California Cyanobacteria Harmful Algal
Bloom Network Meeting
April 24, 2024, 9:00 am to 12:00 pm
Virtual Meeting
Agenda (With Minutes)

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9:00 am **Welcome, Introductions, Announcements, etc. (15)**
Biostimulatory Policy Update – Joe Westhouse
Presentation begins at 0:00 of meeting recording.

Project Scope:
- Water quality objectives for biostimulatory substances in wadable streams
- Tentative microcystin, anatoxin, cylindrospermopsin objectives for REC-1 and MUN protection for inland waters.
- Implementation and monitoring requirements (with reliance upon existing programs/permits/mechanisms).
- Supported by scope based on science available now.
- Establish or amened beneficial use for dogs.
- Water quality objectives for: biostimulatory substances in lakes and reservoirs and estuaries, cyanotoxins for dogs and other domestic animals, and cyanotoxins to protect CUL beneficial uses.
- Formalize bioassessment tools (CSCI and ASCI)

Purpose:
- Prevent biostimulation (eutrophication) and cyanobacteria production.
- Mitigate biostimulatory impacts in already impaired waters.
- Prevent tribal ceremonial and cultural practices, and their participants.
- Prevent HABs and overproduction of cyanotoxins.
- Protect aquatic life, human health, and domestic animals.
- Serve as regulatory enforcement tool to control pollution and discharge of nutrients.

Current Project:
- Biostimulatory Water quality objectives for wadable streams = TN, TP, Bottom chl-a
- Cyanotoxin Water Quality Objectives for all inland freshwater (microcystin, anatoxin, cylindrospermopsin) = REC-1 and MUN
- A program of implementation and monitoring requirements for all inland freshwaters (rely upon existing programs/permits/ and mechanisms) = non-stormwater NPDES, Stormwater, and Non-point source

Status:
- General framework developed.
- Regulatory Advisory group meeting series = receiving input from other regions to help guide decision making
- Water quality objectives = TN, TP, and Bottom Chl-a

- Other drivers/indicators being considered to control or determine impairment = channel stream structure, percent cover, and other non-chemical variables that have an impact on the health of a stream.
- Considering other factors and biostimulatory conditions.
- Beneficial Uses = REC 1 and MUN

Current and Future Engagement:
- Current: State Water Boards Division of Water Quality, State Water Board Roundtables, Stakeholders, FHAB and CCHAB Program, Southern California Coastal Water Research Project, and Regulatory Advisory Group.
- Future: State Water Board, Tribes, and the Public (workshop)

Q&A:
- Sarah Ryan: You say municipal is one of the beneficial uses, and I am not sure if you are familiar with the cow watch program that Big Valley is working with tracking California or the Public Health Institute with, but we have recently published on the private/self-supplied water systems and the cyanotoxin issues and even the intact cyanobacteria coming out of the tap water of a number of homes that we've tested on Clear Lake. So, I am wondering about municipal (given its public water systems and state smalls… is there any attention being paid to these self-supplied systems that are on water bodies throughout California and their lack of appropriate treatment for them? If so, would that be factored into requirements and objectives for ambient toxins?
  o Answer (Joe Westhouse): Being that I am in the division of water quality, a lot of the immune is essentially focused on the water that feeds into the reservoir that does ultimately get to our drinking water (or drinking water collected). We're more in the nature realm and not necessarily in the treatment itself. The division of drinking water is more focused on this and is working closely with us on this project as we develop our side of the policy regarding MUN. We want to accommodate DDW's objectives and do what we can to support that and ensure that we are doing what we need to support health.

9:15 am   ***What, How, When, and Where: Spatiotemporal Water Quality Hazards of Cyanotoxins in Subtropical Eutrophic Reservoirs** – Bryan Brooks, Professor, Baylor University (30)*
Presentation begins at 14:21 of meeting [recording](#).

- Recently published a paper in ES&T led by PhD student Kevin Stroski.
- Motivation for investigations: A few years ago, we posted a question asking if these HABs were becoming a bigger water quality threat than we might expect in the Inland waters.
  o Did a lot of work with Prymnesium parvum impacting fish within a reservoir during a bloom.
  o Approaches were focused on finding niched base understanding conditions. Not just what caused the bloom to happen but also the toxins production.
  o Prymnesium parvum measured the toxins reliably/robustly is a challenge.
- States we need to be thinking about the environmental mechanistic interpretation of environmental conditions/gradients that trigger the protection of the toxins not just the presence of the cells.
- "You only find what you are looking for… if it is in the concentrations high enough to be detected by the method being used to analyze for it" – WT Waller
- Satellite imagery helps a lot, but the use of specific target LC mass spectrometry is still quite limited in the literature. This led to the motivation for the study.
- Developed a targeted method for cyanotoxins.
  o Instrument = Agilent 6420 Triple Quadrupole Mass Spectrometer
- Microcystins: ELISA vs LC/MS/MS
  o ELISA kits are low cost, high throughput, and used for measuring total MCs

- o LC-MS/MS is more expensive, more labor intensive, however robustly quantities individual congeners.
    - o 56% of LC-MS/MS detections were not detected by ELISA
    - o Cylindrospermopsin in 34% of samples by LC-MS/MS
- Anatoxins, Cylindrospermopsin, Saxitoxin: Probabilistic hazard assessments
    - o No exceedances of ANA canine recreational value
    - o CYN and SAX exceedances of canine values were observed
    - o ANA detections in Texas trigger Teir 2 warning advisory restricting swimming and fishing.
- Synopsis: Failure to consider what cyanotoxins are examined, how cyanotoxins are measured, and when/where surface water samples are collected differentially influence water quality assessments for public health and the environment.
- Q&A:
    - o Mike Paul: Given the vertical migration of some of these taxa, I am surprised you did not see a difference there. I was wondering if you guys did any Diel measurements to recommend the best time to surface 3 meters? (Best time to sample).
        - ▪ Answer (Bryan Brooks): We couldn't, this was more of a pilot study. We did not do any type of assessments of integrated water column, fixed depths, or Diel activities. Maybe this critical monitoring experience was a pragmatic approach as this is a large state and we do not have a large group of people.

9:45am   ***Pilot Study to Assess the Relationship between Cyanobacterial Harmful Algal Blooms (HABs) and Respiratory-Related Health Care Visits** – Jordan Murray, HAB Epidemiologist, Wisconsin Department of Health Services (30)*
Presentation begins at 45:25 of meeting [recording](#).

Barriers to studying cyanoHAB illnesses
- Illnesses are often underreported.
- Illnesses are not widely recognized in the medical community. There are no commercially available diagnostic tests.
- Health research is expensive.
- Real-time water quality data is limited.

To better understand the risk that cyanoHABs pose to health, we can use:
- Large scale epidemiological health data
- Accessible and longitudinal environmental data
- A large team of scientists studying HABs

Project focus/notes:
- Respiratory illnesses from inhaling aerosolized cyanotoxins.
- Microcystin detection in nasal swabs from people in direct contact with water blooms as well as near water blooms.

Information gaps:
- How frequently aerosolized cyanotoxins are inhaled.
- The burden of respiratory-related cyanoHAB illnesses.
- CyanoHAB exposure among people living near a freshwater body.

Available health-related datasets:
- National poison data system detects upticks in calls
- Syndromic surveillance: detects anomalies in disease incidence in emergency departments.
- Insurance claims data: insurance claims data for the United States
- Electron health records: low-cost way to access longitudinal data on large populations.

Available HAB Monitoring Data:
- State, territorial, local, and tribal health departments

- Federal agencies: EPA, NASA, NOAA, USGS
- Remote sensing data

Objective:
- Use electronic health records to explore the relationship between cyanobacterial bloom occurrence and the frequency of respiratory-related health care visits for residents living near/on a freshwater lake.

Methods:
- A time series analysis was conducted from 2017-2019.
- Hospital visits and Hab data were aggregated by week.
- Poisson generalized linear models estimated the association between weekly counts of HAB data and hospital visits.
- Models were adjusted for covariates.

Study Region: Green Bay
- The lower portion of the Green Bay Region has a lake that blooms fairly consistently and the population of interest was residents that live in zip codes of a three mile radius of this region.

Demographics:
- Sample size: 2,743
- 50/50 male/female
- 35% less than 19 years old and 65% are above/equal to 19 years old.
- Race: 61% White, 21.12% Black, 1.5% Asian/Pacific Islander, 10.14% American Indian/Alaskan Native, 6.24% Unknown
- Ethnicity: 86.1% non-Hispanic, 12.44% Hispanic, and 1.46% Unknown
- More Black and Native American populations were seen seeking more respiratory related health care than expected. There are plans to look at this more carefully in future analysis.

Health Data:
- Obtained from the Wisconsin Hospital Associated
- Includes patient types: Emergency department, inpatient, outpatient, and ambulatory surgery.
- Includes 8 diagnostic codes per patient.

Internal Classification of Disease (ICD) Codes:
- Hospital visit records were searched for asthma exacerbation, wheezing and allergic rhinitis primary ICD-10 diagnostic codes.
- For this study, only the primary diagnostic codes was examined for each patient, not the other 7.

Cyanobacteria Data:
- Remote sensing data: because we needed a data set that was longitudinal and had consistent repeated measures over time across the US.
- Cyanobacteria Assessment Network (CyAN):
- Developed a weighing metric:
  o Total Pixels – pixels with no data = total available pixels
  o # pixels with detects/total available pixels = Weighted %
  o Median Chl-a x Weighted % = Final Value
  o The weighting helped to adjust skewed pixel detection counts by helping smooth some of the values where only a few pixels were contributed to the value. Overall, the pattern of data remained constant showing typical bloom season patterns.

Health Data vs. Cyanobacteria Data:
- Comparing weekly hospital visits to Chl-a values: did not see any apparent relationship between them. The relationship between them was explored later in regression models. When creating regression models, it was decided that data would be easier to analyze and interpret if chl-a values were categorized. To catalyze values, the 2021 guidance

created by the World Health Organization for recreational exposure to cyanobacteria. Most values fell under category one as little to no risk.

Statistical Analysis
- Variables considered: Temp, school week, dew point, season, year, pollen, and air pollutants.
- Wind was not an impactful variable for this study.
    o Little variability in wind direction during study period
    o Wind was not blowing towards populated areas during peak bloom season.
- In the end, variables taken into account were temperature, year, dew point, and season.
    o Temp and dew point were highly correlated with CyanoHAB.

Conclusion:
- Analysis limited by small sample size, low power, high correlation between confounders (Temp and dew point)
- This is the first study to model the relationship between cyanoHAB and population health using CyAN data and EHRs.
- Next step: subsequent study looking at two additional areas of interest (Winnebago and the Madison Area chain of lakes).

Q&A:
- Thomas Hayashi: What type of regressions were used in the model and thoughts of incorporating LAGs into the model?
    o Answer: Yes, we did a Poisson linear regression model. And yes, a 4 week LAG and a one week LAG between respiratory hospital visits and cyanoHAB occurrence and did not find any statistically significant results from them.
- Follow up question (Thomas H.): Is there are reason you chose to use a Poisson linear regression generally?
    ▪ Answer: will have to reach out back to you to answer that later.
- Sarah Ryan: Do you think with the redo of this project, will you look at phycocyanin instead of chl-a... and or using toxin data?
    o Answer: Does not think that will be included. Toxin data is one of the limitations of this study (not able to compare with satellite data).

10:15am **CCHAB Network updates (15)**
Solicitation for co-chairs nominations **– current co-chairs**
CCHABs user survey **- current co-chairs**
Presentation begins at 1:20:15 of meeting recording.

- Sarah Ryan and Jayme Smith are reaching the end of co-chair positions. Both are open to staying in co-chair spot if they are nominated again.
- Linked a survey about potential community CCHAB improvement needs.

10:30am **Break (15)**

10:45am **Subcommittee Updates (15)**
Benthic Subcommittee
Presentation begins at 1:26:35 of meeting recording.

Benthic HABs Subcommittee
- Evaluating recent science and considering revisions to Benthic Guidance
- Reconvened May 2023 and paused for summer break
- Continued meeting in October 2023 and monthly meetings planned through May 2024
- Approximately 10 members
- Overarching guidance question: Should human use or domestic animal use be restricted in waterbody due to the presence of benthic HABs?

- Expanded goals of the benthic guidelines to provide processes for immediate event response, follow up monitoring, and route monitoring.
- Conducted literature review for latest science and existing field protocols. Continuing to evaluate indicators and metrics of a potential new monitoring protocol.
- List of indicators being considered: coverage, cyanobacteria, and toxins.
- Envisioning a "grab bag" approach to the guidance.
- Overview of the list of indicators being considered in guidance:
  - Coverage: percent cyanobacterial cover and cyanobacterial presence/absence
  - Cyanobacteria: DNA, Macroscopy, and Microscopy
  - Toxins: qPCR, ELISA.LCMS (toxins in mat material), and SPATTs (time integrated measure)

Next Steps
- Evaluate options for coverage assessment protocol.
- Definition of recreational sites
- Evaluation routine monitoring scenarios
- Develop recommendations and present to CCHAB Network

Illness Workgroup
Presentation begins at 1:35:09 of meeting [recording](.).

Changes to Freshwater HAB page
- 158 HAB related case determinations over past 6 years by humans, fish, and dogs. Numbers for humans and dogs are listed as individual cases, while fish and other wildlife are represented as groups.
- Updated county maps on their website to show the spatial distribution of HAB illnesses reported in the last 6 years.
- Marine HABs: had over a thousand stranding events between the sea lions, dolphins, and other seal species due to domoic acid off of the Southern California coast.

11:00am   Monitoring Updates (40)
Presentation begins at 1:41:37 of meeting [recording](.).

Regional Board HAB Coordinators
- Funded permanent staff, about 1 staff per region (most part-time)
- Coordinates HABs even response, monitoring, and communication

Region 1(North Coast Region):
- Klamath Basin and Big Lagoon: biweekly microcystins monitoring
- Russian River: Biweekly cyanobacteria ID
- Pre-Holiday Assessments
  - Waterbodies sampled: Lake Mendocino, Lake Pillsbury, Lewiston Reservoir, Ruth Lake, Salmon Creek Estuary, Stone Lagoon, and Trinity Lake
- USEPA ROAR Project (2nd Year): participating in development of standardized benthic sampling methods.
- University of Nevada Reno: Spatial variation in anatoxin production within and across river networks in California
- Benthic Monitoring Recommendations
  - Tiered Approach: deploying SPATTs as sentinel samplers for cyanotoxins, visual assessments for cyanobacteria percent cover, and benthic mat collections to confirm bloom toxicity.
  - CCHAB Benthic Subcommittee: RB1 submitted draft technical memorandum describing 2022-2023 pilot studies evaluating the tiered approach.
- 2024 Partner Trainings

- Hosting Virtual and field trainings this year
- Field trainings available

Region 2 (San Fransisco Bay Region):
- Two HAB incidences so far in 2024
  - Lake Merritt: 2 incidents of a suspected red tide – dissipated quickly. The City of Oakland and EBMUD are exploring modified clay/PAC to control future red tides.
  - Lake Hennessey: cautionary advisory
- Pre-Holiday Planning
  - Crissy Field Marsh – dog illness last year
  - Marina Lagoon beach in San Mateo: caution level advisories last year. City will consider adding HABs to their routine bacteria monitoring based on this year's results.
  - Mountain View Shoreline Lake
  - Napa Institute for Conservation Advocacy Research and Education: 3 popular swimming locations
  - Sonoma Ecology Center: 2 popular swimming locations
- Partner monitoring
  - Rotary Nature Center at Lake Merritt: monthly sampling (May-October) at 2 locations, weekly DO readings with SWAMP sonde, and incident response as needed.
- Partner Agency: Weekly HABs monitoring
  - East Bay Regional Parks District
  - Popular swimming and boating parks
  - HAB observations and lab tests
  - Weekly year-round updates

East Bay Parks:
- Danger advisories at Horseshoe Lake, Quarry Lake, Lake Temescal, Lake Chabot, and Del Valle
- Caution advisories at Shadow Cliffs Lake and Lake Anza
- Treatments being coordinated at Lake Temescal and Lake Anza

Region 3 (Central Coast):
- Following suit with other regions by also doing pre-holiday assessments in their most popular waterbodies that have been prone to blooms.

Region 4 (Los Angelos):
- Gaining new partners this year and continuing with pre-holiday assessments

Region 5 (Central Valley):
- Holiday assessment: Restore the delta is going to sample a handful of sites around Staockton and Fresno staff is going to sample Hensley and Eastman Lakes. Tulare county of environmental health is going to sample Kaweah River and Lake Kaweah. Waterboard Fresno staff is going to sample Hensley and Eastman Lake.
- Continuing partnership with Restore the Delta in the Stockton area and special study with Tulare County environmental health staff to sample Kaweah River and Lake Kaweah.

Clear Lake:
- During the winter 10 sites were visited monthly and tested for cyanobacteria/other analysis. Toxins were discovered but they were below the 0.8 Micrograms/Liter. They do think that the next sample event will have different results, as they are seeing small blooms present.
- Received back the cyanotoxin fish tissue testing results for 48 fish from multiple locations in the Clear Lake watershed. Out of the 48 there were 30 that had tissue (not liver) microcystin result values. Highest value seen was a 7.01 micrograms/Liter of microcystin in the tissue.
- SPAT bag analysis and grab samples for creek benthic cyanobacteria monitoring: majority resulted in non-detects in the creeks.

Region 6 (Sierra Nevada and Foothills):

- Only one bloom report this season for a river in Alpine County. Detections through qPCR of cylindrospermopsin but not toxins present.
- Monitoring about 20 waterbodies during September/October months
- Continuing partner monitoring program with Inyo County for Diaz Lake and Inyo Pond.
- Starting a new benthic stream assessment on two systems based off data collected by the CDFW bio-assessment over the last few years. Looking at the Little Truckee River and Big Meadows Creek.

Region 7 (Colorado River Region):
- Reduced budget allocations for HABs, therefore HABs work is limited to incident response and Holiday Assessments
- New partner monitoring site this year includes Imperial County conducting sampling from Wiest Lake.
- Events: Unconfirmed human illness at Bombay beach in Salton Sea. Results inconclusive.
  o No monitoring after that as salt and sea in a perpetual HABs bloom.
- Upcoming work:
  o HABs is a growing concern at Havasu
  o R7 awarded funding for study by FHABs program, collaborating with USEPAs Office of Research and development as well as Arizona's department of environmental quality (Arizona Center for Algae technology Innovation). Conducting the first phase of a long-term adaptive study that's being carried out at Lake Havasu and lower Colorado river.
- Q&A:
  o Sarah Ryan: During your cyanotoxin analysis, what kind of toxins are you seeing and what kind of result values are you getting?
    ▪ Answer: Answers may vary, but sometimes we find the absence of toxins in the water but then we'll find them in the algal mats (sometimes exceeding protocol levels). We'll usually end up issuing caution warnings and had a couple of danger levels for anatoxin.
  o Sarah Ryan: We've heard that blooms are worse when there are invasive muscles present in water bodies, is there any attention paid to this with monitoring?
    ▪ Answer: the focus of this study is pretty narrow, so this will probably not be included. This has crossed our mind, but we are keeping the focus narrow as we progress in this pilot project for now.

Region 8:
- Pre-holiday assessments: reaching out to similar waterbodies from the past like Lake Hemet, Lake Elsinore, Mill Creek, etc. Looking for potential benthic mats.
- With lake levels rising at lake Elsinore, there is recent monitoring being collected on behalf of the city, there have been no toxin detections (at least they have been low enough to be below the caution advisory).

Region 9 (San Diego):
- Some bloom reports already. The most toxin was Lindo Lake with over 8,000 micrograms/Liter of microcystins.
- Mitigation Efforts
  o Lake San Marco: Conduct human and ecological risk assessments, identify sources of waste within the watershed, recommend and implement mitigation measures in watershed, identify and implement remedies in San Marcos Creek and Lake San Marcos, Alum treatment scheduled in June.
- Pre-Holiday assessments: Spring Pond, Cedar Creek Falls, Lindo Lake, San Luis Rey River mouth, and Guajome Lake
- Special Study: Cyanobacteria and cyanotoxin screening (14 waterbodies)
  o Small public ponds and lakes, not monitored historically, used for tribal and subsistence fishing and/or other recreational uses by underserved communities.

California Department of Water Resources:

- Coordinated with the state water project cyanotoxin monitoring and started routine monitoring project last week. Should be able to share the results by next meeting.

11:40am   **Wrap up (5)**
Presentation begins at 2:25:05 of meeting [recording](#).

11:45am   **Adjourn**
Presentation ends at 2:26:19 of meeting [recording](#).