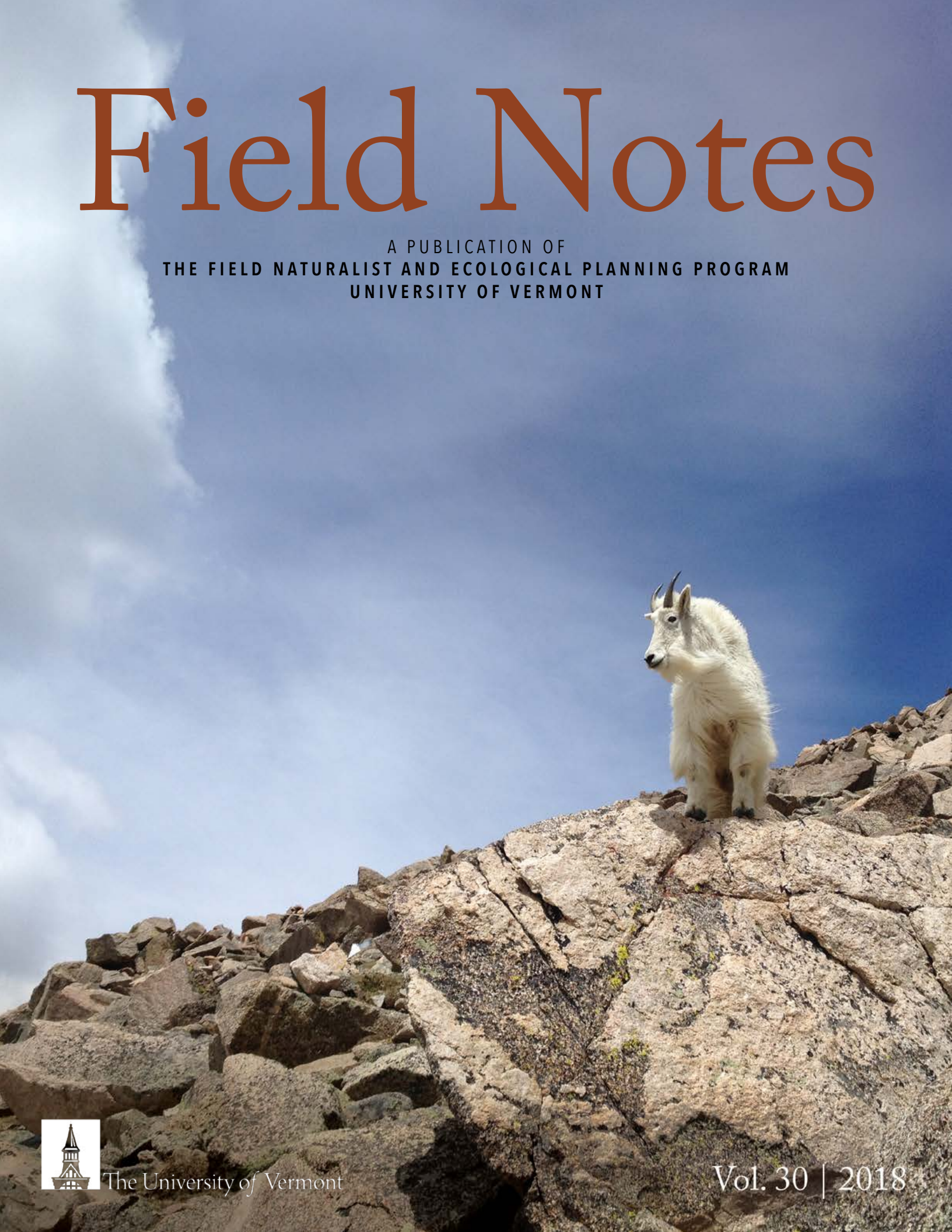
Field Notes

A PUBLICATION OF
THE FIELD NATURALIST AND ECOLOGICAL PLANNING PROGRAM
UNIVERSITY OF VERMONT



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FIELD NATURALIST &
ECOLOGICAL PLANNING
PROGRAM

Image: *Robins* by Bernd Heinrich

CHRISTIAN SCHORN

Some of the best advice I've gotten in the past year came from our program director, Jeff Hughes. *If you ever start to lose your place, or your momentum, or other people's attention during a presentation, he said, just stop and ask, "Well, so what? Who cares? What am I even talking about, anyway?"* His theory is that it serves as a centering question that snaps your audience's attention back to you, and gives you a few seconds to remember what you're even talking about, anyway.

Among my colleagues in the Field Naturalist and Ecological Planning Program, this strategy is known as the Great So-What. We use it more frequently than perhaps appropriate—during presentations, sure, but also when expounding on our personal theories about the next Star Wars movie, or when somebody doesn't seem to be listening to a really funny story that you're telling. But I've come to realize the Great So-What is more than a punchline. When you use it as the good Dr. Hughes intended, it can be a lifeline to your fundamentals, from which you can regain your bearings and renew your sense of purpose.

And what is our country's bearing and purpose? In the past year, it surely hasn't been toward the benefit of nature. Nor has it been for the preservation of wilderness, the protection of natural resources, or the advancement of international environmental action. What were uphill battles to begin with feel now even more hopeless among widening cultural gulfs of opinion and belief. For those of us who have invested some portion of our lives into working to bring about a more sustainable world, it's hard not to feel helpless or discouraged.

So maybe it's a good time to stop and ask: So what? This isn't about stalling for time, but making connections to the things, places, and ideas we care about, and remembering why we stood up and started talking about them in the first place.

In this issue of Field Notes—our thirtieth edition—you'll find different angles on the Great So-What. Our department chair and director reflect on two recent traumas that affected our program: the devastating fire of the Pringle Herbarium at Torrey Hall and the death of FN alumna, botanist, and ecologist Elizabeth Farnsworth. Other essays seek answers by contemplating the curiosity of ravens, the footsteps of insects, the glory of humble sedges, and the power of failure. We search for meaning in landscapes of different scales: Manhattan, a milkweed meadow, a park bench, eight square inches of bark.

So what? What's the point? Why do we care?

We've got our own answers, but so do you.

We are indebted to the contributors from our alumni community this year—Brett, Charley, and Mike—and thankful for the support and guidance of our program faculty, especially our writing instructor, Bryan Pfeiffer. Sincere thanks to Maria Dunlavey for all her editorial counsel, and to Lauren Sopher, Andy Wood, and Becca Waldo for their proofreading prowess.

Though Jeff will tell more of her story, I would like to dedicate this note to Elizabeth Farnsworth. She was my mentor at the New England Wild Flower Society, a consummate, inspiring naturalist, and the first person to encourage me to apply to this program. I owe her more than I was able to repay. Thanks, Elizabeth.

DR. JEFFREY HUGHES

Conservation is about trying to keep things from being lost. But *which* "things?" How do we decide where to direct our efforts?

Some things we value have no chance of being saved. As dispiriting as an impending loss can be, it gradually pushes us to rethink our priorities and purpose. Those of us with aging, failing parents or grandparents know this feeling.

The unexpected death this past fall of Elizabeth "Beth" Farnsworth, a Field Naturalist from the G-Team, pushed some of us abruptly into that existential upheaval. Beth was so purposeful in life—the senior research ecologist for the New England Wild Flower Society, an authority on ant biology, a talented botanical illustrator, a passionate advocate for women in science—how do we begin to measure up?

Comparing one's own abilities and accomplishments to others is a good way to get depressed. What hope is there for we mortals who think that Beth Farnsworth probably made God feel like a slacker? Read on, you might be surprised.

When Beth was a student in the FN Program—already glowing with talent and potential—she stopped by my office one day with something on her mind. After closing the door she proceeded to expound on the remarkable talents and qualities of her FN teammates. It took a while, but Beth's underlying angst finally surfaced: she saw herself as lacking in ways that her teammates were not. She needed assurance that she was good enough.

Are you kidding me?! I wanted to scream.

That Beth Farnsworth ever questioned whether she was good enough should be a wake-up call for the rest of us. We are defined by what we are, not what we aren't. Beth Farnsworth certainly proved that.

Hub Vogelmann, founder of the Field Naturalist Program, used to preach a similar message. To paraphrase: "Just go out there and do what works for you. Don't try to do everything, and don't dwell on where you fall short. And don't worry about how others do it. Individuals are the ones who move mountains."

In her inspiring life, Beth Farnsworth obviously figured out how to move mountains. Beth embraced everything she cared about with a damn-the-torpedoes, take-no-prisoners mentality. She'd say it in her own inimitable way, of course, but if Beth were here today and pressed for guidance on how to keep special things from being lost, here's what I bet she'd say: "Don't worry about who the other guys are, or that what they say or do or think is important. You know better than any of them."

But she wouldn't leave it there without adding some sassy rejoinder, of course. Most likely it would be along these lines: "Damn your own damn torpedoes!"

That's pretty good advice, I think.

Jeffrey Hughes is the director of the Field Naturalist Program.

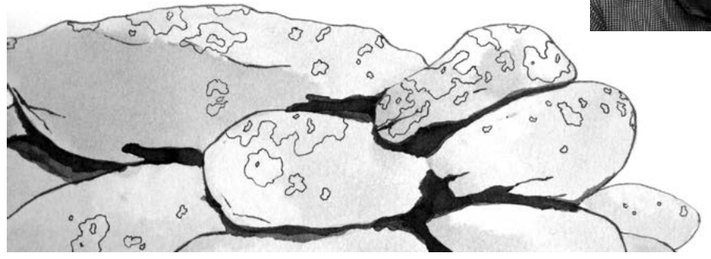


Image: *Stonewall* by Chelsea Clarke

DR. WALTER POLEMAN

Cultivating the capacity to integrate across field science disciplines has always been at the heart of the Field Naturalist experience. I was reminded of this as I listened to long-time director Jeffrey Hughes describe Hub Vogelmann's foundational vision for the program to a room filled with prospective Field Naturalists at the open house this past January. The increasing trend toward specialization in graduate education was of deep concern to Hub, who often found himself wondering: How will future generations of scientists see the big picture? Who will tackle the complex problems? These questions gave birth to the Field Naturalist Program 35 years ago. With the enticing invitation to seek solutions by practicing "integrated field science at the landscape level," future Field Naturalists from across North America came to the forests, wetlands, and waters of Vermont to learn their trade.

Back in the early nineties, I was one of those who heeded the call. I arrived at the University of Vermont with a vision of becoming a well-rounded generalist—like the naturalists of the 19th century—with license to dabble in geology, botany, ornithology, meteorology, and everything between. Yet I soon came to agree with Jeffrey that, at the heart of the matter, Field Naturalists are not generalists but specialists in integration. They are trained as scientists who see the connections between disciplines, as professionals with the capacity to reintegrate the whole. The Field Naturalist training hones the ability to weave together traditionally separate fields of study into a coherent and interconnected narrative.

With this unwavering commitment to integration and systems thinking, it is not surprising that the Ecological Planning Program emerged at the start of the 21st century as a complementary curriculum incorporating social science and the cultural dimensions of the landscape. Our first Ecological Planning director, Deane Wang, strove to expand our programmatic focus beyond the ecosystem level to the realm of social-ecological systems—places on the landscape where nature and culture intertwine and unfold through time. It was a wise move. Not only did the reframing allow us to blend important themes like ecosystem services valuation, place-based ecological design, and watershed planning into the training, it also helped our students get great jobs with organizations seeking to integrate sustainability science into their overall approach. On more than one occasion, a prospective employer has remarked to me over the phone during a reference check on a recent graduate, "We've been needing an ecological planner!"

As we grapple with today's pressing issues of human-induced climate change, water pollution, and environmental injustice, society's need for integrative thinkers has only intensified. Complex problems require integrated solutions, and the combined FNEP Program is poised to embrace this complexity by expanding beyond the sciences into the realms of law, policy, health, humanities, and education. This shift is aligned with the Ecological Society of America's recent call for the training of a new breed of translational ecologists: "professional ecologists who engage across social, professional, and disciplinary boundaries to partner with decision makers in order to achieve practical environmental solutions to primary challenges." By collaborating closely with partners at Vermont Law School, the University of Vermont's Leadership for Sustainability Master's Program, and the Vermont Agency of Natural Resources, we are well on our way to answering this call as the program moves into its exciting next phase. I think Hub would agree.

Walter Poleman is the director of the Ecological Planning Program.

A Serengeti at Every Scale

Image: *Mushrooms*, Linocut by Lauren Sopher

JASON MAZUROWSKI

There's a sugar maple in the Maine woods—old and gnarled and riddled with holes. There are millions of others like it, scattered across New England's rolling, rewilding landscape. Nearly split in two, its bark is peeling and its seasons are numbered.

I first encountered this particular tree with a couple of colleagues on a gray January afternoon. At a glance, not much could be said about this half-dead hardwood—I can't even recall what had initially drawn our attention to it—but over the course of a few days it would become a source of inspiration and curiosity. Before long, our hand lenses were out, and we had begun our exploration of a bizarre world.

A well-trained naturalist can find fascination in something as mundane as a sugar maple, but my formative experiences studying the natural world transpired halfway across the continent, in a place that is far from mundane—Yellowstone's Lamar Valley. One might assume that Lamar's sagebrush hills, dotted with herds of bison, have nothing in common with the rotten cambium of a sugar maple. That would be wrong.

There are countless valleys in the Rocky Mountain west, surrounded by snow-capped peaks, carved by meandering streams, but Lamar is a valley of legends. The Greater Yellowstone Ecosystem is celebrated amongst ecologists and wildlife biologists, and Lamar Valley—"North America's Serengeti"—is the crown jewel.

It captures the imagination of even the most sedentary tourists. They pry themselves from their RVs and SUVs, scramble up a hill and join a crowd of onlookers. Wolves howl, elk bugle, ravens croak and visitors wait their turn to peer into a spotting scope. A National Park Service volunteer narrates the scene, often unfolding over a mile away. At the end of the day, they clamber back into their vehicles and recount tales of their distant encounters over a bison burger and a beer.

The wolves of Lamar have a cult following. Some even have their own Facebook accounts. Dedicated amateur wolf watchers document the drama unfolding between rival packs and post it to blogs daily. When a wolf perishes, videos and slideshows are created *in memoriam*.

But without radio collars and blogs to tell us where to look, without spotting scopes or park employees, one can gaze out over the valley and see no sign of wolves or grizzlies. At a glance, Lamar is just another valley in the Rocky Mountains.

Once we know where to look, inspiration and exploration can be found almost anywhere: a road cut on I-90, a floating mat of sphagnum, a backyard compost pile. It is no longer necessary to buy a plane ticket to Bozeman and camp out in Yellowstone to witness the excitement of the natural world. Look no further than the bark of a sugar maple in Maine.

Through the perspective of a hand lens, a world vastly different than Lamar emerged on the surface of the maple. This world was subtle, hidden, but just as wild. There were no wolves or grizzlies, elk or bison, but still, I was compelled to stay and watch different fauna as they roamed this strange landscape. Within its cavities, signs of life were everywhere: networks of mycelium, tunnels carved by beetles, beechnuts cached by mice or jays. Beneath the bark, dormant spiders were reanimated with the warmth of my breath.

How many organisms has this tree given life to? How many squirrels have tapped into its sap? How many seeds has it produced? How many insects has it harbored? How many lives will it continue to support in death?

I returned to the tree the next morning, to see it at a different time of day. I returned again in the afternoon, as a pileated woodpecker went to work, littering the snow with fresh chips of wood. That evening I took a piece of bark, about four inches long and two inches wide, brought it back to the cabin and put it under a microscope. Looking deeper, examining more detail, I roamed the contours. The bark had its own topography and microclimates, a wilderness of lichens and moss. It felt as if I had set foot on an alien world, exploring towering forests of fungi.

It may be a misconception that we are distancing ourselves from the natural world, that the laws of nature only exist within pristine wildernesses somewhere across the great divide. Like the wolves of Lamar, seen through a spotting scope, this tree has its own stories to tell. With the aid of a microscope, we can witness life and death. We can observe battles between predator and prey, growth and decay all taking place on a sliver of bark, taken from a single maple. One of millions like it across New England.

But a dying maple in the Maine woods will never draw the same crowds as the wolves of Lamar Valley. Decaying cambium in a hardwood forest is not flashy enough to be the subject of a BBC series. No park service will be dedicated to preserving this tree, no group of followers to keep track of the drama playing out on its surface. No controversy, no legends—just decay.

This is our responsibility as naturalists: to tell the stories that will draw tourists out of their RVs to embrace the Serengeti of their own backyards. We strive to inspire a distractible society to appreciate nature at all scales—from the charismatic megafauna of the Lamar Valley to the equally important relationships playing out in eight square inches on the bark of a tree.

Jason Mazurowski is a current Field Naturalist in Cohort AI.

Image: Jason Mazurowski

Curated Content

MIKE BLOUIN

Image: *Wapati*, by Mike Blouin

The crowd outside the American Museum of Natural History is a protean river of well-bundled bodies, loosely organized in a line that stretches down the sidewalk and into the distance. I trudge past hundreds of people, most of whom appear cheerful despite the bone-chilling cold, and finally find its terminus. After a brief hesitation, I join the line, and soon it has swelled behind me. We shuffle slowly forward, up the stone steps, through the rotary doors, into a cavernous foyer. In here it is loud, like a large train station at rush hour. There's an unintelligible cacophony of conversations. The line has split into two or three or four, each meandering toward the ticket counters. After an hour, it's my turn, and I purchase a day pass. It feels like the airborne moment of a leap into icy water: irrevocable, and perhaps a poor idea.

I am midway through my four-day visit to New York City from Vermont. This trip to the museum is intended to be an unscientific examination of what natural history looks and feels like in a building that houses 33 million specimens. Unwittingly, I have chosen one of the busiest days of the year: New Year's Day. But even among the crowds, I encounter profound beauty and wonder—and thorny questions about wonder, consumption, and our collective relationship to the natural world.

My first destination is the Hall of North American Mammals. I expect to find the stuffed animals distasteful at minimum, and perhaps even grotesque, but instead I'm impressed. The hall is dim, almost cave-like, and each well-lit display features one or two animals, frozen within a strikingly realistic depiction of the tundra, meadow, or forest where they once lived. Inches away, on the other side of a glass panel, two wolves stalk their prey on a snowy moonless night. In another display, bison amble through a 19th century Wyoming prairie. Next to that one, 1,700-pound Alaskan bull moose battle for a mate. Some of these scenes are so beautiful, so startling, that they catch me off guard. I'm not the only one: children press their faces to the glass, adults chuckle and shake their heads in amazement.

At the same time, I feel like I'm at the mall. I am part of a shifting sea of people, filing past the exhibits dutifully, examining each for perhaps four or five seconds before moving on. Many of my fellow museum-goers snap photos with smartphones or large-lensed cameras. The mood seems to be a mix of curiosity and grim determination to see all that may be desirable to see.

In the Hall of North American Forests, there is a cross-section of a preposterously large tree trunk from a giant sequoia cut down in 1891, after 1,400 years of life. Small signs with arrows have been affixed to the cross-section to highlight years in which certain rings grew, along with historical events that occurred in these years. This behemoth was already 450 years old when the Vikings arrived in Greenland, more than a thousand years old when Galileo looked through a telescope. A sizable crowd has gathered, and I can feel a subtle but persistent nudging, more from body language than physical contact, as people try to carve out space for photos next to the tree.

I notice this phenomenon of posing with the artifacts in a few places throughout the day, most notably in the Hall of Pacific Peoples, where perhaps 50 people have lined up to take photographs with a cast of a *moai*—an enormous stone figure carved by denizens of Rapa Nui. There are 887 *moai* on the island of Rapa Nui, where they are considered sacred. This one, however, was featured in the film *A Night at the Museum*, which may explain its popularity. There is something off-putting about this surface-level interest, of brief poses and camera flashes in front of wood and stone that required so much time and effort to create.

This superficial curiosity is clearly not relegated to the museum; selfie sticks may now be more prevalent than walking sticks at Yosemite Falls and Old Faithful. We could, of course, blame technology. Many of us (myself included) have found the span and quality of our attention altered by technological and cultural shifts. Eighty-one percent of U.S. adults have smartphones;[1] in 2016, the average American devoted 10 hours and 39 minutes each day staring at a screen.[2] I suspect many have experiences like mine: the brief seduction of short bits of content, quickly followed by waning interest and scrolling or clicking to find the next hit. To me it seems likely that this behavior carries over to museum artifacts and real-world wonders; we gravitate toward what's interesting, snap a photo, perhaps share it on social media, quickly lose interest, and move on.

But there is also something more insidious and fundamental on display here: a relationship between humans and nature characterized by consumption. The creatures of the museum and I are not part of a scene together; I am an observer peeking through a glass partition at well-preserved, long-dead specimens, gobbling up impressive sights and information. Here it is harder to find the feeling of smallness that often comes outdoors, where I am humbled by the rain, the cold, the mid-summer sun beating down, the insects that feast upon me. But in the museum, the grizzly won't attack—rather, it is here for my entertainment and edification. The unspoken message is that the world is a fantastic place, but I can see it all, safely, as I stroll through carpeted rooms with optimal lighting. These exhibit halls are not the cause of this consumptive relationship, of course, but they are an excellent place to see the symptoms.

For me, the museum is a strange mix of beauty and wonder and spectacle and consumption. It is a place where wide-eyed kids hold hands with snapshot-obsessed parents, a place with the power to promote both conservation and hierarchical relationships. All of us here are driven by forces within and outside the museum, complex and insidious, that promote our species' peculiar and pernicious relationship to the natural world.

At the end of the day, I find that I'm exhausted by the onslaught of sights, sounds, and information. I descend three flights of stairs and exit through the rotary doors, into the cold, windy night, to the messy, banal, beautiful world beyond.

1.https://www.cnn.com/2016/06/30/health/americans-screen-time-nielsen/index.html

2. Ibid

Mike Blouin is a member of Field Naturalist Cohort AE and lecturer in the Rubenstein School of Natural Resources.

Image: Mike Blouin

Natural Curiosity

BERND HEINRICH

Image: *Common Raven*, Bernd Heinrich

A young raven recently out of the nest spends hours of the day approaching, touching, pecking, and manipulating literally everything in its path. For a month or two, it continues to be fed by its parents as it gets to know every thing in its environment: the knots on a twig, pine cones, a flower petal, a bright gold coin, a shiny beetle. The individual does not start out searching for anything in particular but is always comparing the unfamiliar with the familiar, attracted to everything it does not yet know by learning or programming. Not yet driven by hunger and the need to find food, nor by any utilitarian purpose, the young raven is driven by curiosity, an investment essential for its survival.

We, too, consider ourselves a curiosity-driven species, yet we may inadvertently squelch curiosity as though it were either a trivial pursuit or a distraction that leads us to harm and prevents us from getting down to the serious business of living. I propose that curiosity is instead a core to successful living—one that shapes all of our personal journeys, including my own.

The curious raven has the ability to support itself in a larger diversity of habitats than any other bird in the world. I suspect this is possible for this species because it is not strongly pre-programmed or adapted to the offerings of any one specific habitat or season. Instead, ravens program themselves with their curiosity, which rewards their exposure to whatever the local environment has to offer. Thus, they not only survive in a diversity of ecosystems and biomes but can also adjust seasonally within the same environment. Whatever the food, enemies, nesting places, or means of foraging may be, their curiosity will create options. Curiosity concerns the becoming of individuals in a variable and/or rapidly changing world, and one individual that I can apply this question to with empirical evidence is myself.

As a child, I began to feel the connection to other animals like myself by living in the forest. It happened to be by necessity—by being derailed from the common and almost universally accepted paths of most others of our time, by disasters of almost inconceivable and certainly unanticipated proportions. It may have started for me with a throwback to a hunter-gathering lifestyle, but it turned out to be my first exposure to scientific observation. Though my goal was to find mushrooms and berries, I couldn't stop myself from seeking out other experiences with nature—tracking ravens to the carcass of a boar, hunting for the hidden nest of a winter wren, pit-trapping for rodents and shrews and also finding there gorgeous carabid beetles, shaking caterpillars from trees, digging into wood ant mounds, and watching sand wasps bringing in their caterpillar prey. I was in a sense looking at—and for—everything, and that led to the discovery of the amazing and unimaginable and to ever-more elusive treasures of birds, small mammals, sphinx moths, and butterflies. My evolution into a biologist-naturalist was shaped by this environment, just as a raven in the desert becomes a lizard-hunting specialist or one in the Arctic follows polar bears to their kills.

As with crows and ravens who take an instant interest in whatever a companion examines, I learned also from associates and from mentors what was valuable and therefore merited my time. A nondescript yellow and black wasp I found at age five sent my father into a frenzy of delight. Without valuation and the possibility of possessing it and other such things, they would not have been worth pursuing. They would have become merely part of the background—something that the young raven may give a peck or two to before moving on.

My evolution into a biologist-naturalist was shaped by this environment, just as a raven in the desert becomes a lizard-hunting specialist or one in the Arctic follows polar bears to their kills.

As highly social animals, we derive value not only from what we see and what we can have but from the example of what we see others value. Like bees' learning to visit the productive flowers via the scent clinging to other bees' bodies, we learn to chase the signs of success that cling to humans we admire. However, as we go after the same signs, we sometimes forget that the successful bees' choice had been individual and personal, and that the more we go for the flowers they've already discovered, the less reward may be available from those specific ones in the long run. There is thus a paradox which arises from the social validation: reported discoveries may channel our behaviors and narrow the window of further discovery too soon. Diversity matters in the long run. For a biologist, the ultimate reward of curiosity, both personally and socially, is the discovery of something new, which is always in the unknown future. You cannot look for what is not known.

Being socially directed where to look, we can encourage curiosity in various directions, and promote discovery. By the same social mechanisms, we can socially devalue curiosity as well. In 1867, the admired Harvard biologist Louis Agassiz wrote, "The time for great discoveries is passed—the work of the naturalist, in our day, is to explore worlds the existence of which is already known: to investigate, not to discover." He further speculated that the discovery of new species is "the lowest kind of scientific work." This haughty vertical stratification has continued to channelize science, exemplified by Sir Ernest Rutherford's famous quote: "Physics is the only real science. The rest is stamp collecting."

And if you believe it, it's true; when you tell yourself an environment is totally explored or already known, curiosity becomes a pointless distraction. The adult crow or raven that is perfectly at home in its environment and has become educated there ceases to peck at odd objects, because there is little need or expectation of finding a new, delicious bug or berry. Those fully satisfied, especially by the ersatz of the screen designed for instant gratification, will seldom be motivated to spend hours or days looking around in the real world, prospecting for meager but invaluable specks of gold.

A late bloomer, I grew up blissfully unmoved by the notion that the time for discoveries in natural history was passed. For a long time, I had no idea that collecting beetles was considered stamp collecting by some, but I did know early on from respected mentors that natural history and science are of the highest importance to understanding life on Earth. They engendered the ideals I still strive for today. That social validation was important enough for me to make any discovery a joy, not to be judged or measured. Furthermore, no matter where one wants to go, one clearly cannot get there without taking the first necessarily small steps, hopefully and joyously. Following my curiosity in the forest was one of mine, as it has been for many. Maybe it was like the young raven's way, picking at any of the many unknown and unknowable possibilities that arise from the wonderful and endless variations of the natural world. As the young raven's play is activated by curiosity in the field of nature, I made discoveries beyond my wildest imagination, also following the simple and accepted rules as of any game. Maybe it was only play, maybe just luck. I say they necessarily go together.

Bernd Heinrich is a scientist, writer, and professor emeritus at UVM.

Monarchs, Migrations, and Miracles

ALICIA DANIEL

I first crossed paths with monarchs in Colorado the summer I turned five. My older brother and I found a dead monarch in the backyard. Its black and orange wings had dried straight out from its body, as if frozen in flight. We decided to heal it, which involved gently anointing the furry black body with water. We were called in to lunch. When we came back outside, the butterfly was gone. I looked up in time to see a monarch fly over the garden wall. I ran inside to tell my grandmother, who called the story "hogwash." As a devout Christian, she of all people should have embraced this resurrection. I didn't argue with her, but I knew a miracle when I saw one.

In Vermont, I have spent many happy hours hunting caterpillars in knee-deep milkweed in nearby meadows, which are sadly disappearing. The height of the plant and the buttery softness of the leaves tell me the milkweed is once mowed, creating the perfect feeding ground for monarch caterpillars. As I weave through a field, my corgi, Zeus, leading the way, my eyes scan the milkweed. I look for telltale signs: a pattern of bites taken out in small arcs about the size of a fingernail, and bundles of digested leaves the size and shape of miniature rabbit poop. But the meadows aren't the only thing getting harder to find: so are the caterpillars.

I was born in Texas and journeyed north to Vermont in stages. Alone in the car, I still sometimes listen to country and western music. When it comes to monarchs, I really understand the line from country band Old Dominion's song, "You gotta love like there is no such thing as a broken heart."

There is heartbreak in my love affair with monarchs. One graph distributed by the Center for Biological Diversity shows that monarch populations have fallen more than 80 percent in the past two decades. The data are collected by measuring the total cover in their wintering grounds, where they congregate in the tops of oyamel firs in numbers that turn whole trees orange. The oyamel firs are themselves one of the rarest forest types in Mexico, growing only at higher, cooler elevations. A perfect storm of factors—including global warming, pesticides, logging in their Mexican wintering grounds, and houses sprawling into their meadows, here in Vermont, and everywhere else—are contributing to a war on milkweed and monarchs.

Image: Emma McCobb

Image: *Monarch Montage* by BryanPfeiffer

Some people are fighting back by planting milkweed, protecting wintering grounds, trying to limit or reverse global warming, and confronting the stubborn nature of human sprawl. For us to wake up in time to avert a monarch tragedy will take…well, a miracle.

When someone first gave me a chrysalis nestled on a pad of cotton and wrapped in a box decades ago, I thought the chrysalis was a piece of jewelry—a jade pendant glistening with gold flecks. But it was not an exquisite, man-made object. Inside the living chrysalis, the caterpillar, releasing enzymes to dissolve its tissues, had digested itself. In the protein-rich soup, rapid cell division was driving the formation of wings, antennae, legs, eyes, and all the other features of an adult butterfly. The adult would soon rise from cells poetically named imaginal discs.

For 25 years, I have reared monarchs from chubby black and yellow caterpillars with soft green bellies, to chrysalises, to butterflies. I binge-watch the terrarium, hoping to catch a caterpillar shedding its skin, becoming, for a moment, wriggling goo. Later, I will take the darkening chrysalis with me, tied to a goldenrod stem, so that I can see the butterfly somersault out of the clear confining membrane and unfold its tiny origami wings, and pump fluid out from its fat abdomen. When the wings dry, I watch the monarch waft away.

Perhaps we will find the transformative powers within us to save not only monarchs, but also other life around us—to find ways to let other beings continue their own dance of development, regeneration, and rebirth. Even though I am not five anymore, I still believe in miracles. And I believe in giving miracles a hand.

This article is dedicated to Porky Reade for her legendary love of monarch butterflies.

Alicia Daniel is a member of Field Naturalist Cohort E and the city naturalist for the City of Burlington.

Redefining Success

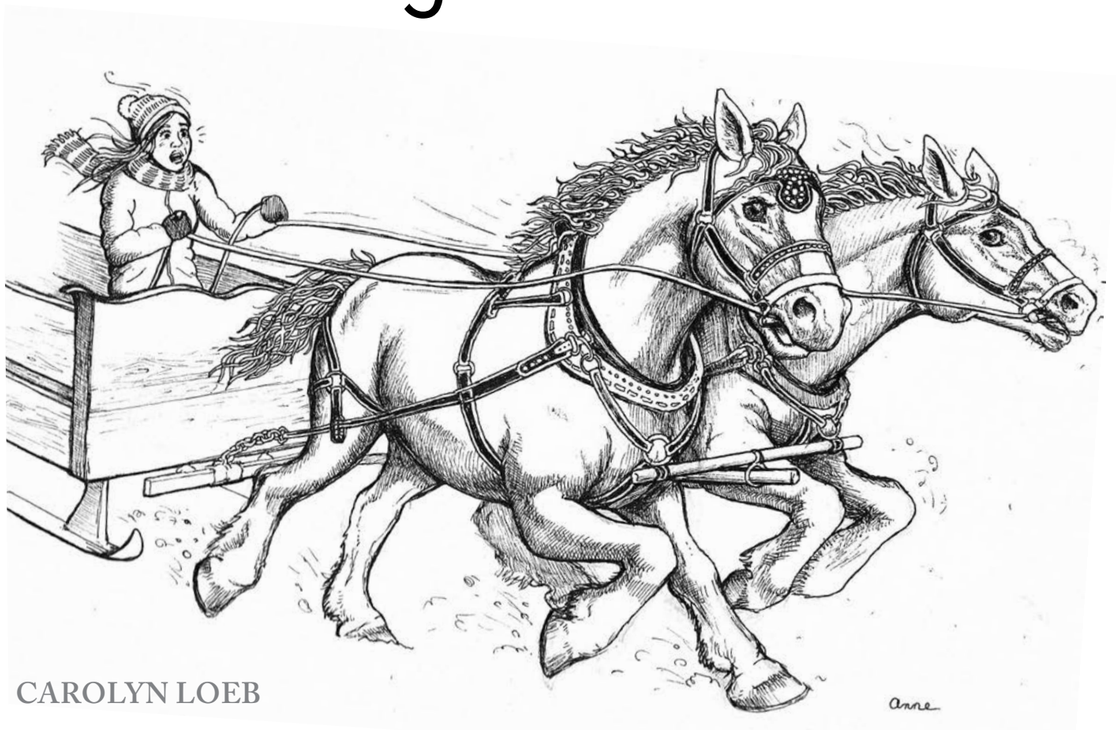


Image: *Reining It In*, Pen and Ink by Rebecca Loeb

CAROLYN LOEB

Years of driving did not prepare me to work the draft horses. It was January in southern Vermont, and I had signed on as a farm apprentice for the year. That meant learning how to handle Ellie and Daisy, our 2,000-pound draft team. My boss and I pulled the old wooden sleigh free of the barn, hitched the horses to it, and climbed in. Then, without warning, Tim passed me the lines and yelled "step up!" Ellie and Daisy shot forward. To say that I was driving them would be generous. We zigzagged wildly across the snowy fields, and I hung on for dear life. When we stopped, Tim was grinning. "Not bad," he said.

In March, the water pipes on the farm began to leak. Tim handed me a wrench and hose clamps and told me to go find the leaks and fix them. "Don't come looking for me, even if you don't know what to do," he warned. I located the broken pipes and stood there staring at them for what seemed like hours, unsure of where to begin. When I went to ask for help, I knew I had failed.

Failure became a ritual that year. At first, it was a struggle to concede defeat. After a while, though, it was just another part of life. I battled escaped animals, runaway tractors, smoking chainsaws, malfunctioning electric fencing, and trees that fell in the wrong direction. By December, I felt so good about failure that I embraced the fact that I spent an hour and a half trying to attach a bucket loader to a tractor. When I finally appealed to Tim for assistance, he took one look and said, "Jesus, you spent an hour and a half on this?" I grinned.

Life on the farm revolutionized my definition of success. I eventually realized that my most creative ideas emerged from moments of despair. After struggle, achievement became even more meaningful. My setbacks initially demoralized me because my formal education had never encouraged me to acknowledge defeat. In the end, though, my new relationship with failure made me resilient, resourceful, and more likely to succeed.

Across the nation, there are good teachers who cover content, offer support, and prepare their students for the SAT and college. However, few traditional schools train students to cope with uncertainty and failure—issues we grapple with in our lives, especially in a world facing climate change and accelerated species extinction. If we want to prepare students for the future, we need to let them experiment with defeat out-of-doors and in interactive classrooms early on so they learn to overcome it. Failure is a predecessor to sought-after qualities like humility, creativity, flexibility, perseverance, problem-solving, and critical thinking. Let's use it to our advantage.

* * *

At a time that most of my peers were leaving school for good, I was eagerly filling out applications to re-enter the world of education. My first job was as an international English teacher, and later I worked with preschool and college students. Mainly, though, I found inspiration as an environmental educator for elementary, middle, and high school groups in the woods of eastern Massachusetts, the White Mountains of New Hampshire, and in Yosemite National Park.

Teaching kids to confront failure in any setting is difficult. In Yosemite, I'd routinely present my groups with novel team challenges. One morning, I was met with stunned silence when I told my straight-A eighth graders that their challenge that day would be to verbally direct their teammates to navigate a difficult obstacle course—blindfolded. "What if we fail?" one student finally asked. "Will we get a bad grade?"

I did not penalize my students for being wrong. I found that once the stress of being graded was removed, they relaxed and shared their ideas more openly. I encouraged my groups to test out new strategies, even if they tanked—and then to try again.

Overcoming failure takes time. I once had a group of rowdy fifth graders on my outdoor program who spent 30 minutes each day working on the helium stick challenge. The task was seemingly simple: to lower a long stick from chest height to the ground, balanced atop the team's pointer fingers, without any fingers ceasing to touch the stick at any time. Some of the kids melted down over this. Eventually, though, they learned to talk things over, and finally synchronized their group breathing to successfully bring the stick to the ground. Such challenges may feel contrived, but they are also a first step in training for novel, real-world problem solving.

Many of the classroom teachers who chaperoned my programs embraced this form of learning. However, the reality is that students are under immense pressure to bring home high marks, just as teachers are pressed to help kids perform well on standardized tests and teach to grade-specific learning standards. There is not enough time to help students work past failure in school. So perhaps we should change our grading paradigm. One possibility would be to allow students to resubmit work until they understand the material. Another would be to replace grades with teacher comments alongside a pass/fail mark. And we need to continue to challenge the place of standardized tests—at least in their current form—in education.

We also need to make space for interactive exploration and novel challenge in school. Given our primate origins, desk work makes little evolutionary sense. We are primed to learn by tinkering, exploring, observing, and taking calculated risks. So let's redesign our classrooms to support such objectives. Whether we take kids outside to engage with the world, redesign lessons to be interactive and interdisciplinary, or reinvigorate traditional apprenticeships as a part of school is up to us. What is clear is that our current national model is at odds with our biology.

Finally, we need to broaden our educational emphasis on social and emotional learning, creativity, and personal growth. Students should be able to engage in group problem solving, take on leadership roles, and self-reflect as a routine part of school. Discussions on empathy and inclusion should be as normal as those around algebra and Shakespeare. We must also adequately fund subjects like art, music, and physical education, which support these qualitative aims.

At some level, these kinds of changes will require an overhaul of the traditional education system. It will not be easy, but the rewards could be substantial. To reinvent public schooling, though, teachers need support from parents, school administrations, and from the state and federal agencies that oversee them. They cannot do it alone.

No method is perfect. Many environmental education programs grapple with how to best deliver high-impact, long-lasting transference to students' home lives. Such programs also suffer from the fact that participants may associate their experiences only with conserved lands. Traditional schools are well-grounded in students' surroundings and lives, but they need to do more to encourage the real exploration, creative, and critical thinking that good environmental education programs cultivate. Combining the best of both could herald the birth of a new educational model for the nation.

Now more than ever, our education system is tasked with preparing students to meet the unknowable, and to mine it for opportunity. Global challenges must be met by bold new solutions. If we want to create intelligent, resilient individuals who can meet such challenges head-on, we need to educate people to embrace failure as a part of the process, and not to give up when they meet it. To an outsider, such a model might look something like a wild January sleigh ride, in which we hand students the reins of their education and coach them to hang on as they learn how to steer with confidence towards the future.

Carolyn Loeb is a current Field Naturalist student in Cohort AI.

Image: *Carex backii* by Brett Engstrom

Lessons from *Carex backii*

BRETT ENGSTROM

Breeding plumage male Blackburnian warbler at 40 meters? Piece of cake. Blossoming pink ladyslipper at 10 meters? Surely. Vegetative Back's sedge among a dozen other upland sedges in late autumn? As my old ornithology professor would say of a questionable identification by a novice birder: "I.I.T." (Interesting, If True.)

How we come to know a species is obvious in most cases, including the circumstances of our first encounter and important characters for keying out or identifying it through field guides. As to why we come to know a species, I present the story of how I came to know *Carex backii*, an upland sedge ranked uncommon to rare in New England and New York. Through this intimate relationship with a single obscure sedge species, I find a greater understanding and appreciation for all species.

Several years into my career as a field naturalist I began to get a handle on our many native grasses and sedges, including the large sedge genus *Carex*. But *Carex backii* eluded me. I thought this upland sedge would be easy to spot, since various references all note it as unique among our *Carex* in having large scales (bracts) that completely hide the fruit (perigynia). To my great fortune, I landed my first contract as a field naturalist in 1990 doing a natural areas inventory of Chittenden County, Vermont, with Liz Thompson and Marc Lapin for the Vermont Natural Heritage Program. For a budding naturalist, it was like being a kid in a candy store: lakeshores, bogs, clayplain, sandplain, limy hills, quartzite pavement, delta floodplain forests, and big mountains. Chittenden County has it all, including a plethora of sedges of all stripes and habitats. But *Carex backii* was eluding me.

Given that *backii* was known from a few historical collections and a couple of recent sites in the county, I thought I had a good shot at finding it. A 1982 record for the sedge, then considered rare, from a dolostone cobble in Milton piqued my interest. Searching that rocky cobble in September, I came up short. Oblivious to its phenology at the time, I quite rightfully missed *backii* because the fruiting stems are all withered at that late time in the growing season, and I did not know its vegetative characters.

Years later in early June, 1995, I finally found *backii* in a rich, rocky red oak-northern hardwood forest on Mount Prospect in Lancaster, New Hampshire. While walking off the mountain, dog-tired at the end of a long day in the field, I spotted a single fruiting plant growing in thin soil over a calcium-rich diorite rock outcrop along the summit road. "So this is *backii*!" I said out loud to myself. Although distinctive with its large bracts hiding the perigynia, the fruiting stems (culms) were so short that they were hidden by the leaves!

***Backii* Lesson 1:** The culms are distinctive in the early growing season, but often hidden.

Much to my delight, I had not only finally met *backii*, but I had simultaneously rediscovered the species first documented from Mount Prospect some 50 years prior.

While wetland inventories constituted the bulk of my contract work in the 1990s, it was only in 2001 when I started doing inventories that included uplands that I began to find *backii* on a regular basis. Once I learned its unique characters, even in vegetative condition I could pick out *backii* among the other similar small green-bladed clumps of upland sedges.

***Backii* Lesson 2:** Leaves are thicker than other upland sedges and, perhaps uniquely, it lacks pleated leaves, which results in a low-relief "M" cross-sectional shape.

And the clincher:

***Backii* Lesson 3:** After the perigynia have dropped and the culms withered, identity can be confirmed by looking carefully for the short dried culms with flattened and broadened distal ends.

My field work throughout Vermont over the last 16 years has produced a long list of new sites for *Carex backii,* a species once considered rare but now listed by the Heritage Program as uncommon. It is now documented from at least 108 sites in 69 towns spread among all of Vermont's 14 counties. I have seen it in 88 sites scattered in all Vermont counties, including six sites which I believe are new records for Bennington, Essex, Lamoille, Orange, Orleans, and Washington counties. The limy hills of the southern Champlain Valley (Rutland, Addison and Chittenden counties) and Windsor County contain the great majority of the sites, while the northern and southern tier counties have fewer sites.

Like a moth drawn to a porch light, the dry, rocky fertile hills of Vermont—*backii* country—have a magnetic pull on me. It is the sweet spot on a steep, mid to upper, southerly-facing slope, rocky with stone outcrops containing at least a trace of lime, dry and sunny enough for red oak but fertile and moist enough to support sugar maple, hop hornbeam, white ash, and basswood. As I scramble up the slope through the rich, ferny sugar maple toe, and up into where trees get a bit stunted and the canopy more broken, the diversity of herbs, grasses, and sedges expands to include blue-stem and sharp-leaved goldenrods (*Solidago caesia* and *S. arguta*), heart-leaved and white wood asters (*Symphyotrichum cordifolium* and *Eurybia divaricata*), blunt-lobed hepatica (*Anemone americana*), early saxifrage (*Micranthes virginiensis*), false melic (*Schizachne purpurascens*), mountain rice (*Oryzopsis asperifolia* and *Piptatherum racemosum*), as well as *Carex laxiflora*, *C. communis*, *C. pedunculata*, and *C. platyphylla*. And always, marginal woodfern (*Dryopteris marginalis*). It is here among Mother Nature's rocky gardens that I find *Carex backii.* And if I continue up onto the convex, acidic, and even drier summit woods, replete with lowbush blueberry, huckleberry, and bracken, I have gone too far.

***Backii* Lesson 4:** Association with red oak is particularly tight, even in northern sites where red oak is uncommon and local.

For example, the only two sites where I found backii in Essex County are the only two sites known for native red oak in Essex County.

I came to know where to find *backii* to the point where I would walk into a site and say to myself, "Feels like *backii* country"—and often find it within a few paces. The more I found it, the more I knew it. The more I knew it, the more questions I had about its life: like how it moves around the landscape, why only a handful of plants are found at a given site, and whether it has a relationship with fire. *Backii's* conjectured relationship with fire arises due to its fire-prone habitat, strong affinity with red oak, and work at Mont St. Hilaire in Quebec by McGill botanists who found strong correlations between *backii* and elevated phosphorus in the soil—often an indicator of fire.

But why have I come to know this obscure sedge so intimately? Perhaps it is equivalent to desiring to know the shyest person in a room full of people, he or she likely leading as remarkable a life as the brash and bold. It is the recognition of the life of a particular species, not just another generic sedge. It is knowing a species among its kindred species and natural community of plants, animals, soil, rock, and water, as well as in a landscape, both regional and continental. It is knowing that the life of this one fascinating and beautiful sedge is just one of hundreds of thousands of other intriguing and beautiful species of plants, animals, fungi, cyanobacteria, and other life forms. In the appreciation of the obscure we are awarded with an appreciation for the grand sweep of life. It is biophilia.

Brett Engstrom, a member of Field Naturalist Cohort C, is a freelance field naturalist who lives beneath Drew Mountain in Marshfield, Vermont.

Solomon Nkumba Kills Giraffes

MARIA DUNLAVEY

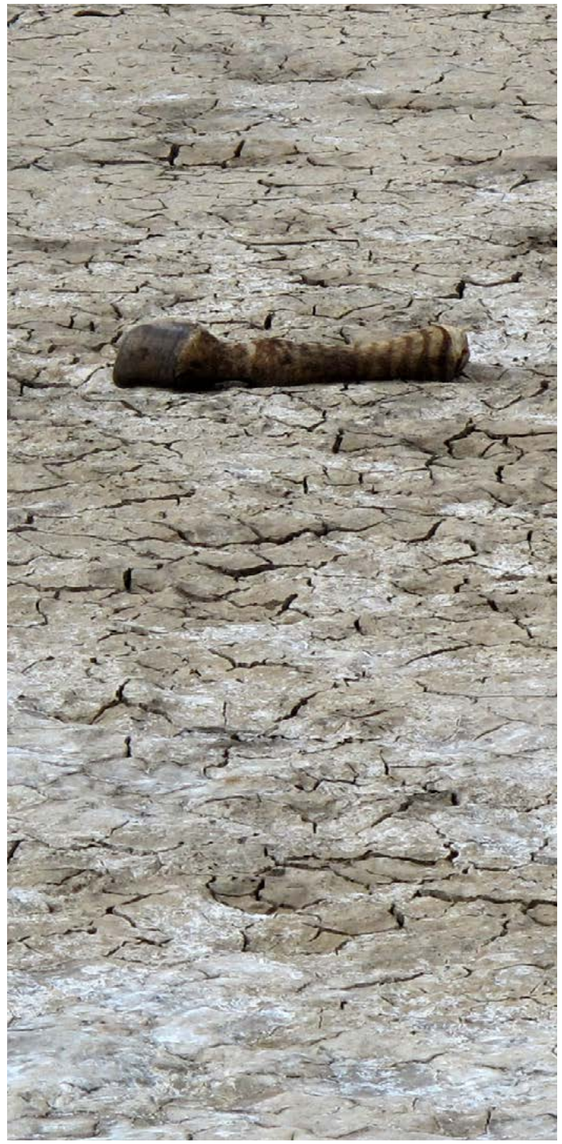


Image: Jenny McCarty

He calls them *twiga*, their Swahili name, and tells me they're good meat. His customers prefer them to impala, zebra, and wildebeest. They're harder to take down, though, with Solomon's tools: a couple of friends, a machete, and the brightest flashlight he can buy. It's death by deer-in-the-headlights: blind an animal and butcher it standing. Some go down easily. With *twiga*, you need to take out the legs first.

Solomon is shorter than I am, and no older than twenty. He's muscular, though, and highlights his physique with a skintight t-shirt of the sort Tanzanian shops source, through some arcane transhemispheric process, from American donation bins. It reads, in pink bubble letters, *Senior Women 2002*. I find him and his friends playing cards in a dusty yard under an acacia tree in Kigongoni, one of the villages that fringe the northern edge of Lake Manyara National Park. When I ask him what he does for work, he counters, "Do you think we'd be gambling at ten in the morning if we had jobs?"

Solomon is a bushmeat poacher. He hunts his game inside the park, and while he shares little with the rifle-armed gangs of professionals who terrorize the continent's populations of elephants and rhinoceri, his livelihood is just as illegal. He sells his product to locals here, and sometimes as far afield as Arusha, two hours down the highway. It comes packaged in five-gallon buckets, hidden under opaque white lids. It's cheaper than domestic meat.

Two years ago, Solomon says, when the government was paving the road to Arusha, no one hunted bushmeat. Day jobs with reliable wages were far preferable to potentially life-threatening nighttime excursions onto forbidden land. Now, he sees little else to do. He's angry. He tells us he sometimes kills more than he can carry and leaves the excess carcasses for park rangers to find. It's a message, born of impotent fury, to all those who profit from Tanzania's booming wildlife tourism-based economy and leave Solomon and others like him behind.

Solomon's story is as old as conservation. From the Adirondacks to Lake Manyara, the history of many a preserved area comes with its seedy underbelly of poachers, squatters, and thieves. Most national parks, at some point, displaced whatever human populations came before—whether the Blackfeet from Yellowstone or the Maasai from the Serengeti. Many of those groups fought back and ignored new restrictions, taking into their own hands what they saw as inalienable rights to water, grazing, or game.

Increasingly, environmentalists—many of whom are also socially liberal—view these "criminals" as sympathetic figures. Legal restrictions are changing to allow for traditional ways of life. From Inuit whaling to Cherokee herb-gathering to Maasai pastoralism, these multiple uses of protected land are gaining official, and legal, recognition. Hunting may not be allowed in Lake Manyara National Park, but the Hadzabe, a traditional hunter-gatherer society in the neighboring Eyasi basin, now have the hard-won right to hunt their own lands. For a Tanzanian government with a history of forcing traditionally nomadic peoples into modern, sedentary lifestyles, this is progress.

What, though, of Solomon? He is no Hadzabe, and any claim he has to hunt here bears no signifiers of tradition, ancestry, or even good conservation sense. He doesn't hunt for subsistence, and he kills more than he needs. He is just a person, carving out a livelihood — perhaps a morally indefensible one—in a sparse and indifferent world. Scholars of environmental history would recognize him. From the American settlers in Cronon's *Changes in the Land* to the modern societies in Hardin's "The Tragedy of the Commons," the self-interested capitalist is a familiar figure in the mythology of environmental crisis.

But there are reasons to resist that narrative. The capitalist villain is still a person, his actions informed by a lifetime of experiences: class division, opportunity and its absence, the moments that make him feel heroic or small. To forget that complexity is to lose sight of an elemental truth. Conservation issues are inherently social issues: what needs conserving, from what, and for whom?

The characters in this story aren't always likeable. They aren't the media-tested, perfectly sympathetic heroes and heroines of a political stump speech. But any hard look at the future of Africa's natural landscape requires equal attention to its human one. Population growth, climate change, and resource availability are all central issues to Tanzania's people and its wildlife alike. Poachers share a stage with corrupt government officials, zealous Western do-gooders, hard-working farmers, and the Catholic Church. Like Solomon, none of them live up entirely to caricature. Nor do they wholly defy it.

The question, then, is not what to think of Solomon or of the myriad bad actors like him. It's whether environmentalists can embrace the messy reality that their cause is a humanist one. The world's great conservation problems cannot be solved in a vacuum. To get it right, you need to know the people who share in them, take them as they are, and care about their cares. Solomon's life isn't made up of dilemmas to be puzzled over or policies to be enacted—it's just a reality in which he has no choice but to survive.

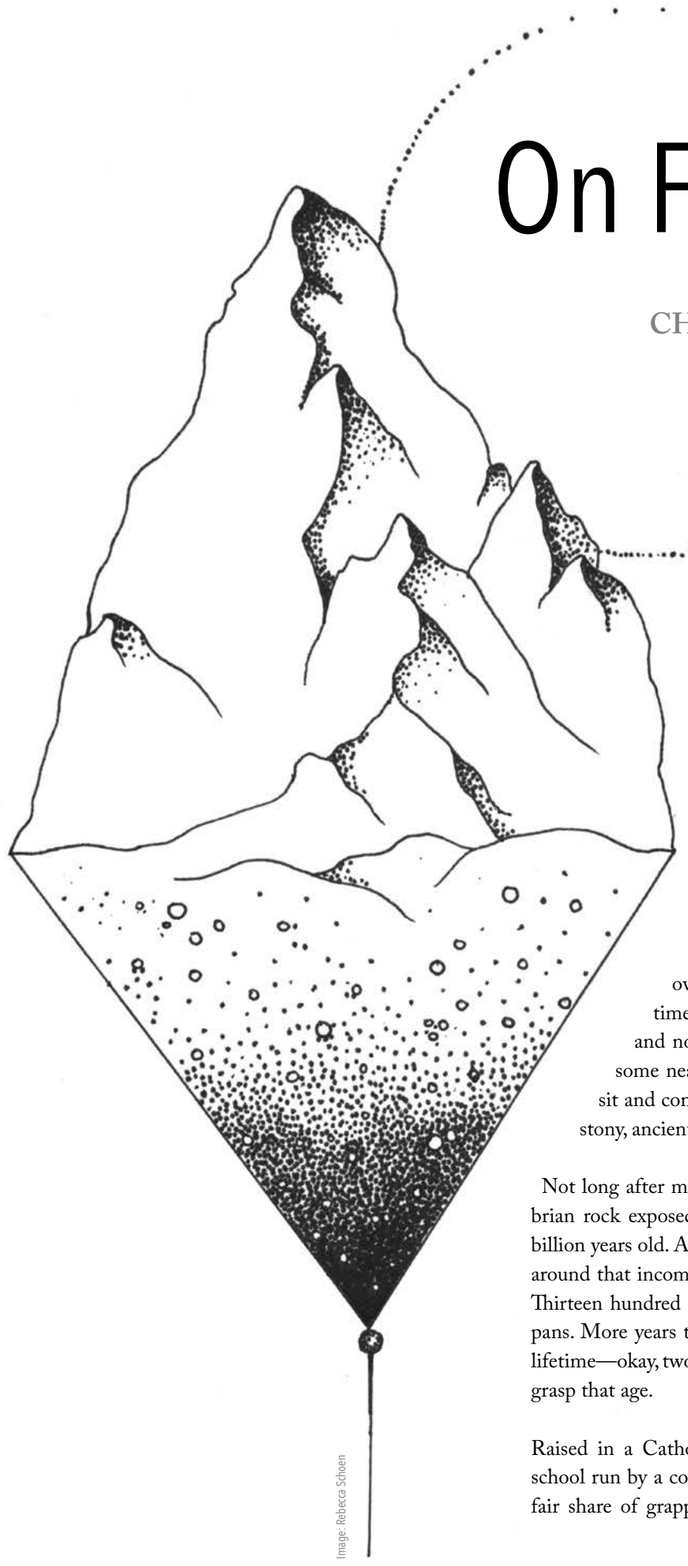
The capitalist villain is still a person, his actions informed by a lifetime of experiences: class division, opportunity and its absence, the moments that make him feel heroic or small.

That survival may not be compatible with that of his country's stunning diversity of wildlife. Solomon knows it. His mind is as attuned as any park ranger's to the biology and population dynamics of the game he hunts. He may not be making the decisions about who can use his country's natural resources, for what, and why, but he's part of them all the same.

I ask him what effects he thinks poaching has on the park's animals. I'm curious whether he'll laugh at me, or express some form of regret. Instead, he pauses, looking as serious as I've seen him, and thinks.

"*Nyumbu*—wildebeest—they are always having babies. There will always be *nyumbu*," he says. "*Twiga*, I think we will finish him."

Maria Dunlavey is a current Field Naturalist in Cohort AH.



On Fathoming

CHRISTIAN SCHORN

Image: Rebecca Schoen

On summer evenings, a small crowd often gathers at Perkins Pier, two blocks from my apartment here in Burlington, to watch the sun set over Lake Champlain. Evening is also a great time to go for a run—if you can focus on the path and not on the magic show across the water. After some near misses with other joggers, I opt instead to sit and contemplate the mountains across the lake—the stony, ancient Adirondacks.

Not long after moving here, I was informed that the Precambrian rock exposed in these mountains has been dated to 1.3 billion years old. As I sit and take in the view, my thoughts eddy around that incomprehensible number. One point three billion. Thirteen hundred millions. About sixteen million human lifespans. More years than breaths an average person will take in a lifetime—okay, two lifetimes. No matter how I translate it, I can't grasp that age.

Raised in a Catholic family, and having attended a Catholic school run by a community of Benedictine monks, I've had my fair share of grappling with the unfathomable. Some selected doozies: God is all-knowing and unknowable. Original sin is inescapable yet something we should strive to escape anyway. Don't get me started on the Consubstantiation of the Eucharist or the number of angels that can fit on the head of a pin. Many of my notes from my religion classes were littered with the addendum "(?)". In the years since, I've become neither a practicing Catholic nor a monk. But sitting by the lake, looking out toward the mountains, I can't help but continue to apply the frameworks and contexts of the faith of my youth.

If you're a theologian or a geologist, you're likely already convinced of the puniness of man. The lessons of geology tell us that if time were measured along a human wingspan, one stroke of a fingernail file could erase our recorded history. Even the time since the formation of the Adirondacks' Precambrian roots represents a measly quarter of Earth's history. And on dark nights, if we look to the heavens, we are confronted with a quiet, vertiginous truth: there are billions of stars like our sun and probably millions of planets like Earth. Yet I've felt this same puniness in the hush of a cathedral—in awe not of its architecture, but of what it purported to harbor.

My studies of nature haven't yielded lessons much different than those of Genesis, and there is a paradox I find at the foundation of both perspectives. In high school, I was taught that we are insignificant before God, but made in His image and given dominion across the beasts of the earth and the birds of the sky. Today, I feel insignificant before this billion-year-old rock, but I and all the happy couples and ice cream-cradling tourists enjoying the sunset have managed, in a blink of geological time, to wrench the Earth's climate out of an ice age and acidify its oceans.

How do we reconcile that? We bear the original sin of being born privileged Americans, with a carbon footprint twice the global average. There is a cognitive disconnect here that rational knowledge cannot bridge, as we confront questions far more fundamental than how to address climate change. Where do we belong in the world? Are we rulers or plunderers? Artists or animals? Do we reject the worldly, or integrate ourselves into it? Our intrinsic search for moral clarity and wisdom on these matters indicates some higher consciousness on our part, sure, but also an anxiety about our place in the universe.

Trained as a scientist, I look for evidence and explanations to bring me to defensible conclusions. But no conclusion will help me comprehend or accept the collapse of ecosystems, the finality of extinction, or the eventuality of death. Rational thinking doesn't inspire grief, and more importantly, it cannot justify its prerequisite: love. I can't grasp these things—the extremes of the heart—any more than I can grasp what it means to be 1.3 billion years old. How do you live with what you can't understand? How do you fathom the unfathomable? Catholicism didn't work for me, but I am realizing that it's rational scientific counterpart doesn't hold the full answer either.

Rational thinking doesn't inspire grief, and more importantly, it cannot justify its prerequisite: love.

I think it's up to everyone to invest in a theology of their own, even if they don't call it that. It's always been human nature to build frameworks to explain our place in all this—who we are, where we came from, who's in charge, and what we ought to do with our time on Earth. But these are bottomless, dimensionless, omnipotent questions, and I don't think they can be answered with objective truths.

I think that's what keeps bringing me to this bench beside the lake—the pew in the cathedral I've been missing. I need this time to contemplate the mystery, the paradox, even the "(?)" in the notebooks of life. And I believe there are lessons to be learned by watching the sun set over ancient rocks with strangers, though I could not say what they are.

We may never agree on our place in the universe, but I think the striving to understand is more important than the discovery of an answer. It's no different than building a relationship with an unknowable God or seeking redemption for the sins we are born with. We redeem ourselves by trying anyway. In our learning to abide the unfathomable, whatever personal truths we find are stronger than rational understanding—self-informed and self-evident, perennial and perpetual. Our connections to the things we can't fathom often end up being stronger than the ones to the things we can. If the end result of education is tolerance, as Helen Keller stipulated, the end result of theology must be love.

So I sit by the lake, and I squint at the Adirondacks. The alpenglow of the High Peaks is luminous enough to seem like a fog that fills the Sentinel Range. Through it, I can see more peaks beyond, or maybe just the shadow of antediluvian mountains, and mountains beyond that, mountains beyond fathoming, and some holy mystery of time and the world.

Christian Schorn is a current Field Naturalist in Cohort AI.

The Fire at Torrey Hall

DR. DAVE BARRINGTON

Just after eight o'clock on the morning of August 3, 2017, the interior roof of Torrey Hall—the building that houses the University of Vermont's Natural History Museum—caught fire.

In the days and months since, the details of the event have taken shape, coalescing out of the initial haze of shock. The fire was apparently related to braising work on the new roof being installed on the building. It took hold between the interior and exterior walls. No one was hurt. Within the hour, thanks to the remarkable efforts of Burlington firefighters, it was completely under control.

At the time, though, anyone on the scene was witness only to the thirty-foot flames that engulfed the entire top of the building. A plume of black smoke rose over Burlington, making it clear to the entire university that a major blaze was in progress. The firefighters who entered the building's uppermost floor to battle the flames displayed unfathomable courage and skill. Inside, the fate of the Cyrus Pringle Herbarium—a 300,000-specimen collection of botanical specimens from six continents, encompassing over two centuries of scientific labor—remained unknown.

I was among the first group to enter Torrey Hall once the flames were out. As curator of the Pringle Herbarium, I had worked in the building for over 40 years; suddenly, it looked unfamiliar. The flames had spared the collections, but the deluge that put them out had left standing water on every level. The electrical system and floor coverings were completely compromised, as was all of the plaster in the building—including a fine set of student murals painted over the last 40 years.

Sifting through the mess, though, we discovered how lucky we'd been. The collections in metal cabinets were entirely undamaged by water. The animal specimens comprising the Zadock Thompson Zoological Collections were unharmed, as was the herbarium library and virtually all of our accessioned collections of plants.

That left the unsheltered material—new acquisitions and anything else left sitting out, the subject of active work. Here, the impact of the massive influx of water was random, even capricious. In some places, plants out in the open, simply held in folders, were dry. In others, hundreds of specimens were soaked.

When Torrey Hall was opened in the summer of 1863, the very future of the university was in doubt. It was the turning point of the Civil War—the Confederate army was on its way north to Gettysburg—and so many young men had answered the call to service that there were few students left to teach. Reverend Joseph Torrey, ninth president of the university and a botanist himself, dedicated the building. The Burlington Free Press, in its account of the opening, reported: "It is felt that the building erected is a safe and solid structure. It affords room not only for the library and [collections] already belonging to the University, but for those additions which it is confidently hoped will be made in the future as they have been in the past, by individual donations."

Image: Water-damaged *Cyathea cf. armata*, Cathy Paris

Image: Cathy Paris

And for over 150 years, our Natural History Museum has grown—as a result not only of donations of specimens, but of an inestimable donation of time and devotion from generations of dedicated botanists, naturalists, and volunteers. It provides a working space to promote and advance the exploration of biodiversity, both through original research and the teaching of natural history. The Pringle Herbarium is the third largest of its kind in New England; naturalists use the collections as identification aids and as sources of information about the distribution and habitat preferences of plants in this and many other parts of the world. The herbarium is part of a consortium of northeastern herbaria with a common interest in documenting the impacts of climate change using herbarium specimen data.

In the wake of the fire, the response of those other herbaria, and of the international community of natural history collection curators, has meant so much to us. Even after triaging the collections, the work of recovery had barely begun. We needed to dry the specimens and protect them from insect damage, and fast.

Within a day of the fire, we had emails from over 60 colleagues, including from the major North American herbaria as well as herbaria in Europe and Asia. The offers of support were generous and sincere; we will be ever grateful to the community for its amazing response. Fortunately, we had such a massive number of volunteers show up outside Torrey Hall that we had all the help we could put to work right here in Burlington. At the same time, we had wise advice on recovery provided by the informal group of people who call themselves the Cultural Heritage Emergency Response Network, a group of Vermonters working with cultural heritage collections—such as libraries, museums, historical societies, town offices—that provides mutual aid in preparedness for, and response to, emergencies. Soon after, the American Society of Plant Taxonomists provided funding for a larger-capacity freezer to cope with increased vulnerability to insect pests. With this abundance of help and expertise, we were able to respond quickly enough to keep the Torrey Hall emergency from becoming a disaster.

Now, six months later, exterior renovation contractors at J.A. Morrissey have removed Torrey Hall's fire-damaged roof components and are well on the way to restoring the 19th-century slate mansard roof. In the first weeks after the fire, G.W. Savage Co., the local emergency restoration specialists, removed the compromised portions of the building interior, leaving the rich architectural features intact but opening up the possibility of an innovative redesign and reconstruction of the building interior to suit our vision for the University of Vermont's Natural History Museum. And at a November meeting of UVM's senior leadership convened by Tom Sullivan, the twenty-sixth president of the university, the decision was made to support the continued dedication of Torrey Hall to the Pringle Herbarium and the University of Vermont's Natural History Museum.

Torrey Hall took root in an age of uncertainty and crisis. If it has survived the crises of the past 155 years, as well as the crisis of this one, it is because people have believed in its mission, and strove to help it grow through them. And when we return to the restored Torrey Hall in 2020, it will be with the hopes of sustaining this mission and serving Vermont as a resource for the ages.

Dave Barrington is the chair of the Plant Biology Department at UVM.

Image: Charley Eiseman

Among the Obscure and Unknown

CHARLEY EISEMAN

In June 2007, my friend Noah and I attended a wildlife tracker certification session with Mark Elbroch, author of *Bird Tracks & Sign* and *Mammal Tracks & Sign*. We were tested on our ability to identify tracks, from a single partial print left in mud by a woodland jumping mouse to those made in leaf litter by a scent-marking black bear, as well as sign, like the disturbance caused by a deer digging for false truffles. At one point some of us got into a debate about whether tracks on a dusty road were made by a beetle or a grasshopper.

Little did I know that those tracks belonged to a trail I would still be following over a decade later—one that culminated in a book. But even that was only a beginning.

The desire for such a book had been brewing for years. Like any field naturalist, I had field guides to help puzzle out mammal and bird tracking mysteries. I had spent countless hours with botanical manuals learning to identify plants. There were of course plenty of guides to birds, herps, butterflies, dragonflies, and other insects. But where was the book to tell us about those shiny red disks on the undersides of logs and rocks? What about those feathery patterns etched in the algal films on birch bark and propane tanks? And what was up with those flies Noah and I kept finding stuck to the undersides of leaves?

When I suggested to Mark that he write this guide, he replied: "No, I think it's up to you." "But I don't know anything about invertebrate tracking," I protested. He responded that he knew nothing about skulls when he decided to write a guide to them, and that there's nothing like a deadline to make you learn what you need to learn. He suggested I give myself a year.

For the rest of that summer and fall, I photographed insect sign in earnest, and I spent the winter digesting the contents of university libraries. The next year, Noah and I traveled the country, scouring the coastlines for signs of piddocks and gribbles, puzzling out pygmy mole cricket burrows along the Mississippi River, tracking giant centipedes along the Rio Grande and scorpions in the Mojave Desert, savoring the slime of banana slugs on the Olympic Peninsula, and perusing the prairies of North Dakota for clearings made by harvester ants. And so we created the guidebook we wanted, *Tracks & Sign of Insects and Other Invertebrates*.

When the book came out, I was working for the Massachusetts Natural Heritage & Endangered Species Program, staring at orthophotos of Nantucket in ArcGIS to draw estimated habitat polygons around observed populations of rare plants. One day, the state botanist passed along a request for proposals from the Nantucket Biodiversity Initiative, which wanted to support studies of neglected taxa on the island. So I proposed a survey of insect tracks and sign to see how many species Noah and I could add to the island's list that had been missed by typical collecting methods.

In four days on Nantucket that September, we added over 80 species to the island's list, mostly gallmakers and leafminers. As I went through our photos and samples, I soon found that while there are a few good resources for identifying galls, my own 32-page chapter was the most comprehensive guide to North American leafminers in existence, and it was simply inadequate for identifying every mine to species. Having been through this drill once already, I wasted no time in starting to write a book on the subject.

After four years of literature research supplemented by my own observations, I managed to construct keys to the known leaf mines on every plant genus in the U.S. and Canada. But there was a small problem: my work was far from complete. Of the over 2,000 insects that are known or presumed to be leafminers, the immature stages (and thus the leaf mines) are known for only around half of them. And that's just the described species; hundreds of others don't even have names yet. Although my goal was simply to create a guide to the known mines, an unintended consequence was that I had also created a guide to discovering new natural history information and new species.

At this point I've published 20 papers on leafminers (plus more on other obscure herbivorous insects and their parasitoids), collaborating with taxonomists around the world to describe new species and provide biological information for species previously known only from adults. I recently submitted a manuscript describing 30 new species of flies, with over 100 new host plant records for other species. There is no end in sight. Last winter, my wife and I spent a few weeks exploring the deserts and canyons of the Southwest, and nearly everything we found was unknown to science.

What is the point of my pursuit of tiny creatures that hardly anyone has bothered to think about? To be sure, I'm motivated purely by my own curiosity. But I believe that naturalists have a crucial role to play in the ecosystem of modern society. It turns out that the vast majority of people already believe in the intrinsic value of all other species, at least in the abstract. As recently as 2015, a nationwide poll found that 90 percent of registered voters in the U.S. support the Endangered Species Act. It just happens that we keep electing a government that doesn't reflect these values. This is why our most important task is not simply to remind people that nature is "out there," but to show them that it is all around us, and that our own choices and actions can help or hurt the wild things we care about.

Studying natural history can also remind us to be humble. We go about "managing" natural resources as if we have it all figured out, when in fact thousands of organisms are known to us only as names—we don't have a clue what they need to survive or what role they play in the ecosystem. Common and conspicuous animals in my own front yard don't even have names yet. In addition to reminding us how much we have left to learn about our world, naturalists can tell stories of complex interactions that disabuse the rest of us of simplistic ideas, like there being such things as "beneficial" and "harmful" species.

I believe that naturalists serve our function best by simply following our passion, letting our enthusiasm for the natural world become contagious, and providing others with opportunities to become inspired themselves. How can a child help but watch in awe as a striped milkweed-munching caterpillar transforms into a gold-studded piece of jade jewelry and then into a fluttery orange-winged butterfly? Who wouldn't be astonished to learn that the common spherical swelling on a goldenrod stem is caused by a fly developing inside, which has tricked the plant into growing its shelter, and which finally pops open an escape hatch in the gall by blowing its face into a big balloon? Why fantasize about space travel when we can witness such improbable creatures and events in our own yards? Surely, if we can help humanity maintain a sense of wonder and reverence for life, it will save the world.

Or at least maybe we can settle the "beetle vs. grasshopper" question.

Charley Eiseman, a member of Field Naturalist Cohort V6, conducts plant and wildlife surveys and natural resource inventories for various organizations throughout New England. In his spare time he rears, researches, and writes about little-known herbivorous insects, including in his BugTracks blog (https://bugtracks.wordpress.com/).

FIELD WORK | CLASS OF 2018

COHORT AH: THE GREAT BLUE HERONS

Chelsea Clarke: Learning with Phenology

Wildflowers in New England bloom an average of 10 days earlier than they did in the 1850s. Trees leaf out earlier and keep their leaves later. What will these changes in phenology—the timing of the seasonal life stages of plants and animals—mean for Vermont forests? Will oaks replace our beloved sugar maples? Will fall foliage peak later? How will this affect wildlife? To engage more people with these questions, and maybe even help find answers, Chelsea Clarke designed and piloted a phenology monitoring program for Shelburne Farms. The new Shelburne Farms Phenology Walk gives visitors an opportunity to learn about seasonal cycles and engage with climate change on a local scale while collecting data on familiar plant species.

During the summer Chelsea led workshops with visiting teachers to introduce them to the Phenology Walk and brainstorm ways to incorporate citizen science and phenology into their curricula. Then she put their ideas to use in a fall pilot program with a local middle-school class. Students studied local phenology and field tested the data collection materials on weekly outings, all while contributing valuable data to a national database accessible to scientists across the country.

Maria Dunlavey: Protecting Ginseng in a National Park

Most police departments don't have a resident botanist. But at Shenandoah National Park, where poaching threatens some of the healthiest remaining populations of American ginseng, plant protection is a top law enforcement priority. An unassuming forest herb whose root is prized in traditional Asian medicine, ginseng is now considered globally endangered due to centuries of habitat loss and overharvest, and many populations have dwindled or disappeared. For her Master's project, Maria Dunlavey's goal was to help prevent Shenandoah's ginseng from doing the same.

Working with scientists and law enforcement officers, Maria spent her summer resurveying ginseng populations, teaching plant identification, and mapping the history of poaching in the park. Back at UVM, she prepared a comprehensive ginseng field guide as a resource for novice and experienced rangers alike. It's now being printed for use in annual ranger trainings. Through it all, she's enjoyed grappling with the practicalities of backcountry law enforcement in one of America's most visited national parks—and with the complex cultural and ecological history of a plant that's been knitting hemispheres together for more than two centuries.

Andy Wood: Roads and Wildlife

Four million miles of roads grid the United States of America, enough for eight round trips to the moon. Our transportation network is good for business and travel, but wildlife pay a heavy toll with fragmented habitat, isolated populations, and the risk of becoming roadkill. Working with The Nature Conservancy and the Massachusetts Department of Transportation, Andy Wood researched wildlife mortality and behavior near roads, bridges, and culverts in western Massachusetts. Andy deployed camera traps to study mammal behavior, crawled into culverts to assess wildlife crossing opportunities, and scoured the asphalt for roadkill.

Andy's results demonstrate that some wildlife successfully navigate the Massachusetts road network, but others are not so clever or lucky. His recommendations will help transportation agencies and conservation partners decide where to invest in wildlife-friendly upgrades to aging bridges and culverts. Andy also wrote how-to guides to equip citizen scientists with tools for studying road ecology in Massachusetts and beyond. The upshot? Smart infrastructure along wildlife corridors from the Green Mountains of Vermont to the Hudson Highlands of New York.

Lauren Sopher

The black and white beach stones of Lake Champlain's shores ground Lauren in place through her passions: art, science, and people. An Iberville shale ring, a token of her home, accompanied Lauren during her studies of art and design and environmental science in Michigan, the desert southwest, and Namibia. In the Namib Desert, she stumbled upon welwitschia, a peculiar plant endemic to the region, while tracking black rhinos—an encounter that inspired a new pursuit of plant knowledge. With the Green Mountains beckoning, Lauren hovered over the botanical books and dried plant specimens of UVM's Pringle Herbarium, dug in school gardens and illustrated posters of vegetables to improve food access in the Northeast Kingdom, and supported individuals with intellectual disabilities to access their Chittenden County community.

As a graduate student, Lauren seeks social-ecological approaches to conservation. She intends to help people, especially underserved populations, engage with the natural and cultural history of the landscapes they call home. Lauren looks forward to working with the Town of Greensboro community for her master's project this summer.

Lynn Wolfe

After graduating from college, Lynn hopped on her bicycle, ready to try out the desert and cactus of the west coast in place of the rock and pine of her home in Maine. Reaching the Pacific, she hung up her helmet and traded in her bike cleats for footing more suitable for tide-pooling. She spent a season guiding school groups as they scampered along the rocks in search of moray eels. In Arizona's scorching heat, she planted cottonwood trees along the shores of the shrinking Colorado River. In the floodplain forests of Vermont, she trudged through streams collecting seeds and cuttings for plant propagation. Her willingness to crawl through thorn-covered shrubs was required as she searched for the elusive New England cottontail rabbit along Maine's coast. Eventually, she settled at Shelburne Farms on Lake Champlain's shores, where she raised vegetables, tapped maple trees, and developed a new sense of community. As she was exposed to the natural resource field, her urge to contribute to a greater conservation initiative grew.

Lynn will be completing her Ecological Planning thesis project at Shelburne Farms this fall.

Image: *The Cabin and Mt. Bald* by Brent Heinrich

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THE RUDDY TURNSTONES

Carolyn Loeb

At a young age, Carolyn realized that to understand the world she would have to learn its languages–both human and ecological. Since that time, her thirst for knowledge has taken her to far-flung places. After graduating from Macalester College in 2008 with a B.A. in environmental studies, she continued her education by bushwhacking through Panamanian forests in search of poison frogs, chasing sheep in dew-laden Vermont pastures, and immersing herself in freshwater mussel research in Minnesota. Carolyn has walked through rivers to help students ground their study of water in place, and used soccer as a conversational tool to teach English. A Massachusetts native, she has lost her heart to homes in Yosemite, Acadia, and Glacier National Parks and in French Guiana, Chile, Senegal, and Hungary. An avid potter, linguist and backpacker, she takes her inspiration from the human and natural communities around her.

After graduating from the Field Naturalist Program, Carolyn plans to remain in the Northeast and use her skills to contribute to holistic resource conservation, innovative land management planning, and to connect people to nature's many voices.

Jason Mazurowski

After graduating in 2011 from SUNY Buffalo with a B.S. in geology and a B.A. in environmental studies, Jason promptly left the rust belt for the Sangre de Cristo Mountains of northern New Mexico. Over the course of five summers, he led hundreds of teenagers into the mountains to meet marmots and smell ponderosa pines.

Since leaving the southwest, Jason has continued to pursue work centered in outdoor education as a naturalist in New Hampshire's White Mountains and as a dogsled musher in the Boundary Waters Canoe Area Wilderness. Most recently, he worked with native plants in southwest Montana.

In the FNEP Program, Jason hopes to continue developing his skills as a professional field ecologist while learning how to tell some of nature's untold stories. He can usually be found either digging soil pits or chatting with barred owls.

Christian Schorn

Chris first came to New England from the suburbs of Washington, D.C. As an undergraduate at Connecticut College, he was drawn to the intricacies of botany and the epic of natural history as he studied, hiked, and explored the New England landscape. It was a rich and fantastic world, but imperiled–one that needed stewards and advocates. After graduating with a double major in botany and environmental studies and a minor in music, he became further ensnared in plants as he delved into molecular study as a plant science intern at the New York Botanical Garden, digitized tens of thousands of historic New England botanical specimens for the Harvard University Herbaria, and coordinated rare and endangered plant surveys for the New England Wild Flower Society.

After making a new home in Maine, Chris came to the Field Naturalist Program seeking to learn how to conscientiously apply botanical and ecological knowledge to questions of land management and conservation. He looks forward to building skills that he can use toward a career in protecting and promoting regional biodiversity and natural heritage.

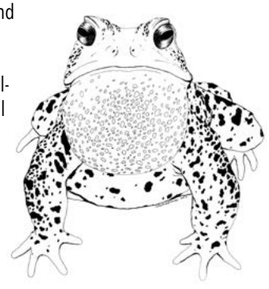

Image: *Toad* by Chelsea Clarke

A Nature Calling

DR. DEANE WANG

Unprecedented global wealth and unprecedented global poverty seem to be the norm as we head toward 2020. The price paid for both is unprecedented global environmental and ecological decline, as the wealthy exploit natural resources for profit, and the poor extract them for baseline survival. Culturally, it is a time of reckoning for many other crucial questions of social justice and public policy—Black Lives Matter, MeToo, GunControlNow.

But another quiet revolution is happening, as Earth's "first responders" toil away in a movement of their own. In the U.S., over 400 land trusts with more than 8,000 staff and 207,000 volunteers have conserved 9 million acres of land between 2010 and 2015 (National Land Trust Census – 2015). Dedicated funding for stewardship of conserved lands in the US has grown to $588 million. Conservation organizations continue to play a critical role in legal, policy, and on-the-ground work to stem the tide of human depredations of nature. The 21st century skill set for these nature workers is not obvious, but passion seems to be a common element among all.

Here in Vermont, a unique program of study emphasizing field smarts and collaborative leadership has found great success in growing the pool of Earth's first responders. These Field Naturalists and Ecological Planners have spread themselves across the country and to other continents to work on nature's behalf. Support this crusade by joining the ranks of FNEP students or by sponsoring their work through funding projects and fellowships.

Deane Wang is the former director of the Ecological Planning Program and lives in Seattle, Washington.

Join us!

FIELD NATURALIST & ECOLOGICAL PLANNING
ALUMNI ASSOCIATION

Dear Alumni and Friends,

It's easy to spot an FNEP graduate student—the purposeful soul traipsing through forest and wetland, field guides piled high, hand lenses dangling, lunching from jars of peanut butter.

We're making it easier to spot FNEP alumni as they tackle the messiest environmental challenges of our time: saving species, rewilding landscapes, and advocating for policy at the government's highest levels.

The newly established Field Naturalist & Ecological Planning Alumni Association (FNEPAA) strives to strengthen the network of alumni and friends worldwide by providing opportunities to convene and collaborate in person and online. As a member of FNEPAA, you'll have exclusive access to our membership and networking databases, a current job board, and numerous professional development opportunities. Additionally, your funds will support annual Alumni Association gatherings.

Join us! Visit www.fnepalumni.com to learn more.

The FNEP Alumni Association Board of Directors

Image: *Heron* by Lynn Wolfe

Image: *Event Map, Molly Bog Complex*, Pen, by Lauren Sopher

Call for Proposals

The Field Naturalist and Ecological Planning (FNEP) programs seek to match gifted graduate students with organizations working at the frontiers of conservation science. Our students investigate the natural world, find answers, and use their intensive training to solve real-world problems.

Our partnerships serve two core functions: First, we offer professional-level research and field work to non-profit organizations at a fraction of market costs. Next, we blend academic excellence in the natural sciences with practical conservation on the ground.

FNEP researchers have mapped remote natural communities in Maine and tracked the expansion of white pine blister rust in the High Sierras. We've developed innovative strategies for controlling invasive species in Vermont and modeled wildlife connectivity in New York. We've brought communities together to understand and enhance a river in Oregon and a watershed in Puerto Rico.

In return for our services, we ask sponsors to contribute $5,000 to our Master's Project Fund. This contribution is used to help defray students' tuition expenses.

We now welcome project proposals for the coming year. We expect to link students with projects by January 2019, with planning and details wrapped up in time for the summer field season. Data analysis and report writing continue into the fall semester of 2019. Final products will be delivered to sponsors between December 2019 and May 2020.

If you are interested in having a field naturalist or ecological planner work with your organization, please contact Jeffrey Hughes at Jeffrey.Hughes@uvm.edu or 802-656-0708.

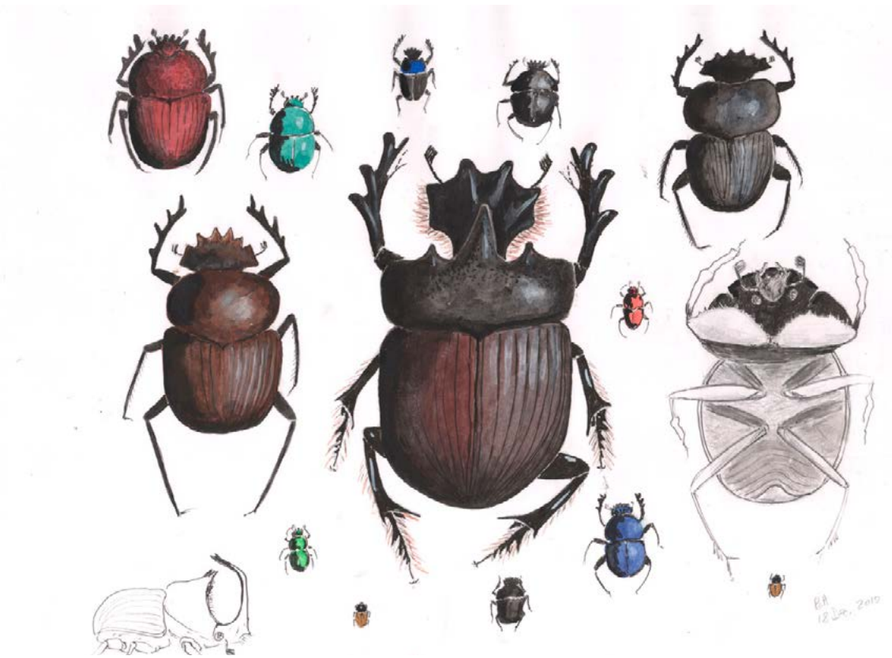

Image: *African dung beetles* by Bernd Heinrich

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