PORTLAND STATE UNIVERSITY

LAKE WISE

WINTER
2001

NEWSLETTER OF THE CENTER FOR LAKES AND RESERVOIRS
AND THE OREGON LAKES ASSOCIATION

Blue and Fairview Lakes

Jim Graybill
Oregon Lakes Association

Blue and Fairview Lakes are located in the eastern Portland metropolitan area, just south of the Columbia River and a mile west of the Sandy River delta. These lakes are separated from one another by a sandstone ridge that alludes to their diverse histories. Historically, both lakes were subjected to periodic scouring by the spring floods of the Columbia River and Sandy River. Dikes installed by the US Army Corps of Engineers in the 1940's stopped the occasional cleaning of the lakes. An earthen dam was built by neighbors and Multnomah Drainage District No. 1 in the late 1940's to raise the level of Fairview Lake and provide a means of storing storm water runoff from Fairview Creek.

Blue Lake and Fairview Lakes are very different even though they are only 200 feet apart. Blue Lake is filled with water that runs off of the Metro County Park on the north shore and 50 home sites on the south shore and groundwater that is pushed by hydraulic pressure of high water from the Columbia River. When the Columbia River is low, water levels in Blue Lake drop several feet. Fairview Creek collects the storm water from Gresham, Wood Village and Fairview, an area of about 6.5 square miles and empties into Fairview Lake, which drains into the eastern portion of the Columbia Slough, much of which is pumped into the Columbia River.

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2001 Lakes and Reservoirs Symposium

PSU Center for Lakes and Reservoirs

The September 2001 Oregon Lakes and Reservoirs Symposium was a big success! Approximately 70 people attended the conference hosted by the PSU Center for Lakes and Reservoirs and the Oregon Lakes Association (OLA). Attendees listened to over 6 presentations focusing on Invasive Species Management and 11 presentations on Limnology and Lake Management. During lunch, the Annual OLA Business Meeting was held and new appointments were made. Congratulations to the new OLA President Jim Graybill, President-elect Lori Campbell, and Treasurer Steve Lundt. (Thank you and farewell to the past OLA President Jim Carpenter).

After the conference, everyone gathered for an Open House and Mixer at the Center for Lakes and Reservoirs building on the PSU campus. While enjoying the food and beverages, lake projects were discussed and raffle prizes were awarded. Finally, on Saturday, a group of attendees assembled for the Metro Lake Tour. The day included a hosted tour at Smith and Bybee lakes by Elaine Stewart, manager of the wildlife refuge; a presentation, boat ride, and lunch at Blue and Fairview lakes hosted by Jim and Jane Graybill; and a boat ride and tour of the aeration system at Lake Oswego hosted by Steve Lundt.

Aspecial thanks to all presenters for a job well-done. A complete listing of the presenters and presentation abstracts can be found on the OLA website at http://www.oregonlakes.org.

Inside this issue

For more information on lakes and lake management on the web go to:

http://www.oregonlakes.org or *http://www.clr.pdx.edu*

How Many Boats Does It Take to Make a Shallow Lake Muddy?

Impacts and Influences of Sediment Re-suspension Caused by Boating on Oswego Lake

Steve Lundt, Water Resource Director, Lake Oswego Corp.

It is often suggested that motorized boats used on shallow (1-3 meter) lakes cause certain water quality problems (e.g. higher turbidity, re-suspended nutrients, aquatic plant disturbance, shoreline erosion, and decreased water clarity). As the lake manager for Oswego Lake, it was my job to convince shareholders that this does occur around the shallower areas of the Lake and to see if I could improve water quality by changing the boating activities.

During the summer of 2001, water quality samples were collected to see how much lake bottom sediments were actually being re-suspended into the water column by motor boats. The goal was to quantify boating impacts to the Lake and to make lake-use management recommendations.

What is sediment re-suspension? Sediment re-suspension occurs when bottom shear stress exceeds the critical shear stress of the sediment load. The type of bottom material, the grain size, and water content determines the critical sediment shear stress. An example, 2-3 cm/s of water movement is sufficient to re-suspend clay and silt. Sand particles require water velocities of 20 cm/s (Bloesch, 1994). The intensity of sediment re-suspension is determined by lake exposure, boating activity, wind speed, and water depth.

There have been previous studies done by Y. A. Yousef to determine how deep water is mixed with different horsepower outboard motors. It has been found that a 50 HP outboard motor can mix water as deep as 5 feet and disturb sand particles, the same outboard motor can also disturb silt particles in 10 feet of water (Yousef et al, 1978). This water mixing can not only re-suspend sediments, it can also washout roots, cut macrophytes, increase nutrients, increase phytoplankton, and increase surface water turbulence.

For Oswego Lake, the dominant recreation is boating with a 200-HP ski boat, either pulling a person or cruising around the perimeter, sightseeing. Oswego Lake's sediments are mostly silt, clay, and organic detritus. With this combination of recreation and sediment type, studies suggest that silt sediments will be re-suspended in water that is 10-12 feet deep. To see if this is accurate, Sara Peel, LOC limnology intern for summer of 2001, did a re-suspension study to measure the re-suspension settling rate in four different locations.

Oswego Lake has two 1-mile long canals rimmed with homes that are only 3-4 feet deep. These canals are heavily used by boats as waterways to the main section of the Lake. Only idle speed is allowed. There are also two small bays, West Bay is 10 acres in size and only 3-4 feet deep and Lakewood Bay is 36 acres and about 10 feet deep. Idle speed is only allowed in West Bay, but Lakewood Bay has no boating restrictions.

The method used to quantify re-suspension was to secure glass Mason jars 0.5 meters above the sediments. The "sediment traps" were anchored with a cinder block and a small plastic milk crate was used to hold four jars, two upside down and two right side up. The upside-down jars were needed to subtract the weight of the seston material (algae growth) that formed on the inside of the jars. We did not want to over estimate the mass of sediments collecting in the upright jars.

These sediment traps were then placed in the four shallow embayments and were retrieved every Monday and Friday to compare weekday and weekend data. Water samples were collected from the jars and filtered and dried. The sedimentation rate was then calculated (SR = Dry Mass/ Cross Sectional Area of Jar * Time).

Sedimentation rate varies from lake to lake. Deep, oligotrophic lakes are expected to have low rates between 0 – 10 $g/m^2/day$. Shallow, more eutrophic lakes can have a sedimentation rate between 10 – 100 $g/m^2/day$ (Evans, 1994).

The results for the four Oswego Lake embayments (Lakewood Bay, West Bay, Oswego Canal, and Blue Heron Canal) are shown in figure 1.

Notice the very high sedimentation rate. In all cases, except for Blue Heron Canal, the weekend rates were greater due to more boating activity on days that people typically do not work. Lakewood Bay was the lowest in all three categories and West Bay seemed to have the most re-suspension due to the depth and a different soil type that is more colloidal.

Other observations were documented during this study. Aquatic

Continued on next page

Oswego Continued

plants in Lakewood Bay were abundant all summer long, most likely providing some help in keeping sediments on the bottom of the Bay. Also in Lakewood Bay, the number of boats per acre were recorded for weekdays and weekends. During Lake Appreciation Week, Lakewood Bay was the host of a water ski show. Water samples were collected before and after to see how the show changed the water quality. Finally, the use of an aquatic weed harvester did increase re-suspension on the cutting days in the Canals.

The conclusion is that any prop action in West Bay and both canals re-suspends an enormous amount of lake sediments that are rich in phosphorus. For Lakewood Bay, aquatic plants seem to help keep sediments on the bottom, but the density of fast-moving boats on the Bay pose a possible safety concern.

As to the lake-use management recommendations and convincing shareholders that their boating is reducing water quality, that is an entire project in itself. Recommendations that infringe on people's freedom to boat in certain areas at certain times can be hard to swallow if they are not used to time and space zoning concepts. If we want to maximize water quality, not just on Oswego Lake but on all lakes, lake users need to realize the impacts that they are making below the water surface and try and minimize this impact with smart, educated decisions when enjoying a lake.

Figure 1

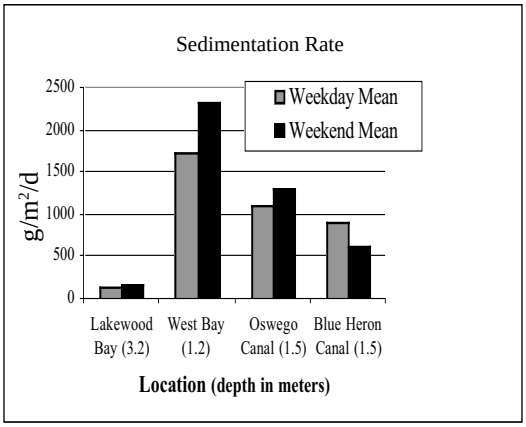
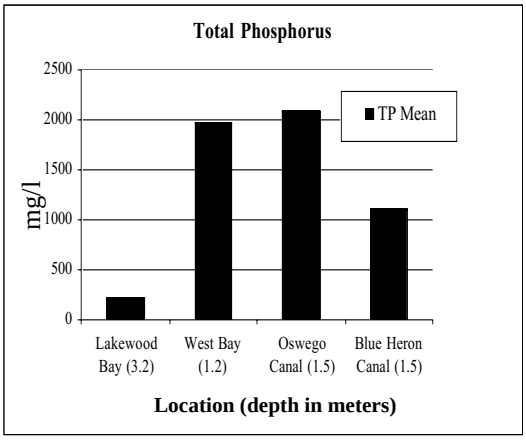


Figure 2

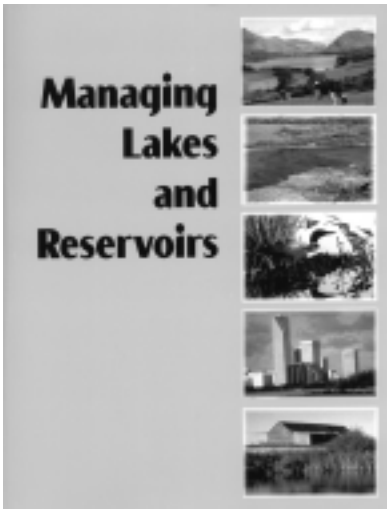


Resources

Bloesch, Jurg. 1994. A review of methods used to measure sediment re-suspension. Hydrobioligia. *284: 13-18.*

Evans, R. Douglas. 1994. Empirical evidence of the importance of sediment re-suspension in lakes. Hydrobiologia. 284: 5-12.

Yousef, Y. A. et al. 1978. Mixing effects due to boating activities in shallow lakes. U.S. Dept. of the Interior Technical Report (ESEI 78-10). Washington, D.C.



The third edition of Managing Lakes and Reservoirs is now available from NALMS. Members get a discount off the $33.95 cover price. Visit the NALMS online bookstore at www.nalms.org for more information.

Two improved websites made their debut in January. Please visit the Oregon Lakes Association website and the Center for Lakes and Reservoirs websites at:

http://www.oregonlakes.org

http://www.clr.pdx.edu

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Then and Now: The Evolution of Oregon's Lakes

John Salinas, Rogue Community College

Lakes may be too large to suspect that they are changing, but change they do. Lakes can change for many reasons and people involved in the history of lakes are documenting change in the lakes' sediments. Each year a new layer of growth is deposited on the floor of a lake and that layer indicates many physical and biological aspects of the lake for that specific year. Diamond Lake, Crater Lake (Mt. Mazama), Spirit Lake (Mt. St. Helens) and Waldo Lake are compared and shown to each be uniquely changing.

The sediments of Diamond Lake have been cored and studied by Joe Eilers working with others with support from the Umpqua National Forest. They have discovered that Diamond Lake has become more green (eutrophic) since the early 1900's when people began to work and settle in the area. This cultural development of the forest around the lake first took the shape of roads, then campgrounds, cabins, and lodges. Diamond Lake has always been a relatively rich body of water where life abounds. Deeper layers of sediment have been collected in sediment cores. These deep layers have been dated using several techniques to calculate the times of lake change. In the early 1900's rainbow trout were planted in the lake and found the lake rich and inviting. No fish were known to inhabit the lake naturally. In the late 1940's and early 1950's Diamond Lake changed dramatically as populations of the Tui Chub minnow increased quickly. These "trash fish" are commonly used as bait. Efforts to control the competing fish population lead to a poisoning of the lake in 1954. Each of these events may be seen in the sediment core. The campgrounds and lodge area were put on a sanitary sewer in the mid 1970's in hopes of reducing nutrients entering the lake. Changes in the sediments again occur about this time. Diamond Lake remains a shallow, warm summer (frozen winter), biologically rich lake.

Crater Lake resides in the collapsed volcano that was once Mt Mazama.

Joe Eilers and others have also cored several High Cascade lakes in Southern Oregon. He says that at some shallow depth (about a foot or two down) there is a layer of very dense sediment that is difficult to core. Those upper few feet of loose sediment contain all the history of these lakes since Mt. Mazama collapsed 7700 years ago. When Mount Mazama collapsed it spewed deep layers of volcanic ash over much of the Cascades and areas to the east. Today, Crater Lake, at 1943 feet is the deepest lake in the United States. It also has a rich sediment history, but the history of Crater Lake is only about 7000 years old. In this deep lake the sediments are very inorganic and graded from large blocks nearest the precipitous walls to fine sands out in the central basins. Blais and Kalff (1995). suggests that during earthquakes or rockslides, the finer material can be transported farther out in the basin than the larger material. Organic sediment is scant at Crater because of the recycling in the deep lake by bacteria.

Historically fishless, Crater Lake was planted with rainbow trout by William Steel, the person who spent his life opening the lake to visitors and finally getting it National Park Service (NPS) status in 1902. In the 1940's the NPS halted fish planting in an attempt to better protect the natural lake. But the planting of millions of fish may have altered the lake irreversibly. Today there is no "going back" either to study the lake before the annual fish plantings or to remove all the fish from this lake. Mark Bucktenica, Park Biologist at Crater Lake, is studying the healthy populations of rainbow trout and Kokanee salmon living and reproducing in Crater Lake today. No one will know exactly how the many native populations of organisms have been impacted because of the historic fish introductions.

In central Oregon the Willamette National Forest manages many lakes. Waldo Lake is the second largest natural lake in Oregon (by surface area) and was also fishless at one time. A vast majority of fish planted in Waldo Lake through the 1900's have not survived. This was the feeling when the Oregon Department of Fish and Wildlife was asked to halt fish planting (dumping of organic waste) into Waldo Lake by the Waldo Wilderness Council. In 1995 fish were not planted for the first time in many years and none have been planted since. There may have been an undocumented change in the lake with the introduction of nonnative fish into the lake. Today, with the help of the Willamette National Forest, Allan Vogel (ZP's Taxonomic Service and Chemeketa Community College) and I are documenting the change occurring in this lake as fish populations decline.

Change in lakes is natural and expected, but the increase in the number of zooplankton individuals at

Continued on next page

Garrison Lake: Recent Salinity Shanges

Mark Rosenkranz PSU Center for Lakes and Reservoirs

Garrison Lake has gone through some dramatic changes over the past ten years. From the surface the lake does not look much different. However, starting about three meters down, the lake is very unique.

Prior to 1992 outflow from the wastewater treatment plant was discharged into the lake. Accelerated eutrophication of the lake led the city to explore options for wastewater disposal. In 1991 a dune disposal system was approved and it was built in the foredune separating Garrison Lake from the ocean. The wastewater disposal system was effective in keeping approximately two million gallons per day of effluent from the lake.

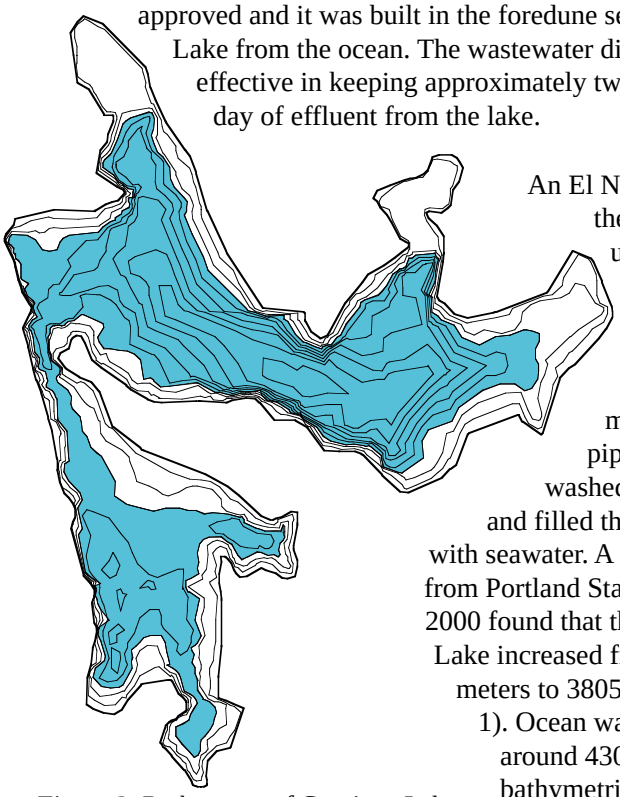

Figure 2. Bathymetry of Garrison Lake

An El Niño storm event during the winter of 1997-1998 brought unusually high seas and strong southerly winds that eroded the foredune separating Garrison Lake and the ocean. Along with washing most of the waste disposal piping out to sea, the ocean washed over the now reduced dune and filled the bottom of Garrison Lake with seawater. A study by Richard Petersen from Portland State University in September 2000 found that the conductivity of Garrison Lake increased from 6597 µS/cm at three meters to 38056 µS/cm at four meters (figure 1). Ocean water conductivity is generally around 43000 µS/cm. Based on a bathymetric survey by this author in 2001, the total volume of Garrison Lake is 1,879,000 m^3. The volume of salt water starting at three meters is 637,000 m^3, or roughly a third of the lake volume (The shaded area in Figure 2).

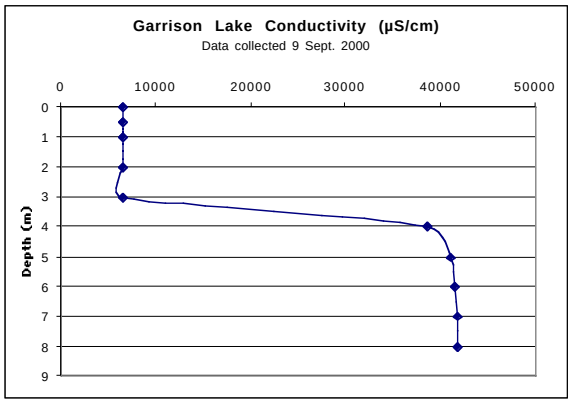

Figure 1. Conductivity profile of Garrison Lake

The consequences of such a large amount of salt water in the lake is a very stable chemolimnion that will not easil mix with the surface water. Extended stratification may lead to hydrogen sulfide production in the chemolimnion that could be released if the stratification were destabalized by a large wave from the ocean or other high-energy event.

Oregon Lakes Continued

Waldo Lake in recent years is astounding. These barely macroscopic animals were severely cropped by the small fish planted in the lake each year. Since fish planting has stopped this form of predation is decreasing and the lake is responding.

Mt. St. Helens exploded in May of 1980. The blast moved Sprit Lake down the mountain and made the lake impossible for fish to inhabit for years. Doug Larson, retired US Army Corps limnologist and adjunct faculty member of Portland State University Biology Department, has watched Spirit Lake return to life. Beginning with the bacteria and microscopic organisms, the lake today is again a place where all life can exist. Fish have been seen in the lake but have not been planted. Watching Spirit Lake return to life reminds us that life is resilient and the most inhospitable areas may again become oases' given time.

A lake may be too large to witness change. But given the tools to observe and delve into the history of a lake, change is evident. A single constant in Nature is change. A lake must change in this part of the World, through the seasons and through the years. It appears that the greatest agent of change is man. We transplant the many organisms; most evident is fish, into every lake available and sometimes forget to notice the change we produce. Lakes do change with time and with our activities, intended or not.

Additional Reading

Blais, J. M., and J. Kalff. 1995. The influence of lake morphometry on sediment focusing. Limnology and Oceanography. 40(3): 582-588.

And The Survey Says....

The 2001 Oregon Lake Survey results are in and Oregon residents have spoken in strong favor of lake health. The survey was conducted to help define problems and issues related to lake use and quality in Oregon. Organizations involved in its development were the Oregon Lakes Association and Portland State University.

The survey was comprised of eight categories including:

- Aquatic Plants
- Lake Water Quality
- Watershed and Shoreline Activities
- Recreation
- Lake Level Management
- Organizational and Funding Issues
- Fisheries
- Water and Wildlife.

The data were analyzed to identify the issues of most and least importance within each category.

The survey was sent to over 660 people in a newsletter sent to the Center for Lakes and Reservoirs mailing list. Although only 42 people responded they were of various backgrounds. The groups included lake consultants, lake association members, agency biologists, lakeshore residents, vendors representing lake management services and academic supplies and others. The greatest number of participants were lakeshore residents.

Most Important

Water quality
Invasive aquatic plants
Enforcement of shoreline and development regulations
Noise pollution from personal watercraft
Extreme low water
Working with government agencies on lake issues
Effect of endangered species act on lake management
Conservation of waterfowl and wildlife habitat

Least Important

Use of mechanical and other plant control methods
Swimmers itch
Construction and removal of piers
Placement and maintenance of buoys
Flooding of the lake and shoreline
How to organize a lake association
Fishing regulations
Beaver problems

The table lists all of the most and least important issues. The results clearly state that there is a concern for the health of lakes. According to the respondents, many management issues need to be addressed to help improve or maintain lake conditions. Many expressed the need for greater state involvement.

Although participation was low in the 2001 survey, we hope to conduct a lake survey in the future to identify lake issues that matter most to Oregonians.

Blue and Fairview Continued

Public access to Blue Lake is through the fully maintained county park during specific hours of the day. Blue Lake is 65 surface acres and has a maximum depth of 20-22 feet. Fairview Lake is 106 acres and has a consistent depth of 4-5 feet in the summer and 0.5 to 1.5 feet in the winter when not storing storm water runoff. A public park was recently built by the City of Fairview with public boat access limited to canoes and kayaks. The residents of Blue Lake enjoy water skiing, fishing, swimming, and beautiful views of the county park and the ridges to the north of the Columbia River. The 184 residents on Fairview Lake enjoy sailing and evenings of aspen glow on Mt Hood from their party barges in the summer time. Ducks and geese have found a comfortable over night home on the lake in the winter.

Blue Lake is about 50% littoral and 50% limnetic. The littoral zone supports several native and non-native aquatic plants. About 20 years ago, Eurasian milfoil took over most of the littoral zone. Physically harvesting the plants with an underwater mower was used as a control, but proved to be ineffective. The lake was lowered approximately 10 feet by pumping the water out thus drying the shoreline and exposing the soil to freezing during the winter. This too was ineffective. The milfoil was finally eradicated with chemical treatments of 2,4D and/or Sonar. Recently, Curly leaf pondweed has become the latest nuisance to boating and swimming, but is responding to treatments of Sonar. With recent District Court rulings, it remains to be seen whether or not the Sonar treatments can continue.

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DEQ Recommends Lake Projects to EPA

The Oregon Department of Environmental Quality has recommened two lake projects to the US Environmental Protection Agency for funding under EPA's Section 319 Nonpoint Pollution Grant program. The proposals were submitted by the Tenmile Watershed Council and the Center for Lakes and Reservoirs.

The Tenmile Watershed Council proposed a project that would conduct nine activities at the Tenmile Lakes:

- Develop a Water Quality Management Plan.
- Monitor algae and survey and survey aquatic plants.
- Conduct additional ground-truthing and detail working with Landowners of previously assessed riparian zones of eight tributaries.
- Conduct a stream temperature and flow monitoring program.
- Conduct a Basin-wide upslope seeding program of identified high sediment risk sites.
- Revegetate riparian areas identified in Riparian assessment as having less than 50% shade values with native deciduous seedlings.
- Treat 1.25 miles of Noble Creek, a high risk sediment tract, with a sediment fence and and remove a high-risk stream crossing.
- Continuation of Watershed Council's water quality education and outreach programs.
- Establish an automated lake elevation and temperature gage.

Partners for the Tenmile project include the Oregon Watershed Enhancement Board, City of Lakeside, Oregon Department of Fish and Wildlife, U.S. Forest Service, Oregon Department of Environmental Quality, Oregon Department of Forestry, Oregon Water Resources Department, Oregon Division of State Lands, Private Industrial Timber Companies, Private Agricultural Landowners, Eel~Tenmile S.T.E.P., Coos County Road Department, and TLBP.

The Center for Lakes and Reservoirs proposal was for Regional Lake tion in lakes that are water quality limited (303(d)-listed). Limited studies will be done to determine if nutrient loading is a cause of lake problems and to determine if Total Maximum Daily Load (TMDL) allocation is necessary on selected lakes. Where aquatic weeds are a reason for the listing, integrated aquatic vegetation management plans will be developed.

Smith, Sunset, and Cullaby lakes in the Clatsop plains are targeted for the first year. If successful, the regional lake planning model may be applied to other water quality limited lakes in the future. Partners on the project include Cullaby and Smith Lake Associations, and the Watershed Councils of Clatsop County.

An EPA decision on the DEQ funding recommendation is expected in March.

Oregon Invasive Species Council Meets

The inaugural meeting of the Oregon Invasive Species Council (OISC) was held on January 23 and 24 in Portland. The OISC was established by the legislature during the last session to address invsive species issues in Oregon. Permanent members of the OISC include representatives of the Oregon Department of Agriculure, Oregon Department of Fish and Wildlife, Portland State University, and Oregon Sea Grant. Other members include representatives of the aquarium, nursery, shipping/port, aquaculture, and grass seed industries. Local government and environmental groups are also represented.

The initial meeting included discussion of different perspectives on the invasive species issue, updates on "hot topics", and presentations on woodland weeds, english ivy, and aquatic nuisance species management. Dr. Dan Hilburn, ODA representative, was elected Chair of the OISC. Dr. Mark Sytsma, PSU representative, was elected Chair-elect.

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Fairview Lake is shallow, but plant growth is light limited because of suspended silt in the water. Secchi disk readings of 11 – 17 inches are consistent throughout the year. Strong winds, large populations of common carp and yellow bullhead catfish contribute to silt resuspension. Hence the popular local name "Mud Lake". Much of the riparian area along the lake was created from dredge spoils deposited by the drainage district during expansion of the storm water reservoir. The riparian areas are now mostly covered with reed canary grass. The City of Fairview is making a concerted effort to replace the reed canary grass with native grasses and other native vegetation. The edges of the bank are steep and drop several feet with little area for aquatic plants to grow. Thus, the residents enjoy weed free boating and swimming.

Blue Lake has self-sustaining populations of warm water game fish, i.e. bluegill sunfish, black crappie, and large mouth bass. Oregon Department of Fish and Wildlife does stock rainbow trout in the spring. Fairview Lake fish populations are predominately common carp and yellow bullhead catfish. Prior to diking the Columbia River, coho salmon migrated a short distance from the Columbia, around the west end of Blue Lake into Fairview Lake and then finally into Fairview Creek to spawn.

Blue Lake has been fully developed for twenty years or so. Fairview Lake on the other hand was only 40% developed five years ago, but is 95% developed now. What changes, if any, will occur in Fairview Lake as a result of the new houses and streets will be interesting to follow.

***LakeWise* is published by the Center for Lakes and Reservoirs at Portland State University with funding provided by OLA, PSU, and the Oregon Watershed Enchancement Board**

LakeWise is available in alternate format (e.g., large type of braille) by contacting the Center for Lakes and Reservoirs, Portland State University, PO Box 751, Portland, OR 97207-0751. Phone: 503-725-3834

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