Keeping you up to date on South River Science Team activities Winter 2007-2008

At A Glance: Floodplain Soil Sampling Scheduled for this Winter

After the April 2007 South River Science Team meeting, a work group began developing a South River floodplain soil sampling plan to meet the requirement of the Virginia Department of Environmental Quality (VDEQ) 100-year monitoring plan. The floodplain soil sampling plan is scheduled to be implemented this winter and will help the team understand how floodplain soils can function as mercury sources to the South River as well as provide valuable information for other team projects, such as the ecosystem study. The sampling plan divides the river into sections based on bridge crossings, flooding frequencies, and land use (i.e., wetlands, open space, forest, pastureland, and cropland). Soil samples will be collected from several soil depths from as many as 600 locations. After the samples are analyzed, they will be stored at the Science Team office in Waynesboro in case additional analysis is needed in the future. All samples will be collected in locations along the 25 river miles from Waynesboro to the confluence of the South River and North River at Port Republic. All samples will be analyzed for total mercury concentrations. Soil sample collection is expected to begin in late February 2008.

Soil samples will be collected by hand using a bucket auger.

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In the Fall 2000, the South River Science Team was formed to serve as a focal point for technical issues concerning mercury in the South River and downstream waterways. The Science Team is a cooperative effort between the Virginia Department of Environmental Quality, Department of Health and the Department of Game and Inland Fisheries and representatives from academia, citizens groups, the Environmental Protection Agency and DuPont. The Science Team provides technical direction for the mercury monitoring program and ensures that there is effective communication provided to the users of the river. The Science Team's goal is to understand why mercury in South River fish has not decreased over time and to identify potential solutions to improve the situation.

TechCorner:
Trophic Transfer Models Will Help Guide Future Activities

The South River Science Team has studied mercury concentrations in various ecological species (e.g., clams, periphyton, sediment, fish, crayfish, birds, earthworms) of the South River. Over the past several years, the team has gathered data with the primary goals of understanding why mercury in South River fish has not decreased over time and identifying potential species of concern. Now Dr. Mike Newman [College of William and Mary's Virginia Institute of Marine Sciences (VIMS)] is applying the knowledge gained through these studies by using trophic transfer models to help the Science Team predict how mercury is moving through the food web. This information will be used to guide future activities and make decisions that will have the greatest positive impact on the South River environment and wildlife.

Figure 2. Photographs of some of the species collected (top, L to R: dragonfly and damselfly larvae, crayfish, snail, and periphyton).

In an ecosystem, every form of life is food for another. A food chain is a food pathway that links different species in a community of living things. A community may contain hundreds or even thousands of different species. Each species is usually involved in several different food chains. Therefore, different food chains often interconnect to form a large network, called a food web. In a food chain, each species occupies a certain position in the chain, called a trophic level. For example, bass eat crayfish, so if a food chain contains a bass and a crayfish, the bass will be at a higher trophic level.

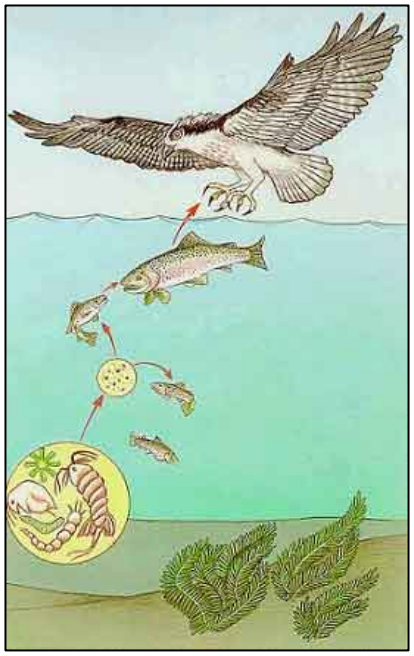

Figure 1. A simplified food chain showing three tropic levels. (Source: Seowon University *Energetics in Ecosystems*).

Figure 1 shows an example of a simplified food chain containing species at three trophic levels. Actual food chains are much more complex, and the same species can occupy different trophic levels in different food chains. For instance, a bass will feed on small invertebrates when it is young, and the young bass may also be food for larger fish. Until recently, these complex eating habits (omnivory) made it very difficult to model how mercury is moving through the food web and, eventually, into South River fish. Using a new approach called nitrogen isotope discrimination analysis, Dr. Newman is performing trophic transfer modeling to quantify how mercury enters the food web and eventually ends up in edible fish. In addition, the modeling will quantify what proportion of total mercury tissue at various trophic levels is methylmercury.

The first step is to determine the trophic level food web structure. By analyzing existing tissue data of various food web species for stable nitrogen isotopes (^{14}N and ^{15}N), Dr. Newman was able to verify that mercury concentrations in tissue do increase as you go up the food chain. The results show a clear relationship between nitrogen isotope ratios and mercury concentrations in various species at three locations along the river: Dooms Crossing, Augusta Forestry Center, and Grottoes Town Park.

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TechCorner: Trophic Transfer Models
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To confirm these results, the team sampled six sites along the river (Constitution Park, Dooms Crossing, Augusta Forestry Center, North Park, a river pool between Dooms Crossing and the Forestry Center, and Grottoes Town Park) in May and June 2007. Five fish species were collected at each location, as well as algae and eight types of invertebrates such as snails, clams, and crayfish (see Figure 2). Tissue samples were processed and analyzed for mercury, methylmercury, and nitrogen isotopes. These results, along with data from past and future studies, will be used to develop a trophic transfer model to predict mercury concentrations in fish with changes in mercury concentration in the river waters and sediments. A successful model can be used to evaluate whether changes in the amount or concentration of mercury in river water and sediments will impact to the level of mercury in fish tissue.

For more information about trophic transfer modeling efforts, contact Dr. Mike Newman at newman@vims.edu or (804) 684-7725.

From the Team…
BioDiversity Research Institute Assesses Mercury in Bats

When bats emerge at night from their day roosting areas, they require drinking water and forage for insects over river surface waters and floodplain edges. Scientists from the BioDiversity Research Institute (BRI) in Maine completed a study to identify the bat species present in the South River watershed. They also collected blood, fur, and tissue samples from bats to develop an understanding of potential mercury exposure in these animals. The efforts focused on four locations along the South River between Waynesboro and Port Republic and three reference locations on the Middle River. The scientists used Sonobat® technology to identify the species of bats living in the South River watershed, mist nets to capture bats, and radio transmitters to locate roosting sites.

All field work was completed between dusk and 1 A.M., which is the busiest time for bat activity. Bats were captured using mist nets that were strung directly in front of ledge outcroppings, between trees along small access roads, or in the middle of the river using a configuration that funnels the bats into the nets. The nets were checked every 15 to 30 minutes, and captured bats were quickly removed and placed in cloth bags. Over 160 bats were captured, weighed, and measured. Prior to releasing the bats, blood, fur, and wing skin samples were collected. The blood samples were used to determine the bats' recent mercury exposure and test their immune systems and reproductive status. The fur samples were analyzed to determine long–term mercury exposure. Analysis of the wing skin samples will contribute data to the stable isotope study (see Tech Corner article on page 2).

Scientists collect a blood sample from a Hoary bat.

Because the mist net sites are limited to locations on the river with easy access, the researchers used the Sonobat® technology at other locations. Sonobat® identifies bat species by using a computer to electronically record echolocation calls. Six bat species were identified based on their calls. All of the species found by the Sonobat® recordings were represented in the mist net captures.

Mercury levels in the blood and fur of bats collected at the South River locations are elevated compared to bats collected from Middle River locations. This finding is similar to studies of bats from other mercury-impacted areas in Virginia and other U.S. sites. The next phase of the study will be to determine if the presence of mercury has any adverse effects on the South River watershed bat populations.

For additional information about this study, contact Mr. David Yates at dave.yates@briloon.org or (207) 839-7600, ext. 114.

Did You Know?
Living Cave/Living River Program at Grand Caverns

A new experience is waiting for local 6th grade students at Grand Caverns in Grottoes, Virginia. This fall, the Living Cave/Living River program hosted over 500 students from Augusta and Rockingham Counties in an effort to get students to think about how they interact with their environment on a day-to-day basis and how they can take care of it in the future. The program was designed to meet the curriculum requirements for a "Meaningful Watershed Experience," which requires every high school student to have one watershed or stream experience before graduating. Eight stations around the park introduce students to chemical and biological aspects of the South River and the geology of the area and teach students how to conserve renewable and nonrenewable resources. The result is a day where students use analytical thinking to question themselves and their actions. Program organizers and volunteers hope that with all of the information learned, the students will be able to make informed decisions about the environment and take care of the earth that they are inheriting.

Betty Gatewood shows a sixth grader how to use a water temperature probe.

The program is closed to students for the winter, but will reopen in April. Self-guided tours for the general public are available by appointment, and a web site with the details of the program is set to launch in Spring 2008.

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South River Science Team
Attn: Kathy Adams, Technical Writer
508 West Main Street
P.O. Box 1326
Waynesboro, VA 22980

CONTACTS:

Virginia Dept. of Environmental Quality
Don Kain, (540) 574-7815
dgkain@deq.virginia.gov

Virginia Dept. of Game and Inland Fisheries
Paul Bugas, (540) 248-9360
paul.bugas@dgif.virginia.gov

Virginia Dept. of Health
Doug Larsen, (540) 332-7712
douglas.larsen@vdh.virginia.gov

DuPont
Mike Liberati, (302) 892-7421
michael.r.liberati@usa.dupont.com