LAKE WISE

... a voice for quiet waters

NEWSLETTER FROM OREGON LAKES ASSOCIATION

OCTOBER 2023

Theo Dreher & Ron Larson, Newsletter Editors

IN THIS ISSUE

Fall 2023 OLA Conference in Corvallis November 15 & 16

We'd love to see you at the OLA Fall Conference at the Oregon State University Memorial Union in Corvallis. The theme for the conference will be ***Oregon Reservoirs: Science and Management,*** which will make up the Wednesday, November 15 program. This will address advances in our knowledge and evolving priorities that are changing the way Oregon's reservoirs are being managed.

On Thursday, November 16, there will be presentations on CyanoHABs, lakes under stress, and other topics. See the full program and Abstracts of Presentations online, and below for a summary of the program.

The program has a late start on Wednesday (9:30 AM) designed to allow you to travel to Corvallis that day, so you need only one overnight stay. Register for the conference here: early bird registration by October 25.

Conference registration will include:

Lunch both days: selection of sandwich & wrap platters
Thursday breakfast: buffet of pastries, fruit, hot eggs & potatoes
Coffee breaks
…. from OSU Catering

OLA Fall 2023 Conference Schedule

Oregon State University, Corvallis, November 15 & 16
Remote participation via Zoom also offered

Wednesday, Nov. 15

9:30 Welcome: Theo Dreher (OLA President)

Oregon Reservoirs: Science and Management

Reservoir Biology, 9:40 – 11:50

Includes keynote talk: Christina Murphy, USGS & Univ. of Maine, *Phytoplankton to fish: An ecological exploration of reservoirs*

11:50-1:00 Lunch

Reservoir Management and Monitoring, 1:00 – 2:40

Includes keynote talk: Greg Taylor, US Army Corps of Engineers, *History and Evolution of Water management at the Willamette Project, OR*

2:40-3:40 Coffee Break & student mentorship opportunity
Posters, Silent auction

Thursday, Nov. 16

8:00-9:00 Breakfast
Lakes under Stress, 9:00 – 10:00
General Lake Science, 10:00 – 11:40
CyanoHABs, 11:15 – 12:15
12:30 Lunch
1:30 OLA business meeting open to all

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American Avocets flock to Oregon’s Eastside Lakes

Ron Larson, Oregon Lakes Association

American Avocets. Photo by Ron Larson

To most limnologists, scientists who study lakes, what is under the surface of our lakes is usually what gets their attention. However, Oregon’s eastside saline lakes show that there is plenty of action on the surface. That’s because these shallow and productive lakes east of the Cascades, especially those that are salty, attract thousands of waterbirds when water is present, such as in 2023 (see “Lake Abert once again has water” in the July 2023 Lake Wise newsletter). Take for instance Lake Abert, our saltiest, where over 40,000 waterbirds were seen this summer during one-day counts; and in some years, even more have been reported from the lake.

What attracts birds to these eastside lakes is the high invertebrate production that occurs in summer. After the birds have nested, they are focused on eating because they are replacing worn feathers and are building fat reserves in preparation for long distance, southbound, winter migrations. Some birds, such as Wilson’s Phalaropes will fly
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as far as Argentina to spend the winter. Thus, the abundance of invertebrate food in these lakes at a critical time is important for their continued survival.

It's now recognized that the saline lakes east of the Cascades and Sierras are very important seasonal waterbird habitats because of their high invertebrate productivity. The big three are: Great Salt Lake, Lake Abert, and Mono Lake, but as we will see, other Oregon lakes are significant too for at least one waterbird species, the American Avocet. Unfortunately, these lakes are being adversely impacted by water diversions upstream and by a warming climate causing increased evaporation.

Lake Abert has been studied for several decades by a small number of scientists, including Dave Herbst from the University of California, and Ron Larson, an OLA director. This year the US Geological Survey (USGS) began monitoring the lake's water level and chemistry to get a better understanding of how it is changing. Additionally, this summer as part of a region-wide study of saline lake ecosystems, the USGS tagged two avocets in Suisun Marsh near San Francisco, California and 40 avocets in two primary regions of the Great Basin — southcentral and eastern Oregon and the Great Salt Lake (GSL) in Utah, to document their movements. The birds were fitted with tiny GPS transmitters powered by the sun and which transmit the bird's location frequently through the cell phone network, so that a detailed record of their movements is produced. So far, the study has resulted in over one-hundred thousand GPS locations from those 42 tagged birds and more locations will be recorded until the transmitters either fall off the birds or stop working.

One of the Suisun-marked birds migrated to GSL to nest and subsequently migrated to Oregon and northeastern California, eventually settling in Goose Lake and most recently visiting Alkali Lake in southern Oregon. The other avocet left Suisun where it was tagged in April, stopped at Honey Lake and Goose Lake in northeastern California, and eventually moved to Malheur Lake, where it nested and then relocated to Goose Lake. Of the 20 birds marked at GSL several have migrated to Mexico but most remain in the GSL region (Figure 1A). The Oregon-marked avocets (9 marked at Malheur, 3 at Lake Abert, and 7 at Summer Lake) have made significant movements between and among habitats in the region including Malheur, Summer, Abert and Goose Lakes (Figure 1A). While only three of the 20 avocets marked in Oregon were captured and tagged at Lake Abert, 13 of the 20 marked in the region have visited the lake showing how important it is for the birds (Figure 1B).

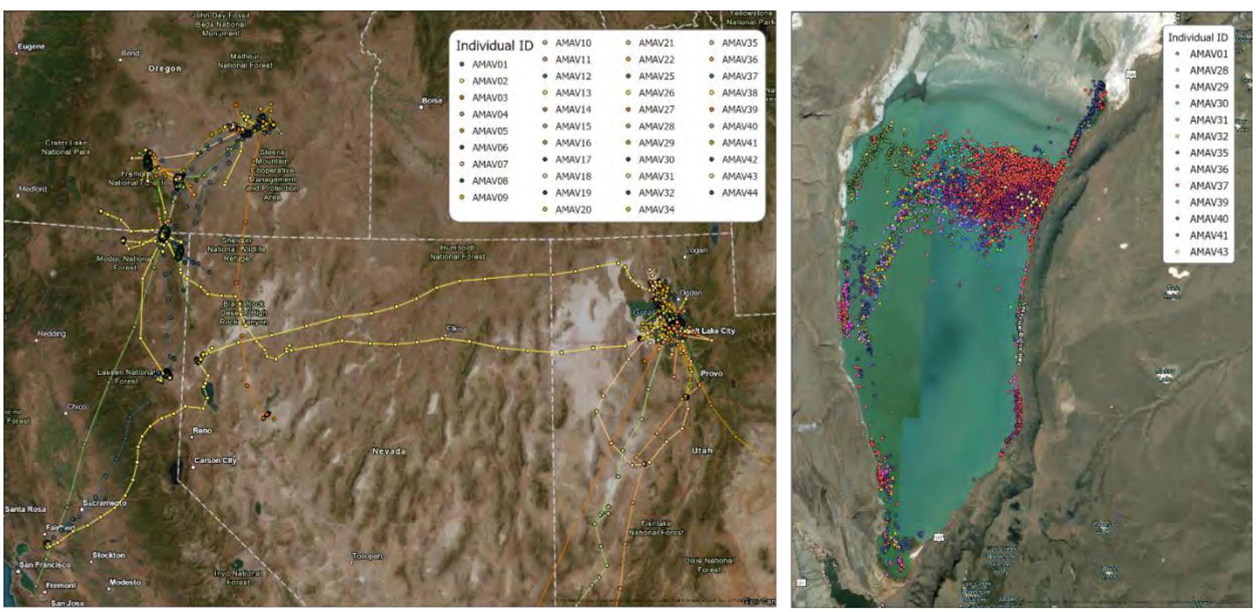


Figure 1. A (left): Results of the USGS tracking of American Avocets across the Great Basin over approximately 4 months in 2023. There was significant movement between habitats in southeastern Oregon and northeastern California. Also, some movement between GSL and Oregon was evident, and several GSL birds flew to Mexico, and one Oregon-marked avocet is in the San Francisco Bay Region. **B** (right): Enlarged map of Lake Abert showing GPS locations of 13 individual avocets around the lake and their focus area at the north end of the lake (12,600 data points). Each bird is represented by a different color. Data and figures courtesy of Michael Casazza, Austen Lorenz and Cory Overton, USGS.

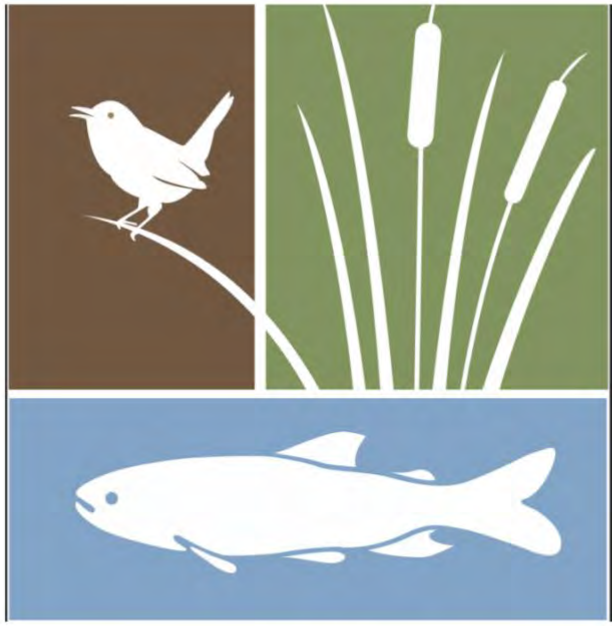
The tracking data show that American Avocets are using multiple lakes within a season and can utilize a broad array of wetland habitats. Lake Abert is located somewhat centrally within what is called the SONEC region — Southern Oregon and Northeastern California, and that likely contributed to a significant amount of use around the lake, but most likely the birds are going there because of the availability of invertebrate food. Although avocets flew to three main areas around the lake, they were mostly concentrated in the northeastern part where avocets, phalaropes, Northern Shoveler ducks, and other waterbirds were seen this summer from Highway 395 by Haley Tobiason (an intern supported by Oregon Natural Desert Association) during her summer of bird counting (Figure 2). The GPS locations show avocets at Abert frequently flew to Summer Lake and occasionally dispersed to other regional lakes, including Goose and Malheur Lakes.

Figure 2. Thousands of avocets used the north end of Lake Abert in September 2023, with the highest one-day count during 2023 being over 7,500 (Haley Tobiason). Tracking showed 13 different radio-marked avocets using Lake Abert this summer. Photo: Ron Larson.

The detailed picture that is emerging from these new data is that avocets move around much more than we thought and make numerous flights around each lake and to other regional lakes, apparently searching for the best feeding areas. Avocets at Lake Abert feed on alkali fly larvae by using their curved bill to sweep through the water or by sweeping over the mud where the fly larvae live (Figure 3). Alkali flies are very numerous in some years. In less saline lakes, other aquatic insects are probably eaten by avocets.

Already, this study has provided further evidence that Lake Abert and other Oregon interior lakes and wetlands are critically important habitats for avocets and other waterbirds. From this study, which is the most detailed of its kind for any waterbird in our region, we will have a much more complete picture of avocet movements in response to changing water conditions resulting from water diversions, climate change, and other factors. These data will help us reduce the impact of these threats to ensure their continued survival.

Figure 3. An American Avocet sweep feeding at Lake Abert. Note how the bill is curved upwards near the tip, perhaps making it easier to swish over the mud. This bird is a female because the bill of male avocets is less curved.

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Volatile Organic Compounds signal Toxin Contamination in Upper Klamath Lake

Kimberly H Halsey[1], Lindsay P Collart[1], and Duo Jiang[2]
Departments of Microbiology[1] and Statistics[2], Oregon State University

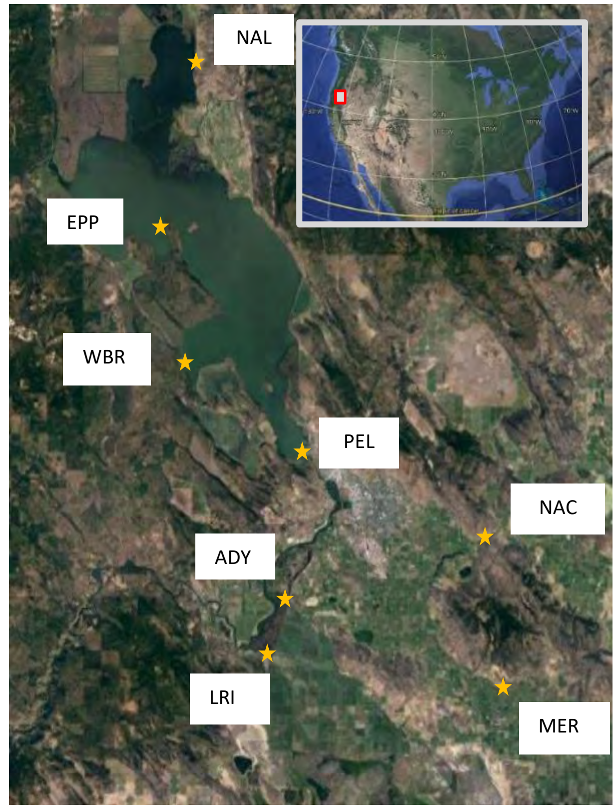
Increasing frequency and severity of toxic harmful algal blooms (HABs), their ongoing spread into previously pristine waterways, and unpredictable trajectories, emphasize the need for novel, rapid, inexpensive monitoring approaches. Direct toxin measurement can be costly. The combination of biological and environmental factors leading to toxin production by cyanobacteria are not fully known, but shifts in cyanobacterial physiology are associated with the overproduction of dangerous toxins, including microcystin. With this idea in mind, we considered that other biological molecules could serve as proxies of toxin production.

Volatile organic compounds (VOCs) are produced by algae, including cyanobacteria, and the collections of VOCs released by cells depend on the algal species and its growth conditions. The physical properties of VOCs cause them to diffuse across cyanobacterial membranes into the bulk water where they can be measured by specialized mass spectrometers.

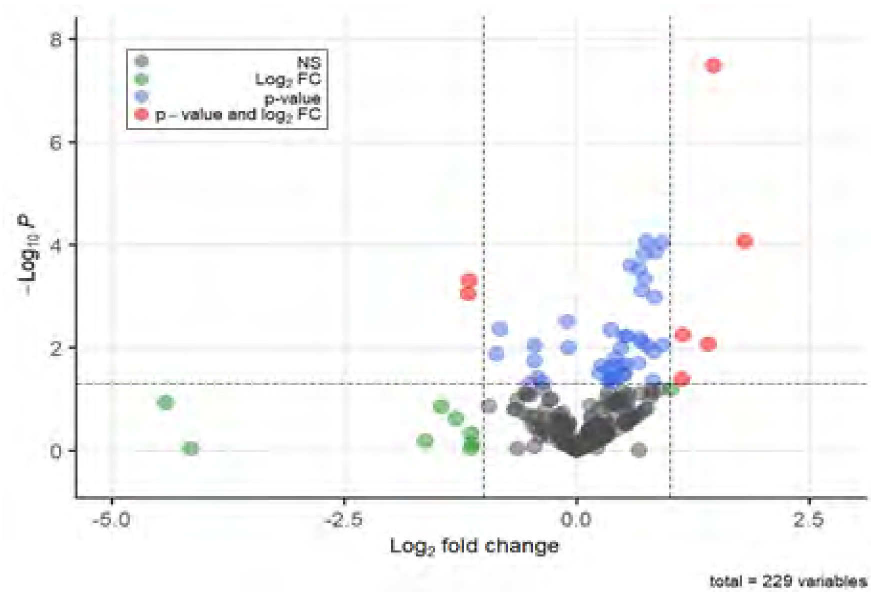
Upper Klamath Lake in southern Oregon is a hub of important water use for agriculture, wildlife, recreation, and Native American culture and sustenance. Ongoing human activities and drought has sufficiently altered Upper Klamath Lake such that toxic HABs occur annually, but the timing varies. As part of their dissertation work in the Department of Microbiology at Oregon State University, Lindsay Collart investigated whether VOCs could serve as effective signals of toxin contamination in Upper Klamath Lake. With help from Theo Dreher (OSU) and several OSU undergraduate and graduate students, Lindsay collected lake and canal water samples across 2018 and 2019, and measured in-water VOCs in addition to water chemical and biological parameters.

A massive HAB in Upper Klamath Lake, Sept. 2019

Sampling sites in Upper Klamath Lake and associated canals.



Over 225 VOCs were detected across all water samples. A multiple linear regression model using the seven VOCs present in significantly discriminating amounts in toxic vs non-toxic samples was unable to predict toxin contamination. That result indicated to us that that statistical tools involving complex data analysis would be needed to bring to bear upon this toxic HAB monitoring problem. Duo Jiang, Associate Professor in Statistics, guided Lindsay through development of Elastic Net regularized regression models. One important value in this approach is that Elastic Net identifies a small subset of the total VOC collection that is predictive of the outcome (i.e., microcystin concentration). The elastic net models Lindsay developed using VOCs were compared to models developed using common water monitoring properties (e.g., chlorophyll, pH, temperature). The VOC-based elastic net models statistically outperformed the comparator models. Those results suggest the potential for VOCs as rapidly detectable proxy molecules of microcystin-contaminated water.



Of the 227 VOCs detected in all 70 samples from Upper Klamath Lake, five VOCs (red symbols) were in significantly higher abundance in samples contaminated with microcystin and two VOCs were in significantly higher abundances in uncontaminated samples.

The VOCs identified by the elastic net models included some VOCs previously shown to be associated with microcystin production, such as a sesquiterpene, limonene and ß-ionone. Other VOCs identified by the elastic net models were tentatively assigned to medium chain length saturated fatty acids (SFAs). SFAs contribute to cyanobacterial membrane structure and localization of photosystems. Upregulation of SFA metabolic pathways is linked to oxidative stress in some cyanobacteria. Currently, microcystin is thought to protect photosystems and peroxidases against oxidative damage, thus SFA accumulation would make useful targets for microcystin detection.

This work presents a proof-of-concept that small, highly diffusible molecules can be harnessed as signals of ecosystem states. In addition to Elastic Net models predicting microcystin contamination, additional Elastic Net models demonstrated that different subsets of VOCs could indicate the relative abundance of cyanobacteria genera and the four most abundant microbial phyla and classes. This study used discrete water sampling from Upper Klamath Lake, but new technologies may facilitate real-time monitoring of the overlying atmosphere.

Following the success of the Upper Klamath Lake study, we partnered with Eugene Water and Electric Board (David Donahue, Lisa Ekert) and City of Salem (Brandin Hilbrandt, Elijah Welch) to sample three additional lakes in two different watersheds. Sampling was conducted throughout 2022 and 2023 in Blue River, Cougar Reservoir, and Detroit Lake. The cyanobacterial genera present and toxins that are occasionally produced in these lakes differ from those in Upper Klamath Lake, providing a good opportunity to explore relationships between VOCs signatures, toxin contamination, and microbial community composition. Data analysis is currently underway for these lakes. We are grateful for scholarship support to Lindsay from Oregon Lakes Association and the College of Science and Agricultural Research Foundation at Oregon State University for project support. The full manuscript can be found here.

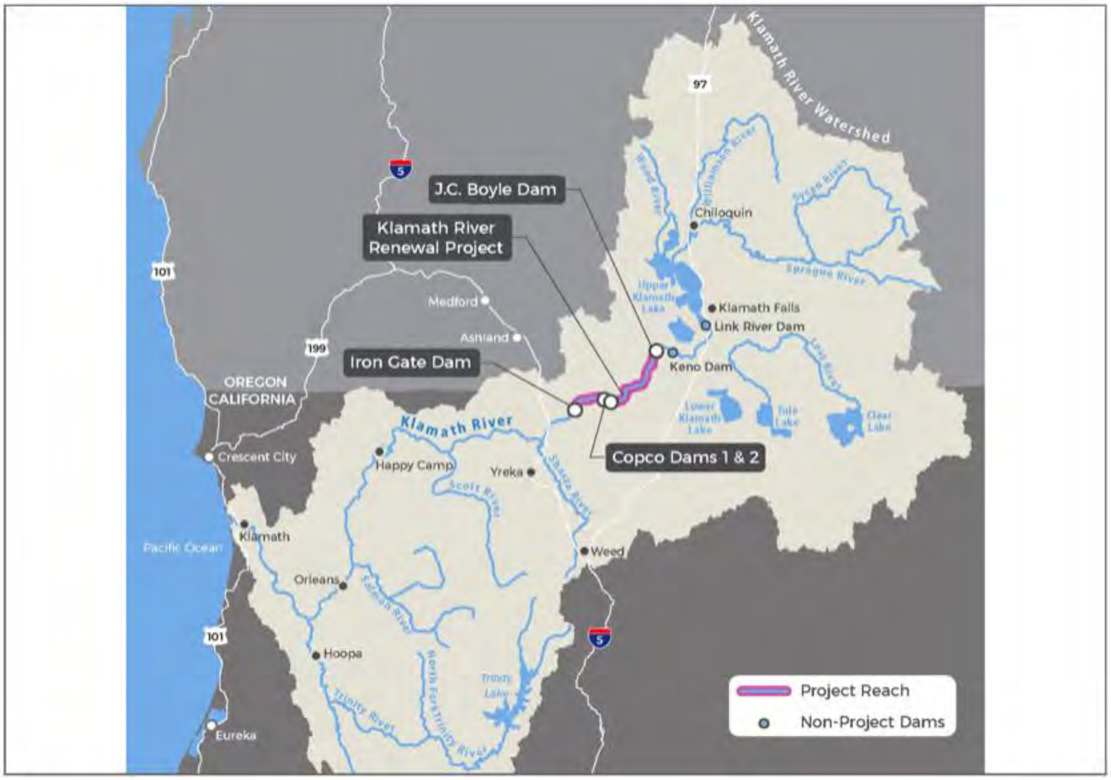
Klamath Dam Removals are Underway

Desirée Tullos, Department of Biological & Ecological Engineering, Oregon State University

The world's largest dam removal on the Klamath River (OR, CA) is underway. Construction activities began in early 2023 and the first of the four dams was removed during the summer of 2023. The dams, previously owned by PacifiCorp, are being removed after a lengthy FERC licensing process resulted in the decision to remove the dams. Removal was justified by the cost of establishing fish passage, as required under the FERC process, relative to the small amount of hydropower revenue generated from the dams, which represented ~2% of PacifiCorp's power portfolio. In addition, the lakes formed by the dams produce severe harmful cyanobacterial blooms that result in annual recreational contact advisories for the lake and downstream river, and impact water temperatures in the downstream river. The dams also contribute to the high risk of salmon infection by a deadly pathogen (*Ceratonova shasta)*. In Nov. 2022, FERC authorized the transfer of the license to the Klamath River Renewal Corporation and the decommissioning of the dams, closing the chapter on a multi-decadal process that was led in large part by local tribes and river advocates.

Decommissioning and removal of Copco 2 Dam (Credit: Shane Anderson)

Drawdown of the remaining structures (JC Boyle, Copco 1 and Iron Gate dams) will begin on January 01, 2024 and could take ~3-4 months, depending on winter and spring flows. The timing was scheduled to minimize impacts to fish and to coincide with the timing of naturally high suspended sediment loads. During and after the reservoirs are dewatered, suspended sediment concentrations in the river will be high, with the peak exceeding 10,000 mg/L (USBR 2012). The reservoirs contain 85% fines, a large fraction of which is organic material accumulated from decades of cyanobacterial blooms. Dissolved oxygen in the river will drop with the release of the reservoir carbon. Over time, stored sediments and nutrients will flush out of the system and water quality and habitat conditions will recover, both from the immediate effects of dam removal and from the influence the dams have had. The exposure and availability of new salmon habitat, including the connection of cold-water springs and tributaries, will occur rapidly following drawdown. During and following dam removal, substantial efforts are being executed for restoring the sites, including revegetation, reshaping topography, and establishing new recreational access points.



Map of the Klamath River Renewal Project. From KRCC website

A group of dedicated scientists from across the basin's tribes, universities, and governmental and non-governmental agencies has been collaborating to document the changes in the river. Research topics range from water quality and primary production, to the fate of the stored sediment, to fish disease risk, among many others. Interested to learn more? Check out some of these online resources:

- Klamath River Renewal Corporation (KRCC)
- New podcast on the Klamath dam removals called *"What it takes to take down a dam."* Also available on Spotify, Audible, Apple podcasts, etc.
- USGS's science synthesis page

Lakes in the News

Theo Dreher

Urban Lake Rehabilitation in India

Rapid development and growth of the high-tech city Bengaluru (Bangalore), India, in recent decades led to a depleted water table and degradation of local lakes. Appalled by the stinking state of local lake, Anand Malligavad, a mechanical engineer by training, devoted himself to rehabilitating lakes in and around the city. He began with 36-acre Kyalasanahalli Lake in 2017. Over 45 days, heavy equipment and hundreds of workers removed pollution including sewage and plastic that had accumulated in the lake floor, using some of the excavated mud to created vegetated islands; blocked drainage channels were opened, and carved stones were positioned at inflows to trap silt. Within the year, Kyalasanahalli Lake was restored to a lake with clean water and wildlife, similar to its state around 2010, when it could still be used as a drinking water source.

The design philosophy of Mr. Malligavad's work was principally borrowed from the practices of the Chola dynasty, which reigned in Southern India in the period 850-1200. He does also use modern methods, such as floating islands. In addition to the physical design challenges of his work, opposition by developers and landowners has added difficulties. Nevertheless, to date, 35 lakes around Bangalore have been restored by his methods. For more information, read in the NY Times and listen to a TEDx talk.

Restored Kyalasanahalli Lake, Bengaluru (NY Times)

Invasive Quagga mussels found in Twin Falls region of Snake River, Idaho

In mid-September, quagga mussel larvae were found in multiple samples taken from the Snake River near Twin Falls, Idaho. The Idaho Department of Agriculture (IDSA) has closed river use between Twin Falls and Niagara Springs. It is considered that detection was early enough for containment and eradication efforts to have a chance of success. IDSA conducted an aggressive eradication effort using the copper-based treatment Natrix®. Together with zebra mussels, quagga mussels have been a well-known invasive threat to Pacific NW lakes and waterways as they can grow unchecked on underwater structures, clog pipes, and alter food webs. Decontamination of boats traveling from other regions and early detection methods have been implemented to help prevent invasion. Current information on the containment and eradication efforts can be found at the ISDA website. And remember, always Clean, Drain, Dry your watercraft to prevent the introduction and spread of invasive species.

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.

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