Field Notes

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Image: Jaime Van Leuven

DEANE WANG

This issue of Field Notes *is*
dedicated to Professor Jeff Hughes
who is retiring this summer after teaching at UVM for 33 years

Change the World

Among his many exploits, Dr. Jeffrey Hughes was the Director of the University of Vermont's Field Naturalist (FN) Program during its formative years to the present. Hub Vogelmann—scientist, conservationist, professor, fundraiser, and big thinker—chose Jeff to be the Program's second director in 1988. Unique, unconventional, and cross-disciplinary in its philosophy, Hub's FN Program was created to train the next generation of Rachel Carsons and Aldo Leopolds. They would not only be conservation leaders, but also bold thinkers, ready to take on an unwieldy planetary future. Jeff, with his unconventional background—Maine guide, proprietor of a fly fishing store, West African Peace Corp Volunteer, French teacher, National Parks Naturalist, ballroom dance instructor, research scientist, and Hubbard Brook student/teacher advisor—was the ideal leader for this nascent program. In his characteristic way, Jeff took on this challenge with his confident, savvy, DownEast, and sometimes cranky but always sagacious, style.

While the program has adapted and evolved with a changing world and changing students over the almost 35 years that Jeff has nurtured it, its core and unique educational philosophies of interdisciplinary holism, learning in the field, learning by doing, and communicating effectively with the real world, has been sustained. Jeff's interpretation of Hub's vision has allowed a small group of talented students to be inspired (as well as inspire each other) and emerge as conservation leaders in organizations throughout Vermont, the country, and the world. The impact of superb teachers is manifested in their students. Jeff's graduates have conserved tens of thousands of acres, have managed effective organizations that have expanded conservation work, and, in turn, have trained the next generation of conservation leaders.

Being trained to help save the world is not easy work. The weight of the world's woes rests heavily on their shoulders, and the acquisition of the knowledge, skills, and values can challenge even the toughest and most experienced students that are selected to enter the Program. Jeff's door was always open. His careful listening, wise counsel, deep empathy, and constant encouragement took precedence over the mountain of other work perpetually crowding a professor's desk. Unassuming and down-to-earth, Jeff was easy to approach. In those 30 plus years of advising Field Naturalists (and Ecological Planners in the "sister" program), he has successfully mentored over 100 graduate students. Years after graduation, many students return to his door to reconnect, chat about life, and say thanks.

With his departure from UVM, Jeff would say, in his typical self-deprecating way, that no one would miss him, but he is so wrong. The Field Natural Program will continue to evolve and educate great students, but a remarkable chapter in its history will close.

Deane Wang (Associate Professor Emeritus) is the Founder and previous Director of the Ecological Planning Program, sister program to the Field Naturalist Program.

What Actually Happened?

The theme of this issue is a fundamental question not only to nature writing, but to the sciences more broadly. The pursuit of truth, reliability, and accuracy is necessary for any discipline, but especially those that investigate subjects too small or large, too slow or fast, too far away or long past for our naked senses to pick up. The record is often both incomplete and unclear. How do we follow the thread of our stories and winnow the facts from fictions and truths from lies, exaggerations, and mistakes?

We have witnessed a year of disturbance, of alterations, of adaptation, a year when a whirlwind of news and change has made it hard to distinguish well-supported claims from wild rumors. This has left many of us wondering, "What *actually* happened?"

Yet, the question is more broad than what lies in the background of the global pandemic. Even when the written word tries to reflect reality, it is always passed through some form of lens or filter. No writing escapes this. The quest to identify and clear away these distortions is fraught with peril; our own biases cloud our sight even if we can expunge others. We attach meanings and personal significance to everything, which can flavor our memory or even divert us away from true experiences. For many of these issues of recollection, inspection, and interpretation, when it comes to objective truth there is no safe place to stand. And yet, as scientists, naturalists, and writers in a time of upheaval, we must take a stand and attempt to describe *what* actually happened.

The root of this seemingly Sisyphean task comes down to paying attention. Being mindful of the present moment led us to our theme; partially because the pandemic has forced us to live day-to-day and partially because observation drives our work as scientists and naturalists. The pandemic has limited our ability to prepare and operate as normal, but nature, too, never plays along our carefully plotted scripts. Nothing has quite gone according to plan, but we've learned to appreciate the serendipity of what actually *happened*.

So here are a few ways we have wrestled with that search for truth, continuous and incomplete as they may be. These are the stories in our pursuit of *what actually happened.*

Laura Hatmaker ('22) and Rachael Monosson ('22)

Image: Sarah Lindsay

JEFFREY HUGHES

After such a challenging year for so many, we have much to be thankful for in the Field Naturalist (FN) Program. I *could* report that everyone in the Program has escaped the ravages of Covid (because it's true), but that would just invite trouble, so I won't say it.

However, I *will* say that our applicant pool this year was one of the most impressive ever; at least twelve applicants would be competitive for any program anywhere. Over the last twenty-five years, 97% of the applicants offered admission to the Field Naturalist Program have accepted—no program anywhere comes close to that yield percentage.

The first-year cohort of FNs—a talented group of five very different personalities and backgrounds—has shown remarkable resilience in weathering the isolation and remote learning that has been brought on by Covid. This was greatly assisted by the FNEP Alumni Association, which has become an increasingly essential partner in the Program.

Dave Barrington, chair of the Department of Plant Biology and stalwart supporter of the Field Naturalist Program, will be stepping down as chair this May. Dave will continue on in the department as a regular faculty member and will continue to play an active role on the FN leadership team. His replacement as chair has not yet been announced, so keep your fingers crossed on that!

It has taken me more than thirty years to complete requirements, but I will be graduating from the Field Naturalist Program (and Plant Biology, Rubenstein, and UVM) this June, 2021. I won't disappear from the Program when I retire—I'll still populate my office in Jeffords Hall, but future FNs won't be forced to endure my obnoxious probing, they'll need to ask for it.

Walter Poleman will take over as director of the program when I retire. As many of you know, Walter served as associate director of the FN (Field Naturalist) Program for several years before joining the Rubenstein School of Environment and Natural Resources (RSENR). Moving to RSENR did not stop Walter from creating training opportunities for FNs and EPs (Ecological Planners), however. Every fall semester Walt has arranged for FNEPs to apprentice with him as paid field instructors in his large undergraduate course, "Natural History and Field Ecology." And every spring semester, working with the FNEP students, Walt has taken on a place-based consulting project to help a town or other non-profit understand and steward a landscape of special interest or importance. This core experience, "Landscape Inventory and Assessment," prepares students for their upcoming individual sponsored projects.

There's much more to talk about—all of it exciting—so I'll wrap this up so you can get on with the interesting reading you'll find in pages that follow. And since I'm not really leaving the Field Naturalist community, I'll just say bye for now.

P.S: for those who have been wondering, the projected publication date of my book (*A Conservation Leader's Toolkit*, Cornell Univ. Press) is late summer / early fall 2021.

Jeffrey Hughes has been the director of the Field Naturalist Program since 1987.

WALTER POLEMAN

As Jeffrey prepares to step down after 34 years as our program's director, I've been reflecting on the enormous impact his mentorship has had on scores of Field Naturalists – myself included. So many stories and experiences come to mind – from field methods boot camp at his Northeast Kingdom cabin, to his challenging-yet-perfect questions during field finals, to the wickedly funny tales of his days as a Maine guide – it's hard to distill the essence of Jeff's mentorship into something pithy. But since the *Field Notes* editors have limited me to 400 words, I'll highlight two of my favorites:

Support the Null Hypothesis. That bit of wisdom, printed on a bumper sticker prominently displayed on his office door for many years, is emblematic of the mentoring that I and so many graduate students received from Jeffrey. He taught us to question our assumptions and biases, and to dedicate ourselves to thinking scientifically. We practiced this over and over again in the field by observing patterns, asking questions, proposing hypotheses, and testing to see if the patterns were real – all before moving on to the more seductive "why" questions. Jeffrey instilled in us a rigorous approach to analyzing landscapes that has become central to the Field Naturalist methodology – and critical to effective conservation science.

The Nugget. This is the name students have given to Jeffrey's iconic assignment that is in many ways the *yin* to the bumper sticker's *yang*. Whereas supporting the null hypothesis is all about promoting objectivity, the nugget assignment asks students to explore and celebrate their subjective side. Assigned at the conclusion of his *Fundamentals of Field Science course,* this has been Jeffrey's way of encouraging students to practice communicating – in a 30-minute slideshow – that which they are most passionate about. The resulting presentations are spectacular and moving – and I make a point never to miss them.

These two seemingly opposing elements of Jeffrey's approach manifest the genius of his mentorship when woven together into the unique training the program provides. The integration of scientific integrity and passionate communication is at the heart of what it means to be a Field Naturalist, and is destined to be a key part of Jeffrey's enduring legacy. I am deeply grateful that we have such a solid foundation to build upon as we train the FNs of the future.

Walter Poleman is the incoming director of the Field Naturalist Program.

Image: Rachael Monosson

The Last Ash

RACHAEL MONOSSON

In front of Burlington's City Hall, crunching over the early March mush of grass and mud and unmelted snow, I look for a tree. Not a species of tree, but one particular individual: the one that, very soon, may be the last living ash tree in the city of Burlington.

Although the emerald ash borer has not been found yet within Burlington's limits, the city is, as city arborist V.J. Comai told me, essentially "surrounded" by the beetles. Emerald ash borers have been found on Grand Isle, in Richmond, on South Hero, and in Quebec, moving outward year by year on their own wings and by people moving firewood. These insects, brought over accidentally from their native China, have driven the three New England ash species into such a precipitous decline that the trees have been listed as endangered. In some states where the borer has been present for many years, experts thought that the beetle would move through like a wave, taking out the mature ash trees before dying out itself, allowing the saplings to regenerate the species. But instead, the beetles seem to persist in the forest at a lower level, attacking smaller and smaller trees, killing saplings as small as one inch in diameter.

A single ash tree can be saved by drenching the roots with systemic insecticides, but this costs $250 or more per tree and must be re-applied every other year as long as the beetles are present. Apart from the economic burden, this would be self-defeating if used to preserve ash trees in a living ecosystem, as it prevents native insects from feeding on the ash, excluding the trees from their food chain. According to Comai, the large green ash in front of City Hall is the only one in Burlington under consideration for this expensive but life-preserving treatment, because it is particularly large and because it has been preserved despite recent renovation and construction in the park.

Squinting up at the leafless branches and looking for diamond-cracked bark, I find this designated last ash across the lawn from the City Hall building, its grand trunk double the diameter of the little ashes growing along the street. The color of the bark is dull gray from a distance, but up close is spangled with tiny, bright specks of yellow and orange lichen. And, because this is an urban tree, and because life is imperfect, there's a dog turd smeared against the trunk.

Green ashes like this one, resistant to road salt and compacted soils, have been a favored street tree in many New England towns since Dutch elm disease decimated the American elm. Now, once again, an invasive organism threatens to wipe out our urban trees. Though, of course, like all native trees, ashes are much more than a lost shade tree or timber resource. They are a vital part of the ecosystem, both in uplands and in floodplains, feeding everything from sphinx moths to tadpoles. Their role in the web of life cannot be replaced like a landscaper swaps out one street tree with another.

The human impacts from the loss of ash trees are also more than aesthetic or utilitarian. The black ash holds a place of great spiritual and cultural importance for the Abenaki people, who call it maahlakws. In the Abenaki's creation story, the Creator fired an arrow into the maahlakws, and the People flowed from the wound in its trunk. The trees also hold an important utilitarian purpose in many native cultures: the flexible wood is woven into baskets both for daily use and for sale and income. In the experience of Abenaki basket-weaver Kerry Wood, the craft of basket-weaving with ash has been a deep and meaningful link to culture, family, and tradition. She told me that seeing stands of ash trees decimated by the emerald ash borer was "like seeing a loved one be negatively impacted by disease."

Last October, a headline in the Burlington Free Press read, "Emerald Ash Borer Reaches Chittenden," with the subtitle: "Region's ash trees probably doomed." I don't want to believe that these trees are doomed. The green ash of the floodplains, the white ash of the uplands, and the black ash of the swamps—it is painful to say goodbye to these, in the handful of years they have left. Maybe unbearably so. Many trees look healthy, but in this singular moment, they are like the living dead, teetering on the brink, about to plummet into ecological oblivion. After thousands of years growing on this landscape, they are threatened with extinction by an invasive animal smaller than a penny. Though I have not seen the devastation with my own eyes, I don't doubt this fact. It hurts.

However, not everyone has given up completely. "There is hope for North American ash trees," said USDA entomologist Jian Duan, as he showed me a slide show about a trio of minuscule parasitic wasps that attack the young of the emerald ash borer. One, with big eyes and knobbly antennae, is only a millimeter long, and injects its own tiny eggs into the larger eggs of the beetle. Another, sleek and black like a fighter jet with red eyes, has proven its worth by killing up to 85% of the emerald ash borer larvae in thin-barked sapling ash trees. The third, newly imported from the Russian Far East, brown and leggy with an ovipositor like a drill, can parasitize borer larvae even beneath the thick bark of mature ashes. These three wasps were selected out of more than a dozen beetle-eating candidates because they have not been found to attack any other species of insect, and so present a minimal chance of further upsetting the ecosystem. That said, it takes years for these parasitoid wasps to increase enough in population to affect the beetles. While some white ashes show a degree of resistance, most of the trees growing today may not live long enough to see the emerald ash borer brought under control by its enemies.

In our conversation, while admiring his excellent macro-photographs of wasps and discussing beetle larva mortality, Duan assured me that our ashes will not go extinct. But can we really know this? In between introduced wasps, seed banks and directed breeding, they might have a chance. Or they might not. One could imagine the ash trees surviving like the elm trees do: sickly and alone, or in rows of genetically-identical cultivars. Or they might show the tragic persistence of understory chestnuts, sprouting up from the ground again and again in attempts to regrow, before being killed again by an exotic pest. One thing we know for certain is that the emerald ash borer will transform Vermont's forests, as it has already transformed forests across the Upper Midwest. The ashes will die, the canopies will open, and other trees will move in. Perhaps invasive shrubs will gain a stronger foothold in the disturbance. Acre by acre, the ecosystems will shift in ways we can't yet predict.

But then again, forecasting the future has always been risky. Instead, here is the present: on a sunny morning in late March, I revisited the green ash by City Hall. There, I recorded the following verbal notes, transcribed exactly:

There's a firefly hiding in the bark, in the cracks. I see little ants crawling around the base.

It's a big tree; you really could wrap your arms around it if you wanted to. It's substantial. I don't know how old it is. I don't know if it's male or female.

There's a nail in the trunk. Maybe somebody once hung something here, a sign or a poster. Hard to tell. It hasn't been in that long; the tree hasn't grown around it very much. Can't pull it out, though.

These creatures couldn't live in a tree that's full of pesticides. Is a tree disconnected from the web of life really a tree, anymore? Is it just a statement? Is it a piece of art? Is it artifice? A model, here for education, for elucidation on the trees that used to grow here?

Or, do we look at it more as a source of shade? Something utilitarian: cooling in the summer, letting the sun through in the winter. Something to store carbon? This is hardly a forest. It's more like a sculpture.

Yet it's also a living tree, we can't just deny that. It's the last ash tree in Burlington, what can you say? What can you say to that?

It will never make seeds. Even if it's a female, they need cross-pollination, and if there are no other ashes it will never be fertile.

Shallow, craggy divisions, like canyons, like rivers braiding down the trunk. It's rough, thick bark. There's not much insect life on it, but it's early in the season still.

The branches have that thickened, chubby look of ash trees. Even the small twigs seem more robust than those of nearby trees.

It's just an ash tree.

How does it become a symbol? How does it become so important to me?

Rachael Monosson (Cohort AK, '22) is a field naturalist, writer, educator, and complete nerd. Her thanks go out to Jeff Carstens, V.J. Comai, Jian Duan, Ethan Tapper, Liz Thompson, and Kerry Wood. Without their expertise and wisdom, this piece would not have been possible.

Botanical Authorities

GRACE GLYNN

Image: Grace Glynn

It's a November morning soaked by cold rain, and I've gotten into another argument with a botanist on social media. The Vermont flora lies dormant and quarantine drags on, so what else is there to do? This time, I need evidence to prove that I've correctly identified ramps out of season.

In the Northern Hardwood Forest Region, wild leeks wave like victory flags in the spring. Old timers return to carefully-guarded picking spots each May with baskets in tow. The springtime harvest of the Abekani people has likely turned on ramps' timing for thousands of years. But with November growing thin and the ground still bare, I have been doing some early digging.

I climb from the hemlock ravine up to where the bare sugar maples let the sun in. The maidenhair ferns lie flattened against the damp forest floor, a mess of rachises black like whale fins. I follow the plantain-leaved sedges, noticing the red flowering shoots forming at the center of each rosette. A white ash, clutching a twist of barbed wire in its side, guides me to yesterday's digging place.

The ramp flower stalks have done their job. Now they are withering, askew, slowly turning to leaf litter. But the few black seeds still held aloft on the old umbels are unmistakable: round and shining like tiny scarabs. I follow one stalk to its base to find a leaf package the size of an anemic garlic bulb. The leaves-to-be have surfaced, pale green above dark soil and grasping the flower stalk like a ragged parasol.

I think of how crucial it must be for ramps to have everything in order before winter sets in: with no time to waste between snowmelt and leaf-out, it makes sense for spring ephemerals to have their photosynthetic equipment ready to deploy when the sun calls.

I wipe the cold soil from my fingers and open iNaturalist, a social media platform that allows people around the world to submit biodiversity observations for verification by expert naturalists. Overnight and from time zones away, a botanist has disputed my ID of the winter-ready ramps. "*Allium triccocum* var. *triccocum* sprouts in the early spring," he's written, suggesting that I reclassify my identification as just, "Flowering Plants."

But all signs point to ramps: the loculicidal capsules atop the scapose stems are distinctive and the rich mesic woods is just the right habitat. I post the new photos with an air of victory and a note of assurance that the winter ramps are ramps all the same.

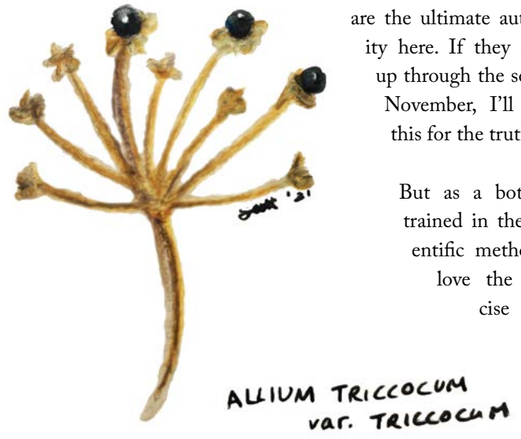
Minutes later, the ding of another comment: "Do you have a reference to a botanical authority that describes this?"

I sit back on my muddy heels and consider my options: I could pluck a peer-reviewed paper to shove across virtual space as evidence that I'm right. I could update my profile to include my advanced degree in plant biology, the title of the manuscript I'm working to publish. But something about this exchange is bothering me.

It's not the challenge to my expertise that's troubling. I no longer feel the need to defend myself against condescension from older, white, male scientists, though it's a tiresome routine. It's not the platform itself—I think that iNaturalist can be a valuable tool—or even the fact that we're both behind screens.

As I wipe bits of leaf litter from my mittens, what bothers me is that I'm not sure to whom this botanist expects me to defer to as the ultimate holder of Ramp Truths. Who are these botanical authorities whose word on *Allium triccocum* is so final? Have the hours of digging in the duff in search of a whiff of garlic amounted to no credibility at all?

Maybe I'll vow to abstain from the literature in a rejection of rigid ideas of who is an expert. I'll delete the whole post in protest and learn only from the source: the plants themselves. As I peer down at their stretching heads, it seems to me that the ramps are the ultimate authority here. If they grow up through the soil in November, I'll take this for the truth.



Drawings: Laura Hatmaker

But as a botanist trained in the scientific method, I love the precise and

collaborative kind of knowing that can come from scientific research. So I carefully return the insulative blanket of leaf litter to the ramps and walk home to my computer, where I search the botanical journals for *Allium triccocum* var. *triccocum*. I read studies on how nutrients are shuttled from leaf to bulb in the summer. I read exquisite descriptions of those ovoid-reniform seeds. But I can't find a single paper describing what ramps do in the days before they're blanketed with snow.

If this phenomenon is missing from the annals of scientific evidence, have I discovered something new? And more importantly, will my ramp observations become real only when I publish a paper titled "Autumnal hypogeous growth and other phenological observations in *Allium triccocum* var. *triccocum*"?

My botanical debate was never resolved. The Master's-of-Science part of me still wants to see the post verified as "Research Grade," with that satisfying little check mark showing that an answer had been found, and that I was the botanical authority. But I know that a check mark doesn't truthfully represent my encounter with the ramps. If the beauty of ecology is its messy jumble of grasped roots and life shuttled between life, surely it is a chain of question marks that ties botanists together in the quest to better understand the lives of plants. And I wonder if the many ways of searching for knowledge—a literature review, a greenhouse experiment, an hour spent bowed to the rich soil—can be tied together, too.

So, in a world where unseen happenings play out beneath the duff, my research always continues. I pick it back up when I visit the rich woods, where the wild leeks, experts in their own right, teach me how they grow at the base of the biggest white ash. And I like to imagine all the botanists I've argued with walking out to some similar patch of hardwoods, scraping away the snow in a place that looks right for ramps, not knowing for sure just what they'll find.

Grace Glynn (AJ Cohort, '20) is a wetland ecologist, botanist, and lover of ramps.

Behind the Red Tape

MARIA DUNLAVEY

Images: Maria Dunlavey

I'd like to tell you about a flower I saw. About the beauty of the day, sunny after an overnight rain; high water on the Oconaluftee River, submerged leaves waving jewel-box green in the clear flood. I'd like to tell you about the glorious solitude, and that you should go there yourself sometime, in the spring like this when the roads are empty and the sun is strong. You can't, though. This particular solitude is once-in-a-lifetime. It's well after 10am before the sun reaches this valley, and by then the daily hordes of visitors are already choking the roads of Great Smoky Mountains National Park.

It's easy for me to tell you about a flower I saw, but it's harder to tell you how I got there. The answers have to do with the Nixon administration, and with my ancestors who attended the first Thanksgiving and fought in King Philip's War. They have to do with bats, and maybe pangolins, and more than one virus that swept across the planet. They have to do with a phone call from the US government, on the morning of March 27, 2020, verifying that a couple dozen permitted members of the Eastern Band of Cherokee Indians might continue to cross the park's pandemic-shuttered border for the purposes of traditional plant gathering. Because I worked for the tribe, administering gathering permits and checking on harvest sites, I could go, too.

That's how I wound up on the banks of the river to see that flower that sunlit day. Or rather, that phone call, combined with a government-to-government plant gathering agreement signed the year before, combined with the reams of paperwork and public consultation periods that enabled that agreement: an environmental assessment, fulfilling the requirements of the National Environmental Policy Act of 1970 (NEPA) and documenting that traditional gathering would cause no adverse impacts to populations of the plant species in question. A federal rule, promulgated under the Obama administration, establishing a framework for the creation of such agreements. A letter from the Principal Chief. A resolution from Tribal Council. More meetings than anyone cares to recall.

In a word, bureaucracy—all of it turning the slow gears of restoration of the traditional Cherokee homeland. While Great Smoky Mountains is among the most accessed national parks in America—there is no entry fee, and over 12 million people visit each year—it shares a legacy of exclusion with many other federal lands, where Native Americans were turned out of their homes, hunting and gathering banned. That particular injustice dovetails with other tragedies brought on by European settlement: the devastation of the Americas by smallpox, the making and breaking of treaties, the Removal of the vast majority of the Cherokee people from their homeland on the Trail of Tears. The Eastern Band are those who stayed behind, taking shelter in the woods or under convoluted legal exemptions. Eventually they secured federal recognition; a piece of land on the border of what's now the park; slow, marginal gains in the control of their own destiny, their own government. Now, the gathering agreement, hopefully the first among many; the Cherokee use hundreds of plant species, for food and medicine and artisan materials. There's a long way to go.

The flower I'd like to tell you about isn't even one of those species, as far as I know. It's a fringed phacelia. *Phacelia fimbriata*. It's just something I saw. It grows in carpets along the banks of the river in early spring, delicate stems tangling into mats, delicate white petals cupping tiny beetles in their fringed embrace. From a distance, it doesn't look like much of anything, but up close it's a spectacular work of symmetry, like a snowflake. I like it because of that, and because it makes me think of other phacelias I saw in the Mohave Desert four years before, and because it's new to me—because of the small obscure marvels of taxonomy, the precise pleasure of calling something for the first time by its name.

I don't know the Cherokee name for fringed phacelia. There is one, I'm sure, though it's not in the 479-page ethnobotanical Ph.D. dissertation that's my easiest reference on such matters. I could ask someone; the Cherokee language is disappearing at an alarming rate, but there's probably still someone who knows. It might take a while to find them, though. They might not want to tell me; if they did, and I found someone else who was also willing to tell me, they might disagree. Language preservation is a complex process—whose word takes precedence? Should you cite them when you say it? Can an endangered language still live and evolve, or must it be frozen first—documented, before it gets lost? We're back in bureaucracy.

Bureaucracy is an easy punching bag. No one likes it. Politicians have been decrying it for years; environmental red tape like NEPA is a frequent target of self-described pro-business types like former President Donald Trump, whose administration hacked away at its foundations wherever they could. They stripped NEPA requirements for oil companies, though not for tribes seeking gathering agreements. They gutted the Migratory Bird Act, though tribal members still need to apply to the US Fish and Wildlife Service's national repository for eagle feathers to use in traditional ceremonies. For colonized peoples, bureaucracy isn't optional—it's often the sole line of defense. In Arizona last year, the Tohono O'odham watched their sacred sites bulldozed to make way for a border wall funded through a legal loophole. In South Dakota, tribes stared down the governor's threat to sue them for closing their borders against COVID-19. In Washington, D.C., the Supreme Court ruled that the tribal reservations making up much of eastern Oklahoma still exist.

There are upsides to bureaucracy, of course. The Biden administration has already moved to restore many of the environmental protections Trump scrapped. Smoothly functioning bureaucracies are more critical than ever in the throes of a global pandemic; at the time of my writing, tribal vaccine distribution programs are running laps around their state and federal equivalents, bolstered by pre-existing government health infrastructure and close ties with the communities they serve. And however onerous the manipulation of the levers of power to achieve it, so far the gathering agreement with Great Smoky Mountains National Park is working. Park and tribal staff are invested; so are community members. Participation and harvest have grown each year. Gatherers tell me they've found the permit and reporting systems easy enough to use and understand.

For colonized peoples, bureaucracy isn't optional–it's often the sole line of defense

Still. There's something of privilege in not seeing the galaxy of moving pieces that have to fall into place for you to go look at a new flower, or to pick yourself some food to eat at dinner, or to take a nice walk on a sunny spring day.

Great Smoky Mountains National Park will look very different this spring. The visitors will be back, likely in new record numbers. The fringed phacelia will still be growing where it always did, but visiting it this spring will come with a soundscape of honking horns and shouting children. I don't think that's necessarily a bad thing; access to nature matters for the many as well as the few. I'm glad that going to a place like this is easy. Most of the time.

I'll remember what it looked like behind the red tape, though. I'll try to remember who the red tape excludes, and what it protects, and who can't live without it, and that sometimes all three are bound up into one. I'll remind myself to take pleasure in naming. And I'll go looking for some new flowers.

Maria Dunlavey (FN 2018) (AH) previously worked as the Conservation Outreach Coordinator for the Eastern Band of Cherokee Indians. She recently transitioned to a new position as a Botanist for the US Forest Service.

Letting Go of Certainty: Seeking Compassion in Contemporary America

LILLIE HOWELL

While researching for my graduate project, I came across some interesting information about the Chewong, a group indigenous to Malaysia. In Chewong belief systems, each species has what they call a different med mesign, or different "eyes". The authors write, "This is true, the Chewong acknowledge, for the siamang, or Malaysian black gibbon. There is a siamang way of perceiving the world. A tiger way. A fruit bat way. A hornbill way. A monitor lizard way. A tapir way. An anteater way. A slow loris way. An elephant way. A water snail way. Thus the distinctive sensory worlds and apparatuses of each sensitive and exquisitely adapted species within the lush Malaysian jungle is fully acknowledged and respected" (Knudtson & Suzuki, 1992).

In Chewong culture, there are infinite versions of reality occurring in any given moment, each one respectfully recognized and revered. This would make sense ecologically, as each species is adapted to its own niche. Each species has specific requirements for survival and is physiologically and behaviorally equipped to thrive in its specific environ. Thus, different "eyes" are necessary for each individual to live well. Perhaps this reverence arose from evolutionary and cultural necessity. In nurturing a veneration for the med mesign of all species, there is a recognition of the role of each one in the functioning of the entire biological system—a system upon which the Chewong closely depend. Compassion, therefore, ensures mutual survival.

Might there be something useful here for the contemporary American? Is the same not true of humans in our staggering range of cultural and spiritual identities, geographies, stories, aspirations, and fears? And because of these differences, might our niches differ, and might we have different requirements to feel safe and secure? Though in Vermont we are far from the lush Malaysian

Image: Sarah Lindsay

jungle, our communities are just as beautiful precisely because of the countless med mesign that dwell among us. As naturalists, we know there is strength and resilience in diversity. Shouldn't we then, as the Chewong instruct, respect and acknowledge them all?

This year, we have all struggled to process the political and social upheaval that surrounds us. As the theme of this publication suggests, there is much confusion about where to turn for truth and certainty. In our efforts to make sense of the world, it is easy to sort people, events, and ideologies into good and bad, right and wrong. It is much easier to surround oneself with people with whom you agree than to heed the wisdom of the Chewong, who teach us that the world is more complex, more nuanced. It is far more difficult to lean in close to an adversary, to risk being wrong, to put your beliefs on the line for evaluation and judgement. But in doing so, we come closer to healing and to truth. The authors later write, "Because the desires and behaviors of each species, however unsettling or even threatening to humans, arise naturally from its vision of the world, the Chewong are inclined to judge them compassionately" (Knudtson & Suzuki, 1992). When feeling unsettled or threatened by others, let us start by asking what niche they occupy, what fears they harbor, or what family they seek to protect. These questions foster compassion.

Rather than exhausting ourselves in our quest to delineate certainty, perhaps the answer lies instead in accepting that we each perceive reality through the filter of our own "eyes". For me, letting go of the certainty I once craved has created space for compassion. This call for compassion, of course, does not imply that we are required to celebrate or even approve of every event or action that we witness. It only asks that we first pause long enough to listen and seek to understand one another, to learn each other's stories, and to see the world, even briefly, through another being's eyes.

Lillie Howell is a master's candidate in the Environmental Law & Policy and Natural Resources dual degree program through Vermont Law School and the University of Vermont.

Paper-Punching Tree Leaves

BERND HEINRICH

Image: Bernd Heinrich

Imagine wandering through the woods of Maine and happening upon this sight: a bona fide tenured and lab-entrenched entomologist from the University of California in Berkeley using a paper punch to create little, round holes into the leaves of small birch trees. Forty years ago, I stood less than a hundred feet from where I'm sitting now with my helper, Scott Collins, performing this seemingly strange activity. We had dug up and planted these white birches into a large, screened cage into which we'd placed mist-netted chickadees, each named and tagged to identify individuals. Day after day, we monitored to determine which of the trees they preferred to visit in our artificial tree plantation.

There are always numerous antecedents that precede a line of activity, a potential discovery appearing within each. There is no beginning and no end. But in my mind, this particular investigation started when I was six to ten years old. I was watching my father beat trees with a club to knock down caterpillars onto a sheet to raise them for hatching out ichneumon, a family of parasitic wasps, for his collection. Seeing caterpillars I'd never otherwise see was an eye- and mind-opener. From then on, I was alert to caterpillar presence and raised them for any of a number of reasons, including for an article on Callosamia cocoons in the January 2021 issue of *Natural History* magazine. But what actually happened to get Collins and me into that cage with our chickadees at my camp in 1981 took place in Minnesota's Lake Itasca Park.

I was invited there to teach a summer field course in ecology for the University of Minnesota. I arrived a few days before the students, scoping out projects for us to do. Walking along the cleared paths of the UMN Experiment Station under a tall basswood tree in June, I saw several leaves that showed clear signs of being partially eaten, but then discarded, the petiole having been chewed through. Bingo!

It requires considerable time and effort for a caterpillar to chew through the tough petiole, and no caterpillar would have done it in order to get rid of food. Since those days watching my father, I had routinely relied on leaf damage as a prime cue for caterpillar presence when hunting for them. Might birds hunting for such "invisible" caterpillars do likewise? Could they be discarding the leaf after finishing their meal as an evolved behavior to dispose of evidence of their presence?

In my quest to discover if caterpillars had evolved this unique behavior, I created a quick project to immediately test my students, including Scott Collins. I tortured them at one poplar bush holding two large caterpillars, challenging them as birds, visually oriented "predators," to find them just by looking. The students could not touch nor divulge to each other what they might have seen, until the end of the timed hour. Most failed to find the caterpillars in that frustrating, but insightful lesson.

The clues they had missed were the small, often unnoticed details. I had noticed in the field that palatable caterpillars did not only clip off leaves after feeding on them, but they also pared them down to a smooth edge while feeding. The result being the leaves looked smaller but held no tell-tale holes or bite marks. Caterpillars that do not clip them off tend to be more irregularly shaped, spiny, hairy to better disguise themselves or are unpalatable. My observations and Collins' interest in birds led to conversations on caterpillars and chickadees that summer.

Our curiosity grew into the experiment in Maine. We used the paper-punch to artificially damage leaves on two birches and left the leaves intact on the others. This time chickadees, rather than ambushed students, were our subjects. Instead of cryptic caterpillars we used non-cryptic mealworms, placing them in hole-punched trees, leaving the undamaged trees mealworm free. We wanted to see if the birds could associate their prey with leaf damage, noticing the patterns my students had not.

We found that after a few trials of hopping from one tree to another, the chickadees in our Maine aviary didn't even bother to look into the trees without holes punched into the leaves. They, noticing the details often missed by others, quickly flew to hunt for the mealworms on trees with paper-punched leaves. We had happened upon an interesting discovery: birds could use leaf damage as a hunting cue to find otherwise nearly invisible caterpillars.

This is not a story in isolation; each question prompts one to ponder and review the situation, to try to place it into the ordinary or plausible. There is then the push-and-pull of competing hypotheses, one the most logical that everyone would assume as correct versus others that seem fantastic or fanciful. The more likely hypothesis is that the story involves intimate details, seemingly insignificant at the time, but make all the difference. The journey of this discovery is the story of what actually happened.

Bernd Heinrich (UVM Professor Emeritus) is an award winning science writer and ecologist.

Summer of Moths

JAIME VAN LEUVEN

A male cecropia moth lay at the base of a yellow birch. Legs crumpled, wings tattered. He was unable to lift his body. Was he alive? Something intuitively said yes. Above his crimson, velvet shoulders, a pair of feathery antennae protruded, blowing delicately in the breeze—antennae that could sense the female's pheromones in the mating box twenty feet away. The door was open, but he was unable to reach her.

I couldn't leave him there.

I bent down and gently scooped this delicate creature into my hands—this beautiful moth—with torn wings of charcoal tapestries, painted with waves of maroon and drops of cream. Did exiting the cocoon render him flightless? Or was he accosted by a bird on his journey? I placed him inside the mating box. Every hour, I checked. Each time, he was closer to the female—using his legs to climb slowly, slowly up the screen. By the end of the day, they were mated.

When I first came to Garden in the Woods botanical sanctuary, I wanted nothing to do with raising moths. The garden raised four species of native saturniid silk moths for conservation and educational purposes; *Hyalophora cecropia, Actias luna, Antheraea polyphemus, and Callosamia promethea*. I knew it was part of our duties as the horticulture staff to facilitate this, but I just wasn't interested. I intended to focus my Native Plant Horticulture Internship on propagating and cultivating native New England plants.

But, that's not what actually happened.

What actually happened was, during this summer of transplanting trillium, hunting for rattlesnake plantain, and culling invasive milfoil, I was pulled deeper and deeper into the world of the moths. A world of pheromones, silk cocoons, lots of frass, and hundreds of babies.

It all started the day Don Adams, our silk moth-raising expert, put a cocoon in my hand.

"You can feel it moving," he said. The garden, my coworkers, and Don faded into the background as all my senses laser-focused on what lay in my hand—a luna moth cocoon. Woven of burnt-umber, iridescent strands of silk, it hardly weighed anything—maybe as much as a black walnut half and about the same size. It could have blown away on the wind. And yet, there was a presence there—a gentle pressure in the palm of my hand. Life.

Drawing: Jaime Van Leuven

A world of pheromones, silk cocoons, lots of frass, and hundreds of babies.

I was transported back to high school, a warm spring evening, staring wide-eyed at my first sighting of a luna moth, clinging to the house clapboard. It's giant, key-lime-green wings glowing in the porch light. Feathery antennae illuminated. I remember being transfixed by the beauty that could exist in the world.

Suddenly—back at the garden—I could feel it move. The luna moth. Shifting inside its cocoon. Rocking gently in my palm. Lowering my ear, I could hear a soft scratching sound of moth moving against fiber, like a person in a paper sleeping bag.

From a human perspective, the life cycle of saturnid silk moths seems tragic. Being an insect at the bottom of the food chain, everything wants to eat them. They begin their lives as tiny, hungry caterpillars in the spring, voraciously eat foliage all summer, then spend nearly nine months of their life in a cocoon. Some never make it out of this silk enclosure. Others are injured in the process. If they can safely exit as moths, they have 14 days to procreate before they die of starvation; saturniid moths do not have mouths. The odds of survival of these species makes their transformation even more miraculous. As I listened to the waking luna, I felt a weight of responsibility. If it was our job, as the horticulture staff, to rear these moths; their fate lay in our hands.

Two days later, during the hour I usually devoted to botanical drawing, I sat in front of two mating luna moths. I turned to a new page in my sketchbook—past goldenseal, columbine, sundial lupine—and began etching evidence of the moths' 24-hour copulation. I couldn't pull my eyes away from the glowing, green symmetry: two sets of tail wings slotted neatly through each other; two, soft-haired torsos mirrored, like a reflection on a lake.

The lunas were the first to mate, followed closely by the polyphemus. Two weeks later, on the day 200 polyphemus caterpillars hatched out of their eggs, my coworker Melanie and I were supposed to be watering the drought-stricken garden. Instead, using tiny paint brushes, we moved split-pea green larva (less than a centimeter in length) onto clippings of oak leaves—one at a time. My eyebrows cramped with concentration. Eventually, one of us had to leave to revive the plants. Melanie went. I stayed with the moths.

By mid-July, I was spending half my workday with the moths. The cecropia population was booming and we were rapidly running out of black cherry—their preferred host plant. I had to switch several broods to gray and yellow birch. Their appetite seemed to grow exponentially as the summer progressed. Their frass (or feces) now the size and shape of wild mulberries, needed to be emptied every day. When I came into the horticulture building to use the bathroom, I noticed a soft, squishy body under my hand as I pulled my suspenders back over my shoulders. A cecropia caterpillar had hitched a ride.

I started thinking about the moths on my days off. Did my coworkers leave the door open to the mating box at night so the male moths could reach the females? Did anyone remember to move the growing promethea caterpillars to fresh branches of sassafras? Would anyone empty the frass out of the paint sleeves while I was gone?

Caterpillar frass, it turns out, is incredibly beneficial to native plants. It contains high nutrient levels, abundant amoeba, beneficial bacteria and fungi, and is considered to be a natural bloom stimulant. It is also hypothesized to trigger plants' pathogenic defense mechanisms. Farmers and horticulturists actually buy frass to enhance their soil; fostering a native population of saturniid silk moths would do the same.

Toward the end of July, I was sweeping off the education patio in the shade of the yellow birch where I once found the tattered-winged cecropia. Among the general plant debris, I noticed an abundance of familiar, mulberry-shaped frass. Looking up into the bright green leaves in the afternoon sun, I could almost hear the clicking sounds of mandibles crunching plant cells. Thirty feet in the air, a wild cecropia population was thriving—unaided by humans—directly above the mating boxes where we housed females in the spring.

On the final day of my internship, I took one last walk through the garden. I reminisced about the blanket of bloodroot that flanked the ridge trail in the spring, revisited the unicorn root I transplanted in the coastal sandplain, and said goodbye to the now-fruiting American ginseng.

But, I had a destination.

Tucked in a quiet thicket of rhododendron near the limestone outcrop was one of the largest and oldest yellow birches in the garden. I had moved a mature population of cecropia caterpillars there the day before. Most of the caterpillars, now the size of small sausage links, were hanging upside down on twigs in what I liked to call their "sleeping" position—holding onto a twig with their suction-cup pro-legs, folding in their true legs, and curling their head forward.

But, not all.

One cecropia was busy in the corner of the paint sleeve. It was moving its head back and forth, back and forth. Every now and then it pressed both its backend and head into the mesh in opposite directions, as if stretching something out. It looked very strong. I climbed into the tree and moved my face close enough that it was inches away from the caterpillar. The evening sunlight silhouetted its spiky, swollen body, and illuminated thin strands of silk—the first layer of its cocoon.


Image: Fatema Maswood

My sincere appreciation goes to the horticulture staff at Garden in the Woods Botanical Sanctuary for the learning opportunities they provided last summer and Don Adams for sharing his enthusiasm and moth-rearing wisdom. I'd also like to thank the moths for continuing to show me the ephemeral beauty that exists in the world.

Jaime Van Leuven is a current Field Naturalist graduate student in cohort AK.

The Layer Cake Illuminated

ALICIA DANIEL

You may have been out exploring Vermont landscapes with me—a cold-air-talus woodland in Bristol, a quaking bog in Stowe, the cliffy headlands of Lake Champlain, or a landslide in the Adirondack Mountains of New York. If you have, then you know that I use the layer cake approach. I teach from the ground up. This approach stacks up the layers of a landscape in unique and interesting ways and moves us through time from the Iapetus Ocean to the present. I always saw the beauty in its design. I only later understood why it is so compelling.

It allows us to tell stories.

This is the story of how the layer cake came into my life. One summer night in 1988, I drove to meet my Field Naturalist teammates at Yale School of Forestry Camp in Connecticut. My headlights shone around bend after bend on a winding forest road until they settled on a massive lodge with an empty parking lot. I was the first one to arrive for the legendary summer course we called "Siccama and Johnson" aka Terrestrial Ecology. Tom Siccama (Yale/plants) and Art Johnson (UPenn/geology and soils) cooked up a course using "the layer cake approach." We spent the next two weeks slogging through white cedar swamps, hiking along pegmatite dikes, and crisscrossing the often impenetrable academic boundaries between the earth and life sciences. Between sites, you could ride with Art who blasted Bruce Springsteen's newly released "Tunnel of Love" or ride shotgun Tom's pickup where you recorded all of the stop signs (he was documenting their unchecked proliferation across the landscape). Either way it was a trip.

That first night as I waited for my classmates to arrive, I pushed open the lodge's massive wooden door and shone my flashlight into its cavernous depths searching the dark corners for a light switch. No luck in the kitchen. I moved on to the study where my flashlight beam swept across a stone fireplace and then illuminated a room full of shining eyes. As the beam settled on the face of a snarling bobcat, my heart jumped and I actually shrieked before I saw that I was looking into a glass display case full of stuffed animals. Spooked, I retreated to the forest to set up a tent.

Waiting that night for Tom and Art to show up and turn on the lights turned out to be prescient. During the next two weeks, I learned how profoundly in the dark I was about natural history. I was months into the Field Naturalist Program, but my knowledge was still lacking crucial context. I discovered that my perspective was as restricted as a moth-eaten bobcat in a glass case. By taking us into the woods day after day to look at geology maps, dig soil pits as wide and deep as a grave, core trees, describe plant communities, and search for signs of land use history (i.e. scouring the forest for barbed wire), Siccama and Johnson opened up a wide, new world. They changed my worldview profoundly. It was as if they smashed the glass, resuscitated the bobcat, and set it free in the wild woods. What I knew about the natural world came to life. My natural curiosity had a place to roam. At the end of that life changing adventure, Tom scrawled across the bottom of my final paper, "If you learned this much in two weeks, you should be teaching this stuff." And now, that is what I do.

Science has a habit of naming, collecting, dissecting, and labeling things like the taxidermied bobcat at Yale Forestry Camp. But places are not the sum of their parts nor the total of their pieces. Places have stories. Places have histories. The base of Bristol's talus slope has black spruce, Labrador tea, and sphagnum moss growing in a narrow band. But the story is one of cold air sinking, water freezing, ice persisting into summer, boulders settling into the angle of repose, and hot rocks radiating heat up to the cliffs where oaks grow and peregrine falcons soar.

Seeking the upside to lockdown, I decided to set aside my resistance to remote teaching and recorded a series of online hikes. Now I also take people I have never met out to read the landscape. Sometimes in these videos (shot in a series of single takes all in the same day), I get caught up in the excitement of the emerging story and I make mistakes. I recently made the Adirondacks about 75 million years older than they really are. These recorded human errors make me wince. Yet, the popularity of these casual rambles can't be denied. Is it because my love for nature is so evident? The online hike about wildlife habitat at Raven Ridge just passed 1,000 views in two short months. Which shows that even when it is not perfect, even when it is virtual, people really do like a good story.

Above: the author (bottom right) with a team of Field Naturalists in Alaska. Photo from the May 1989 issue of Vermont Quarterly.

Alicia Daniel is still teaching Reading the Forested Landscape to UVM Field Naturalists. She is also the Executive Director of the Vermont Master Naturalist Program and a Field Naturalist for the City of Burlington. To join her on an online nature hike, visit her YouTube channel: Vermont Master Naturalist. And for those of you who are still wondering, all of the light switches at Yale Forestry Camp lodge are in the basement stairwell.

Ways to Capture a Frog

SARAH LINDSAY

Image: Sarah Lindsay

It's late morning toward the end of summer in a small wooded swamp in Vermont. Our field botany class is here, predictably, to look at plants. We press the spongy bark of black ash and trace the golden-furred vines of creeping snowberry to find tiny ghostly fruit. A familiar pulse of movement pulls me out of this plant world, and almost without thinking, I pounce. I've caught hundreds of frogs in my life, but the joy never dims. I love their strange, damp skin, their slightly downturned mouths. Most of all, I love their eyes—like miniature Fabergé eggs, gold-spangled works of art. I know that frog eyes have evolved to function better than mine in low light, that a nictitating membrane enables their visual transition from land to water, but I've never heard an explanation for their beauty. The frog looks placidly indifferent to my admiration, as frogs always do.

Field Botany Notes from August 26, 2020
Location: Bliss Pond Cedar Swamp, Calais, Vermont
Notable plant species: *Thuja occidentalis, Fraxinus nigra, Gaultheria hispidula, Cornus canadensis, Linnea borealis, Circeaea alpina, Orthilia secunda, Rubus pubescens, Coptis trifolia, Gymnocarpium dryopteris, Micranthes pensylvanica, Mitella nuda, Carex leptalea, Dryopteris cristata, Osmundastrum cinnamoneum*
Additional notes: Caught one adult frog. Skin mottled green and brown on dorsal surface, striping pattern present across hind legs. Dorsolateral ridges present. Rotten onion musk absent. Likely *Lithobates clamitans.*

A female green frog is searching for a nice juicy cricket when the ground shakes. Instinct tells her to leap quickly away from the intrusion. She leaps, lands, leaps again. Before she can find a mossy rock or fallen log to nestle under, she's skybound, supported by something suspiciously warm. She's never seen the ground from this height before. Her usual view of the forest involves sphagnum and sedges; now that view is suddenly eclipsed by a great beige moon, from which two gigantic eyeballs blink stupidly. A third eye, set in an ungodly rectangular contraption, hovers uncomfortably close to her face. Her brain has evolved to register the movements of anything small as prey, and to flee from the movements of anything bigger. She has no evolutionary script for being gently held four feet off the ground and not eaten.

Months later, as winter turns to spring in fits and starts, I sit at my computer and try to capture the frog, to somehow distill reality from photos and fragmented notes. I stare into the gold-spangled eye on my computer screen. I think of the summer I spent at Mount Rainier, learning to estimate the number of tadpoles wriggling in the rushes along lakeshores. My project's stated goal was to survey wetlands and map the distribution of amphibian breeding sites. Many times, I came across spawning pools that had dried too quickly, egg masses lying like beached jellyfish on the cracked soil. If I got there in time, I'd carefully carve channels to create inlets of fresh water. I wonder if any of those eggs survived to become tadpoles that became frogs that were one day caught, their golden eyes to be admired by some human.

Sarah Lindsay is a current Field Naturalist graduate student in cohort AK.

What Really Happened in the Sibium Mountains?

MICHAEL SUNDUE

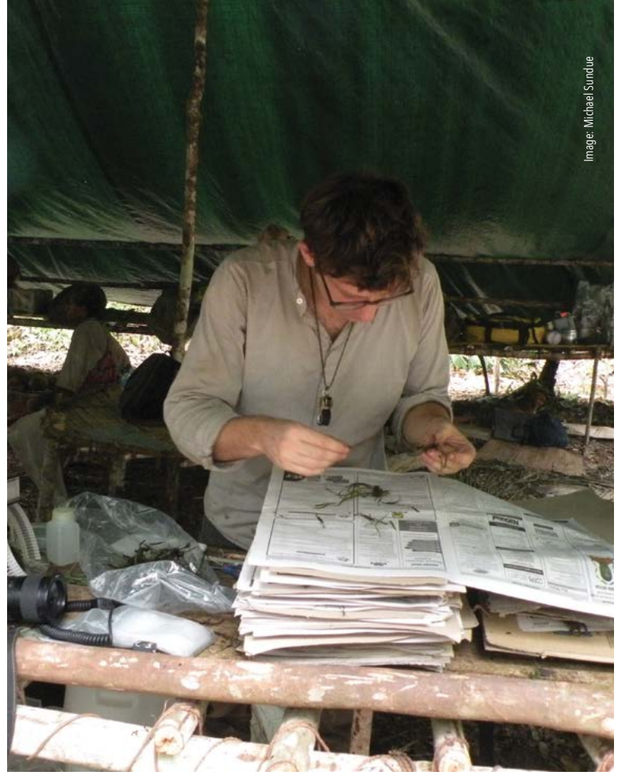


Image: Michael Sundue

"Allen! He's here!" exclaimed Alfred, alarming our expedition leader.

"Who's here?" Allen replied, trying to focus on the frog specimen he was preparing.

"The stranger!" came the strained whisper.

Allen gave up on the frog and threw his arms up in the air, "well, then go and meet him."

With that, Alfred and the other local field assistants set off toward the dark edge of camp wearing headlamps and brandishing bush knives.

For days, the field assistants, who were all from Itokama village, had been rumoring about people lurking in the shadows just out of sight, observing our camp in the Sibium Mountains of Papua New Guinea. These "strangers" were imagined to be from a neighboring village. Perhaps, as the story went, they were incensed by our research activities, felt excluded from work opportunities, and were envious. Now, one of the field assistants had caught a glimpse of a stranger upstream and was determined to make contact. All were very tense and very serious.

I was busy trying to figure out where to hide. I was pretty sure there was going to be a machete battle in the middle of our camp and I had nowhere to go. My tent? Too obvious. Run off into the forest? That would just delay the inevitable; Papuan villagers have legendary tracking and hunting skills. A wild pig would stand a better chance than I would. I froze and went inwards, explicitly imagining the process of how I would be killed. As another researcher had told me, first your Achilles tendons are chopped with a bush knife to keep you from running. Then, when you fall onto your knees, you are skewered in the torso with a spear. I got in my tent and turned off my headlamp.

This was my first trip to Papua New Guinea. I was part of the 2012 expedition of the Papuan Plants Project to the Sibium Mountains. Herpetologist Allen Allison and botanist Shelley James, both from the Bishop Museum of Hawaii, were the expedition leaders. We were joined by Oliver Tallowin, a herpetologist who at the time was working as an assistant to Allen; Bulisa Iova, a zoologist from the national museum of Papua New Guinea; Dubi Damas, a botanist from Lae Herbarium, the national herbarium of Papua New Guinea; and Si He, a bryologist from Missouri Botanical Garden. We had chartered a flight from the small airport in Port Morseby across unbroken rainforest to the grass airstrip that serves Itokama village, then built our camp a day's hike from the village. I was there to help inventory fern diversity and assemble DNA samples to aid my effort to reconstruct the phylogenetic history of the Polypodiaceae. Most of the other researchers had a great deal more experience than I did working in the region. I knew the ferns well enough to be an effective collector, but I was more than a bit naïve about local customs. Most of what I knew about Papuan culture came from flipping through the 1930s issues of National Geographic as a kid. I was trained as a botanist, but no one told me I had to study culture as well.

The biological splendor of the Sibium Mountains was overwhelming. I spent long days in the field with two villagers who knew the trails, Sampson and Albert. They showed me wild foods and explained that previous generations had relied upon them before taking up gardening. Macrofungi were emerging that month and I tried to find a species that Sampson didn't know. It took a while; his knowledge was breathtaking. We encountered spectacular leaf-mimic stick insects, a giant orb-weaver spider, and a pizza-sized *Dictyonema* lichen growing horizontally around a vine. Even the mosses were giant; we walked through carpets of *Dawsonia*, the 'Sequoia' of hair-cap mosses. I saw jaw-dropping ferns that I only knew from herbarium specimens: *Antrophyum*, a large leathery epiphytic tongue; *Lecanopteris*, with bulbous stems that are home to ants; *Syngramma*, whose bizarre morphology obscures its alliance with the brake-ferns; and *Tomophyllum*, a frail dangling epiphyte hiding in the shadows of overhanging tree branches and perhaps the best example of parallel evolution between new world and old world ferns—it is the spitting image of the Neotropical *Alansmia* which inhabits the same niche.

There in my tent, awaiting death, my mind was split between two possibilities. Most likely I was delusional, and the stranger would turn out to be a curious and shy person from a neighboring village. I had been exhausted and dehydrated from working long days in the tropical heat. I was taking malaria medication which, true or not, carries the reputation for deteriorating mental health. I had slipped and fallen down mud-slicked trails and sliced myself open on rattan palms and spiny *Pandanus* leaves. The relentless spam and taro dinners were getting to me. Sweat bees ate my bar of soap. On one hand, I was just experiencing the paranoia of an unfamiliar place. On the other hand, I might be in real danger. Afterall, the previous expedition of the Papuan Plants Project to the Kamiali wildlife preserve had been cut short by an outburst of inter-tribal warfare and it was our own local field assistants who were driving the narrative of the stranger. Were they imagining things, or were we all? Was anyone else as nervous as I was?

There in my tent, awaiting death, my mind was split between two possibilities.

Inter-tribal skirmishes have a deep history in New Guinea. It is a culture thought to have developed in response to scarcity of resources. Most instances de-escalate without serious consequences and, compared to Western conflicts, account for far fewer casualties. In recent years, however, conflicts have become more fierce. Increased resource extraction particularly from mining industries, along with the influx of money and displacement of communities are thought to be worsening conflicts. But wasn't I just being a paranoid Westerner, out of my element and primed to believe stories that fit my expectations from 60-year-old magazines that glorified the otherness of Papuan culture and played into pernicious colonialist stereotypes?

Alfred and the other field assistants walked back into the camp along with the "stranger". To everyone's surprise, it was no stranger at all. It was Oliver, assistant to the herpetologist. Returning with the others into the camp, he looked more amused than afraid. He had been found alone with his lights turned off, knee-deep in the river, trying to make an audio recording of a frog call, when the field assistants surrounded him, and simultaneously lit their headlamps to catch him off guard. It worked; he was surprised and so were the rest of us.

There really wasn't a stranger, unless you count me, a foreign researcher who didn't have much of a clue what was going on. What really happened in the Sibium Mountains? We built a field camp in a remote corner of rainforest on the island of New Guinea and lived there for weeks eating taro and spam and listening to Cassowary hunting stories over smoky campfires. Researchers worked alongside local landowners to document the biodiversity. We collected hundreds of fern specimens, a backlog of which I am still working through. We discovered new species and gathered data for half a dozen research papers. We mixed cultures and personal experiences, and for a moment, we all let ourselves fall prey to a very ridiculous story.

Michael Sundue (UVM Research Assistant Professor) is from the Department of Plant Biology and a curator of the Pringle Herbarium.


Image: Michael Sundue

Memories of Pawpaws

LAURA HATMAKER

I remember the sun filtering through trees, landing in scattered patches along a bank of the Potomac River. I was wandering the floodplains, on a hunt for pawpaws. I meandered through a crisscrossed dirt trail alongside weekend warriors of the Washington DC metro area. Waves of music from air-pods drifted tinnily to me as they jogged past until it was subsumed by the steady gurgle of the Potomac and rustling of damselflies. I scanned the trees for my prize: pawpaw fruit. Feeling the slight give in their supple skin, I plucked the ripest. My pocket knife was in my hand in a flash; the soft skin split easily, yielding sweet and slightly tart pudding-soft flesh, which I sucked greedily into my mouth. I shot brown butter-bean seeds into the earth around me.

I knew where to forage from prior sallies into the riparian thicket. Along the Potomac River, the pawpaw, *Asimina triloba*, is a common sight. Accustomed to shade and fond of reproducing using root suckers, the small tree is prolific compared to other understory plants. Tufts of three spirally-arranged, simple, lance-shaped leaves appear along smooth-barked branches. A month prior, I would have seen its flowers: blood-red and purple, mimicking the three-lobed appearance of the leaves in a double layer of six fat oval petals. But now I was able to admire its result: the yellow-green fruit. Dangling in oblong pods, the soft and tangy yellow fruit attracts passing mammals, concealing multiple kidney-shaped seeds awaiting dispersal in exchange for the plant's gift of food. The flesh is creamy at its ripest, almost a custard with a taste reminiscent of mango and banana, which has given rise to the pawpaws' other common names: the West Virginia banana, banango, and hillbilly mango to name a few.

Memory is tricky. We use this concept all the time to describe everything ranging from inanimate life to the complex stories and details that make up the human experience. While we acknowledge the memory of a computer is not the same as that of a biological being, after that it gets fuzzy, especially when it comes to other mammals. Plants, usually, get classified as a passive organism: existing, but not thinking and certainly not remembering—right? Yet, plants have mechanisms for recalling past experiences and even passing it on to their progeny.

For people, memory is the combination of sensation, knowledge, and past experience into one lavish and vivid recollection. As I write, I summon my recollections of pawpaws—woven from sensation, knowledge, and traces of the past into one vibrant and intricate tapestry, one that I am simultaneously aware of being and of experiencing. The pawpaw was so soft, but consciousness feels so hard.

Is it merely because I am able to process and describe it in a fashion familiar to humans that makes it memory? This question isn't new. As long as humans have realized their sense of self, they've quested and pondered the keys to our mental complexity: our self-knowing and recollection of experience. It's a question that won't be solved in 1500 years, let alone 1500 words. The enigma of memory and consciousness remains.

As perplexing as that issue is, a more thorny puzzle arises: how to describe consciousness in other species when we don't even understand the depths of our own? Even the word "experience" refuses to be kept in a neat, tidy definition. The inadequacy of our own tongues pin us into this trap of using anthropocentrically loaded terms to describe the world around us. However, I don't assume that my species is the only one capable of these feats simply because we have not discovered how they operate or how to detect them.

When I turn to science to discern the extent of what we know of our mental workings and distill these vivid details and past experiences, I am told they are nothing more than synapses firing, ions transferred across cell membranes, and a combination of proteins made from transcribed DNA that are cataloged and stored. If this is true, then what about the pawpaw? Does it, or any plant, remember? If so, how?

Jeanne Harris, professor in UVM's Plant Biology department and specialist in plant physiology signaling networks and developmental genetics, told me that when a plant survives stress—be it freezing, salt, or drought—it remembers this time in its life. It primes its defenses in case it should experience that stress again—making it more likely to survive a second encounter. However, this act of survival comes at an expense, as the plant trades off stress-resistance with slower growth, low- or even no- seed production, or less investment in the seed's cotyledon.

Two mature Asimina triloba specimens stand amongst a collection of plants; all labeled, pruned, and mulched by the Jeffords horticultural specialists. Here in Vermont, they're far outside their natural, more temperate range. These pawpaws remember frosty winds that whip across Lake Champlain from the Adirondacks and layers of snowpack rather than the rainy slush of a typical Maryland winter. Far from the Potomac floodplain, they have learned to produce in shorter, cooler, windier, and less humid summers. Year after year, they have experienced the more extreme ends of their natural tolerance and thrived.

Even when I say they have experienced and remember, I still second-guess myself. How can I know the tree remembers? While so quintessential to my being, not I—or anyone—understand how memory works or even where the rest of the living things on this orbiting rock fall on that spectrum. Conscious thought, memory, experience—there is nothing other than to grapple with it, regardless of the spongy matter's capacity. And so, we must continue to persevere in the labyrinth.

While measuring the pawpaw's growth would require a more invasive study, one tradeoff is readily observed and catalogued in my memory. When I arrived in the brief Vermont summer, they had sent up clonal shoots, an attempt to extend their reach and create their own family grove in a land of strangers. In early fall, they bore fruit, the familiar yellow-green and swollen oval shaped pods I saw along the Potomac. Clearly, reproduction was happening—both sexual and asexual.

Asimina triloba flowers in late April and early May, and Vermont's last frost date is reliably on the very late edge of that window. In order for their reproduction to succeed, their protective bracts must remain sealed, not opening until later in the season to prevent frost from ravaging the tender petals. Yet how are they able to remember winter isn't over and not be fooled by a few warm days in April?

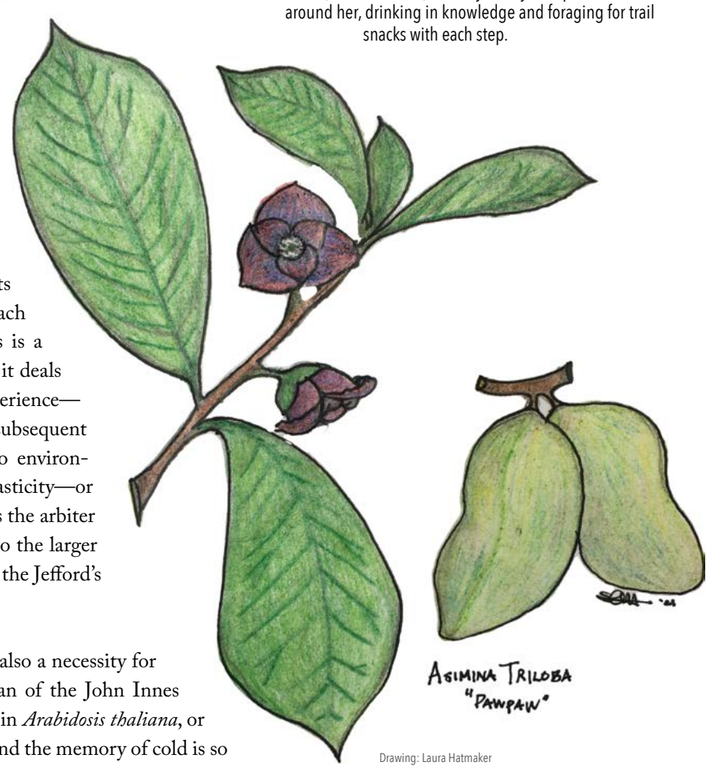
One answer to the mystery is vernalization, a process combining seasonal cues and epigenetics. Jill Preston, a UVM Plant Biology professor, explained to me how lengthening days, temperature, and plant hormones all play a role in helping plants determine if their flowering should begin—and each of these are controlled by epigenetics. Epigenetics is a relatively new frontier in plant biology. Simply put, it deals with turning on and off genes related to a plant's experience—and it is absolutely necessary for vernalization and subsequent flowering to occur. These modifications respond to environmental cues within the plant's life, giving them plasticity—or adaptability—to their environment. Just as a brain is the arbiter of our processes, each cell in the plant contributes to the larger decision-making process. This is part of what allows the Jefford's pawpaws to thrive in their new northern home.

But cold is not just a deterrent from flowering, it is also a necessity for it. Plants need cold to flower. Dame Caroline Dean of the John Innes Center has been studying vernalization for decades in *Arabidosis thaliana*, or thale cress, a common botanical study plant. She found the memory of cold is so strong within plants that even a clipping from one that has experienced cold will grow in the same manner as its parent. Every cell of the plant remembers the cold, vital for its continued success.

Epigenetic memory isn't just relegated to vernalization efforts during a plant's life, but can be responsible for other feats—some of which can even be passed down to progeny. Dr. Preston also described how the monkey flower (of the genus *Mimulus*), comes in two varieties: haired and hairless. The hairy adaptation allows those plants to fend off herbivore predation. Those that are not hairy will continue to produce hairless seeds, if left alone. However, should they come under herbivory, those plants that survive will sow seeds that come up hairy. There is no other explanation than the transference of that predation experience from parent to child.

Plants adapt to their environment and use memory to thrive from past experience. The pawpaws in the garden at Jeffords will bloom in April, grow fruit over the summer to drop in the early fall. Their lives go on, each season recorded in bark, leaf, and seed. To what extent this is the same thread of memory that lies within humans is hard to say. The more we discern about ourselves, the world, and its biota, the more things seem beyond just DNA, ions, and receptors. Perhaps memory, in all its varieties, is the thread that links us as living beings.

Laura Hatmaker (AK Cohort, '22) is on a journey to explore the world around her, drinking in knowledge and foraging for trail snacks with each step.



Drawing: Laura Hatmaker

Greetings from the Year 2337

CHRIS AJELLO

Image: Laura Hatmaker

Greetings from the year 2337,

I'm writing you just to say that everything turns out all right. What I mean is that you'll grit it out somehow, as one says (Does one say this? My sources are inexact), and that from the vantage of centuries, your problems appear both unsurprising and fine.

I should begin by explaining my view from here. Were I to require a window, the view of town would be marvelous: a near endless plait of piping. But as it stands, I'm presently lounging in my study, surrounded by cacti and reams of facsimiles. I am nourished by various extruded nectars and spend most mornings at the baths. I remain nude for much of the day, save what one refers to as a helmet: an intricate tool that demands the minute and copious attentions one might once have paid to dogs, children, and their equivalents. Once fitted, one can remain in these helmets for days at a time—it's often quite necessary. Besides our extensive helmet work, we've made commensurable advances in genetics, systematics, and paralinguistics. Toads, for example, are now considered vegetables, and in all forms of social discourse, one only ever says what they mean. This covers the most salient points.

I suppose you're skeptical. Why would a being such as I waste time with your remote, slovenly era? Au contraire! My current research has led me to understand your era as the grappling hook by which this paradisal future arrives (Does one still use this term, grappling hook?). In fact, the primary purpose of this letter is to make clear that your valiant and righteous projects—regarding habitat conservation and strict behavioral mandates—will one day blossom into my be-helmeted ease.

Nonetheless, your situation feels delicate: plague ravages both your rulers and your peasant classes. Not only this, but your rulers are wracked by divisions that threaten the selfsame status quo that suckles them—these divisions have naturally mapped themselves onto the peasant classes, who are driven to the streets on behalf of these rulers, spectacularly lofting what chains them. In for a penny, in for a pound, as they say (Is this true?). Meanwhile, the unemployment-lines (metaphorical, I believe) and the soup-kitchen-lines (literal, I believe) are miles long, despite the communal larders being remarkably well-provisioned. In short, your era has strayed from the strictures of your sages, and out of what's termed self-preservation, you flout evidence-based action and stumble headlong into existential threats.

It is afternoon here—I know this because of a marvelous invention referred to as a clock—and while I mull over what next to bestow upon you, knowledge-wise, I pace my chambers. These chambers are built of an inflexible polymer (biologic in origin, of course), therefore my footsteps and breathing echo off the walls, which I find invariably soothing. I stop now and then at the mantle to rest my chin and to fidget with the votive bauble that's mounted there. Trapped inside the crystal is a gentle mousse of red algae, fixed there as if in the paroxysm of current. I'm reminded that this is the key: the veneration and celebration of lowest forms, of primary producers. Indeed, it is the lowly and esoteric field of Ecology that will save your world—what must seem in your era a jealous and meager science, flocked to by so many anguished and ascetic adherents. How is this possible, you ask fervently—even rabidly—given your disgusting predicament? Held up, this bauble yields the fundamental insight: we are all one! Every being on this planet constituting a single unified organism! One part fails, all suffer! It follows that laws once governing interspecies dynamics are now extensible rather than moot; in the end, it was the trophic level, those great descriptors of food webs, that came to delineate for us a more orderly, crystalline embodiment of human society. The plant or alga must never be outnumbered by the herbivore, the herbivore never by the predator, and thus we too could be organized by the polite and gracious transfer of excess value up the ziggurat of human society, as it were. The accordance with these first principles of harmony should be obvious.

We have not been reduced to cannibalism—neither are our valises wrought from human skin, as your perversity suggests. We're not regimented or otherwise forced to bondage. We are devout, and ours is a system without biases, one that is accepting of all particularities. Its singular focus: energy in, energy out. The needs of those who labor at the lowest levels—for food, water, and shelter—are tended dutifully, for the needs of all high levels (e.g. the production of nectars and helmets) rest upon this foundation. What can be culled is empirically determined via the laws of thermodynamics, and we have become so advanced in this regard that there are thermodynamic conversions for thermodynamically portentous behaviors: openness, amenability, tactical generosity, the willingness to hum, and the treatment of individuals in strict accordance with statistical truths.

Ah, the sublime nature of algae! The thought sends me pirouetting across these echoey, polymer floors. Were you here with me, nude and be-helmeted, I would show you more. I would show you the halls of industry, the communes, the sorting tables. You could browse my humble collection of historically significant paintings, with its noble representatives of your lowly era—a Georgia O'Keefe, a Giuseppe Arcimboldo—visionaries who presaged this rebuff of anthropomorphism by reading the vegetable into the human. But I'm all flustered now, and the meter in the corner behind the ostrich feathers is now ablaze with my expenditures—I mustn't forget that. The blue-gray glass of this meter is a softish cold—that is, a cold that feels infinitely absorbent…

That should suffice for now. As I said, don't worry, everything turns out all right: you're on the right track! Or to use your native expressions, wish in one hand, shit in the other (Does one actually say this? I don't quite understand it myself). From my windowless room, the beacon of our gloriously equanimous and considerate future shines like the sun—bright enough to pierce the centuries that separate us and lead you, like an adorable but solemn donkey, along the path of the righteous.

Chris Ajello is a current Field Naturalist graduate student in cohort AK.

Image: Sarah Lindsay

What the Hawk's Feathers Tell the Naturalist's Brain

THOR HANSON

I crouched on the trail, surrounded by feathers. They lay in haphazard tufts and scatters, matted into the grass, testament to a great struggle and plucking that I was too late to witness firsthand. But it had obviously been a sizable bird, a raptor. There were the tail feathers, clearly banded with broad, black stripes, and next to them a small pile of brown secondaries—flight feathers from the inner wing. That narrowed things down, but there were still several possibilities in my mental bird book that might fit the bill. Then I spotted a clump of fluff with the telltale curve of breast feathers. They glowed a rusty orange in the morning light, giving away not only the bird's species, but its age. It was a juvenile northern harrier, which made perfect sense. Hawks rarely find themselves on the receiving end of predation, but when it happens, young, inexperienced birds are the most likely targets. But who was the attacker?

For cases of avian homicide, great horned owls always feature in my lineup of usual suspects. Notoriously bold and indiscriminate, they've been known to take down prey as large as a great blue heron. I've found crows and Cooper's hawks dismembered beneath their perch trees, and once dissected a single pellet containing the complete femur, tarsals, and toes of a greater yellowlegs. Young harriers would certainly be on the menu, but then again, the setting seemed wrong. I was hiking in the middle of a coastal prairie, far from the trees and cover that the owls prefer for staging their ambush attacks. In a contest over open ground, the nimble harrier would have had a strong chance of getting away clean. That left a bald eagle as a possibility, or more likely, the peregrine falcon that I'd seen in the area on several recent walks. Though slightly smaller than a harrier, the falcon was fast enough to out-fly anything, and strong enough to deliver a killing blow, particularly if it caught up with the hawk at the bottom of a steep dive. What's more, the crime scene matched the way falcons will pluck a kill quickly in place—looking out constantly for eagles or other would-be thieves—before carrying their prize off to feed in a safer, more private location.

Without turning back the clock, I could never know precisely what happened. But the harrier's remains made at least the outline of the story crystal clear: a feathery collision, grasping talons, and the desperate wind of large wings flapping their last. Natural history is often like that, less a practice of certitude than one of informed deduction. But there's nothing unusual about filling in details after the fact. We do it all day long, playing a game of constant mental catch-up between what happens around us, and how we perceive it. That's because while our senses may be rapid, they are not instantaneous. Visual data, for example, must travel from the eye to various parts of the brain for processing, recognition, and reaction, an operation that takes nearly half a second. Which means, oddly, that we don't fully grasp and respond to events until half a second after they happen. So if you've ever had that experience of feeling perennially behind on things, you are. You're half a second behind, all the time. There are exceptions to this rule, however, and one of the best-known examples comes to us from a surprising source: the feeding behavior of frogs.

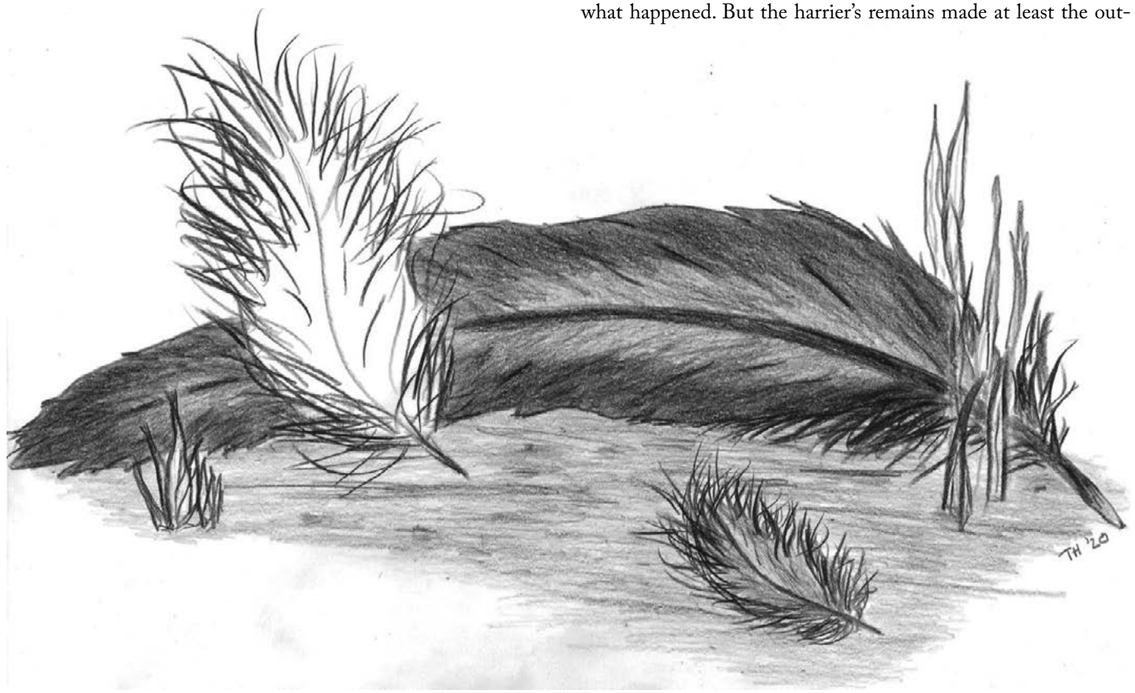


Image: Thor Hanson

I've been told that any neuroscientist worth their salt is familiar with a study from 1959 titled, "What the Frog's Eye Tells the Frog's Brain." It describes an investigation into the curious fact that a frog will starve to death, surrounded by food, if that food is not in motion. Put a hungry frog into a tank filled with juicy flies, and the poor creature will just sit there, wasting away, unless the insects begin to move. But as soon as a fly twitches or takes flight, the frog will lunge and lash out as fast as a falcon. In fact, any moving speck will prompt the same response—a black spot on waving paper, a tuft of lint dangled from a string. The reaction to moving, prey-shaped items is instinctive, and so fast that the researchers realized the frogs were doing it literally without thinking. There simply wasn't enough time between a fly's movement and a frog's strike for the brain to receive and process the information. In a sense, the frogs weren't actually seeing the flies. Instead, their eyes had evolved to send what amounted to a message in code, raw patterns of light and dark that triggered an immediate muscle response, completely bypassing the image-forming parts of the brain. For frogs, the importance of catching prey had made thinking about it obsolete.

Human brains contain a lot more neurons and complexity than the tiny nubs found within frogs, but it turns out that under certain circumstances, we too can respond faster than thought. If you have ever caught sight of something moving out of the corner of your eye, and turned to look, that reaction didn't go through your brain—at least not in the same way as normal vision. We know this because people can turn toward a moving object in only a fifth of a second, less than half the time it takes to fully see something and react. Even damage to the visual cortex does not blunt this response—when it comes to peripheral motion, our eyes are as hardwired as those of a hungry frog. That doesn't make us good at catching flies, but it must have given our ancestors an edge in other situations of consequence. For most of human history, sudden movements at the edge of vision included things like pouncing lions and charging buffalo, or, for that matter, thrusting spears. In any one of those scenarios, forgoing visual clarity in favor of speed would be fertile ground for the forces of natural selection.

The biology of perception is often compared to an act of continuous improvisation, where the brain selects only a few key details coming in from the senses, and ad-libs the rest from memory, assumption, and expectation. I like the fact that certain imperatives can override that system, creating shortcuts for the most vital information about our world. It's an idea based in science, but one that also resonates with metaphor. What better way to describe those deep jolts of insight we sometimes feel in nature, when our observations seem to hum with sudden clarity? How better to explain the pure joy that can rise up unbidden for even the most commonplace occurrence: fox tracks in snow, the scent of a poplar, or the sound of siskins taking flight, hundreds strong? Perhaps we're hardwired for those moments as well. Perhaps they, too, occur closer to real time, closer to how the world is, rather than how our brains contrive to portray it. Seen in that light, every find on every field walk holds the promise of potency, and natural history is more than just deduction; it is imminence.

Thor Hanson (O Cohort,'99) is an award winning science writer and biologist.

Image: Laura Hatmaker

MEET THE CLASS OF 2022

COHORT AK: THE HOT DOTS - *Arthonia kermesina*

Chris Ajello

Chris studied literature at Cornell University and the sciences at Central Oregon Community College. He has taught language in the US and abroad, as well as doing related consulting and freelance work. He has also spent a number of seasons on construction, farm, trail, and fire crews.

Laura Hatmaker

Laura holds a BA in Classical Archaeology and Early & Late Antiquities from the University of Mary Washington and an MA in Latin from the University of Georgia. She worked as a Latin and English teacher for over a decade before her road branched to accommodate a burgeoning passion for the sciences and environmental conservation. She became an apprentice wildlife rehabilitator at City Wildlife and Owl Moon Raptor Center, and took night classes in biology, chemistry, and ecology. Laura's experiences have pointed her in one direction: humanity and nature are inextricably linked, and the way forward is a Gordian knot that can only be resolved by taking both intertwined. As a member of the Field Naturalist Program, she's found her way under a single beautiful canopy: a conservator of dead language and of the living world, curating wisdom from the past to cultivate paths for the future.

Sarah Lindsay

Sarah grew up in the East Bay Area of California and earned a BS in Biopsychology from Tufts University in 2013. Before joining the Field Naturalist cohort AK, she worked in environmental education across a variety of biomes. Her past employers include the Pacific Science Center, Aspen Center for Environmental Studies, and the National Park Service.

Her dearest wish is to find a hognose snake in the wild.

Rachael Monosson

A self-proclaimed environmentalist from a young age, Rachael grew up south of San Francisco and lived there her whole life before moving across the country to Burlington. As an undergraduate at Stanford University, she studied Earth Systems with a focus in ecology. She has worked as a propagation assistant at a California native plant nursery, a blogger and fact-checker for the Sierra Club's print magazine, a hands-on science educator for Science Is Elementary, and a trail guide at the Aspen Center for Environmental Science. Most recently, she has worked as a tutor and after-school teacher of English and Biology. She now joins the AK cohort in pursuit of her passion for environmental education. She is especially interested in connecting with the public on a personal level about caring for the natural world, and in breaking down complex science concepts to make them easier for nonspecialists to understand.

Jaime Van Leuven

Jaime has spent much of her life connecting with the land–through playing in the woods as a young person, farming throughout college and beyond, making plant medicine as a home herbalist, and traversing the backcountry through her work with the Appalachian Mountain Club. She holds a BA in Studio Art with a focus in sculpture from the University of New Hampshire and spent a semester studying global and local sustainability in Auroville, India. The summer before starting the FN program, Jaime worked as a horticulture intern with the Native Plant Trust at their Garden in the Woods botanical sanctuary in Framingham, MA. She hopes to work at the intersection of ethnobotany and conservation following completion of her graduate studies.

NOTES FROM THE FIELD

COHORT AJ: THE GREEN DARNERS - *Anax junius*

Meredith Naughton

Trail recreation is at the center of the outdoor industry right now. Hiking, biking, and skiing are all growing in popularity as our society looks to the outdoors for wellness, camaraderie, and connection to the world. In Vermont, trail-based industry is booming, and rural towns are using trail recreation to attract visitors and provide jobs. The pressure for landowners to develop trails is overwhelming. How can you argue against building trails when your neighbors are excited and all the research shows time outdoors makes us happier people? But do we understand the impact trails have on our natural environment? In collaboration with Vermont Fish & Wildlife, and Vermont Forests, Parks, and Recreation, Meredith took a deep dive into the scientific literature to examine the whens, wheres, and hows of the ecological impact that recreation trails have on wildlife. Based on her findings, she is designing management recommendations and a Vermont-based case study. This work will help the state and other landowners include potential effects on wildlife as an important factor in recreation planning with the hopes of sustaining a long-term coexistence of trail recreation and healthy wildlife communities.

Image: Sarah Lindsay

FN CHALLENGE:

DRAW A TOAD FROM MEMORY

Image: Chris Ajello

Image: Sarah Lindsay

Image: Jaime Van Leuven

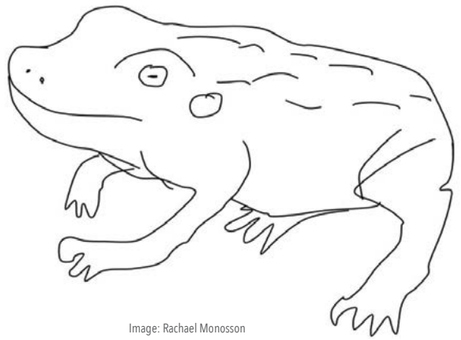


Image: Rachael Monosson

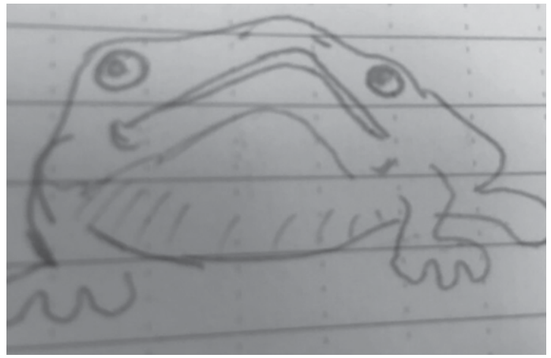


Image: Laura Hatmaker

YOUR TOAD HERE:

FIELD NATURALIST & ECOLOGICAL PLANNING

ALUMNI ASSOCIATION

CONNECT WITH US & BECOME A MEMBER

Over 35% of our alumni are members: that's a huge testament to the strength of our community! Our goal is to have 50% of alumni as active FNEPAA members. Please take a moment to head over to **fnepalumni.com** to join or renew your membership through 2021. There are several membership levels to choose from. The membership benefits are the same regardless of level, but becoming a member at a higher level provides expanded support for our students and alumni. Program affiliates who wish to support the Alumni Association's work are invited to make a donation through the website.

FNEP SYMPOSIUM, SPRING 2022

We plan to host an in-person Symposium in spring 2022 and, as was the plan for spring 2021, we hope to gather at the Eagle Hill Institute in Steuben, Maine for a long weekend of coastal ecology and socializing with FNEP peers. We will be in touch as details settle into place!

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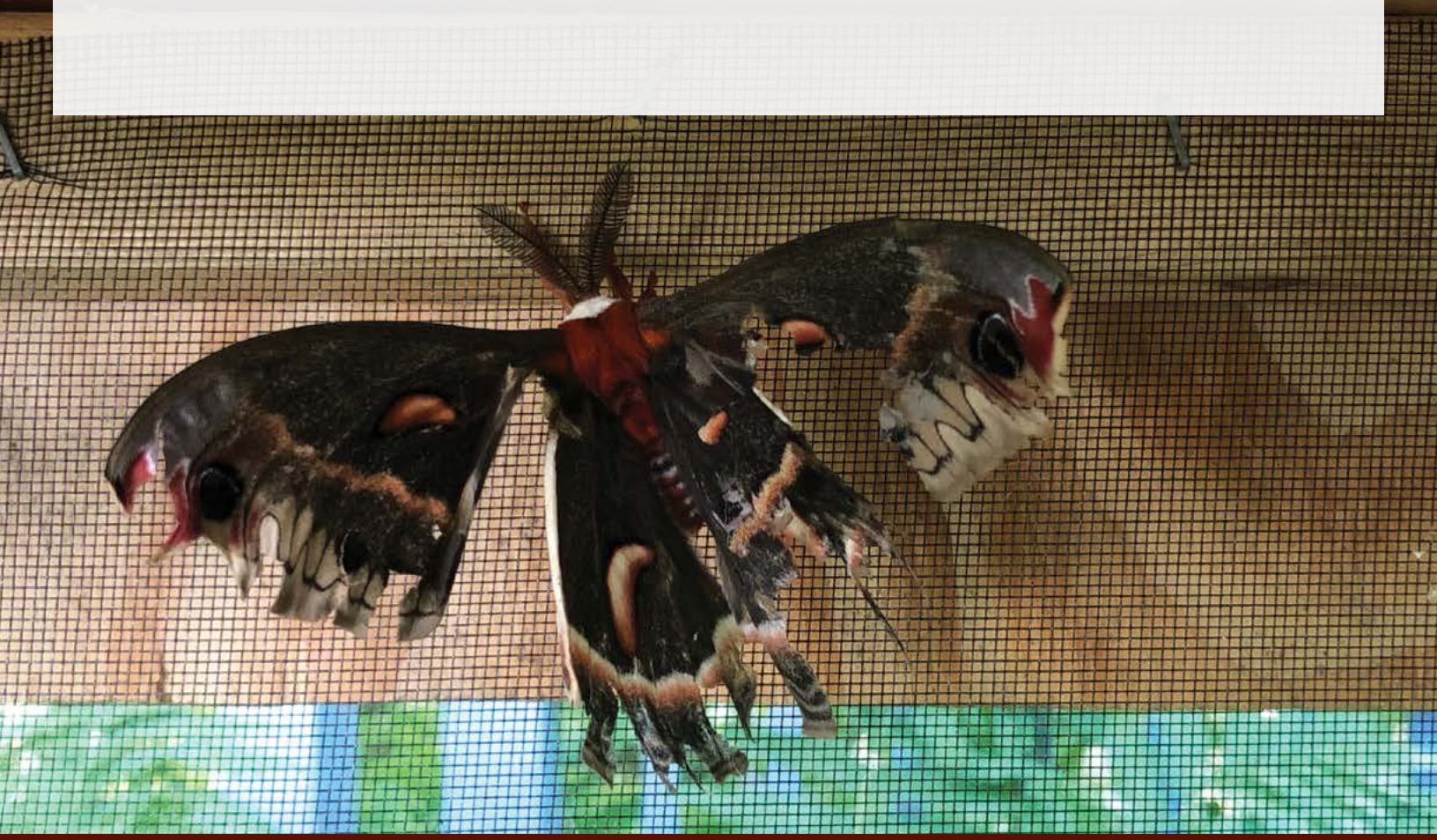

Need Professional-Level Assistance?

Each year Field Naturalist graduate students consult on projects of importance to conservation organizations. Past projects have ranged in scope from tracking white pine blister rust in the High Sierras to mapping natural communities in Maine to improving trout habitat in Oregon streams to modeling wildlife corridors in New York to creating watershed-level conservation plans in Puerto Rico. More descriptive overviews of projects can be found by going to the Field Naturalist website (www.uvm.edu/fieldnaturalist) and clicking on "About the Program." When a Field Naturalist graduate student takes on a substantive project, we ask the sponsoring organization to contribute $6,000 to our master's project fund; the entirety of the $6,000 goes to helping offset student tuition. Contact Walter Poleman (walter.poleman@uvm.edu) for more information. Thanks to the Alumni Association of the FNEP Program, those seeking help from a Field Naturalist professional now have another option. If you need short- or long-term professional help with field work, stewardship, or outreach (in the U.S. or abroad), send us your needs and we will post them on our job board. A number of organizations have already taken advantage of this service. Send your needs to: FNEPalumniassociation@gmail.com.