PORTLAND STATE UNIVERSITY

LAKE WISE

Spring 2000

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

Center for Lakes and Reservoirs Update

by Mark Sytsma

The establishment of the Center for Lakes and Reservoirs has been a priority for OLA and PSU. In 1998, Senator Tarno (Republican, Coquille) addressed the OLA meeting at Diamond Lake, and challenged the organization to propose a lake management program for Oregon. OLA and PSU produced a proposal that Senator Tarno developed into legislation. The legislation received support from a diverse set of interests, from agriculture to environmental groups. Senator Tarno was instrumental in designating the Center as a priority for funding with from the Salmon and Parks initiative (Ballot Measure 66). The purpose of the Center is to provide: 1) education, 2) management planning and technical assistance, and 3) research. One of the initial focuses of the Center will be invasive and nuisance aquatic species.

PSU has developed a funding proposal that the Oregon Watershed Enhancement Board (OWEB) will soon consider. If approved, OWEB will propose to the legislature's Emergency Board that the Center be funded.

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Fairview Lake Riparian Planting

by Mary Coolidge

On Saturday, February 19, over 40 community volunteers and a team of 9 AmeriCorps members planted native trees and shrubs around Fairview Lake at the east end of the Columbia Slough. This was an event cosponsored by the Columbia Slough Watershed Council and the Fairview Lake Property Owners Association.

One vision of the Columbia Slough Watershed Council is to foster watershed stewardship in the community by focusing on on-the-ground projects. This planting idea began when Bettianne Goetz, a Fairview Lake resident, suggested a joint project between the watershed council and the neighborhood association to address erosion concerns. The water of Fairview Lake is managed by Multnomah County Drainage District for summertime recreational use and rainy season water storage. These management scenarios result in dramatic seasonal fluctuations in the water level. This, coupled with strong East winds from the Columbia River Gorge and clearing of native vegetation along the shoreline, causes extreme erosion bank instability and undercutting.

So, after two months of planning, with the participation of homeowners, volunteers, SOLV, PGE, City of Portland, City of Fairview, Interlachen Homeowners Association, and AmeriCorps members, 525 native plants were installed on 6 public and private lakefront sites! Site design considered fundamental principles of "Naturescaping" such as: use of native plants to absorb and filter stormwater runoff, provide wildlife habitat, reduce erosion and stabilize shoreline soil, shade lake water, and reduce water and pesticide use. *A Naturescaping for Clean Rivers* Workshop was also organized in the Fairview lake area to provide more information about the use of native

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Inside this issue

Lake Lytle Milfoil Control

by Rupa Shrestha

Native aquatic plants are considered important components to the ecology of lake ecosystems. Aquatic plants stabilize near-shore sediments, provide food and habitat for fish and wildlife, and contribute to the cycling of nutrients that maintains aquatic ecosystem function. However, if nonnative, noxious weeds invade aquatic systems, these benefits can be lost, causing reductions in native vegetation, degradation of fish and wildlife habitat and water quality. In addition, the dense surface mats that are formed by noxious aquatic plants interfere with recreational use of lakes.

Lake Lytle, a shallow coastal lake situated about 5 miles north of Tillamook Oregon is an important recreational lake for the residents of Rockaway Beach. The overall quality of the lake, deteriorated after the infestation of Eurasian watermilfoil (*Myriophyllum spicatum*), a noxious weed, which was introduced in the Oregon coastal lakes about forty years ago. Eurasian watermilfoil multiplies rapidly and forms canopies over the native plants, literally choking out native plants and severely restricting recreational activities. In addition, it degrades water quality and fish habitat and accelerates eutrophication. Needless to say, the local economy has suffered due to excessive milfoil growth in the lake. The deteriorating condition of the lake requires management attention.

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SONAR (FLURIDONE) FACTS

How does the SONAR work?

Fluridone inhibits carotenoid (yellow pigment) synthesis in plants. The carotenoid pigments protect chlorophyll (green pigments) from damage by sunlight. When the carotenoid synthesis is inhibited, the lack of protective yellow pigmentation causes the chlorophyll to be photo-retarded. Without chlorophyll, the plant is unable to produce carbohydrates through photosynthesis and the plant is starved of the basic energy producing molecules essential to survival. Fluridone has a short-term impact on native species, such as bleaching of leaves and stem apices, however, native species population should be able to reestablish the following year.

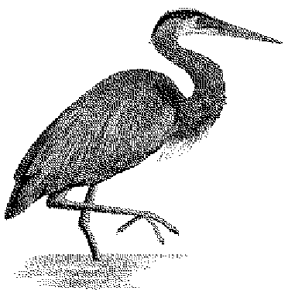
Impact of Fluridone

The nuisance plants such as Eurasian water milfoil that are killed by the herbicide will not significantly impact on dissolved oxygen in the lake. The plants will die at different times and the decay process will occur gradually so there will not be a significant increase in Biological Oxygen Demand (BOD). Thus, the treatment should present no threat to fish and other aquatic life in the lake. At recommended treatment levels, the lake can be used for swimming, boating, and fishing with no restrictions. However, water treated with fluridone should not be used for irrigation purposes.

Fairview Lake Planting continued

plants in urban landscapes. This workshop was a critical follow-up, because it furthered public education about homeowner impacts on the landscape and raised awareness about the function and value of native plants to the health and sustainability of Fairview Lake and the Slough.

The enthusiasm elicited from neighbors who participated in this event was exactly the response that was hoped for. Fairview Lake received a number of letters of appreciation for organizing the community planting event, and numerous inquiries about follow-up plantings and requests for assistance in organizing similar projects in the future. This event has helped to start a wave of community stewardship and conservation for wildlife, plants, and water-quality in the watershed, which is invaluable!



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Lake Wise is available in alternate format (e,g., large type or braille) by contacting
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Environmental Sciences and Resources, Portland State University, Portland, OR 97207-0751
(503) 725-3834

Are You Introducing a Potential Noxious Weed?

by Susan Schouten, ODA Horticulturist

Introduced species, such as corn, wheat, rice, and other food crops, and cattle, poultry, and other livestock, now provide more than 98% of the US food system. Other exotic species have been introduced for landscape restoration, biological pest control, sport, pets, and food processing. Clearly, these are beneficial to our society. Some non-indigenous species, however, are weeds or pests and have caused major economic losses in agriculture, forestry, and several other segments of the US economy, in addition to harming the environment. There are currently over 50,000 non-native species in the US and the number is increasing. It has been estimated that $97 billion in damages has been caused by 79 exotic species, a small minority, between 1906 and 1991.

Many alien plants now established in the US were introduced for food, fiber or ornamental purposes. An estimated 5,000 introduced plants have escaped and now exist in natural ecosystems, some of which have displaced several native plants. Non-indigenous weeds are spreading and invading approximately 700,000 ha/yr of the US wildlife habitat. One example, European purple loosestrife (*Lythrum salicaria*), was introduced in the early 19th century as an ornamental plant and has been spreading at a rate of 115,000 ha/yr. This one species alone is changing the basic structure of most of the wetlands it has invaded. It has reduced the biomass of 44 native plants and endangered wildlife, such as the bog turtle (*Clemmys muhlenbengil*) and several duck species, which depend on native plants. Purple Loosestrife now occurs in 48 states and costs $45 million/yr in control costs and forage losses.

In crop systems, including forage crops, an estimated 500 introduced plant species have become weed pests. Johnson grass (*Sorghum halepense*) and Kudzu (*Pueraria lobata*) were actually introduced as crops and then became pests. Many other weeds were accidentally introduced with crop seeds, from ship-ballast soil, or from various imported plant materials. Of the woody plant species which have become weedy in North America, 85% were introduced for landscape purposes.

It has been estimated that if 10% of the 260,000 vascular plants in the world are good colonizers, then 26,000 potential weed species exist in the world. Since only about 4,000 of these have been distributed around the world, that leaves about 22,000, or 85% of the potential weed species yet to be introduced. How to minimize the introduction of potential noxious weeds is a question receiving more and more attention.

What can we do?

Horticultural professionals—including growers, retailers, landscapers, and staff at public gardens—can learn to recognize the traits associated with invasiveness. High proportions of the species that are invasive in the US share certain traits. Here are questions horticulturists should ask before introducing a new plant species.

- Is it invasive in other parts of the world?
- Can it complete its reproductive cycle in this area?
- Does it reproduce vegetatively (e.g., by rhizomes and root suckers, etc.) as well as by seed?
- Does it produce abundant seed?
- Does it have potential to disperse seed long distances?
- Do the seeds germinate without pretreatment?
- Is it highly competitive for limited resources?
- Does it have a relatively short juvenile period?

If the answer is “yes” to all or most of these questions, there is a high probability the plant could become invasive, eventually. If not, more evaluation is necessary to determine if one or more of these traits is enough to allow invasiveness.

Taxonomic relationships also provide some clues as to invasiveness. Of the 76 serious pest species in one study, 63% belonged to just six families: Rosaceae, Leguminosae, Myrtaceae, Salicaceae, Oleaceae, and

Continued on page 4

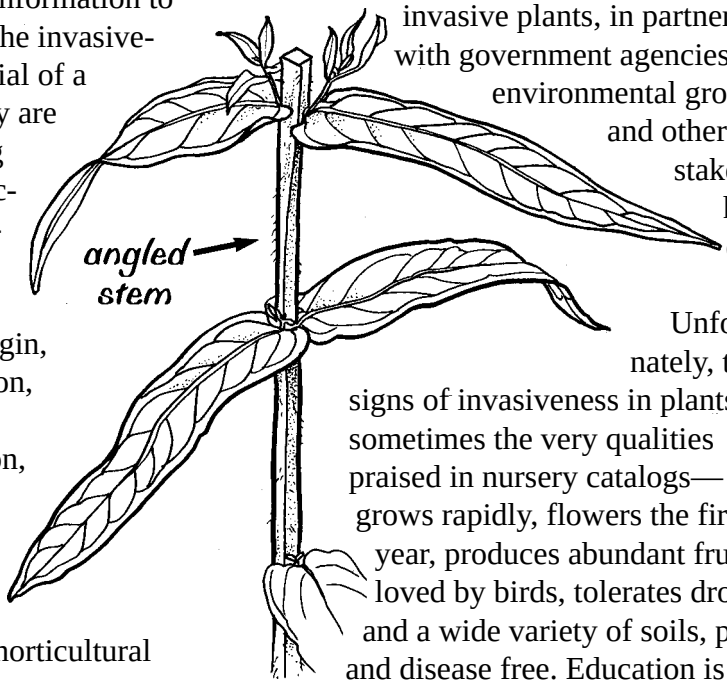
Noxious Weeds continued

Caprifoliaceae. A species that is in a family or genus with known invasive ability might not necessarily become invasive. If, however, a species is a weed in another part of the world and also has relatives that are weeds in the US, there is a high probability that it too will be invasive here, because species that are descended from a common ancestor often share traits.

Resources

Horticulturists can usually obtain the information to determine the invasiveness potential of a species they are considering for introduction. Information about a species' origin, hybridization, vegetative reproduction, and seed requirements often appears in horticultural texts and journals. A visit to a well-equipped library will provide access to floras, plant manuals, or horticultural books (such as Hortus Third). Web search engines or abstract services available at university libraries on CD-ROM (e.g., AGRICOLA and BIOSIS) are helpful, as well. Those with World Wide Web access can use a site developed in Australia, which lists more than 9,000 invasive species.
http://www.agric.wa.gov.au/progserv/plants/weeds/weeds/weedlist.htm

With the enactment of the President's Order on Invasive Species, invasive species councils are being formed in many states, including Oregon. The horticulture industry has a responsibility to take an active part in preventing the introduction of potentially invasive plants, in partnership with government agencies, environmental groups and other stakeholders.



Purple Loosestrife
Lythrum salicaria
(illustration modified from:
Through the Looking Glass...
A Field Guide to Aquatic Plants)

Unfortunately, the signs of invasiveness in plants are sometimes the very qualities praised in nursery catalogs—grows rapidly, flowers the first year, produces abundant fruit loved by birds, tolerates drought and a wide variety of soils, pest and disease free. Education is the key. We must educate our employees, our customers, and ourselves so that knowledge about invasive plants reaches everyone involved, and is continuously updated. Customers also will appreciate industry efforts to provide them with plants that are beautiful, useful, and non-invasive.

Center for Lakes and Reservoirs continued

Consideration of the request should occur on June 23.

PSU has provided some start-up funding for the Center and has been actively pursuing federal funding opportunities. Representative DeFazio has inserted report language into the Clean Lakes Program of the Clean Water Act that instructs the EPA to fund management activities at Waldo and Tenmile Lakes through the Center. Representative Blumenauer and others in the Oregon congressional delegation have supported development of a cooperative agreement between the Center and the U.S. Army Corps of Engineers for work on aquatic weed problems in Oregon and the Pacific Northwest.

If all goes well, the Center should receive funding in July. In the first year, funding will be used to complete a state management plan for nuisance aquatic species, provide technical assistance, and education to lake users and stakeholders. We hope to be able to restart the Lake Watch Program, which was coordinated for many years by PSU with funding from the Oregon Department of Environmental Quality. Through the Center, the Lake Watch Program will be a collaborative effort with Southern Oregon University.

Thanks to everyone who has provided support. We are getting closer to establishment of a dedicated program to address lake issues in Oregon.

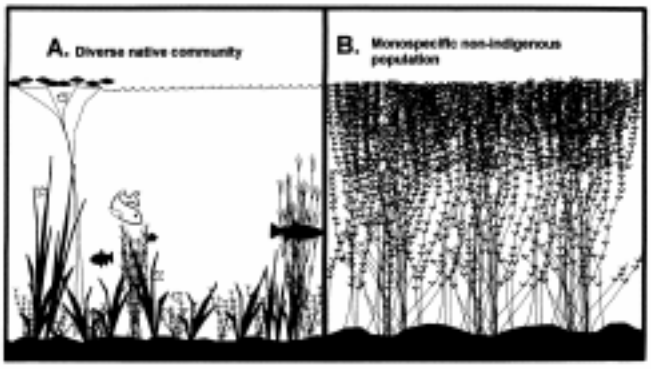
Lake Lytle continued from page 2

Considering the need to rehabilitate Lake Lytle, an aquatic vegetation management plan was prepared for the lake in 1998. The plan was developed with the input from the City of Rockaway Beach, Oregon State Board, Oregon Department of Fish and Wildlife, and Oregon Department of Environmental Quality.

The management plan is to treat the lake with herbicide (SONAR, a.k.a. fluridone). Milfoil is susceptible to fluridone. Fluridone, 1-methyl-3-phenyle-5-[3-trifluromethyl) phenyl]-4(1H)-pyridinone, is a slow acting, systematic type herbicide. Fluridone inhibits plant growth by interfering with carotenoid pigment synthesis, leading to chlorophyll degradation and characteristic whitening of leaves in treated plants.

A three-year project is underway to implement the management plan. The project is funded by Sepro Corporation, City of Rockaway Beach, and Northwest Food, Forest Education Foundation, State Weed Board, and the Oregon Department of Agriculture. The goal of the project is to eradicate Eurasian watermilfoil and restore the native submersed aquatic plant community in an environmentally sensitive and cost-effective way. In 1990, Lake Lytle was treated with a high dose (150 ppb) of floridone. This treatment successfully killed 80-95% of the milfoil population, however, it also severely damaged the native vegetation. Additionally, isolated patches of milfoil reestablished in 1992, and by August 1993, most of the open areas of the lake were again occupied by milfoil.

The current plan calls for treatment with liquid floridone (SONAR 4AS) of a low-rate (10 ppb) over a longer period of time. This state-of-the-art application method should effectively remove milfoil and should not adversely affect most native plants. Vegetation and water quality of the lake will be monitored before, during, and after the treatment. A public education programwill also be conducted to prevent re-infestation of the milfoil to the Lake Lytle. It is anticipated that within the three-year project period, milfoil will be completely controlled and native vegetation will restored. Upon completion of the project, the City of Rockaway Beach will be responsible for long-term monitoring and maintenance control of weeds in the lake.



Impact of introduced plants on lake eccosystems (from Madsen 1997)

Devils Lake Aquatic Seed Bank Characterization

by Melissa Waggy

Devil's Lake, near Lincoln City, is a shallow coastal lake that is popular for fishing, boating, and water skiing. The lake is surrounded by residential homes and development is growing steadily. Invasive, nonindigenous weeds degraded the habitat and water quality of the lake and impacted recreational opportunities and lake aesthetics. In 1986, triploid grass carp were introduced into the lake to control Eurasian watermilfoil. Following the fish introduction the lake was invaded by a new nuisance plant, Brazilian Elodea. In the years following the introduction, surface mats of vegetation were reduced and recreational uses of the lake were enhanced. The grass carp population in the lake was supplemented with additional fish in 1993. In 1994 all the vegetation in the lake was eliminated by the fish. Since that time, warmwater fish populations have decreased and certain waterfowl populations using the lake have declined.

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OREGON LAKES ASSOCIATION NEWS

Activities in 2000

by Jim Carpenter, OLA President-elect

Welcome to Spring 2000!

It certainly seems like an auspicious occasion with the millennium unfolding before us. As President Elect of OLA, I would like to take this opportunity to make this a very good year for the organization. So far it is looking great. Thanks to the leadership of our own Mark Sytsma and a lot of help from the troops, we now have established the Center for Lakes & Reservoirs at Portland State University. On the national scene it is looking like reauthorization of Sec. 314 of the Clean Lakes Program will happen, having passed the House of Representatives with overwhelming support. Even the Federal family is catching the wave, having jointly announced through the Secretaries of Agriculture and Interior, the Unified Federal Policy to Ensure a Watershed Approach to Federal Land & Resource Management. Basically what this policy says is that the various Federal agencies will work collaboratively with each other and the stakeholders in affected communities to improve water quality and stewardship of federal lands in the watershed. This seems particularly important here in the West where so much of the uplands, which drain to our lakes, are in Federal ownership.

It is clear that the overarching environmental issue for the new millennium will be water, and Oregon Lakes Association, as our tag line says, is "the voice for quiet waters".

From our perspective down here in Southern Oregon things are anything but quiet, and that is the way we like it. Here on Upper Klamath Lake (UKL), Oregon's largest, is where we live and work, primarily in the field of natural resources. More particularly we consult in the algae industry. No, that is not an oxymoron, we have so much algae in the UKL, it is Klamath County's biggest agricultural commodity.

Right now, the Klamath Watershed is the focus of a wide range of very big issues – Total Maximum Daily Loads (TMDL's), Agriculture water quality management plans, water rights, adjudication, tribal treaty rights, endangered fish species, hydro relicensing, interstate compacts and development pressures, to name just a few.

It is not all work though. Our other hat is as Commodores of the Klamath Yacht Club. The KYC is a 53-year-old organization dedicated to the recreational use of what is one of the fines sailing lakes on the West Coast. With an active racing and cruising fleet, youth sailing program and year round social calendar, the Klamath Yacht Club is the most direct and enjoyable access to the heart of our watershed.

We are looking forward to showcasing Upper Klamath Lake and the Klamath Basin this October during OLA'S annual meeting here. With a wetland and water quality theme, organized around the conference facilities at the beautiful Running Y Ranch Resort, it promises to be a mix of good science and good times.

Plan on spending an extra day or two. There are more things to see and do here than fit in a weekend. Grab your camera and take an afternoon trip along the newly designated Volcanic Legacy Scenic Byway and All American Road. Along the way see Crater Lake, the Lava Beds National Monument and active environmental restoration projects. Birdwatch in the largest wetland complex in the West - the Klamath Basin National Wildlife Refuges system.

The Oregon Lakes Association is a nonprofit organization dedicated to lake protection and management in Oregon. For additional information on OLA, to get involved, or to obtain a membership application form write to:

OLA, PO Box 345, Portland, OR 97207 or visit our web site at http://www.ola.pdx.edu/

OREGON LAKES ASSOCIATION NEWS

THINGS OLA MEMBERS SHOULD KNOW.....

♦ **Fall Conference:** The board is currently considering where and when to hold the fall conference. Potential dates are October 6-7 or October 13-14, 2000 and the meeting will be held at The Running Y on Klamath Lake.

The tentative agenda includes: An update on the Klamath Lake project and the Center for Lakes and Reservoirs; as well as the wetlands restoration under way around Klamath Lake and the management of the Lower Klamath Lake marshes. There are several hydropower facilities throughout the Pacific NW undergoing relicensing and this process is another topic that could be of interest. Members are encouraged to contact the board to indicate which weekend would work better and to discuss potential topics that should be addressed. Remember this conference is for you!!

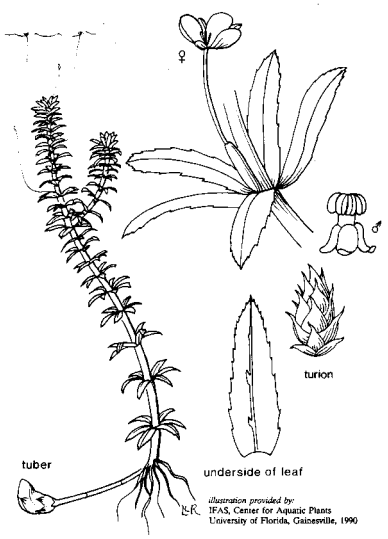
♦ **MTBE:** DEQ will do dedicated sampling for methyl-tertiary-butyl ether this summer, and is looking for appropriate candidate lakes. MTBE poses a hazard to the health of our lakes and must be monitored closely. Lakes with significant motorized water sports and lakes in areas where oxy-fuels are mandated in winter would be good selection criteria. Ten Mile Lake, Lake Billy Chinook, Detroit Lake, Henry Haag Lake, Lake Lytle, Cooper Research, and Lake-of-the-Woods were all suggested as options for this monitoring.

♦ **Roslyn Lake**: The deliberations between PGE and the Portland Water Bureau have reached a point where it is likely that the lake will persist after the dams presently feeding water to the project from the Sandy and Little Sandy Rivers are removed. The plan to reduce the surface area of the lake while making it deeper seems to be the preferred option at present. As the Water Bureau will only provide water in the Winter and early Spring, the lake will be sealed to minimize leakage. Provisions will be made to allow the lake to be drained into the Bull Run River if the need arises. Background material on this hydropower license can be found at www.pge-hl.com.

♦ **United Federal Policy:** This is a plan prepared by the US Departments of Agriculture and the Interior to coordinate the implementation of watershed improvements on federal land between federal, state, and tribal agencies. There was a meeting on the policy in Portland in early March, and written comments were accepted up to April 24, 2000. You can review the proposed policy at www.cleanwater.gov/ufp.

Next OLA Board Meeting: June 20th

HELP HALT HYDRILLA



If you see this plant, please call the

Hydrilla Hotline

503-986-4621

WASHINGTON LAKE PROTECTION ASSOCIATION CONFERENCE A SUCCESS

Oregon and OLA were well represented at the Washington Lake Protection Association conference convened at SeaTac in April. There were six papers presented by Oregonians, including OLA members Jacob Kann, who described "The role of blue-green algal dynamics, water quality, and mixing in recurrent fish kills of endangered suckers in Upper Klamath Lake"; Richard Raymond, who reported on "Incomplete mixing of inflows to Lake Billy Chinook and implications for Deschutes River water quality"; and Mark Sytsma, who updated his on-going projects with "Non-chemical weed control in flowing water with potential applications to reservoirs".

The conference spanned four days, beginning with a pre-conference workshop on non-point pollution sources. Other topics addressed were watershed studies, endangered fisheries, impacts of urbanization and land use, bacterial contaminants and waterfowl problems, eutrophication and food web interactions, reservoir tailwater/downriver issues, Lake Washington, macrophyte control, limnology for the lake association member, lake association reports, and eutrophication assessment and lake restoration. Keynote presentations discussed toxic cyanobacteria, human effects on lake/watershed interactions, non-point source nutrients, and invasive exotic species.

The non-point pollution sources workshop was especially well-conceived. Washington will include non-point pollution loads with allocations from point sources in establishing TDML's. If non-point load allocations are less than the actual loading from these sources, then measures to reduce these pollution loads will be included in the action plan. Methods to reduce non-point loading include lakescaping along lake shore lines, and interception of larger inputs such as streams or storm drains. The goal of lakescaping is to reestablish a buffer zone of diverse, natural lake shore vegetation to eliminate runoff of fertilizer and pesticides, to protect the shoreline from erosion, and to increase biodiversity. Interception methods include chemical treatment to remove phosphorus, pre-reservoirs and detention basins to promote sediment deposition, and constructed wetlands. Experience with all these methods is increasing and guidelines for their design are becoming available.

A point stressed in several of the conference presentations was that most of the world's lakes are small and shallow, and the lake processes from deep lakes are not necessarily applicable in shallow lakes. Thermal stratification may not occur in shallow lakes, making resuspension of sediments the rule rather than the exception. Because internal nutrient recycling then becomes more important than external loading, efforts to reduce nutrient inputs may not produce a noticeable effect. Because of this regular mixing, it is unlikely that a small shallow lake will be weed free with clear water. The more likely choices are clear water with macrophytes, or water showing significant turbidity from algae growth. Available nutrients will stimulate the growth of either algae or macrophytes. Which it will be often depends on whether the lake fauna is dominated by zooplankters that feed on algae or fish that feed on zooplankton.

Resident ducks and geese were the subject of much discussion. Their waste has been implicated in declining water quality and it reduces the attraction of lawns at beaches, parks, golf courses, or wherever these waterfowl congregate. Within an urban setting they are free from their natural predators, and they have year round access to plants for grazing so they no longer have a reason for annual migrations. Breeding populations are increasing in spite of all control measures tried to date. This growing problem has led the US Department of Agriculture Wildlife Service to consider lethal methods to keep the populations at appropriate levels.

Devils Lake continued

In 1996, Portland State University evaluated the effectiveness of a revegetation program that would include the reduction of grass carp. The study confirmed that Devil's Lake is a highly productive eutrophic system and that macrophytes will quickly become reestablished if grass carp were removed. This summer, Portland State University has partnered with the Devil's Lake Water Improvement District (DLWID) to investigate the seed/propagule bank in Devil's Lake in more detail to evaluate the potential for the lake to revegetate naturally. The primary objective of the investigation is to provide information on the composition of the seed/propagule bank that can be used for grass carp reduction and management planning.

A field study will be conducted this summer. Cages will be placed in several locations in the lake to exclude grass carp from the area. After the growing season, the vegetation in the exclosures will be assessed. A laboratory study will conducted simultaneously. Sediment from Devil's Lake will be maintained in the laboratory at PSU and the identity and relative abundances of different germinating seeds and aquatic plant propagules recorded. The study will provide essential information about the aquatic plant composition in Devil's Lake, specifically it will help identify whether or not nuisance species are still present in the seed bank that will reestablish if the grass carp are removed from the lake. This information will help DLWID make the best management choices possible before the grass carp are removed from the lake.

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For information on how to join the OLA contact any board member

Living Lakes: Spring Changes

by John Salinas

Look outside! Through the year our landscape changes depending on our latitude or our distance from the Earth's equator. Living in Oregon places us close to the 45th parallel or as far from the equator as from the North Pole. Because of this and the fact that the Earth is tilted on its axis in its orbit around the sun, we observe seasonal changes in our landscape. The star patterns change in our night sky, the sun follows ever changing arcs over our heads, day length changes, and plants and animals respond to each of these. Our lakes are also affected by these seasonal changes.

Water is the most dense at 3.98 degrees C. This is commonly the temperature throughout the whole lake (from top to bottom) in early spring before the sun begins to warm its surface . During this period of uniform temperature, water in the lake is able to descend or rise depending on the winds and the currents and the lake is said to be destratified. This lake "turn-over", happens only twice during the entire year, once in spring and sometimes again in fall. In cold lake water, the amount of oxygen dissolved in the lake is higher than in warm water. This is the condition we find our lakes as they begin spring. Now the warming begins changing many features of the lake.

As the sun warms the lake's surface, the water temperature increases and, the density of this warmer water decreases and the water takes up more volume. This warmer water, called the *epilimnion*, remains at the surface "floating" on the *metalimnion*, where the temperature gradient drastically changes. The colder, more dense water layer on the bottom is called the *hypolimnion*. Now the lake is said to be stratified. During stratification, only surface waters are oxygenated and only benthic (or bottom waters) absorb important nutrients from the soil. Stratification is usually not complete until summer. These changes signal the beginning of the most productive season of the year for a lake; the time when algae are blooming, zooplankton growing, and fish are active. Watch our next issue for the summer structure of our lakes.

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