LAKE WISE

... a voice for quiet waters

NEWSLETTER FROM OREGON LAKES ASSOCIATION

JULY 2023

Theo Dreher, Newsletter Editor

IN THIS ISSUE

Fall 2023 OLA Conference in Corvallis November 15 & 16

Reserve Wednesday 15 and Thursday 16 November for our annual conference to be held in the Memorial Union at Oregon State University in Corvallis. The theme for the conference will be ***Oregon Reservoirs: Science and Management.*** This will address advances in our knowledge and evolving priorities that are changing the way Oregon's reservoirs are being managed. In addition to presentations on this theme, we invite talks or posters on any topic that is focused on lakes. Remote attendance via Zoom will also be available. Submit your abstract here by October 2, and stay tuned for conference program and registration information at the OLA website and incoming emails.

2023 Oregon Cyanobacterial Harmful Algal Bloom Stakeholder Meeting Report

Theo Dreher and Dan Sobota

The 2023 OR CyanoHAB Stakeholder Meeting was held on March 17 at Oregon State University, with a live-stream online option. During the morning, Oregon Health Authority, OR-Department of Environmental Quality, US Forest Service, US Army Corps of Engineers, and US-EPA presented recaps of the 2022 bloom season and discussed any regulatory or monitoring changes for 2023. Fortunately, 2022 was a relatively mild HABs year, and for the second year running, there were no HAB spikes

in Cascade reservoirs downstream of slopes seriously affected by the wildfires of the summer of 2020. Since such fires are known to mobilize nutrients into streams, agencies were bracing for serious blooms. Clearly, we do not yet understand the drivers of CyanoHABs well enough to make reliable predictions.

The reports from OHA and DEQ, who collaborate in monitoring and regulating drinking water sources for cyanotoxin contamination, showed that Oregon now has a robust system for ensuring that drinking water remains safe. Unfortunately, we have not in recent years seen a parallel improvement in the oversight of recreational exposure risks to people visiting lakes that may have toxic CyanoHABs. There has still been no compilation of a list of designated lakes subject or potentially subject to HABs to direct monitoring across the summer/fall bloom season. The federal agencies have increasingly retreated to posting generic signs warning of the hazards of toxic CyanoHABs, with toxin analysis conducted only very occasionally. Monitoring of lakes for CyanoHABs or cyanotoxins still occurs entirely on a voluntary basis. This situation is not optimally protective of public health, and we are not learning about the CyanoHABs that do or don't occur in Oregon's lakes, which are in heavy demand for recreational use.

Aerial photo of Ross Island Lagoon, whose greenish water indicates the presence of a CyanoHAB. An opening to the right (not visible) allows bloom material to leave the lagoon and enter the Willamette River, with scums periodically accumulating at sites through the Portland downtown area. Photo: Desiree Tullos.

In the afternoon, speakers described recent and ongoing CyanoHABs-related research in Oregon or neighboring states. Stuart Dyer (DEQ) discussed the properties of the gas vesicles that provide cyanobacteria with the critical competitive advantage of regulatable buoyancy. This allows cyanobacteria to undergo diurnal vertical migration, moving to the surface to capture maximal sunlight early in the day, while later sinking to avoid photodamage in high light intensities and absorbing nutrients in the hypolimnion. These nutrients can be too deep to allow access by those cyanobacteria with weaker gas vesicles, thereby shaping the cyanobacterial population structure. Other talks discussed: how one might mitigate the problematic HABs that amplify in Ross Island Lagoon and sweep down the Willamette River (Desiree Tullos, OSU; see photo); genomic studies of nontoxic *Woronichinia* and *Limnoraphis* cyanobacteria that often coexist with toxic cyanobacteria (Theo Dreher, OSU); widespread anatoxin produced by benthic cyanobacteria attached to cobbles and other surfaces in the lower Klamath River (Laurel

Genzoli; Univ. of Montana); inclusion of HABs-related water quality impairments in DEQ's 2022 Integrated Water Quality Report (David Waltz, DEQ); use of hyperspectral data collected from aircraft, drones or microscopes to monitor periphyton/benthic cyanobacteria (Kurt Carpenter, USGS); validation of a high-sensitivity ELISA assay for detection of cyanotoxins below the health advisory level (Kale Clauson, DEQ).

See a recording of the meeting or look at slides shown by each speaker here.

Lakes in the News: The power of satellite data collection used to document global loss of lake water storage

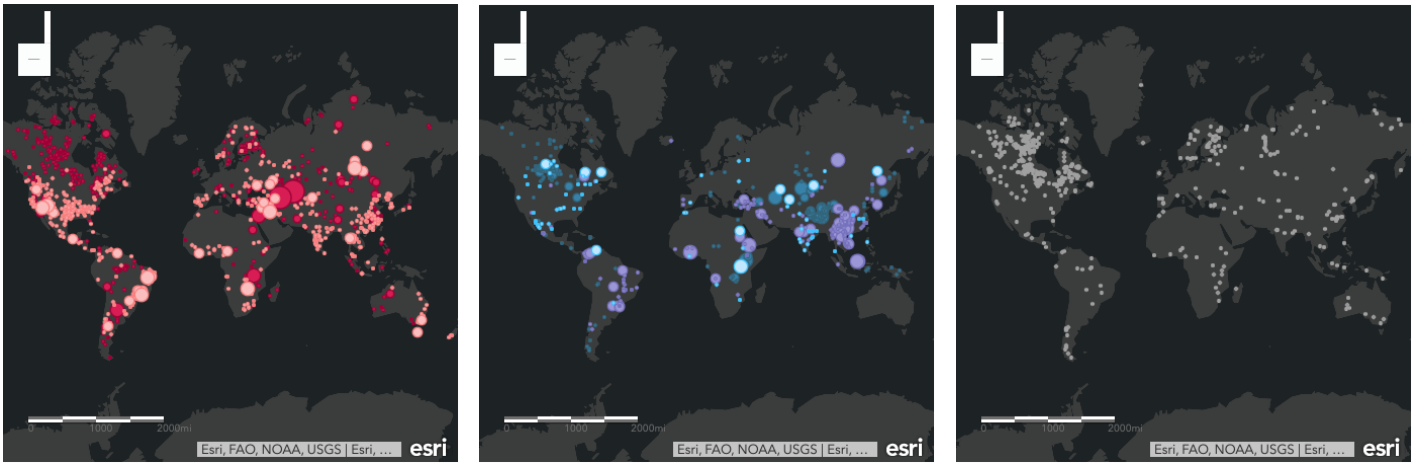
Theo Dreher

A recent paper in *Science* (Satellites reveal widespread decline in global lake water storage, by F. Yao and colleagues) looked at estimated water volumes in the 1,972 largest lakes on Earth for the 3-decade period 1992-2020. They pulled together various comprehensive datasets that have been collected, including climate data, hydrologic data and modeling in watersheds, and land use data. The natural lakes studied were larger than 100 km^2, and reservoirs were >4 km^2.

A key factor was the estimation of lake surface levels, from which water body volumes could be calculated based on bathymetric properties. Lake levels are often revealed by Landsat images showing the lake/shore interface. In recent years, more direct measurements have become possible with satellite-based altimeters that determine the elevations of air/water, air-land or water/land interfaces. ICESat and ICESat-2 are altimeters based on Lidar; ICESat provided observations with 170 m pixel size from 2003-2010, and ICESat-2 has provided data with 17 m pixel size and +/-4 mm vertical accuracy since 2018. Both instruments make observations every ~90 days in a relatively narrow transect across the Earth's surface, producing a band of data across a lake; data acquisition requires cloud-free days. Landsat-based estimates of lake elevations, which are available back to 1992, were correlated and validated by comparison to the recent years with ICESat data.

Yao et al.'s study over a 28-year period allowed a comprehensive look at lakes all over Earth in a timeframe that spans shorter-term anomalies, such as droughts of a few years, to reveal ongoing trends. About half (54%) of the studied lakes (from all parts of the world) experienced significant volume loss, while there were gains in 24%, chiefly representing new reservoirs in developing countries and lakes fed by glacier melt, such as in Tibet. Using lake floor data, it was evident that ongoing sedimentation is a larger contributor to volume losses in older reservoirs than climate-related factors.

Water storage declines were more prevalent in arid regions, where about 60% of lakes have lost water volumes. Climate factors and human consumption were clear contributing factors. Overall, the results suggested that drying trends affecting lakes worldwide are more extensive than previously thought. There will clearly be a need to continue and refine such observations, so that appropriate actions might be taken before lake ecosystems collapse. Yao et al. estimated that ~25% of the world's population lives in the basin of a drying lake.



Lakes and reservoirs that have dried (decreased water volumes)(left), increased in volume (center) and not showing changes (right) in the period 1992-2020. Extent of change is reflected in size of the dot. Data from Yao et al., 2023 accessed here.

Such considerations are top of mind for us as we continue to participate in discussions between conservationists and Chewaucan valley residents about the recent desiccations of Lake Abert. Within the last couple of months, USGS installed a real-time gauge at the lake to monitor water levels, as well as air and water temperature, and ultimately salinity. This is a big improvement on the staff gauge (a calibrated measuring stick) that has required manual reading. However, both are located at a site along the eastern shore that becomes dry if the lake recedes to low levels. After being dry last summer, a strong winter snowpack and inflow from the Chewaucan River has considerably filled Lake Abert, well above the newly installed gauge, which should be providing real-time water elevation data soon.

Fortunately, recently developed, more comprehensive satellite-based instruments will in the future provide large amounts of new data on the status of lakes and the surrounding watersheds. The SWOT mission, a US-French collaboration, is just coming online with a radar-based altimeter that can detect water elevations with 10 cm accuracy (the height of many waves) and 100 m pixel size every 21 days. Rather than collecting data in narrow sweeps, the entire area of a lake can be monitored to provide an average value and to observe seiche effects from persistent winds moving water from one end of a lake to the other. SWOT data are being processed to produce water volume estimates of lakes worldwide and also discharges of rivers with widths >100 m https://hydroweb.theia-land.fr/; https://www.reachhydro.org/home/records/grades.

Other satellite-based instruments support estimates of evapo-transpirational water loss (OpenET, https://openetdata.org) that can allow estimates of water diverted for irrigation as well as increased plant demands in hotter periods with low relative humidity. Soil moisture can be estimated from Landsat-8 and Sentinel-2 satellites by using the fact that light reflectance with certain signatures is affected by soil water content. https://skywatch.com/estimating-soil-moisture-from-satellite-data/

Many of these remote sensing products are publicly available and will undoubtedly contribute valuable information to decision-making as more watersheds become affected by water shortages stemming from a warming climate, growing human demands and diminishing groundwater. They do not replace the need for ground-based data, which will typically be more accurate because the measurements are more direct. The power will lie in the synergism of the two types of data.

Lake disappearance by dam removal

Roger Edwards

I recently had a chance to visit the former dam site on the Sandy River where water was diverted to the Little Sandy River to supply Roslyn Lake. This lake was created by these diversions installed by Portland General Electric (PGE) in 1912-13 to provide water for its Bull Run Hydroelectric Project.

The diversion dams on both of these rivers were removed in 2007 and 2008 to reestablish salmon habitat, and Roslyn Lake is now gone too. The Sandy River has recovered well. The concrete wall on the north bank is the only trace of the former 47 x 195 ft Marmot dam. A natural streambed was quickly reestablished and just a few years later, there are scant signs that there was ever a dam at the location.

Sandy River, looking upstream from the bridge at the dam site. The concrete wall at left is the only remaining sign of the former dam. Photo: Roger Edwards

Lake Abert once again has water!

Theo Dreher

In the last issue of Lake Wise, the following pictures showed the reduction of water in Lake Abert between spring and summer 2021. The lake remained dry throughout 2022, except for a strip of water against the eastern shore that was sustained by springs originating from Abert Rim. Fortunately, this last winter and spring brought robust precipitation to the Chewaucan watershed. Lake Abert is now about three-quarters full, as shown in the photo.

Aerial photos of Lake Abert in April 2021 (left) and July 2021 (right). Photos by Ron Larson.

The US Geological Survey recently installed a real-time instrument cluster to monitor the lake level, air and water temperatures, and ultimately the lake salinity. The data are publicly accessible here. In early June, the lake was at 4252 ft. Temperatures at Lake Abert have been mild so far this summer, limiting evaporative losses. Once the salts have redissolved from the sediment and re-equilibrated, this water level would put the lake in its optimal salinity zone for invertebrate (brine shrimp and alkali fly) productivity. Time will tell how robust the invertebrate recovery is, and whether the lake can once again support large populations of migratory shorebirds.

Lake Abert, looking north from Abert Rim (14 June 2023). Photo: Theo Dreher

Discussions have continued between Chewaucan watershed residents and conservation groups interested in preserving Lake Abert. State funding has now been provided to support two years of professionally mediated conversations, guided by experienced mediators from Oregon Consensus (Portland State University) and Oregon State University. OLA continues to be deeply involved in this effort.

Crawford Lake in Canada selected as site marking the onset of the Anthropocene

Theo Dreher

The International Commission on Stratigraphy (11 July, 2023) has chosen Crawford Lake in Ontario, Canada, as the reference site with stratigraphic physical features that mark the beginning of the Anthropocene, circa 1950. The lake was chosen as the best site to contain well-resolved deposits through the relevant transition from the Holocene Epoch to the yet-to-be-formally-declared Anthropocene Epoch.

The sediment of Crawford Lake has annual deposits of calcite crystals that are precipitated each summer from the alkaline surface waters, capping recently accumulated organic matter. The lake is in the highly industrialized Lower Great Lakes region, situated about 40 km SW of Toronto, some 10 km from Lake Ontario. While thus having been exposed to the airborne effects of industrialization and other human activities, it has been protected from recent direct human disturbance by inclusion in a conservation area since 1969. The lake is small (2.4 ha) and deep (max 24 m), occupying a sinkhole in dolomitic limestone. Groundwater provides most of its water, with only a single small inlet stream. The meromictic (unmixed) nature of the lake, and the absence of bioturbation in the sediment, are important properties allowing the formation of obvious and stable annual layers that form a chronological sequence. The meromictic character is stabilized by the lake's high depth to area ratio, and by high concentrations of Ca^{+2} and CO_3^{-2} ions forming a dense layer below the chemocline (~15 m).

The annual layers of the lake show accumulations of features such as plutonium from nuclear weapons testing, ash from burning fossil fuels, heavy metals and microplastics that document human activities during the last century.

Reference: McCarthy, F.M., et al;, 2023. The varved succession of Crawford Lake, Milton, Ontario, Canada as a candidate Global boundary Stratotype Section and Point for the Anthropocene series. *The Anthropocene Review*, *10*, 146-176.

Lake Crawford, Ontario, Canada. Source: AAAS

The Oregon Lakes Association Mission

OLA, a non-profit organization founded in 1990, promotes understanding, protection and thoughtful management of lake and watershed ecosystems in Oregon. Serving entirely through volunteer efforts, the Oregon Lakes Association puts on an annual conference, publishes a tri-annual newsletter, sponsors Harmful Algal Bloom trainings, and works as an advocate for lakes in the legislative arena. For additional information on OLA, write to the address above, or visit our website

OLA and *Lake Wise* welcome submissions of materials that further our goals of education and thoughtful lake management in Oregon. OLA is grateful for corporate support that helps sustain the organization. Corporate members are offered the opportunity to describe their products and services to *Lake Wise* readers. These descriptions are not OLA endorsements and opinions appearing in *Lake Wise* are not OLA policy statements.

LakeWise
Oregon Lakes Association
P.O. Box 345
Portland, OR 97207-0345