Temporal and Geographic Progression of *Prymnesium parvum* (the ‘Golden Alga’) in the Southwestern United States

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EPA Region 9 HABs Meeting
Southern California Coastal Water Research Project
Costa Mesa, CA
April 25-27, 2017
'Emerging' freshwater HAB issues in the U.S. have mostly focused around a variety of cyanobacteria & associated toxins (of course, they’re not really new at all; only to public awareness)
Another ‘new’ concern in the southwestern U.S.

*Prymnesium parvum*
(the ‘Golden Alga’)

Toxins: Prymnesins + unknowns
A photosynthetic organism (an alga), but also... a microscopic killing machine.

The ‘mixotrophic’ Golden Alga (*Prymnesium parvum*).
An EDAB (Ecosystem-Disruptive Algal Bloom) Well known in other parts of the world.

First ‘confirmation’ of *Prymnesium parvum* associated with fish kills in the U.S. 1985 in Texas.

North Texas lake (2010)
Prymnesium parvum is widely distributed in the U.S.

Take home message:
• Probably NOT a new species to U.S. (living in the background?)
  But something has changed to allow dominance in some of these places.

(‘invasive species’ vs. ‘environmental tipping point’)

from Roelke et al. (2015)
A very toxic alga that has been causing fish kills in Texas (and moving west) during the past few decades in the southwestern U.S.

Golden alga causing thousands of fish deaths in Arizona river

TOXIC ALGAE CAUSE OF 100 ELK DEATHS IN NORTHEASTERN NM

New Mexico Department of Game & Fish sent this bulletin at 10/22/2013 10:37 AM MDT

FOR IMMEDIATE RELEASE, OCT. 22, 2013:

TOXIC ALGAE CAUSE OF 100 ELK DEATHS IN NORTHEASTERN NM

SANTA FE – The Department of Game and Fish has concluded that a toxic alga bloom caused the deaths of more than 100 elk discovered Aug. 27 in northeastern New Mexico.
Most recent fish kills that were ‘near misses’: in states neighboring California
Lake Las Vegas: A bit of a scary prospect...
Fish Kills are not new to California

EPA: 52 reports in 1975 (1/3 from lakes); ≈300,000 fish
Small private lakes***.
Relatively young, most are shallow.
(≤5 m-ish)
(man-made, or highly modified)
(heavily managed)
Lake Menifee
(≈25 yrs old)

Fish Kill: Apr, 2014
Lake Laguna Niguel
(≈50 yrs old)
Fish kill: Aug, 2014

NOT the ‘Golden Alga’, in this case, but still had ramifications...
Rancho Santa Margarita Lake
(Lago Santa Margarita; max depth ≈3m)

Fish Kill: Sept-Oct, 2014

Fish Stressed and Dying in Lake Rancho Santa Margarita
Hundreds of dead fish are lapping at the shores.
Lake Mission Viejo
(larger & deeper: 125 acres; >10 m ave. depth, but still man-made; ≈27 yrs old)

Fish kill: Oct-Nov, 2014

2006 George Coniglio caught a 19.7-pound largemouth bass, the 13th largest of all time.

The Death of a Trophy Bass Lake
Why is this species emerging only recently as a problem in these southern Californian lakes? Why is it just now attaining dominance in our ecosystems?

Corollary: If it’s been here for a long time (as geographic distribution in the U.S. would indicate), it might imply that consistent environmental changes in the lakes have led to dominance of the ‘Golden Alga’.
Are there issues in common among the lakes?

Lots of surrounding development.
But, not all are eutrophic
(so what is the common thread?)
Deep red = exceptional drought.

>>>Drought
>>Severe Drought
>Extreme Drought

*Reduced precipitation;
*Increased evaporative losses
What is the response of these ‘relatively young’ local lakes?)

Figure 2-1b Average-Annual Electrical Conductivity Trend 1978 – 2013

Courtesy of Tom Buckowski (Lake Mission Viejo)
‘Rules for success’ of a mixotrophic alga
The Golden Alga

The ecological ‘sweet spot’ for blooms of the Golden Alga

Little or no growth

Toxin production

Little or no toxin production

So Cal Lakes?

from Roelke et al. (2015)
How can/do managers cope with the problem?

Sometime these are repetitive treatments.

Also, ‘spot’ treatments.

Clearly, NOT a viable long-term management strategy

Chelated or unchelated Copper

*Long-term management strategies are desperately needed.
Going forward

An environmental ‘tipping point’ concept is consistent with our observations. Population genetics still pending (we have cultures from the lakes).

It’s probably not a coincidence that the Golden Alga’ appeared and bloomed in several lakes around the same time.

Similar stressful environmental conditions (increased evap)
Confirmed rising conductivity (at least in one of the lakes)
BUT, even with our wet winter, it is staying around!

***If this is a tipping point, management strategies need to be aimed at reversing those conditions. These ARE highly managed lakes (and small, and private) so it may be possible, if we can figure out an effective approach.

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