PORTLAND STATE UNIVERSITY

LAKE WISE

January
2001

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

OREGON LAKE WATCH

Portland State University
Center for Lakes and Reservoirs

New Season!

The Lake Watch Program limped through 2000 with no funding but a dedicted crew of volunteers. With Oregon Watershed Enhancement Board funding of the Center for Lakes and Reservoirs in late summer, the volunteer coordinator, Carrie Haag, was able to visit several of the volunteers and lakes in the program to promote continued monitoring. An annual report on the 2000 Lake Watch Program is nearing completion. We will distribute the report to volunteers soon.

In contrast to the 2000 Lake Watch season, the Program plans to start and end strong in 2001! We will continue to support and encourage the current dedicated volunteers that have provided valuable data and input to this program. We hope to recruit many more volunteers and lakes into the program. In order to accomplish expansion of the program, we ask for your help by "spreading the word." Let your neighbors and friends know about the importance of lake monitoring. If you or your friends have any questions regarding the CLW Program, please contact Carrie at haagc@pdx.edu or 503.725.3834.

Oregon Aquatic Nuisance Species Plan

The Center for Lakes and Reservoirs at PSU has completed a draft Plan for management of aquatic nuisance species in Oregon. The Plan includes a system to classify all nonindigenous species in Oregon, identifies the proper management for each class, details current authorities and programs, and sets objectives that will lead to the accomplishment of the Plan goal. These objectives include the establishment of a management structure that coordinates Aquatic Nonindigenous Species (ANS) activities, a strong prevention program, a monitoring program that allows for the early detection and eradication of pioneering ANS, a control program aimed at established species, education, and research. Specific actions under these objectives include establishment of an invasive species council, support of regional efforts, provisions for dedicated funding for ANS management activities, development of a ballast water management program, an

Continued on page 4

Aquatic Weed Costs in Oregon

The Oregon Department of Agriculture recently released an economic assessment of weeds in Oregon. Two aquatic weeds that are likely to be familiar to most lake residents were included in the assessment: Purple loosestrife and Egeria (aka Brazilian elodea).

Briefly, the assessment indicates that Egeria infestation in lakes takes a $3.5 million bite out of the Oregon economy. Purple loosestrife has a nearly $1.5 million impact. Spartina, a serious problem in estuaries in Washington would have a $8.5 million impact if it were to colonize Oregon estuaries.

The Oregon Department of Agriculture has developed a strategy to deal with noxious weeds in Oregon. You can download the strategy, along with the economic assessment from the ODA website (www.oda.state.or.us/Plant/Weed_Control/plan/contents.html) or call the Noxious Weed Program at 503-986-4621.

Inside this issue

Roslyn Lake Decommissioning On Hold

Roger Edwards
Portland Bereau of Water

The Atlas of Oregon Lakes lists a variety of mechanisms that have created lakes. Roslyn Lake however, is in a class by itself. It is a man-made lake west of Mt Hood, adjacent to the Bull Run River. The idea for the lake was conceived in 1903 as part of a hydroelectric project that would divert water from the Little Sandy and Sandy Rivers, to flow back into the Bull Run River after passing through a power-house at the bottom of a 300-foot cliff. The three rivers are all part of the same drainage, which in its natural configuration has the Little Sandy flowing into the Bull Run and the Bull Run flowing into the Sandy. Roslyn Lake, located downstream of the natural confluence of the Little Sandy and Bull Run, served as a forebay for the project.

Using horse drawn scrapers, the lake was constructed in 1911. Dirt from the excavation was used to dike low-lying areas. The lake's 2.7-mile perimeter includes about 8000 feet of dikes. The full-pool elevation of the Lake is 650 feet. Its area is 130 acres; it has a maximum depth of 27 feet and a mean depth of 8 feet. Its volume is 1000 acre-ft, or 326 million gallons.

Water supply to the lake comes from water rights secured in 1906 to take 800 cubic feet/second in total, from either of the two rivers. This volume of water is equivalent to 1586 acre-ft per day, or 517 million gallons per day. So when the project is running at capacity, the amount of water moving through the lake in a day is greater than its volume.

Because the Little Sandy River is generally cleaner, water is preferentially diverted from this river to the lake. However, the natural flow in the Little Sandy is seldom enough to meet 800 cfs, so Sandy River water is used to bring the total diversion to its regulated level. The Little Sandy diversion essentially dewaters the river, although natural accretion does produce a 3-5 cfs summer flow at the Bull Run confluence, 1.7 miles downstream of the dam. The dam itself is about 16 feet high by 114 feet long. Its crest is at 703 feet elevation. Water is diverted at the dam into a 14,900-foot long, 9.5-foot deep, 14-foot wide wooden flume. The flume crosses several canyons on trestles and passes through an 11-foot diameter, 457-foot long tunnel before reaching Roslyn Lake.

The Sandy River dam is 47 feet high and 345 feet long. Its crest is at 732 feet elevation. The dam can divert up to 600 cfs into a 3-mile long canal, which passes through 4 tunnels with a combined length of 12,650 feet, before dumping into the Little Sandy River, just upstream of the dam there.

The powerhouse receiving water from Roslyn Lake has a generation capacity of 22 megawatts. The mean generation history for the project from 1993-97 shows that it is producing electricity at just less than 60% of capacity. Infrastructure maintenance costs and increasingly stringent regulations for anadromous fish runs have reduced the perceived benefits of the project. It is owned by PGE, who have indicated they want to dismantle it rather than renew its Federal Energy Regulatory Commission license, which expires in 2004. Their plans to take out the dams, remove the flumes, seal the tunnels, and drain the lake caused public concern, chiefly about the loss of the lake and Sandy River salmon hatchery operations.

There is a possibility that the lake could be saved by the Portland Water Bureau. They now have the capability to pass 100 million gallons per day into the lake from one of their conduits taking water to Portland. Once lake water ceases to be used for power generation, this flow rate is enough to fill the lake in about three days. However, the Bureau cannot guarantee water over the summer months. It is questionable whether the lake can retain enough water over the summer to continue its attraction as a recreation site.

Removal of the dam on the Sandy will make the entire river free running. Because there will be no barrier to fish passage, wild and hatchery fish will both have access to habitat above the dam site. The proposed elimination of the fish-sorting feature of the

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Lake Wise is published by the Center for Lakes and Reservoirs at Portland State University with funding provided by OLA, PSU, and the Oregon Watershed Enhancement 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 503-725-3834

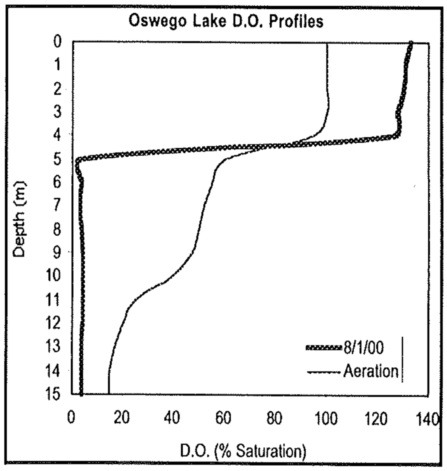
Oswego Lake Water Quality Improvement Project (Two-layer Aeration)

Steve Lundt, Water Resource Specialist
Lake Oswego Corporation

Oswego Lake, located 8 miles south of Portland, has a long history of algae problems. Cyanobacteria blooms in summer have caused surface scums, foul odors, fish kills, poor water clarity, and anoxia. A bloom of the toxin-producing cyanobacteria, *Microcystis aerginosa*, led to the closing of the lake to water contact recreation on the Fourth of July, 1998.

Anoxia of bottom water (hypolimnion) caused by decomposition of dead phytoplankton cells that settle out of the well-lit, productive upper waters (epilimnion) causes a change in phosphorus cycling in the lake. Decomposition in the hypolimnion produces a high oxygen demand (1,400 Kg dissolved oxygen/day), and causes anoxia below about 5 meters. Half the lake volume is devoid of oxygen and unable to support aerobic organisms from May to November. Anoxia at the sediment interface allows iron reduction to occur, which causes release of phosphorus into the water column and produces hydrogen sulfide. Sulfide can react with iron in the hypolimnion and result in precipitation of ferrous sulfide. Since iron is important in regulating phosphorus concentrations, removal of iron from the watercolumn by precipitation, combined with the anoxic conditions in the hypolimnion, causes a tremendous release of phosphorus from the sediments, which fuels even more phytoplankton production and accelerates the rate of eutrophication.

Phytoplankton blooms are a symptom of excessive nutrient loading to a lake. Usually phosphorus is the problem-causing nutrient. Some lakes are naturally very productive (eutrophic), and support large phytoplankton populations under natural phosphorus loads. Many Oregon lakes, however, are enriched with phosphorus by human activities in the watershed, such as fertilization, soil disturbance, and septic tanks. This human-caused increase in nutrient loading, and the subsequent increase in lake productivity is called "cultural eutrophication".



Measured (8/1/00) and predicted (Aeration) dissolved oxygen profiles in Oswego Lake with installation of the aeration system

High phosphorus loading to Oswego Lake from the watershed and the Tualatin River has been an historic problem. Recently, Tualatin inflow to the lake has been reduced, and internal loading from the lake's highly enriched sediments has taken on increased importance.

The Solution

The Lake Oswego Corporation (LOC) has reduced the external loading of phosphorus as much as possible, and continues to work with the City of Lake Oswego to minimize phosphorus loading from the watershed. The LOC will address internal loading of phosphorus from the sediments by installing hypolimnetic aeration. A two-layer aeration system will use diffusers to oxygenate water below 10 meters and four metalimnetic diffusers to oxygenate water between 5 and 9 meters.

Aeration will be provided by two 75-HP air compressors located on the shoreline. Over 13,000 feet of air lines will be anchored to the lake bottom. The system will circulate approximately 100 million gallons per day through the six diffusers, every 15-18 days half of the lake volume will go through the aerators. The aeration system will operate from about May to October each year and remain idle for the other six months while the lake mixes naturally.

The Goal

The LOC has set water quality goals for the aeration system. Expected results of the treatment include: average phosphorus $\leq$ 15 ug/L, chlorophyll-a $\leq$ 10 ug/L, and a Trophic State Index (Carlson, 1977) that averages $\leq$ 40, which is within the mesotrophic range. It is expected to take approximately 4-6 years to reach these goals.

Because of the increase in water clarity expected with the aeration, the LOC has anticipated an increase in rooted aquatic plants (macrophytes) in the lake. The LOC has purchased a mechanical macrophyte harvester to control macrophyte problems.

Roslyn Lake continued

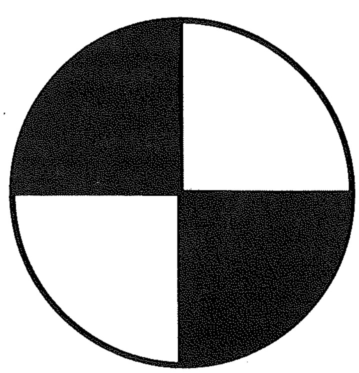
dam has resulted in heated discussions that have yet to be resolved. The decommissioning schedule for the project is on hold until this question is settled. The Oregon Fish and Wildlife Commission will choose one of four options ranging from elimination to various degrees of reduction of the river's hatchery runs. A fifth option that includes a sorting structure will also be available to the steering committee that will make the final decision. Further delays to the project decommissioning could come from the deregulation of the electric industry if the value of electric power increases enough.

State ANS Plan continued

a citizen monitoring network, emergency response plans, technical assistance to watershed councils, public education, and research on management options.

When it is completed and receives the Governor's approval, the Plan will be submitted to the National Aquatic Nuisance Species Task Force. The Task Force can provide funds to help implement the Plan.

For additional information on the Oregon Aquatic Nuisance Species Plan contact Erik Hanson (503-725-3834/ehanson@pdx.edu).



A Secchi disk

Dip-In 2001

Join your friends and neighbors in celebrating LAKES! during Lake Appreciation Week. The Oregon Lake Watch Program will celebrate the occassion by coordinating a Secchi Dip-In.

The Secchi Dip-In started in the midwest in 1994 and has grown into a nationwide effort. Although the results of such a large program must be interpreted with caution (the lakes included in the Dip-In are selected by the volunteers and are not a representative sample of lakes across the country), the program does provide a snapshot of lake water clarity across the nation. Oregon Lake Watch volunteers have participated in the Secchi Dip-In in past years, although participation has slipped in recent years with loss of funding for coordination of the Lake Watch Program.

The Oregon Secchi Dip-In 2001 will require volunteers to take a transparency (Secchi disk) measurement at the lake they monitor during the first week of July. OLW Coordinators will travel to several lakes throughout Oregon during this week to help participate in this event. We encourage volunteers to use the Dip-In as a springboard for spreading the word about the value and importance of lakes in Oregon. All of the data collected will be submitted to the national Dip-In database, which has grown to over 14,000 records on more than 4,500 separate waterbodies. The data will also be used in the Oregon Lake Watch Annual Report.

If you have any questions, or would like to participate in Oregon Secchi Dip-In 2001, please contact Carrie Haag at the Center for Lakes and Reservoirs (503-725-3834/ haagc@pdx.edu). More information regarding this event will be included in the next edition of Lake Wise. Additional information on The Great North American Secchi Dip-In can be found at http://dipin.kent.edu/whatis.htm.

What is a Secchi Disk?

A Secchi disk is an 8-inch (20 cm) disk with alternating black and white quadrants. It is lowered into the water of a lake until it can be no longer seen by the observer. This depth of disappearance, called the Secchi depth, is a measure of the transparency of the water. Transparency can be affected by the color of the water, algae, and suspended sediments. Transparency decreases as color, suspended sediments, or algal abundance increases.

While a number of factors influence water transparency, a long term record is a simple and useful way to monitor human impacts on lakes. A decrease in transparency should stimulate investigation of possible human-induced causes. Transparency can serve as an early-warning that activities on the land are having an effect on a lake.

You can have your very own Secchi disk if you are a volunteer in the Oregon Lake Watch Program!

Living Lakes: Winter

John Salinas

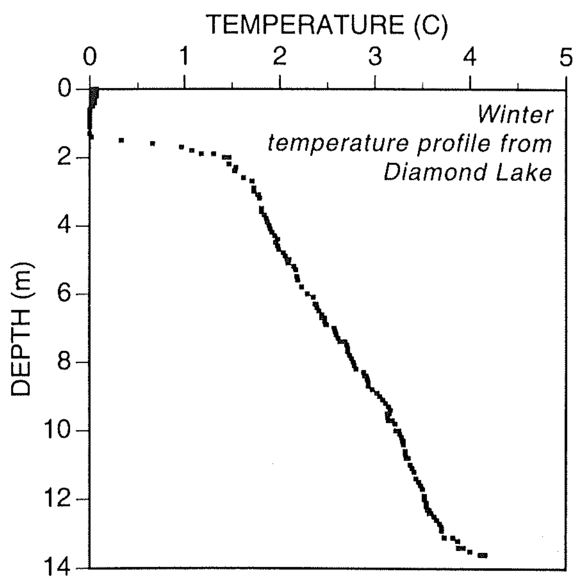
Watch your lake for some subtle and some more obvious changes this winter – mostly caused by some unique characteristics of water.

Water is a remarkable substance. Water is most dense at 3.8°C (38°F). That means that water colder or warmer than 3.8°C will rise in the water column and "float" over the 3.8-°C water. This characteristic of water allows ice cover to form on lakes in winter. As water cools below 3.8°C, it begins to freeze as water molecules form portions of the expanded crystalline ice matrix. At 0°C water is a solid, and since it is less dense than water at 3.8°C, it floats on the surface.

An ice layer on a lake creates interesting conditions below. Ice and snow transmit very little light to the liquid lake water. Microscopic plants (phytoplankton) and animals (zooplankton) may become dormant or disappear from the lake completely. Macroscopic plants also respond to the low temperatures and low light conditions by becoming dormant in the lake bottom. Fish are much less active in winter and become less interested in feeding.

In 1997 we performed a winter survey of Crater Lake. Crater Lake is almost 2000 feet deep, and as the surface water temperature drops to 3.8°C it sinks in the water column. The sinking 3.8°C-water displaces warmer bottom water, which rises to the surface, cools, sinks, and displaces more warmer water. The volume of Crater Lake is huge, and this process can occur all winter without water temperatures reaching the freezing point. Thus, we found only a thin layer of ice covering the lake surface in the morning hours. We can thank the density characteristics of water for the winter photos of the open, blue (why the lake appears blue is another story) water of Crater Lake that contrasts so dramatically with the snow covered surroundings.

Diamond Lake in winter represents a stark contrast to Crater Lake. We surveyed Diamond Lake during the winter of 1998/1999. Diamond Lake is only 50 feet deep, there is less heat present in the lake, and water can cool to the freezing point during winter. We rode snowmobiles to our summer lake sampling location (located with a GPS receiver), and dug through four feet of snow and a foot of ice with shovels and metal digging bars. Below the ice was a dark liquid lake.



Multiparameter (temperature, pH, dissolved oxygen, conductivity, turbidity) and photometer (red, green, blue, white light) recording instruments were dropped through the hole as well as zooplankton nets and water collection bottles. The low amount of phytoplankton and zooplankton were not surprising. Neither was the lack of light. The high concentrations of chemical nutrients on the lake's bottom did raise some eyebrows. Bacterial decomposition of organic materials produced in summer occurs in winter, which can result in low dissolved oxygen concentrations and release of nutrients from the sediments. Since there is little mixing of water in an ice-covered lake, these nutrients stay near the bottom.

All Oregon lakes change with the seasons, some more than others. Winter temperatures on the coast, for example, are not usually low enough for a long enough period for ice to form, even in shallow lakes. Coastal lakes, like Woahink Lake for example, are typically the same temperature from top to bottom (isothermal), there is little density stratification, and the water column mixes completely. Nutrients, trapped in the hypolimnion during the summer stratified period, are brought into the upper, well-lit portions of the water column where they are available for phytoplankton. While low temperatures and short days often limit phytoplankton production in winter, some lakes can have dense phytoplankton blooms all winter long.

Is your favorite lake like Crater Lake, Diamond Lake, or Woahink Lake in winter? Whichever type, it is the unique characteristics of water that determine it's winter condition.

The author would enjoy hearing from you. Contact him at jsalinas@rogue.cc.or.us to pose a question or ask for help understanding some feature of your lake. Until next issue, enjoy the season!

OREGON LAKES ASSOCIATION NEWS

The First Annual Oregon Lakes and Reservoirs Symposium
and
Annual Meeting of the Oregon Lakes Association
will be held
September 21 and 22, 2001
at
Portland State University

The Symposium on September 21 will include technical papers on limnology in Oregon and the Pacific Northwest – a call for papers will be issued soon. September 22 will focus on integrating limnology into watershed action plans and volunteer lake monitoring.

The Oregon Lakes Association Business Meeting will be held in the evening on September 21.

A Workshop on Woahink Lake
will be held on
April 21, 2001
at the
East Woahink Meeting Hall

We will discuss recent limnological surveys conducted by the Center for Lakes and Reservoirs, management of aquatic weeds, potential funding via the Clean Lakes Program, and begin development of a workplan to address eutrophication and invasive species issues.

Watch your mailbox for additional information, but
mark your calenders now!

OLA Welcomes New Director

The Oregon Lake Association (OLA) would like to welcome Steve Lundt, a new member of the OLA Board of Directors. Steve has been the Water Resource Specialist for Oswego Lake since August 1999. He received a Bachelor of Science from Pacific University and a Masters of Science in Environmental Science from the School of Public and Environmental Affairs at Indiana University. While studying in Indiana, Mr. Lundt was the Indiana Volunteer Lake Monitoring Program Coordinator and is currently responsible for the Oswego Lake Water Quality Monitoring Program. Other related activities include membership in the North American Lake Management Society (NALMS) and the Indiana Lakes Management Society. He is also an active participant in the Tualatin Watershed council, Chair of the Lake Oswego Corporation Water Quality Committee, and Project Manager for the Oswego Lake Water Quality Improvement Project. (To learn more about Mr. Lundt's work with the Oswego Lake Water Improvement Project, please see page 3).

Steve is excited to be a new Board member. He states, "I would like OLA to be the leader for monitoring, evaluating, and managing Oregon's lakes. The newly established Center for Lakes and Reservoirs at Portland State University will provide the necessary academic structure and facilities to have a central, organized Oregon monitoring and volunteer program. I am excited to use my graduate experiences to help with the volunteer monitoring program and assist with setting up a similar lake monitoring program that Indiana has implemented."

If you would like to contact Steve, he can be reached at 503.636.1422x23/ lundt@cybcon.com.

OREGON LAKES ASSOCIATION NEWS

Oregon Lakes Association Board of Directors

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/

Center for Lakes and Reservoirs Research Focus

The Dynamics of the Plankton Community of Two Oregon Reservoirs

Miguel Estrada, MS

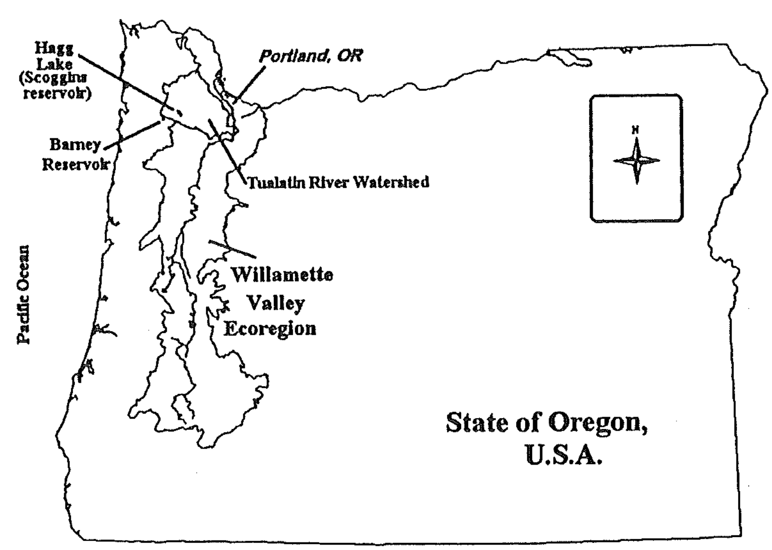
From June 1998 to July 1999, I studied the dynamics of the plankton in Hagg Lake and Barney Reservoir (Oregon) with three purposes; 1) to identify the succession dynamics of the planktonic species, 2) to test the Plankton Ecology Group (PEG) model, and 3) to explore the relationships between phytoplankton successions and the physical and chemical changes in the lakes.

Inferences were made about the interactions of the physical and chemical variables and their effects on the plankton using a conceptual model (see page 8). Based on the observed interactions, three statements were made:

1. Hagg Lake and Barney Reservoir have a mesotrophic lacustrine zone.

2. In Hagg Lake changes in water level regulate dissolved oxygen concentrations, and summer disturbances in the watershed increase sediment loadings.

3. In Barney Reservoir extreme variation in water level influence the temperature regime of the water column and the nutrient dynamics.



Based on discrepancies between the PEG model predictions and the observed succession, I made two more statements:

4. In Hagg Lake, high winter 1998 and early spring 1999 water inflows and mixing did not allow a stable winter - spring succession. Species adapted to low light and low temperatures were common.

5. The early start of mixing in Barney Reservoir interrupted

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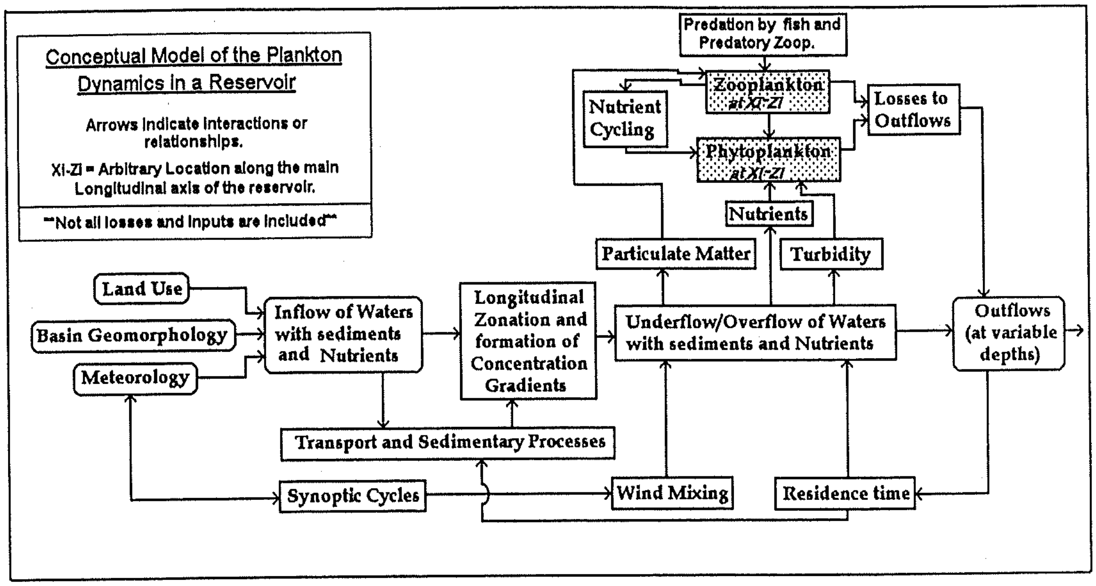
CLR Research continued

the fall succession, and a continuous ‘resetting’ of the succession favored populations of cryptomonads and small zooplankters.



The main conclusions of the study were:

- A model to identify the dimensions and factors that define a reservoir under study should be developed if a model of reservoir planktonic dynamics is to emerge.
- The PEG model needs to be modified to include longitudinal variation in nutrient concentrations of and the effects of convective and dispersive forces.
- A hypothesis is put forth regarding the plankton dynamics if fish stocking is initiated in Barney Reservoir: With stocked fish exerting more pressure on cyclopoids, calanoids will be able to colonize the reservoir; in turn grazing-resistant algae, adapted to low nutrients, will become more abundant.

For more information on this research contact the Center for Lakes and Reservoirs (503-725-3834)

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