



Hunting for Dynamic Equilibrium in the Hurons

By Tom Dibblee

On an August morning this past summer, David Costello, an ecosystem ecologist from Kent State University, led a tour of Mountain Stream, one of several waterways Costello has been studying in the Huron Mountains. Costello is conducting research on rivers and streams to see how healthy ecosystems function, and he uses the insights he gathers from the Hurons as points of contrast with impaired waterways closer to Kent State, near Akron, Ohio.

The group accompanying him caravanned out to the Mountain Stream road bridge, parked, and set out to walk upstream. I stood on that road bridge, and the water underneath certainly looked pristine to me.

To me, pristine meant clear water flowing over rocks free of slime. It meant I could wade in with no fear that any gross or threatening critter might come and get me. My vision of the pristine was all about cleanliness so perfect that it was borderline sterile. No dirt, no muck, no slime, no critters: just water, rocks, and me.

My amateur concept of the pristine turned out to be different from Costello's.

We waded into the water, and Costello started to show us what was really in there. Hidden under a shell of tiny pebbles stuck to its body was the stone-cased caddisfly, a fly larvae that eats algae.

Beneath a sheath of sticks was the stick caddisfly, which eats leaves that have fallen into the water from the canopy overhead. In an eddy was the mayfly, another algae eater. And tucked into the top layer of the sandy streambed was the dipteran, an animal that eats the waste produced by the bugs just mentioned.

To Costello, a pristine waterway is one that teems with life. It's a web of networks and overlapping boundaries between the surrounding forest and the water, between the vegetation and the invertebrates and the fish and mammals.

"What I look for in a pristine river is complexity and diversity, in both organisms and form," Costello said. "In a healthy waterway, there are a lot of different food sources available. Some of those food sources are things we think of as potentially messy, like algae and slime or fine particles like bits of leaves and sticks. But with a diversity of organisms, the macroinvertebrates will eat all that up and remove the material and keep the water clear."

The stream looks clean because an army of organisms is in there preventing the algae from growing too much, preventing the leaves from piling up, and preventing any one organism from taking over.

To support a diversity of organisms, a waterway has to have a diversity of habitat. Pristine waterways feature a wide range of habitat



Left: Costello has studied metals in the waterways marked with red triangles and nutrients in the waterways marked with green circles.

Right: Some of the many critters that keep the water clean.



naturally – fast areas, rocky areas, slow areas, sandy areas, grassy areas, sunny areas – while waterways modified by humans tend to be less complex, with straightened channels and managed vegetation along the banks.

“For a stream to clean itself up, the water has to slow down somewhere so that critters can suck the nutrients and particles out,” Costello said. “If you have a straight channel, those particles in the water don’t have anywhere to go, and the water becomes muddy.”

The term Costello uses to describe the phenomenon of a complex series of physical processes working together to maintain balance is “dynamic equilibrium.”

“Streams are naturally always changing because floods move around the rocks, wood, and sand. Fish and bugs can crawl back upstream after the flood recedes, but the bed material will inevitably make its way downhill to a lake or ocean. Pristine streams replace those flooded-out rocks and sand with freshly eroded material. So counterintuitively, a natural stream must move, erode, and change to stay stable.”

Metals and Nutrients

Costello first ventured to the Upper Peninsula shortly before the Eagle Mine – which the Toronto-based Lundin Mining acquired from Rio Tinto in 2013 – began production on the Yellow Dog Plains. He wanted to know how healthy ecosystems would respond to potential contamination with metals, and he set up a series of experiments in waterways both around the Huron Mountains and elsewhere in Marquette County.

“We do a lot of measurements where we take integrated snapshots of what the ecosystem is doing as a way to understand potential impacts from human activity,” Costello said.

To gauge the impact of metals – which have not made their way from the Eagle Mine into any Huron Mountain rivers or streams – Costello puts a plastic canister in the water that contains stream mud contaminated with nickel and copper. On top of the canister, he puts a porous ceramic cap. To organisms in the river, the ceramic cap appears to be a rock. As the metals seep out of the canister, Costello records data on the algae that grows on the cap.

Costello has found that “algae will continue to crank along regardless of contamination.” But while that algae might appear to be growing just fine, its contamination with metals means ripple effects farther down the food chain.

“For animals relying on algae, even if the algae is growing ok, it’s going to be full of metals,” Costello said. “For instance with snails, we saw consistent changes in behavior. The snails did not want to eat the contaminated algae. The base of the food web was fine, but one level up was where we saw the most consistent responses.”

Costello’s work with nutrient contamination looks similar. Nutrients like nitrogen and phosphorous, which are found in fertilizers, tend to run off into waterways that abut agricultural fields. In the Huron Mountains, Costello puts nitrogen and phosphorous into canisters, watches the algae grow on the cap, and traces the ripple effects of increased algae growth.

With metals, Costello is focused on ecosystem resilience. How would a stream respond if metals made their way into the water? With nutrients, Costello is more focused on gaining broader insight into how ecosystems function.

Above: Costello looks at the interactions between habitats and organisms in order to gauge the health of waterways.

Below: Alice Costello is one of the Midwest’s number one bug finders.

“When we added the cups of nitrogen and phosphorus, the algae took up those nutrients and grew quicker and thicker,” Costello said. “In pristine streams, algae have a large capacity to take up nutrients, and most of those nutrients get converted to food for fish and bugs. This capacity for growth and nutrient uptake is not seen in more human-dominated streams. When algae in streams don’t have the capacity to take up added nutrients, those nutrients can move downstream and cause big problems in lakes and oceans, like harmful algal blooms and anoxia.”

Back in Ohio

By studying healthy waterways on the Upper Peninsula, Costello hopes to bring insights back to Ohio into how best to think about impaired waterways, whether polluted with agricultural runoff or paved in and surrounded by city.

Some of this applicability is practical. By digging into the functionality of an impaired waterway’s ecosystem, Costello can identify clear features of that ecosystem to prioritize. The classic example of this, long practiced in the restoration of fisheries, is identifying a lack of a species – say, brook trout – and prioritizing the rehabilitation of that species’ population.

But much of that applicability has more to do with the type of awareness Costello helped me develop on the tour we took of Mountain Stream. Costello hopes that, by revealing what’s really going on in the ecosystem, he can encourage more of us to understand that even channelized, murky waterways have much more going on than one might expect.

“A lot of people will walk right by impaired waterways and think there’s nothing in there,” Costello said. “But if you actually get into the water and look around, you see it’s actually doing some things. There are things living in those streams, interesting macroinvertebrates, cool-looking bugs. People walk right by and don’t realize there’s biology going on in there. Bringing light to the full scope of biology right in front of us is what I like to do.”

HMWF Annual Meeting 2023

On August 8, 2023, Board President Henry Dykema called the annual meeting of the Huron Mountain Wildlife Foundation to order. Henry updated the roughly 40 attendees on the work of the Foundation, which included the first “Ives Lake Research Conference” at the HMWF Field Station in September 2022. This gathering of researchers from different disciplines provided a great opportunity for cross-fertilization, as they learned about each other’s projects. Henry announced that plans are already in the works for a second such conference in 2024.



President Dykema noted that HMWF research continues to produce important findings using the Huron Mountain Club property as a natural laboratory. As Dykema said, “There’s magic here.” He discussed recent improvements to the Ives Lake complex and took time to acknowledge the many people whose contributions fuel the Foundation’s success. He most particularly acknowledged the Foundation’s Director of Research, Dr. Kerry Woods, who is marking his 20th year in that position, and retiring newsletter editor Jill Riddell. As a thank you

for Jill’s 12 years of amazing volunteer service, she was presented, in absentia, with a beautiful mosaic mayfly plaque created for the occasion by HMC artist Mary Driver.

Director Kerry Woods elaborated on the importance and plentitude of the Foundation’s ongoing research, highlighting that it typically results in publication of 6-12 papers each year in peer-reviewed publications and receives 500+ citations of these publications annually. He discussed HMWF’s data-archiving initiative, aimed at preserving the invaluable baseline and long-term data-sets generated by Foundation research projects, and making them available to future researchers. He also announced publication of the most recent version of the Huron Mountain All-Taxa Biodiversity Inventory, which currently lists about 6,000 species, a total that has increased by approximately 114 species each year since first compilation of the ATBI.

Dr. Woods introduced the 2023 featured speaker, Dr. David Costello, an ecosystem ecologist and professor at Kent State. His research focuses on the structure and function of stream ecosystems and how they respond to stress and to human activity in particular. His projects under the auspices of HMWF include specific focus on the effects of metal contaminants in local waterways. He documented their condition both before and after the Eagle Mine and was happy to report that he did not detect any elevated levels of copper and nickel. His research relies heavily on the comparison among more and less contaminated streams, and those at HMC provide critical baseline data for his broader comparative studies with streams throughout and beyond North America. The day after the annual meeting Dr. Costello generously took time to lead a walk for members spotlighting the rich insect life in Mountain Stream.

The meeting also included the annual presentation of the Manierre Award. The 2023 award winner is Dr. David Houghton, whose work is discussed in a separate newsletter article.



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Above: The newly painted Thorpe House
 Below: Wendy and Chris Sutter

A Letter from the President

Dear Fellow Huron Mountain Wildlife Foundation Supporters:

The Huron Mountain Wildlife Foundation had another year of successful discovery and productive change in 2023. We hosted a variety of investigators conducting a myriad of exciting studies, all dependent on the pristine quality of our reference ecosystem. The infrastructure work we have completed was greatly appreciated by our guest researchers. From the new roof for the Stone House and new paint for the Thorpe House, to the cleared and cleaned septic lines, our season of investigation ran without a hitch. With all we have accomplished over the last few years there is still much to do to keep our facility up and running and in tip top shape, and we depend on your continued support to make this happen.

Among the significant changes in 2023 we have bid farewell to our facilities caretaker Brock Frances who is pursuing new job opportunities in the hospitality and sustainability fields. We appreciate all his work on our behalf and wish him all the best in his future endeavors. We have welcomed Chris and Wendy Sutter as our new caretakers and are excited by their talent and zeal for the job. Many of you may know Chris, who works at the HMC gate. Chris is also the current Big Bay fire chief. Chris and Wendy have already inventoried many of the maintenance projects that need our attention and have identified other possible improvements for the future. They have very complimentary skills in both carpentry and management and together are ready to make our program continue to flourish. We are lucky to have them and their two sons join the Foundation's team.

Another big change for the HMWF this year was the installation of a new fiber optic cable that will allow for a significant improvement to our data sharing and communication. This technological advance will provide the needed bandwidth for the increasingly complicated data sets that are being generated at Ives Lake. Thanks to all who specifically contributed to this project and thanks to all of you for your generous support of the HMWF.

With continued appreciation,
 Henry Dykema
 HMWF President

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You can make a donation by mailing a check made out to "Huron Mountain Wildlife Foundation" to:
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By Kerry Woods

Each year, I compile an update on published research results from HMWF-supported projects. These newsletter summaries are limited to products that are available to the larger scientific community: papers in peer-reviewed journals, theses, presentations at regional and national meetings, and (beginning last year) publicly archived data-sets.

In last winter's newsletter I provided some background on this last category and discussed some of the reasons that accessible data-archives are of particular importance. In 2023, the Foundation supported an initiative focused on documenting and archiving some of the many long-term and historical "base-line" data-sets produced under HMWF support, and I am hoping to sustain this focus going forward. The backlog is large!

Everything here will be listed at our website (www.hmwf.org), as well, under "Research Reports" and "Datasets" tabs). Note that an increasing proportion of publications is "open-access," so you can freely download the full paper; publications that are not open-access are typically available from authors (or through academic libraries). HMWF also maintains a large collection of internal reports – each project submits annual and final reports to the Foundation – which are also listed at the website, and can be made available to researchers and other interested parties (for current/recent projects, with the permission of the researchers).

THESES AND BOOKS

Lane-Clark, Shelby Nicole. 2023. *Impacts of introduced earthworms on sugar maple sap chemistry and the discourse of invasion ecology*. M.S. Thesis, Michigan Technological University, <https://doi.org/10.37099/mtu.dc.edtr/1609>

Fritz, Dana. 2023. *Betula papyrifera: an elegy*. Limited edition artist's book. [This emerged from our (relatively) new "artist-in-residence" program. Fritz visited the field station in 2022, along with researcher Rose-Marie Muzika. More information on the book is at Fritz's website, www.danafritz.com]

PEER-REVIEWED PAPERS

Fleissner, E.R., R.L. Putland & A.F. Mensinger. 2022. The effect of boat sound on freshwater fish behavior in public (motorized) and wilderness (nonmotorized) lakes *Environmental Biology of Fishes* 105:1065–1079. doi:10.1007/s10641-022-01318-5

Gorring, P.S. & B.D. Farrell. 2023. Evaluating species boundaries using coalescent delimitation in pine-killing *Monochamus* (Coleoptera: Cerambycidae) sawyer beetles. *Molecular Phylogenetics and Evolution* 84:107777. doi:10.1016/j.ympev.2023.107777

Houghton, D.C. (and 7 others). 2022. Checklist of the caddisflies (Insecta, Trichoptera) of the Upper Midwest region of the United States. *ZooKeys* 1111: 287–300. doi:10.3897/zookeys.1111.72345

Houghton, D.C. & DeWalt, R.E. 2023. The caddis aren't alright: modeling Trichoptera richness in streams of the northcentral United States reveals substantial species losses. *Front. Ecol. Evol.* 11:1163922. doi:10.3389/fevo.2023.1163922

Qiu, T., ..., J.M. LaMontagne, ..., J.S. Clark. (95 authors) 2023. Masting is uncommon in trees that depend on mutualist dispersers in the context of global climate and fertility gradients. *Nature Plants* 9: 1044–1056. doi:10.1038/s41477-023-01446-5

Ochoa-Hueso, R., ..., J.M. LaMontagne, ..., E. Bremer (76 authors). 2023. The bioavailability and coupling of macro and micronutrients across global topsoils is driven by environmental context and atomic properties, but is altered by global change. *Global Biogeochemical Cycles* 37: e2022GB007680. doi:10.1029/2022GB007680

Bogdziewicz, M., ..., J.M. LaMontagne, ..., J. Clark (95 authors). 2023. Linking seed size and number to trait syndromes in trees. *Global Ecology & Biogeography* 32: 683-694. doi:10.1111/geb.13652

Malhotra, R., Lima, S., & Harris, N. C. 2022. Temporal refuges of a subordinate carnivore vary across rural–urban gradient. *Ecology and Evolution*, 12, e9310. Doi:10.1002/ece3.9310

Mancuso J., E. Messick and S.D. Tiegs. 2022. Parsing Spatial and Temporal Variation in Stream Ecosystem Functioning. *Ecosphere* 13, e4202. doi:10.1002/ecs2.4202

Rutherford, R. 2022. Two southern plant species, *Nuttallanthus canadensis* (L.)D.A. Sutton and *Opuntia cespitosa* Raf., discovered as disjunct in the Huron Mountains, Marquette County, Michigan. *The Great Lakes Botanist* 61:65-69.

CONFERENCE PRESENTATIONS

Adams, R. and J.M. LaMontagne. 2023. Relationships between alternative visual methods to quantify tree reproduction. Poster presentation at the Midwest Ecology & Evolution Conference. University of Louisville, Louisville, KY.

Mancuso, J.L., Messick, E., S.D. Tiegs. 2022. *Parsing Spatial and Temporal Variation in Stream Ecosystem Function*. Joint Aquatic Sciences Meeting (JASM). Grand Rapids, Michigan



Wilson, B. R., A. Johnston, S. Fiedler, C.D. Tyrrell, J.M. Orlofske, R. Headley. 2022. Assessing the fluvial habitat preferences of riverine dragonflies (Odonata) in the Huron Mountains (Michigan, USA). Joint Aquatic Science Meeting, Grand Rapids, MI

Fiedler, S., A. Johnston, B. R. Wilson, J.M. Orlofske, C.D. Tyrrell, R. Headley. 2022. Linking fluvial and sedimentation characteristics to larval dragonfly. American Water Resources Association.

Headley, R., Johnston, A., Sieren, B, J.M. Orlofske, and C.D. Tyrrell. 2021. Linking fluvial and sedimentation characteristics to larval dragonfly habitat. Geological Society of American, Joint Section

PUBLISHED DATA-SETS (more at <http://www.hmwf.org/archives/data/>)

Lambrecht, N., S. Katsev, C. Wittkop, S. J. Hall, C. Sheik, A. Picard, M. Fakhraee, and E. D. Swanner. 2019. Biogeochemical and physical controls on methane fluxes from two ferruginous meromictic lakes. doi:10.6073/pasta/58e69641730756555069631ebc687a61

Swanner, E. D., N. Lambrecht, C. Wittkop, S. Katsev, G. Ledesma, and T. Leung. 2021. Water properties of Brownie Lake, MN and Canyon Lake, MI from 2015-2019. doi:10.6073/PASTA/4EAF698B4EFBAF793B83D95F464D1672

Marcarelli, A. and A. Coble. 2023. Sonde Data (2010-2014) from the Salmon Trout River in the Huron Mountains, Marquette Co., Michigan. ver 1. Environmental Data Initiative. doi:10.6073/pasta/98c1438402c7488808dd8b833fe866a4

Eberhard, E.K., E.S. Kane, and A.M. Marcarelli. 2023. Data from: Heterogeneity in habitat and nutrient availability facilitate the occurrence of N2 fixation and denitrification across wetland – stream – lake ecotones of Lakes Superior and Huron ver 1. Environmental Data Initiative. doi:10.6073/pasta/6707bb3c21ae0e63e593e7a82aab9146

Myers, P, A. Poor, R. Manville. Long-Term Studies of Huron Mountain Club Small Mammal Populations ver 1. Environmental Data Initiative. doi:10.6073/pasta/bcf2ad8642c783b96c5ad1313b0d4f0e

Stuart, P. and Huron Mountain Wildlife Foundation. 2023. Plot-based vegetation data for a large tract of old-growth hemlock-northern hardwood forest, Marquette Co., Michigan: 1988 ver 1. Environmental Data Initiative. Doi:10.6073/pasta/eb675fba6e2c48fd87383ee3fe781219

Woods, K.D. 2023. Long-term (1993-2019) dynamics of tree populations on a mapped 3-ha permanent plot in old-growth northern hardwood forest, Huron Mts., Marquette Co., MI, USA ver 1. Environmental Data Initiative. Doi:10.6073/pasta/5ede069260d10190980ffc7c63d8963

Woods, K.D. 2023. Long-term (1962-2019) tree demography on permanent plots in old-growth northern hardwood forests of the Huron Mountains, Marquette Co., Michigan. ver 1. Environmental Data Initiative. Doi:10.6073/pasta/3ddb679824593fe0f72a7989dc8c3438



Manierre Award 2023

The Manierre Award recognizes recent significant publication, in peer-reviewed journals, based on research sponsored by the Huron Mountain Wildlife Foundation. The endowed award recognizes long-time supporters of the Foundation's work, Dr. William and Anne Manierre. The first Manierre Award was in 2000 and the 2023 award is the twentieth.



Dr. David Houghton, of Hillsdale College, is the 2023 Manierre Award recipient. Houghton is an authority on caddisflies (Order Trichoptera), one of the most diverse and ecologically important groups of aquatic insects. Houghton has published many papers documenting caddisfly diversity and ecology throughout the upper Midwest. He has been studying the group at the Huron Mountains since 2014, and has, so far, recorded over 150 species for the area. Many of these are new regional records or rare species and at least one proved to be new to science.

Several publications documenting this remarkable diversity are listed at www.hmwf.org.

The 2023 Manierre Award recognizes two publications that synthesize this research in analyses of regional trends and patterns in caddisfly communities. Data from the Huron Mountains, in both papers, provided critical baseline information for assessing effects of human-caused landscape change on diversity and community structures. These studies are excellent realizations of the "reference ecosystem" values of the Huron Mountain landscape that provide one of the Foundation's greatest attractions to researchers. The papers (citations below) can be accessed online or through libraries:

Houghton, David. 2021. A tale of two habitats: whole-watershed comparison of disturbed and undisturbed river systems in northern Michigan (USA), based on adult Ephemeroptera, Plecoptera, and Trichoptera assemblages and functional feeding group biomass. *Hydrobiologia* 848:3429–3446 doi: 10.1007/s10750-021-04579-w

Houghton DC & DeWalt RE. 2023. The caddis aren't alright: modeling Trichoptera richness in streams of the northcentral United States reveals substantial species losses. *Frontiers in Ecology and Evolution* 11: 15pp doi: 10.3389/fevo.2023.1163922

David Houghton and students at a bridge over Mountain Stream in the Huron Mountains.

HURON MOUNTAIN WILDLIFE FOUNDATION



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

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

Henry Dykema
67 Vernetti Road
Red Lodge, MT 59068
hbdykema@gmail.com

Editors: Sarah Quiroga and Barbara Manierre

Designer: Amanda Micek

