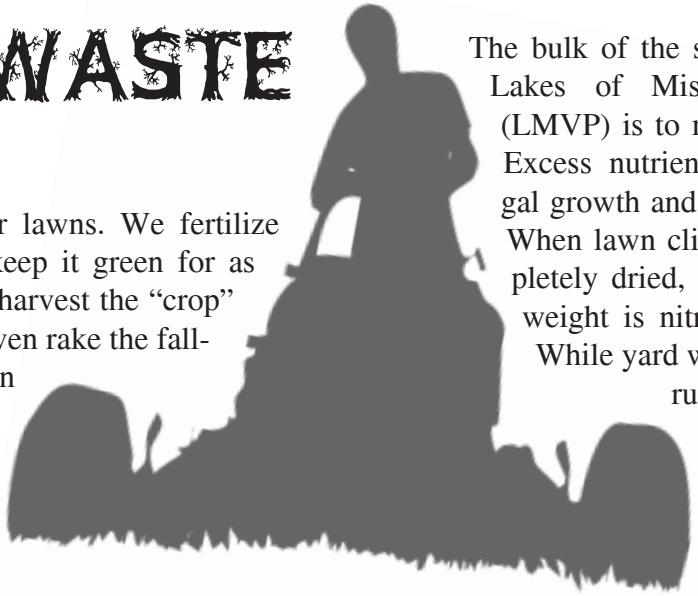
NEWSLETTER OF THE LAKES OF MISSOURI VOLUNTEER PROGRAM

The Water Line

Volume 13 Number 3

YARD WASTE



Americans love their lawns. We fertilize and water grass to keep it green for as long as possible, we harvest the "crop" by mowing and we even rake the fallen leaves off so we can see it during autumn. Unfortunately, the way we dispose of our "harvest" has the potential to harm our lake.

Some people might dump their yard waste right into the lake. They will say they are "creating fish habitat" or "feeding" the fish. What they are really doing, however, is polluting their lake. The best thing for your lawn (and the lake) is to leave the grass clippings on the ground. If you have a mulching mower with a good, sharp blade, you are doing your lawn the most good. Thatching is not an issue if you mow often enough. If you simply must pick up the clippings, or if you notice clumps of grass from the previous mowing, you can collect your grass clippings and use them as mulch around landscape plants to block out sunlight and hold back weeds, as well as release nutrients. Composting is another great solution.

The bulk of the sampling work done by the Lakes of Missouri Volunteer Program (LMVP) is to monitor nutrients and algae. Excess nutrients contribute to excess algal growth and make our lakes look green. When lawn clippings and leaves are completely dried, a full 3% of the remaining weight is nitrogen, 0.3% is phosphorus. While yard waste has 40% less phosphorus than found in cow manure (per pound), it has more than 4 times the nitrogen of cow manure.

Algae in our lakes can typically be controlled by limiting the nutrients nitrogen and phosphorus. Phosphorus is usually the nutrient in the shortest supply, so controlling phosphorus is often the best long-term way to manage algal growth. Given that the LMVP measures nutrients in parts per billion (µg/L), a little phosphorus goes a long way. As reported in The Water Line in 2008, a typical Ozark forest drops 6 to 7 pounds of phosphorus per acre each year as leaf litter. If your lakefront lot is a quarter acre, and your tree density is one-fourth that of a typical Ozarks forest, your trees are dropping roughly 181,440,000 micrograms (µg), or 6.4 ounces of phosphorus each year. Now imagine if you and several of the neighbors in your cove are all dumping your leaves in the lake. Repeat every year. Notice that this calculation doesn't include grass clippings; increase the numbers if those are going into the lake.

On average, 100 pounds of dried yard waste (including grass clippings) contains 4.8 ounces of

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phosphorus, which equals 136,000,000 micrograms (µg). Adding that amount of phosphorus to 1.4 million gallons of water will result in a final phosphorus concentration of 25 µg/L, the same as Lake of the Ozarks near the dam. Though not quite the same scale as "The Lake", 1.4 million gallons is equal to 4.3 acre feet, a volume of water one acre in size and 4.3 feet deep.

Leaves and lawn clippings aren't just a problem when they're dumped directly into the lake. People may dump their grass clippings in "that gulley behind the house" or rake their leaves into the creek. Though it's not as direct, if you live in a lake's watershed, much of the nutrients will eventually get to the lake.

The leaves of overhanging trees will naturally fall into the water and contribute nutrients. This is a driving factor in some streams, providing valuable nutrients to the benthic (bottom-dwelling) invertebrates that are integral to stream food webs. Leaves that hit the land in forested areas, however, tend to stay near where they fell, usually travelling less than 2 feet. Most of the nutrients from these leaves would be available for the tree that dropped them or vegetation surrounding that tree and wouldn't reach the stream or lake.

Grass clippings are not a naturally occurring component of an ecosystem, yet turf grasses are the single largest irrigated crop in the United States, with three times more irrigated land devoted to growing grass than to growing corn. It's unfortunate that our grass clippings don't have as much value as our food. People would be much less likely to dump a bushel of corn into their lake than they would a bag of grass clippings.

Some tricks to composting yard waste

(1) Compost grass clippings in thin layers to avoid matting, ideally interspersed with layers of autumn leaves.

(2) Let the grass clippings dry out for a couple of days before composting to speed the decomposition process.

(3) If you have too many grass clippings in your compost pile, turning it every few days will speed up the process.

When you're done, you'll have a pile of great, nutrient-rich soil, something that's in short supply in southwest Missouri.

For more information, visit:
www.healthyyards.missouri.edu

Source Nutrient content	% Nitrogen	% Phosphorus
Cow manure	0.7	0.5
Sheep and goat dung	2.0	0.51
Poultry manure	2.9	1.26
Lawn clippings and leaves	3.0	0.30

(Table from: http://www.fao.org/docrep/007/y5053e/y5053e0e.htm)

The North American Lake Management Society

Why do you care about lake water quality? Are you only interested in the water quality of 'your' lake or are you concerned about water quality across the state? What is the biggest water quality concern you have? What is most important to you, improving the fishing, ensuring safe swimming or maintaining your property value? While we may all answer these questions differently, the common denominator is that we are concerned about lake water quality. No matter the reason, if lake water quality is something you are interested in, you should know about the North American Lake Management Society (NALMS).

NALMS was formed in 1980, and over the last 30 years has grown into an organization with a diverse membership with a common interest – lake water quality. NALMS appeals to a wide variety of folks because its mission is "…to forge partnerships among citizens, scientists, and professionals to foster the management and protection of lakes and reservoirs for today and tomorrow." Much of this mission is met through education, and a key to the success of NALMS is knowing that different approaches are required to reach the general public (volunteer monitors, lake associations, and lake users), researchers (scientists, academics, and professional lake managers) and policy makers (politicians, legislators, and regulators).

The society's stated goals are to:

1. Facilitate the exchange of information
2. Promote public awareness of lake ecosystems
3. Encourage public support for programs that promote lake/watershed management
4. Provide guidance
5. Improve professional status of lake managers
6. Identify needs and encourage research on water quality issues.

Goals are met through a variety of publications, conferences/meetings, and the release of policy statements.

NALMS is responsible for two quarterly publications. LakeLine is magazine-styled and targets the general public, offering news, commentary and articles focusing on a variety of lake/watershed management topics. Issues often feature multiple articles relating to a central theme. The articles may focus on different aspects of the central theme or have varying (and maybe even opposing) perspectives. This approach allows readers to broaden their understanding of a water quality topic. Some recent issues of LakeLine have focused on algal toxins, shoreline management, fisheries management, and lake aeration.

The second NALMS quarterly publication is Lake and Reservoir Management, a peer reviewed journal that features scientific research on topics important to the management of lake resources. Some recent articles have dealt with shoreline stabilization using rip-rap, influence of lake age and land use on water quality, internal nutrient loading, the impact of zebra mussels on water quality, and the use of alum for phosphorus removal. With 8-12 articles per volume, it is a good bet that at least a few studies will be of interest to most readers.

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NALMS members get together to network and share successes, failures, and ideas on a regular basis. Each year NALMS hosts a conference where members can get together and learn from each other's experiences. The location of the conference changes each year, with the 2010 symposium taking place in Oklahoma City on November 3-5. The conference will feature presentations on a wide variety of water quality topics, as well as social events that allow for a more casual exchange. NALMS is also present (and usually supplying support) at other national conferences such as the annual Enhancing the States' Lakes Programs conference in Chicago and the biennial National Water Quality Monitoring conference.

If you are concerned about lake water quality and would like to benefit from the knowledge of others who share your interest, the North American Lake Management Society is a group you should consider joining.

Visit www.nalms.org for more information about NALMS.

The Attorney General's Symposium on Water Quality at the Lake of the Ozarks

Missouri Attorney General Chris Koster hosted a 2-day symposium at the Lake of the Ozarks to discuss water quality issues. The event, titled "Protecting Water Quality at Lake of the Ozarks: An Environmental Road Map for the Future," took place August 17 and 18 and was opened by Governor Jay Nixon.

There were quality talks covering topics ranging from pollution types and sources, water-borne illnesses, existing lake data, waste-water issues, solutions to existing problems and many more. All presenters' talks were centered specifically on the environmental and economic well-being of the Lake of the Ozarks. Representatives were present from MU, the United States Geological Survey (USGS), the Missouri Department of Natural Resources (DNR), the Missouri Department of Conservation (MDC), the Missouri Department of Health and Senior Services (DHSS), Ameren UE, the Missouri Senate as well as the cities of Osage Beach, Camdenton and Warsaw.

Both LMVP co-coordinators, Dan Obrecht and Tony Thorpe attended the meeting and presented information.

Video of the entire symposium can be found online at: http://www.ustream.tv/channel/lake-tv-32

Presentation materials are available for download at the Attorney General's website: http://ago.mo.gov/agriculture/Lake_Ozarks_Symposium.htm

OIL AND WATER DON'T MIX

Review of the journal article: *Toxicity of crude oil to the mayfly, Hexagenia bilineata*

Authored by Mark P. Ort, Susan E. Finger and John R. Jones, published in Elsevier Science Limited, 1995

The April 20th tragedy involving the Deepwater Horizon oil rig and subsequent 3 month long oil leak has raised questions concerning how the oil will affect the Gulf coast. Given the timeliness of the topic, we review a scientific article published in 1995 that examined the toxicity of oil using a series of laboratory experiments. The research was conducted in response to oil spills that occurred in Missouri; a 1988 spill that contaminated the Gasconade River and a 1990 spill near the Chariton River. While field studies following these and other spills indicate a substantial effect on aquatic insect populations (which are analogous to the canary in the coal mine), the response of insects to oil spills was poorly studied and not well understood.

The Oil

Crude oil breaks down into three main components in the aquatic environment. The volatile fraction evaporates off of the water surface and thus poses no long term threat to aquatic life. The water soluble fraction remains in the water, where it goes through chemical changes over time. Because crude oils differ in their initial chemical makeup, and the environments in which spills occur vary (temperature, dissolved oxygen, etc.), the rate of breakdown and the chemistry of by-products produced during breakdown are not easily predicted. The third component is the insoluble residue that tends to settle out of the water column, contaminates the sediment and poses a long term source of exposure.

Two crude oils were used in these experiments, a sweet crude similar to that involved in the Gasconade spill and the intermediate weight oil spilled into the Chariton River. In lab, the oils were processed to isolate the water soluble fractions and the insoluble residue.

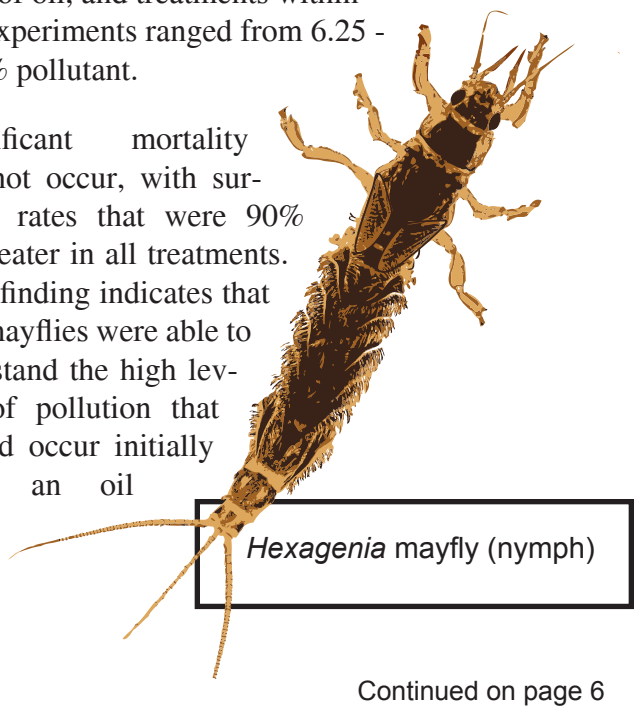
The Test Subjects

Hexagenia bilineata, a common burrowing mayfly, was chosen as the test subject for the experiments. This mayfly is abundant in a variety of aquatic environments, making results applicable to a wide geographic range. This species is also ecologically important to aquatic systems as a food item for fish and is universally considered as representing healthy aquatic environs. The experiments involved immature or nymph stages of the mayfly that live in and feed near the sediments. *Hexagenia* species generally have a life span of one year (two in colder climates), which is substantially longer than any of the conducted experiments.

Experiment 1

Short term experiments were conducted to determine if mortality would occur during a 4 day exposure to high levels of the water soluble fraction of crude oil. The goal of these experiments was to see if the mayfly could survive the initial high concentrations of the water soluble fraction of crude oil associated with a spill. Separate experiments were conducted for each type of oil, and treatments within the experiments ranged from 6.25 - 100% pollutant.

Significant mortality did not occur, with survival rates that were 90% or greater in all treatments. This finding indicates that the mayflies were able to withstand the high levels of pollution that would occur initially after an oil



Hexagenia mayfly (nymph)

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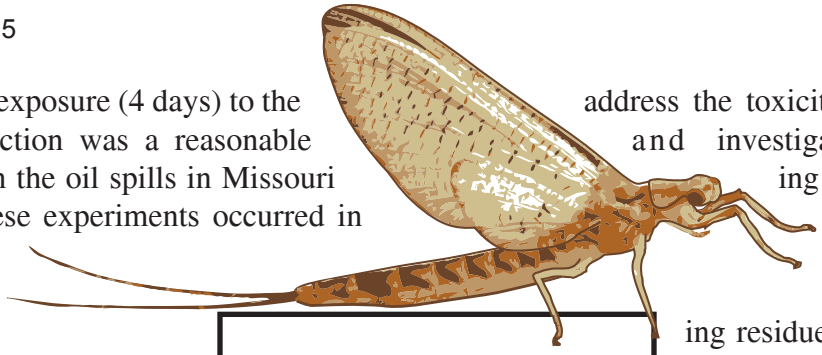

Hexagenia Mayfly (adult)

spill. The limited exposure (4 days) to the water soluble fraction was a reasonable time period, given the oil spills in Missouri that prompted these experiments occurred in river systems. The constant flow of water would translate to limited exposure to water soluble fractions of oil for most aquatic insects in the river (the exception being in backwater areas where the water does not constantly flush).

Experiment 2

A 24 hour behavioral test was conducted to see if mayflies actively avoided burrowing into residue contaminated sediment. The goal of this experiment was to determine if the mayflies would recognize the presence of oil residue and avoid contact with contaminated sediment. The treatments ranged from sediments that were 0.005% residue to .08% residue. Visual inspections to determine if the mayflies were burrowing or actively avoiding the sediments were made eight times during the 24 hour period.

The experiment found more mayflies burrowed into uncontaminated sediment (92-96% of individuals) than contaminated sediment (81-90% of individuals), but the differences were not statistically significant. Individuals that did not burrow tended to remain on the sediment surface and did not exhibit active avoidance through swimming. These results suggest that the mayflies did not recognize the contamination, and by remaining in contact with residue tainted sediment the mayflies would be susceptible to long term exposure.

Experiment 3

Long term (21 days) exposure to contaminated sediment at fairly low concentrations of residue was conducted to investigate how extended exposure would affect mortality. The goal of this experiment was to address the toxicity of long-term exposure and investigate if 6 weeks of "weathering would reduce the toxicity of residue contaminated sediment. This experiment was conducted using residue from the oil involved in the Chariton River spill at different levels of sediment contamination (0.01 - 0.14% residue). A separate experiment was conducted using sediment collected from the Chariton River six weeks after the spill had occurred. Contaminated sediment was collected 35 miles below the spill site, as well as 6 miles above the spill site (used as uncontaminated "control" treatment). The level of residue contamination in the downstream sediment was measured at 0.19% of dry weight.

The study found limited mortality after the first week in all of the treatments. After week two there was some mortality in treatments with contaminated sediment, but it was not statistically significant. By the end of the study there was significant mortality (45-60% of individuals) in the three treatments with the highest levels of residue. Similar results were found in the experiment using sediment from the Chariton River; mortality was significant after 3 weeks in the treatment containing the contaminated sediment relative to the upstream, uncontaminated sediment. Combined, these two experiments indicate that long-term exposure can be a problem for the mayfly, and that the problem exists even after the residue has been in the environment for 6 weeks. Given that mortality increased with each week of the experiment, it is possible that longer exposures would lead to even greater mortality.

Relevance to the Gulf Oil Leak

It is difficult to draw directly from this work to predict outcomes in the Gulf due to differences in both the type of oil and the environment in which the spill occurred. The most applicable findings might be that even if initial exposure to water soluble fractions of

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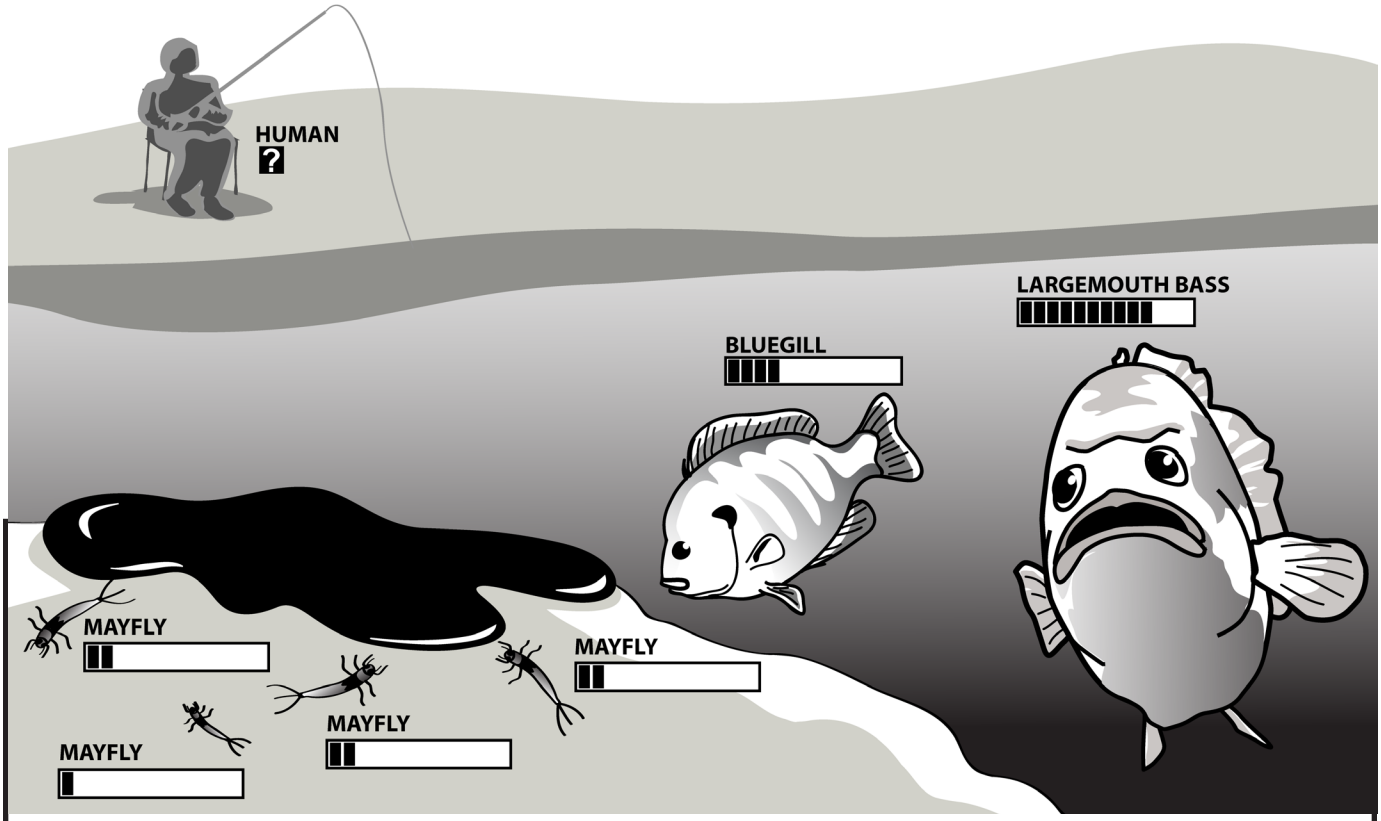
the oil do not cause harm to aquatic life, extended exposure to residue contaminated sediment might. It should be noted that the exposure to water soluble fractions only lasted 4 days in these experiments, a time period that seems reasonable in the case of the Gasconade and Chariton river spills. Given the duration of the Deep Water Horizon oil leak, exposures to water soluble fractions of oil probably lasted longer. Also, the enormous scale of this disaster (estimated 4.9 million barrels of oil leaked into the Gulf) means that a quick and thorough clean-up of all contaminated areas is virtually impossible. It is hard to imagine that residue contaminated sediment will not have some long-term effects on aquatic life in the Gulf.



Bioaccumulation and Biomagnification

Short-term exposures to crude oil fractions did not lead to mortality in the mayflies, but long-term exposures did. These results may indicate that the mayflies were accruing toxins over time, a process known as *bioaccumulation*. During the 3 week experiment the mayflies would have the potential to continuously consume residue as they fed on organic matter within the contaminated sediment. Small doses of residue did not seem to affect the mayflies, but the accumulation of toxins over time could have led to the increased mortality.

If the mayflies accumulated a fair amount of toxins in their bodies prior to death, they would transfer those toxins to any organism that consumed them. This means that insect eating fish such as bluegill would be consuming residue toxins even though they didn't directly feed on sediment. In turn, these bluegills would accumulate toxins and pass them on to their predators. Because a bluegill will eat many mayflies, it has the potential to end up with a much higher level of contaminant than any of the individual mayflies it consumed. This process is referred to as *biomagnification* and explains how pollutants can make their way through the aquatic food web and affect species that seem far removed from the original pollutant.

US Environmental Protection Agency Region VII, through the Missouri Department of Natural Resources, has provided partial funding for this project under Section 319 of the Clean Water Act.

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