The Water Line

Newsletter for the Lakes of Missouri Volunteer Program

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If you are interested in participating in the poster session let us know and we will work with you to put together a presentation.

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Lake Profile - Lake Taneycomo

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Lake Taneycomo is a 22 mile long, 2,080 acre lake in the White River Basin. It is located between Table Rock Lake and Bull Shoals Lake. Lake Taneycomo was formed in 1913 when the Powersite Dam was constructed across the White River. It was believed to be the largest impoundment of water in the country at that time. Since then Lake Taneycomo has been a popular site for trout fishing, boating and recreation as well as a source of power for the area.

Lake Taneycomo has been part of the LMVP since 1992. The program has been lucky to have a team of diligent volunteers, most of them members of the Friends of Lake Taneycomo. Bill Sheriff, owner of the Briarwood Resort at Lake Taneycomo, coordinates the sample pick ups and samples sites on the lake. Volunteers sample six sites on the lake, three inflowing creek sites (Bull Creek, Turkey Creek and Cooper Creek), and a site at the Sewage Treatment Plant. Figure 1 shows a map of the lake and the sample sites. These sites give a good snapshot of the water quality during the sampling season.

Lake Taneycomo is a very unconventional lake due to its water source, volume and **residence time.** The water in the upper end of Taneycomo comes from the **hypolimnion** of Table Rock Lake. These waters are rich in nutrients causing Lake Taneycomo to have about twice the normal amount of nutrients found in other lakes in the region. While the majority of Lake Taneycomo's watershed is forested, the lake is influenced by the location of Branson and other developed areas nearby. Figure 2 shows box plots indicating the levels of phosphorus and chlorophyll at site 1 near the Powersite Dam. The three components shown in the box plot are: 1) the box, which encompasses the middle 50% of the data, 2) the horizontal line within the box represents the median value, and 3) the vertical lines extending above and below the box, which indicate maximum and minimum values respectively.

Prior to 1996, the effluent from the Branson Sewage Treatment Plant entered Lake Taneycomo carrying a high load of phosphorus. During periods of low flow in the lake, phosphorus would accumulate downstream from the treatment plant and produce **algal blooms**. Since the treatment plant has initiated phosphorus removal from its effluent, levels at Site 1 have been lower. Also, chlorophyll values have not been as extreme.

Potential threats to the water quality are those that would increase the amount of nutrients in the lake, especially phosphorus. Activities and development in the watershed that causes erosion or increases in the amount of waste released into the lake could be considered threats. The water quality in Table Rock Lake also has an obvious influence on the water quality of Lake Taneycomo. We must do all that we can to protect these beautiful and valuable lakes in our state.

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Fig 1. Map of Lake Taneycomo sample sites

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Fig 2. Levels of phosphorus and chlorophyll from 1992 through 1998 in Lake Taneycomo at Site 1 near the Powersite Dam.

LAKE INVADERS

by Jennifer L. Johnson

Horses. Starlings. Goldfish. Ginko trees. Lotus. Kudzu vines. Chestnut blight. Zebra mussels. What do all of these things have in common? They are all examples of organisms that have been introduced into the United States, either intentionally or accidentally.

Compared to the native flora and fauna, introduced species may comprise anywhere from a few percent to more than 20% of the total number of organisms found in a particular region. Results of introductions have ranged from little or no effect to large-scale changes. Introduced species often lack natural predators and other mechanisms for population control that are found in their native habitats. For this reason introduced species can have profound effects on native populations and systems. In aquatic systems introduced species can alter ecosystem processes such as **primary productivity**, decomposition, **hydrology, geomorphology, nutrient cycling,** and **natural disturbance regimes**. The successful introduction of a species can change the composition and the dynamics of an entire ecosystem, as well as reduce biological diversity.

The zebra mussel, *Dreissena polymorpha*, is a well-known example of a species accidentally introduced into the United States. This species was introduced from Europe in 1985 or 1986 by transoceanic ships that discharged ballast water into the Great Lakes. The zebra mussel spread rapidly once it arrived and has had far reaching economical and ecological effects. It causes economic damage by fouling surfaces and has even entered into the waterworks of industries and municipalities. According to a 1993 report from the Office of Technology Assessment, the cost of clearing blocked intake pipes will eventually reach about $3.1 billion over a ten year period. The ecological consequences of the zebra mussel introduction are also staggering. Zebra mussels reduce algae populations and biological productivity. The introduction has also caused local extinction of several populations of native mussels.

A species recently introduced into Missouri reservoirs is the crustacean zooplankter *Daphnia lumholtzi*. *Daphnia* species in general are more commonly known as "water fleas." *D. lumholtzi* is native to Africa, Asia and Australia. *D. lumholtzi* was first observed in the United States in zooplankton samples collected from Oklahoma in 1989. By 1991 it was recorded from numerous sites in southwestern Missouri, eastern Texas and the southeastern U. S. By 1996, *D. lumholtzi* was found in 21% of lakes in Missouri and had been detected as far north as Ohio, as far west as Arizona, and as far east as the Carolinas. In the United States, *D. lumholtzi* is common in reservoirs, rivers, and oxbow lakes, and has also been reported in swamps. Although the exact mechanism of *D. lumholtzi* introduction is currently unknown, it has been suggested that it reached the United States via the aquarium trade.

Daphnia reproduce by a method called **cyclic parthenogenesis.** Female *Daphnia* will **asexually reproduce** only female offspring during ideal environmental conditions. An environmental cue will eventually signal to female *Daphnia* that conditions are no longer ideal, and the females will begin to produce male *Daphnia*. These males will sexually reproduce with the female *Daphnia.* This sexual reproduction will result in resting eggs, called ephippia (Figure 1). Ephippia can tolerate freezing, drying, and digestion by fish and birds. This method of reproduction can allow a few females or resting eggs to establish an entire new population once introduced into an ideal aquatic environment.

Crustacean zooplankton are a primary food

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Fig 1. Ephippia or resting egg of the *D. lumholtzi*
Adapted from Havel, et. al 1993.

resource for planktivorous fish. *D. lumholtzi* initially attracted attention because it has substantially larger spines than do native *Daphnia* species (Figure 2). The large spines of *D. lumholtzi* inhibit predation by larval bluegill, although not by the larger sized juveniles of this species. The introduction of *D. lumholtzi* into new habitats provides the potential for competition with native *Daphnia* species. Competition is an interaction between organisms that use a common resource, such that one or both species reduces access of the other to the shared resource. The effects of *D. lumholtzi* on native zooplankton communities are currently unknown. Monthly sampling from Stockton Lake, Missouri between 1994 and 1996 indicated that *D. lumholtzi* is not displacing native zooplankton. In contrast, samples collected by the Illinois Natural History Survey found that after *D. lumholtzi* invaded Lake Springfield, Illinois in 1992, native zooplankton populations declined the following year. In a worst case scenario the introduction of *D. lumholtzi* may reduce numbers of "easy to eat" native zooplankton and therefore also reduce fish numbers. On the other hand, *D. lumholtzi* may just act as an additional food resource for fish.

The movements of man have provided mechanisms for dispersing freshwater organisms over long distances, as illustrated by both the zebra mussel and *D. lumholtzi*. The bait buckets, bilges, and live wells of recreational fishing boats provide additional mechanisms for dispersal. The rapid spread of *D. lumholtzi* in Missouri, and across the U.S. may in part be a result of recreational fishing boats.

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Fig 2. Morphological differences between *D. lumholtzi* and the Missouri native *D. parvula* .Length of scale bar = 0.5mm *Adapted from Havel, et. al 1993*.

A study conducted by John Havel and Jennifer Stelzleni-Schwent at Southwest Missouri State University suggests that *D. lumholtzi* can survive in the live wells of stored boats for up to three days, although ephippia could survive for much longer periods of time. As part of the study, 62 boaters were surveyed before they launched their boats, and their live wells were sampled. Living zooplankton were found in the live wells of several boats, however no *D. lumholtzi* or ephippia were found (ephippia have been noted in live wells outside this study). The majority of the boaters surveyed regularly took their boats to different lakes and a third of them fished frequently (within three days), a time period in which *Daphnia* could potentially survive in the live wells. Few of the boaters surveyed drained and flushed their live wells, suggesting that they could potentially be moving zooplankton among lakes.

What can you do to help prevent the spread of introduced aquatic species? The answer is simple. Drain and flush your live wells, and rinse your bait buckets on dry land immediately after removing your boat from the water, and before transporting your boat to another lake. Rinsing off your boat and trailer, and ensuring that there are no weeds or plants attached to either will also go a long way to preventing the spread of introduced organisms. The most important way to help stop the spread of introduced species is to share your knowledge with your friends and families so they can act as well.

If you are interested in learning more about introduced species, or *D. lumholtzi* the following websites are a good place to start:

1) Great Lakes Commission - http://www.glc.org

2) Michigan's Nonindigenous Aquatic Species Plan - http://www.deq.state.mi.us/ogl/plan.html.

3) USGS Biological Resources' news release about Zebra Mussels in California- http://biology.usgs.gov/pr/newsrelease/1995/8-16.html.

4) Other USGS news releases- http://www.usgs.gov

References for this article available upon request.

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IMPORTANT TERMS

1. Algal blooms - a very large algal population that may cause a green coloration of the water or form large floating mats. Such a large population may be stimulated by high nutrient levels, warm-water temperatures and long periods of sunlight.

2. Asexual reproduction - a method of reproduction in which sex does not occur, there is no fertilization of an egg by sperm.

3. Geomorphology - the surface features of the earth.

4. Hydrology - the distribution, characteristics and effects of water.

5. Hypolimnion - the region a of body of water that extends from the metalimnion to the bottom and is essentially isolated from major surface waters.

6. Natural disturbance regime - cyclic, naturally occurring events that disturb an ecosystem.

7. Nutrient cycling - the path of an element through an ecosystem.

8. Parthenogenesis - reproduction by means of unfertilized eggs (cyclic parthenogenesis would be alternating between reproduction by means of unfertilized eggs and reproduced by means of fertilized eggs).

9. Primary productivity - accumulation of energy and nutrients in green plants and other photosynthetic organisms.

10. Residence Time - the theoretical time that it takes a whole lake volume to be replaced by new inflow.

NEWS BITS

Fall 1998, Momentum[1] - Gary Allee, a swine nutritionist at UMC, is working to reduce the phosphorus in hog waste. He is experimenting with a corn hybrid that has more digestible phosphorus. If the hogs can digest more of the phosphorus in the corn, there will be less excreted. This translates to less phosphorus being released into the environment and washed into our streams and lakes. The low-phytate corn is thought to reduce phosphorus in hog waste by 37%.

December 1998, Missouri Conservationist[2] - Monies from the North American Conservation Act, Ducks Unlimited, Missouri Department of Conservation, Natural Resources Conservation Service, Nature Conservancy, and others have been used to purchase 6,975 acres of flood-damaged farmland in west-central Missouri. The land connects two existing tracts of the Four Rivers Conservation Area, creating a single area of almost 14,000 acres. The area will be managed primarily for waterfowl but will benefit many species including 24 species listed as rare or endangered in Missouri.

12/28/98, USA Today - Of Missouri's 21,105 miles of streams, forty-nine percent or 10,341 miles do not meet clean water standards based on a state report filed to the U.S. EPA.

Winter 1998-99, Missouri Resources[3] - *Groundwater Resources in Missouri,* a 210-page technical report published by DNR's Water Resources Program is available to those interested in basic information concerning Missouri's groundwater. The document costs $14 and can be ordered by calling (573) 368-2125.

1/13/99, USA Today - Premium Standard Farms, Missouri's largest hog producer, has hired an environmental audit team to inspect their numerous operations. It is hoped that this step will help clean up their operations and reduce pollution.

1/24/99, Columbia Daily Tribune - As the ocean temperatures rise and pollution from the land intensifies, there have been increased reports of dying coral, diseased shellfish and waters infected with human virus. About 10% of coral worldwide has died. If present trends continue, up to 40% could be lost.

1/24/99, St. Louis Post-Dispatch - Nitrogen flowing down the Mississippi River into the Gulf of Mexico is causing a large oxygen depleted zone in the Gulf. The nitrogen promotes large algal blooms which use up the available oxygen when the bloom dies and decomposes. Changes in farming practices to lower nitrogen runoff and restoration of wetlands along rivers are key to reducing the problem.

1 - Momentum is the University of Missouri-Columbia's College of Agriculture, Food and Natural Resources Alumni paper.
2 - Missouri Conservationist is the monthly publication of the Missouri Department of Conservation.
3 - Missouri Resources is the Missouri Department of Natural Resources' quarterly publication.

If you come across any NEWS BITS
that others might be interested in, please send them to us!!!

PROPER PROCESSING PROCEDURES, THE THREE P'S FOR QUALITY RESULTS

After a long day out on the lake it may be tempting to put your sample bottle in the refrigerator and take care of it tomorrow. But what would happen to the sample? This past season we found out what can happen to a water sample that isn't processed right away. One of our volunteers was going to collect an extra round of samples from four sites on his lake. He called to let us know he would need more chlorophyll filters. Thinking he wouldn't sample until he received the filters, we placed them in the mail. Our volunteer ended up sampling the day he called. Having only four chlorophyll filters, he decided to prepare one filter from each site. He then placed the sample bottles into the refrigerator and waited for the extra chlorophyll filters to arrive. Four days after the sample was collected he processed the second chlorophyll filter from each bottle. The results are found in Table 1.

Table 1. Changes in the chlorophyll content of lake samples stored refrigerated for a four day period. (ug/L)

Bottle	1	2	3	4
Initial	5.4	5.2	5.7	4.7
4 days later	3.4	3.0	2.9	2.8

As you can see, in all four cases the chlorophyll value decreased after the four day refrigeration. The initial values were all relatively low so the actual drop in chlorophyll doesn't seem that extreme. Though in terms of a percent of the initial value, we are looking at significant decreases (37 to 49%).

In an attempt to further investigate how delayed processing would impact chlorophyll values, I went out and collected six bottles of lake water in the middle of January (I would have been better off if I wanted to collect ice samples!). After getting back to the lab I combined the water in buckets in an attempt to make sure that the water was well mixed. I then refilled the six sample bottles and processed one chlorophyll filter from each bottle that same day. Three bottles were then placed in a refrigerator and three bottles were left to sit out on a counter top. After one, two, and five days I came back and processed another chlorophyll filter from each bottle. What I found was a little bit of a surprise and can be seen in Table 2.

For those samples placed in the refrigerator, chlorophyll values increased after one day of storage. On day two we see that values were decreasing but still higher than the initial values. By day five the chlorophyll values had dropped well below initial values. For the bottles left on the counter we see that chlorophyll values were higher after one day of storage and increased even more after two days. On the fifth

day the algal populations were decreasing but still above initial values.

Table 2. Changes in the chlorophyll content of lake samples over a five day period. Values are averages from three bottles. (ug/L).

	Initial	1 Day	2 Days	5 days
Refrigerator	9.3	10.1	9.9	6.6
Counter	9.6	13.4	14.9	13.6

The results from those bottles left on the counter were not that surprising. These bottles received some sunlight, therefore the algae was able to photosynthesize and reproduce. Results from those bottles stored in the refrigerator were a little bit of a surprise. Being stored in the cold and dark would, I thought, lead to a decrease in algal chlorophyll after just one day. Instead there was an increase in chlorophyll during the first 24 hours. After being placed in a low-light environment (the dark refrigerator) the algae most likely produced more chlorophyll in an attempt to maximize photosynthesis. There probably was not an increase in the number of algal cells but instead an increase in the amount of chlorophyll per algal cell. By day two the lack of light had started to take its toll and the algae were dying. The cold temperature in the refrigerator probably did not influence the algae as it was similar to the temperature of their previous lake environment. Samples collected during summer, when waters are much warmer, may exhibit a different response when refrigerated due to a more drastic temperature change.

In the end we see that delayed processing of samples does impact chlorophyll readings, however the result is not always a decrease. Factors that influence how chlorophyll values change include the temperature of the lake water, the temperature during storage, and the amount of light reaching the sample bottle during storage. Another factor to consider is the amount of zooplankton in the sample. If a sample bottle contained enough zooplankton and storage in a refrigerator did not kill them, we would expect chlorophyll values to decrease as the zooplankton ate the algae.

Volunteers should make sure they process their samples the same day they are collected. Over time, changes in chlorophyll values will occur and these changes are not always predictable. During the next few months we will be doing more experiments to determine how samples may be impacted by failure to follow procedures. We will also experiment to determine how samples might accidentally be contaminated. Watch for results in the May newsletter!