LAKE WISE

... a voice for quiet waters

NEWSLETTER FROM OREGON LAKES ASSOCIATION

MAY 2021

Connie Bozarth, Newsletter Manager

IN THIS ISSUE

Annual Conference Sessions

Remote 1.5 to 2 hr Sessions

Annual Conference of the Oregon Lakes Association (OLA)

October/November

(topics and dates to be determined)

Because of lingering uncertainties caused by the coronavirus pandemic and some advantages of short remote sessions spread across several days, we will hold conference sessions using the same format as last year: connection via Zoom, with several 1.5 to 2 hr midweek sessions across October and November, avoiding the dates of face-to-face meetings that are being sponsored by WALPA (20-22 October) and NALMS (25-18 November).

Look for an invitation to submit abstracts soon, and a program and registration info later!

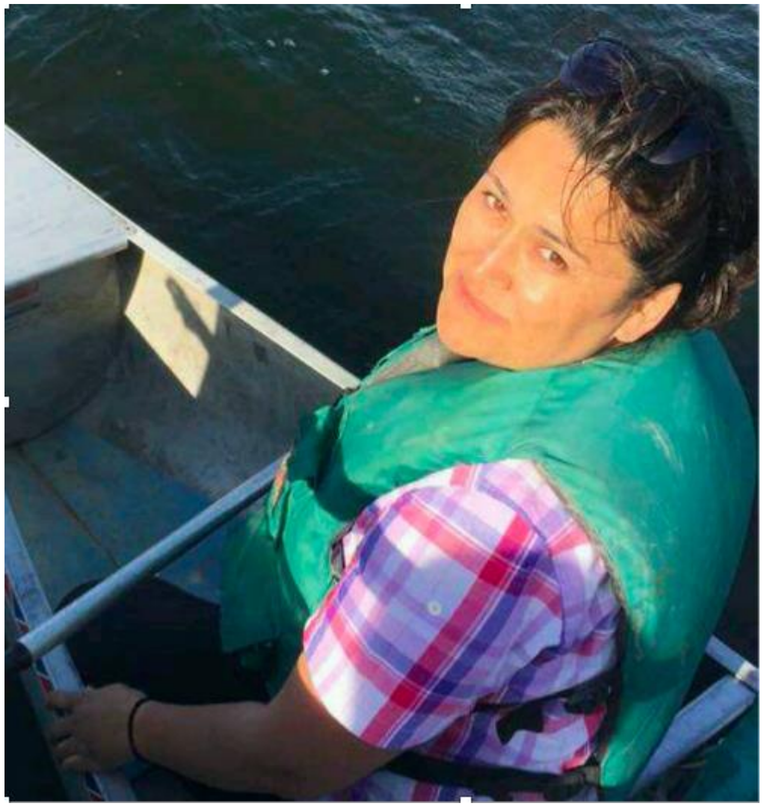
Forthcoming details on the

conference event website

2021 Oregon Lakes Association (OLA) Graduate Student Scholarship Recipient

Contributed by Rich Miller, OLA Board Director

OLA Awards 2021 Graduate Student Scholarship to Jamila Baig



Oregon Lakes Association is pleased to award this year's $1500 research scholarship to Jamila Baig, PhD candidate in the Environmental Sciences, Studies, and Policy and Geography Departments at University of Oregon. Jamila has a Master of Philosophy degree in Animal Sciences from Karakoram International University (KIU), Pakistan; a Master of Science degree in Zoology from University of Peshawar, Pakistan; and both Bachelor and Master of Education degrees from Notre Dame Institute of Education in Karachi, Pakistan. Jamila is the first in her family and one of few women from the northern part of Pakistan pursuing Doctoral studies. Jamila is currently affiliated with KIU as faculty, and once back at KIU, she would like to continue collaborative research between KIU and UO and train many young paleo-ecologists in Pakistan's mountainous region.

Jamila's PhD research under the direction of Dr. Daniel Gavin and Dr. Patricia McDowell at UO aims to reconstruct paleotemperature, vegetation change, fire history, and lake productivity using chironomids, pollen, charcoal, carbon-nitrogen ratio, and carbon-13 from a 13-m long sediment core collected from Gold Lake near Willamette Pass in Lane County. The core has outstanding properties including a high sedimentation rate that allows detailed sampling, sections of varved sediment (visible annual layers), and well-preserved tephra layers from the Mount Mazama eruption. Sediments in the core correspond to the past 13,000 years. Jamila will establish modern pollen and chironomid analogs using surface samples of Gold Lake. Pollen data will be analyzed to reconstruct pollen percentages and see the vegetation change over the studied time scale. Vegetation will be divided into different zones based on the abundance of vegetation type, time scale, and climatic conditions that will be inferred qualitatively based on the vegetation type. Chironomid-inferred temperature would be used to find whether vegetation in Gold Lake's vicinity was in equilibrium or not with climate change. This research will be a great addition to regional paleoenvironmental data, and it will fill the gaps and answer the questions that cannot be answered using a single proxy. The response of terrestrial vegetation and aquatic ecology to disturbance events, such as forest fires and volcanic eruptions, can be determined from the Gold Lake core because of its unique qualities. This understanding of how the environment has responded to past climatic variations will help advance predictions of the changes associated with climate change. Jamila will use the scholarship funds to obtain more radiocarbon dates and conduct more charcoal analysis on the core.

Find out more about Jamila's research at the Oregon Lakes Association Fall 2021 conference (date is yet to be determined), or you can email Jamila at jbaig@uoregon.edu. If you'd like to read about the previous nine OLA scholarship recipients, access their master's theses and doctoral dissertations, or to contribute to the Scholarship Fund, visit our scholarship page at www.oregonlakes.org/Scholarship. If you're a student looking for support for your research, applications for the 2022 OLA Scholarship will be open during the winter of 2022.

Harmful Algae Blooms (HABS) Corner

Contributed by Theo Dreher, President, OLA, Professor Emeritus of Microbiology, Oregon State University

CyanoHABs outlook for Oregon

Many people are expecting large CyanoHAB events in Oregon's Cascade foothills reservoirs this season because of last year's massive wildfires affecting large parts of the Clackamas, North Santiam and McKenzie watersheds. Large amounts of nutrients and sediments can be expected to flow into reservoirs, and those nutrients will be available to feed HABs. While it seems very likely that CyanoHABs will increase in reservoirs downstream of affected areas, the timing of such events will be influenced by other factors, such that big blooms may not happen this year but in later years. April snowpacks in the Cascades that were currently near or above long-term median values will provide extended flows of cold water into reservoirs, disfavoring cyanobacteria. Several groups are ramping up monitoring efforts to track this season's CyanoHABs to study the influences of the recent wildfires. All eyes on CyanoHABs this year!

CyanoHAB legislative action in Salem

Two important bills affecting Oregon's response to freshwater HABs are currently active. Both were introduced by Rep. Ken Helm, Chair of the by House Committee on Water, and both were passed out of committee and are currently with the Joint Ways and Means Committee, which considers the funding requests. In hearings, at one of which I provided comments and expertise on behalf of Oregon Lakes Association and Oregon State University, legislators were very concerned about the possible effects of the massive wildfires on CyanoHABs.

HB3102 calls on OR-Department of Environmental Quality (DEQ) to purchase a second cyanotoxin autoanalyzer to ensure capacity for analyzing samples from drinking water utilities and from lakes used for recreation. The bill also provides funds for supplies and two new positions to run the toxin analyses and to help with sample collection.

HB3093 calls on DEQ and Oregon Health Authority (OHA) to expand their current activities in monitoring, education, and response to CyanoHABs, providing one new position to each agency. The bill also directs DEQ to develop watershed management plans to mitigate future CyanoHABs. This bill has the essentials of the Comprehensive CyanoHABs Program that OLA proposed in 2018. I think that Oregon Lakes Association can be proud in having brought the CyanoHABs issue to the attention of Oregon legislators, especially Rep. Helm, with a clear outline for action.

The status of these and other bills can be tracked at the Oregon State Legislature website.

HABs research: Newly recognized cyanobacterial neurotoxin fatal to bald eagles and other wildlife

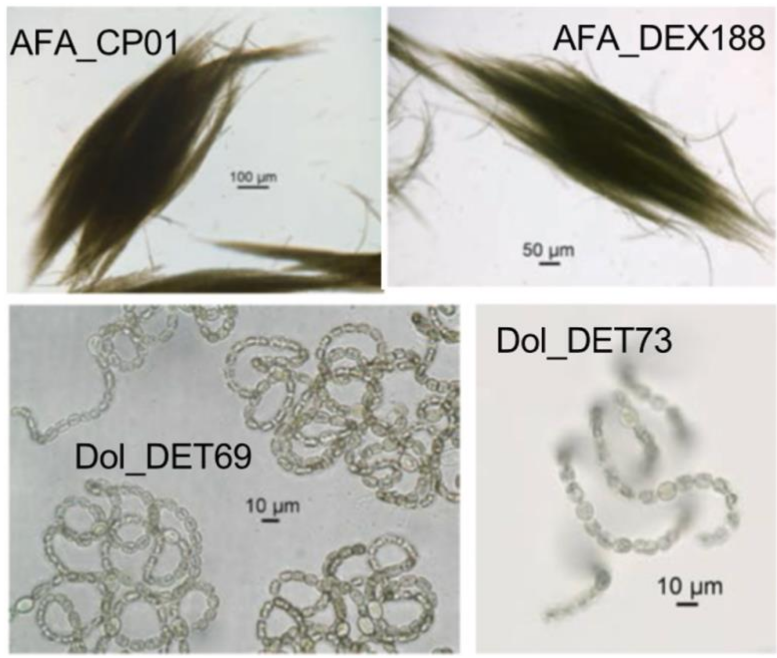
A recent paper in the journal *Science* describes a multidisciplinary study that identified a new toxin, aetokthonotoxin (AETX), produced by the cyanobacterium *Aetokthonos hydrillicola* growing epiphytically on the invasive water weed *Hydrilla verticillata*. AETX bioaccumulates during transfer up the food web, especially targeting birds of prey, such as bald eagles. The toxin causes the fatal neurological disease vacuolar myelinopathy (VM) that is present in the south-eastern US. AETX is a brominated alkaloid, and the association with *Hydrilla* is important because this plant hyperaccumulates bromine, which can come from natural or manmade (e.g., diquat dibromide algicide, PBDE fire retardant) sources.

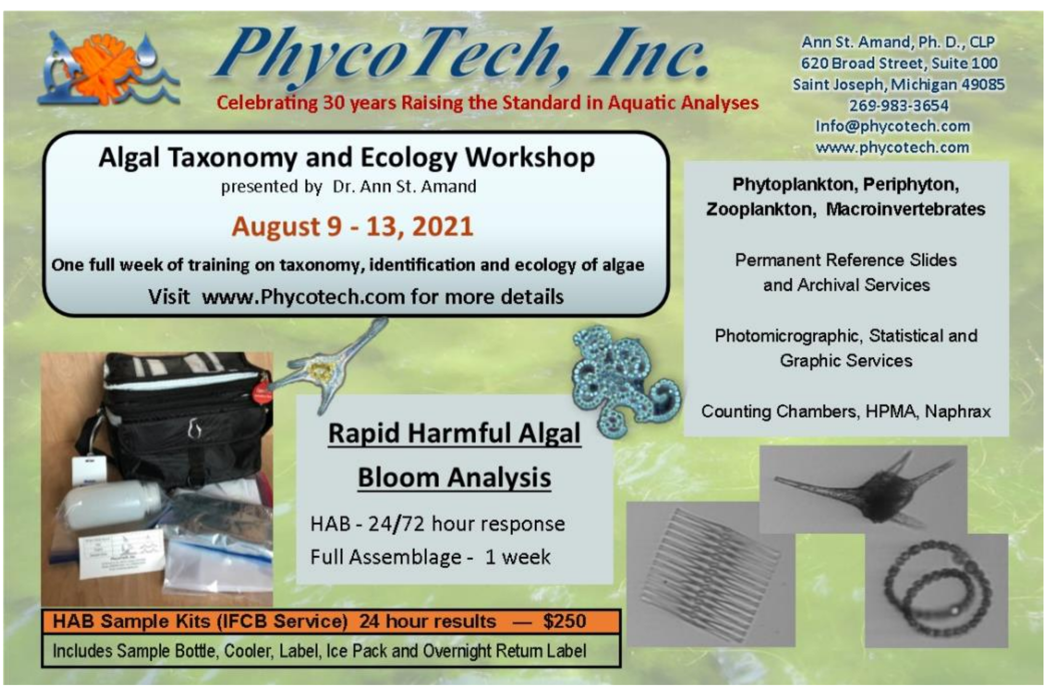
HABs research: Genome sequences of several toxic and nontoxic HAB-forming cyanobacteria from Oregon

The Dreher lab at Oregon State University has recently published two papers describing the genomes of *Dolichospermum* and *Aphanizomenon flos-aquae* cyanobacteria that caused HABs between 2015 and 2018 The papers, *Complete genomes derived by directly sequencing freshwater bloom populations emphasize the significance of the genus level ADA clade within the Nostocales* and *Comparative genomics of the ADA clade within the Nostocales* are available in Harmful. Interpretation of the genome sequences provides many benefits, as you can imagine from current parallel examples in medicine: tracking the spread of new variants of the COVID-19 virus and paving the way for individualized cancer treatment by sequencing cancer cell genomes. In the case of CyanoHABs, genome sequences tell us which cyanobacteria are toxigenic or can produce geosmin, tell us about differences between HABs in different parts of Oregon, and tell us about the relationship between morphology (how you would classify a cyanobacterium by looking at it under the microscope) and genetic relatedness (how cyanobacteria are placed on a family tree). Having genome sequences in hand provides the opportunity to design specific monitoring tools that can be used for research or management goals.

Our studies show that *Dolichospermum* and *Aphanizomenon flos-aquae* are part of a group that includes benthic *Anabaena*, called the ADA clade. Current species names do not align with genetic relationships, and there will likely be revisions to the taxonomic names of these cyanobacteria in the future. A large variety of ADA cyanobacteria form HABs in Oregon, and there is more genetic diversity than is suggested by morphology. Only some of these cyanobacteria are toxigenic, but they do include microcystin, cylindrospermopsin and anatoxin-a producers.

The figure shows microscope images of two *Aphanizomenon flos-aquae* and two *Dolichospermum* cyanobacteria sampled from HABs in Crane Prairie Reservoir (AFA_CP01; July 2016), Dexter Reservoir (AFA_DEX188; September 2018) and Detroit Reservoir (DET69, May 2018; DET73, July 2018). Genome sequences show that AFA_CP01 and AFA_DEX188 are closely related (98% identical) and are not toxigenic. The two *Dolichospermum* cyanobacteria from Detroit Reservoir have similar morphology but are only 89% identical and should belong to different species. Dol_DET69 has genes for producing the toxin cylindrospermopsin and Dol_DET73 has genes for producing microcystin.





Careers in Freshwater-Panel Recap

Contributed by Lara Jansen, Secretary and Student Director, OLA

On April 8th, Oregon Lakes Association (OLA) and Washington Lake Protection Association (WALPA) in partnership with Portland State University hosted 'Careers in Freshwater', a virtual career panel focused on the diverse work in freshwater science and management in the Pacific Northwest. OLA's student director, **Lara Jansen**, organized and moderated the panel. There were six panelists: ***Wafa Tafesh***, a water quality planner for King County's Water and Land Resources Division; ***Toni Pennington***, an aquatic biologist for Environmental Science Associates; ***Angela Strecker***, an associate professor and director of the Institute for Watershed Studies at Western Washington University; ***Zach Penney***, the fishery science department manager for Columbia River Inter-Tribal Fish Commission; ***Lisa Brown***, an attorney for WaterWatch; and ***Jennifer O'Reilly***, a fish & wildlife biologist at U.S. Fish and Wildlife Service.

Careers in Freshwater began with the announcement of OLA's Scholarship Award recipient - Jamila Baig, a PhD candidate at University of Oregon. Next, the panelists were introduced and then general questions were posed to all panelists, such as what were key experiences that helped them in their field. Wafa Tafesh and other panelists encouraged students to seek work in multiple sectors (NGOs, private, government) as it illuminates the perspectives of different stakeholders, which is helpful as all sectors work together to some degree. While multiple panelists highlighted writing and analytical skills as the most important in freshwater science jobs today, Zach Penney and Jennifer O'Reilly also noted good interpersonal skills are key in agency jobs. One participant asked about opportunities for team-based work in the field. In response, Angela Strecker recommended for an academic setting to seek early-career workshops to develop collaborations, while Toni Pennington and Lisa Brown described how consultants and NGOs often work in partnership with agencies and other organizations. For the last portion, panelists were divided into separate breakout sessions where students could ask questions specific to the panelist's background. There were about 30 student participants from Oregon, Washington and Idaho from undergraduate to postdoctoral. A video recording of the event is posted on the OLA website for the next 3 months for those interested, but who could not attend. OLA and WALPA hope to host another career panel in future years.

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Recent Investigation of the Lower Deschutes River Downstream of Lakes Billy Chinook and Simtustus

Contributed by Joe Eilers, MaxDepth Aquatics Inc. and Director, OLA

We recently completed a study funded by Portland General Electric (PGE) and the Confederated Tribes of the Warm Springs (CTWS) that included sampling of the two major impoundments and the Lower Deschutes River (LDR). This was the first water quality study of the LDR following construction and operation of a new selective water (SWW) withdrawal structure in 2010 that allowed the operators to blend surface water with bottom withdrawal waters (Eilers and Vache 2021a, b). The objective of the SWW installed at Round Butte Dam on Lake Billy Chinook was to create a blend of waters that more closely reproduces the temperature in the LDR that would occur naturally if the Project was not in place. A second objective of the SWW was to create an attractant flow to the dam and thus better orient the smolts to move to the outlet for capture and release below the hydropower project. Both objectives were met with the SWW. However, the release of surface waters, unlike the pre-SWW conditions which were exclusively cold, hypolimnetic waters, also discharged phytoplankton and altered the release of nutrients.

The recent study, done in cooperation with PGE staff, involved sampling Lake Billy Chinook, Lake Simtustus, the three major tributaries to Lake Billy Chinook (Metolius, Deschutes, & Crooked), the tailraces of the three project dams and another 11 sites throughout the length of the LDR. The sampling in the impoundments included conducting water quality profiles, and sampling nutrients, phytoplankton, and zooplankton. Most of the work in the LDR focused on sampling the periphyton and nutrients. The field work
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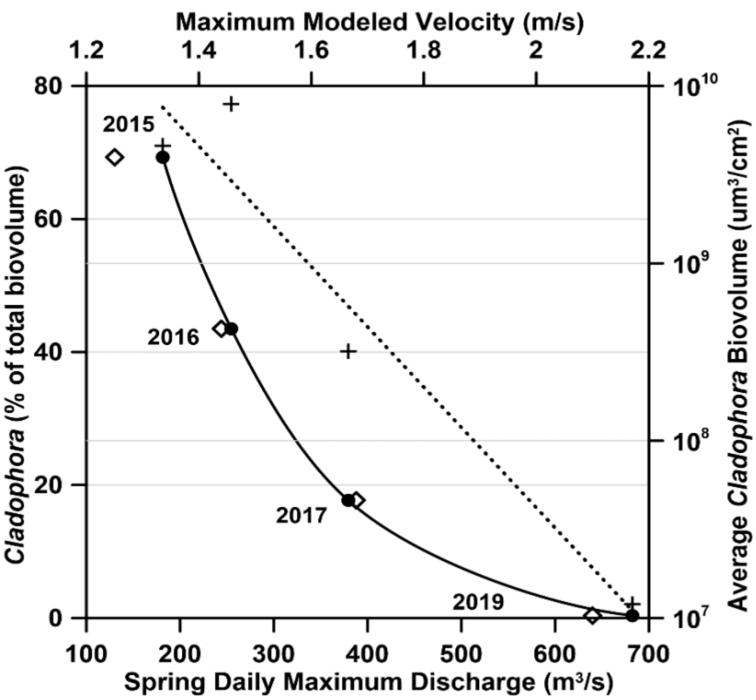
began in 2015, was most complete in 2016, but also included sampling of the LDR in the summers of 2017 and 2019. We had hoped to be able to compare the periphyton in the river sampled in 1997 for the licensing work on the Project, but those data were judged inadequate for comparison. Nevertheless, the results showed that pH and concentrations of dissolved oxygen in the river had increased slightly post-SWW. This is not surprising because the temperatures of the spring release waters were now warmer (by design) and increased water temperature increases the rate of algal metabolism.

The periphyton communities in 2015 and 2016 were dominated by *Cladophora*, a filamentous green alga common worldwide. However, in 2017, *Cladophora* declined considerably in the river and by 2019 it was nearly absent. The dominant periphyton taxa in 2017 and 2019 was now a blue-green genus called *Homoeothrix*, also common in western US streams. Neither genera have the capacity to fix nitrogen, so the change cannot be attributed to changes in nitrogen dynamics. What did emerge is that there appeared to be an association between the magnitude of spring high flow events in the LDR with the abundance of *Cladophora*. The following figure illustrates the observed relationship between maximum spring flows and abundance of *Cladophora* in the river. Clearly, this does not establish cause-and-effect, but it offers a hypothesis that can be tested through changes in river flows.



Spring daily maximum discharge (at Moody) versus percent of total biovolume of *Cladophora* (●) and modeled river velocity versus percent of total *Cladophora* biovolume (❈). Spring daily maximum discharge versus average annual biovolume of *Cladophora* (+) in the Lower Deschutes River from 2015 to 2019.

A review of historical records shows that spring flows in the Deschutes River have decreased since the major dam construction period in the basin whereby most of the reservoir storage was constructed between 1949-1964. Flows over a similar period in the John Day River (which has no dams) showed no decline in the magnitude of spring flows in the latter part of the 20th century analogous to that observed in the Deschutes River. So, if a reduction in spring flows results in increased growth of filamentous algae in the Deschutes River what can be done to return the flow regime in the Deschutes River to something more closely resembling natural patterns?

Part of the challenge in releasing greater spring flows in the Deschutes River is that PGE and CTWS only controls about 19% of the active storage in the basin (active storage is the volume of water permitted for release during the year), the remainder being controlled largely by reservoirs operated by the Bureau of Reclamation. Also, current regulations restrict PGE and CTWS to release water within a limited range. Other challenges to returning the Deschutes River spring flows to historical levels include risk of flooding to structures that now border the river and concern by ODOT regarding the structural integrity of the Hwy 26 bridge at Warm Springs to withstand high flows.

Nutrients also play a role in affecting the periphyton community composition in the Deschutes River, but in somewhat counterintuitive ways. In 2015 and 2016 when flows were relatively low, nitrogen became limiting in the Lower Deschutes River, especially downstream of Sherars Falls. Consequently, it is surprising that *Cladophora*, a green alga that cannot fix atmospheric nitrogen, was so dominant. It appears that *Cladophora* benefited by association with an epiphytic diatom, *Epithemia*, one of the few diatoms that can fix nitrogen. *Epithemia* can form abundant densities on the *Cladophora* filaments and leak inorganic nitrogen to its

Cladophora host substrate. With greater flows in 2017 and 2019, nitrate concentrations increased in the river, *Cladophora* and *Epithemia* declined, and were replaced by a nonNitrogen-fixing cyanophyte, *Homoeothrix*.

One of the long-terms concerns raised in this study regarding water quality in the impoundments of the Deschutes Basin is evidence of increased atmospheric warming and a declining snowpack. Mote et al. (2018) report that the snowpack in the Cascade Range has declined from about 80 cm to 55 cm (over the period 1950 to 2017) corresponding with increases of about 0.8 °C in air temperature for the Pacific Northwest in the 20th century (Mote and Salathé 2010). Increasing temperatures create water quality concerns because of the likelihood that warmer water temperatures in the impoundments will increase the frequency and intensity of cyanobacteria blooms (Paerl and Huisman 2008). Additionally, increased loss of glacial meltwater in the basin will result in greater water temperature in tributaries to the Deschutes River. Efforts to monitor and mitigate these possible outcomes become increasingly important to water resources management in the Deschutes Basin and throughout the state.

Eilers, J.M and K. Vache. 2021a. Water quality study for the Pelton Round Butte Project and the Lower Deschutes River: Monitoring and modeling. Report prepared for Portland General Electric and the Confederated Tribes of the Warm Springs Reservation of Oregon. MaxDepth Aquatics, Inc. Bend, OR. 586 pp. + appendices.

Eilers, J.M. and K. Vache. 2021b. Water quality and periphyton in the Lower Deschutes River: Summer 2019. Report prepared for Portland General Electric and the Confederated Tribes of the Warm Springs Reservation of Oregon. MaxDepth Aquatics, Inc. Bend, OR. 22 pp.

Mote, P.W. and E.P. Salathé, Jr. 2010. Future Climate in the Pacific Northwest. *Climate Change*. 102:29-50. *https://doi.org/10.1007/s10584-010-9848-z*

Mote ,P.W., S. Li, D. Lettenmaier, M. Xiao, and R. Engel. 2018. Dramatic declines in snowpack in the western United States. *Climate and Atmospheric Science*. 1:2; *doi:10.11038/s41612-018-0012-1*.

Paerl, H.W. and J. Huisman. 2008. Blooms like it hot. *Science*. 320:57-58.

Oregon Lakes in the News

Contributed by Connie Bozarth, Newsletter Manager

Drought Emergency Declared in Klamath Basin

Klamath County faces another drought emergency as dry conditions persist in 2021. This 2015 file photo shows a farmed field in the Klamath Basin.
Devan Schwartz / EarthFix

According to Mark Johnson, Deputy Director of the Klamath Water Users Association, inflows to Klamath Lake are the lowest since the 1930's. Multiple drought years have resulted in lower water tables, decreased water quality and not enough water to meet the needs of any one stakeholder group, much less all of them. This has reulted in Governor Brown declaring a drought emergency in Klamath County, which will result in additional financial resources to help Klamath County. Follow the story on Oregon Public Broadcasting to learn more:

Klamath County commissioners declare drought in the basin
Oregon governor declares drought emergency in Klamath Basin
Tensions rise in water battle along Oregon-California line
Klamath drought will hurt already endangered fish

Camping to Open at Detroit Lake after the Fires

Boaters head out on Detroit Lake in this file photo, taken before the Santiam Canyon wildfires. LC- The Oregonian

Although the Santiam Canyon wildfires burned more than 400,000 acres with the loss of homes, towns and much natural landscape, only about 40 acres of recreational areas were damaged at Detroit Lake. Minor repairs to the campground have been completed and campsites are available for reservations. Click the photo for more information

Keep an Eye on that Fishing Gear!

The Deschutes County Sheriff's office reports 7 cases of stolen fishing gear from Crane Prairie and Wickiup Reservoirs recently. In one case, an estimated $15,000 worth of gear was stolen from the back of a truck. You read it correctly--$15,000 worth! Click photo to get the details.

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Drought Impacts to Lake Abert and Upper Klamath Lake-Spring 2021

Contributed by Ron Larson, OLA Board Member

With much of southcentral Oregon classified as being in extreme or severe drought and the snowpack being below normal, it should be no surprise that regional stream flows and lake levels are being impacted. This is especially true for Lake Abert in Lake County and Upper Klamath Lake in Klamath County. This is a brief report on current conditions in these important lakes.

Lake Abert

Lake Abert, Oregon's sixth largest lake when filled, is especially low and is likely to be lower than when it was nearly dry in the summer of 2014. Since 1995, the lake has experienced a few wet years, such as around the year 2000 when water levels increased, but years of low precipitation have dominated and the trend has been progressively downward (Fig. 1, graph of water levels and Fig. 2, comparison photo).

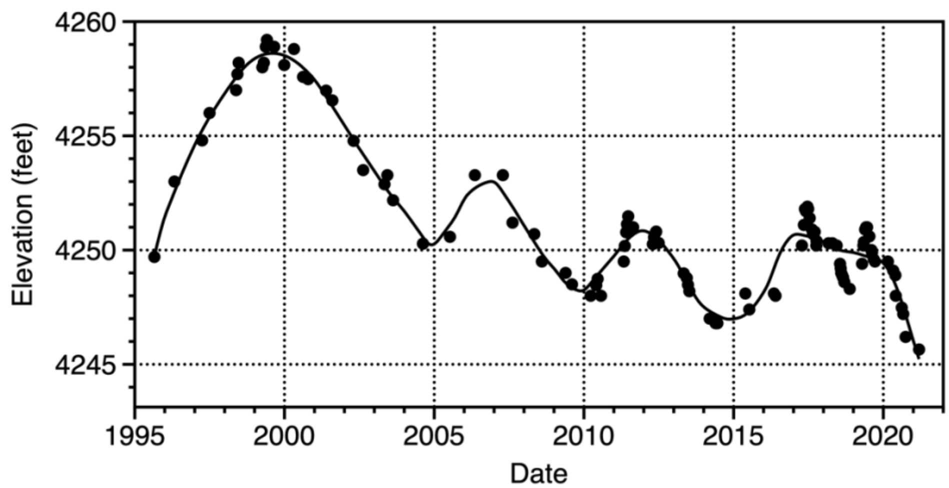

Fig. 1 Lake Abert elevations 1995-2021 based on readings of a gage in the lake. Note how water levels, although fluctuating, are showing a distinct downward trend. Water levels were lower than shown here in the summer of 2014 but were too low to measure because the water was nearly a mile away

Fig. 2 Comparison of the south end of Lake Abert on 8-9-2019 and 3-12-2021 showing how the lake has receded (Ron Larson photos).

A recent Landsat satellite image of the lake shows just how low it is (Fig. 3, satellite image). Partly, this is due to low flows in the Chewaucan River, the lake's only substantial water source. Table 1 shows how recent flows compare with those measured since 2014 on the same date. Flows in the river are now the lowest in recent years and are much below normal for this time of year, which normally experiences high flows as a result of melting snow in the upper reaches of its drainage. What this likely means for Lake Abert is very high salinities and loss of habitat and food for migrating waterbirds this summer. Normally the lake supports tens of thousands of avocets, stilts, sandpipers, and other shorebirds that come to the lake to feed on the abundant brine shrimp and alkali flies. Lake Abert is one of just a few saline lakes in the western US that supports large numbers of birds in summer. However, the salinity is likely to be too high this year for brine shrimp and alkali flies, so there is unlikely to be food for these birds.

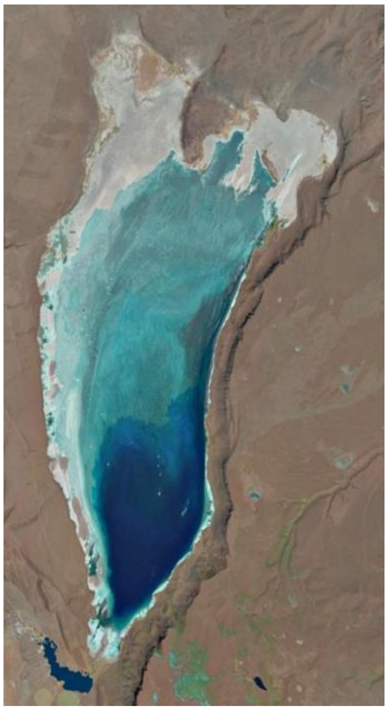

Fig. 3 Landsat 8 image of Lake Abert, 4-6-2021 (source: USGS Landsatlook viewer). The darkest blue area is the lake. The other blue areas are wet and damp mud resulting from winter storm surges that piled water onto the north end.

Table 1. Chewaucan River flows (Paisley gage) on April 6 of water years 2014 through 2021. The water year begins on October 1.

Water Year	2014	2015	2016	2017	2018	2019	2020	2021
Cumulative Flow (1000 acre feet)	33.52	42.98	43.96	107.58	28.37	34.60	21.65	16.07

Upper Klamath Lake

Upper Klamath Lake, Oregon's largest lake (Fig. 4, landscape image), while not nearly as low as Lake Abert, is still abnormally low for this time of year. In spring, the lake should be getting close to being full, but flows in its source rivers, the Sprague, Williamson and Wood, are much below normal owing to a small snowpack and continued drought (Fig. 5, graph of Williamson River discharges). Similar to Lake Abert, Upper Klamath Lake is environmentally critical. It provides spawning and rearing habitat for two endangered suckers, the Lost River and shortnose, that live in the lake, and it delivers much of the water for threatened coho salmon that rear downstream in the Klamath River. Furthermore, the lake is the main source of water for irrigated agriculture, an important economic driver in the Klamath Basin.

Upper Klamath Lake and the Klamath River have both experienced adverse water quality resulting from poor land management and other factors. Harmful blooms of cyanobacteria in the lake (Fig. 6) and in downstream hydropower reservoirs cause water quality problems and some cyanobacteria such as *Microcystis* produce toxins. A shortage of water this summer will likely exacerbate environmental and economic problems.

Fig. 4 Upper Klamath Lake from Modoc Rim with Mt McLoughlin prominent in the distance, 6-10-2019 (Ron Larson photo).

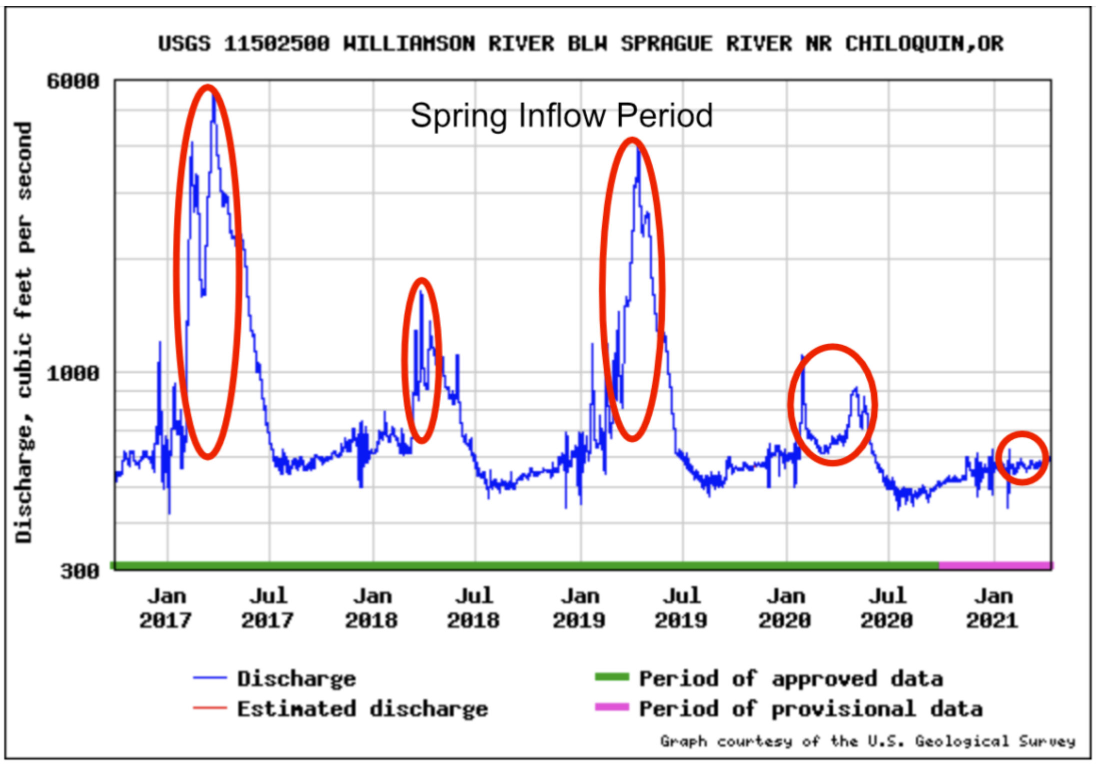

Fig. 5 Graph of Williamson River discharge below Chiloquin, October 2018-April 2021. The period of spring peak discharge is circled in red. In the spring of 2017 and 2019, inflows were quite high. In 2020 and so far in 2021, inflows are quite low. Source https://nwis.waterdata.usgs.gov/

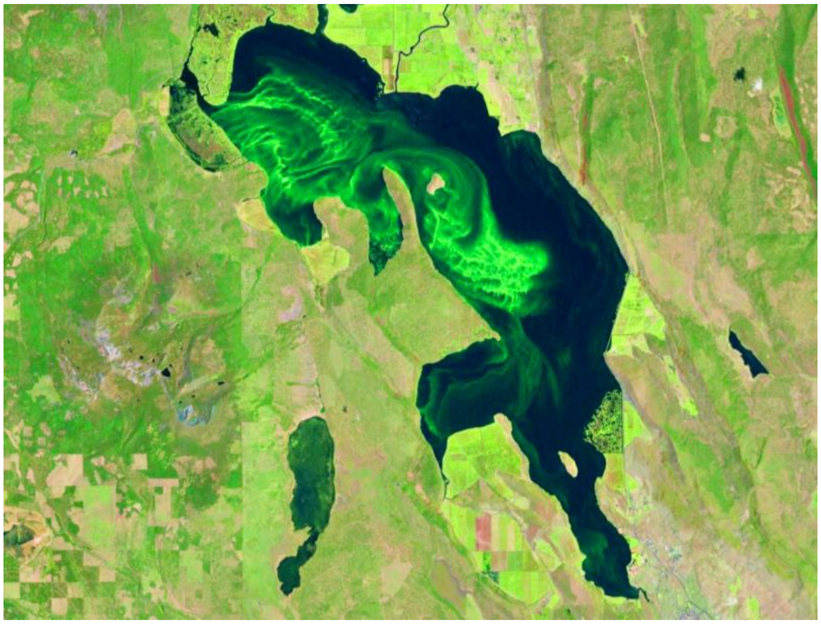

Fig. 6 A Landsat satellite view of Upper Klamath Lake showing a large cyanobacterial bloom (7-10-1989). Blooms like this occur regularly during the summer.

Great efforts continue to be made to improve conditions in Upper Klamath Lake and in the Klamath River and to recover the imperiled fishes, especially by Indian tribes that view these water bodies as sacred. Some progress is being made through habitat restoration and removing sources of pollution. For example, the four hydropower dams are slated to be removed in 2023, but much more needs to be done, especially in regards to improving water quality.

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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 at **http://www.oregonlakes.org**.

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.