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

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Texas A&M Agrilife Extension

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)

Western Lake Erie

Another 'new' concern in the southwestern U.S.

Prymnesium parvum
(the 'Golden Alga')

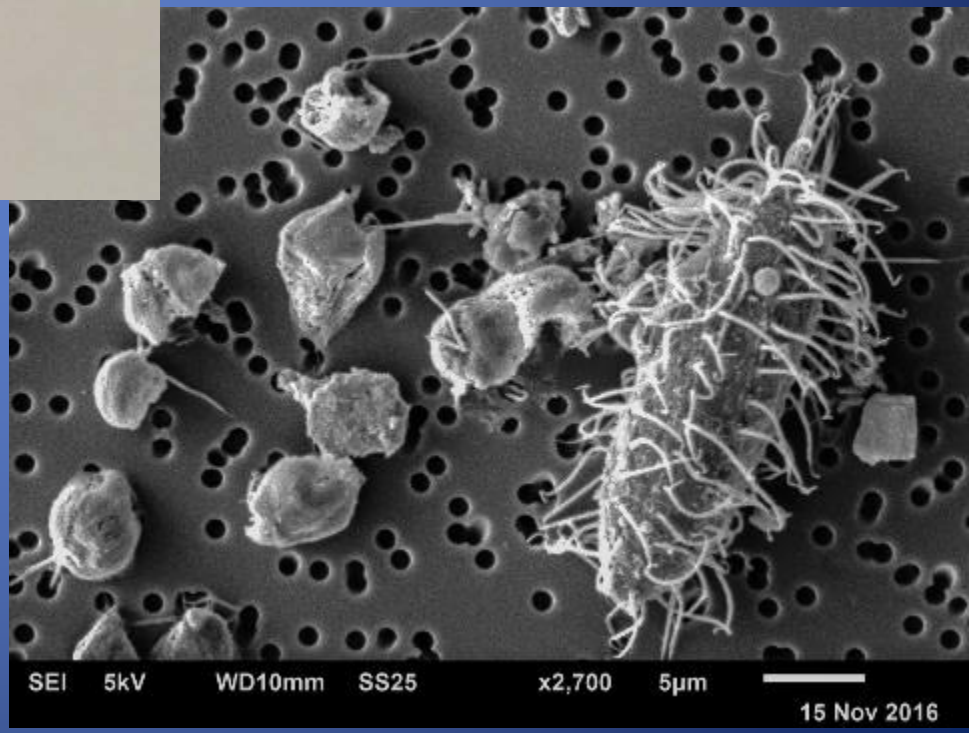

Dave Hambright, OU


Gary Turner, Brazos River Authority TX)

Toxins:
Prymnesins + unknowns

The ‘mixotrophic’ Golden Alga (*Prymnesium parvum*).

A photosynthetic organism (an alga), but also…
a microscopic killing machine.



Picture courtesy of Kevin Carpenter

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.

from Roelke et al. (2015)

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')

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

BY: abc15.com staff , Mike Palm
POSTED: 2:35 PM, Jul 6, 2012
UPDATED: 6:37 PM, Jul 6, 2012
TAG: csa other | region csa

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

New Mexico
WILDLIFE NEWS
www.wildlife.state.nm.us
James S. Lane Jr., Director

New Mexico Department of Game and Fish
Media contact: Rachel Shockley, (505) 476-8071
Public contact: (888) 248-6866
rachel.shockley@state.nm.us

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 algae bloom caused the deaths of more than 100 elk discovered Aug. 27 in northeastern New Mexico.

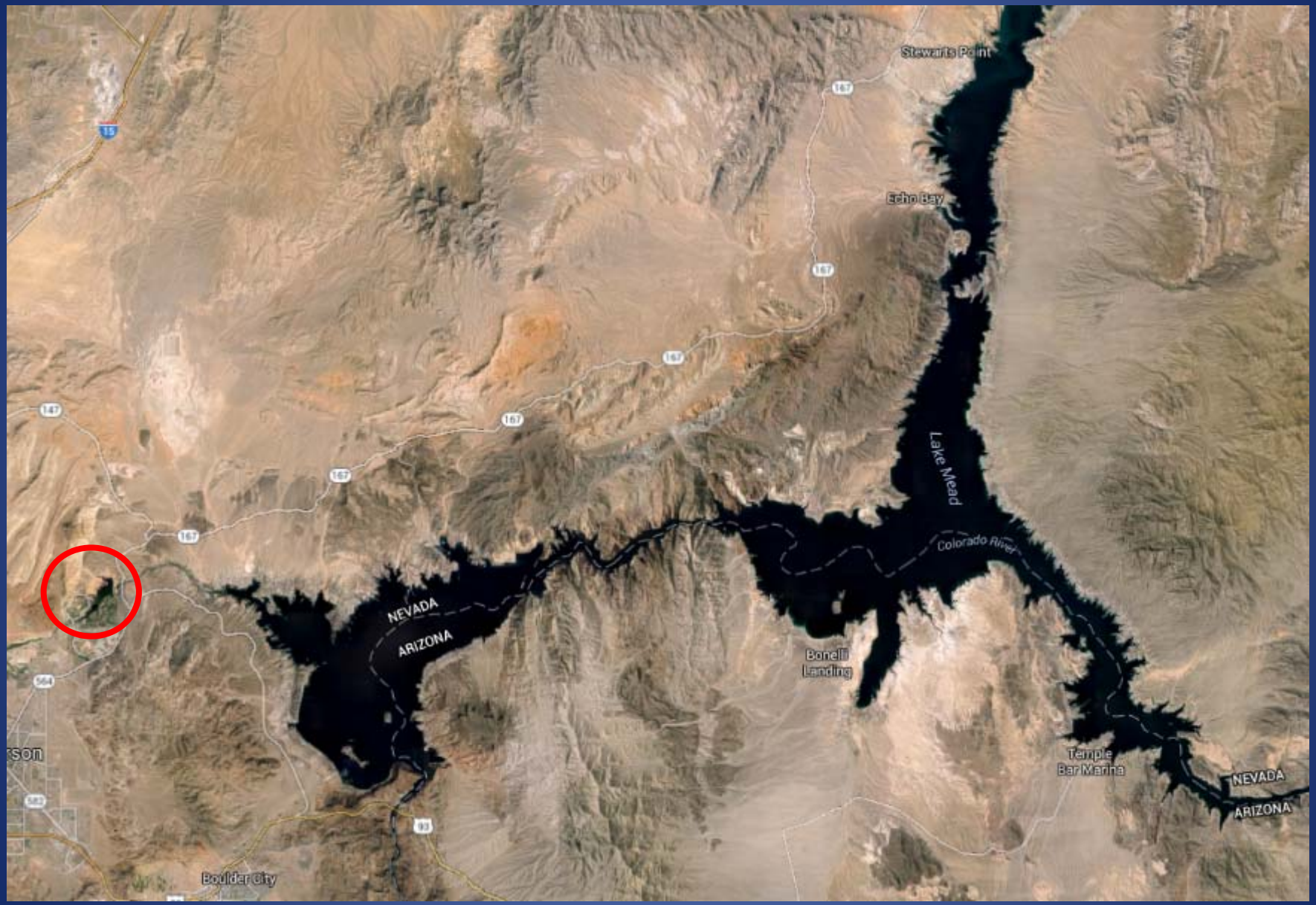
Golden alga cause of fish kill on Altus-Lugert Lake

by Ed Godfrey *Published: January 4, 2013*

Altus-Lugert Lake is the latest body of water in southwest Oklahoma where fish are dying as a result of golden alga blooms.
The fish kill started the week before Christmas and became worse last week with several thousand fish dying in the lake, said Larry Cofer, southwest fisheries chief of the Oklahoma Department of Wildlife Conservation.

- 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

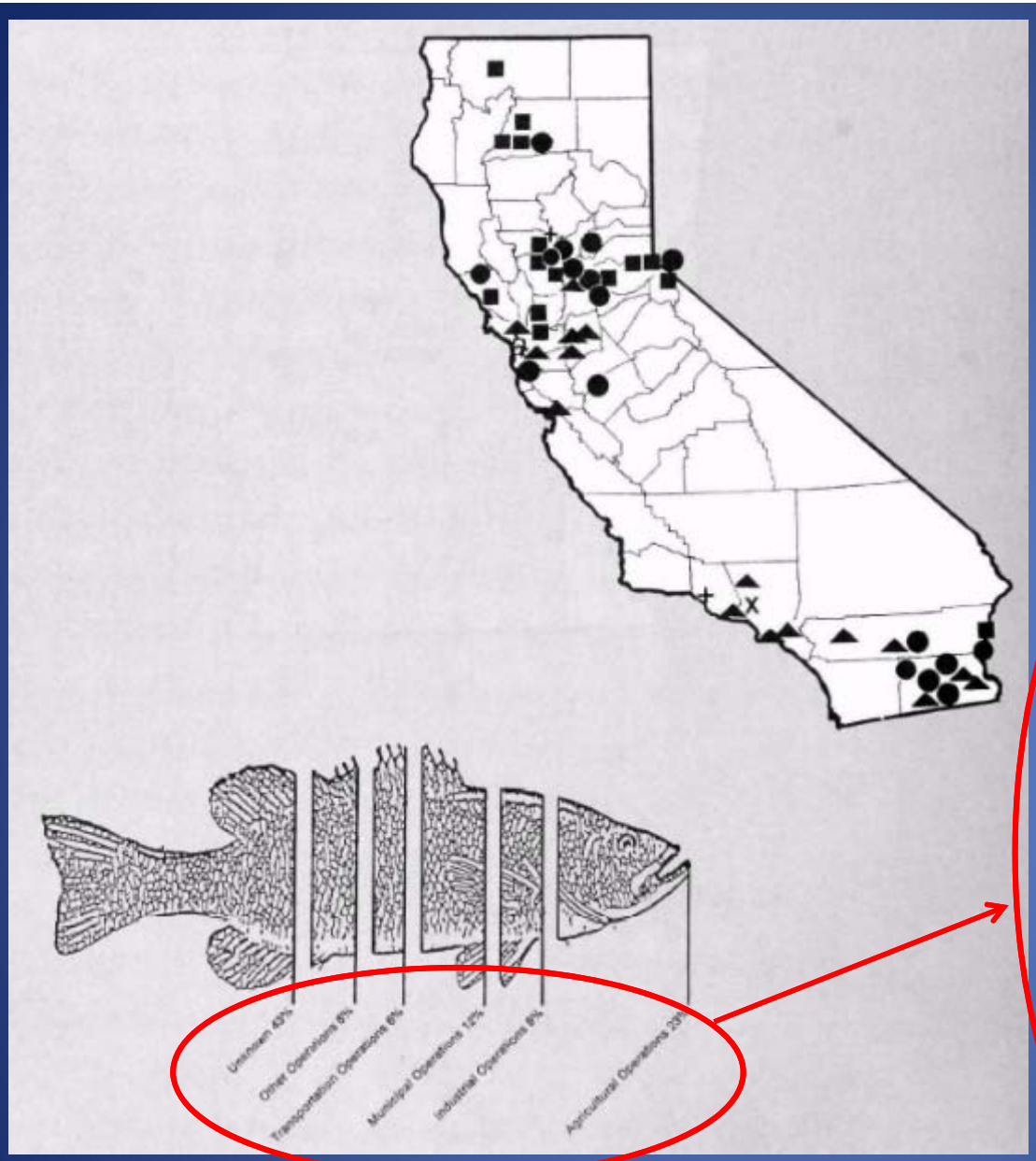
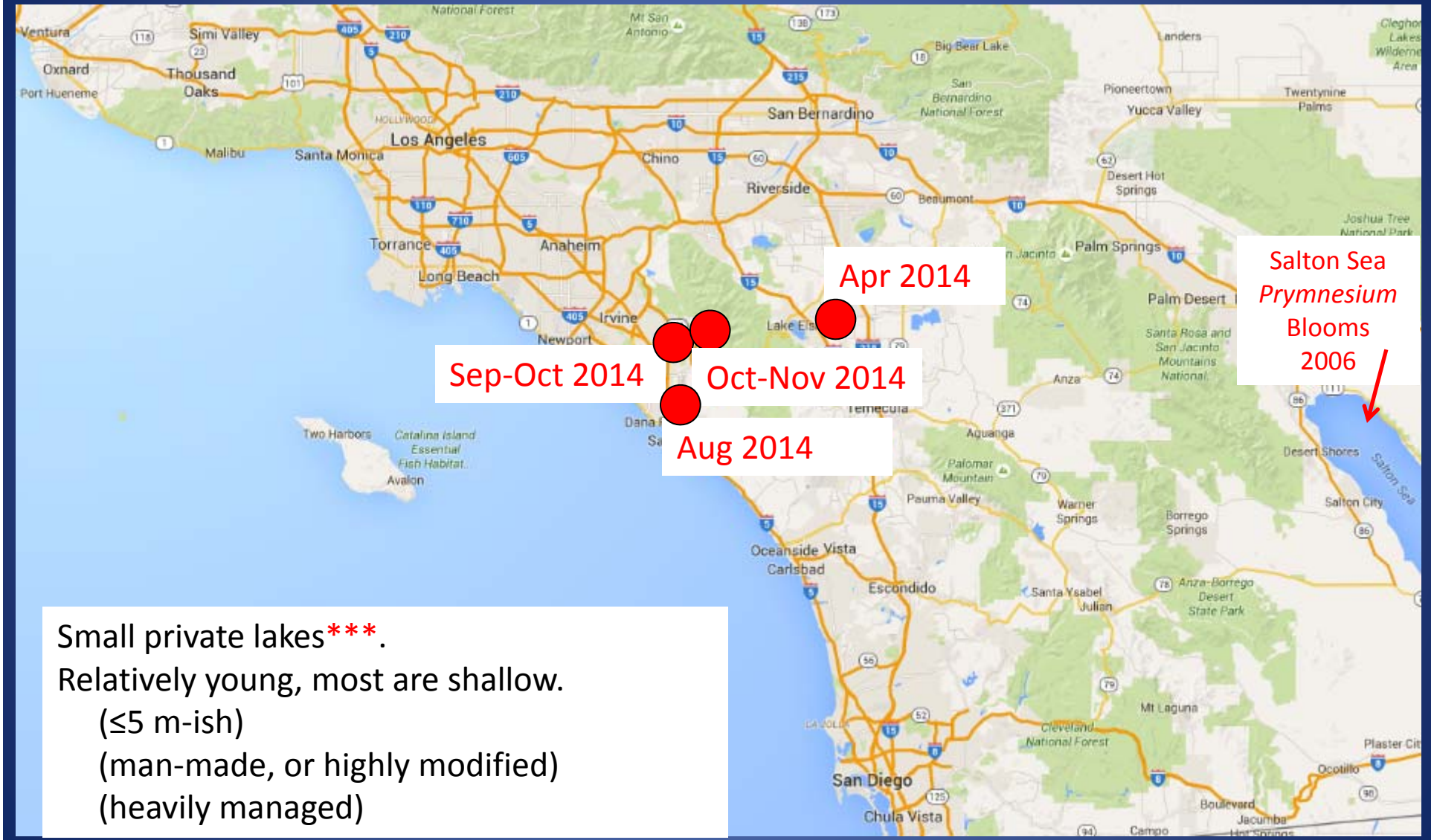


Table 2—Fish Kill Summary by Source of Pollution, 1975

Source of pollution	Total reports	Reports specifying number of fish killed: No. of reports	No. of fish
Agricultural:			
Insecticides	63	52	221,194
Fertilizers	16	14	186,951
Manure-silage drainage	39	35	362,597
Subtotal	118	101	770,742
Industrial:			
Mining	20	19	263,768
Food products	20	18	56,559
Paper products	11	11	30,382
Chemicals	29	26	95,711
Petroleum	23	20	57,412
Metals	6	6	300,974
Combinations			
Other	13	11	87,903
Subtotal	122	111	892,709
Municipal:			
Sewerage systems	70	66	353,457
Refuse disposal	2	2	1,612
Water systems	6	5	1,944
Swimming pool	3	3	375
Power	9	9	10,021,015
Subtotal	90	85	10,378,403
Transportation:			
Rail	5	4	15,594
Truck	30	30	237,066
Barge or boat			
Pipeline	12	10	213,364
Subtotal	47	44	466,024
Other operations	78	64	435,335
Unknown	169	136	3,167,997
Total	624	543	16,111,210

EPA: 52 reports in 1975 (1/3 from lakes); ≈300,000 fish

And Recent Fish Kills in Southern California So. Cal.



Small private lakes***.

Relatively young, most are shallow.

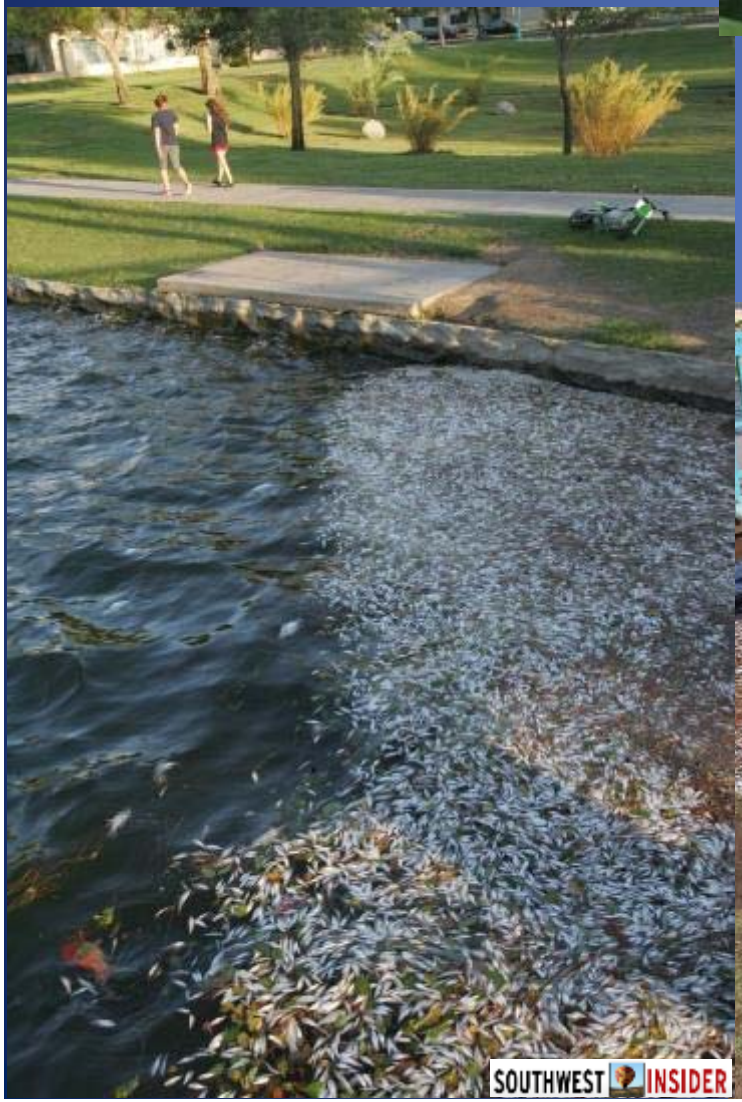
(≤5 m-ish)

(man-made, or highly modified)

(heavily managed)

Lake Menifee
(≈25 yrs old)

Fish Kill: Apr, 2014



THE PRESS ENTERPRISE

NEWS

MENIFEE: Fish kill strikes community lake

The water body in the Menifee Lakes community has thousands of fish carcasses floating on the surface

Menifee 24/7

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

NOT the 'Golden Alga', in this case, but still had ramifications…

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SOCAL FRESH UPDATE

LAGUNA NIGUEL Lake Reverts To Previous Management

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Rancho Santa Margarita Lake
(Lago Santa Margarita; max depth ≈3m)

Fish Kill: Sept-Oct, 2014

Rancho Santa Margarita Patch | Find Your Patch

Patch LocalStream | Advertise With Us | All Topics › Community Corner

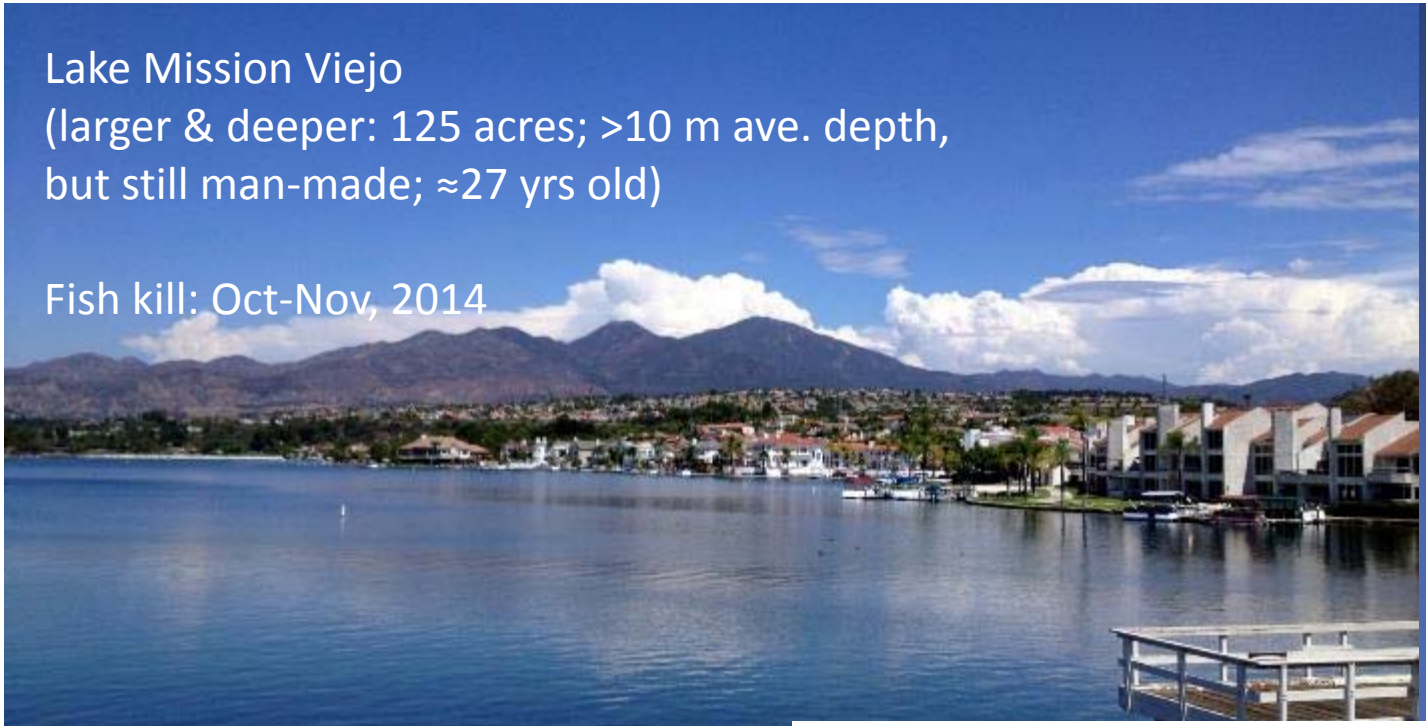
Next on Patch » 'Tis the Season at Disneyland

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?

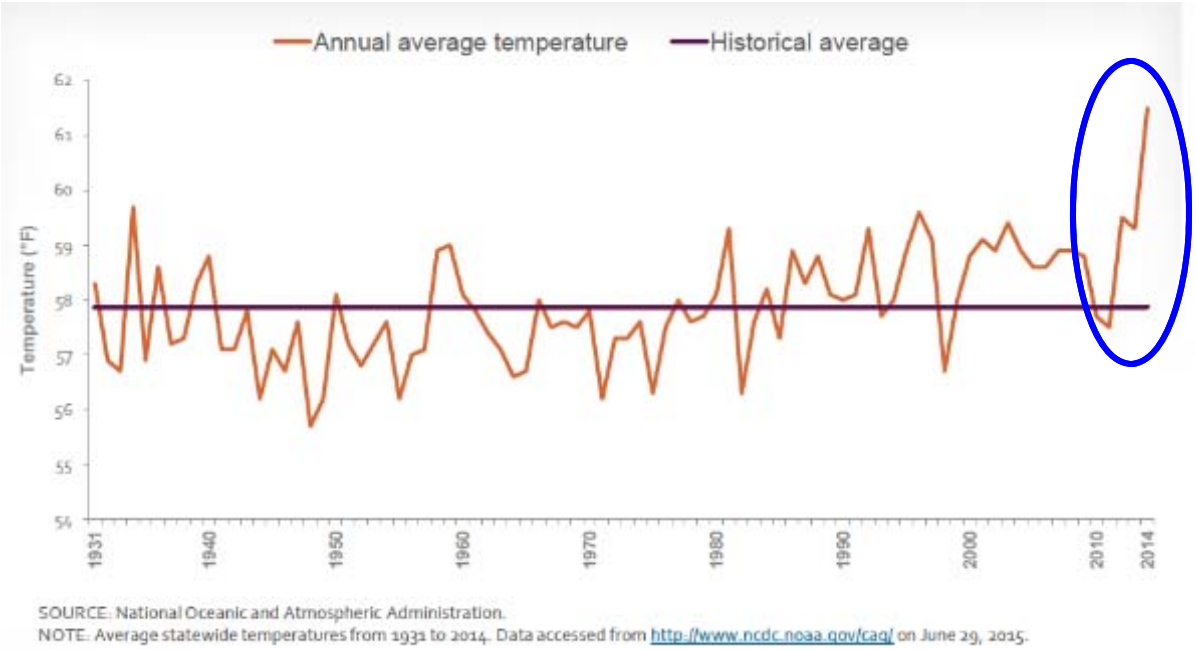
Corollary: If it's been here for a long time (as geographic distribution in the U.S. would indicate), it might imply that consistent environmental changes in the lakes have led to dominance of the 'Golden Alga'.

Are there issues in common among the lakes?

Lots of surrounding development.

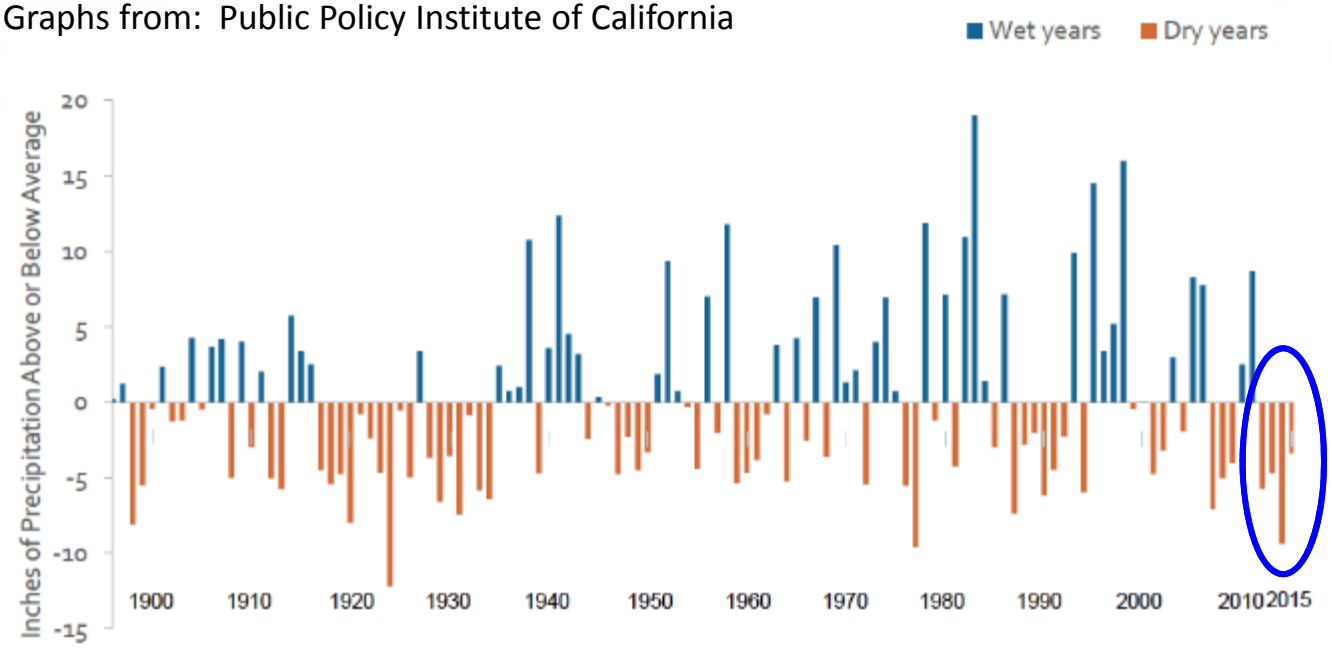
But, not all are eutrophic

(so what is the common thread?)

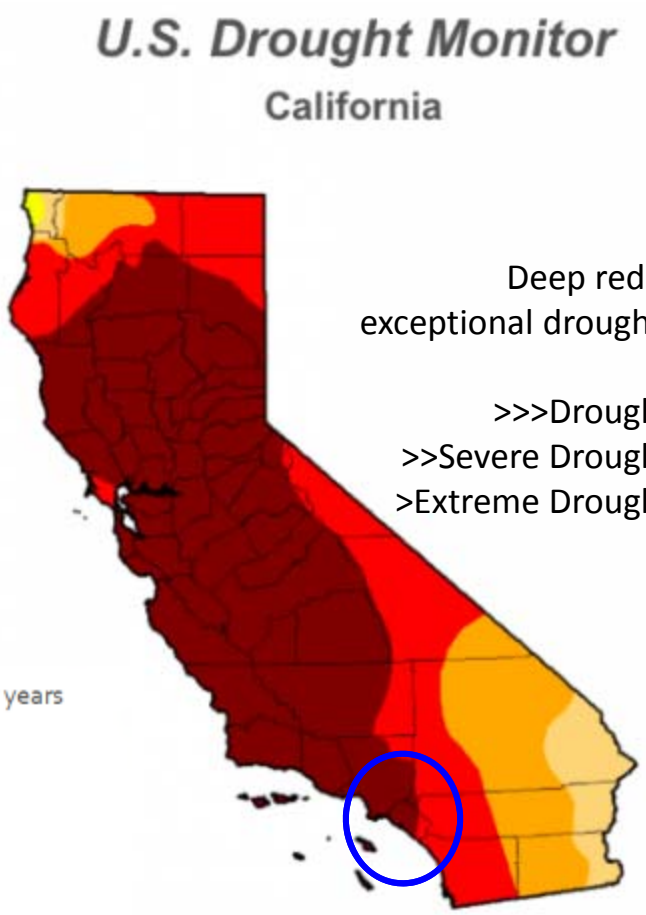


SOURCE: National Oceanic and Atmospheric Administration.
NOTE: Average statewide temperatures from 1931 to 2014. Data accessed from http://www.ncdc.noaa.gov/cag/ on June 29, 2015.

Graphs from: Public Policy Institute of California



SOURCE: Western Regional Climate Center. Bars show inches above/below long-term statewide average precipitation (21.42 inches) based on water year (October–September) since 1896.



Deep red = exceptional drought.

>>>Drought
>>Severe Drought
>Extreme Drought

Anthony NOAA/NWS/NCEP/CPC

*Reduced precipitation;
*Increased evaporative losses

What is the response of these ‘relatively young’ local lakes?)

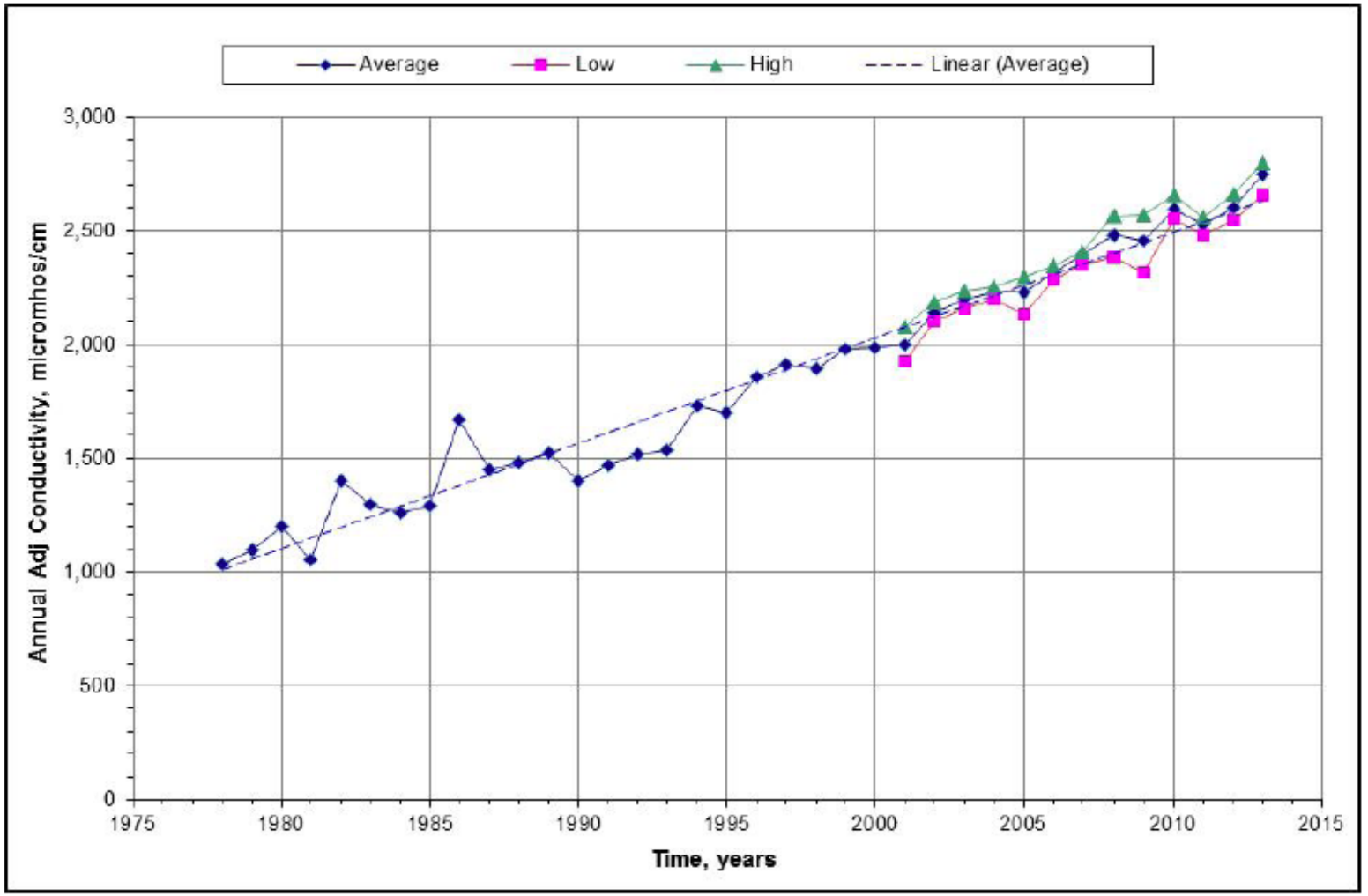
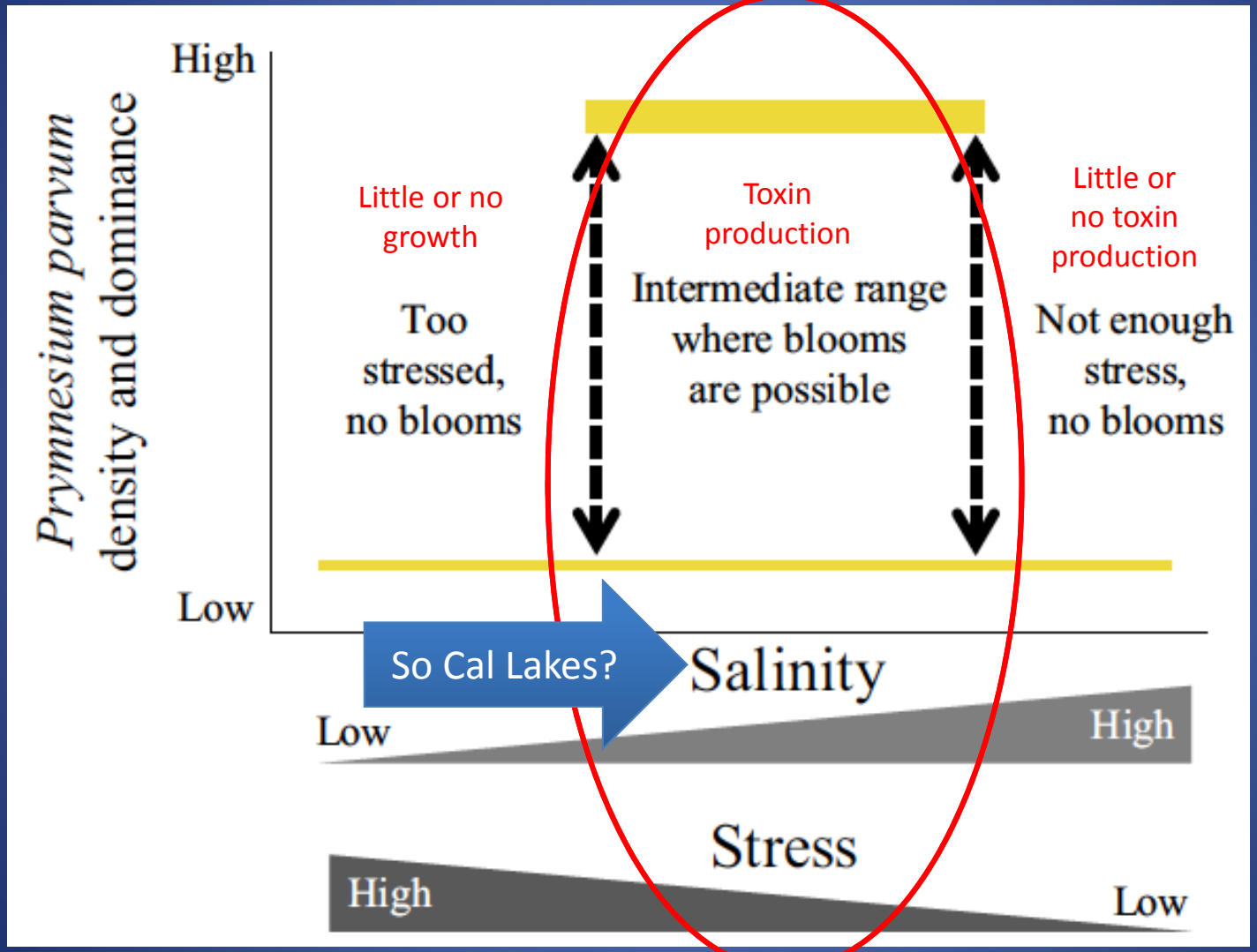


Figure 2-1b Average-Annual Electrical Conductivity Trend 1978 – 2013

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

from Roelke et al. (2015)

How can/do managers cope with the problem?

Chelated or unchelated Copper

Sometime these are repetitive treatments.

Also, ‘spot’ treatments.

Clearly, NOT a viable long-term management strategy

*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.

Acknowledgments

- Thanks to local lake mangers (Menifee Lakes, Lake Mission Viejo, Lago Santa Margarita) who shared time, samples and insights.
- Funding: USC Dornsife College of Letters, Arts and Sciences