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LAKE WISE

A Voice for Quiet Waters

The newsletter of the Oregon Lakes Association

Phillips Lake Adds Tiger Muskies

It has been well reported that ODFW personnel oversaw the stocking of 25,000 tiger muskie fingerlings into Phillips Lake on the evening of June 25th. Besides the local significance of this event, it marked the first official welcome of any member of the pike family in Oregon. There are large sections of North America where pike fisheries are well established and popular, but the positive attributes of these fish are little appreciated in river drainages with salmon runs. Pikes are lean and hungry flesh eaters that consider almost all of their neighbors as potential prey. Under the right conditions, salmon can co-exist with pike, but they cannot thrive.

ODFW brought tiger muskies to Phillips Lake because they are sterile predators that have proved effective elsewhere in restoring balance in lakes where unwanted introductions have overrun established fisheries. Phillips Lake is an impoundment on the Powder River in the Columbia River basin, which is already subject to the presence of tiger muskies in both Idaho and Washington lakes. The success of these programs in neighboring states makes the introduction of tiger muskies attractive here as an experimental control for the yellow perch in Phillips Lake.

Tiger muskies are hybrids produced by crossing two pike species, the northern pike, *Esox lucius*, and the muskellunge, *E. masquinongy*. An acceptable definition of a species includes all the individuals that can mate and produce fertile offspring. Female tiger muskies can produce viable offspring by mating with muskellunge or northern pike males, but this union is unlikely to occur in the Phillips Lake reservoir. Male tiger muskies however are sterile, which supports the conclusions that northern pike and muskellunge are distinct species, and that tiger muskies are hybrids, which are commonly produced by fertilizing muskie eggs with northern pike milt. Hatchery experiments with tiger muskies began in the late 1930's and female muskellunge were initially chosen for this cross because they produce more eggs than their northern pike counterpart. It was later observed that northern pike seek weed beds for spawning and their eggs are adhesive and stick to vegetation. Hatchery spawning is best done in clear water where northern pike eggs clump together. Clumping is less of a problem with muskie eggs, which in nature are broadcast in open water areas of a lake. Hatchery spawning is further complicated because northern pike spawn two to four weeks before muskellunge, making timing a key issue. Species incompatibility lowers the success rate of this cross even more.

While tiger muskies are hard to produce and have hatchery rearing problems as well, their production has become feasible even though only a low percentage of the eggs made available develop and survive for stocking. The batch for Phillips Lake was surplus production from the federal hatchery near Casper WY. These 5 inch fingerlings are expected to begin eating perch immediately and should attain a weight of 30 pounds within a few years. A record, 44.26 pound tiger muskie was recently caught in Idaho. This fish was 50.5 inches long and had a girth of 25 inches. Like the tiger trout that ODFW has previously placed in Phillips Lake and the Fish Lake in Jackson County, anglers must release any tiger muskies they catch.

The impact of tiger muskies on Phillips Lake perch will be closely watched. Perch are notoriously prolific and can recover from shocks to their population numbers. Measures to reduce the perch population sufficiently to re-establish a rainbow trout fishery will have to be continuous and multi-faceted. Substantial perch removals in net traps over successive years have had little effect, and the stocking of tiger trout has not brought the sought level of control since that program began in 2011. Periodic creel surveys are planned to evaluate how the addition of tiger muskies changes the conditions in the reservoir, and to determine future stocking levels. Tiger muskies have a life span of about 15 years and their inability to reproduce makes their continued presence in Phillips Lake dependent on additional releases. The ban on harvesting could be lifted if their numbers become excessive.

Goodrich Lake Vindicated in Baker City *Cryptosporidium* Outbreak

The 2013 Baker City *Cryptosporidium* outbreak has now concluded, but for the adoption of a strategy to ensure it will not be repeated. The quick recognition of a problem by the staff at St. Alphonsus Medical Center and the Baker County Health Department kept the incident from becoming much worse. There were just over 20 confirmed cases but investigations of the State Public Health Division estimate the number of infections were easily 10x that number in a city with a population of 9828. Not all cryptosporidiosis infections produce symptoms and most cases are resolved without treatment by the immune response of the victim. Nevertheless, a waterborne disease outbreak is deemed serious because they are preventable by established water treatment protocols.

The water system supplying Baker City has grown with its population. Water is currently drawn from 11 surface streams and at least one well. The Baker City water supply is one of the few surface water systems in Oregon that is still unfiltered. The system is anchored by a reservoir at Goodrich Lake, which has sufficient capacity to provide the needed water during the dry summer months. The lake is a small cirque lake at the base of Elkhorn Peak and at the head of Goodrich Creek. It is a labeled feature on the 1936 ODOT highway map of Baker County. The name honors the memory of A. C. Goodrich, who brought surveying and construction skills to the mining town of Auburn in the early 1860's. He had a key role in the construction of the Auburn Ditch, which diverted water from Goodrich Creek at or near the present diversion site for the Baker City aqueduct.

Goodrich Lake became a reservoir in 1961 with the construction of a 65 foot dam, stretching 385 feet across the creek channel. The dam increased the area of the lake to 23 acres and its capacity to 603 acre-feet. The lake lies at an elevation of 6877 feet in a steep basin less than one square mile in area. Water leaves the reservoir through a glory hole outlet next to the dam and is delivered to the historical creekbed. Water flows about 3 miles and drops about 2400 feet before it is diverted for municipal use. The lake is within the 10,000 acre Baker City Watershed, which has limited public entry.

The other surface sources of the water supply are also creeks flowing off the Elkhorn Mountains toward Baker City, but further to the south of Goodrich Creek. They too have their headwaters within the protected watershed. Elk Creek is the southernmost of these streams. Water is diverted into an aqueduct from these sources and it joins the Goodrich Creek aqueduct on the west edge of Baker City, where the water is disinfected with chlorine and moved to storage reservoirs.

Water sampling to detect the source of the *Cryptosporidium* was essentially negative until 913 oocysts were found in a 10 L sample collected on August 4th from Elk Creek. The Elk Creek supply was shut down on news

of this lab test. Subsequent investigations found cows and calves had wandered into the Elk Creek drainage from an adjacent grazing area. Calves have been previously implicated in numerous *Cryptosporidium* outbreaks.

After the first cryptosporidiosis case was confirmed on July 29th, suspicion was initially directed to Goodrich Lake because water from that source had just been brought on-line on July 15th. This was the only change to the water system during the period, and the time lag was right for the incubation period for cryptosporidiosis symptoms to appear. Furthermore, mountain goats were known to be in the Goodrich Lake drainage, and they might have been the source for the contamination. In hindsight, the surface level outlet from the reservoir minimizes the chances of oocysts entering the water system from the lake because particulates tend to settle in slack water. Recognition of this fact is why a settling tank is included on the Elk Creek arm of the municipal aqueduct.

Long Lake and a Long Time Ago

Native American archeology is abuzz over the news last month of petroglyphs that were dated to between 10,500 and 14,800 years ago. The limestone rock carvings are described in a paper titled, "Dating North America's oldest petroglyphs, Winnemucca Lake subbasin, Nevada", by L.E. Benson, E.M. Hattori, j. Southon, & B. Aleck in *Journal of Archaeological Science*, 40(12):4466-4476.

The existence of these petrogylphs in the ancient basin of Winnemucca Lake on the Nevada Piute Reservation has been long known. They are deeply carved in soft limestone, making them especially prominent. Their age was established by radiocarbon dating the carbonate crust that sandwich the carvings. This date range was further narrowed by examining cores from adjacent Pyramid Lake, which overflows into Winnemucca Lake at surface elevations greater than 3960 feet. This evidence showed the rocks of Winnemucca Lake were exposed from 10,500 to 11,300 and from 13,100 to 14,800 years ago. While the precise era of the carvings cannot be determined, this range is older than petroglyphs previously thought to be the oldest in North America, which are on the rim around Long Lake in Lake County, Oregon.

Some of the Long Lake carvings were buried in ash from the Mount Mazama eruption, which occurred a mere 7700 years ago. There is no telling the real age of this set of rock art, so the Winnemucca petroglyphs now have the distinction of being the oldest dated grouping of this art form in the continent. The Long Lake carvings are found scattered irregularly in the basalt boulders that form the rim of the lake. The lake is just over 2 miles long, and about 0.2 miles wide. It lays in a steep NW/SE axis on Bureau of Land Management lands, about 10 miles east of Crump Lake. The BLM describes the area topography as, "large sagebrush flats with low hills providing some minor topographical relief. There are several small open ephemeral lakebeds that occur as shallow depressions." Long Lake is one of these depressions. It does fill seasonally, to varying extent from year to year, and it is the NW end where the water persists longest. The BLM has constructed a 10 foot diversion dam at the SE end to create a 15 acre pool of water for livestock or wildlife. BLM maps show that the road crossing the NW end of the lake is closed.

Long Lake is within the High Lakes Area of Critical Concern, which was established in 2003 to protect cultural values. The rock art within this region is diverse and accumulated over a significant time span. The depiction of mounted horsemen obviously dates much later than the carved abstract designs that were found beneath Mount Mazama ash.

Have You Seen any Turtles Lately?

Present day turtles, like their crocodile cousins, can be traced in the fossil record back to the Triassic Period, which got underway somewhere around 200 Mega-annum ago (1 Ma = the time of one million years). To have persisted for such a duration, one must conclude that turtles are well adapted to their ecological niche. It is also well established that modern turtles have a lifespan substantially longer than the attention span of juvenile humans. Therefore when Toby the Turtle is no longer fun to play with and is liberated to seek his own fortune, it is not unlikely that Toby will find a life mate and live out his years in his new surroundings by adhering to the methodical manner that serves turtles so well.

The release of non-native turtles has muddled turtle distribution world-wide and in Oregon. In 1948, Oregon State College zoology professor Fred Evenden published a paper titled, "Distribution of the Turtles of Western Oregon" (see Herpetologica 4(6):201-204) that provides useful insight on the turtles we should expect to see in our lakes, ponds, and streams. His studies found just two species, the western pond turtle, *Actinemys marmorata*, (previously known as the Pacific mud turtle, *Clemmys marmorata*) and the western painted turtle, *Chrysemys picta belli*. After examining the reported turtle sightings throughout the Pacific northwest, he concludes the range of these two species is complementary in the Willamette Valley, with the western painted turtle generally limited to east of the Cascades, but along the Columbia and lower Willamette Rivers. He found none of this species south of Salem, but the western pond turtle was common south of this latitude in the Willamette valley, along the coast, and in the Cascades.

Sightings of the western pond turtle have been reported as far north as British Columbia, but these reports are rare and come from areas adjacent to population centers. Professor Evenden opines that, "the turtles either have been there all the time, but local observers have not seen them (which is very unlikely), or they have just recently come into prominence because of increasing numbers, possibly as a result of man's importing and liberating them." It is of interest that the reports from Tacoma and British Columbia were made in 1939 or before.

Since this early warning was issued, the problem of importation and liberation has become even greater. Oregon now has four turtle species and they are jostling one another for dominance. Furthermore, the importation and liberation of bullfrogs and bass have added new predators for turtles here to be wary of. Raccoons still relish eating turtle eggs and loss of habitat poses the same threat to turtles as it does for other species.

It is the red-eared slider, *Trachemys scripta elegans*, and common snapping turtle, *Chelydra serpentine*, that have been added to Oregon wildlife. The red-eared slider can be distinguished from the others by horizontal red stripes behind its eyes. It is becoming increasingly common along the coast, in the Willamette valley, in the east Cascades, and the Klamath Mountains. Identifying features of the snapping turtle are its larger size and its serrated tail. It has become established in the Willamette valley and the western Cascades.

The introduction of these non-natives has made the distribution of all four turtle species a matter of interest to ODFW. They have partnered with the Oregon Zoo to rear and release western pond turtles, and with Native Turtles of Oregon to coordinate recovery efforts for both native species. A simple way the public can help in this work is by reporting sightings to www.oregonturtles.com. The information sought there is a description of

the turtle, and where and when you saw it. These details are readily available from a cell-phone camera. It might help too if frog legs became a greater delicacy.

Preventing the Spread of Aquatic Invasive Species: Oregon's First Constructed Boat Wash Station

by Glenn Dolphin, AIS Coordinator, Oregon Marine Board

Preventing the spread of Aquatic Invasive Species (AIS) via recreational boats has become an important priority for the State of Oregon since the creation of the Aquatic Invasive Species Prevention Program (AISPP) in 2009. The current program is co-managed by the State Marine Board and the Fish and Wildlife Department. The basic structure of the program is such that the Marine Board implements the boat permit program ($5 annual permit fees for boats with and without motors), collects the revenue and oversees expenditures, coordinates with law enforcement agencies to ensure on-water compliance, oversees outreach efforts to boaters, and has established financial agreements with partner agencies and organizations to implement different aspects of prevention efforts. One of the most important aspects of the program is to work with and provide funding to the Oregon Department of Fish and Wildlife (ODFW) to implement the state network of highway boat inspection stations. During the summer of 2013 ODFW managed five such stations and so far has been successful at intercepting contaminated boats with AIS, such as the dreaded zebra and quagga mussels along with boats transporting aquatic vegetation.

Not long after the AIS boat permit fees started in 2010, boaters began making requests to the Marine Board for the state to construct boat washing facilities so the tools could be made available for boaters to meet the state "clean launch law" (also new as of 2010) and be able to implement the boating practices being communicated through the "Clean, Drain, Dry" outreach message. At just about this same time the Tenmile Lakes Basin Partnership, a non-profit Watershed Council, approached the state to inquire about the possibilities of funding and building a boat wash station at the Coos County Parks Department boat launch facility located at Tenmile Lake. During this first year of the AIS Prevention Program, the revenue was slow to arrive and the basic structure of the program was still being established. However, after holding several planning meetings it was decided to move forward on preliminary efforts to explore the concept.

Local partners for the project came forward from the U.S. Forest Service, Coos County Parks Department and the Tenmile Lakes Basin Partnership. To really give the project a jump-start the U.S. Forest Service secured an internal agency grant that would ultimately fund half of the total costs. It wasn't until the 2012 Marine Board budget year that revenue from the AIS Prevention Fund (those $5 annual boat permit sales) was adequate enough to be able to support the other half of the proposed project.

During the winter of 2012/2013 the engineering and design work for the project took place. The Marine Board has on staff several licensed engineers that accepted the challenge of designing the wash facility. With this project being a first of its kind in Oregon, other similar projects were researched from around the country. Ultimately a boat wash station built at Hauser Lake in Hauser, Idaho and one at Hagerman Lake in the Upper Peninsula of Michigan were used as models. The main goal of the station is to provide boaters a way to clean off aquatic vegetation either before or after launching their boat in Tenmile Lake. The station features include a two bay set-up so multiple boats can be cleaned at the same time. Cold water is provided through hoses mounted on spring loaded auto-retract reels with low pressure nozzles, wash water is collected in a 1,000 gallon underground tank with screens to trap vegetation and other debris before the water is pumped to a settling pond

for infiltration. A filter sock is installed over the discharge pipe for additional cleaning of the water. The location of the settling pond is such that it won't allow any water to reach the lake and the high infiltration rates of the sand allow accumulated water to disappear quickly. Approval was granted from the Oregon Department of Environmental Quality for this discharge system and it will be monitored closely to determine how well it operates.

A secondary benefit, but of equal importance to the project, is that posted signage at the station will help to further educate boaters on the topic of AIS and the how and why it's important to clean boats. To monitor the goal of increasing the awareness level of boaters and to document the use of the station, researchers at the Portland State University Center for Lakes and Reservoirs were contracted with to perform both pre and post station surveys of boaters. The data is still being compiled but preliminary results show a very positive outcome to the station being constructed.

The Marine Board along with the project partners will be closely monitoring this project for the next year to determine if any similar types of wash stations would benefit Oregon Lakes for consideration in the future.

Management and mitigation of Harmful Algae Blooms (HABs): Chemical treatment using Phoslock®

by Wayne Carmichael, OLA Board Member

Algal bloom refers to a dense growth of algae, visible to the unaided eye in a water body, to the extent that the water is tinted red, green, brown or yellow. In fresh and brackish waters the algae group most responsible for a HAB are certain genera and species within the Cyanobacteria (formerly blue-green algae). The "harmful" aspect of these blooms from an environmental context begins with a loss of water clarity, which suppresses aquatic macrophytes, and negatively affects invertebrate and fish habitats. Bacterial decomposition of dying blooms may lead to oxygen depletion (hypoxia and anoxia), and subsequent fish kills. Many CyanoHABs produce toxic metabolites which can cause serious acute and acute lethal intoxication in mammals (including humans).

Management and mitigation of HABs involves three primary areas, with an understanding that total watershed management is also important. These three areas are 1) Physical controls, which include such strategies as locating water intakes at places or depths to avoid HAB concentrations, or using aerators or mechanical mixers to discourage or disrupt the blooms. 2) Biological controls are best described as the manipulation of the lake's watershed and lake ecology to favor reduced cyanobacteria growth. 3) Chemical controls. While chemical controls are used for all the major chemicals of interest it is phosphorus that has received the most attention. Common phosphorus treatments include lime, aluminum sulfate, ferric chloride, and some types of clay particles. These treatments act by binding with algae cells to form flocs which settle out and remove the bloom from the water column, including some forms of phosphorus. While not their main purpose they can also act to bind phosphorus and make it inactive for nutrient purposes. These treatments can often involve large amounts of product, sometimes tons to effectively treat a large water body. Treatments are often shortlived and require repeat application.

A newer more effective phosphorus binding compound product was developed about 10 years ago. Available in the U.S. since 2010 and marketed by SePRO, this product is called Phoslock®, a patented phosphorus locking technology containing lanthanum (5%), a naturally occurring earth element, embedded inside a clay

matrix (~95%). Phoslock was developed by the Australian national science agency, Commonwealth Scientific and Industrial Research Organization (CSIRO), to remove phosphorus from water bodies and restore water quality. Phoslock is produced through a patented ion exchange process whereby lanthanum ions displace sodium ions within the clay matrix. The formulation process of Phoslock absorbs lanthanum into a non-toxic carrier such that the lanthanum retains its capacity to bind phosphate when applied to aquatic environments and results in a non-toxic mineral that becomes an inert component of the sediments.

Following an application of Phoslock, the lanthanum ions sorbed to the clay matrix react preferentially with free phosphate compounds in water (removing free reactive phosphorus) and form a highly stable insoluble mineral. The resulting mineral complex becomes integrated as an inert component into the natural sediments of the waterbody and is not bio-available. Due to the specificity of Phoslock to phosphate, as long as binding sites are available, it will continually bind new incoming phosphorus from internal and external sources.

Unit costs of Phoslock are higher than other phosphorus binding products, but application rates are much less, with typical applications being about 150 mg/L. These lower application rates also make it much easier, with less labor and equipment required, to carry out.

Ecological risk assessment studies with sentinel zooplankton, fish and benthic invertebrate species show that Lowest Observed Effect Concentrations (LOEC) are well above, and often orders of magnitude above, the application rates for Phoslock. This is because the lanthanum formulation in Phoslock is not bio-available in aquatic systems. An explanation of this follows: Lanthanum is a naturally occurring earth element. Lanthanum can occur in many forms. One such form, lanthanum chloride ($LaCl_3$) can be potentially toxic to aquatic organisms. However, when lanthanum is applied to surface waters in the form of Phoslock, the risk of potential lanthanum toxicity to aquatic organisms is negligible due to the formulation of Phoslock (absorbed to the clay matrix) and a limited potential for exposure to free lanthanum. When Phoslock is applied to water, lanthanum associated with the clay in Phoslock preferentially binds with phosphate (PO_4), forming a stable mineral called rhabdophane ($LaPO_4$). This resulting rhabdophane complex has a very low solubility product constant (Ksp) of $< 10^{-27}$ (the more negative a Ksp the less soluble a compound is) and is not influenced by changes in pH and redox reactions in waterbody sediments, thus is not bio-available. Lanthanum can only be extracted from rhabdophane in the laboratory using strong acid extraction methods.

While time and use will tell if there are overlooked or emerging issues that might make Phoslock less useful or safe for binding phosphorus, present understanding indicates it is a product well suited to the toolbox of methods for management and mitigation of CyanoHABs.

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*Carmichael W.W. (2001) Health effects of toxin producing cyanobacteria: the cyanoHABs. Human Ecological Risk Assessment. 7:1393–1407.

*Phoslock®. Since 2010 Phoslock has been marketed by SePRO in the United States. http://www.sepro.com/phoslock/

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OLA Mission: The Oregon Lakes Association, a non-profit organization founded in 1990, 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 OLA policy statements.

Visit our website: www.oregonlakes.org

OLA/WALPA Conference Set for October 16-18

Join us at this meeting for discussions about Collaborative Lake Management. It is the second joint meeting of the Oregon and Washington Lake Associations, and it promises to be as worthwhile as their 2006 lake conference held at Portland State University. Combining the memberships of the two organizations attracts more vendors to display their products and services, and draws from a wider range of researchers to report on their work.

Attendees coming to Vancouver WA for this year's meeting can choose between two pre-conference workshops on Wednesday, and multiple sessions scheduled for Thursday and Friday. The Wednesday workshops are an Aquatic Weed School, taught by the PSU Center for Lakes and Reservoirs staff, and WALPA's Limnology 101 training course.

The Conference takes place in the Hilton Vancouver, Washington, which is offering special room rates for the event. Go to the OLA website for additional details and registration instructions, www.oregonlakes.org.