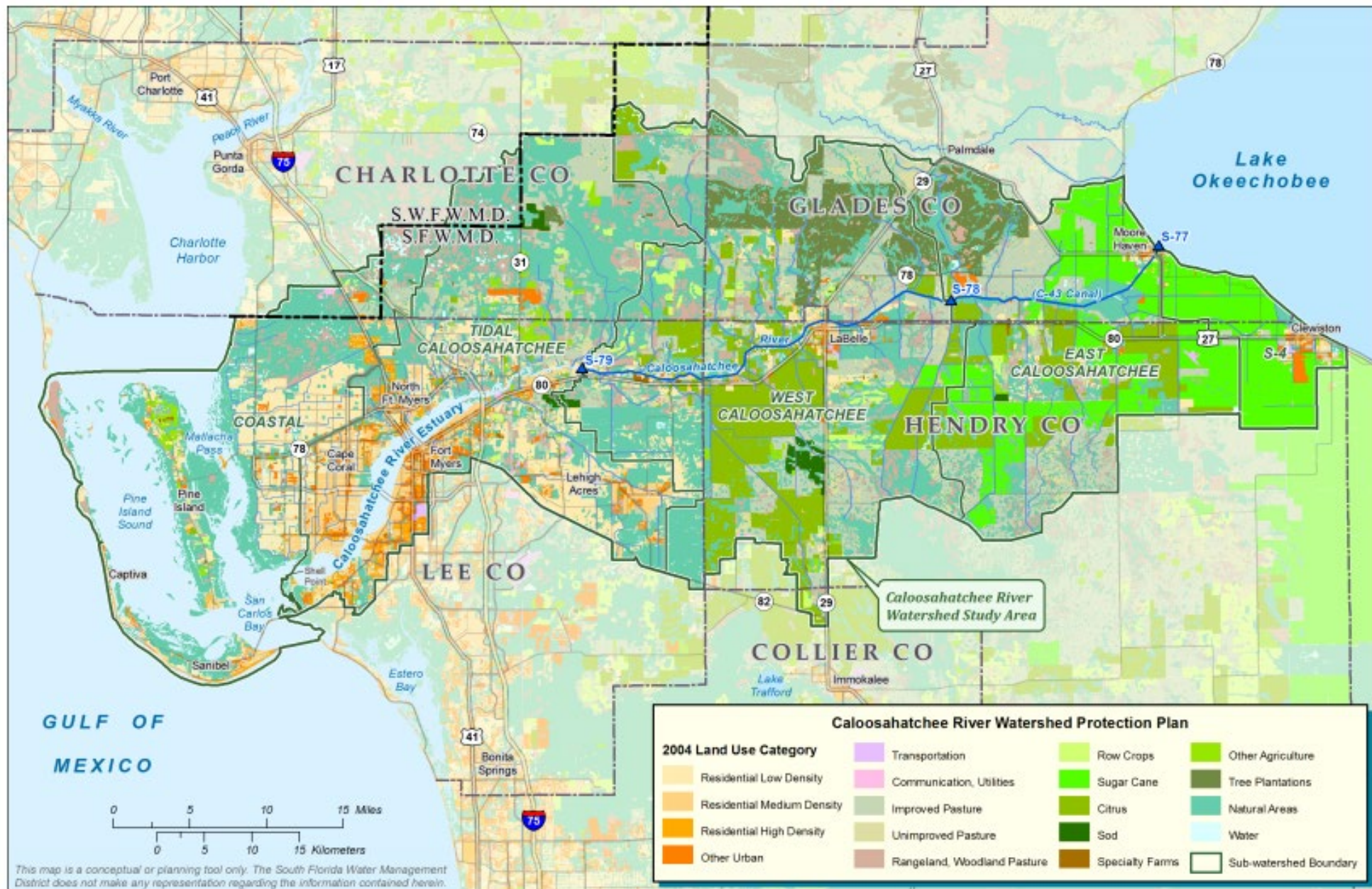


Disclaimer:
The South Florida Water Management District does not warrant, guarantee,
or make any representations regarding the use of information on this map.

2004 Land Use



Source: SFWMD



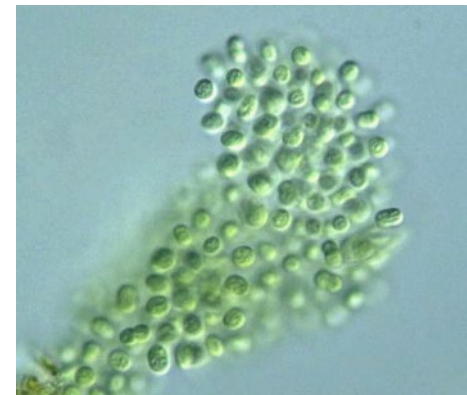
Source: SFWMD

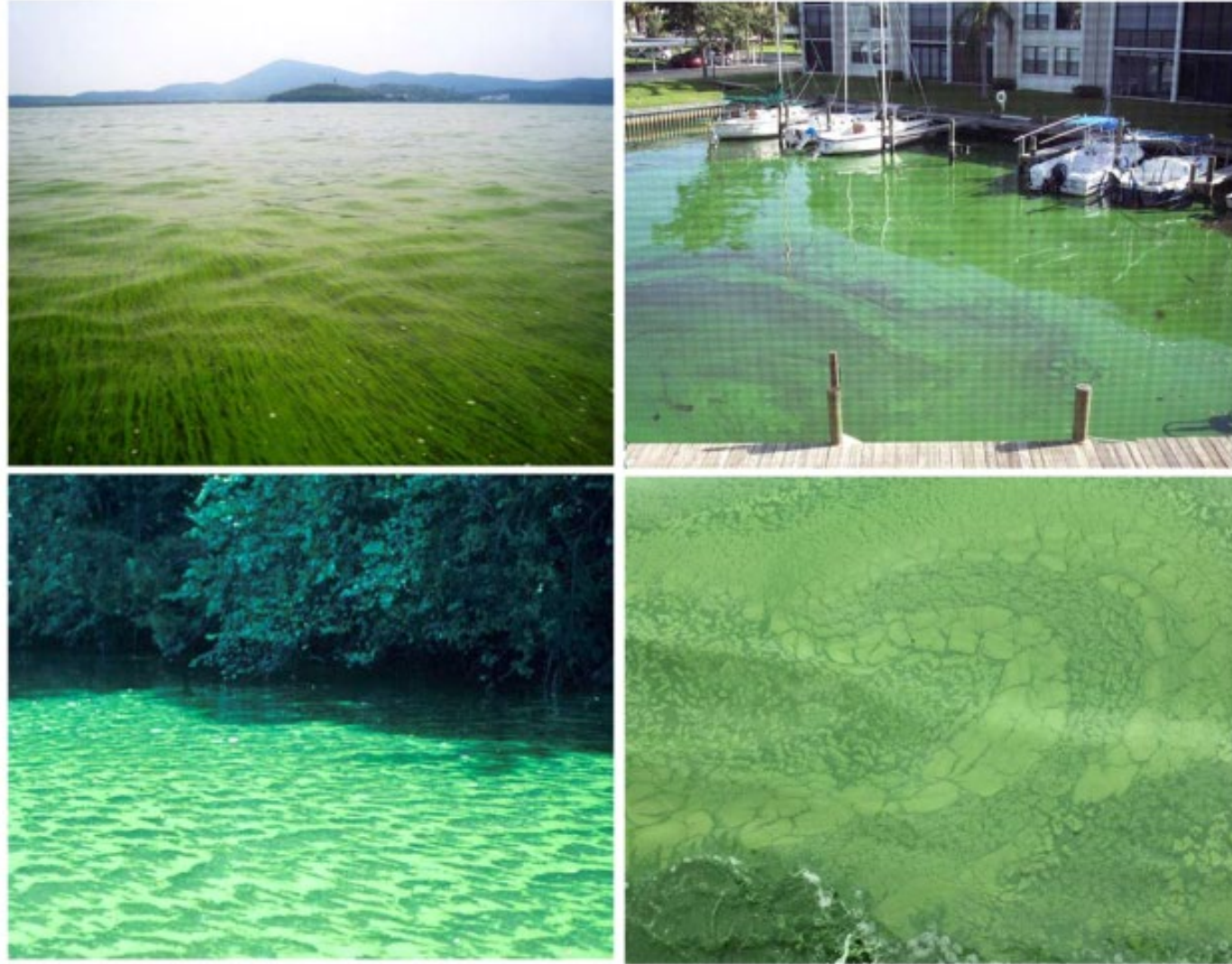
What Has Changed?

Anabaena – 1990's
western shore



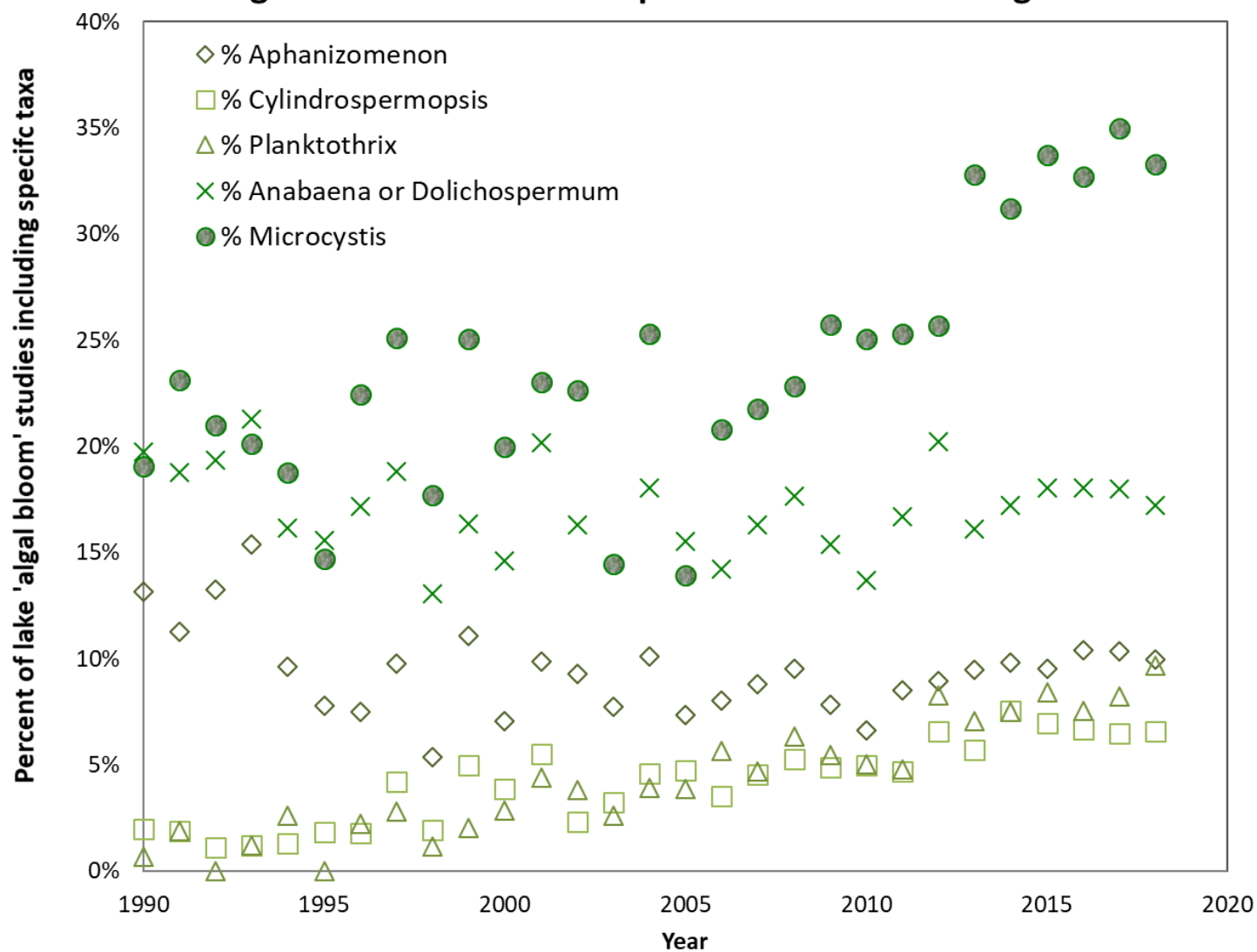
Microcystis – 2005, 10, 16, 18
lake-wide



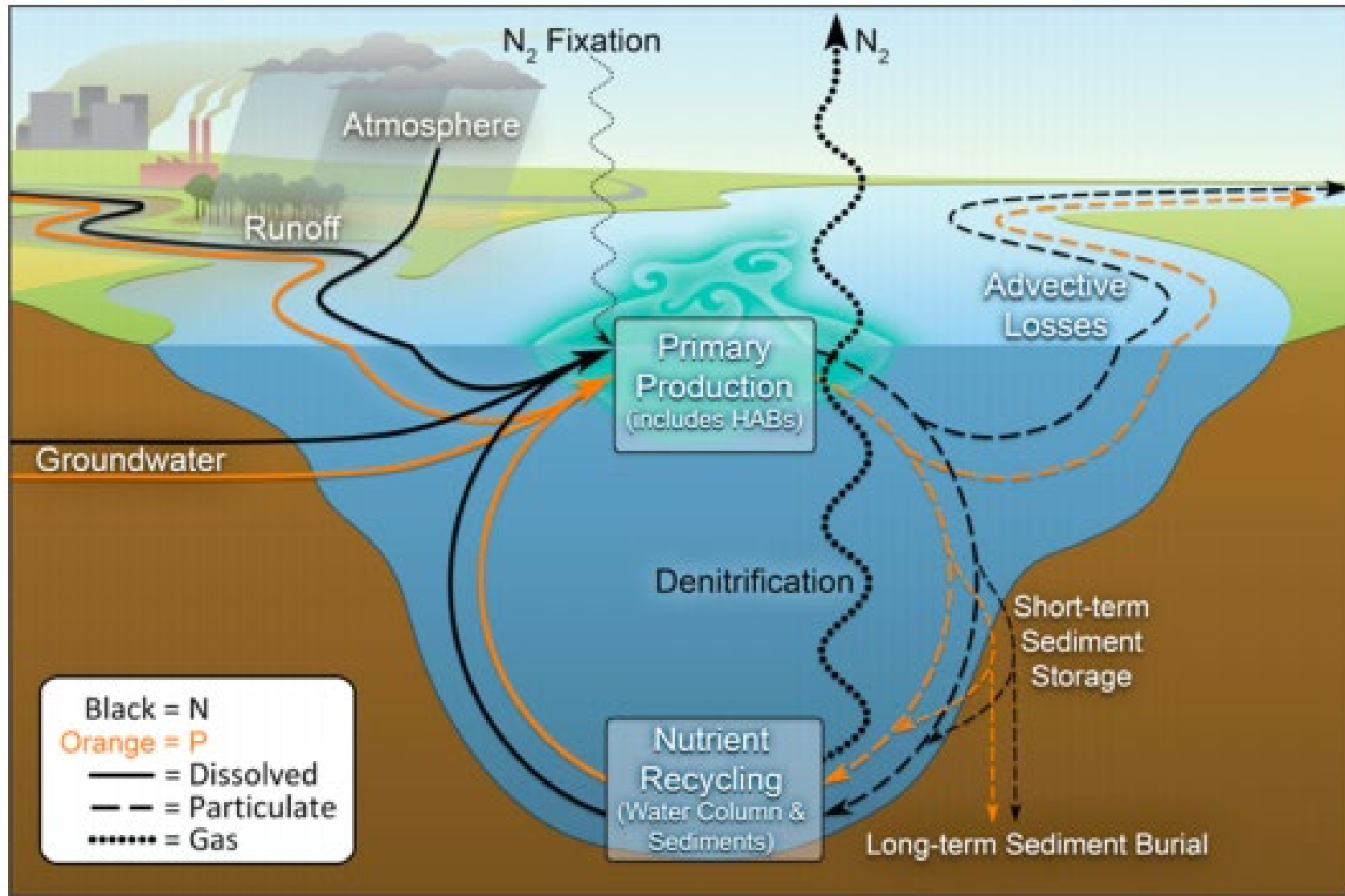


Source: Paerl et al. 2016

Google Scholar Searches for publications on lake 'algal bloom'



Source: Paerl, Havens, Gardner et al., in review



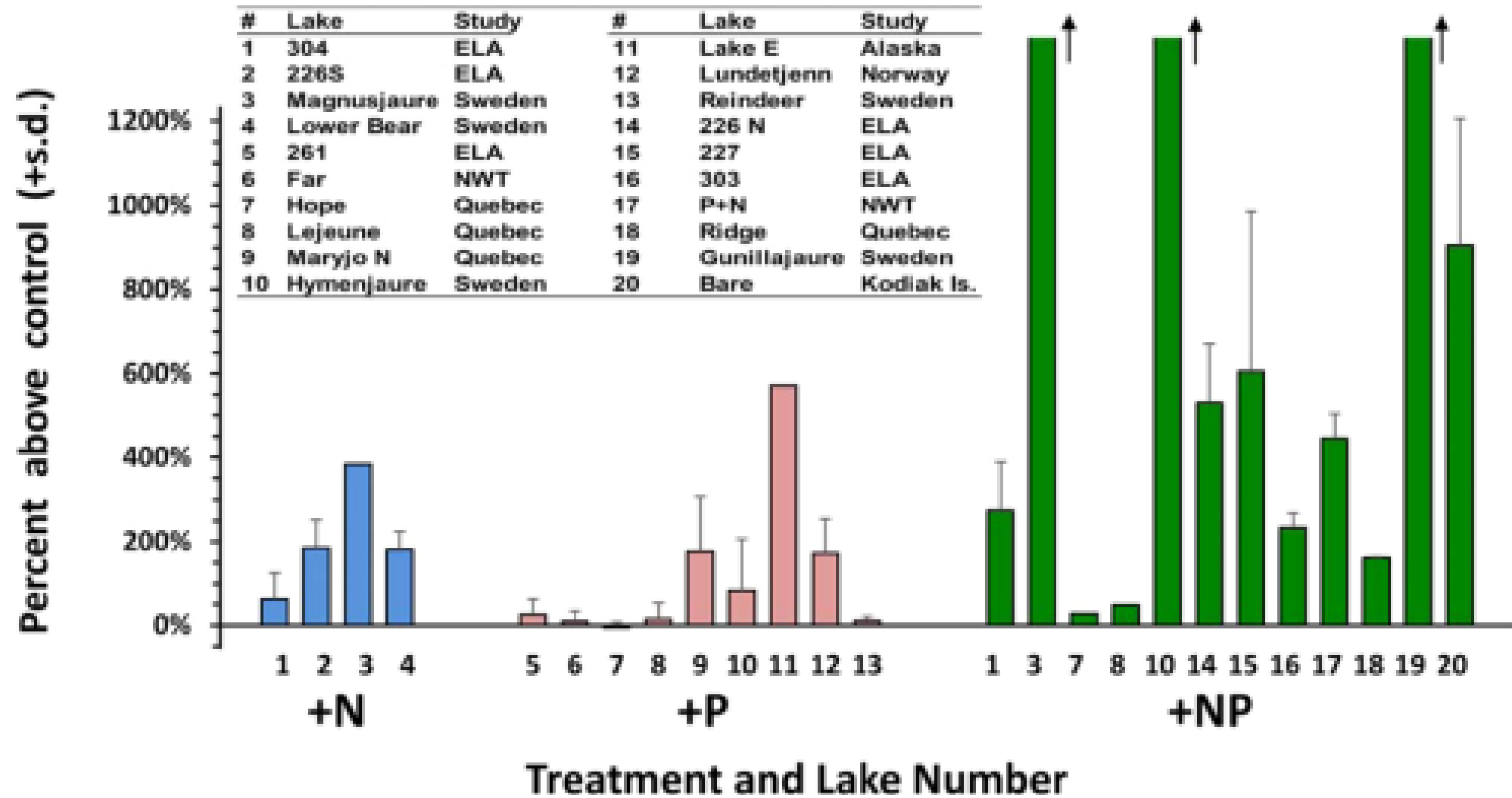
Source: Paerl et al. 2016

Nitrogen vs. Phosphorus

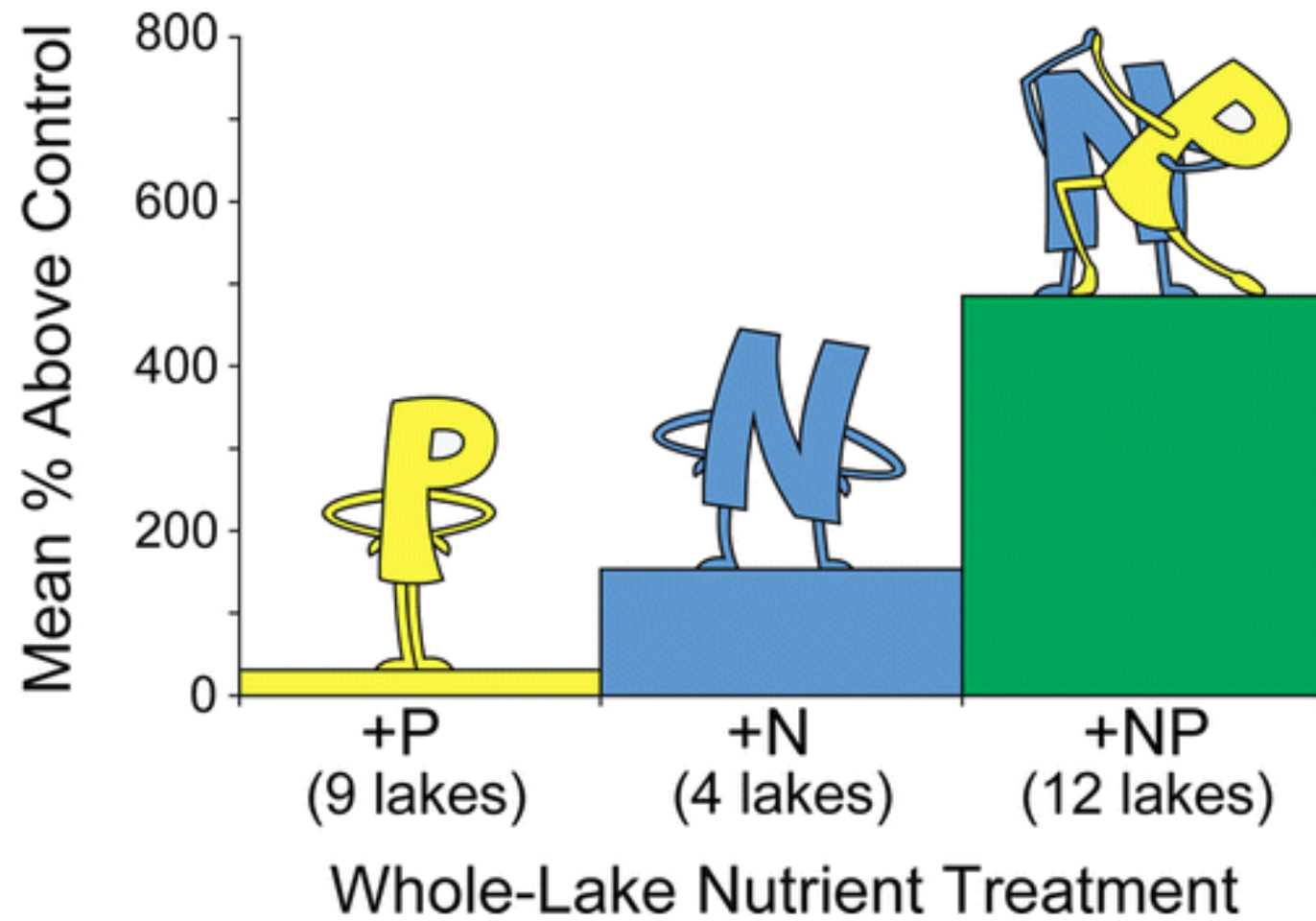
The dogma since 1970's
control P = control blooms

What we know now?

In many lakes there is a need for control of both P and N ... in fact, was that earlier idea ever correct?



Source: Paerl et al. 2016



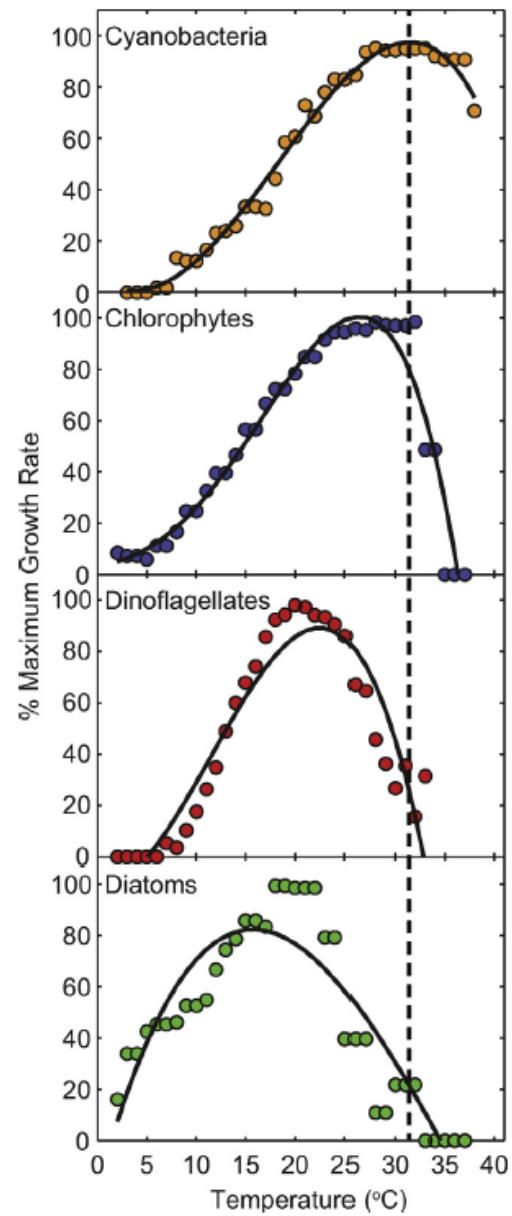
Source: Paerl et al. 2016

What we know for certain?

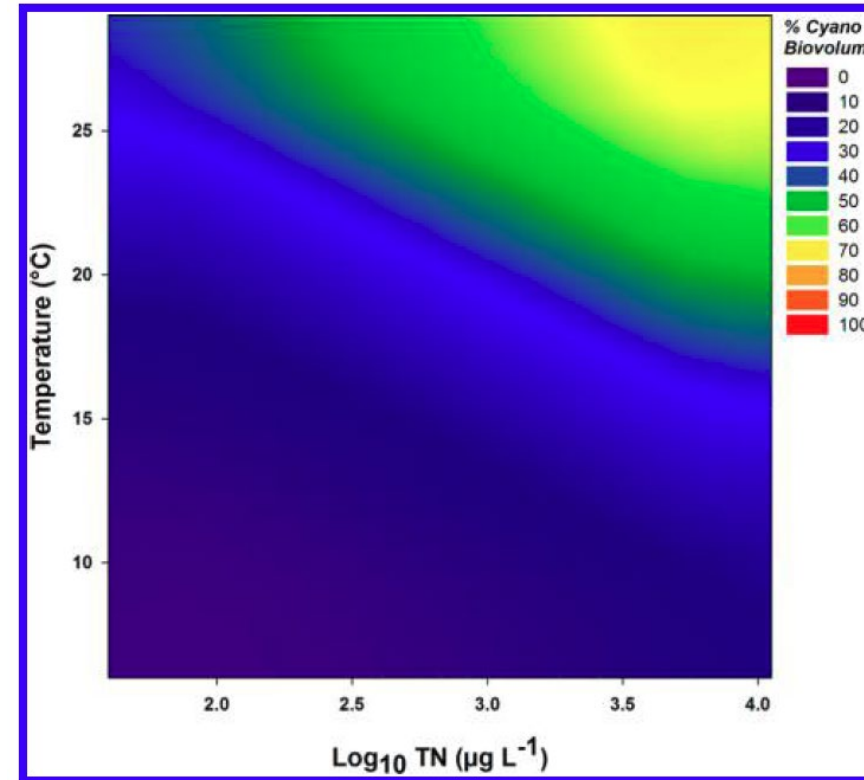
Today many lakes are enriched with P.
Inputs of N stimulate blooms of
Microcystis and other toxic
cyanobacteria.

Okeechobee is one of those lakes.

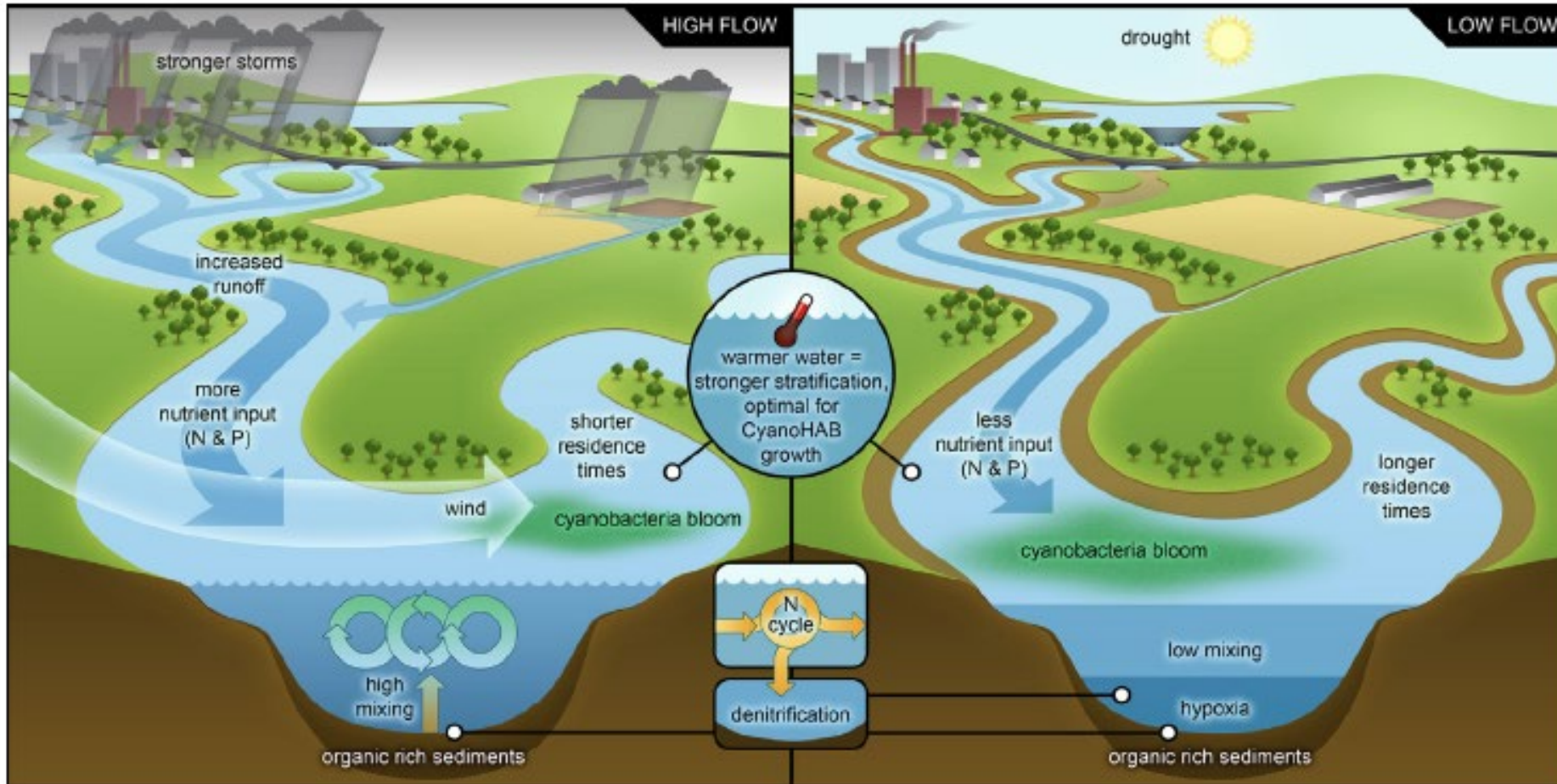
Climate Change



Source: Paerl, Gardner, Havens et al. 2016



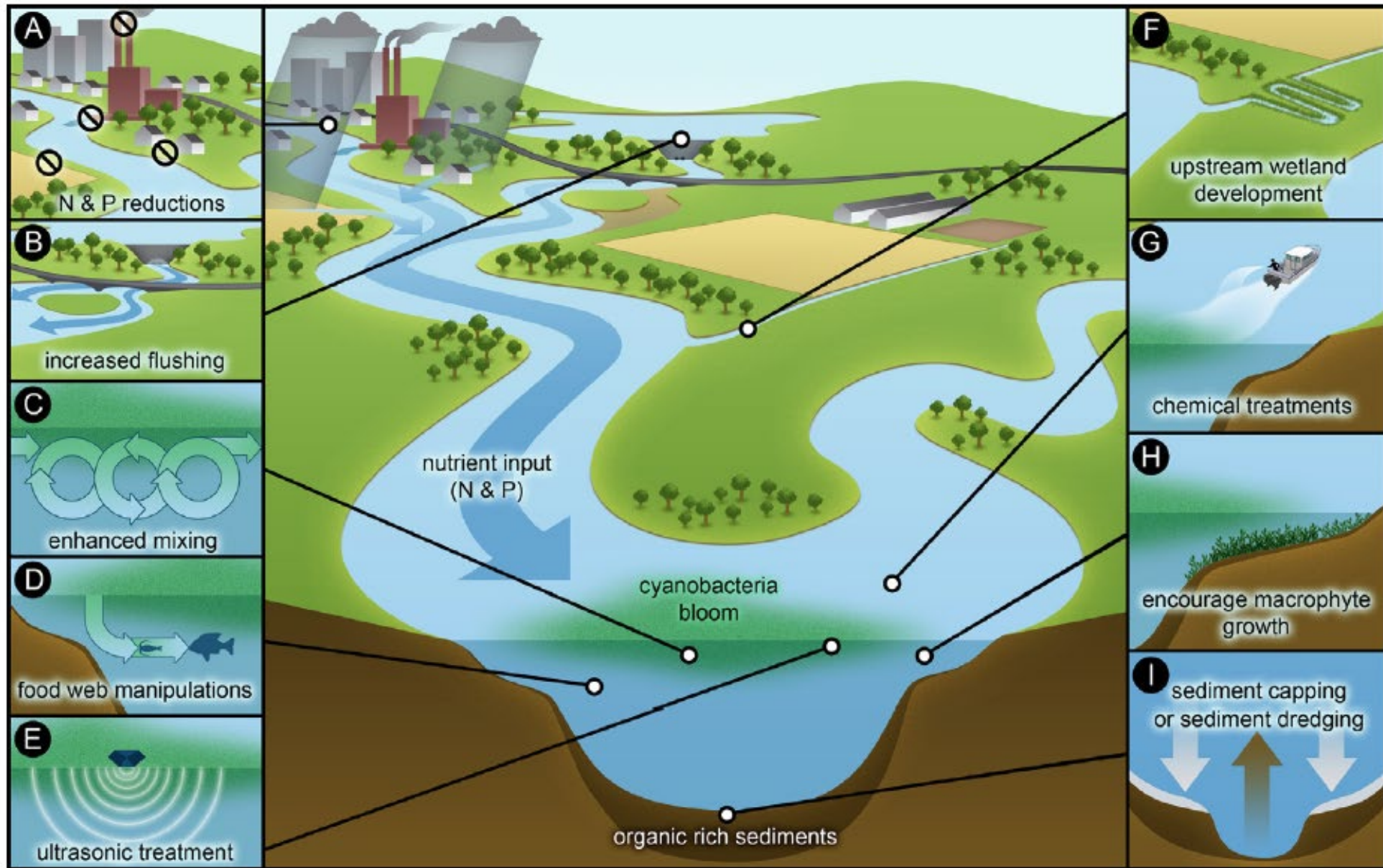
Source: Havens and Paerl 2015



Source: Paerl, Gardner, Havens et al. 2016

Solutions

There is no quick fix, and warming will make it harder to solve this problem.



Source: Paerl, Gardner, Havens et al. 2016

Solutions in FL

Long	Source ID Effective BMPs Treatments for legacy N and P
Mid	Better predictive capabilities
Short	Better characterization of impacts



Thank you