Oregon Lakes Association 2016 Annual Conference: *From lakes and reservoirs to vernal pools and oxbows*

Columbia Gorge Discovery Center & Museum, The Dalles, Oregon, October 14-16

Conference Agenda at a Glance

Friday October 14th
3:00 – 6:00 pm. **Petroglyph Tour.**
7:00 – 8:30 pm. **Science on Tap:** Fisheries Biologist and photographer **Mary Edwards** will present ***"Below the Liquid Line – The Wet Side of a Dry Story"***. Free event at Spooky's Pizza

Saturday October 15th
7:30 – 8:30 am. **Registration and continental breakfast**
8:30 – 8:40 am. **Conference welcome**, Paul Robertson, Oregon Lakes Association President
8:40 – 9:30 am. **Plenary presentation**, Bob Spateholts, senior aquatic biologist for Portland General Electric's Pelton Round Butte Hydro project.
9:30 - 10:10 am. **Session 1: Mapping, Imagery, and Water Quality Monitoring**
10:10 - 10:30 am. **Poster Session and Information Booth Break**
10:30 – 12:10 am. **Session 2: Cyanobacterial Ecology and Genetics**
12:10 – 1:30 pm. **Lunch break and raffle**
1:30 – 3:10 pm. **Session 3: Lake Ecology**
3:10 – 3:20 pm. **Break**
3:20 – 4:40 pm. **Session 4: Lake and Reservoir Management**

Sunday October 16th
11:00 am. **Tour of The Dalles Dam**.

About the Petroglyph Tour. Join us for an afternoon hiking through ancient history of the Columbia River basin. We will meet at the Columbia Gorge Discovery Center & Museum, 5000 Discovery Way, The Dalles at 3 pm for carpooling across the river to the site. From there we will go on a guided 1/2 mile and approximately 1 1/2 hour hike. Dress appropriately with hiking shoes and layered clothing. As a bonus, there may be an opportunity to view some kolk ponds formed in the basalt bedrock from raging Missoula floodwaters. Parking fees onsite included for carpoolers.

About Science on Tap: Nez Perce Tribe Fisheries Biologist and photographer **Mary Edwards** (maryedwardsphotography.com) will present ***"Below the Liquid Line – The Wet Side of a Dry Story"*** in which she will emphasize the importance of using images to help tell scientific stories, whether in the field of fisheries, applied sciences or other technical fields. The free public event will be held at Spooky's Pizza, 3320 West 6th Street in The Dalles. Donations to the OLA Scholarship fund will be encouraged. Oregon Lakes Association Board members will be on hand to talk about the organization and scholarship fund.

About the Plenary Presentation. Bob Spateholts will talk about balancing water quality, fish passage, recreation and hydropower production on the Deschutes River. Bob is the Senior Aquatic Biologist at the Pelton Round Butte Project, has worked for PGE for 11 years and was previously employed by Warm Springs Tribes, Utah Wildlife Resources and Cornell University. He is certified as a fisheries professional by the American Fisheries Society, and received a Master's Degree from Idaho State University.

About The Dalles Dam Tour: Meet at The Dalles Dam at 11:00 am with the tour starting at 11:30 and lasting for approximately an hour. Transportation to the dam is not included.

Technical Session Agenda

Plenary 8:40-9:30	The Pelton Round Butte Project- balancing water quality, fish passage, recreation and hydropower production on the Deschutes River	Bob Spateholts, Portland General Electric Company
Session 1:		
9:30-9:50	Using satellite imagery for a preliminary water quality investigation of ponded features with limited connectivity to the lower Columbia River reservoirs	Daniel Turner, US Army Corps of Engineers
10:10-10:10	Monitoring and mapping off-channel water quality in the Willamette River, Oregon	Norman Buccola, Stewart Rounds, Cassandra Smith, Joseph Mangano, Chauncey Anderson, Krista Jones, and Rose Wallick, U.S. Geological Survey
10:10-10:30	**Poster and Information Booth Break**	
Session 2:		
10:30-10:50	How 5-day weather patterns and buoyancy regulation impact algal community assemblage	Roberta Brunkalla, and John Rueter. Portland State University
10:50-11:10	Understanding the links between cyanobacteria physiology and hydrodynamics may help find adaption strategies for toxic blooms.	John Rueter. Portland State University
11:10-11:30	Annie, Fannie, Mike, … and Torry - Rethinking sources of algal toxins to include benthic species	Kurt Carpenter, U.S. Geological Survey Oregon Water Science Center
11:30-11:50	Whole genome analyses of Anabaena-related bloom-forming cyanobacteria	Theo Dreher, Oregon State University
11:50-12:10	What's in the Lake? Management implications for using visible remote sensing to sort things out	Joseph Ortiz, Kent State University
12:10-12:15	The Oregon Lakes Association Scholarship Award	Wayne Carmichael, Oregon Lakes Association
12:15-13:30	**Lunch Break**	
Session 3:		
13:30-13:50	Research overview of the cyanobHAB plague at Willow Creek Reservoir	Frank M. Wilhelm. University of Idaho,
13:50-14:10	Estimation of Within-Lake Regenerated Nutrients Using Two Methods	Sarah H. Burnet and Frank M. Wilhelm. University of Idaho,
14:10-14:30	Monitoring and mapping dynamic cyanobacteria blooms in Willow Creek Reservoir, Heppner, OR	Casie Smith, U.S. Geological Survey
14:30-14:50	Recovery of zooplankton communities following whole-lake disturbance	Brian McGann, and Angela Strecker, Portland State University
14:50-15:10	Environmental DNA (eDNA) detection of aquatic plant species in freshwater ecosystems	Crysta A. Gantz(1), Mark A. Renshaw(2), Daniel M. Erickson(3), David M. Lodge(4), Scott P. Egan(5). [1]Portland State University, School of the Environment, Strecker Lab, [2]Hawaii Pacific University, [3]University of Notre Dame, [4]Cornell University, [5]Rice University
15:10-15:20	**Break**	
Session 4:		
15:20-15:40	Examining responses of reservoir conditions and food webs following deep drawdowns in Fall Creek Reservoir	Sherri Johnson, Christina Murphy, Ivan Arismendi, USFS PNW Research Station and Department of Fisheries and Wildlife, Oregon State University
15:40-16:00	Does Science Matter When It Comes to Lake Management? A Case Study from Lake Abert, Oregon	Joseph Eilers, MaxDepth Aquatics, Inc.
16:00-16:20	Using wetland water to disrupt Cyanobacteria buoyancy control: a mesocosm study	Arick "Kit" Rouhe, Portland State University
16:20-16:40	Reservoir Management of the U.S. Army Corps of Engineers' Dams in the Lower Columbia and Lower Snake Rivers: Balancing Water Quality and Fish Passage.	Tina Lundell. U.S. Army Corps of Engineers – Portland District
Posters and Information Booths		
	The Oregon Lake Watch Program	Rich Miller and Angela Strecker, Portland State University
	Aquatic and riparian invasive plants in Mid-Columbia River reservoirs	Rich Miller and Mark Sytsma, Portland State University

Presentation Abstracts

The Pelton Round Butte Project- balancing water quality, fish passage, recreation and hydropower production on the Deschutes River. Bob Spateholts, Senior Aquatic Biologist, Portland General Electric Company. robert.spateholts@pgn.com

The Pelton Round Butte Project includes a series of three dams and reservoirs constructed on the Deschutes River in Central Oregon between 1956 and 1954. Portland General Electric Company and the Confederated tribes of the Warm Springs Reservation of Oregon are co-owners under a new license issued by the Federal Energy Regulatory Commission in 2005. Lake Billy Chinook and Lake Simtustus are productive reservoirs which provide significant recreational opportunities. The project operates run- of -the river, with daily peaking generation at Round Butte and Pelton with a Reregulating Dam and reservoir that maintain steady flows in the lower Deschutes Reservoir. In 2009, a selective water withdrawal (SWW) was constructed on the penstock at Round Butte Dam. The SWW has surface and bottom intakes which can be selectively blended to allow management of water temperature and water quality. State of the art fish passage facilites on the SWW allow reintroduction of salmon and steelhead into 300 miles of historic upstream habitat. We conduct extensive monitoring of water quality and fish populations in the tributaries, reservoirs and the lower river to evaluate project success. We continually work with regulatory agencies, stakeholders and the public to balance objectives of power production, water quality standards, fish passage and recreation.

Using satellite imagery for a preliminary water quality investigation of ponded features with limited connectivity to the lower Columbia River. Daniel Turner, US Army Corps of Engineers, Portland District. daniel.f.turner@usace.army.mil

Bonneville, The Dalles and John Day Dams form large, linear reservoirs along the lower Columbia River. At the edges of these reservoirs are many smaller, secondary impoundments with limited hydrologic connectivity to the main reservoir. These features are not regularly monitored for water quality. The Landsat 8 satellite data provides the opportunity for a preliminary investigation of waterbodies greater than 8100 m^2 (2.0 acres). I evaluated 78 secondary impoundments which included flooded tributary mouths, ponds, side channels and coves cut-off by railroad beds or highways. The evaluation is based on the visual interpretation of the true color images created from the Landsat 8 satellite between April 2013 and August 2016. Clouds, haze and wind can degrade the image quality. Approximately half of the area has a sampling rate of 16 days (average of 24 usable images), while the remainder has a rate of 8 days (average of 52 usable images). For each usable image, secondary impoundments were categorized based on whether there was (1) no evidence of a water quality issue or similar condition to main channel, (2) the likelihood of an algae bloom, or (3) the likelihood of greater inorganic suspended sediment concentration than the main channel. This information can be used to rank the secondary impoundments for follow up monitoring for potential Harmful Algae Blooms and dissolved oxygen / pH. The secondary impoundments can have different water quality conditions to the main reservoir due to longer residence times, shallower bathymetry and local sources of nutrients.

Monitoring and mapping off-channel water quality in the Willamette River, Oregon. Norman Buccola, Stewart Rounds, Cassandra Smith, Joseph Mangano, Chauncey Anderson, Krista Jones, and Rose Wallic, US Geological Survey. nbuccola@usgs.gov.

The floodplain of the Willamette River in northwestern Oregon includes remnant slower-moving sloughs, side-channels, and alcoves that provide rearing habitat and potential cool-water sources for native cold-water fish species, such as the federally threatened Chinook salmon. The mapping and characterization of the hydraulics and water sources of these off-channel areas is the first step toward protecting and restoring these resources for future generations. A primary focus of this study is to determine how flow management can increase the effectiveness of these off-channel areas, especially during summer low-flow periods when water temperatures in the main channel regularly exceed lethal temperatures for salmonids. The U.S. Geological Survey, in cooperation with U.S. Army Corps of Engineers and Oregon State University, has been measuring the diversity of off-channel water quality in the Willamette River under a variety of water levels in summer 2015-16. About 30 diverse off-channel sites within the Willamette floodplain are being monitored and compared with conditions in the main channel. Hourly water temperature, conductivity, and dissolved oxygen (DO) data are being collected at a subset of these sites. Some deep off-channel pools have substantial, consistent cool-water inflows that can dominate locally, allowing them to function as cold-water refuges for salmonids at varying mainstem Willamette flows. Other sloughs have varying characteristics due to intermittent connections to the main channel, depending on river levels. A vibrant community of algae and aquatic macrophytes often coincide with thick layers of fine sediment or organic detritus near the bed, coinciding with low DO zones (<5 mg/L) in many slower-moving off-channel areas. We propose some preliminary hydro-geomorphic categories to better explain cool inflows as sourced from regional groundwater aquifers or localized subsurface river features.

How 5-day weather patterns and buoyancy regulation impact algal community assemblage. Roberta Brunkalla and John Rueter, Portland State University. broberta@pdx.edu. ***Student Presentation.***

The purpose of this study is to model how 5-day weather patterns and algal buoyancy regulation influence the competition between two bloom forming cyanobacteria species in Upper Klamath Lake, Oregon. Sudden changes in weather patterns can quickly impact lake thermal structure, which can rapidly influence the competition between buoyancy regulating cyanobacteria. By modeling competition, I hope to address how altered climate would shift the competitive advantage to toxin forming cyanobacteria. I plan on accomplishing this by coupling a one-dimensional hydrodynamic and algal competition model, with lake specific physiological parameters. A sensitivity test of the model could reveal dramatic shifts in algal competition under future climate change scenarios, which could have implications in how Upper Klamath Lake is managed and how restoration efforts are implemented.

Understanding the links between cyanobacteria physiology and hydrodynamics may help find adaption strategies for toxic blooms. John Rueter, Portland State University, Environmental Science and Managment Program. rueterj@pdx.edu

Even though we are managing lakes to decrease algal blooms overall, harmful algal blooms seem to be showing up more and more frequently. Although the word "blooms" connotes dominance and rapid growth, dangerous accumulations of cyanobacteria can occur because of combinations of physiological advantages and particular weather and hydrodynamic conditions. I am particularly interested in specific conditions that might favor Aphanizomenon versus those that might favor Microcystis in Upper Klamath and Agency Lakes. Aphanizomenon is a nuisance and large blooms can lead to oxygen depletion and fish deaths. Microcystis can both be a nuisance and is toxic. The comparison of the physiologies of these two cyanobacterial strains could lead to an understanding of both short term adaptation and mitigation tactics as well as long term lake restoration strategies. Ideally, we would like to employ lake restoration strategies and see constant improvement leading to safer and cleaner water. However, either because of threshold effects or ineffective lake management approaches, we might have to take short-term manipulations that can reduce local accumulations of cyanobacteria to protect the health of humans and other species. These short term tactics must have three characteristics: First, we need to find mitigation techniques that might knock down or stall a bloom of algae from occurring. Second, we have to have ways to model and monitor these manipulations over relevant time and space scales. Third, any short-term techniques we employ should not substantial interfere with the long term goals of lake restoration, i.e. the quick fix shouldn't undermine the solving the problem. I will present several potential short-term solutions based algal physiology and hydrodynamics. Then I will describe how we have used temperature datalogging (10 minute intervals) and high-resolution transects (1 meter spatial resolution) to understand impacts on accumulation processes. Then finally, I will describe a framework for supporting fast and cheap methods to adapt to cyanobacteria accumulations that don't result in unintended consequences or interfere with lake restoration efforts.

Annie, Fannie, Mike, ... and Torry - Rethinking sources of algal toxins to include benthic species. Kurt Carpenter, Hydrologist, US Geological Survey Oregon Water Science Center, Portland, Oregon. kdcar@usgs.gov

Harmful algal blooms in Oregon affect numerous lakes and reservoirs, but benthic algae (periphyton) may also produce cyanotoxins (hepatatoxins and neurotoxins) such as microcystins, cylindrospermopsin, anatoxin-a, and saxitoxin, and could be an underappreciated source of these compounds. Detection of anatoxin-a at a drinking water intake in the lower Clackamas River in August 2015 suggests that cyanotoxins may originate from benthic sources. There is also evidence suggesting benthic blue-green algae may have contributed to dog deaths reported on the South Umpqua and other affected rivers. Surveys for benthic blue-green algae during summer 2016 turned up Nostoc, Oscillatoria, Spirulina, Wollea, Anabaena, and others. Preliminary results of cyanotoxin analyses from rivers, streams, lakes, and reservoirs using enzyme-linked immunosorbent analysis (ELISA) will be presented and discussed.

Whole genome analyses of Anabaena-related bloom-forming cyanobacteria. Theo Dreher, Oregon State University. theo.dreher@oregonstate.edu

We have determined complete or near-complete genomes from a number of N-fixing filamentous cyanobacteria from Pacific NW lakes that are commonly classified into the *Anabaena*, *Dolichospermum* or *Aphanizomenon* genera. Bloom-forming strains group together with strains from multiple continents to form a discrete cluster of related cyanobacteria among the wide genetic variation represented by Nostocales (filamentous and N-fixing) cyanobacteria. Within this group, there is a sporadic presence of toxin and taste-and-odor biosynthetic genes. Our results demonstrate how genomic approaches can reveal the presence or absence of key genes for the biosynthesis of cyanotoxins or taste-and-odor compounds, providing information that can be help manage the problems presented by these compounds.

Whats in the Lake? Management implications for using visible remote sensing to sort things out. Dr. Joseph Ortiz, Kent State University. jortiz@kent.edu

Dr. Joseph Ortiz at Kent State University, (Oregon Stat Univ. Ph.D., Oceanography, 1995) will discuss the use of visible remote sensing to differentiate algae from cyanobacteria using visible remote sensing and field radiometers. The method can be applied to a variety of types of satellites or using measurements from field instruments (spectroradiometers) or lab (spectrophotometers). The optical technique is rapid and can be validated against cell count data or pigment measurements, adding an additional tool for likewise management.

Research overview of the cyanobHAB plague at Willow Creek Reservoir. Wilhelm, Frank, M., Burnet, S. H., Rajkovich, H. E., Harris, T. D., and C. J. Adams. University of Idaho. fwilhelm@uidaho.edu

Willow Creek Reservoir, a small US Army Corps of Engineers Reservoir on Willow Creek in northeastern Oregon, was primarily built for flood protection but also offers recreational opportunities given it is the only reservoir in a 60 mile radius. However, most summers the reservoir is plagued by blooms of toxic cyanobacteria which result in no contact advisories upwards of 100 days in some years. Personnel at the University of Idaho Limnology Laboratory have conducted research at the reservoir, inflow streams and in the watershed to construct a detailed mass-balance of sediment and nutrients, determine seasonal patterns of algal, and zooplankton dynamics, and experimentally examine methods to remediate the cyanobacteria blooms. In this presentation we provide highlights of this ongoing research.

Monitoring and mapping dynamic cyanobacteria blooms in Willow Creek Reservoir, Heppner, OR. Casie Smith (Ecologist) US Geological Survey. cassandrasmith@usgs.gov

The U.S. Geological Survey and U.S. Army Corps of Engineers are investigating the spatial and temporal dynamics of blue-green algae (cyanobacteria) blooms in Willow Creek Reservoir in north-central Oregon. We have used a combination of visual devices and water-quality monitoring equipment to assess the frequency and duration of blooms and their effects on water quality. We used an automated camera to capture images of the northwest corner of the reservoir, where blooms tend to accumulate due to the prevailing summer winds, collecting images every 15 minutes during daylight hours. In 2015, we deployed a water-quality monitor in the northwest corner of the reservoir to continuously measure water temperature, pH, dissolved oxygen, specific conductance, turbidity, total chlorophyll, and the blue-green algae pigment phycocyanin. In 2016, we used a water-quality monitor and collected measurements along tracks throughout the reservoir to create spatial maps of water-quality. We repeated the spatially integrated mapping process on three different days under varying bloom conditions. Also in 2016, we worked to establish a telemetry connection making the reservoir images available in near-real time to resource managers.

Results from 2015 indicate that surface accumulations of a cyanobacteria bloom can form and dissipate within minutes in the reservoir, and that there were substantial changes to water quality during a bloom. Through the efforts in 2016, we learned that having telemetered images from remotes sites can be difficult, but is possible. In this presentation, I will discuss the water quality time-series data, mapping results, management implication, and the potential for these monitoring techniques to be used in other remote water bodies.

Recovery of Zooplankton communities following whole-lake disturbance. Brian McGann and Angela Strecker, Portland State University, Environmental Science and Management, Center for Lakes and Reservoirs. bmcgann@pdx.edu. ***Student presentation***

Community assembly following disturbance, is a key process in determining the composition and functioning of the future community. However, replicated studies of community assembly at whole ecosystem scales are rare. Here, we describe a series of whole-lake experiments in which the recovery of zooplankton communities are tracked following an ecosystem-scale disturbance. Fourteen lakes in eastern Washington were chosen for study: seven lakes were treated with rotenone, while the remaining seven were controls. Each lake was monitored six months before and one year after the rotenone treatments. Recovery was assessed as no significant difference between treatment and control in zooplankton communities. Zooplankton tows were taken monthly, at a middle, deep, and shallow site in each lake, and were later enumerated and identified. Preliminary data analysis shows a steep decline in the abundance and diversity of the zooplankton community post-treatment, and varying recovery times between lakes. Lake bathymetry and surrounding geology are predicted to be major factors in determining the rate of recovery. This study will help determine the importance of abiotic and biotic factors to the recovery of zooplankton.

Environmental DNA (eDNA) detection of aquatic plant species in freshwater ecosystem., Crysta A. Gantz(1), Mark A. Renshaw(2), Daniel M. Erickson(3), David M. Lodge(4), Scott P. Egan(5). (1)Portland State University, School of the Environment, Strecker Lab, (2)Hawaii Pacific University, (3)University of Notre Dame, (4)Cornell University, (5)Rice University. cgantz@pdx.edu ***Student presentation***.

Aquatic invasive plant species cause negative impacts to economies and ecosystems worldwide. Traditional survey methods, while necessary, do not always result in timely detections of aquatic invaders, which can be cryptic, difficult to identify, and with very rapid growth and reproduction rates. Environmental DNA (eDNA) is a new, but proven method which is used to find multiple types of animals in freshwater and marine ecosystems through DNA shed from the organism into the water column or sediment. Few studies have examined whether eDNA is an effective surveillance tool for aquatic plants. We designed a high sensitivity quantitative PCR (qPCR) assay to detect the aquatic invasive species Hydrilla verticillata in freshwaters across several U.S. geographic regions. Additionally, we designed mesocosm experiments with Elodea species to determine the ability to detect accumulation and degradation of the DNA signal for aquatic plants. Information about eDNA detection for aquatic plants will strengthen efforts for early detection and rapid response of invaders in local freshwater ecosystems. eDNA collection is a method that is highly amenable to collection by citizen scientists. Additional work by the author at Portland State University will focus on training citizen scientists, including teachers and volunteers, to collect water samples for later laboratory processing and screening of eDNA. Training of undergraduate students for part of the laboratory process is also a future goal. Target non-native species for these efforts include rusty crayfish, Hydrilla, Asian peaclam and Brazilian elodea.

Examining responses of reservoir conditions and food webs following deep drawdowns in Fall Creek Reservoir. Sherri Johnson, Christina Murphy and Ivan Arismendi. USFS PNW Research Station and Department of Fisheries and Wildlife, Oregon State University, USFS Pacific Northwest Research Station. sherrijohnson@fs.fed.us

To improve passage of juvenile Chinook Salmon through dams, USACE has begun to draw down Fall Creek Reservoir to streambed levels for short periods during late fall/ early winter. We began examining the physical, chemical and biological responses to repeated, extended drawdown in Fall Creek Reservoir in 2013. We also are studying similar limnological and food web parameters in two additional reservoirs, in order to have metrics of reference conditions without the deep drawdown. We hypothesized that deep drawdown would lead to export of nutrients and taxa (both native and introduced fishes) downstream, triggering potential cascading effects for reservoir food web and productivity the following seasons. The export of both native and introduced fishes could alleviate predation upon juvenile salmonids, but changes in suspended sediment, nutrient availability, primary production, and zooplankton composition could modify the quality of reservoir habitat and food resources for juvenile salmonids as well.

After deep drawdown and spring refilling of the Fall Creek Reservoir, we observed reduced light transmission through the water column and shallow thermocline, likely related to resuspension of bed sediments as the reservoir refills. Zooplankton species abundances, such as Daphnia, show unusual bimodal distribution in the water column and reduced densities during mid-summer in Fall Creek Reservoir in comparison with Hills Creek and Lookout Point Reservoirs. To compare similarities and differences in trophic relationships (e.g., dietary overlap and piscivory) among reservoirs, we analyzed stable isotopes ratios of nitrogen and carbon from each reservoir's food web (primary producers, macroinvertebrates, zooplankton, and fishes). We observed that Largemouth Bass and Rainbow Trout were surprisingly feeding as zooplanktivores in Fall Creek Reservoir. This could have potential implications for availability of zooplankton prey at key periods for Chinook Salmon growth in the reservoirs. We also note shifting fish community composition in Fall Creek Reservoir following repeated deep drawdowns.

Does Science Matter When It Comes to Lake Management? A Case Study from Lake Abert, Oregon. Joseph Eilers, MaxDepth Aquatics, Inc., Bend, OR. j.eilers@maxdepthaq.com

Lake Abert is a large terminal lake in southern Oregon that used to serve as a major feeding site for large numbers of migratory birds. The birds were attracted by immense populations of brine shrimp and shoreflies that proliferated in the saline waters. However, in the last two decades there has been an increased use of water from the Chewaucan River drainage depriving the lake of freshwater. This has caused an increase in lake salinity and a dramatic reduction in invertebrates which previously supported abundant bird life. Although state and federal agencies have maintained that the cause of the lake desiccation is drought, independent analyses have shown that the reductions in freshwater inputs have been exacerbated by incremental anthropogenic withdrawals for agricultural use and wildlife enhancement projects. The presentation will review actions/inactions of various organizations and the role of science in affecting management of this lake.

Using wetland water to disrupt Cyanobacteria buoyancy control: a mesocosm study. Arick "Kit" Rouhe, Portland State University. arouhe@pdx.edu

Cyanobacteria taxa use unique characteristics to dominate lake and reservoir systems, forming blooms. Key characteristics include superior growth in low light, nitrogen fixation, the ability to grow at low TN/TP ratios, clumping to avoid grazing, low nutrient content to avoid grazing, storage of phosphate, and controlling floating and sinking. Most management and mitigation techniques involve reducing and/or manipulating nutrients to create conditions that favor other algal taxa. The research presented here focuses finding or creating conditions that reduce the advantage of floating and sinking for buoyant taxa of Cyanobacteria. Previous studies by our research group, using small volume (70ml) microcosms, showed that mixing wetland water with lake water disrupts buoyancy control by *Aphanizomenon flos-aquae* in Upper Klamath Lake, Oregon. The study presented here contains the results of our experiments in which wetland water and lake water were mixed with *A. flos-aquae* in larger volumes (35-100 gallons) using in-lake and beside-lake mesocosms. Wetland treatment levels in each replicate vary from 0% up to 33% with each treatment lasting for 3 days (72 h). Treatment groups were compared using an external pressure test (which indicates the level cellular turgor pressure), light levels/extinction rate, nutrients, ion concentrations, and water chemistry parameters pH, conductivity, and temperature. Our research goal is to determine an effective dose of wetland water that will disrupt buoyancy control by *A.flos-aquae* rafts in Upper Klamath Lake in order to diminish blooms and lower surface accumulation. Our effective dose can then be managed using wetland water input and measured using in-lake transects to map the effective dose throughout the lake.

Reservoir Management of the U.S. Army Corps of Engineers' Dams in the Lower Columbia and Lower Snake Rivers: Balancing Water Quality and Fish Passage. Tina Lundell, US Army Corps of Engineers, Portland District. tina.m.lundell@usace.army.mil

Reservoir management for water quality issues, specifically Total Dissolved Gas (TDG) saturation, and fish passage operations at the Lower Columbia and Lower Snake River reservoirs is a balancing act. The review of real-time project operations for fish passage and the subsequent water quality data can result in a potential struggle to meet both the Endangered Species Act (ESA) and the Clean Water Act (CWA).

The Action Agencies annually develop a Fish Operations Plan (FOP) that provides detailed information on the implementation of the Biological Opinion (BiOp) spill operations for juvenile downstream fish passage. Since spring and summer fish passage operations include discharging outflow through the spillway, the saturation of total dissolved gas increases in the tailwater as this higher head flow entrains more gas. These gas levels may be close to or higher than the State of Oregon and Washington Water Quality Standards at times. However, as a result of the TDG gas abatement studies, several structural and operational improvements have been made over the last couple of decades to improve both juvenile downstream fish passage and water quality conditions.

The Corps provides the State of Oregon and Washington an annual report on the success of meeting these State Water Quality Standards throughout the fish passage operations. The Corps, the CWA, and the ESA have the common goal of improving water quality conditions and fish survival in the Lower Columbia and Lower Snake Rivers.

The Oregon Lake Watch Program. Rich Miller and Angela Strecker, Center for Lakes and Reservoirs, Portland State University. richm@pdx.edu ***Poster Presentation***

Aquatic invasive plants and animals pose a significant threat to the native species, water quality, and economic well-being of our lakes and reservoirs as well as the communities dependent on these waterbodies. The Oregon Lake Watch (OLW) volunteer monitoring program was developed to detect aquatic invasive species early while their spread and impacts can be minimized, track long term changes in water quality, and foster the appreciation of our lakes and reservoirs. During the four years in which the OLW has been in operation a total of 59 volunteers have been trained to survey for and identify 9 high priority invasive animals and 14 invasive plant species. Volunteers were also trained to monitor water transparency and water temperature. Volunteers have monitored 38 different lakes and have detected several invasive species including submerged and emergent aquatic plants, freshwater clams, and crayfish.

Aquatic and riparian invasive plants in Mid-Columbia River reservoirs. Rich Miller and Mark Sytsma, Center for Lakes and Reservoirs, Portland State University. richm@pdx.edu ***Poster Presentation***

Hydroelectric dams have significantly altered aquatic habitats in the Columbia River. Operations have resulted in slower velocities, longer residence times, more stable water levels, and warmer temperatures. These physical changes have resulted in extensive habitat suitable for growing submerged and emergent aquatic vegetation including many non-native species. Field surveys of the the John Day and McNary pools conducted from 2014 through 2016 indicate that several non-native species dominate the species assemblage including false indigo (*Amorpha fruticosa*) along riparian habitats and Eurasian watermilfoil (*Myriophyllum spicatum*) in shallow water habitats. Management of these long-established populations in extremely challenging. The highly invasive, habitat-altering species flowering rush (*Butomus umbellatus*) has just begun to invade the Mid-Columbia. Early detection and coordination among stakeholders has led to effective management of this newer invasion.