NEWSLETTER FOR THE LAKES OF MISSOURI VOLUNTEER PROGRAM

The Water Line

Volume 6 Number 1 Winter 2002

NON-POINT SOURCE POLLUTION - WHERE ELSE IS IT COMING FROM?

This is the fifth and final article in a series about Non-Point Source Pollution (NPSP). In the last four issues of *The Water Line* we introduced the concept of NPSP, discussed urban sources, rural sources, and the impacts that we, as individuals, have. Up to this point we have focused on pollution that comes off of the landscape. With this last article we turn our eyes towards the sky as well as the water.

By Air

Hopefully everyone reading this is familiar with the term watershed. If not, a lake=s watershed is the area of land that drains into the lake (either by flowing over land or through the soil). A new term for all of us to learn is AIRSHED. The EPA defines an *airshed* as the geographical area that emits 75% of the air pollution reaching a given waterbody. Airsheds are calculated through mathematical models and are therefore grounded more in theory than an actual physical delineation. The concept is further complicated by the fact that not all air pollution behaves the same. A lake=s airshed for Pollutant A may be twice the

(Continued on page 2)

In This Issue

There are a number of organisms in nature that live just above or below the surface film, collectively called the **neuston** (pronounced "noo-stun"). No doubt you are familiar with several of the larger neuston, like water striders or duckweed. There are also many microscopic species that live at the surface.

Some neuston spend only a part of their lives in the surface film, as either larvae or as eggs. Others will live their entire life at or around the surface. These organisms may live above the surface film, supported by the surface tension, or they may live below, hanging from the surface tension. Adaptations of the neuston include spindly legs, water repellant bodies, light weight, "hairy" feet, etc. The neuston living below the surface may have adaptations that, not unlike a coat hanger, allow the organism to suspend itself from the surface film.

Neuston are adapted to take advantage of the higher concentrations of organic matter found in the "surface scum". Some algae species thrive in the nutrient and sun-rich surface film. The larger neustonic organisms typically consume the smaller neuston that are "eating" in the surface film.

There's a lot going on in the lake's top eighth of an inch. That's why you should always skim the surface of the water and make sure your bottle goes well under the surface when sampling. We don't want to misrepresent the lake by inadvertently sampling this nutrient and microbe-rich surface layer. Keep the neuston out of the sample bottle!

Tony Thorpe

"Treat the Earth well. It was not given to you by your parents. It was loaned to you by your children." - Kenyan Proverb

NPS part 5—continued from page 1

size as the airshed for Pollutant B.

How does air pollution get into the lake? The answer - *ATMOSPHERIC DEPOSITION!* Airborne pollutants can fall as a wet deposition (with rain or snow) or as dry deposition (as dust or a gas). This deposition can occur directly onto the water surface or onto the watershed, where the pollutant is carried into the lake with runoff.

Air pollutants that are the greatest threat to our lakes and streams fall into five categories; nitrogen, mercury, other metals, pesticides, and combustion emissions (pollutants from incinerators). While there are natural sources for many of these pollutants, human activities account for most of the air pollution in these categories. The Lakes of Missouri Volunteer Program measures the amount of nitrogen in lake water and has addressed terrestrial inputs in the past. Now let=s take a brief look at nitrogen pollution from the air.

Atmospheric deposition can be a significant source of nitrogen into a waterbody. Studies estimate that 21% of the nitrogen pollution entering Chesapeake Bay comes from the air. Although the air we breathe is 78% nitrogen (N_2), it is ammonia (NH_3) and nitrogen oxides ($NO_{\#}$) that are considered pollution. A major source of atmospheric nitrogen pollution is the burning of fossil fuels. Nitrogenous air pollution can make a waterbody more productive, causing algal blooms and decreased water clarity (the same problems that are associated with terrestrial nitrogen pollution). Airborne nitrogen can also, under the right conditions, fall as acid rain in the form of nitric acid (sulfur is the other major contributor to acid rain). Acid rain can impact a waterbody by leading to changes in pH. Shifts in a lake or stream=s pH can harm aquatic biota.

By Water

Threats to water quality don=t just come from the land and air. They also come directly from those of us who are out on the lake! Millions of people regularly enjoy recreational boating. All of these boats can and do have impacts on water quality. NPSP associated with recreational boating includes chemicals from cleaning compounds, petroleum products, sewage, and shoreline disturbances.

Boat cleaning products can contain chlorine, ammonia, and phosphates. Chlorine and ammonia can be harmful to some aquatic life forms, while phosphates, as well as ammonia, can lead to increased algal production. Petroleum products find their way into sediments where they can persist and accumulate, causing harm to bottom dwelling creatures. Sewage...its sewage, do I really need to go into why this isn't desirable in our lakes? Shoreline disturbances (such as wakes created by boating) can negatively impact plant growth in shallow areas and cause erosion along the shore. This leads to more soil material and nutrients in the water as well as a loss of aquatic habitat.

While the impacts from one single boat may seem negligible, the combined impact of hundreds or thousands of boats can be significant. Use of non-toxic cleaning products, careful refueling, proper engine maintenance, proper disposal of sewage, and lake-friendly boating practices (i.e. limited wake in shallow or near shore areas) can go a long way to reduce boater impacts.

We are all part of the solution

Hopefully this series on Non-Point Source Pollution has made you more aware of the many threats that face our lakes and streams. We have come a long way since the passing of the Clean Water Act. Gone are the days of burning rivers and a biologically dead Lake Erie. Regulation of Point Source Pollution has made a great impact, but we are only half-way there. Non-Point Source Pollution, which is difficult to regulate, is the next focus. If we are to make future gains we must educate ourselves, our children, and our neighbors. Everyone must take an active role and the efforts must start on the community level.

Evaluate your impacts, educate those around you (lead by example!), and become active. Our goal is to leave our lakes, rivers and streams fishable and swimable for the next generation.

Dan Obrecht

Windrows and Scum lines

What is that crud on my lake?! You may have said this to yourself after seeing rows of scum on the surface of your lake. You may have noticed that these rows appear to be pointing in the same direction as the wind and are parallel to one another. These scum rows, also called windrows, scum lines or windlanes, are caused by a rather complex water movement known as **Langmuir Circulation**. A specific blend of wind speed and wave movement is required for Langmuir circulation to be established, but it happens rather often on many Missouri lakes.

If you want to know how this works, keep reading. Otherwise, turn the page quickly while your sanity is still in tact. It takes some 3 dimensional visualization, but I've put together an illustration that might help. Here goes: As the wind blows across a lake, a unit of water is moved from *point A* to *point B*. As this unit of water leaves *point A*, more water rushes up from beneath to occupy the space left behind. This net movement of water creates an **upwelling**. At *point B* there is now more water than before. A **downwelling** occurs as the excess water pushes downward.

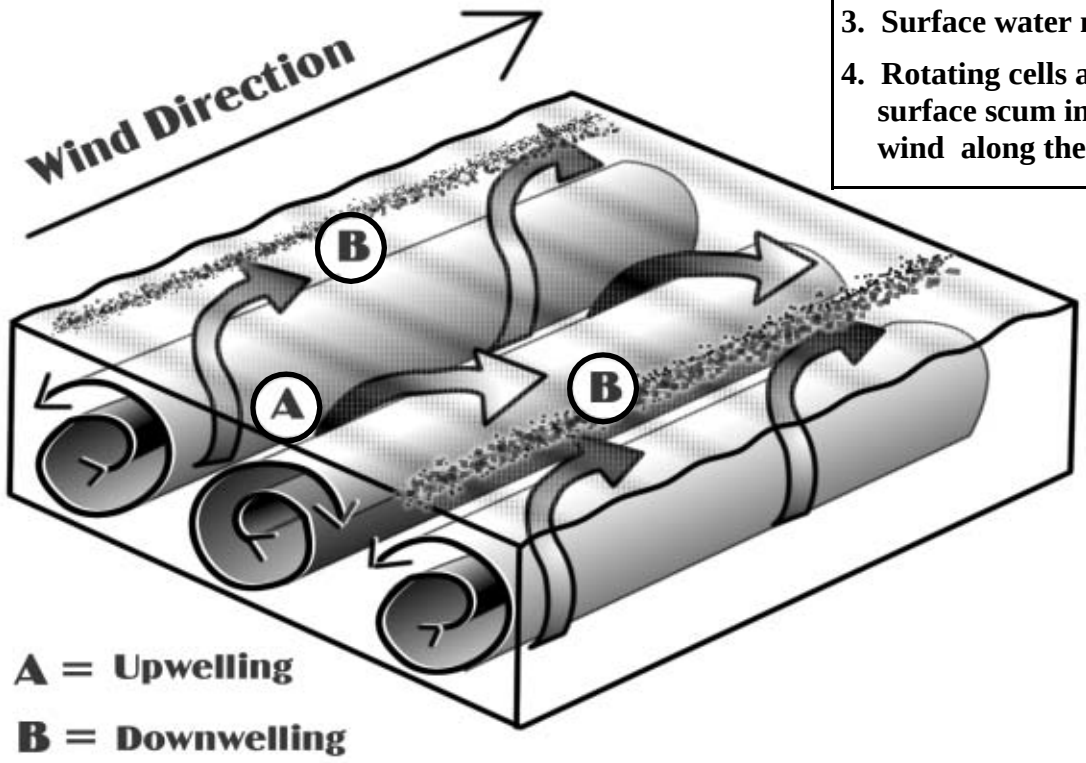
As this continues to happen, spiraling "cells" are established in the water. In the picture the "cells" are the things that look like fruit roll-ups. The arrows indicate the direction of the water movement within each cell. Wherever the "cells" touch the surface, scum resting on top of the surface tension is pushed from the upwelling point to the downwelling point.

When you're on the lake and you see a scumline, look around for another. The distance from one scumline to the next is equal to the width of 2 "cells". If you put your boat on one of these scumlines, the water beneath you is more or less moving down and downwind. If you park your boat in between two scumlines, the water beneath you is coming up and moving downwind. When you collect your sample, be sure to position your boat over an upwelling point as opposed to over a scum line. This will help keep the nutrient-rich surface scum out of the sample.

There are other forces working in a lake that influence water movement. Otherwise, all of the water would be in a big heap on the downwind shore of the lake! I'll discuss these one by one in future issues of The Water Line

Tony Thorpe

1. **Surface water moves from A to B**
2. **Sub-surface water moves up to replace water at A**
3. **Surface water moves downward at B**
4. **Rotating cells are created that push surface scum into lines parallel to the wind along the areas of downwelling**



Lake Foam

When looking out on a lake or stream, sometimes we can see a brown, funky "foam" in eddies or at a lake's edge. The sight of this foam immediately makes one think of soaps, detergents and pollution in general. These associations understandably lead us to assume that some manner of human-induced pollution is responsible. While it is possible that humans are to blame for the foam you see, it is more than likely just a natural phenomenon.

A quick test is to smell the foam. If it has a nice floral or perfume-y smell, it is most likely a detergent. If the foam smells fishy or "earthy", it's probably natural. Also, natural foam tends to be darker in color than the foam of detergents, though natural foam can be light in color. By law, the sudsing agent of detergents produced today must be biodegradable, meaning that the foam will be short lived if the detergent gets into a water body. This is in contrast to the late 50's and early 60's, when foam caused by detergents was a big problem.

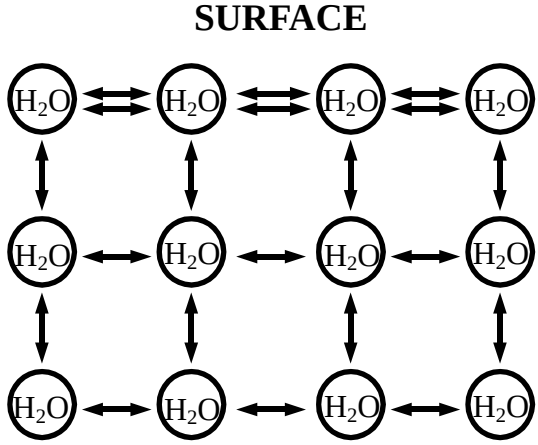
Organic matter in water reduces surface tension. Foam may form if there is enough agitation from wind or stream flow.

Here's the nitty-gritty on foam formation. Water molecules *want* to cling to each other. At the surface, however, there are fewer water molecules to cling to since there is air above (thus, no water molecules). This results in a stronger bond between those molecules that actually do come in contact with one another, and a "film" of strongly bonded water (see diagram). This surface film (held together by *surface tension*) creates a considerable barrier between the atmosphere and the water. In fact, other than mercury, water has the greatest surface tension of any liquid. If the surface tension is reduced, bubbles are more likely to be formed. This is due to the water's reduced ability to "regroup" after agitation. The greater the surface tension, the easier it is for water to pull itself together and force out trapped air.

The surface tension of water varies depending upon the dissolved stuff in the water and by the temperature. Organic compounds from decomposing plant or animal matter, or from actively photosynthesizing plants can reduce the surface tension of lake or stream water. Both detergent and heat reduce water's surface tension, allowing the water to enter smaller pores and fissures. That is great for forcing dirt out of your clothes. Hard water increases surface tension. Water softeners reverse this effect, reduce the surface tension and ultimately give cleaner clothes and sudsier baths.

On lakes, in bathtubs and in mugs of beer, the cause for foam is the same. Agitation at the surface causes air to get under the surface film of the water. Weakened surface tension is unable to force the air out, but rather keeps water wrapped around a volume of air, creating a bubble. If this happens for long enough, foam is created. On lakes, the agitation is usually due to wind, and the resulting foam will collect on the downwind side of the lake. In streams you will see the foam in eddies or floating downstream, and it is created by the flow of the water disturbing the surface film.

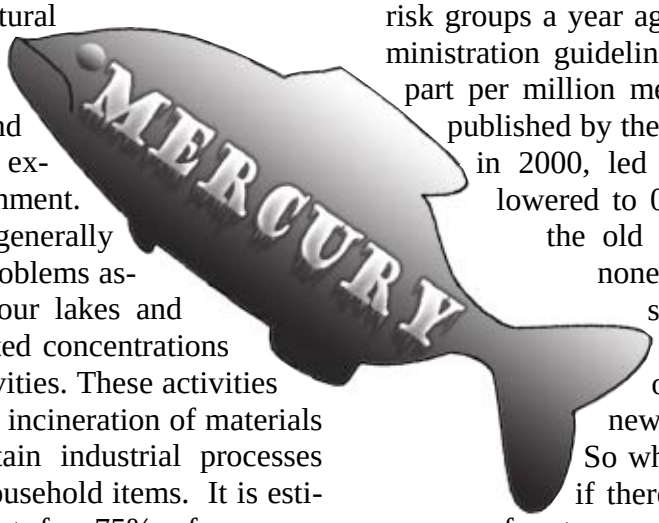
Tony Thorpe



Surface tension—molecules at the surface form stronger bonds

Last summer a new advisory was issued by the Missouri Department of Health. The advisory warned pregnant women, women who may become pregnant, nursing mothers, and children under 12 years of age to avoid eating largemouth bass over 12 inches in length, due to mercury contamination. The shocking part of the advisory was that it covered *all* streams and lakes in the state, not just a handful of waterbodies. Missourians were left to ask **AWhy the sudden problem with mercury?@**

Mercury is an element that is naturally found in rocks and minerals. Natural events such as volcanic eruptions and erosion account for the low background levels of mercury that we expect to find in the environment. These natural levels are generally not a cause for concern. Problems associated with mercury in our lakes and streams occur due to elevated concentrations associated with human activities. These activities include the burning of coal, incineration of materials that contain mercury, certain industrial processes and the disposal of some household items. It is estimated that humans account for 75% of mercury emissions worldwide.



Elemental mercury is often the form that is emitted into the atmosphere. This form is not very toxic, but it can travel great distances making it a threat to almost all waterbodies. **Atmospheric deposition delivers mercury to our lakes and streams**, where it can undergo a change into the highly toxic methyl mercury. Methyl mercury remains dissolved in the water and is incorporated into the tissue of aquatic organisms.

Mercury levels in the algae, zooplankton and even small fish are usually not of concern. It is when the mercury has had time to build-up or bioaccumulate in larger, long-lived organisms that problems arise. That's why the advisory in Missouri focuses on largemouth bass 12 inches or longer. These fish are at the top level of the food chain and have had time to accumulate enough mercury in their tissues to make eating them a cause for concern.

The primary health impacts associated with mercury are on the development of the central nervous system and brain. Methyl mercury is completely absorbed into the blood and distributed to all tissue (including the brain). The mercury will readily pass through the placenta to the fetus where it may cause developmental neurological abnormalities. That is why the high-risk group encompasses pregnant women and women who may become pregnant. **Children under the age of 12 are susceptible to mercury because their nervous systems are still developing.** The mercury levels in bass over 12 inches in length is not high enough to be of concern to those not in the specified high-risk groups.

Mercury levels were not a worry to the high-risk groups a year ago. Federal Food and Drug Administration guidelines and EPA criteria were at 1 part per million mercury in fish tissue. A study published by the National Academy of Sciences in 2000, led to the mercury criteria being lowered to 0.3 parts per million. Based on the old criteria of 1 part per million, none of Missouri=s waters were unsafe. With the lowering of the criteria, 40 lakes and sections of streams were now above the new threshold.

So why there is a statewide advisory if there are only 40 lakes or sections of streams that are above the new criteria? The simple fact is that not all waters have been tested. The 40 impaired waters make up 29% of the 141 lakes or stream sections that have been tested. A lack of data, along with the knowledge that mercury contamination tends to be widespread, has led government agencies to err on the cautious side.

Missouri is not the only state dealing with mercury pollution. **Forty-one states have fish consumption advisories associated with mercury**, with 13 of those states issuing state-wide advisories. In fact, mercury is the most frequent basis for fish consumption advisories. The state is working on plans to decrease the amount of mercury in our waterways but it may be a while before the current advisory is lifted.

While the mercury advisory was announced this summer, a 1985 fish consumption advisory for chlordane was lifted. The use of chlordane, a termite pesticide, was banned in 1988 and concentrations of the contaminant in fish populations have dropped to safe levels.

Dan Obrecht

What's the Big Deal With TMDLs???

Waters of the State are classified by their intended uses. Some of these uses include drinking water, swimming, boating and canoeing, cold or warm water fishery, livestock watering, and industrial. For example, the uses for Table Rock Lake include Livestock and Wildlife Watering, Protection of Warm Water Aquatic Life and Human Health associated with Fish Consumption, Whole Body Contact Recreation, and Boating and Canoeing. If these uses can not be met due to pollution or habitat change, then the water is listed on the 303(d) list as impaired. Once a waterbody is placed on the 303(d) list, federal law requires the State to develop a plan to clean up the water.

The Total Maximum Daily Load or TMDL estimates the amount of pollution that can enter a waterbody while maintaining the intended use of that waterbody. The TMDL is determined by examining all contributing sources of a single pollutant (such as sediment), next, a numerical value is calculated to establish how much pollution can be added from each source each day, while keeping the water clean enough to maintain the intended use. The calculation includes a margin of safety, and accounts for seasonal variations so that the water will always meet the intended uses.

So, What's Next for Missouri???

As of 2001, the EPA is under court order to establish TMDLs if Missouri does not. There are 174 waters on the 1998 303(d) list of impaired waters. Of those, 25 TMDLs have been written and approved by the EPA. Two drafts have undergone public comment, and will be sent to EPA for approval. That leaves 147 waterbodys that need a TMDL. In the next two years, MDNR must complete 40 TMDLs. The remaining waterbodys must have a TMDL in place by 2009.

The proposed 303(d) list for 2002 removes nine lakes for atrazine and cyanazine. However, 17 lakes are being added due to atmospheric deposition of mercury and three for Fecal Coliform. There will be 33 lakes on the list. Creve Coeur Lake is the only lake with an approved TMDL. Table Rock Lake is listed for both nutrients and mercury. Lake of the Ozarks is listed for fish trauma, gas supersaturation, and low dissolved oxygen.

What Can You Do?

Local citizens can assist the TMDL process by getting involved at the public meetings and identifying methods for reducing pollution that enters the waterbody. Nonpoint sources such as fertilized lawns, golf courses, leaking septic tanks and boat sewage discharges can be addressed by local action groups. Funding is available for education and installation of pollution reduction practices. Each proposed TMDL is listed on the department's website for public notice. During that time your comments and insight are welcome.

For more information, visit:
www.epa.gov/owow/tmdl/
or: *www.dnr.state.mo.us/deq/wpcp/wpc-tmdl*.htm

Georgeanne Bowman is with the DNR's Water Pollution Control Program. You can call her at 573-751-1300 if you have any questions.

What the heck is this 303(d) list anyway?

303(d) refers to the section of the Clean Water Act which states:

> 303(d)(1)(A) "Each state shall identify those waters within its boundaries for which effluent limitations required by section 301(b)(1)(A) and 301(b)(1)(B) are not stringent enough to implement any water quality standard applicable to such waters. The State shall establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters"

Translation:

The state must determine which of its waters have problems with water quality. Then the state has to rank those waters on a list and address the list from the top down. The priority ranking may be based on how bad the pollution is as well as how people are intended to use the water.

The *lakes* on the 2002 proposed list (as of January 7, 2002) are shown on the next page.

Lakes proposed for the 303(d) list as of January 7, 2002

This is a **proposed** list, *alphabetically arranged*, and is subject to change. Be sure to check the links page of the LMVP web site. We'll post a link there that will always have the current list.
The designation "Added" in the "Status" column means that the lake is an addition since the 1998 list.

LAKE	POLLUTANT	STATUS	ACRES
Bluestem Lake	Mercury	Added	15
Cameron #1 Lake	Atrazine		25
Clearwater Reservoir	Mercury	Added	1650
Cooley Lake	Mercury	Added	300
Creve Coeur Lake	Chlordane		300
Crowder SP Lake	Mercury	Added	18
Fellows Lake	Nutrients, Mercury	Added	820
Foxboro Lake	Mercury	Added	25
HS Truman Lake	Manganese		5560
Hough Park Lake	Mercury	Added	7
Hunnewell Lake	Mercury	Added	228
Indian Hills Lake	Mercury	Added	326
LaBelle #2 Lake	Atrazine,Cyanazine		112
Lake of the Ozarks	Fish trauma, Gas supersaturation, Low DO		50
Lake of the Woods	Mercury	Added	3
Lake St Louis	Chlordane		525
Lake Ste. Louise	Fecal Coliform	Added	50
Lake Taneycomo	Low DO		1730
Lamar Lake	Nutrients		180
Mark Twain Lake	Mercury	Added	18600
McDaniel Lake	Nutrients		300
Monroe City Rt J Lake	Atrazine, Cyanazine		94
Noblett Lake	Mercury	Added	26
Pleasant Hill Lake	Chlordane		115
Schuman Park Lake	Mercury	Added	5
Smithville Reservoir	Mercury	Added	7190
Spring Fork Lake	Nutrients		178
Table Rock Reservoir	Mercury, Nutrients	Added	43100
Vandalia Lake	Atrazine		37
Wallace Sp Lake	Fecal Coliform	Added	6
Watkins Mil Lake	Fecal Coliform	Added	126
Weatherby Lake	Mercury	Added	194
Winnebago Lake	Mercury	Added	350