Keeping you up to date on South River Science Team activities First Half 2009

South River Mercury Study

This newsletter issue is devoted to summarizing the status of studies conducted by members of the South River Science Team, as well as describing the initial findings that have resulted from the work conducted over the past several years.

As many of you know, mercury was used at the former DuPont plant in Waynesboro from 1929 to 1950 and was released to the South River as a result of past practices at the plant. A Virginia Department of Health fish consumption advisory has been in place on the South River and South Fork Shenandoah River since the mid-1970s.

The South River Science Team was formed in 2000 as a nonregulatory, collaborative partnership and has been working since that time to characterize the distribution of mercury in the watershed and identify potential options to decrease mercury availability to aquatic and terrestrial organisms. Science Team studies have included collecting samples from floodplain soil, river sediment and water, birds, bats, crayfish, small mammals, insects, fish, toads, and turtles, among others.

Members of the South River Science Team have been collecting samples from all types of aquatic organisms, including fish.

Past issues of this newsletter have summarized the sample collection methods and results of these individual studies. This newsletter issue presents the key findings that the Science Team is using to guide its future work. So much data have been collected that it is difficult to describe the findings in one newsletter without losing some of the more interesting details. Nevertheless, the Science Team hopes that the information contained in this issue is useful to readers.

Questions about any South River Science Team activities can be directed to any of the team members listed on page 4.

About this Newsletter…

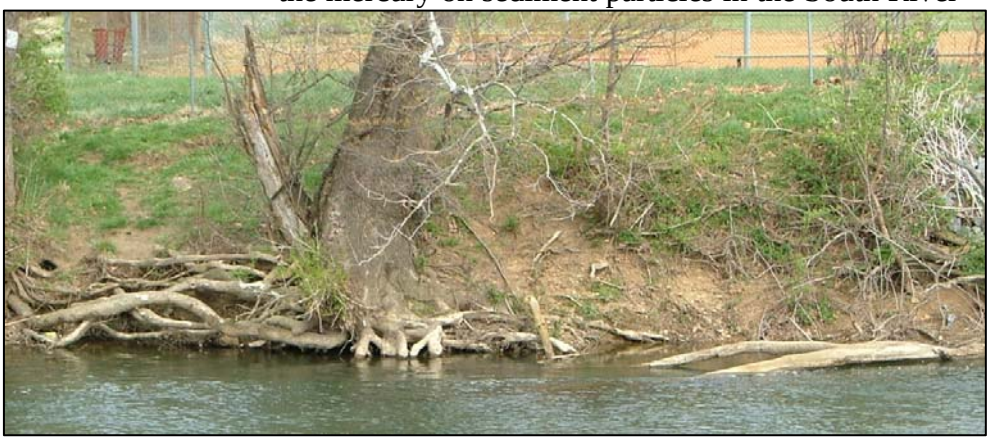
In the Fall 2000, the South River Science Team was formed to serve as a focal point for technical issues concerning mercury in the South River and downstream waterways. The Science Team is a cooperative effort between the Virginia Department of Environmental Quality, Department of Health and the Department 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.

The Big Picture and the Next Steps

The work of the South River Science Team has been extensive. With so many samples being collected, it is important to frame the key findings as part of the bigger picture. The findings are provided in a question and answer format below, along with the team's future plan for the topic.

How is mercury entering the South River?

Mercury seems to be entering the South River in two primary ways. The main entry appears to be from the erosion of mercury-impacted soil on the floodplain and the river banks. Fine sediments dispersed throughout the river itself also play a role. Other minor sources include residual mercury from the former DuPont plant, atmospheric deposition, and groundwater.



Photograph of a typical eroding bank along the South River.

Mercury tends to be tied up or bound when it first comes into contact with soil and sediment particles. When mercury is bound to particles, it typically does not enter the food web (see the Winter 2007-2008 issue of the newsletter for a discussion of food webs). However, under specific and not yet well understood situations in the South River, the mercury on particles transforms and becomes available for uptake by aquatic organisms and enters the food web. Understanding the process of mercury entry into the food web is a major focus of the Science Team.

How does the soil on the floodplain enter the South River and why is this important?

The work of the Science Team has shown that mercury-impacted soil on the floodplain is transported into the river by several different erosion processes. Flowing water during normal and storm conditions erodes river banks and floodplains. Human and animal activities can also cause soil erosion, and river banks can collapse into the river due to the winter freeze and thaw cycle.

The Science Team has measured erosion in many locations on the 25 miles of the South River between Waynesboro and Port Republic. The findings reveal that more river banks are eroding in the upper stretch of the river between Waynesboro and Crimora compared to the lower stretch between Crimora and Port Republic. When erosion occurs, soil particles containing the mercury enter the river and some fraction of the mercury detaches from the soil particles and enters the food web. This process is one explanation of why mercury is distributed throughout several miles of the South River.

Similar to mercury on soil particles, some fraction of the mercury on sediment particles in the South River detaches and enters the river water and the food web. Even though the river bed consists primarily of rocks and gravel, there is sufficient sediment in the South River to provide a small but steady source of mercury to the river and the food web.

The Science Team is unsure exactly how the mercury detaches from soil and sediment particles and how it then enters the food web. The team will try to gain a better understanding of this process in its future work. If the erosion processes that transport mercury-impacted soil to the river can be slowed down or stopped, it is believed that some of the mercury entering the food web could be reduced or eliminated.

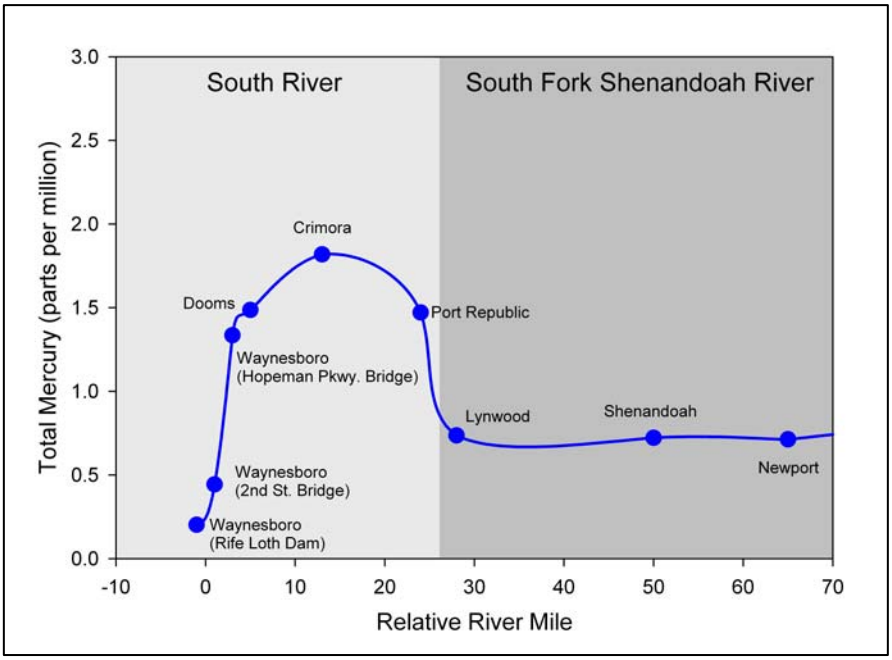
The Science Team will complete a river bank stabilization project in Waynesboro in late summer 2009. Across the river from Constitution Park, approximately 500 linear feet of eroding river bank will be stabilized and vegetation will be planted. This effort is considered a demonstration or pilot project to measure the changes, if any, that might occur when river bank erosion is reduced or stopped. Depending on its success, this approach may be one

option that could be applied to other eroding river banks that contain mercury-impacted soil. Construction activities will be visible from Constitution Park or while driving over the Main Street bridge in Waynesboro.

What are the key findings of the Science Team's fish and aquatic organism studies?

Measurements of mercury in fish date back to 1977, and now the Science Team has analyzed many other aquatic organisms in the South River for mercury. The information from these studies has helped improve the understanding of where mercury resides in the South River food web.

The mercury level in aquatic organisms typically increases downstream of Waynesboro, and the mercury level in many organisms is the highest near Crimora. Downstream of Crimora, the mercury level in fish and other organisms begins to decrease and the mercury level declines even more downstream of Port Republic. This rise and fall (i.e., a "hump") of the mercury level in aquatic organisms can be plotted on a graph, as seen below.



This graph shows the total mercury levels in filets of largemouth bass and smallmouth bass from the South River and South Fork Shenandoah River. Between 1981 and 2007, the Virginia Dept. of Environmental Quality has collected filets from 1,605 fish and analyzed them for mercury.

Why do we see this "hump" in the level of mercury in aquatic organisms? A greater percentage of river banks are eroding in the upper stretch of the South River between Waynesboro and Crimora compared to downstream of Crimora. Mercury levels in river bank soil tend to be higher in the upper stretch as well. These two conditions seem to support a connection with higher levels of mercury in aquatic organisms in the upper stretch of the South River. In the upper stretch, the South River flows more slowly, the floodplain is wider, and there is more sediment at the base of the river bank compared to the downstream stretch.

Although sufficient measurements of the connection between erosion and the mercury level in aquatic organisms have not yet been made, the connection seems plausible and worthy of further investigation.

How might humans be exposed to mercury?

The Science Team continues to examine all of the ways in which humans might be exposed to South River and South Fork Shenandoah River mercury, such as eating fish, wildlife, crops, and livestock and through living and recreating on the river.

The fish consumption advisory provides important information about the amount and types of fish that should not be eaten. Less is known about mercury levels in wildlife, and the Science Team has begun sampling waterfowl and game that is typically hunted and consumed.

With the exception of interior locations at the former DuPont plant, mercury levels in the South River and South Fork Shenandoah River, as well as the groundwater in the area are below those identified as safe for drinking. For those people participating in recreational activities, mercury levels are not believed to pose a significant health concern. Science Team activities have focused on potential human exposure to floodplain soil and crops. Results show that the vast majority of floodplain soil samples have low mercury levels. These low levels are below the U.S. Environmental Protection Agency (USEPA) level that is considered safe for people (including children) who routinely have contact with the soil. Samples with higher mercury levels were collected at a limited number of sample locations (e.g., forested, agricultural, or commercial areas) where direct human contact with soil is expected to

be infrequent and potential risks to humans are expected to be limited to nonexistent. A few samples with higher mercury levels were obtained from areas where more frequent contact might be expected. These areas will be revisited to determine if additional soil samples should be collected. Findings from a floodplain crop study show that mercury in edible crops is not a significant route of exposure to people.

The Science Team also performed an outdoor air study to determine whether mercury levels are higher than normal background levels in the vicinity of the South River and its floodplain. All measured concentrations are comparable to global background concentrations, meaning that the amount of mercury in the air is similar to what is normally found on Earth in places that do not have a local mercury pollution problem.

Shortly after mercury was discovered on the floodplain in the 1970s, samples from edible portions of a limited number of cattle that grazed in the area were analyzed for mercury. No mercury was found at levels that pose a health risk from eating beef from cattle raised on the floodplain. Sampling was limited in the study, so additional investigation may be needed to confirm these findings.

What are the next steps?

There is still much to learn about mercury in the South River and adjacent floodplain environments, so it is important that the Science Team's collaborative efforts continue. Unfortunately, mercury is a difficult material to understand, particularly in a system like the South River that is changing over time through climatic, geologic, and human activities. Mercury can change chemical forms, move about in the environment, and be converted by microorganisms to a more active, toxic form. It is important to understand these dynamic processes in the South River in order to identify potential remediation options that may improve the mercury situation.

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