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Developing a Monitoring Strategy for Clear Lake, California: Fourth Year of an Unprecedented *Lyngbya* Bloom

Clear Lake, 2011

Clear Lake,2010

What is the problem with Clear Lake?

- The past three years have seen an unprecedented *Lyngbya* bloom.
- Areas of the lake have been covered with thick mats of *Lyngbya* known to produce lyngbyatoxin-a, aplysiatoxins and saxitoxins in addition to the lipopolysaccharide skin irritants.
- Mats can grow to an unsightly four feet thick with a constant sewer gas odor.
- The water becomes recreationally unusable.

Why do we monitor ? Part 1

- Lake County has the responsibility to protect the public's interest in Clear Lake, California's largest lake (40,000 acres) and the nation's oldest lake (maybe 2.5 million years).
- Clear Lake is the basis of Lake County's economy.

  64,665 residents of Lake County

  75,000 visitors to Lake County annually

What data did we use to develop a monitoring strategy?

- History

  In 1969/70 the Clear Lake Algae Research Unit was established under Dr. Alex Horne, UC Berkeley (disbanded in 1978/79).

  HABs go back to the 1960s and 1970s when Aphanizomenon was dominant.

  Severe Microcystis blooms occurred in the 1990s.

  Identification of the particular cyanobacteria involved in the bloom is fundamental to a monitoring plan.

What other research did we do to fine-tune our monitoring strategy?

- Web-based research

  What is the response to cyanobacteria blooms?
  - California, Humboldt County
  - Federal government, EPA and USGS
  - Other states, KS, OH, WI, MN, NC, OR
  - Other countries, Australia, Guatemala, UK, China
- University interest and emphasis
  - UC system, Santa Cruz, Berkeley
  - Hans Paerl at UNC
  - Frank Rodgers at Clemson University
- Commercial HAB monitoring
  - Satellite imagery, sonar imagery
  - Chl-a and phycocyanin sondes

Guidelines and References

- Harmful cyanobacteria blooms and their toxins in Clear Lake and the Sacramento-San Joaquin Delta (California), Mioni and Kudela 2011
- Cyanobacteria in California Recreational Water Bodies: Providing Voluntary Guidance about Harmful Algal Blooms, Their Monitoring, and Public Notification, SWRCB, CDPH OEHHA, July 2010 Draft
- Guidelines for Design and Sampling for Cyanobacterial Toxin … in Lakes …, USGS

Gudelines and References

- Monitoring Recreational Fresh Waters, Graham, Loftin and Kamman, Lakeline, Summer 2009
- Facts about Cyanobacterial Harmful Algal Blooms, DHHS, CDC
- Cyanobacteria in Lakes and Reservoirs, Chp 7.5 Graham, Loftin, Ziegler, Meyer, 2008
- WHO Guidelines for safe recreational water environments, Volume 1: Coastal and freshwaters

Scientific monitoring on Clear Lake

- Cecile Mioni and Raphael Kudela, University of California, Santa Cruz – Institute of Marine Sciences

Jun-Sep 2010: tested 29 samples

24 ND for mycrocystin variants, 5 < 10 ppb

2 tested positive for anatoxin-a

Jul-Oct 2011: tested 35 samples

13 ND for microcystin variants, 16 < 0.1 ppb

5 < 10.0 ppb

1> 10 ppb

2 tested positive for anatoxin-a

1 tested positive for lyngbyatoxin-a

How are we continuing to monitor cyanobacteria conditions in Clear Lake?

- HAB decision-making in Lake County
  - Water Resources, 707-263-2344
  - Health Services
    - Public Health, 707-263-1090
    - Environmental Health, 707-263-1164

Balancing responsibility

Alarming folk OR Giving folk advice

- Signage
- Press releases
- Media information
- Linking to internet resources

How and what do we monitor?

- Veterinary and medical reports.
  - Investigation of human/animal illness
- Observation of HABs at Clear Lake public access points (19) and public beaches (8) by County personnel.
- Phone calls from the general public.
- Field testing or lab testing of cyanotoxins.
- ID and numeration of cyanobacteria.

Why do we monitor? Part 2

- To post advisory signs at HAB affected beaches and access points
- To correllate investigation of human/animal illness with cyanotoxin presence
- Evaluate the impact of mitigation methods that may result in cell lysis and transient increases in cyanotoxins.
- To inform small, locally regulated drinking water systems of potential presence of cyanotoxins.

More decision-making

- Cell count and/or cyanotoxin level
- Which cyanotoxin
- Sample preparation – cells lysed?
- When
- Where
- How often
- In-house or laboratory
- Cost may be prohibitive