Potential Future Studies of Mercury Accumulation in the South River

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Bioaccumulation of mercury in terrestrial amphibian components of the riparian ecosystem

Hg is a contaminant that readily accumulates in female tissues, and can then be maternally transferred to young. Once in the egg, it is highly teratogenic and can result in reduced reproductive success due to embryo-larval mortality and developmental malformations. Few studies have examined maternal transfer of any contaminant in amphibians. We are very interested in examining maternal transfer of mercury at the South River site and quantifying its effects on development and reproductive success of native amphibian species. We would examine multiple species representing different trophic positions, associated with the aquatic environment. For example, wood frog (*Rana sylvatica*) larvae are omnivorous grazers whereas most salamander larvae are carnivorous. We would compare a streamside salamander species with the wood frog to examine exposure scenarios based on different ecology of the species. This study would collect individuals from the contaminated site and a reference site and breed them under controlled conditions to assess maternal transfer of mercury, clutch size, hatching success, embryo survival, etc.

One of the other factors that is missing in amphibian ecotoxicology is the link between contaminants and population-level change. We can quantify female reproductive success by measuring maternal transfer, clutch size, embryo survival, larval survival, and metamorphic recruitment. We can then make higher level predictions about how these effects translate into population level changes. This could even be further enhanced if we can focus on a species that has been well studied (e.g., wood frog) where other data exists on their vital rates.

Additionally, because fish are highly mobile, a study of less mobile species, such as terrestrial amphibians, may provide more insight as to where the contamination is occurring.

Bioaccumulation of mercury in mammalian components of the riparian ecosystem

Methylmercury (MeHg) biomagnifies through the food chain as predators eat other organisms and absorb the contaminants that their food sources contained. Over time, an individual who consumes plants or prey contaminated with methylmercury will acquire levels greater than in either its habitat or its food. As a result, top predators will acquire greater body burdens of mercury than the fish they consume. Elevated mercury levels in predatory species may cause behavioral changes, neurological defects, reproductive failures, and/or mortality depending on degree of exposure. Detrimental effects will depend on the level of exposure, the species diet, and the susceptibility of the species (among other things). To interpret how environmental exposure in a river will accumulate up a food chain, wildlife benchmarks need to be established. These species could be used as "biosentinels" helping assess the risks to wildlife and allow landscape-level extrapolations of the hazards. Studying bioaccumulation in mammals is also relevant as a model for studying bioaccumulation in humans.

The terrestrial species most likely to be affected by mercury levels in rivers are those closely associated with the riparian environment. These include: the river otter (*Lontra canadensis*), the mink (*Mustela vison*), the beaver (*Castor canadensis*), the muskrat (*Ondatra zibethicus*), and the raccoon (*Procyon lotor*). Of these species, it is likely that the river otter, the muskrat, and the raccoon, occur in the South River. These three species would be interesting to study and compare as their diets go from mostly herbivorous (muskrat) to almost entirely piscivorous (otter). This study proposes examining mercury levels in these 3 species in the South river and in a reference population for comparison. In addition, population level affects can be examined through live capture and radio collaring of individuals. This would allow examination of general health, behavior, and reproductive success of exposed and unexposed individuals and allow population level predictions.

Continuation of the accumulation and mercury dynamics model development and analysis

We propose exploratory analysis of the BASS model and potential expansion to the Olin-Mills (Hg) site on the North Fork of the Holston River. James Vance can conduct this exploratory analysis next semester and this may lead us to attract other research co-sponsors in Fall 2005.