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LAKE WISE

A Voice for Quiet Waters

The Oregon Lakes Association Newsletter

The Current and Future Costs of *Dreissena* Mussel Infestations

Zebra and quagga mussels, *Dreissena polymorpha* and *D. burgensis*, respectively, were introduced to the Great Lakes region of the US in 1985-86. They quickly proved themselves to be impossible to eradicate, difficult to contain, and very disruptive. The experience that was gained in dealing with these invasive, fresh water mollusks suddenly became more significant on the west coast when quagga mussels were discovered in Lake Mead in January 2007. Hurried examinations by the end of February revealed the mussels had already spread downstream on the Colorado River beyond Hoover Dam to Lake Havasu, which is the diversion point for the Colorado River Aqueduct that delivers water for domestic use to southern California. In August 2007, the first discovery of quagga mussels in the San Diego region was made at Lake Miramar, a reservoir receiving water from both the Colorado River Aqueduct and the California Water Project. By September 2010, the mussels were know to be in all but two of the water bodies connected to the San Diego County Water Authority's untreated delivery system.

The presence of quagga mussels in the water supply for San Diego County has not led to an interruption of delivery to the system's 3 million end users. Maintaining this uninterrupted flow of potable water however, has become more complicated. The job descriptions of local water service personnel have been amended, and additional steps are now part of delivery protocols. These changes were made after careful consideration of how to best respond to this new crisis, and the conclusions of the response there are applicable elsewhere.

The premise underlying the SDCWA response plan was that the continued infestation of their source water means that the infestation cannot be reversed. The objectives for overcoming this on-going problem then is to control quagga numbers within their system, and to prevent the further spread of the mussels to uninfested waters. The response examines the problem from seven perspectives:

1. Evaluate system component vulnerability.
2. Perform regular system monitoring for quagga/zebra mussels.
3. Comply with established reporting requirements.
4. Promote awareness of quagga/zebra mussels and take proactive steps to minimize further spread.
5. Participate in selected research projects to improve options for mussel response and control.
6. Implement Best Management Practices to minimize mussel spread.
7. Implement Best Management Practices for mussel population control.

These steps require new expenditures or increased priorities of existing budget items and so demonstrate the worth of preventing *Dreissena* mussel infestations. Discussions of the list's final three points are especially interesting for the insight they give about the current thinking about managing these invasive species.

The SDCWA does not have the capacity for primary research, but they have agreed to help fund pertinent projects and can also aid investigations by providing quagga mussels and/or space in their waterways for device testing. Principal topics of *Dreissena* research are material tests to find a coating the mussels will not colonize,

and inactivation methods that can exclude or kill them. Two promising inactivation projects now underway are (1), examining how modifying the electrical fields produced by impressed current cathodic protection might create mussel exclusion zones, and (2), defining the effectiveness and specificity of Zequanox™ as a molluskicide.

Impressed current cathodic protection uses an external source of direct current to create an electrical field that overwhelms natural electrical cells producing galvanic corrosion of dissimilar metals in infrastructure components. It is a standard methodology already in place, which may also be able to produce an electrical field that mussels cannot tolerate. Zequanox™ is a preparation awaiting EPA approval after tests have shown it to be a useful agent for control of *Dreissena* mussels. Its chief ingredient is the dead cells of a particular strain of *Pseudomonas fluorescens* bacteria, which produce a toxin lethal to all stages of *Dreissena* mussels, but to little else.

Best Management Practices that SDCWA has now adopted are numerous. Included are filtering raw water releases that may reach uninfested waters through a 25 µm mesh, or a 150 µm mesh with chlorination; shortening the interval between scheduled maintenance of critical components; increased component exercise frequency; using reservoir and pipeline drawdown for mussel desiccation; preference for metal to metal valve seats; and retrofit of injection ports and cleanouts. These and the other changes necessitated by the infestation all add to operating costs.

While *Dressena* mussels have yet to be found in the lakes or streams of Oregon, there have been several instances where they were discovered on highways around the state. These discoveries occurred in part, because an investment has been made here to educate the public about non-native invasive species in general, and zebra mussels in particular. The most recent incident was on May 18th, when a Washington man towing his newly purchased, 15 foot Boston whaler voluntarily stopped for an ODFW inspection at Ashland. The boat had come from Michigan, and had just recently passed through a California inspection on the Arizona border. Because zebra mussels were readily seen on the boat motor, the California inspection was hopefully focused on agricultural produce rather than aquatic invasive species. The ODFW team decontaminated the boat with a hot water washing before it was allowed to continue the drive to Everett, Washington. Current Oregon law states that inspections for aquatic invasive species can only occur with a boat owner's permission, but HB3399, now under consideration in the Oregon Legislature, would make these roadside inspections mandatory for commercial and recreational boats.

Better communication between state inspection teams was in evidence on April 7th, when ODFW was notified that a boat with quagga mussels was headed to Oregon from Spokane. The mussels had been discovered in Idaho, but a mechanical problem delayed decontamination until the boat arrived in Hood River. Word has also been received that Nevada's Rye Patch and Lahontan Reservoirs have tested positive for quagga veligers. Rye Patch Reservoir is about 100 miles south of the Oregon border, on Hwy 95, and Lahontan Reservoir is just 45 miles from Lake Tahoe, which has raised serious concern there.

The Oregon prevention effort is supported by a $5 increase in boat registration fees that raised $680,094 last year. As reported in the November 2010 *Lake Wise*, this money is providing aquatic invasive species education, training, and inspections throughout Oregon. While significant, this expense is not comparable to the reallocation of scare resources now needed in San Diego County.

Phillips Lake has a Problem with Perch

And the same can be said for Phillips Reservoir. Fortunately for ODFW, which must deal with the problem, these two instances are actually just one, due to the inconsistent naming of water bodies. Phillips Lake and Phillips Reservoir are both references to the Bureau of Reclamation reservoir behind a 167 foot dam on the Powder River, 17 miles southwest of Baker City. Phillips Lake is the officially recognized name for this reservoir according to the USGS, which has the responsibility to ensure that maps of the United States are consistent.

Significant snowpack and dry summers fostered the idea of developing an irrigation reservoir on the upper Powder River back in the 1930's. It was not until 1965 that construction of the dam got underway however, and the newly completed facility began filling in November 1967. The reservoir has a maximum depth of 125 feet, a storage capacity of 90,540 acre feet, and provides irrigation to 18,500 acres, most of which is north of Baker City. Under the operating protocols of 1969 to 1978, the reservoir's water surface elevation typically fluctuates between 4056 feet in May and 4031 feet in October. Flood control, recreation, and fish and wildlife conservation were other considerations included in the design of the reservoir.

Phillips Lake quickly became a very popular recreation destination. Its location in the Whitman-Wallowa National Forest made the USFS responsible for managing the shoreline, and they developed campgrounds and boat ramps. ODFW started a program of stocking the reservoir with trout and found fingerlings survived and grew well there. A survey in 1985 showed that the reservoir had been host to 35,000 angler days. This number dropped to just 800 angler days in 1997 after the illegal introduction of yellow perch had decimated the previously successful trout fishery.

Perch were first noticed in the reservoir in 1991. Because Phillips Lake has the conditions needed for perch reproduction, they soon dominated the fish population. Perch are a popular game fish that can attain a 12 inch length and a weight of about 2 pounds. Females tend to be measurably larger than males. The Oregon record yellow perch weighed 2 pounds, 2 ounces and was caught in 1971 at Brownsmead Slough, which is on the Columbia River about 15 miles east of Astoria. But the average size of Phillips Lake perch is 7-8 inches, due to their overpopulation and their over utilization of the reservoir's zooplankton. Trout fingerlings do not grow to legal size without an abundant diet of zooplankton, so continuing angler interest in Phillip Lake now requires ODFW to stock more expensive, harvestable sized trout. Water quality is also at risk without abundant zooplankton because of the cleaning action of their indiscriminate filter feeding is no longer available.

ODFW negotiated an excellent example of a true Win/Win agreement with their counterpart in Idaho to make Phillips Lake perch available for stocking in Idaho. Approximately 100,000 perch were taken from the reservoir in 2004 and the Idaho personnel returned in 2005 for another 200,000. This straight-forward operation led to an experimental project, just concluded this last April, to see what effect annual removals of 200,000 perch would have during three successive years. The removals were conducted soon after ice-out and thus before the annual spawning season, which gets underway as water temperatures reach 6.7 to 12.8° C. (44-55° F.) It took just five days to net the 2011 quota of perch, a catch of 41,631 pounds, suggesting there are still abundant numbers of these fish as the experiment comes to an end.

Stable perch fisheries elsewhere rely on a strong predatory pressure to keep perch numbers in check. Stunting in perch fisheries is well documented where populations can grow without adequate checks. Largemouth bass, walleye, and fish eating birds such as cormorants, kingfishers, and mergansers have been noted for their

appreciation of perch. Yellow perch too are piscivores and will cannibalize other perch, but not noticeably in Phillips Lake. ODFW will stock fingerling tiger trout this fall as a potential perch predator. These fish are sterile hybrids of brook and brown trout parents, and should be a welcome prize for perch anglers next year. There is no limit for perch in Phillips Lake and the reservoir is open year round. Ice fishing for perch continues to attract enthusiasts there.

The yellow perch, *Perca flavescens*, is not native in Oregon. It is a freshwater, North American fish that is naturally found east of the continental divide between the latitudes of Nova Scotia to South Carolina. The perceived good features of this species has brought widespread introductions in the western US and elsewhere. It is a schooling fish that prefers shallow, still or slow moving water with aquatic vegetation. Yellow perch do not do well in oligotrophic waters, but in productive waters with a temperature range encompassing 21-24° C., they commonly achieve dominance over existing trout populations. Fish with a preference for warm water are tolerant of low dissolved oxygen levels.

Yellow perch have a life span of up to ten years, and the adult fish surviving to reach this senior citizen status may have participated in eight spawning seasons. Females lay their eggs in shallows near the shoreline and their semi-buoyant, sticky, ribbon of eggs, are fertilized by multiple males. Typical brood size is 23,000 eggs but there is a wide range in this number. The eggs are abandoned soon after mating and they begin hatching within two to three weeks, depending on water temperature.

These perch are predators, and by the success of their reproduction, they are a prey species as well. Their newly emerged fry will school and feed on the crustacean segment of zooplankton that is found in weedy shallows. As they grow, their diet expands to include insect larvae, worms, and whatever else they can overpower. In optimal conditions, the young of the year can reach 3 inches during their first summer and will then be looking at other fish, crayfish, and snails for food. Adults feed throughout daylight hours, but the early morning and again in the afternoon seem to have a special emphasis for this activity.

The problem of yellow perch in Phillips Lake then, is not necessarily their presence there, but rather their numbers. There is a benefit in perpetuating the fishery of a game fish that is good tasting, easy to catch, and self sustaining, and all the more so when re-establishing a trout fishery would require annual stocking. It is the goal of ODFW to maximize the angler day numbers at Phillips Lake, and if they choose to let yellow perch be the attraction for this attention, then managing excesses instead of shortages will be the nature of work at this reservoir.

It is Surely Time for Summer

It is June, and the 2011 lake season is underway; albeit slowly given the prolonged precipitation in all parts of the state. As of May 1st, the measured snowpack in all of Oregon's interior drainage basins was ≥149% of normal, and everywhere other than the Harney and Malheur basins had experienced >109% of normal precipitation. The storms have been more persistent than heavy, which means the sun has rarely broken through the clouds. The resultant cooler air temperatures have contributed to the delay in warming the surface waters of the state's lakes and reservoirs.

A pleasant side effect that must surely be somehow connected to our wet, cloudy spring, is that Oregon Public Health has still issued no recreational advisories for harmful algal blooms. Last year, there was an HAB

advisory in effect somewhere in the state continuously from April 21st to January 18, 2011. The last time the year's first advisory was not posted until June occurred in 2006. It will of interest to see if the late start for increasing cyanobacteria counts, and the available snowpack, which will delay the onset of reservoir drawdown, will bring the number of advisories issued this year below the 22 that were posted in 2010.

Oregon Public Health was modified its HAB advisory protocol for this year, but the program continues to serve as a way to make Oregonians realize that cyanobacteria present a health threat, and that a water body with discoloration or a scum of cyanobacteria cells is not a good choice for water contact recreation, whether or not there is an HAB advisory posted. The changes to the protocol seek to better document advisories by requiring expert analysis of water samples. All manner of HAB information, including the list of laboratories able to perform identifications, enumerations, and measure cyanobacteria toxin levels, can be obtained by e-mailing questions to hab.health@state.or.us. For the added expense of requiring analyses, petitioners will gain knowledge of the algae that is causing the problems.

Lakes or reservoirs with recurrent HAB problems might inquire about installing a permanent sign that OPH has available. The triangular, aluminum sign warns of HAB conditions that people should be aware of, and it can be unfolded into a diamond shape if those very conditions lead to an HAB advisory at the lake immediately behind the sign.

Small Reservoir Washes Out in Rural Baker County

A recent article covering this event in the *Baker City Herald* brings to mind the never ending conflict between immovable objects and irresistible forces. The battlefield for this particular engagement was Vogel Reservoir, an irrigation impoundment constructed in 1924 and now within the Elkhorn Wildlife Area, 3 miles ENE of the Phillips Lake dam. The original plan for Vogel Reservoir diverted water from Union Creek into the unnamed creek that flowed down California Gulch, and then diverted this water into Poker Gulch, upstream of its dam. The diversion spans a distance of 4 miles and a drop in elevation of about 950 feet. The impoundment stored storm runoff and pooled normal flows for later use. Perhaps importantly, the dam was designed to hold 30 acre feet of water. It was constructed of scraped and hydraulically sluiced earth into a structure 15 feet high. The top of the dam was 6 feet wide and 1055 feet long, and it had a steeper slope on its upstream face.

The reservoir was not currently being used for irrigation, and the diversion ditches may not still be operational. It has been noted that the impoundment had lost about a third of its capacity to sedimentation, and indeed, the reservoir pool looks much wider than long in Google Earth views. It seems unlikely that a short reservoir pool could exert enough pressure against a long dam to cause a failure. Nevertheless, at about 2:00 pm on March 30th, the dam gave way. The torrent rushed down Blue Canyon to its confluence with the Powder River, a distance more than 3 miles. Ranchers along the route reported lost fencing, crop damage, disrupted cattle herds, flooded outbuildings, and a scoured creek bed, but no injuries.

Inspectors from the Oregon Water Resources Department had last examined the dam in 2009 and its next inspection was scheduled for 2015. In the post breach inspection, evidence of water flowing over the top of the dam and animal burrows were observed, along with the 40 foot gap the failure left in the dam. Because the reservoir was not being used, it is unlikely that it will be repaired. But while this local landmark has lost its significance, it will likely continue to be featured on new maps of the area. Vogel Reservoir is registered in the USGS Geographical Names Information System, an institution that is not as responsive to change as is erosion on the downstream face of a dam.

Observations About Riprap and Lakescaping

The unordered placement of stones along an embankment to prevent lakeshore erosion can be an effective solution to problems of slumping, wind driven wave action, and boat wakes. The Oregon Department of State Lands and the US Army Corps of Engineers must be notified of riprap projects. Not all situations require this extreme measure, but when warranted, placing riprap offers many advantages. It provides protection as soon as it is in place. It will stay put indefinitely and needs little maintenance. It dissipates the energy of waves rather than reflecting their force laterally, and so is less prone to cause lakebed scour. A rip rapped shore retains its slope, and does not lose the connectivity between the land and the water. Spaces between the stones provide refuge for plants and animals both above and below the water surface. Its appearance can be softened by adding soil and plants above the high water line.

Armoring a shore with riprap has flexibility. It can readily accommodate curves and irregularities, and even be placed as a projection into the water to shelter the adjacent shore from lateral flows. Breakwaters of riprap placed offshore have successfully reduced erosion and produced bank stabilization, but some long term effects of this approach are not always predictable. Riprap is a good remedy for aging seawalls. The slope of piled stones eliminates the abrupt drop-off of the seawall, which is hazardous and presents a challenge to lakescaping objectives. Seawalls can be buried complete or first truncated as described in the June 2009 *Lake Wise*. Removing or reducing the height of a seawall allows the land behind it to be sloped into a gentler transition from land to water, which provides a better surface to receive riprap protection.

There are disadvantages to riprap protection. It requires permitting. The use of heavy equipment operating along the shoreline may be needed. The necessity of erosion protection raises the question about the suitability of the land for development. It inserts an interruption in the land/water interface. A rip rapped shoreline can make water access more difficult. Lakescaping methods exist that are less intrusive and provide comparable protection, although not in the same time frame.

The “immovable objects” that anchor lakescape projects in place are rooted plants. As the situation warrants, these holdfasts can belong to a living tree, stabilizing a shoreline slope, or the emergent vegetation that retards wave action from resuspending sediments. Root wads however, must grow in place so significant planning is required to determine what protection is needed and how these features can best be supplied. Part of any lakescaping plan under development must consider how to shelter the plantings until they become well established enough to perform their designated function.

There is a wealth of products available to safeguard the plants through at least their first few seasons. The staunchest of the natural products used in the set up of lakescape restoration projects are the biodegradable, coir fiber logs, commonly in 6-20 inch diameters, 6-9 lbs/ft^3 densities, and in either 10 or 20 foot lengths. They are log shaped bundles of coconut fibers, with a net mesh wrapping. They are securely staked in shallow water along the shoreline to provide a stable platform for seedlings. In the 3-5 years it takes for them to decompose, they support and mulch the plants placed in their core. Coir logs, wattles, and erosion control mats and blankets can be used together to address a variety of specific problems in shore stabilization.

Where harsh conditions present an on-going threat of erosion, there is a good selection of long lasting products that can also be incorporated into a lakescaping remedy. Riprap is among these options. Rolls of synthetic mesh overlay can reinforce sizable areas in the littoral region of the lakebed, cellular webbing products provide protection for pockets of soil at the waterline, and interlocking paving stones can create a solid, honeycomb

surface where needed. Because there is such an array of these products, it is often beneficial to consult with a local lakescaper with experience in their selection and use.

A Decade Makes Quite a Difference for Klamath Falls

It has been 10 years now since more than 15,000 people came together in Klamath Falls to show their displeasure of a change in Federal priorities. The Klamath Reclamation Project was approved in 1905 and succeeded in establishing the Klamath Basin as a productive agricultural region. By the year 2000, the 210,000 acres of Project lands held 1400 farms producing over $94,000,000 annually in sales. The Endangered Species Act became law in 1973, and both the Lost River sucker (*Deltistes luxatus*), and the shortnose sucker (*Chasmistes brevirostris*) were listed in 1988. They were joined by the northern California and southern Oregon coho salmon (*Oncorhyrnchus keta*) in 1997.

The conflict between these opposing programs became evident in 2001. Klamath Basin water shortages were predicted in February and became more certain in the following weeks. On April 4th, a judicial ruling was issued that found the Bureau of Reclamation in violation of the ESA for not conferring with other Federal agencies about the water needs of listed species. Reclamation responded on April 6th with an announcement that there would be no irrigation releases from Upper Klamath Lake, but 70,000 acre-feet would be available from Gerber Reservoir and California's Clear Lake reservoir. In a dry year, this news was especially distressing to families suddenly facing financial ruin. They responded with a symbolic act of civil disobedience on May 7th. Their bucket brigade stretched 1 mile and moved 51, 4 gallon buckets of disputed water from Lake Ewauna to behind the locked headgates of Canal A, the Upper Klamath Lake point of diversion for irrigators.

Demonstrations continued through the summer, and a caravan of farm vehicles made a national tour of farming communities, keeping the issue in the news. A July 4th Tea Party in Klamath Falls loosed a trickle of water from the Canal A headgates, and on August 21st, a 10 foot tall bucket commemorating the May bucket brigade was placed on permanent display at the Main Street offices of Klamath County. The US Department of the Interior pursued justifications for water releases, and funds were sought to compensate farmers for their lost crops. The vigils became less boisterous after September 11th, when the attack on the Pentagon and New York City's World Trade Center reminded everyone involved how much they have in common. An additional demonstration of reality occurred in September 2002 with a massive die-off of salmon in the Klamath River.

The issue remains controversial and unresolved today. The intervening years have seen progress in reducing the magnitude of the water shortage. There is a greater reliance on groundwater in the basin now, and in some instances, fields have been left idle when water rights have a greater commodity value than do the crops they could irrigate. As farming becomes less profitable, farmlands are sold and are often allowed to revert to their natural state. Many of these lands have been returned to wetlands by breaching the dikes that had made them arable, which increases the storage capacity of Upper Klamath Lake. Screening irrigation diversions have decreased sucker deaths among crop rows, and the removal of Chiloquin dam reopened 70 miles of sucker spawning habitat on the Sprague River.

As these developments were getting underway, the realization began to coalesce that the several different factions pitted against one another, actually shared some mutual interests. Representatives of 26 stakeholder groups began discussions in June of 2005, and the roll call of participants grew as the sessions continued. The deliberations became more complicated in April of 2006 when the Federal Energy Regulatory Commission

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Klamath Falls Decade … (cont.)

license for PacifiCorp's four Klamath River dams expired. The FERC license renewal demanded attention because the dams produce the electrical power needed to run the irrigation system, but also contribute to the degradation of water quality in the Klamath River that hampers the restoration of the salmon runs there. The negotiations were contentious, but did reach an accord in 2009 with a majority approval of the Klamath Basin Restoration Agreement, and the Klamath Hydroelectric Settlement Agreement. The documents were officially signed by most of the conferees on February 18, 2010. The principal provisions commit PacifiCorp and the other signatories to removing the Iron Gate, Copco 1, Copco 2, and John C. Boyle dams. All means of maximizing the water available for fish will be considered, and making improvements in Klamath River water quality will be a focus. Anadromous runs of salmon and lamprey will be extended to the upper reaches of the basin. The volume of water available for irrigation of Klamath Project lands will be reduced, but that volume will be less subject to change. Future power costs for irrigators will be kept comparable to present rates. A Drought Plan will designate water allotments during dry years.

The paired Agreement documents are more of a list of desirable outcomes than a detailed procedure of how they can be achieved. The goals do favor fish over farming, which follows the current dictate of Federal laws, but each of the interest groups is offered a plum to savor. The Agreements and their $1.5 billion budget have yet to be ratified by Congress, and there are many parties in the Klamath Basin who are pleased with this delay. Remedies to a contradiction often end this way.