Monitoring Monday – Let's look at lakes

Join us each Monday as the Clean Water Team shares information and resources on a water quality topic.

Lakes Appreciation Month continues through July so let's look at lakes and lake monitoring programs and resources. While national and international attention is often given to California's magnificent coastline and beaches, California also has more than 3,000 named lakes, reservoirs, and dry lakes.

LAKE, POND OR WETLAND?

A lake is an inland standing body of water. Scientifically and legislatively, lakes are indistinguishable from ponds, but lakes generally are considered to be longer and deeper lentic, or still, waters. In the 18th and 19th centuries, scientists attempted to distinguish the two more formally, stating that ponds were shallow enough to allow sunlight to penetrate to the bottom, but this exists today as an unofficial point.

According to limnology, or the study of inland waters, lentic waters tend to fill in with land over time. Thus, they generally slowly evolve from lake to pond to wetland. Ponds filled with plants that break the surface of the water would generally be considered a wetland, which includes marshes, bogs and swamps.

Reservoirs are artificial lakes, usually built by damming a river and flooding a valley. When reservoirs are filled by rivers, the area in which the river flows have a current and is quite similar, physically, and biologically, to a river. Depending on the reservoir, this semblance of a river can occupy most or even the entire reservoir. If the water remains in the reservoir for a short period of time, giving it a short residence time, it is more river-like. Longer residence times make reservoirs more like natural lakes. Reservoirs are used for recreation, water storage and hydroelectric power. Lake Mead is the largest reservoir in the United States, and Shasta Lake is California's largest.

Drier climates often have saltier lakes, due to high evaporation rates that leave behind larger concentrations of salt. While water in freshwater lakes tends to flow somewhere else, when lakes are

the terminus of rivers, they are saline and called “endorheic” or “inland seas.” Endorheic lakes are technically defined as lakes with salt concentrations exceeding 5,000 parts per million and such formations are present on every continent.

The most famous endorheic lake in California is Mono Lake. The 343-square mile Salton Sea in Riverside and Imperial counties was formed between 1905 and 1907 when the Colorado River broke through a levee. Situated 237 feet below sea level, the Salton Sea is becoming increasingly saline (about 60 parts per thousand) as it recedes. By comparison, seawater is 35 parts per thousand.
www.watereducation.org/aquapedia-background/lakes

CALIFORNIA LAKE FACTS

In terms of volume, the largest lake in California is Lake Tahoe. Straddling the border between California and Nevada, Lake Tahoe is the second largest lake in California with a surface area of 122,000 acres. With a depth of 1,645 feet, Lake Tahoe is the second deepest lake in the US after Oregon's Crater Lake.

The largest lake in California is the Salton Sea, a lake formed in 1905 which is saline and is now declining in size. It has occupied 376 square miles (970 km2) in the southeast corner of the state, but because it is shallow it has only held about 7.5-million-acre ft (2.4 trillion US gal; 9.3 trillion l) of water.

Clear Lake and Mono Lakes are believed to be two of the oldest lakes in North America. Clear Lake sits on a huge block of stone which slowly tilts in the northern direction at the same rate as the lake fills in with sediment, thus keeping the water at roughly the same depth. Core samples of the lake's sediments, taken by U.S. Geological Survey geologists in 1973 and 1980, indicate that the lake is at least 480,000 years old. Although Mono Lake's sediments have been disturbed by past eruptions of the Long Valley Caldera and associated volcanoes some believe the lake to be at least 760,000 years old and probably 1–3 million years old; among the oldest lakes in North America.

LAKE CONFERENCES

California Lake Management Society (CALMS) 37th Annual Conference

- October 13, 2022 - Cal State East Bay Oakland Center - 1000 Broadway, Oakland, CA 94607
- October 14, 2022 - 8 am - noon: Field Tour at Temescal reservoir

Register before 9/1 for early bird discount! - www.california-lakes.org/calms-conference

North American Lake Management Society (NALMS) 2022 Conference
Leveraging Experience to Manage Diverse Lakes, Landscapes, and People
There will be technical workshops all day Monday, November 14. Beginning Tuesday, November 15, three days of presentations will be organized into themed tracks and sessions. Early bird registration rates are available through Friday, September 23rd. After this date, rates will rise to the "regular registration" level and be open through Friday, November 4th. The registration fee schedule and cancellation/refund policy is posted on the conference website.

LAKE MONITORING RESOURCES – CITIZEN MONITORING & COMMUITY SCIENCE

Volunteer Lake Monitoring: A Methods Manual
The EPA has developed Volunteer Lake Monitoring: A Methods Manual (PDF) (65 pages, 868KB) to present specific information on volunteer lake water quality monitoring methods. It is intended both for

the organizers of the lake volunteer monitoring program, and for the volunteer who will be sampling lake conditions. Its emphasis is on identifying appropriate parameters to monitor and setting out specific steps for each selected monitoring methods. Careful quality assurance/quality control procedures are advocated throughout this manual to ensure that the data collected by volunteers are useful to States and other agencies.

30+ Years of Volunteer Lake Monitoring

"30+ Years of Volunteer Lake Monitoring The 30th anniversary of NALMS seems an appropriate time to reflect on a citizen movement that has grown and flourished during this same time – the monitoring of lakes, ponds, and reservoirs by trained volunteers. It is tempting to call volunteer monitors "ordinary folks," but in fact they are not: They stand out because of their persistence in the face of uncooperative weather, equipment, bugs, and boats; their ability to learn and do new things; and their dedication to helping the lakes they love."

- **Volunteer Monitoring: Lake Monitoring (Video Recording)**
  Volunteers collecting lake data is one of the oldest forms of aquatic citizen science in the United States with programs starting in 1970. Lake monitoring is a great example of community-lab partnerships with volunteers playing diverse roles in collecting and analyzing water quality samples. This webinar will highlight two lake volunteer monitoring programs, their protocols, community case stories, and examples of data use.

A Coordinator's Guide to Volunteer Lake Monitoring Methods (NALMS)

The purpose of this report is to assist people who develop, manage and participate in volunteer lake monitoring programs by:

1. Presenting background information on several important lake water quality parameters that are monitored in volunteer programs.
2. Highlighting the monitoring methods undertaken by programs in the Upper Midwestern states of Illinois, Indiana, Michigan. Minnesota, Ohio, and Wisconsin.
3. Recommending specific methods that will enhance the reliability and usefulness of volunteer monitoring data.
4. Discussing the use of trophic state analysis to aid in data interpretation.

- **Volunteer Monitoring Methods (NALMS)**
  Secchi Dip-in and volunteer lake monitoring resources.
  www.nalms.org/secchidipin/monitoring-methods/

CDFW Invasive Species Reporting App

See an invasive species in California? There's an app for that! "EDDMapS" (Early Detection and Distribution Mapping System) allows invasive species reports to be submitted from your smartphone. On the user-friendly app, anyone can report an invasive species sighting, submit photos, provide sighting details, and document a negative survey. EDDMapS is available on both Apple and Android platforms. Learn more about EDDMapS and our other Citizen Science projects.

California Freshwater & Estuarine Harmful Algal Bloom Report Form

- Managed by California State Water Resources Control Board's Freshwater and Estuarine Harmful Algal Bloom (FHAB) Program. https://mywaterquality.ca.gov/habs/do/bloomreport.html

Citizen Science Tahoe

Help protect Lake Tahoe by becoming a citizen scientist. In less than five minutes, you can help protect Tahoe's beauty and health. While you enjoy Tahoe's beaches, deep blue waters, or soaring mountains, share your observations through the Citizen Science Tahoe app to help scientists better understand and protect the Lake. https://citizensciencetahoe.org/home

- Ashley Williams is keeping Tahoe blue by using the new Citizen Science Tahoe App! See how you can help keep Lake Tahoe blue and clean. (Video 7-14-2022)

Clear Lake Fish Kill Monitoring Project
Clear Lake Fish Kill Monitoring is a citizen science project to record fish kills wherever they occur on Clear Lake and nearby tributaries. www.inaturalist.org/projects/clear-lake-fish-kill-monitoring-project

BloomWatch App: Crowdsourcing to Find and Report Potential Cyanobacteria Blooms
State and local officials can't be watching every lake at all times! By using the bloomWatch app on your smartphone, you will help us understand where and when these organisms may be causing issues. https://cyanos.org/bloomwatch/

Score the Shore (Lakeshore Habitat Assessment)

- 2022 Score the Shore Data Form
- Score the Shore procedure
- Score the Shore Fact Sheet
- Visit the Lake Training webpage for additional Lakeshore Habitat Assessment training materials

Snapshot Surveys for Lake Monitoring, More Than a Shot in the Dark
Environmental degradation and loss of ecosystem services due to anthropogenic activities are an issue of global concern (Cardinale et al., 2012). Lakes act as effective sentinels of environmental change as they respond to atmospheric, terrestrial, and hydrological processes (Williamson et al., 2008). Understanding lake dynamics can help determine the scale and frequency of occurring changes, establish control measures and maintain ecosystem integrity. Thus, monitoring is necessary, but it is rendered impossible since there are over 117 million lakes globally.

Here, we explore the advantages and disadvantages of widely used sampling strategies. We focus on multi-lake snapshot surveys and discuss the limitations of the approach. This strategy allows broad spatial coverage, while remaining affordable. We use mostly phytoplankton examples, because of its rapid response to environmental change. www.frontiersin.org/articles/10.3389/fevo.2018.00201/full

Snapshot Day Events: Water Quality Monitoring-Blitz Featuring Monterey Bay & Lake Tahoe (Video Recording)
What could you do with water quality monitoring field crew consisting of teams numbering up to a hundred or more individuals? That is a question Snapshot Day coordinators deal with annually. For a single day of mass monitoring, trained volunteers collect water quality measurements and samples which collectively present a Big Picture worth of data. During this webinar you will learn about Snapshot Days from the two longest lived Snapshot Day events in California, Monterey Bay & Lake Tahoe.

LAKE MONITORING RESOURCES – CALIFORNIA

Are our streams & rivers healthy? Healthy streams, rivers, and lakes provide safe drinking water, recreational opportunities, and important habitat for species ranging from the red-shouldered hawk to

steelhead to crayfish and dragonflies. Maintaining healthy streams, rivers, and lakes can reduce the need for water treatment and water supply costs and make landscapes more resilient to climate change.

California Freshwater CyanoHABs Program (Blue-Green Algae)

Observations of harmful algal blooms (HABs) and algal toxins have increased globally in recent years. HABs are problematic because they can affect multiple beneficial uses including recreation, aquatic life, and drinking water by reducing aesthetics, lowering dissolved oxygen concentration, causing taste and odor problems, and producing potent toxins. Water Board staff are working with state and local entities to identify and respond to HAB incidents throughout California. The Water Board first began to formally address this issue in 2005 when it formed the Blue Green Algae Work Group, later renamed the California Cyanobacteria Harmful Algal Bloom Network (CCHAB). An initial product of this group was the Voluntary Guidance Document (original release 2010, updated 2016). Subsequently, SWAMP prepared California Freshwater HAB Assessment and Support Strategy to articulate a coordinated program to assess, communicate and manage HABs in California. Since then, staff at both the State and Regional Water Boards have worked to coordinate monitoring and follow up when algal blooms are detected. SWAMP has also developed the infrastructure (bloom reporting form, guidance documents, field and lab procedures, etc.) to support the strategy and to coordinate monitoring when blooms are detected.

California Lakes and Reservoirs - Bioaccumulation in Fish and Wildlife

The Long-term Monitoring Study (initiated in 2015) will continue to monitor long-term trends in mercury concentrations in lakes dominated by bass (a fish species known to accumulate high levels of mercury). This study will provide updated information on the status of these lakes and a statewide perspective on long-term trends to evaluate effectiveness of management actions (e.g., mercury control plans) as well as the impacts of factors such as increases in global emissions or climate change on fish mercury levels.

Keep Tahoe 450 nm - Researching Lake Tahoe's "Blueness"

Lake Tahoe's deep cobalt blue color is of great ecological and economic value and a focus for lake management strategies of the region. While water clarity has been scrutinized and routinely measured for more than five decades, the blueness of the lake has never been quantified scientifically, until recently.

In collaboration with NASA-JPL and the Université Laval, Québec, Canada, TERC has developed the blue water index (Bw) to quantitatively express Lake Tahoe's blueness. This objective measurement of water color enables us to conduct continuous monitoring of Lake Tahoe's color as well as the color of other oligotrophic lake waters. https://tahoe.ucdavis.edu/measuring-blueness

LAKE MONITORING RESOURCES – NATIONAL

National Lakes Assessment

The National Lakes Assessment (NLA) is a statistical survey of the condition of our nation's lakes, ponds, and reservoirs. It is designed to provide information on the extent of lakes that support healthy biological condition and recreation, estimate how widespread major stressors are that impact lake quality, and provide insight into whether lakes nationwide are getting cleaner.

- **NATIONAL LAKES ASSESSMENT: The Third Collaborative Survey of Lakes in the United States**
  This report summarizes the National Lakes Assessment's key findings on U.S. lake condition. EPA and its state and tribal partners conducted the survey in 2017.
  https://nationallakesassessment.epa.gov/webreport/
- **NLA Dashboard**

EPA developed an interactive dashboard to accompany this report. It contains regional results and allows comparisons between natural lakes and reservoirs. For a subset of lakes, those at least 4 hectares in area, results are available back to 2007 (NLA 2007 included only these larger lakes).

Users can also get to the dashboard by following the link at the bottom of each graph in this report. Those links will bring users to a customized page with regional data for each indicator. Users can then navigate to other dashboard views using the "Condition Estimate" dropdown and other dashboard controls.
https://nationallakesassessment.epa.gov/dashboard/?&view=indicator&studypop=al&subpop=national&label=pe&condition=good&diff=2v3

Lake monitoring and Research (USGS)
Studying lakes provides an improved understanding of lake ecosystem dynamics and valuable information that helps lead to sound lake-management policies. The USGS collects hydrologic data in lake settings, studies water, and nutrient budget development, conducts source-loading analysis, explores groundwater interactions, and performs lake water-quality modeling.

Lake Monitoring Field Manual (USGS)
This manual was originally developed for a project examining the status of inland lakes in several National Parks around the Great Lakes. The parks included in the study ranged from essentially an urban park to a designated wilderness area, so a monitoring program for all these parks had to be adaptable to many lake types. Initially, chemical, and biological data from these lakes were collected over the course of two summer seasons plus an additional spring sampling. Using the data collected, monitoring protocols applicable to these lakes were developed. The lakes included in the baseline study now have a significant amount of data available about the chemistry and biology, but information about other lakes in the parks will have to be gleaned from past research or newly collected.

LAKE MONITORING RESOURCES – GLOBAL

ESA Lakes Climate Change Initiative
This dataset contains the Lakes Essential Climate Variable, which is comprised of processed satellite observations at the global scale, over the period 1992-2020, for over 2000 inland water bodies. This dataset was produced by the European Space Agency (ESA) Lakes Climate Change Initiative (Lakes CCI) project.

GLEON Networked Lake Science: Understand, Predict and Communicate the Role and Response of Lakes in a Changing Global Environment
The Global Lake Ecological Observatory Network conducts innovative science by sharing and interpreting high resolution sensor data to understand, predict and communicate the role and response of lakes in a changing global environment. https://gleon.org/

Global Lakes and Wetlands Database
The Global Lakes and Wetlands Database (GLWD) includes the best available data sources and GIS functionality for global lakes and wetlands focused on three scales (1) large lakes and reservoirs, (2) smaller water bodies, and (3) wetlands. The map scales provided range from 1:1 to 1:3 million resolution. Level 1 (GLWD-1) comprises the 3,067 largest lakes (area ≥ 50 km2) and 654 largest reservoirs (storage capacity ≥ 0.5 km3) worldwide and includes extensive attribute data. Level 2 (GLWD-

2) comprises permanent open water bodies with a surface area ≥ 0.1 km2 excluding the water bodies contained in GLWD-1. Level 3 (GLWD-3) comprises lakes, reservoirs, rivers, and different wetland types in the form of a global raster map at 30-second resolution.

Living Lakes – The international Network

The Living Lakes is an international network program managed by the Global Nature Fund (GNF) to enhance the protection, restoration, and rehabilitation of freshwater lakes worldwide. GNF seeks the partnership of decision makers, communities, and businesses to conserve the water quality and biodiversity of these wetlands through sustainable use and development, thereby also ensuring the reservoirs of drinking water.

Erick Burres
Clean Water Team Coordinator
California Water Quality Collaboration Network Facilitator
Safe to Swim Network Co-facilitator
erick.burres@waterboards.ca.gov
213 712 6862 mobile