HURON MOUNTAIN WILDLIFE
FOUNDATION

Summer 2019
Newsletter

Records of the Rings: An Ancient Archive Informs the Future

By Jill Riddell

It was Leonardo da Vinci who first recorded that tree rings form annually and that the rings carry information about past environmental conditions. This was in the 1500s, and a hundred fifty years after his discovery, when only six of America's thirteen colonies yet existed, a seed from the cone of a hemlock germinated beside a long, deep lake in the Huron Mountains.

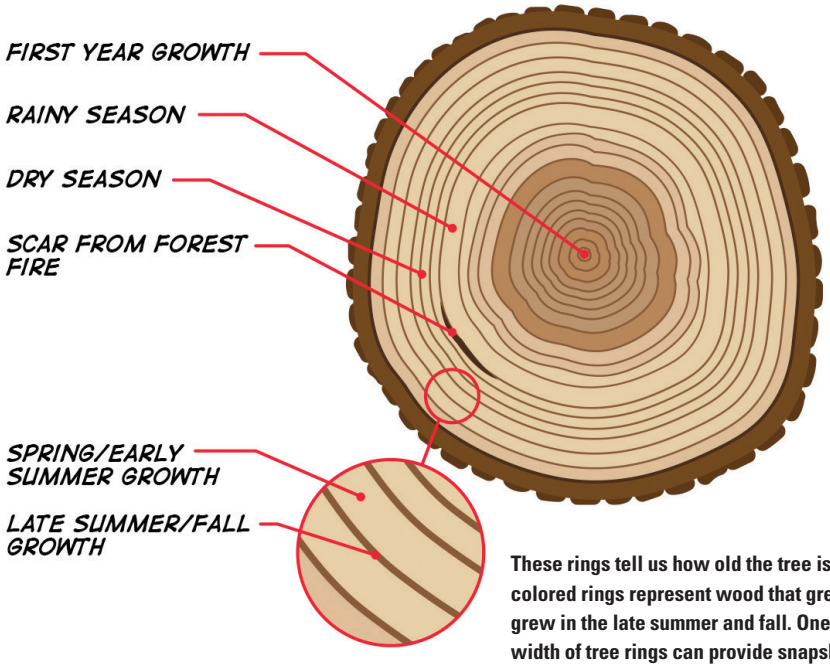
Alex Dye has spent 2 seasons researching the biomass of the forest.

Flash forward another three hundred years to 2016. Biogeographer and Huron Mountain Wildlife Foundation-supported researcher Alex Dye finds the tree that got its start all those centuries before. He carefully screws the sharp end of a Swedish-made increment borer into the hemlock's trunk and pulls out a core of woody material, a few millimeters wide and 20 centimeters long. He slides the core into a plastic map tube to protect it. The week of mosquito swatting and patient field work completed, he gets in his truck and drives it and several other tree cores back to the lab.

Increasing knowledge about climate

For the past two field seasons, Alex Dye, a postdoctoral fellow at the Pacific Northwest Research Station of the U.S. Forest Service, has performed similar actions on every tree of every species over ten centimeters (four inches) in diameter within four sampling plots in the Huron Mountains. Each plot is relatively small, just a 16-meter wide circular area. The work was done while he was working with his thesis advisor, Dr. Amy Hessel, at Montane Forest Dynamics Lab at West Virginia University.

"This research project is funded by PalEON, a multi-institution project based out of Notre Dame University that's reconstructing the biomass of sixteen forests in the northeastern United States between now in 2019 and the ancient past, as far back as we can go—thousands of years," says Dye. "PalEON uses that data and other inputs for ecosystem models that can better inform predictions about climate, using what happened in the past to make educated guesses about the future."



The value of tree rings

Reliable data on rainfall and temperatures started to be collected, verified and retained in the Upper Peninsula around 1890. "So from the 1890s on, we have good data. We compare the growth rate of an individual hemlock with what we know was happening weather-wise that year and in the years around it," Dye says.

Hemlocks thrive best in cold, wet conditions. To some degree, hemlocks make their own luck: with their dense canopy, dark shading and deep layer of duff, hemlocks create a relatively moist, cool microclimate. But like all plants, hemlocks remain partly at the whim of external conditions.

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These rings tell us how old the tree is, and what the weather was like during each year of the tree's life. The light-colored rings represent wood that grew in the spring and early summer, while the dark rings represent wood that grew in the late summer and fall. One light ring plus one dark ring equals one year of the tree's life. The color and width of tree rings can provide snapshots of past climate conditions. *Image courtesy of NASA/JPL-Caltech.*



Coring is how foresters determine the ages of individual tree. The practice offers powerful insights for diverse fields of research including ecology, climatology and archaeology. Scientists wear nets to protect themselves from mosquitoes in the Huron Mountains. Here, they are taking various measurements and coring a tree.

FOUR FUN FACTS ABOUT HURON MOUNTAIN TREES

In the Huron Mountains, the species of tree that lives the longest is the hemlock.

- Age and size don't necessarily correlate. Two individual trees can start life thirty years apart and both grow successfully into adulthood, and at full maturity, their sizes may be dramatically different from one another. The shorter tree might be the older of the two. Height depends on which individual receives the most sunlight.
- The sugar maples in the Huron Mountains are extremely old for sugar maples. Some are almost as old as the oldest hemlocks, dating back to the late 1600s and early 1700s.
- In the study plots, the bigger trees are absorbing carbon at a faster rate than the younger ones are. This may mean that those three-century old beauties are still growing at a fairly rapid rate, and that their "leaf cover," the area that photosynthesizes, is increasing.
- The oldest tree we know the age of for certain is one in the Cathedral Woods, the old growth forest in the preserved area of the Huron Mountain Club property. It's an eastern hemlock tree born in the year 1679. This summer it will celebrate its three hundred fortieth birthday, so if you happen to stroll through that area, be sure to bring a present.

Studying the data, Dye discovered that growth rates for hemlocks were most robust not *during* a year that had hemlock's preferred growing conditions but in the year *following* a cool, wet summer.

Armed with his discovery, Dye extrapolated what the climate had been in the years before 1890. "We use the annual growth rings from the periods where we know the conditions to understand what the climate was in years when we don't have any instrumental data."

The trees provide information that predates the invention of weather measuring devices. (Daniel Fahrenheit didn't invent the thermometer until 1714.) Trees archive ancient climate.

Dye's study plots sequester carbon by capturing carbon dioxide from the atmosphere and transforming it into biomass through photosynthesis. So reconstructing what the biomass was within these plots during particular periods of time over centuries and millennia is important to understanding carbon dioxide release and retention. Since carbon dioxide is a primary contributor to climate warming, the information about the past gained from studies of like Dye's are critical for scientists making climate projections.

The "Fading Record"

Dye cored all live and standing snags in his plot areas. "When I could, I also tried to core logs but they rot pretty quickly," Dye says. "A big limitation of biomass reconstructions is that the whole point is predicated on the idea that you get *all* the trees in your plot, so that you get per square meter or per acre data. But of course you're going to miss the trees that died well before you started your study. Say a tree started growing in 1920 and died in 1999—if I'm trying to reconstruct what the biomass was from that era, I'll end up underestimating." There's no reliable way

Mounted, measured, and sanded eastern hemlock core (top) and American basswood (bottom) from HMC. Note how much clearer the rings on the hemlock are. Pencil dots are a date marking technique Dye uses to ensure he doesn't lose his place and for archiving. "One dot" indicates a decadal year (e.g. 1990, 1770). "Two dots" indicate a mid-century year (e.g. 1950, 1750). "Three dots" indicate a century year (e.g. 1900), and "four dots" indicates a millennial year (e.g. 2000).

of accounting for this issue; knowledgeable people utilizing the research understand the natural limitations of the data.

At the Huron Mountains this inevitable issue is mitigated somewhat because another ongoing study since the 1960s does what Dye is trying to do, but in "real time" on what are called permanent plots. Dye's 16m-wide plots exactly overlap four of these permanent plots. Essentially, in a permanent plot, the same trees are manually marked and re-measured every 5-10 years, so it's possible to look at biomass growth and record when and where trees died. Prior to that is when the biomass record drops precipitously.

When Dye brings the cores back to the lab, he places them on wooden dowels. "Then comes something that resembles a six-month arts and craft session," Dye says. "It's uncommon for a core to come out in one piece, so first you match up the segments. You can't see any rings on it because they get all scuffed up from the drill, so you have to sand the wood, like sanding furniture where you start with the really rough stuff and eventually make your way to the 2000 grit sandpaper that's so soft it's like a piece of felt. You eventually reach the point where what got pulled out of the hemlock is so smooth you can see the cells of the tree."

The work Dye does is all human-based—there's no machine that can do this. And when he counts the rings, it's one by one in a microscope.

Importance of Huron Mountains

"Having the old growth forest for this study was very important, especially in a place like the Midwest where practically all the forests have been logged or farmed or converted into city. There's not much remaining across the landscape," Dye says. "It's the only place you have a chance of studying multi-century forest growth patterns."

As crucial as titans like Da Vinci and Fahrenheit were to human knowledge, so are forests. Their ancient data preceded scientist's instruments and insights. Within their bodies, in the very stuff they are made of, trees encode history and with their continued help, science advances.

THANK YOU

The Board of Directors of the Huron Mountain Wildlife Foundation would like to thank Wayne Thorpe for his valuable and important work for the Foundation. After fourteen years of keeping the HMWF facility at Ives Lake functioning and welcoming to researchers, Wayne retired this season.

As the facilities manager for the HMWF, Wayne oversaw the resurrection of the Red House, maintained the grounds, kept rooms clean and ready, monitored the solar electrical service, and provided his wealth of HMC knowledge to our visiting scientists. Wayne has been an invaluable asset to the Foundation and we extend a very special and heartfelt thank you.

HMWF Research Projects in 2019

By Kerry Woods

One of the things I look forward to with each new year is the new crop of research proposals. The Foundation's target date for submission is the first of February of each year, so I typically start getting inquiries from interested scientists in early January. Formal proposals trickle in through the month, with a large "dump" arriving in my email inbox the evening of the target date. Much of February, is dedicated to careful evaluation, consulting with expert reviewers, and working out details with prospective researchers. In early March, I bring recommendations to the Foundation's Board of Directors and we thrash out responses, including offers of grants to researchers.

The Foundation can take justifiable pride in the amount of good research it enables on a shoestring budget. Typically, the total research funding budget is in the neighborhood of $40,000; in comparison, most grants from the National Science Foundation run far more than that for a single year of a single project. This amount doesn't include maintaining and operating the Ives Lake Field Station, but, as it should be, the property management is the largest budget item. I don't know of any other research-supporting organization that implements as much productive research so efficiently.

But it's always that last, stage of proposal review where we decide how much we can offer each scientist that involves the toughest decisions. With a substantially increased research budget, we could accomplish much more.

In the criteria the Foundation uses in assessing proposals and allocating funding, one high priority continues to be long-term monitoring of populations and ecosystems, one of the most valuable uses of the pristine "reference ecosystems" of the Huron Mountains. The scientific community is currently finding this aspect particularly relevant for understanding consequences of changing climate. Other priorities include biodiversity documentation, another research arena that has special value in the "hyperdiverse" natural areas maintained by the Huron Mountain Club; and projects where small grants where the Foundation's seed money may help researchers acquire preliminary results that can intrigue a richer agency to will support their future grant proposals. Several current projects have followed that trajectory, and have received support from other public and private agencies.

Finally, we actively invite researchers to propose small exploratory projects that can be conducted at little cost but have the potential to solidify initially ambiguous research questions and possibilities.

In 2019, we had twenty-six proposals we judged scientifically appropriate, which was a few more than last year. About a third of the current year's projects are new in 2019, and many of these are explicitly exploratory. I'll start my summary with these to give you an idea of the sorts of projects that might take shape over the next few years.

NEW AND EXPLORATORY PROJECTS

Several new projects focus on ecosystem processes in the unique, old-growth forests with the Huron Mountain Club Reserved Area. **Robert Fahey (University of Connecticut)** is a returning researcher. About a decade ago, he conducted a landmark study of white pine populations using tree-ring analyses; his new project, growing indirectly from that work, uses LIDAR (a radar-like, laser-based technology) for detailed analyses of forest canopy architecture in an effort to detect "signatures" of past forest disturbances. A team of young researchers, led by **Jeff Atkins (Virginia Commonwealth University)** with collaborators at Purdue University, University of Michigan, and NASA-Goddard, also plans to use LIDAR data, along with microclimatic monitoring sensors, to gain insight into response of forest growth and productivity to extreme heat events. Both of these projects are exploring the use of aerial drones carrying LIDAR sensors. Finally **Xiaoyong Chen (Governor's State University)** will be undertaking initial explorations towards analyses of soil carbon pools in old-growth forests; these carbon pools are assumed to be large, and consequently important in understanding greenhouse-gas dynamics, but are poorly quantified.

In addition to forest ecology, HMWF has long supported an array of studies of stream and lake ecology, and new projects in 2019 continue that tradition. **Rachel Headley (University of Wisconsin-Parkside)** leads a team exploring potential for far-reaching field research and modeling of the effects of sediment types on stream ecology, potentially building a valuable linkage to ongoing studies of sediment changes in the Salmon Trout. With collaborators, **Amy Marcarelli (Michigan Technological University),** another past HMWF researcher (and Manierre Award-winner), is initiating a new project exploring the potential for remote surveying of river habitats and, especially, the dynamics of sediment plumes in Lake Superior at stream mouths. Marcarelli's team also uses "drones" – both aerial and underwater – which are clearly becoming an important research tool. **David Houghton (Hillsdale College),** is following up on a one-night visit a couple of years ago to undertake more intensive documentation of caddisfly diversity. His earlier visit added over 60 species to the All-Taxon Biodiversity Inventory and established several new records for Michigan; Houghton anticipates a substantial increase in these numbers with more extended sampling.

Other new projects range widely across the diversity of research arenas historically supported by HMWF. **Dan Cziczo (Purdue University)** leads another multi-institution team of researchers in an exploration of the potential to extract tree-ring records, which can carry detailed climate-history information, from sunken logs (which can be preserved for centuries). This project is aimed at extending the tree-ring "chronology" for Huron Mountain, built several years ago by Rose-Marie Muzika for red pine, perhaps by several centuries (perhaps to a millennium?). **Erika Hersch-Green (Michigan Technological University)** is undertaking an initial exploration of consequences of invasive fruit-flies and fungal pests for fruit production and reproduction in blueberries and other "soft-fruit" plants.

CONTINUING STUDIES

A diverse collection of continuing, multi-year projects offers a good cross-section of the scope of research enabled by HMWF – and of the multi-faceted appeal of the Huron Mountain landscape to researchers in many areas of field sciences.

Thomas Werner (Michigan Technological University) and **Jim Bess (independent researcher)** continue biodiversity documentation in several groups of insects. After several years, they have, together, added several hundred species of moths to our All-Taxon Biodiversity Inventory, and there's no indication that the rate of discovery is slowing down. In addition to moths, Werner focuses on butterflies and fruit-flies, and Bess studies leafhoppers and, this year, begins to focus on the distinctive (and diverse) "micro-lepidoptera" (mostly leaf-mining moths). Another ongoing study of biodiversity focuses on genetic diversity and hybridization in the two flying squirrel species present in the area; **Cody Thompson (University of Michigan)** is attempting to understand whether increasingly rarity of northern flying squirrels leads to interspecific mating.

Two studies focus on mammalian predators. **Diana Lafferty (Norther Michigan University)** and **Erin McKenney (North Carolina State Univ)** use American martens as a study organism in assessing whether ecological context – here, differences in forest management regime – affects the diversity and nature of the animals' gut microbial community, and, therefore, digestive function; this would document a little-understood pathway for human effects on ecological systems. **Nyeema Harris (University of Michigan)** (and last year's annual meeting speaker), and her grad student **Natalie Madden** are initiating the next phase of a multi-year, state-wide study of "mesocarnivore" (predators larger than weasels and smaller than

wolves…) communities using extensive networks of trail cameras. This year's work begins documentation of differences in potential prey communities across habitats – and, serendipitously, contributes a follow-up to earlier studies of small mammal communities of the Huron Mountains over the last 50 years.

A multi-institution team, led by **Elizabeth Swanner (Iowa State University),** and including **Chad Wittkop (Minnesota State University – Mankato)** – our featured meeting speaker a few years ago – is in the sixth year of an intensive study of the unique geochemistry and biology of Canyon Lake; this study is now supported by major grants from the National Science Foundation and NASA. In a newer lakes study, **Susan Knight (University of Wisconsin – Trout Lake Field Station)** is in the second year of inquiry about mysterious "fairy-rings" of pond lilies in Howe Lake, hoping to understand what sort of factors lead to this distinctive growth pattern.

Brad Wells and Casey Huckins (Michigan Technological University) continue studies of salmonid populations in the Salmon Trout River. This study builds on over a decade of work by the Huckins lab; the current focus "drills down" to address competitive interactions among different fish species and how these are influenced by stream environment. In another study of stream ecology, **Karen Murchie (Shedd Aquarium)** is in the third year of a regional study of spawning migrations of suckers into streams tributary to Lakes Superior and Michigan; her particular focus is on the timing of these migrations and the environmental cues that trigger them. Streams at Huron Mountain afford her northernmost study sites.

ONGOING LONG-TERM STUDIES

At the other end of the spectrum from the new and exploratory projects I started with, several projects active this year add to long-term (sometimes decades-long) data-sets, providing the sort of long-term perspective essential to ecological understanding, but requiring rare stability of research program. I've been particularly interested and impressed by the serendipitous linkages and spinoffs that spring from such long-term studies.

Two of these focus on the effects of deer browsing on forest patterns and processes. **Don Waller (University of Wisconsin-Madison)** and collaborators is in the ninth year (of a planned decade) of research based on the large deer exclosure near Fisher Creek. While the Waller project addresses many aspects of forest community processes, another 10-year study (now in its fifth year), developed by **Walter Carson (Pittsburgh University)** and **Rose Marie Muzika (Carnegie Institution),** focuses on loss of diversity among understory wildflowers where deer-browse is intense. Carson and Muzika are particularly interested in exploring the role of "refugia" (like rock outcrops and boulder-tops inaccessible to deer) in maintaining populations of these species. Waller has partnered with another long-term researcher, **Dennis Riege (independent researcher).** Riege has, for over a decade, monitored white pine and hemlock regeneration in a large permanent plot, which now also serves as a control plot for Waller's work, and supports an opportunistic study of the effects of beaver incursion on forest dynamics.

Another long-term study, the 15-year "Huron Mountain Climate Observation Network" maintained by **Ken Hinkel (University of Cincinnati)** and **Fritz Nelson (University of Delaware)** involves a network of sensors and loggers supporting modeling of climate variation in the complex terrain of the Huron Mountains. This project has also generated data-sets useful to other researchers, and a baseline of climatic data that will be invaluable in understanding dynamics of climate change.

My own **(Kerry Woods, Bennington College)** long-term project is active this year as well, maintaining a 5-year remeasurement cycle on a network of permanent study plots in upland forests. While I have been involved in this monitoring for only 41 years, I have folded into my study a set of plots established by other researchers in 1962. There are few data-sets for old-growth forests that allow rigorous analysis of a population and community dynamics over more than half a century, even though these forests function over time-scales measured in centuries.

On the aquatic front, **Donna Kashian (Wayne State University)** is in the twelfth year of her study monitoring invertebrate communities in a number of area streams with the goal of understanding how differences in land-use and management affect stream ecosystems.

SUMMARY

Part of our ability to facilitate such a lively and diverse research program, and contribute so much to scientific understanding on such a modest budget, rests in the tremendous value of the Huron Mountains landscape. There are only a handful of such world-class research natural areas in eastern North America, and the Huron Mountains are unusual among these in providing security and support for researchers.

ALL ARE WELCOME!

Annual Meeting, Friday, August 6, 2019
4:00 p.m.
The Playhouse

Keynote Speaker
Phyllis Green, Superintendent of Isle Royale National Park
"Predator Prey Restoration: Bringing Wolves to Isle Royale National Park"
Isle Royale lies 160 miles to the north of the Huron Mountain Club. Home to over 600 flowering plants, the habitats include wetlands, uplands, beaches, woods and aquatic environments. It's also the site for the world's longest scientific study of predator/prey relationships. Earlier in 2019, the National Park Service relocated four Canadian wolves to the island in an ongoing effort to restore balance. The superintendent will talk about the science behind the decision and the selection of wolves to bring to the island.

Manierre Award Presentation
The 2019 prize will be awarded to John Willis at Mississippi State University for his work and publication on patterns of seedling growth among temperate forest trees.

Field trips with scientists
August 5, 11:00 a.m.
The Huron Mountains are the site of some of the longest-running forest dynamics study plots in the country. Kerry Woods will guide members and visitors to one of those study plots for a "show-and-tell." This will be a good chance to ask Kerry about his own long-term study and to have an opportunity to learn more about the Foundation's research program.

What the word “old” means in nature

The cover story talks about trees still alive now that have been growing since the 1600s. Yet trees are not the only senior citizens in the Huron Mountains. A pink ladyslipper orchid lives for a century, and many more modest looking flowering perennials as old as our grandparents.

When it comes to longevity, lichens are the winners. Lichens in Greenland make hemlocks look like toddlers: some are 5,000 years old, and while so far, no Foundation researcher has studied longevity specifically of Huron Mountain’s lichens, some surely are quite ancient. A hundred years is not an exceptionally old age for a lichen.

Lichens have a talent for survival: they live in the coldest as well as the hottest places on earth. They’re the dominant vegetation in Antarctica and high peaks in the Himalayas. In the Huron Mountains, you’ll find lichens on tree bark, granite outcrops, and the roofs of boathouses.

This British soldier lichen, named for its bright red cap, is one of the few species of lichens conspicuous enough to have been given a common name. ***Photo by James P. Mann***

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

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