June
2006

Editor:
Roger Edwards

LAKE WISE

A Voice for Quiet Waters

The Oregon Lakes Association Newsletter

Diamond Lake Treatment Prescription is Underway

When the ice was clear from Diamond Lake this Spring, there were sadly no multitudes of tui chub carcasses floating on the surface. The required conditions for a serendipitous winterkill had not occurred under the ice of the drawn down lake. While the drawdown did concentrate the enormous chub population into a smaller lake volume, the dwindling supply of dissolved oxygen may have been augmented at air spaces that formed when the ice cover would crack and collapse as the on-going drawdown left it unsupported. The prospect of winterkill becoming an effective management tool at high elevation lakes would improve if the prescribed drawdown was complete before the lake froze. The 8-foot drawdown specified for Diamond Lake's approaching September rotenone treatment is just the maximum achievable without pumping, given the configuration of the existing canal. The drawdown was still about one foot short of this target when the ice broke up, which met the schedule for drawdown, but did not produce the best possible conditions for winterkill. The actual level of the drawdown required for the oxygen demand to exceed the finite oxygen supply under the winter ice at Diamond Lake has not been determined. Until this and other criteria needed to ensure a Diamond Lake winterkill is better understood, this mechanism cannot be selected as the preferred treatment alternative.

The countdown to the September finale will see several steps to encourage visits from anglers. The daily catch limit for trout has been increased from 5 to 20, and size restrictions have been suspended. Some supplemental stocking was done in late May and more is scheduled at the ODFW's traveling Fish Free Weekend for kids younger than 14 on June 10-11. In July a commercial seining operation will begin to further reduce fish populations. Fund raising to help finance the project continues. Donations can be made through www.restorediamondlake.org. The lake will be closed for a period in September and October to provide an adequate window of time to complete the rotenone application.

Rotenone is a polycyclic aromatic compound that occurs naturally in the stems and roots of some tropical bean plants. Natives long ago discovered that throwing the crushed or broken remnants of one of these plants into a quiet pool would cause fish there to rise to the surface disabled, where they could be readily collected and then consumed. The compound enters the bloodstream as it passes over the respiratory tissues of aquatic animals with gills or those that can breathe through their skin. Turtles are unaffected because they are air breathers. In the blood, rotenone kills by inhibiting the enzyme that facilitates the use of oxygen in the tissue cells. The animal has oxygen in its blood, but it can't be utilized.

The chemical formula for rotenone is $C_{23}H_{22}O_6$. The lack of metal or halogen atoms in the molecule means that it readily decomposes to carbon dioxide and water. There is one intermediate degradation compound that retains some toxicity, but it is less strong than rotenone and it also breaks down quickly.

The rate of decomposition in water is dependent on the water temperature and light intensity. Cool, turbid waters require more time before any rotenone they contain will be completely degraded.

Lake managers throughout Oregon have a stake in the elimination of tui chub from Diamond Lake this Fall. The disruptions the chub have caused to this successful rainbow trout fishery have had tangible impacts for Douglas County. Worse still, their presence has created conditions that stimulate the growth of cyanobacteria to bloom proportions. By feeding on lake zooplankton, the chub have decimated the normal zooplankton population and thereby eliminated the control these filter feeders exert by consuming cyanobacteria cells. Fecal waste from the chub suspends nutrients in the water column where they can be used for algal production. The resultant blooms have generated water contact advisories at Diamond Lake in several recent years and these advisories in turn provided the deciding resolve to move forward with the rotenone treatment. Lakes elsewhere in Oregon also face the threat that cyanobacteria toxin production could bring a health advisory against water contact. A demonstration that the restoration of healthy zooplankton populations discourages cyanobacteria blooms would offer a model to help avoid such advisories. Diamond Lake has been intensely monitored in the years leading up to its second bitter pill of rotenone, and will continue to be closely scrutinized after this treatment. These data will be of good use for managers watching for parallels, both as warnings and as recovery strategies.

Yellow Perch Die-Off at Henry Hagg Lake

After reviewing testing results, the Oregon Department of Fish and Wildlife concluded that natural causes were to blame for the death of approximately 3000 yellow perch in early May. Most of these fish were noted to be male, and all had empty stomachs. The prolonged cold temperatures in the lake may have limited food availability this Spring. When warmer weather brought water temperatures up to the point where they trigger spawning, these combined stresses likely overwhelmed weakened individuals. The lake's populations of rainbow trout and smallmouthed bass were unaffected. The ODFW issued an assurance that fish caught from the lake are safe to eat, and that the strong perch population there would not be impacted by this event. Henry Hagg Lake is a Bureau of Reclamation reservoir completed in 1974 on Scoggins Creek, west of Portland.

The causes of fish kills such as this can be hard to determine. They are not uncommon in the Spring and can be the result of a variety of conditions. Winterkill becomes obvious when the melting ice cover reveals multiple floating fish carcasses. The oxygen depletion that can occur in frozen lakes can kill all fish or just certain populations because of the different oxygen requirements of different fish species. Physical aeration at the air/water interface becomes impossible when ice forms on a lake surface. Light passing through the ice allows oxygen production by photosynthesis, but snow accumulation on the ice surface effectively blocks this light. Without these mechanisms of aeration, fish survival becomes a question of whether respiration will exceed the supply of dissolved oxygen in the water under the ice.

A delayed onset of Spring will prolong the privations of Winter, making fish populations more susceptible to bacterial or fungal infections. Contamination events can happen anytime and can also differentially affect portions of the fish population based on their tolerance to the contaminant. Natural senescence can also be the fate of those happy fish that enjoy a pleasant habitat and have avoided the local predators.

Details on the PNW Regional Conference: "Research and Management Trends in the Pacific Northwest"

by Vanessa Howard, Research Assistant, PSU Center for Lakes & Reservoirs

This year, OLA and the Washington State Lake Protection Association (WALPA) will be co-hosting their annual conference with support of the North American Lake Management Society (NALMS). The Pacific Northwest Regional Conference will be held at Portland State University in Portland, Oregon on September 13th and 14th, 2006. This regional conference offers a unique opportunity to learn the concerns and challenges experienced by other Pacific Northwest states while forging connections among lake and resource managers, researchers, and citizens. Session topics will include: Pacific Northwest lakes, macrophytes, fisheries in lakes, lake restorations/management techniques (alum restorations, aeration, circulation, other lake and watershed restorations), public education & resident involvement, and invasive species.

Additionally highlights of this conference will include two guest speakers, a photo contest, an evening mixer and the option for guided tours of Oswego or Roslyn Lakes. Some of these are described below.

Guest Speakers

Dr. John Stockner will give a plenary presentation on September 13th entitled: "Lake trophic condition: striving to achieve nutrient 'balance' and 'optimal' production for multiple-use in the 21st century." Dr. Stockner's extensive research experience has looked both at causes and consequences of the eutrophic, mesotrophic and ultra-oligotrophic condition in temperate lakes across N. America and in N. Europe. He will discuss how lakes react to nutrient imbalances caused by both excesses and losses of required nutrient supplies. The new 'microbial paradigm' will be introduced and examples of the importance of 'picoplankton' as 'drivers' of C metabolism in Pacific Northwest (PNW) oligotrophic lakes will be discussed. His presentation will conclude with a dialogue on the impact of 'cultural oligotrophication' that can be seen in most PNW reservoirs as they age and in a multitude of salmon lakes and rivers as anadromous salmon runs are depleted.

In addition, a lunchtime presentation on the lakes of Mt. St. Helens will be given on September 13th by Dr. Douglas W. Larson, a limnologist and water-quality consultant in Portland, Oregon. He has served as an instructor and adjunct professor at Portland State University, first in the Departments of Biology and Geology (1972-2000) and later in the Department of Environmental Sciences and Resources (2001-present). He retired from the U.S. Army Corps of Engineers in 1991 and was employed as the Clean Lakes coordinator for the Oregon Department of Environmental Quality between 1992 and 1994. Since 1980, he has tracked the limnological recovery of Spirit Lake and other blast-zone lakes at Mount St. Helens, and is one of several authors of the book "Ecological responses to the 1980 eruption of Mount St. Helens." (2005, Springer, publisher).

Photo Contest

Start digging out your favorite lake photo or take one in the coming months. Stay tuned in the coming month for details on the categories and awards of the conference's photo contest.

* Oregon lake photos will also be considered for submission to an on-line reference source on Oregon lakes and possible re-publication of the 1986 Atlas of Oregon Lakes.

Field Trips

Many interesting lakes pepper the landscape of the Pacific Northwest. When you register for the conference, consider signing up for a guided tour of either Oswego Lake or Roslyn Lake. Each is an easy drive from

downtown Portland and for the minimal cost of the tour you will get a rare opportunity to see and hear what makes each lake unique plus transportation to and from the site and a boxed lunch. Both tours will take approximately 4-5 hours.

Oswego Lake is a eutrophic urban lake with an active management program in place to curb toxic algae blooms and invasive plant growth. Methods utilized have included aeration, limiting nutrient sources, alum applications and diver-operated suction harvesting. This guided tour – via pontoon boat – will give you a water-side view of the lake and first hand information from lake managers.

The decommissioning of the Marmot and Little Sandy dams in 2007 and 2008 will spell the end of Roslyn Lake, which is actually the forebay of PGE's Bull Run hydro project. Come get a behind the scenes look at the dams, lake and water delivery system in addition to hearing about the impacts of dam removal on water quality and fish habitat.

Space is limited on these tours, so sign up as early as possible if you are interested.
On-line registration for the conference and the tours will begin in mid-July at www.nalms.org. More information will be posted there in coming weeks as well as:
www.oregonlakes.org/events/annual_mtg_frame.html.

Phosphorus Still in the News at Lake Oswego

The city council of Lake Oswego is considering an ordinance that would ban the sale or use of soil amendments containing phosphorus for lawn or gardens within their jurisdiction. The interest for such a restriction comes from the connection between phosphate levels in storm runoff and algae blooms that plague the lake. A bloom of *Microcystis* in 2004 caused a lake closure and created support for the alum application in 2005, which is hoped to seal off phosphorus in the lake sediments from becoming re-suspended and available for future algae growth. Lake management approaches to deal with phosphorus concentration in lakes are expensive and difficult. Curtailing the annual input with some sort of ban on landscaping practices is more straightforward.

Largely through the efforts of Lake Corp., the private organization that manages the lake, residents of the Lake Oswego area have had access to phosphorus free fertilizer since 2001. It has been used on many of the 336 lakefront lawns that extend down to seawalls without detrimental effect on these yards. Phosphorus is added to fertilizers to stimulate root growth, flowering, and seed production. These are not features that require attention of greens keepers looking after the grass. Composite soil samples taken from seven areas around the lake had an average available phosphorus value of 51 ppm (range 33-70 ppm) when analyzed for nitrogen, phosphorus, potassium, acidity, salinity, and micronutrients. This level is rated high to very high and is sufficient to support turf growth without supplements.

While the city council weighs questions of desirability, enforcement, and what would become of existing supplies of fertilizers, this same experiment continues in Minnesota. The Twin Cities banned phosphorus in lawn care products in 2001 and this law was extended statewide in 2005. The expansion of the legislation speaks to its effectiveness. Another result of the ban there was an increased availability of products meeting the new requirements.

Miller Lake Lamprey Get A Boost

There are four Miller Lakes listed in "Oregon Lakes, Reservoirs, Ponds, and Puddles"; a small lake SE of Post in Crook County, another small lake SE of the Oregon Caves in Josephine County, a large lake W of Chemult in Klamath County, and a dry lake at the Hwy 97 crossing into California. The Miller Lake where lampreys are found is the 566 acre, alpine Klamath County lake, 10 miles NE of Crater Lake. Curiously, this lake is land locked because its outlet, Miller Creek terminates about 10 mile downstream near the hamlet of Beaver Marsh.

Lamprey are generally thought of as slimy, eel like creatures with a sucker mouth that migrate up streams from the ocean to spawn. This image is true, but it is also true that they are very primitive animals that have been successful in a variety of habitats. They are jawless and have a cartilaginous skeleton. Taxonomists point out structural differences that justify dividing the six species of lamprey the Department of Fish and Wildlife recognize in Oregon into two genera, *Lampetra* and *Entosphenus*, but they can largely be categorized by life history. They all spawn in fresh water but not all have a parasitic phase and those that do may not have a marine phase. *Entosphenus tridenta*, the Pacific lamprey, and *Lampetra ayresi*, the River lamprey are parasitic and spend part of their lives in the ocean. *L. richardsoni*, the Western Brook lamprey, and *E. lethophagia*, the Pit-Klamath Brook lamprey, are non-parasitic and spend all their lives at a local area of a small stream. The Miller Lake lamprey, *E. minima*, is a parasitic fresh water species that is unique because of its small size and because it decreases in size during is parasitic phase. *E. similus*, the Klamath River lamprey, is a parasitic adfluvial lamprey that feeds in fresh water lakes but spawns in streams.

When lamprey hatch from their spawning redds, they are elongate larvae less than a centimeter in length and quickly bury themselves in the bottom sediments in a "U" shaped posture where their head is exposed but their tail is not. There are photo sensors in the tail that cause the larva to reposition itself when light is detected. They filter feed on microorganisms in this manner for 3-7 years. The current of the streams they inhabit tends to move them downstream during their larval stage. In the early years their growth is mostly in length while later they begin accumulating lipid reserves. In this stage, they are known as ammocoetes larva from the name they were given before it was recognized that they were young lamprey. Their structure at this point in their life is very similar to another primitive chordate animal, the amphioxus or lancet. The resemblance and presence of a notochord in these two animals make them a biological curiosity.

During metamorphosis into the adult form, feeding ceases and the fat stores are used for nutrition. There are many changes during this phase but the development of eyes is the characteristic that is most often used to distinguish adults from larval forms. Development of the sucking mouth and rasping teeth is pronounced in parasitic species. Whether in marine or fresh water, parasitic lamprey will attach to fish and feed on the flesh and drainage from the wound they produce. Some of these anadromous species will migrate far inland to their spawning beds. Spawning generally occurs in the Spring after a Winter dormancy. This is also true for the non-parasitic species. Their spawning occurs soon after they metamorphose into adults. The adults die after spawning.

The Miller Lake lamprey was first recognized as a unique species in 1973 after examination of preserved specimens at Oregon State University. It was thought at that time that the species was extinct because Miller Lake had been chemically treated in 1958 to kill the lamprey and Tui chub, which were considered problems there. A two-foot high dam of mortared rock with a metal lip bolted to the top was built in Miller Creek in 1959 to ensure lamprey in the creek would not become re-established in the lake. The lake has low productivity, but

the regular stocking of rainbow and brook trout up until 1948 had created a popular recreational fishery there. Complaints about the declining rainbow fishery and lamprey scaring on the hatchery fish led to the decision to treat the lake.

Biologists from OSU rediscovered these smallest predatory lampreys in the world during 1992 excursions in the upper reaches of the Williamson River. Since then, they have also been found at the lower end of Miller Creek, the Upper Klamath Marsh and its Jack Creek tributary, and the Sycan Marsh and its Coyote Creek, Long Creek, and Sycan River tributaries. A conservation plan has been made to guide ODFW's future management of this species, and the removal of the concrete and rock dam on Miller Creek was part of that plan to expand the habitat available to the Miller Lake lamprey. ODWF announced in early April that this barrier has been dismantled.

Miller Lake is currently recognized for its trophy brown trout fishery. These trout have thrived there since they were first stocked in 1981. Rainbow trout have also been stocked annually since 2001, but their growth is marginal in the unproductive waters of this oligotrophic lake. The introduced population of kokanee has maintained their numbers since their stocking was stopped in 1971. Opening the lake for the reintroduction of lamprey is not considered a threat to these fisheries because the parasitism of Miller Lake lamprey has little effect on adult fish, and brown trout themselves may benefit from this additional food source. Healthy trout/lamprey populations co-existing elsewhere in the Klamath Basin are recognized. The most prominent example is the redband trout and *E. similus* in Upper Klamath Lake. The ODFW will watch with interest how their management of the Miller Lake lamprey will proceed. They are also on record to preserve the lake's angling recreation at current harvest levels.

More Requests for No Wake Boating

The Oregon Marine Board will issue their decisions in June about whether to expand the "Slow, No Wake" zones at docks and boat ramps in Lake Billy Chinook and Brownlee Reservoir. Both of these requests cited the need to improve the safety of people recreating in increasingly congested areas. The Brownlee request was also concerned about the limited dock space that forced boaters to tie up on the shore adjacent to the Hewitt Park moorage, which was the focus of this request. The Lake Billy Chinook petition listed the marina area on the Deschutes Arm and the upper and lower boat ramp areas on the Crooked River Arm of the reservoir.

These requests can be viewed as an example of the increasing popularity enjoyed by Oregon's lakes, and a reminder that a trip out on the lake is now more of an exercise than in times past. Boat ramps and docks are common areas where all manner of lake enthusiasts must share limited facilities. A boating accident will ruin a day on the lake no matter what the excuse for the excursion.

Cyanobacteria Strategy Turns to Education

The Spring interagency meeting on cyanobacteria was hosted by the Center for Lakes and Reservoirs and held on the campus of Portland State University. The meeting provided an opportunity to update attendees on

several issues relating to cyanobacteria, and share the approaches local agencies have adopted to deal with the public health hazard posed by cyanobacteria toxins.

Joe Eilers, of MaxDepth Aquatics, discussed the difficulty of identifying bloom species of cyanobacteria using Crane Prairie samples from 2004 and 2005, a 2005 sample from Odell Lake, and a fourth sample from Maine as an example. All were considered to be *Anabaena* but their morphological characteristics overlapped enough that placing them in the species *flos aquae* or *circinalis* was largely based on judgment. To resolve this question the samples were prepared for DNA analysis of two different gene sequences. The results of these tests show different relations between the samples for each of the sequences tested. The Maine sample best matched *A. circinalis*, but the Oregon samples were identified as *A. lemmermannii*, a third similar species. The additional tests provided more information, but judgment was still a part of the identification. This episode also points out the special needs of sampling for identification rather than cell counts. Lugol's Solution can distort algal cells so fresh unpreserved samples are best when critical identifications are required.

The drinking water perspective on cyanobacteria blooms was presented by Dave Stone, Toxicologist at ODHS. Water treatment is designed to remove particles from water, but in the case of cyanobacteria, the removal must be done gently to avoid bursting the cells and releasing their toxin. There have been successes but no standard recipes have emerged. The characteristics of the water being treated must be considered when dealing with the special case that cyanobacteria blooms present. Coagulation/clarification processes have proved effective at removing cells and granular activated carbon can remove dissolved toxin. More often water suppliers try to limit their exposure by the careful placement of their water intake or avoiding conditions that can lead to blooms. The World Health Organization has set the drinking water threshold for the toxin microcystin LR at 1 µg/L. The level set by Health Canada is 1.5 µg/L.

When the Salem Department of Public Works was not quickly informed about the December 2002 fuel spill into Detroit Lake, they began making plans so future incidents would result in prompt notification. Tim Sherman described the formation of a stakeholders group bound by interest in water protection and reduction of regional contamination risks. They developed a notification list and set quarterly meetings to keep it current. This unofficial communication link proved its effectiveness on a Saturday in last September when the discoloration of a ripening cyanobacteria bloom was noted. Following the plan, the word was spread and by that evening, everyone on the list had been made aware of the situation.

Tim Shibahara outlined the cyanobacteria monitoring that PGE has developed for Timothy Lake and the North Fork Reservoir, downstream on the Clackamas River. Timothy Lake is a 1430-acre meso-oligotrophic reservoir with a pronounced residence time and which develops strong thermal stratification. Cyanobacteria are observed there annually. From May to September, the lake is visited weekly to measure surface temperature, Secchi depth, and visually check for color changes that are indicative of cyanobacteria. Once they are noted, cell counts are performed with the ODHS threshold levels of 40,000 cells/mL of *Microcystis*, or 100,000 cells/mL total of other cyanobacteria in mind. Stakeholders and ODHS are notified if counts exceed these levels. North Fork is a 375-acre mesotrophic impoundment operated for power generation. It has a short residence time, does not stratify, and experiences occasional bouts of cyanobacteria. PGE staff make regular visual observations of the water color but rely on downstream drinking water providers for more extensive monitoring. Stakeholders are notified if *Microcystis* counts exceed 2000 cells/mL or total cyanobacteria rises above 15,000. ODHS is notified if counts exceed the ODHS thresholds. In 2005, counts of *Anabaena sp.* peaked in June at 13,500 at Timothy Lake, and a peak of 4000 cells/mL of *Anabaena/Aphanizomenon* occurred in August at North Fork.

LAKE WISE
The Oregon Lakes Association
Newsletter 2006 #2

PO Box 345
Portland OR 97207-0345

OLA Mission: The Oregon Lakes Association, a non-profit organization founded in 1988, promotes understanding, protection, and thoughtful management of lake and watershed ecosystems in Oregon. For additional information on OLA, write to the address above, or visit our website.

OLA welcomes submissions of material that furthers our goals of education and thoughtful lake management in Oregon, and is grateful for the corporate support that helps sustain the organization. Corporate members are offered a one-time opportunity to describe their product or service to Lake Wise readers. These descriptions are not endorsements, and opinions appearing in Lake Wise are not OLApolicy statements.

Visit our website: www.oregonlakes.org

Rich Miller and other CLR staff tested a surrogate device for chlorophyll α measurements in Diamond Lake. The device is an *in-situ* probe that emits a 460 nm light beam and detects light at 685 nm, mirroring how chlorophyll α absorbs incident insolation and releases light at a lower energy level. Measurements were taken at 0.5 m intervals of depth at 32 sampling sites on a grid pattern. At 15 of these sites, samples were collected at 1, 1.5, and 6 m depths for chlorophyll α and algae counts. A comparison of these two datasets shows a correlation coefficient of only 0.37. The algae counts found 98 different algal species. The most abundant forms were *Anabaena flos aquae*, the diatom *Fragilaria crotonensis*, and the flagellated cryptophyte *Rhodomonas minuta*. Both datasets showed that chlorophyll α concentration varied more by depth than by site. There was little difference however in the distribution of *Anabaena* cells between the sampled sites, and between 0.5 and 6 m depths during a period when maximum *Anabaena* counts were about 4000 cells/L.

On-going monitoring at Diamond Lake during 2005 showed a mid-lake peak of *Anabaena* at 9058 cells/mL on July 18. At the lake outlet, a count of 2.2 million cells/mL was recorded on July 1. The peak microcystin level was 1.57 µg/L on July 18. Only one of six other microcystin samples was above 0.2 µg/L.

This summer, cyanobacteria surveillance will be done much like last year. Visible scums or counts above threshold levels will be cause for water contact advisories. These advisories will be issued by the monitoring agency this year with the acknowledgement of ODHS. Local agencies are encouraged to use the notices and press releases developed by ODHS. There has been no change on the question of fish edibility during advisories. The basis of this concern was raised in two published papers that found cyanotoxins in fish fillets. There have been equally few, if any, papers published documenting human sickness from eating fish caught during a bloom of cyanobacteria. ODHS is following the issue and can be contacted for more information.