HURON MOUNTAIN WILDLIFE
FOUNDATION

Winter 2012
Newsletter

Heavy Metals in North Woods Streams: How Much is Too Much

By Declan Spring

One morning in August, I set out to meet some HMWF researchers and grant-recipients studying the ecosystem effects of toxic metals in streams. It was one of those perfect days, the warm air stirring the pine trees and creating that unmistakable Huron Mountain scent, and as I reached the meeting spot by Pine River, I found researcher Laura Podzikowski already there before me. Podzikowski is a young scientist obtaining her masters degree in conservation ecology from the University of Michigan, and she and her colleague, Raissa Mendonca, an undergraduate from Recife, Brazil were busy setting up tables and laying out equipment for the day. Both work under the direction of David Costello, a post-doc at the University and Professor Allen Burton who received an HMWF grant for this work. A laptop and some other pieces of equipment were plugged in to the engine of their white SUV.

The level of purity of Pine River is something you don't see in most places.

I was there to witness the team collecting samples of river sediments that had been placed in the stream earlier. The crew had already taken nine samples of sediment at other sites: five from the Raisin River forty miles southwest of Ann Arbor—a relatively clean river—and four from the Ocoee River, near Cleveland, Tennessee, a river that's not so clean. It's lined with old mines and ore processing sites, and is polluted with copper and lead.

Sediment chambers at the bottom of Pine River.

The samples had been placed in closed "chambers," which look something like the lint-collecting plastic baskets in washing machines. These chambers contain sediments with different degrees of contamination with copper compounds. They are secured to plastic shelving, and then hammered down to the bottom of the river using a sledgehammer. A little note is placed on a nearby tree branch nearby asking passersby not to tread on the baskets.

The baskets were placed in a concentration gradient with the higher concentrations downstream so as not to effect the less contaminated baskets. (Concentrations ranged from 0 to 2100 milligrams of copper per kilogram of sediment.) The goal here was to remove the samples after one-week, four-week, and twelve-week periods, to assess the state of the sediment ecosystem function after weeks in some of the purest "soft stream water" in the country. "Ultimately," Podzikowski explained to me, "we're trying to create a model back at the lab to determine 'how the geochemistry of sediment relates to the bioavailability of metal contamination.'"

I scratched my head, figuring this would all become clear. Pretty soon, I realized that the "geochemistry" of sediment is basically the chemical form and amount or concentration of natural minerals like carbon, sulfides, iron, and manganese. The "bioavailability" or, basically, the amount of toxic forms of metal (copper in this study) bears a direct relation to a range of ecosystem properties. Creating a mathematical model that predicts this relationship can show two things: how well an environment (like Pine River) resists pollution (for example, from sulfide mining), and how bad things actually have to become before you need to clean things up. While this information might someday prove useful in determining whether sulfide mining is having an impact on stream quality, their team (and the science) are neutral on the issue. The research they're conducting focuses simply on understanding ecosystem responses.

"The level of the purity of Pine River is something you don't see in most places," Mendonca told me, pulling a rock out of the water and holding it up. It was covered at the bottom with what

continued on page 2

From the top: David Costello. Podzikowski extracting the chambers from the river bottom. One of the chambers pulled from the river.

looked to me like small slugs. "See these dragonfly and caddisfly larvae? In most places, I have to look around to find these. Here, they're everywhere."

"The streams at the Huron Mountains are the perfect place to study the reactivity of metals in sediment because of the amazing diversity of streams, including Pine River," Costello told me later. "The findings from this work will be published in scientific journals like *Environmental Toxicology and Chemistry and Environmental Pollution.* Government agencies will be better informed. This information will eventually be taken into account in decision-making processes."

While Podzikowski and Mendonca took the sediment samples out of the stream, a big green frog sat on the riverbank watching the three of us. He kept us company the whole two hours. Crayfish had collected around the baskets, and Podzikowski kept getting pinched.

"Our work in ecology is divided between field work and lab work," Podzikowski says. "While I love spending time in places like this, I spend so much more time working in the laboratory. Extracting and measuring chemicals in the sediment takes hours and months of hard work. The overseer of this whole project is Allen Burton, the Director of the Cooperative Institute for Limnology and Ecosystems Research at the University of Michigan, whose research on ecological risk assessment has taken him to all seven continents. He used to do tons of field work. Now, his research is done primarily in the lab."

After picking off crayfish and carefully carrying the sediment chambers to shore, Podzikowski and Mendonca took the requisite steps to analyze the sediment in three ways. The first was measuring the abundance of diversity of insect species in the sediment: mayfly, stonefly, and caddisfly larvae. Mendonca sieved the debris so that only the insect life remained. This was preserved in containers filled with alcohol.

The second step was to create "oxygen profiles" on different levels of the sampled sediment. Here's where the computer plugged into the engine of the van comes in. "Basically, the healthier the sediment, the more biological activity you see," Podzikowski explained. "The more biological activity, the more oxygen."

To measure oxygen concentrations, Podzikowski placed sediment in a white water-filled tray, and inserted a clear needle called an "oxygen profiler" into it. This needle was connected to the computer, and on the screen, graphs show the different depths. The top layer showed more oxygen, because it is in contact with oxygen-saturated stream water. The more contaminated the sediment, the thinner the oxygen-rich layer at the top.

Thirdly, a sample of sediment from each basket was collected for freezing for the geochemistry analysis. First, Mendonca stuck a pH meter (two probes connected to a blue rectangle) to determine how acidic the sediment was. A 6 to 8 measure supports most biological life; the sediment in Pine River is a little above 8, which means it isn't acidic at all; in fact, it is slightly more basic.

What this all boils down to is that metals tend to stick to sediment. The model these researchers are after can guide new standards for curbing the release of metals in streams as well as the clean-up of historic contamination. Later that day, after I walked away, leaving Podzikowski, Mendonca—and the frog—I couldn't help but be impressed by the researchers' patience and energy. What seems to ultimately drive their work is scientific curiosity and interest in the pristine land and water of this region.

PUBLICATIONS AND PRESENTATIONS

By Kerry Woods
Director of Research

Even though it hasn't been very long since our summer newsletter where we presented a very large crop of publications and presentations that have resulted from projects supported by the Foundation, here are new ones to add to the list:

THESIS

Emily Sessa. 2012. "Phylogenetics and Physiological Ecology of *Dryopteris* (Dryopteridaceae)". Ph.D. Thesis, University of Wisconsin–Madison.

PEER-REVIEWED PUBLICATIONS

Gailing, O., Lind, J. & E. Lilleskov. 2012. Leaf morphological and genetic differentiation between Quercus rubra L. and Q. ellipsoidalis E. J. Hill populations in contrasting environments. Plant Systematics and Evolution 298: 1533-1545. DOI 10.1007/s00606-012-0656-y.

Sullivan, A.R. Lind, J.F., McCleary, T.S., Romero-Severson, J. & O. Gailing. 2012. Development and characterization of genomic and gene-based microsatellite markers in North American red oak species. Plant Molecular Biology Reporter. DOI: 10.1007/s11105-012-0495-6.

CONFERENCE PRESENTATIONS

Lind J. & O.Gailing. 2012. Generic structure of Quercus rubra L. and Q. ellipsoidalis populations at gene-based EST-SSR and nuclear SSR markers. Plant Biology 2012, Austin, Texas, July 20-24.

Woods, K.D. 2012. Biomass and CWD pools show complex multi-decade dynamics in old-growth northern hardwood forests. Ecological Society of America, Portland OR 5-10 August.

Sessa, E., and T. Givnish, 2012. "Leaf form and photosynthetic physiology of eastern North American *Dryopteris* (Dryopteridaceae). Botanical Society of America Annual Meeting, Columbus, OH. July.

Wetzel, M. J. 2012. The aquatic oligochaetes (Annelida, Clitellata) of the Huron Mountain Club area, upper peninsula Michigan, USA. 12th International Symposium on Aquatic Oligochaeta, Fremantle, Western Australia, 10-13 September.

Annual Meeting Attracts Foundation Supporters

The featured speaker at the Foundation's 2012 annual meeting held in August was Jim Bockheim of the Department of Soil Science at University of Wisconsin-Madison. Bockheim has a long history of research at the Huron Mountains, and has conducted ground-breaking research on the effects of tree-fall gaps on the cycling and availability of soil nutrients — processes that could have large consequences for forest composition.

But over the last several years, Bockheim has been concentrating on surveying the surface geology of Huron Mountain Club lands. These lands exhibit features that document a complex history of glacial activity, changes in levels of Lake Superior, and massive floods of glacial meltwater, and so before the meeting, Bockheim led members on a field-trip where he "read" some of these stories directly on the landscape. Excursion participants enjoyed seeing sand ridges that are actually "megaripples" created by long-ago floods that had water volumes equivalent to the Amazon; canyons and rock basins carved massive waterfalls; and outcrops and cliffs that were once part of the ancient shorelines of the glacial great lakes.

The annual meeting is also the venue for giving the Manierre Award, which was created to recognize publication in the peer-reviewed scientific literature of research conducted under the auspices of the Huron Mt. Wildlife Foundation. (See back page for information on this year's recipient.)

Jim Bockheim leads members on a field trip.

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We wish to thank the following contributors for their generous donations in support of the Foundation's program of scientific research and restoration of our historic facilities on Ives Lake:

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SCIENTIFIC ADVISORY PANEL RECRUITS RESEARCHERS AND VET PROPOSALS

By Kerry Woods, Director of Research

Over the last eight years, awareness of the Huron Mountain region as an excellent location for research has spread within the scientific community. Each year, the number of researcher inquiries to the Foundation increases and the range of institutions that our scientists come from broadens. This results in parallel increases in both the number and strength of research proposals.

The greater demand is wonderful news all around. But success in any sphere brings its own set of challenges. For the Foundation, this has meant increased demands on our infrastructure, on the Ives Lake Field Station and on the off-site infrastructure for recruitment and assessment of proposals.

Grants and generous donations have allowed us to stay abreast of new demands on facilities and logistical support. Improvements didn't stop with our 2011 celebration of the Red House restoration. This year, researchers benefitted from improvements in our waste-water treatment and power generation systems. Contributions made in memory of William and Anne Manierre funded upgrades of kitchen and working spaces in the Stone House, and the creation of a beautiful new library.

It's exciting to watch how this work enhances possibilities for researchers at Ives Lake. However, while the research program has become more and more lively our approach to recruiting and assessing proposals and to overseeing and evaluating work at the Station has remained largely unchanged. It's been clear for a while that we've needed a more robust professional infrastructure.

Toward this end, we've created a new Scientific Advisory Panel — a volunteer group of established and respected researchers from diverse disciplinary backgrounds. This group will strengthen our program in at least two very important ways, and maybe in some unexpected ones as well. The research world can be quite an intimate community; much of the important communication occurs through word-of-mouth networking. In the past, I've spread the word about the Foundation and its facilities at conferences and through various online networks, but having a larger body of well-connected scientists as 'built-in' promoters will be an invaluable asset in getting the word out.

The Scientific Advisory Panel will also help review the proposals we receive each February. In the past, I've called upon peers to assess particular proposals in an ad hoc way, and that has worked, but it's a challenge to make it happen expeditiously. With a ready-made panel of scientists with diverse expertise at hand, I anticipate the process to be smoother, faster, and increasingly rigorous.

Stone House at Ives Lake and progress of the Stone House renovations.

For now, we plan to keep this structure exploratory and flexible. I suspect there will be unanticipated ways in which an advisory body of experienced researchers can contribute to the Foundation's continued maturation and growth as a sponsor and promoter of regional, field-based research.

THE FOUNDING MEMBERS OF THE SCIENTIFIC ADVISORY PANEL ARE:

Dr. Jim Bockheim, University of Wisconsin - Madison, Soil Science: Dr. Bockheim is a long-time researcher at the Hurons. His insights from that experience will be as valuable as his expertise in the earth sciences.

Dr. Phil Myers, University of Michigan - Ecology and Museum of Zoology: Also bringing long-term familiarity with the Hurons and northern Michigan, Dr. Myers' expertise with mammals and vertebrates generally will complement expertise of other panel members.

Dr. Greg Mueller, Chicago Botanic Garden: Dr. Mueller is a mycologist who spent many years at the Field Museum before becoming VP for Science at the Botanic Garden. In addition to providing a valuable area of expertise, Dr. Mueller's connections in the museum/botanical garden world will be invaluable.

Dr. George Robinson, University at Albany, Biology: Dr. Robinson is an ecosystem scientist and Chair of the Scientific Advisory Committe of the Huyck Preserve in Rensselaerville, NY. The Huyck Preserve is, like HMWF-Ives Lake Field Station, an independent research station with a long and distinguished presence in the ecological community.

Our annual research proposal cycle calls for proposals to be submitted by the first day of February. That's always an exciting time, but it can also be a little overwhelming. With the advisory panel in place, I find myself looking forward to it with an entirely positive perspective.

Manierre Award Granted for Climate Work

The Manierre Award for 2012 was awarded to Kenneth Hinkel and Frederick Nelson for their joint publication, "Spatial and Temporal Aspects of the Lake Effect on the Southern Shore of Lake Superior." Published in the journal *Theoretical and Applied Climatology,* this paper emerges from an ongoing, multi-year study of microclimatic patterns at Huron Mountain.

Climatologists have long realized that complex landscapes and the effects of large bodies of water can make for wide variations in temperatures and precipitation over short distances. The Hinkel-Nelson study used an intensive network of climate monitoring stations in the Huron Mountains to support rigorous documentation and modeling of these patterns. Their work will be invaluable to other researchers in the region as well as for climate scientists in general.

The Manierre Award is given each year at the annual meeting in August to an HMWF researcher with published work. This year's meeting was the first time the Manierre Award has been given without the presence of the award's founders, Anne and William Manierre. Their daughter Anne was on hand to help bestow the award. Moving forward, the growing list of distinctive studies receiving the Award will be an ongoing reminder of the Manierre's many contributions to natural history research.

You can read this year's Award-winning paper (and other previous award winners) at the Foundation's website, www.hmwf.org.

About the Huron Mountain Wildlife Foundation:
Since 1955, the Huron Mountain Wildlife Foundation has supported original research in a wide variety of scientific fields. The research takes place in the Upper Peninsula of Michigan. More information on the Foundation can be found at: **www.hmwf.org**

We welcome your comments and suggestions on this newsletter. Please send them to:

Timothy H. Brown
4730 South Kimbark Avenue
Chicago, IL 60615
tbrown@wabashco.com

Editor: Jill Riddell
Designer: Amanda Micek

HURON MOUNTAIN WILDLIFE FOUNDATION
4730 South Kimbark Avenue
Chicago, Illinois 60615