Field Notes

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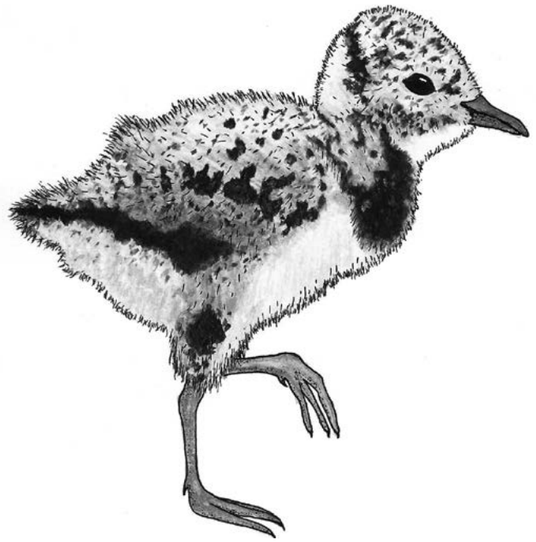
Lapwing egg and chick images: Chelsea Clarke

SONIA DEYOUNG

As every ecologist knows, disturbance is an inescapable process in natural systems. It can trigger radical or imperceptible changes, but it is happening more or less all the time. Regeneration, in some form, follows from disturbance. Nature is never static.

To those of you following the progress of the Field Naturalist and Ecological Planning (FNEP) Programs, disturbance may have been especially evident in the last few years. Deane Wang retired, and the EP Program was put on hiatus. The number of students in a cohort dropped from seven or eight to four. Last spring, the leaders of the program decided to put it on hold for one year. The current students will complete their degrees, but a new cohort did not begin last fall. Director Jeffrey Hughes shares more about this pause in his note on the next page. Meanwhile, rest assured that the program will bounce back: six students will enter this coming August.

Field Notes, a tradition almost as long-lived as the program itself, carries on this year with features by and about our alumni, inspired by the theme of disturbance. Our authors span a wide geographical and professional range, from an entomologist in Alaska to an educator in Vermont to a conservation biologist in Vietnam. A map shows where FNEPs work around the world, and a pie chart reveals the nature of that work. Alumnae share challenges they've faced as women in the field. Personal essays consider disturbances as ordinary as beavers building a dam and as devastating as a Category 5 hurricane or childhood cancer, as straightforward as a snowstorm and as complex as colonization or climate change.



It's hard not to see disturbance everywhere you look these days. I'm writing this note from home instead of my office as the coronavirus shuts down normal life around the world. (The features in this issue were written before the pandemic took hold, and their poignancy has heightened in light of the crisis.) But it was only after soliciting writers that I realized how all-embracing the theme truly was. After all, every story worth telling is about a disturbance. It is the raw material of existence.

John Sanderson reflects in his piece on the inevitability of disturbance, and on its transformative power for good along with bad. Alicia Daniel notes how it can mark time passing. Liz Brownlee strives to bring it about. And Bernd Heinrich watches it attract bees, butterflies, and nesting birds, reminding us—lest we field naturalists ever forget—that disturbance is a prerequisite for life.

Sonia DeYoung '17 (Team AG) works for the Keller lab in the UVM Plant Biology department and for the UVM Natural History Museum.

JEFFREY HUGHES

Our department chair Dave Barrington displays this Peter Drucker quote over his desk: "Management is doing things right; leadership is doing the right things."

Based on how employers and prospective students view the Field Naturalist (FN) Program, we've been doing things right these past 37 years. Applicants offered admission almost always accept (>96%). Conservation organizations regularly characterize sponsored student projects as outstanding, and they often contact us to encourage FNs to apply for their positions. Our program yields only four to eight graduates a year, yet our alumni hold an inordinate number of directorships around the world. They have authored an impressive number of conservation-focused books, as well—more than two dozen at last count.

But living off one's laurels isn't how a great program stays great. Is the Field Naturalist Program *still* doing the right things? Is it *still* doing things right? That's what this past year has been about: diving deep into what we should be doing and how we should be doing it.

As we consider the world's critical emerging needs, we have looked to the FNEP community for ideas and inspiration. Here's some of what's happened:

- We assembled a leadership team (Dave Barrington, Cathy Paris, Walter Poleman, and me) to look toward the future and process promising ideas and directions.
- An October retreat explored possibilities and visions. Two dozen deeply invested members of the FNEP community—alumni, students, faculty, and conservation partners—participated.
- New staff (Sarah Goodrich, department administrator, and Sonia DeYoung, FN alum and Plant Biology staff member) have worked to support our current students and improve the logistics of enrolling a strong cohort this fall.
- We moved Prospective Students Day from January to November to reach those in search of graduate programs sooner.
- We strengthened our proposal to create a joint, cross-college program between the Rubenstein School and the College of Agriculture and Life Sciences—while still ensuring that the FN Program can continue in its current form through the Plant Biology department.

What have we learned from this year of review and visioning?

We are doing many things right. The Field Naturalist essentials—integrative field science, oral and written communication, environmental problem-solving, real-world sponsored master's projects—are every bit as critical today as they've always been. Small cohorts of extremely motivated, bright, mature individuals (with lots of moxie, of course) who live and breathe the FN experience 24/7, learning from each other, are key to success. Challenging students with hands-on, real-world training exercises and conservation problems makes the education real and transferable. And working one-on-one with writing and public-speaking professionals helps Field Naturalists move mountains where others cannot. Focused attention to attracting a strong new cohort has paid off, too: six outstanding candidates have accepted our offer to join the class of 2022.

But our work has revealed ways that the program can get more things right. Three central plans have emerged: First, engage more fully with alumni. Through the new FNEP Alumni Association, alums in conservation leadership positions can mentor FN students and serve on graduate studies committees. Their participation will keep our training cutting-edge. Second, continue our efforts to formalize the collaborative relationship between Plant Biology and Rubenstein by co-administering the new cross-college program. Third, develop further a Field Naturalist–Vermont Law School connection, a key relationship in the land conservation field that would build on the success of the existing dual master's between Rubenstein and the law school.

Three more ideas are receiving serious attention as well: returning the number of students to the cohort size that existed when Deane Wang directed the Ecological Planning Program; giving students leadership roles in managing UVM's Natural Areas Program; and formalizing student contributions to the conservation community through an "Ecological Planning Laboratory" that provides conservation outreach services.

That sums up where we are today, but if you have other ideas—big or small—please send them our way! You've probably heard it from me too many times already, but I'll say it again: details matter. Often the difference between mediocrity and greatness is in the details.

To those who have been part of this ongoing process: thank you.

Jeffrey Hughes is the director of the Field Naturalist Program.

FIELD NATURALIST & ECOLOGICAL PLANNING ALUMNI ASSOCIATION

The Field Naturalist Program has seen a lot of changes over the decades—in directors, faculty, curriculum, cohort size, and offices. Yet, when alumni from different eras come together and share stories—at symposia, at work, in the field—it's immediately apparent that the program's spirit has never changed. It has always been fueled by a passion for nature, scholarship, and camaraderie, and it has always been a transformative learning experience.

The Field Naturalist and Ecological Planning Alumni Association has asked itself: How do we preserve this spirit after graduation? Is there a way to keep FNEPs connected and continuing to learn from one another, while supporting the student experience?

For the past two years, the Alumni Association has experimented with ways of strengthening connections in the FNEP community. Our tribe is growing and spreading, and we aim to provide resources that link us and our work. Here are a few:

- Field Naturalist Symposia (we've hosted three) are multi-day events designed to bring together the entire FNEP community—alumni, students, instructors, supporters, friends—to showcase current work and ideas, share stories from the field, and expand our professional networks.
- The Field Naturalist Mentorship Program connects current FN students with alumni to facilitate professional readiness upon graduation.
- A listserve provides quick electronic access to the FNEP world.
- Our website hosts a job board, alumni database, and information on events and the program.
- Your donations have supported current student endeavors.

We have plenty more ideas but are still growing in capacity. Our work will largely be dictated by what alumni want and take advantage of. If you are a far-flung Field Naturalist or Ecological Planner craving a dose of the program's spirit, do connect with us.

We rely on support from our members, so please consider joining. Visit our website at www.fnepalumni.com or email us at FNEPalumniassociation@gmail.com to get involved or learn more.

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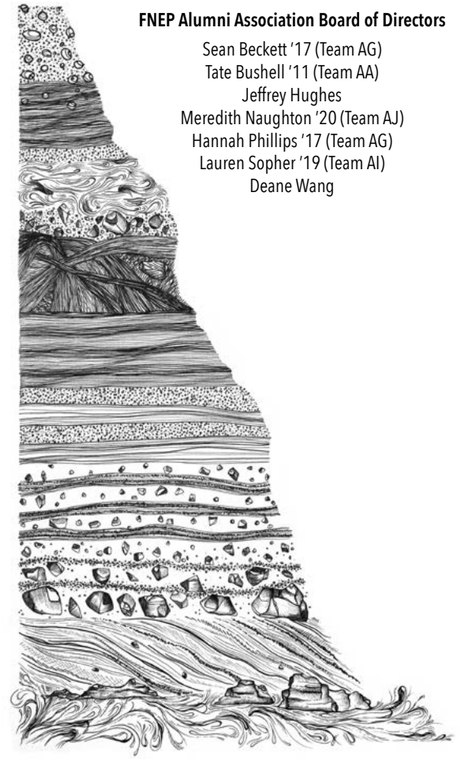


Landslide: Lauren Sopher

Image: Christopher Nytch

After the Storm:

Disturbance and Recovery in Puerto Rico

CHRISTOPHER NYTCH

Hurricane María's cyclonic winds started to pick up around midnight in my rural community of El Verde, Río Grande, nestled in the foothills of Puerto Rico's Luquillo Mountains. We hadn't yet recovered from Hurricane Irma, which had passed north of the island just two weeks before, knocking out the municipal water system and electric grid. By daybreak on September 20, 2017, María's full force was bearing down on us. My wife Noelia and I watched in amazement from the safety of our concrete bedroom, peeking out the jalousie windows across the narrow valley in front of our house. Sustained winds of up to 140 miles per hour first stripped and then toppled trees, howling obnoxiously and clanging the storm shutters. With the winds came 20 inches of pounding rain. It forced its way around every seal and through every seam, even dripping through the ceiling. At some point we gave up trying to stop the leaks and acquiesced to the wet. For several hours the sole source of calm was our children, Leo and Ellie, whose tranquility baffled us. They slept through most of the night, apparently indifferent to the surrounding chaos, waking only when we had to move their beds out of the way of leaks.

After the storm passed, we went outside to assess the damage. Our yard was a tangle of uprooted trees and other organic debris, twisted pieces of metal, and fragments of plastic. Our makeshift shed had blown away, and we wept for the loss of our custard apple and guava trees. But we were fortunate. Several of our neighbors had lost all or part of their roofs. One wooden house was completely obliterated; the only thing left standing was the toilet. Looking up toward El Yunque National Forest, I took a moment to comprehend the bizarre scenery before me: where a short while earlier had stood an intact broadleaf evergreen forest, there was now a landscape of barren and broken trees, like Vermont in November following an early ice storm. Scanning the horizon, I could see fresh orange scars where El Yunque's steep volcaniclastic soils had become saturated and triggered landslides, the swollen rivers carrying tons of sediment and boulders downstream to flood the roadways and damage bridges. As we slowly regained communication with the rest of the island and grasped the extent of the storm's impact, my sense of shock only grew. I wondered how Puerto Rico would repair the devastation. What would come next?

Noelia, Leo, Ellie, and I joined our neighbors to begin the long recovery within our homes and our community. Working in brigades, we slowly cut away fallen branches with machetes and chainsaws while backhoes pushed whole trees and utility poles out of the way. Within a few days we'd made a pathway wide enough for a car to pass through and reach the town to fetch additional supplies. Local church groups prepared and distributed meals, bottled water, and clothes to those in need. Relief materials also arrived from municipal, federal, and non-governmental organizations working in the region. Our neighbor Luis had a generator and gasoline—as scarce and precious as gold in the weeks after the storm—and he shared an extension cord with us to charge our phones and run the refrigerator for a few hours a day. Another neighbor with a flatbed truck and large cistern drove by every couple of days dispensing potable water, and we eagerly rushed outside to fill our buckets and milk jugs, the kids chanting his name, *"Don Gregorio!* like he was a superhero saving the day. And indeed he was. Just before Thanksgiving, our water service returned, and we were truly grateful to put the buckets aside.

One day, about a week after the storm, we decided it was safe to venture out and call my family in the States. Following the recommendations of friends who had come to check in on us, we wound our way up the mountain, picking a path around horizontal tree trunks and mudslides until we found a bar of cell signal, which lasted long enough to call my sister. In a weird telecommunications twist, it took another two weeks and several failed attempts before we successfully contacted Noelia's family, though they live only a hundred miles away on the southwestern end of the island. Eventually, I connected with a friend in Washington, DC, who helped me order a small solar starter kit from Amazon so we could run a fan and turn on a lamp at night. It was quite the celebration when the UPS truck made the delivery several weeks later. We celebrated again when electricity was restored in February, more than five months after the lights went dark.

Some days it feels like Puerto Rico has returned to normal. Other days normalcy seems like a perpetual illusion.

I observed El Yunque's recovery alongside our own. The news stories and scientific studies portrayed widespread destruction, and indeed there was significant damage. A post-hurricane tree assessment from the Luquillo Long-Term Ecological Research Program calculated that María killed twice as many trees as two other cyclonic storms in the past 30 years combined. The change in forest structure and loss of habitat caused severe declines for some types of birds, particularly frugivores like the Puerto Rican bullfinch. Perhaps most devastated of all was El Yunque's population of wild Puerto Rican parrots, a critically endangered species that plummeted to a single bird.

Despite these losses, I experienced a forest that was very much alive. Within a couple of weeks, I noticed leaves poking out of meristems I had given up for dead, looking like bright green lollipops. Cecropia seedlings, a pioneer species especially adept at surviving in the soil for a year or more and then germinating when the canopy opens, began to break through the soil in earnest. Before long, lianas, herbs, and shrubs exploded in the understory, converting relatively open woodlands into dense tangles. While walking through the forest, I also encountered ecological mysteries among the saplings, such as the large, heart-shaped leaves of balsa wood and the opposite, compound leaves of the young African tulip tree, an aggressive colonizer. I had seen both species many times before in disturbed areas, but not in mature forest away from roads. Where did their seeds come from? Would they survive? Again I wondered, what will come next?

Looking up at El Yunque today, I see that the mountain is green again, pumping vast quantities of water up from the soil and out into the atmosphere, where it ultimately falls to the earth as life-giving rain. Many of those opportunistic little cecropia now stretch more than 15 feet tall; my colleagues and I are monitoring them to document the legacy of historical land use and cyclonic disturbance in El Yunque. Together with the sierra palm and dozens of other species, they are regenerating a young canopy and providing shade and habitat for a rich array of flora and fungus—and the fauna that feed on them. The lianas grow relentlessly, and I confess that some days I hate them. They form labyrinths so thick, draped over every tipped-up trunk and branch, that it can take an hour to stumble a hundred yards through the jungle. Yet my frustration is just as often tempered by awe of the flowers and fruits, and the insects and birds who have returned to eat them. Among them is the bullfinch, its sharp trill and buzzy coda reverberating through the forest once more.

The community of El Verde has recovered, too. Most roofs have been fixed, the house that blew away was rebuilt with concrete, and solar systems have popped up on some homes. But the human population has been in flux. Several families have migrated to the mainland U.S. in search of greater economic and political stability, and to escape future hurricanes. I'm not convinced they'll find what they're looking for, though I admire their faith in the American Dream. My family moved, too, but we didn't go far. We now reside one town to the east, in Luquillo, closer to Leo and Ellie's school. El Yunque remains a part of our daily lives. From our balcony we can see the mountain rising up from the sea until it disappears in the clouds. I return to the forest several times a week for work and inspiration.

Almost three years have passed since María roared across the island, and some days it feels like Puerto Rico has returned to normal. Other days normalcy seems like a perpetual illusion. Recent months have been especially challenging, as the island has been rocked by scores of earthquakes that have quite literally shaken everyone's sense of security; at least one knows when a hurricane is coming. Projections for Puerto Rico's economy and the regional impacts of climate change are not reassuring either, but I find hope in the resilient capacity of people and natural communities to collectively survive and thrive. Even the parrot is staging a comeback, thanks to help from the U.S. Fish and Wildlife Service, which aims to reestablish a wild population in the forest. I have witnessed great destruction and distress transform into renewal in El Verde, El Yunque, and beyond. I have also taken part in the restoration process, hand in hand with friends and family, and even complete strangers. That experience galvanizes me to further action. While I still wonder what the future will bring, these days I'm more interested in what I can do to help shape the outcome.

Chris Nytch '07 (Team W7) is an ecologist and educator with the Friends of El Yunque Foundation. He leads the El Yunque National Forest citizen science vegetation monitoring project.

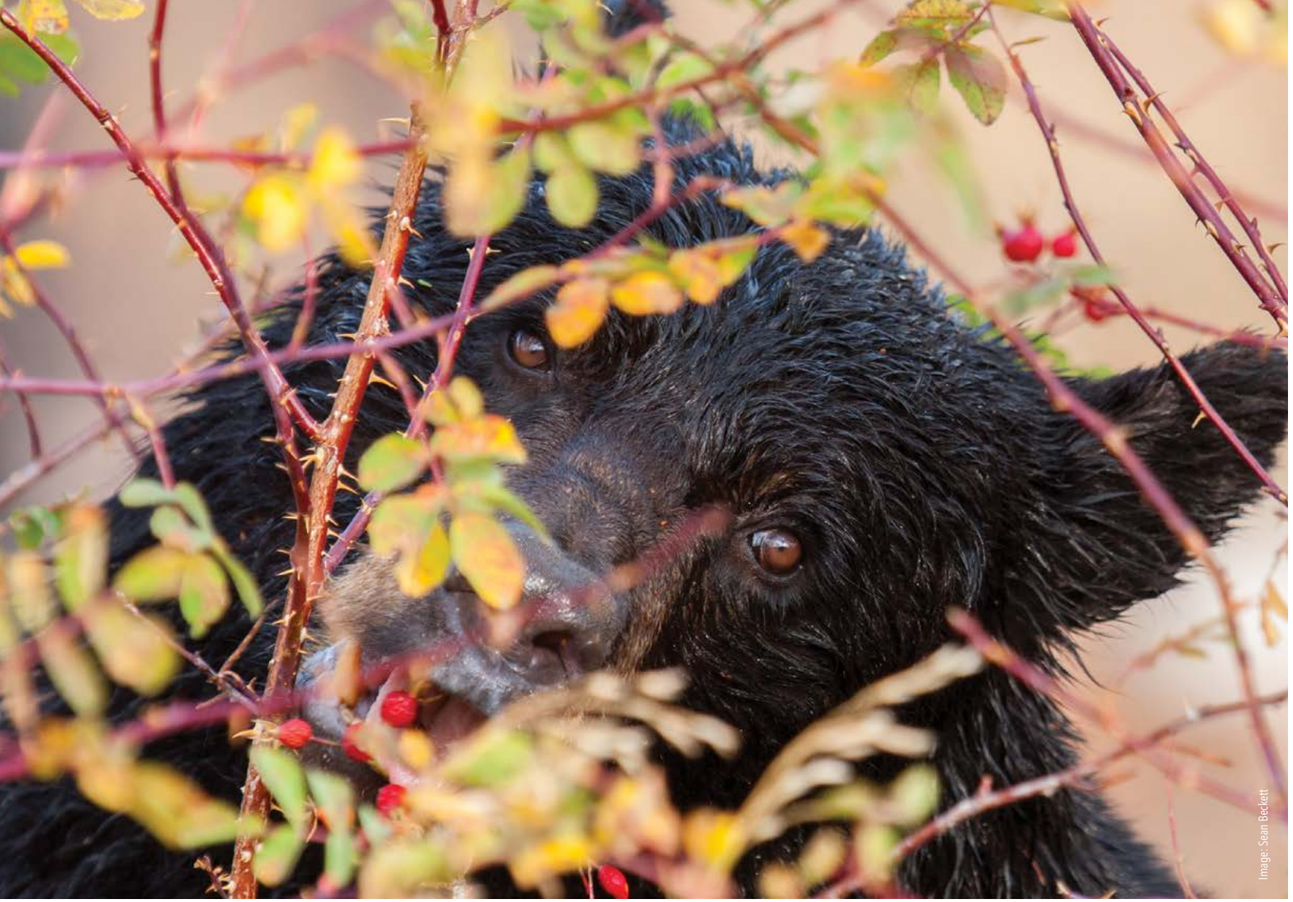


Image: Sean Beckett

Saturn's Second Pass

ALICIA DANIEL

No one becomes a naturalist by accident. It doesn't happen because your guidance counselor suggests it's a good idea. Ask any naturalist: blazing their own trail will be at the heart of their story.

My career path began in the forests, fields, and riversides of Montana, with me watching beavers while my dad and siblings fished for trout. It took another 20 years to arrive at anything resembling a trail head. It was a winding path with no map and plenty of dead ends.

And yet I woke up as a naturalist on an island in Bear Track Cove, Alaska, the summer I turned 28. Yawning from lack of sleep—in the middle of the night, the *shush, shush* of my eyelashes brushing against my sleeping bag sounded like a bear walking around outside my tent—I made my way down to the beach. I'd traveled to Alaska to track black bears. I was, at best, a novice tracker. But when I came upon a set of large pawprints with the mud gooshing up between the five toes, I knew they were fresh and I knew they were bear. I looked across the mudflat that now connected me to the mainland to discover (a) I was *not* on an island, and (b) the bear tracks led right to a black bear. Backlit by the rising sun, a halo of fur glowed around his head. I stood up, shook off my jacket, and waved it around, as I'd been told to do. He started walking toward me. Black bears in Glacier Bay defend their salmon streams against brown bears, which is to say they are big. Clearly there were safer places to be.

My journey to Alaska actually began a year earlier. After landing my dream job in Austin, Texas, with Bat Conservation International, I'd helped them move from Milwaukee to Austin, overseeing the installation of the phones and watching with pride as workmen bracketed bookshelves to the field station's fresh sheetrock walls. I loved the perks of field work, like a trip to Bracken Cave where 20 million Mexican free-tailed bats emerged at sunset like a black tornado. But it was my first day in the new office, and the honeymoon was over. I was sitting at my desk, probably feeling underappreciated, when a rending sound above me made my hair stand on end. A fully loaded shelf of books fell off the wall, one end hitting a filing cabinet to my right to form a triangular cave with the floor. As I threw myself sideways into this shelter, a thousand pounds of shelves and books crashed down where I had been sitting. I rose up out of the rubble with a new, crystal-clear resolve: I was not going to die at a desk slipstreaming behind some famous naturalist. I was going to *be* a naturalist—or at least die trying.

By the time I met up with that black bear, I was in fighting shape.

Every 27 to 29 years, the planet Saturn returns to the sign it was in when you were born. In astrological lore, Saturn is the great taskmaster. He breaks you down, makes you lift heavy weights, so you can get into fighting shape. In my 28th year, I left Bat Conservation International, leapt from an English degree into a Master of Science program, crawled through a flooding cave for my "interview," moved to Vermont where I figured out how to dress in winter layers (not one big bulky sweater), learned to cross-country ski in front of amused peers so I could track moose in Wyoming, fended off unwanted advances from men who were hired to teach me, and much more. By the time I met up with that black bear, I was in fighting shape. As he stared me down, I slipped quietly into the forest. But later my friend and I came back to steal one of his salmon for dinner.

After my encounter with the bear, I got married and spent the next 29 years as a mild-mannered university lecturer raising two children and working part-time as a naturalist. Then, one day when I was walking in the Vermont woods with students, we came upon a black bear skull. By this time, I had found porcupine skulls, beaver skulls, deer skulls, seal skulls, mouse skulls, raccoon skulls, coyote skulls, fox skulls, and even gull skulls, but never a bear skull. As we turned it over, a long canine tooth fell out of its jaw. I took the tooth home and strung it on a leather cord around my neck. Things were about to change. My older daughter was already studying and working in Boston, and my younger daughter was headed off to college, too. My teaching at UVM was drying up under a new budget model. Saturn was returning. I needed to get back into fighting shape.

I dreamed of moving my naturalist teaching out of UVM (keeping ties only to the Field Naturalist Program) and into Vermont townships. So I started the Vermont Master Naturalist Program. I registered this "school" as a business because I am too old to listen to a board of directors, be routinely audited, write lots of grants, or even complete the necessary nonprofit paperwork. Every step of the process has been a bear, from finding insurance to negotiating deals with partners. I quickly discovered that I don't resonate well with business culture. In my new business-owner role, I find people either want to sell me things or teach me how to sell things. (Wear red! Be confident! Hand the person you're talking to your phone so they can't walk away from you!?!) None of this feels natural or even worthwhile to me.

All I want is to find people who dream of being naturalists, create a path for them, help them meet other naturalists, and put them to work on saving nature in their towns. I want them to understand that being a naturalist is a practice. It is how you spend your time, not how much you know. People often don't grow up to be naturalists even when that is their heart's desire. Now the Vermont Master Naturalist Program can make that dream come true.

One Saturday this winter, I went tracking with a group of master naturalists at a granite quarry where bobcat, coyote, porcupine, and fisher tracks mapped out the icy water's edge of the quarry pool. I am, at best, a middling tracker. But I delight in spending time with people who want to be outside. When I see something magical, I want to turn to a kindred spirit and whisper, "Look!" Saturn won't be back for another couple of decades. In the meantime, I will be out in the woods.

Alicia Daniel '89 (E Team) directs the Vermont Master Naturalist Program and serves as the Field Naturalist for the City of Burlington. This coming year will be her 31st teaching in the Field Naturalist Program.

Image: Lauren Sopher

Limestone and Langurs

NEAHGA LEONARD

Image: Neahga Leonard

In the distance a fresh rockfall catches my eye and we turn the speedboat to get a closer look. Balancing against the rolling swell, I see that a gigantic slab of limestone, probably 12 meters tall, has sheared away from the cliff, leaving 800 tonnes of stone broken in the shallow water below. This rockfall can help us make sense of the evolution and endemic biodiversity of northern Vietnam's coastal karst.

Karst landscapes are constantly in motion, constantly evolving. They come in many forms but share a similar origin. We're driving our boat through one of the most dramatic types of karst in the world: drowned tower karst, or drowned 峰林 karst (fēnglín, meaning "forest of peaks").

Here, groundwater running through the calcareous bedrock chemically carves out sinkholes and caves that then collapse, leaving sheer or overhung cliffs. Naturally acidic rainfall eats into the stone, melting channels called karrens that merge into sharp points of rock connected by jagged stone blades, which ring like bells when struck. Hundred-tonne blocks of limestone teeter on the edge of the cliffs, shifting uncomfortably in your hands as you edge by, ready to plummet to the bottom and carry you with them. In valley bottoms and on boulder-strewn slopes, sinkholes lined with stone spikes lie hidden under vines and leaves; you must be sure of your footing. In July and August, nearly two meters of rain fall, temperatures are in the mid-30s°C (90s°F), and the constant humidity makes it feel like the mid-40s°C (110s°F). The rocks sweat as the warm, humid air meets the cool ground, creating a perfect environment for slippery algae. What little soil exists is equally slippery clay. Shoes do not last long here, and a misstep can easily cause injury or death.

It is a challenging place to work, but the very conditions that challenge us generate countless microhabitats, natural speciating laboratories that drive the evolution of many endemic species. Among these is the Cat Ba langur, *Trachypithecus poliocephalus*, a limestone-specialist primate that prefers cliffs, nearly all of which are formed by rockfalls like what we saw in the bay. This langur is what brought me to this part of the world.

The Cat Ba langur is the flagship species for conservation in the area, the most endangered primate in Vietnam and the second-most endangered primate in the world. Found only on Cat Ba Island, it has been hunted to near extinction, with fewer than 70 individuals left. Their ancestral range is unknown, but it extended at least from southern China to northern Vietnam. As the environment changed, the ancestral species fragmented and specialized, leading to two sister species, one in the fēnglín karst of Guanxi, China, and the other in a similar habitat on the coastal floodplain of northern Vietnam. At the conclusion of the Last Glacial Maximum, the sea rose, submerging these floodplains and forcing the population of *T. poliocephalus* into an ever-smaller range until all that remained for the species was a single irregular island roughly 20 kilometers square.

This was a natural change, and while it involved death, disturbance, and destruction, it also provided opportunities for new species to evolve, for diversity to multiply, and for the ecosystem to explore new pathways and relationships.

Then came the humans, and with them also came change. For thousands of years, humans had little impact on the island, their attention focused on marine resources. In the mid-20th century, human activity began increasing and the population of langurs, and other species, fell. We don't know the peak population of *T. poliocephalus.* Over the last 10,000 years, it was probably never more than 6,000 individuals, but by the 1960s only an estimated 2,500 remained. By the time the Cat Ba Langur Conservation Project was founded in 2000, this number had fallen to between 40 and 50 individuals.

Logging, agriculture, fires, hunting for both sport and traditional medicine, and infrastructure development—the latter two driven by a growing tourism industry—took their toll and thrust an already sensitive species to the brink of extinction. There are two key differences between these changes and the ones that came before. First, the current changes are intentional, the consequences of choices made based on what amount to philosophical beliefs structured around economics and politics. The second major difference is how quickly they have happened. The "natural" changes that led to the fragmentation of the landscape took place over thousands of years: rapid on a geological timescale, manageable in an evolutionary framework, and barely noticeable on a generational level. Today we are compressing millennia of landscape- and climate-level changes into a few years, easily perceptible within just a portion of one observer's lifetime. Of course, the rate at which we cause these changes is founded on our dominant philosophies, and that highlights the most important aspect of conservation: people.

Conservation isn't really about animals, plants, and ecosystems; it's about us, *Homo sapiens*, and our place in the world. Every species needs a certain level of environmental support and ecological complexity to survive. For bacteria a simple environment may suffice; primates require a more complex environment. Conservation is largely about protecting *our* environment, the one that we as a species rely on. Remove humans from the equation and many endangered species will recover on their own. Even if they don't, new species will eventually evolve to occupy the niche they once held. With humans in the picture, with our behavior unchanged, those and many other species will soon go extinct, the ecological niches those species inhabited destroyed as well. Every mass extinction has ultimately led to an increase in biodiversity, but for that to happen, an enormous number of species had to die, often including the dominant ones, and an extended recovery period followed.

Humans are uniquely aware of what we are doing, and we can *choose* to alter our behavior. We can choose to avoid damaging our environment so badly that it can no longer support our species. That, however, requires changing people's attitudes and priorities.

As a result, the real conservation work gets done in politics, economics, and education. These fields are where we need people who are mindful of conservation. Rather than training a new set of conservation ecologists who will go work at NGOs or universities, we need to ensure that policymakers, business-owners, educators, and legal experts come to their fields with a strong conservation ethic. In addition, we need people in the conservation field applying lessons learned from anthropology, economics, politics, and psychology.

Cat Ba langurs are starting to recover due to the dedicated conservation efforts of the last 20 years. From 40 individuals and one or two births per year, we have reached 68 individuals and 10 or 11 annual births. This recovery, slow and tenuous as it is, could not have happened without a change in local attitudes. On Cat Ba Island and in Hai Phong Province, there is now a sense of pride in the langurs as a symbol of the region. The fieldwork we do is important, as is the data analysis, but it's the connections with policymakers, the educational programs in all schools on the island, the relationships we have built in the communities, and general awareness of the langurs that have made their numbers climb rather than drop to zero.

The pressures and problems remain, some slow and natural, others rapid and driven by humans. The island continues to calve blocks of stone like a glacier shedding its ice, gradually getting smaller and smaller. Over a shorter time frame, human pressures become greater and greater, and the work is far from done.

Neahga Leonard '11 (Team AA) is the director of the Cat Ba Langur Conservation Project in Vietnam.

Image: Neahga Leonard

A Thunderstorm Over the Midwest

LIZ BROWNLEE

Thunderstorm." That was my dad's nickname for me as a child. For years I assumed it was a term of endearment. Well into adulthood, though, I realized: thunderstorms aren't necessarily benevolent. I tried to rationalize why he had bestowed this unusual nickname. Surely it was meant as a positive, right? My parents encouraged me to be outspoken and adventurous. Thunderstorms are a blessing in our hot Indiana summers. Of course, they also cause damage. Perhaps the nickname was tongue-in-cheek. Still, I wondered if "thunderstorm" might be the right moniker for me after all—and for all sorts of conservationists working in the Midwest. Here in the red heart of this country, we are attempting to change the weather.

Thunderstorms routinely disturb the politically and socially conservative center of America. Their winds fell trees and create gaps for regeneration in our oak-hickory forests. They fuel flash floods that change the course of our rivers. They water crops that form the foundation of our economy and identity.

These titanic forces of disturbance take shape where huge masses of hot and cold air converge, giving rise to whirling convection cells of high winds and steep electrical gradients. Inside the anvil-shaped thunderheads, downdrafts push ice molecules toward the bottom of the cloud, which bump into rising water molecules and release electrons. Over time, positive ions rise to the top of the anvil while negative electrons fall to the bottom. In a fraction of a second, lightning strikes, discharging the electrons and heating the surrounding air to over 50,000°F. The heated air, under high pressure, expands rapidly and generates shock waves: thunder.

Alone, I realize, I will never be a thunderstorm; no single one of us can be. Big changes of any sort are a tough sell in rural communities. But perhaps conservationists like me can help generate a storm. After all, lightning and thunder spring from some of the tiniest players: water and ice molecules bumping into each other. "Molecule" doesn't have quite the same ring, but it's more accurate. I'm one of many spread out over this landscape of forest and prairie and farm fields, trying to impact the status quo by working together and engaging with our neighbors.

Having lived for five years in the Northeast, I know what is possible for conservation and sustainable food. States can set aside funding for protecting land. Communities can create smart zoning policies and invest in equitable food systems. Schools can incorporate hands-on environmental education and serve local food in the cafeteria. Farms can thrive, and habitat can be restored and connected. It is both inspiring and discouraging to have glimpsed this reality and to strive for it here at home.

It takes a great deal of energy to try to create change in the Midwest. For many residents, conservation simply isn't the default worldview. Like a heated water molecule in a thunderhead, I might feel like I'm soaring when new members join our land trust or an event draws a big crowd. Sometimes, I'm ice, sinking under the weight of the task ahead.

It's tiring to explain, again and again, our basic tenets: that natural areas are worth protecting; that it's fun to spend time outside; that green spaces provide ecosystem services for the community, from mental health to clean water. We're asking people to change their habits, upend their daily routines, rethink how they spend their money, reimagine what they do for fun. If I'm being my best self, I bring along enthusiasm and patience, explaining these disruptive ideas in the most palatable terms possible. I work hard to meet my neighbors where they are in a community that doesn't have a shared land ethic. I aim to listen.

Of course, the Midwest is not a monolith, and I am not alone as a wannabe force of disturbance here. It's uplifting to know that I'm one of many conservationists working for change. When we run across each other, we can't help but feel emboldened and a little raucous. More than once, I've sat with a group sipping local brews and putting pen to bar-napkin, drafting grant budgets and collaborations for our next big idea.

I recently crossed paths with Janet McCabe, director of the Environmental Resilience Institute at Indiana University. Speaking to a group of land trust staff on climate change resilience, she said, "If you want to make a difference, be in a place where a difference needs to be made." There's no shortage of opportunities to make a difference here, and I'm happy to report that it feels like we're generating real power. Recently, for instance, my land trust developed an environmental education program to connect grade-school students to nature. Almost overnight, we had a plan, two funded interns, a team of federal, faith-based, and collegiate collaborators, and two grant applications submitted. To mix weather metaphors, the idea snowballed in all the right ways.

Collaboration at this speed was possible because people recognize that important work needs to be done here—and so we are connecting, building energy, and tackling this project together. Countless explanations and invitations and genuine conversations go into our conservation work, and I believe that the energy of these connections will create a charge and a change in my community. The Midwest needs some lightning and thunder.

Liz Brownlee '13 (Team AC) is a regenerative farmer and the executive director of the Oak Heritage Conservancy in southern Indiana.

Image: NOAA

Hearing Beyond the Noise

TEAGE O'CONNOR

My mom's on the other end of the line, running through her checklist: fresh batteries, a charged cell phone, flashlights, candles, a full stack of wood, and a freshly stocked pantry. I can hear a torrent of water rushing in the background as she reminds me to fill my own bathtub with drinking water. A storm is coming, one that looks set to cripple much of Vermont. The forecast calls for freezing rain, giving way to one to two feet of wet snowfall.

Like the gray fox denning up in Centennial Woods, my neighbors seem to think it best to just wait out the bad weather, I observe on my peaceful run the next morning through Burlington's eerily empty streets. The storm has shaken all the water from the sky, and by mid-morning the sun peeks over the Green Mountains in a crisp glow that slowly turns a blinding white. At breakfast, the sun's radiant warmth beams in on my family through the kitchen windows. We're joined by a steady stream of cardinals and chickadees attending to the millet and sunflower seeds in our feeder. They appear oblivious to the world-halting storm. There are, I suppose, many advantages to life in the air.

Our terrestrial lives, however, are consumed by the storm for another 24 hours. It's on the news, it's on my neighbors' minds, Front Porch Forum (Vermont's neighborhood message board) buzzes with calls for help shoveling, the parking ban lights are flashing, and my son delights in the constant parade of snowplows bumping up and down the road.

I get a text from a friend asking how the cottontails might fare in the storm. A former student wonders in an email if a vole in the subnivean zone, scouring the frozen leaf litter for seeds, would even know a storm had passed over. A neighbor walks by while I'm shoveling and shows me her phone, hoping I can identify a set of tracks tracing a path across her backyard. Confronted with a storm of such magnitude, we're rendered still, often by the destructive consequences, but as often by some greater sense of awe that settles into those quiet moments after the storm's passing. For a moment our gaze is cast towards the wild world we live alongside. And in that brief moment, we're captivated, curious, and impressed by those non-human critters who live out their lives without the comfort of snowplows, generators, forced-air heat, and pantries.

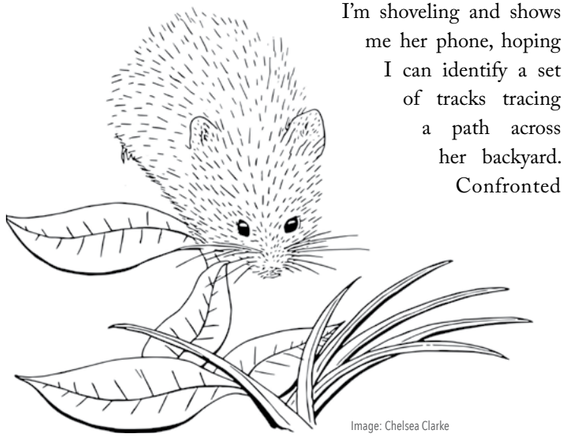


Image: Chelsea Clarke

A few days pass and the roads and sidewalks are cleared, power lines are fixed, and schools reopen. With our comforts restored, we seamlessly plug back into our routines and the memories fade into a string of liked tweets, photos, and posts. But under the weight of a storm like this, when our layers of comfort are stripped away, we feel the effects so viscerally and universally that it creates—if only for a fleeting moment—some shared vocabulary about what it means to be connected to that more-than-human world, to be part of a dynamic ecosystem.

It's easy to fog our lenses, to ignore the passing waves of migratory warblers or the chirruping throngs of fall crickets, those minor perturbations in the backdrop of our daily lives. Last night, while I was sitting on the hood of my car looking at the full moon rising over Mount Mansfield, a woman pulled up next to me and chided all those "damn metal boxes" zipping by, their drivers oblivious to the pink grandeur of the Snow Moon painting the wide expanse of clear sky. We stood in silent camaraderie, pulled into our wildness. I saw the moon, much like the storm, as a deviation from the norm, a disturbance profound enough to cut through the constant drone of anthropogenic content and remind us that our experience of life is fundamentally dictated by the land, that "civilization," as William Durant wrote, "exists by geological consent, subject to change without notice."

As a naturalist, I am constantly training my senses to better see and delight in smaller and smaller disturbances, deviations, and disruptions. Sometimes it's a storm, or maybe the "peent" of a woodcock, or the faint scent of a fallen aspen caught on a warm breeze. As an educator, I seek out opportunities for my students to detect disturbances past, future, and present. I want them to become alert to the possibility of a disturbance before it happens, to be primed to hear that distant thump of the ruffed grouse's wings, to show up to the pond just as the amphibians arrive rather than to note their migration by the morning's road kill.

Teage O'Connor '10 (Team Z10) is the founding director of Crow's Path, a Burlington non-profit that connects people of all ages to wildness; a faculty member at Community College of Vermont; and the author of the Wild Burlington Newsletter (read it at www.phyllotaxy.com).

WOMEN IN THE FIELD♂

EDITOR'S NOTE

Of the Field Naturalist and Ecological Planning Programs' over 200 graduates, almost 60 percent are women. We called on all of them to tell us about challenges they have dealt with as women in the field—either literally doing field work or more broadly in the environmental realm. Alumnae wrote their anonymous responses in a Google doc that ran to 15 pages. We did our best to choose comments for print that reflect the full scope of the issues addressed, from finding suitable field gear to sexual harassment. Some challenges, like menstruating in the backcountry, have nothing to do with the patriarchy, but most do.

The comments barely touch on intersectionality, largely because of the paucity of people of color among our alumni and in the environmental field in general. The program hopes to remedy this dearth in its student body over the coming years.

The idea for "Women in the Field" has been brewing for some time. When Allaire Diamond '09 received the 2018 issue of *Field Notes*, she noticed that most of the contributors were men and exchanged emails with editor Chris Schorn '19 about this imbalance and the notion that our field is not as progressive, gender-wise, as many of us have let ourselves believe. They agreed that a future issue should shine a light on women's experiences. A number of alumnae did reach out to share encouraging stories, or said they had struggled to think of instances of sexism they had faced. One alum suggested that we were "picking a scab." But it's clear that, for some women at least, the wounds are still fresh.

What is a challenge, big or small, you have faced as a woman in the field?

DEALING WITH LOGISTICS

(9 comments)

Finding field clothes and boots that fit. About a decade ago it got better, and I no longer have to order kids' hunting or fishing clothes and boots rather than women-specific.

Recently I tried to find polarized sunglasses for work on the water, but the store where I was shopping only had men's polarized glasses. The women's glasses all had plenty of rhinestones, though–just what I need for field work.

Dealing with my period in the backcountry. (Getting a menstrual cup was a huge game-changer, but it doesn't eliminate the challenge.) Especially when I am with a group of men and have to figure out how to excuse myself.

Finding maternity clothes suitable for fieldwork.

Pumping and dumping breast milk into the river while out for a week. Begging helicopter pilots to fly me to field camp at seven months pregnant (they said no).

Meticulously scheduling field work so I can be back to meet the school bus.

SAFETY IN THE FIELD

(25 comments)

I've planned how to use a soil probe as a weapon if I encounter a creepy guy in the woods.

The constant decision tree of whether you're comfortable going in the woods with a male landowner. Or getting in a truck with a male landowner. Or accepting an invitation into a male landowner's house.

That pit-of-the-stomach feeling when I come across some human sign (old camp, deer stand, boot prints, tire tracks, etc.) doing field work in the woods and then recalculate my route to avoid it.

I have a lot of empathy for prey animals.

I grew to dread walking on the logging roads at my master's project site, for fear that I'd encounter another person (a man) and be unable to hide before being seen. One time I heard an ATV coming from a long way off. I charged into the woods and flung myself behind a small outcrop. Two teenage boys drove by while I watched from not 20 feet away. I wondered if this is what it felt like to be an animal crowded by humans, habitat disappearing.

I often try to borrow a dog for remote field work because I feel much safer with one around.

For many years when I had to find a place to camp I would find a rutted two-track off a dirt road off a one-lane county road, then go back and brush out my truck tracks. I would NEVER camp in a campground. Even so, I always had one ear tuned to listen for another vehicle approaching. I have faced angry mountain lions and guys with shotguns both. Give me wild four-legged animals any day.

I've opted out of opportunities because I don't want to do field work alone.

While I was doing field work alone in the high desert, a man driving a pickup truck stopped and asked if I was okay. I never have the freedom of thinking this is pure kindness. I always, always wonder if it's because I'm a woman.

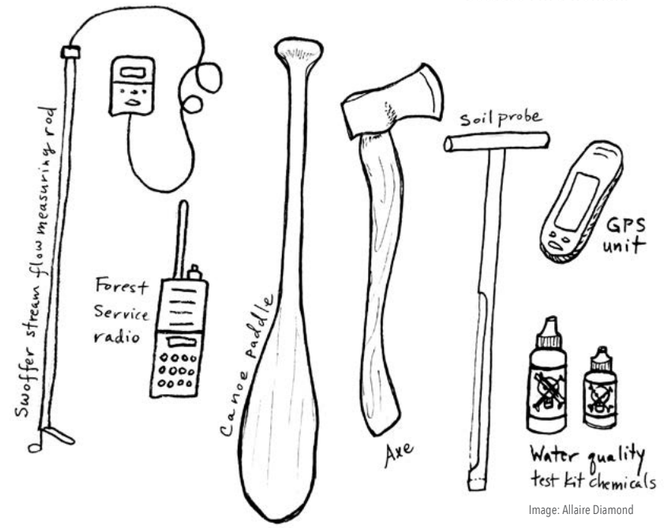


Image: Allaire Diamond

"Can we just list all the things we've thought about using as weapons?"

FAMILY AND CAREER: TRYING TO "HAVE IT ALL"

(9 comments)

When I became a parent, I wanted a job that didn't require 100% of myself. Part-time opportunities abound, but they are largely seasonal, temporary, and/or entry-level. Taking on part-time work as a more advanced professional has been humbling and sometimes even offensive. While this is more closely tied to part-time employment than to gender, I know more moms who seek part-time jobs than dads.

I just got home from a faculty job interview where I spent so much mental energy navigating whether or not or when or to whom I would disclose that I have two children. I thought about not wearing my wedding ring.

Eventually I chose to prioritize my family over my professional life. We live in a rural area, and the only way to make a decent income in the environmental field would be to move. So now I work for myself in a totally different field. I love not having to face the male entitlement office culture or work through pain and injury; I love that I can set a humane work schedule and that my daughters see me work on my own terms (and for way more money!). Yet I still feel like I failed and let my FN advisors down.

I never made a living in the environmental field. Does that count?

Editor's note: 96% of male FNEP alumni work in the environmental field, compared to 85% of female FNEPs.

In the workplace, some female FNEPs find that they are...

NOT TAKEN SERIOUSLY
(13 comments)

I'm constantly underestimated, written off, and ignored by men when I try to relay environmental policies. Lots of comments along the lines of "OK, if you say so, anything for a pretty blonde," with the clear subtext that they were going to ignore everything I said the moment I was out of earshot.

My (male) boss told me that I might be mistaken for "just some dude's wife" by students when I was co-teaching.

I asked for permits for a solo backpacking trip and was told, "You can't do that–that's too far." (Hell yes I did!)

I've gotten emails from the supervisors of crews I've worked with thanking me for coming but addressing me as "young lady" (I'm 40 now).

Snide comments from the good ol' boys–"too emotional."

I had bosses PISSED when they found out I was pregnant.

Members of your field crew apologize every time they swear in front of you, and then apologize as if it's the exact same thing when they use a word like "n*****" or "ho."

My job talk is full of photos of myself and my field assistants–mostly undergraduate women–doing badass field work in remote wilderness settings. I love the work, but it also feels a little performative, like "Look at me, I can hang, I can do the burly stuff."

NOT WELL REPRESENTED
(12 comments)

I'm really sick of being the only woman at meetings.

The biggest discrepancy I see in my field is the relative lack of women in high-level leadership positions. There are lots of excellent women worker bees and managers but many fewer directors and executives.

Being the only woman at a professional meeting puts on extra pressure to be "insightful, smart." When there are more women in the room, the entire atmosphere changes. Fortunately, this is changing, gradually, but we have a long way to go in terms of equal representation.

I have been offered opportunities that I thought were an honor (interviews, podcasts, etc.), but then I later found out that I was asked only because they had originally come up with all men, so they felt obligated to include a woman.

My experience as a woman intersects with my experience as a queer person and I can't separate the two. I spent much of my natural history career in the closet. I was out as a teenager and went back into the closet when I began studying science. There was no specific experience of discrimination that I can recall, but the sense of heteronormativity in science was overwhelming.

HARASSED
(8 comments)

After I was sexually harassed by a male stakeholder at my master's project site, I related the incident to my project sponsor and asked him to let other female employees know they should not be alone with this guy. My sponsor laughed it off.

I live in a "progressive" European country, and I've learned that casual sexism is alive and well in pockets of society here. It was a shock for me to hear a male professor making comments about female PhD students' appearances, etc.–and also a shock that no one confronted him about it.

I've seen female coworkers mistreated and not felt secure enough in my own position to stand up for them.

My research crew leader sexually assaulted me one evening in the crew house. I was afraid to tell anyone for a while because afterwards when I made it clear that activity was not wanted and would not continue, he reminded me of his position, his ability to decide what work I was given, and his control over what the PI heard about each crew member. I eventually did report him, but he only had to take a leave of absence while I finished my contract, and he still works for the same group. I have unfortunately taken that into every relationship with a male manager/professor/colleague since.

I had to fend off the following (non-FN) faculty while enrolled in their classes 30 years ago: a UVM stats teacher ("Come over and listen to jazz with me"), a Wyoming tracker (putting his head in my lap while I sat in front of a fire with classmates), and a geologist from another university (taking me on special one-on-one outings that I hated to turn down but also sort of felt like dates, complete with Bruce Springsteen soundtrack). They were all in their 50s and I was in my 20s.

DENIED OPPORTUNITIES FOR GROWTH
(4 comments)

I accidentally discovered that I and the only other female director in the organization were paid significantly lower than the male directors, even though we had higher degrees and more direct reports than most of them. I raised it to my supervisor and reached out to a lawyer to get advice. Ultimately, over a few years, I was more fairly compensated.

My male colleagues are sent to the more technical trainings (restoration, etc.).

EXPECTED TO TAKE OF CARE OF "VOLUNTEER" OR STEREOTYPICALLY FEMININE TASKS
(4 comments)

People expect me to do more of the menial tasks and not the data analysis.

I take on volunteer duties through my profession and in my community because the men don't step up.

I am expected to take minutes, prepare food, and schedule room reservations. Whenever a man brings food, he receives some grief from the other men.

SUBJECT TO DISCRIMINATORY POLICIES
(2 comments)

The Park Service maternity uniform really needs an upgrade, and nursing in a utility closet because your boss doesn't want "boobs and milk to be part of the scenery" is a good time.

RESPONSIBLE FOR THEIR FEMALE EMPLOYEES' SAFETY
(2 comments)

My biggest challenge was how best to support my intern when she dealt with a difficult landowner and, separately, an inebriated man in the field. She got herself safely out of the situations but wasn't comfortable sharing the experiences with me. She wanted to bury them, and I felt powerless learning about them later. Now I feel much more heavily the weight of my responsibility for the college-aged women I hire and supervise.

ABLE TO USE THEIR GENDER TO THEIR ADVANTAGE
(3 comments)

While I have experienced many awful things, I have also experienced the power of the "good old girl" network, where women in the field help and support each other to succeed and to just make it through the hard stuff.

Especially when working across cultures, women have been much more open to speaking with me (instead of my male colleagues) about how they use and relate to the landscape.

I think it's possible that *because* I am of the minority gender in my profession, my male colleagues (who are not accustomed to having a female leader) give me even more respect than they would a male leader.

Growing the Story

Image: Lauren Sommer

ALLAIRE DIAMOND

There's a master storyteller in each of us. Literally: that three-pound mass perched in our skulls has evolved to interpret energy—photons, sound waves, heat—at an astonishing rate, rendering the world's "noise" comprehensible. Neuroscientist Beau Lotto argues that none of us can actually perceive reality; it's not what our brains, or any animals' brains, have evolved to do. Brains evolved to survive, and fundamentally that means spinning energy into stories that have a record of keeping us alive. Unsurprisingly, given the brain's long evolutionary arc, its stories follow well-worn neural pathways, fitting new information into old narratives.

A familiar story here in Vermont is that of European settlement, with its attendant deforestation and stone walls marching across the countryside. To find these walls in dense, second-growth woods, along with mossy foundations, rusty stagecoach rims, craggy rows of maples, and carpets of vinca, might evoke a pleasing nostalgia. A feeling of kinship with a long-ago settler who once looked out from these hills and saw a completely different land. A feeling of satisfaction to be standing beneath a canopy of trees and not in a muddy, bare dooryard. A feeling of relief, perhaps, that things are returning to nature, that people left when they needed to and the forest reclaimed its former territory. It's a soothing tale. Under the "landscape layer cake" concept that many of us learned as Field Naturalists and Ecological Planners, it might be a delicious forkful.

Yet that account of Vermont's layer cake is only half-baked; the full story is not so sweet. Many streams flowing through today's forests incised the land after deforestation, tracing hard lines through what was once seepy, spongy wetland. Those streams swell with each rainstorm and cut deeper, pulling soil from banks and delivering massive amounts of sediment downstream. Europeans did their best to erase the Abenaki from the landscape, and racist historical policies and a current lack of federal recognition mean the native culture still struggles to find footing. The departed settlers didn't just vanish; they and their descendants cleared land on larger scales elsewhere, one more phase of ongoing global forest loss.

Latter-day settlers move from any number of urban and suburban locales, seeking relief in the abandoned forests of Vermont. Roads and development blaze through these forests once more, chipping them into fragments. The modern invasion might not seem as dramatic as the one that happened two centuries ago: a home with a view of rolling hills at the end of a long wooded driveway, a comfortable yard with carefully chosen plantings, and a garden in the best spot of sun. Or: a long shadow cast into the surrounding woods by humans and their cars and pets, hindering wildlife movement and other natural processes in a forest that was just beginning to recover after a violent alteration.

> We can't see what we can't see, but we can acknowledge the vastness of our collective blind spots.

Beau Lotto writes that "our vision window is tiny, like a miniature porthole." In our eyeballs, the lenses project images made from light—"the narrow range of electromagnetic radiation that is visible to the human eye"—onto the retina upside down, and the optic nerve starts telling a story, beginning by flipping those images upon delivery to the brain. Where the optic nerve meets the retina, just where the raw sensation of light stops and the perception of it begins, sits our physiological blind spot, devoid of light receptors. "There is fiction in the space between," sings Tracy Chapman. That blind spot, that space between, is the start of the story, where all the devastation and achievement, the heartbreak and possibility of humanity originates.

We can't see what we can't see, but we can acknowledge the vastness of our collective blind spots. In the process our stories become less refined and more spacious, giving us greater humility and compassion toward other people, other species, and the places we all want to call home. Our Field Naturalist training fed the flames of our curiosity, encouraged us to broaden and integrate our perceptions and to hone how we communicate them. It opened us to the complexity of the world around us, helping us acknowledge the immensity of what we still don't know and resist the urge to try to explain it neatly, even when asked.

Our long game is to practice the skill of deciding when and how to get out of the way. Our highly evolved brains necessarily told stories that starred humans as heroes, or at least as survivors. Perhaps we can expand our perceptions enough to imagine a story that doesn't feature us and then lovingly communicate this to others. We can choose not to enter a scene—that bucolic yet forest-fragmenting rural homescape, for example—and instead weave a tale of thriving differently somewhere else. This narrative of thoughtful letting-go can lead to fruitful outcomes: dense development with unbroken forests in between; changes in zoning regulations; more funding for conservation; effective ecological restoration; conversations in classrooms, church coffee hours, corporate boardrooms, and even Congress. Probing our human blind spots can be dynamic and creative, generative and rewarding. It's time for a new story.

Allaire Diamond '09 (Team Y9) is an ecologist with the Vermont Land Trust.

Image: Allaire Diamond

A Road Through the Wilderness

JESSICA RYKKEN

Alaska has become a land of rapid change. Talk to anyone who's lived here for decades or generations, and through their stories you can witness the shrinking glaciers, disappearing sea ice, melting permafrost, spreading wildfires—hard evidence that temperatures are heating up fast. These days you hardly need to be a long-term resident to see dramatic changes in the landscape. One year to the next can slump a hillside or break up a river much too early in the spring.

There are less obvious changes in the landscape, too. Imagine a queen bumble bee emerging a week earlier than usual from her underground refuge after a winter of little snow, hangry from her long hibernation. She looks for food, but the willow flowers haven't opened yet and nectar and pollen are scarce. Maybe she starves or has to delay her brood. In either case, the result is fewer pollinators buzzing around and potentially lower reproductive success for both plants and bees. That's a change difficult to think through, let alone measure.

I work as an entomologist at Denali National Park, a place where few people take time for bumble bees (but they'll watch a grizzly bear from the bus, its rake-like claws harvesting a hundred mouthfuls of blueberries from a hillside patch, unaware that the bumble bee is responsible for that bear's survival over the winter). Most visitors to Denali reach the backcountry by riding a bus along a 92-mile dirt road built in the 1930s. The road's construction was a remarkable feat. It charged through a vast wilderness, spanned glacial rivers, and blasted along rocky mountainsides. A bloated economy has grown out of this transport system, including a privately operated fleet of school buses and exclusive private lodges in and out of the park. On top of that, concession fees fund many park programs directly, including the entomologist's salary.

Now, bring in warming temperatures, melting permafrost, and record-breaking rainfall. Around milepost 45, the road traverses a steep rock face and an active rockslide underlain by permafrost. "Active" used to mean that every other spring the park road crew would put some effort into shoring up the road in the area of the slide. As of this winter, "active" potentially means hauling in 600 dump truck-loads of gravel to allow the road to open this summer, and then continuing to combat the forces of gravity through the rest of the season. Park officials have proposed various alternative solutions to this furtive scramble over the last couple of years, including a reroute, a bridge, a tunnel…but closing the road? That heresy was only ever whispered as a last and unlikely resort.

Image: Jessica Rykken

As the park geologist makes monthly helicopter flights out to assess the road's increasingly dramatic drop over the course of the winter, closing the road before milepost 45 looms as a likelier scenario, at least for this season. Predictable reactions to this potential road closure from the bus concessionaire, the cruise lines, and the lodge owners ("You can't do this, you'll slash our revenue!") versus park scientists and managers ("It's an ideal opportunity to monitor the effect of taking road traffic away from the wilderness!") show the irony here: climate may disrupt the park in such a way that business loses and wilderness wins.

And the entomologist? With reduced concession fees, my job will probably end this fall if they close the road. I can't help but feel conflicted about it. As much as I love my job here, I'm optimistic that I can pull my resources together and figure out the next step in my tortuous career. I'm less confident about the resilience of the wilderness that surrounds me. Given the choice, I'd rather see the grizzly bears and bumble bees have their right-of-way returned.

Editor's note: By press time, the park had decided to bring in the dump trucks and keep the road open, at least for this year. However, the buses will be running at minimal capacity, if at all, due to the pandemic.

Author's note: I did not come to UVM with even the vaguest notion of becoming a bug person. My trajectory was set when I took Dr. Ross Bell's legendary Field Zoology class. Ross was an inspiration to legions of entomologists around the world. He passed away last November at 90 years old.

Jessica Rykken '94 (J Team) is an entomologist for the National Park Service. She netted her way through the Boston Harbor Islands, George Washington Birthplace, Shenandoah, Olympic, and North Cascades National Parks before reaching Denali.

A Disturbance on York Hill

BERND HEINRICH

At the word "disturbance," we envision an upsetting of a cherished balance, a violation of something right. The core of our conservation ethic, we might believe, is to protect an ecosystem from such a violation. By that thinking, we could posit that I have grievously violated the hilltop where I live in the Maine woods.

The American Northeast, left to itself, is a dense forest in which trees occupy every space where they can grow, excluding the tips of the bare granite mountaintops, the lakes, the ponds formed by beaver dams, and the space occupied by me and other humans. My space is a one-acre clearing in these woods, near the top of York Hill.

A family of beavers who built their lodge in the nearby brook killed the trees by felling them with their teeth, creating a dam with branches and mud and drowning the rest of the trees within reach of the rising water. That pond was frequented by wood ducks, water striders, spring peepers, green frogs, spotted salamanders, mergansers, and great blue herons. Eventually, after the beavers left, the dam broke and the pond drained. Sedges, grasses, blue irises, jewelweed, and tree seedlings began to grow in its place, and now there is a clearing about the same size as mine. One like it is required for the courtship sky dance of the woodcock and nesting places for palm warblers, veeries, common yellowthroats, chestnut-sided warblers, olive-sided flycatchers, and blackbirds. Twenty or so species of shrubs and vines sprang up too: willow, viburnum, rhodora, winterberry, huckleberry, blueberry, cranberry. The new growth supports, as do most of these same plants in bogs, dozens of species of bees, butterflies, and moths, and the berries feed migrating robins and cedar waxwings.

I cleared my acre of woods with an axe and chainsaw. Within a year, brush of all kinds claimed the ground, an invasion of pin and choke cherry, blackberry, blueberry, spirea, goldenrod, and aster. The bees and butterflies came, then nesting yellowthroats and chestnut-sided warblers, indigo buntings, white-crowned sparrows, goldfinches, robins, and waxwings. Mice, voles, and shrews arrived, and their predators followed: weasels and barred owls, and the *Nicrophorus* burying beetles.

A design to create habitat diversity could hardly have done better than mine or the beaver's. The resemblance between them is striking, yet there are some differences. In the beaver bog, tree swallows nest in the old woodpecker holes of the standing dead trees, while in my clearing they use bird boxes. Great blue herons made their nesting colony in the beaver bog; they remain absent from my clearing because of the lack of water. But my drier conditions promote lush growth of flowering plants that sustain bumble bees, meadow voles, green snakes, and shrews all summer long. A host of amphibians live in the beaver bog, but I had to dig a "vernal pool" with a backhoe. Within a few years it contained all five local species of frog as well as spotted salamanders, predacious diving beetles, whirligig beetles, and hemipteran bugs.

I would be surprised if the biodiversity due to my disturbance of the ecosystem is not more than double that of the surrounding forest. The only way to change the equation would be to redefine biodiversity, disturbance, ecosystem, or all three. Beavers and all animals occupy and disturb the land in the way they see fit for them to live. We are one of them. It is all a question of limits. There are no absolutes.

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

Image: Bernd Heinrich

Floods, Fires, and Cancer:
Disturbance, Resilience, and Renewal

JOHN SANDERSON

School had let out for Thanksgiving break, but my seven-year-old daughter wasn't enjoying the holiday. Instead, she lay on the sofa with flu-like symptoms. My wife suggested a trip to urgent care, "just to be sure." Two hours later, we learned that our daughter's platelets, the cells that clot blood, were hovering at 10,000 per microliter, about one-twentieth the level of a healthy person. Two days later, in the emergency room of Children's Hospital Colorado, our traumatized child screaming as blood poured from her nose, we learned why: she had acute lymphoblastic leukemia.

The news flattened me, like one of the six million spruce and fir trees felled by 120-mile-per-hour winds in the Mount Zirkel Wilderness on the night of October 24, 1997. As a Field Naturalist student, I had learned what to call the forest blowdown: disturbance. During my two years in the program, we witnessed other examples. In Glacier Bay, Alaska, we paddled through a coastal landscape once overwhelmed by glaciation returning over the centuries to spruce forest. On Costa Rica's Osa Peninsula, we saw cecropia trees emerging from a gap created by a fallen rainforest giant. We learned that disturbance destroys. We also learned that disturbance renews.

Disturbance can be tricky to define and understand. Its causes and effects are many. It can span minutes to millennia, inches to continents. Defining disturbance to the satisfaction of my Ph.D. committee was the most challenging part of my comprehensive exam. Of the many definitions, here's one I think serves well: disturbances are abrupt events that can drastically change ecosystems.

Since arriving in Fort Collins, Colorado, in 1994, I've seen plenty of disturbance. On July 28, 1997, a thunderstorm stalled west of town, dumping more than a foot of rain—nearly our annual average—in 24 hours. Living just one house away from Spring Creek, I watched floodwaters pour through my yard and home. The stress that followed the flood broke my long-term relationship. I was lucky. My neighbor to the north waded into the torrential waters to rescue her dog. The dog survived; my neighbor did not.

Just a few years later, a drought engulfed Colorado as deep as the one that drove ancestral Puebloans from their homes 900 years ago. The ensuing 138,000-acre Hayman Fire, Colorado's largest on record, turned vast swaths of ponderosa pine forest into conifer-free landscapes. Around the same time, mountain pine beetles began killing lodgepole pines at epidemic rates. The beetle, a native species, exploded in the wake of the drought, aided by temperatures that have risen 2°F on average in just three decades. Millions of trees across hundreds of thousands of acres succumbed to the beetles each year for a decade—3.5 million acres total in Colorado, millions more from New Mexico to the Yukon Terri-

Stuffed animal friends at Children's Hospital Colorado. Watercolor by John Sanderson and his daughter, Flora.

tory. I think it's safe to say I live in a state of disturbance. It might be fair to say we all live in a state of disturbance.

As ecologists explored concepts of disturbance during the 1970s, they also described the related concept of resilience. One definition of resilience is "the magnitude of disturbance that can be absorbed by the system." Most ecosystems in Colorado have characteristics that make them resilient. For millennia, prairie grasses recovered after grazing and trampling by massive herds of bison that roamed the Great Plains. The ponderosa pine's thick, red, butterscotch-infused bark allows mature trees to survive fire so long as the fire doesn't climb into the canopy. Serotinous cones of lodgepole pine not only tolerate fire, they require it to release their seeds.

Slowly, perhaps too slowly, we are learning the lessons of resilience. In 2013, another flood struck Fort Collins. Since the 1997 flood, the city had bought land along the Poudre River and turned it into open space. We reconnected the river to adjacent wetlands. We required catchment basins in new developments in this fast-growing city, with several basins designed as natural areas with habitat for cottonwoods, red foxes, and great blue herons. The 2013 flood caused disturbance but hardly any loss to people and plenty of benefit to creek chubs and chorus frogs. The lesson is clear: we can manage land and water with resilience in mind, and we can build resilience into our communities.

> Sometimes resistance works; often it doesn't. Resilience serves us better.

If we embrace resilience, we might dare to celebrate disturbance. We might celebrate how, from tide pools on Oregon's rocky coast to prairie dog colonies in Wyoming, disturbance creates space for more species to share the land. We might rejoice over the Colorado River, where extreme droughts and floods created conditions out of which evolved the world's largest minnow and two dozen other fish found nowhere else in the world. By accepting disturbance and building resilience, we might, in this polarized age of extinction, begin the radical work in ourselves and our communities of creating a new relationship with nature and with each other.

Of course, disturbance often isn't easy to bear. Breathing smoke from the 87,000-acre High Park fire that raged just west of town in 2012 was unpleasant and unhealthy. With dead trees still standing and little sign of new, young trees, I worry the forest will never return, now that summers are warmer and drier. Signing a liability release for my daughter's first chemo-delivering spinal tap made my own spine twist. In our pain, we might try to resist. Our oncologist prescribed my daughter medicine to prevent a fungal outbreak during chemotherapy. She and I fought and cried over that banana-flavored mouthwash. Eight months later, the outbreak occurred anyway. Sometimes resistance works; often it doesn't. Resilience serves us better.

Some authors define resilience as the speed at which a community returns to its former state after it has been disturbed. As I've moved through major disturbances in my life, however, I haven't returned to my former state. Instead, I've grown the skills and mindset I need to be more resilient. For me, this has meant strengthening my ability to handle stress and a demanding workload. But building resilience is more than stoically tolerating tough situations. Building resilience means constantly plumbing the value of vulnerability, as Brené Brown urges. It's finding richness in reciprocal relationships of gratitude, as Robin Wall Kimmerer describes. It's deciding, as Albert Einstein suggested, to believe we live in a friendly universe.

I haven't built my personal resilience alone. Here, too, there is a lesson from the scientific literature. In New England salt marshes, disturbance generates extremely salty patches of bare ground. Spikegrass can colonize these patches only by receiving water through stolons from relatives outside the salty patch. Spikegrass causes soil salt levels to drop and facilitates the movement of saltmeadow cordgrass into these patches. Similarly, my recovery from disturbance was supported by family, friends, and complete strangers. When I told my boss about my daughter's diagnosis, he told me, "Take as much time as you need." One evening when we arrived home from the hospital, a woman I didn't know was washing our dishes. We vacationed with extended family courtesy of Domus Pacis, a small, community-funded, volunteer-run nonprofit that gives people dealing with cancer a few carefree days in the mountains.

We just celebrated four years off chemo. My daughter is a healthy, curious, and kind eighth-grader who at five feet, six inches can reach the top shelf when her mom cannot. Yet the disturbance is still with me. Every day I am keenly aware of the resilience lessons I've learned. There will be another disturbance. That disturbance will bring discomfort, even deep pain. In the spirit of resilience, I aspire to step into that discomfort, knowing that chances are I'll not only bounce back, I'll emerge stronger. I've learned that while species extinction and climate change are current realities, I can also find daily delights in work, family, and nature if I just pay attention. The work of life, as I see it, is to move through disturbance while carrying both bad and good, fear and joy, disturbance and renewal.

John Sanderson '93 (I Team) directs the Center for Collaborative Conservation at Colorado State University. He served 14 years as Director of Science for the Colorado chapter of The Nature Conservancy before joining the CCC last year.

NOTES FROM THE FIELD | CLASS OF 2020

COHORT AJ: THE GREEN DARNERS

Grace Glynn | Assessing the Ecological Integrity of Maine's Salt Marshes

Along the world's coastlines, salt marshes cushion land from open ocean, sponging up carbon and forming some of the most productive habitat on the planet. But salt marshes are now in danger of drowning because of accelerated sea-level rise and coastal development. What can be done to help these valuable places persist on the coastal landscape?

Sponsored by the Maine Natural Areas Program, Grace asked: what makes a salt marsh healthy, anyway? And how can we best measure this ecological integrity along the Maine coast? She worked to develop a rapid, feasible assessment methodology specific to Maine salt marshes. Along the way, she piloted new soils-based metrics with the goal of quantifying physical degradation of salt marsh peat. Splattered with salty muck, Grace implemented assessment methods in 24 sites across the state. Results represent the beginnings of a state-wide reference catalogue of salt marsh health, a tool that can be used to identify marsh-restoration and management needs into the future.

Eric Hagen | A Shared Life: People and Biodiversity in Vermont

Eric spent the summer interviewing landowners and land-users in the Winooski watershed about their relationship to biodiversity and the land. He's using the material to write stories that showcase the deep relationships people have with the natural world and that explain the science of biodiversity conservation. The driving idea is that people are motivated by what they feel more than by what they know, but that knowledge is critical for effective action.

Eric's sponsor is the Vermont Alliance for Half-Earth, whose mission is to spread E.O. Wilson's Half-Earth concept: Based on island biogeography and carrying-capacity models, we need to protect half of Earth's surface if we want to preserve 85% of its species. Any less and we lose more species and put the ecological function of our world in jeopardy. Eric's stories will promote Vermont Conservation Design and conservation action at all scales, from Half-Yard to Half-Watershed to Half-Earth. The stories will be published online and distributed by local conservation organizations and schools.

Meredith Naughton | Trails, Wildlife, and the Future

Outdoor recreation plays a major role in Vermont's economy and identity. As more hikers hit the trails, the pressure mounts to expand trail networks, further fragmenting the state's forests. How do Vermont's trails change the way wildlife lives in our woods? What ecological factors are important to keep in mind when planning new trails?

In collaboration with Vermont's departments of Fish & Wildlife and Forests, Parks and Recreation, Meredith examined what is known about how recreational trails change where and how animals react, move, reproduce, and live. From these findings, she will offer recommendations for land managers to consider in future developments during the trail-planning process. In the summer of 2020, she will map natural features on two recently acquired state properties adjacent to the C.C. Putnam State forest, putting these recommendations into practice. Through this project, Meredith will develop one approach to ecologically mindful recreation planning that allows equitable land use between recreators and animals.

Lynn Wolfe | Sugarers in Training

Every year as winter draws to a close, Vermonters of all ages find their way to the woods to tap trees, collect sap, and take part in the great tradition of making maple syrup. As the maple industry continues to grow, it creates employment opportunities.

Through a collaboration between Shelburne Farms, UVM Extension, and Vermont high school teachers, Lynn developed the first ever Maple Career Development Event (CDE) and associated reference manual, primarily for Vermont Career and Technical Education instructors and students. The Maple CDE is a competition designed to test skills and prepare high-schoolers for jobs in maple syrup production. Career and technical centers across Vermont use it to assess students' knowledge through hands-on activities and written test questions. The maple manual provides up-to-date, science-based information on syrup production, creating consistency between curricula taught at different high schools and helping to prepare students for the Maple CDE.

Lynn's resources will help students to become skilled maple syrup producers, bringing this traditional product into the next generation.

Image of Eric Hagen: © Susan C. Morse

The Wind in My Sails:

Reflections from an A-Team Field Naturalist

CAROL SAVONEN

Team A, B, and faculty. Back, left to right: Sandy Whidden, Chris Fastie, Ian Worley, Hub Vogelmann. Middle: Koren Zimmerman Bosworth, John Kasmer, Anne Heise, Dave Publicover, Carol Savonen, Ham Davis (in front of Carol), Greg Streveler, Craig Heindel. Front: Nancy Bazilchuk, Tamara Naumann, Rose Paul.

Thirty-seven years ago, I read a recruiting ad in the back of *Audubon* magazine for the first-ever class of Field Naturalists. I applied, thinking I'd never hear back. To my surprise, in the late summer of 1983 I found myself in my beater VW van driving the 4,000 miles from Alaska to Vermont. I entered the FN Program at the ripe age of 30.

Fellow A-Team classmate Koren Bosworth and I recently looked through old pictures of our graduate days, and what struck us most—besides how young we looked—was that the technology of the day was so primitive. In 1983, we actually used typewriters in the FN office. We carried dimes and quarters in our pockets for the telephone booth. We even knew how to use slide rules. GIS and GPS were clunky and largely unavailable to civilians. Instead, we had stereoscopic aerial photos, slide projectors, and film cameras. There was no Google Scholar—we searched the library stacks and wrote requests for scientific papers to the authors via snail mail.

Conceptual frameworks of the time differed as well. Conservation biology and restoration ecology were terms barely in the vernacular, much less widely practiced. Research and agency work tended to be more reductionist and narrow. And women in science were uncommon—in both academia and the workplace.

But it was an era of wide-eyed wonder. We were ravenous students, eager to see and understand the natural world. The new graduate program, flush with funding, aimed to expose us to as much as we could handle. Specialists taught us in the field—courses on geomorphology and land-use history, and a 10-week desert ecology course out west. We helped catalogue the biodiversity of Haiti's new national parks. We studied tropical ecology in Puerto Rico. One summer in Glacier Bay National Park, we explored glacial geomorphology and plant succession and conducted our own research projects. In our naiveté, we felt that if we could only learn enough, we could save the world. (It has been a long time since I felt like that.)

The program prioritized communicating clearly about science and research to diverse audiences, as it still does today. Our mentor Hamilton Davis, a cigar-chomping, Peabody Award-winning journalist, encouraged us to "show, not tell." Ham managed to coax draft after draft out of us and encouraged us to submit our work to national publications.

Science writing grabbed me. On assignment from Ham, I wrote about my work in Alaska researching salmon returns on a remote island off the coast. I paid a typist a dollar a page to transcribe my pencil-scribbled adventure story and sent it off. I sold a 3,000-word story to a national magazine on my first try.

Beginner's luck is a powerful drug. Sensing a huge gap between scientific knowledge and public understanding, I sought out a mass-media fellowship from the American Association for the Advancement of Science. Through that I worked as a science reporter for *The Oregonian* in Portland. Intellectually it was the most fun I'd ever had, but sadly it came to an end.

After graduating, I bounced from The Nature Conservancy to the Oregon Department of Transportation to the Environmental Protection Agency. But though I had full-time work in science, I still wanted to be a writer. So by night I freelanced magazine articles and wrote part of a widely used high-school biology textbook. Eventually, I became a professor of science communications at Oregon State University, where I wrote for the public about everything from molecular genetics to tropical deforestation, plus teaching and mentoring students.

Luckily for me, I got to take the summers off and spent the time outside, returning to my Field Naturalist roots. I helped with botanical surveys in Crater Lake National Park and in the Siskiyou and Wallowa Mountains. I worked as a ship's naturalist for National Geographic expeditions to southeast Alaska and the Gulf of California. I slept in, backpacked, hiked, and grew a huge garden every summer. But after 20 years in academia, I yearned to return to the natural world full time. I retired from OSU in 2008.

From afar, I had always admired the gutsy activism of the Great Old Broads for Wilderness, a national grassroots conservation organization led by older women. Picture a cross between the Raging Grannies and geezer Girl Scouts—there you have the Broads. I organized the first Oregon chapter. We march and sing at rallies in wildlife costumes. We protest new gas pipelines and old-growth timber sales. We plant trees for beaver habitat, pull weeds, build trails, and search for rare species, all on public lands. After days in the dirt, we can clean up nicely and woo our legislators in the statehouse and in DC. And we aren't afraid to sign on as co-litigants in public lands court cases or even get arrested when necessary. Nine years on, our chapter has grown from a handful to more than a thousand members.

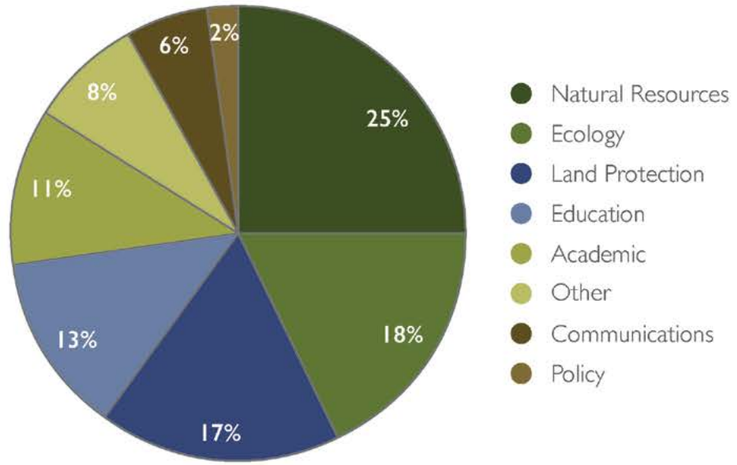
I am soon relinquishing Broads' leadership. I'm mentoring others to run our chapter so that I can write a book on the natural history of Oregon ash before the emerald ash borer strikes.

If I can tease a theme or pattern out of this soliloquy, it is that having a passion for the natural world is the best wind to have in your sails. I am so grateful that I was part of a program that nourished that passion.

Carol Savonen '85 (A Team) is a science writer, naturalist, and professor emerita at Oregon State University.

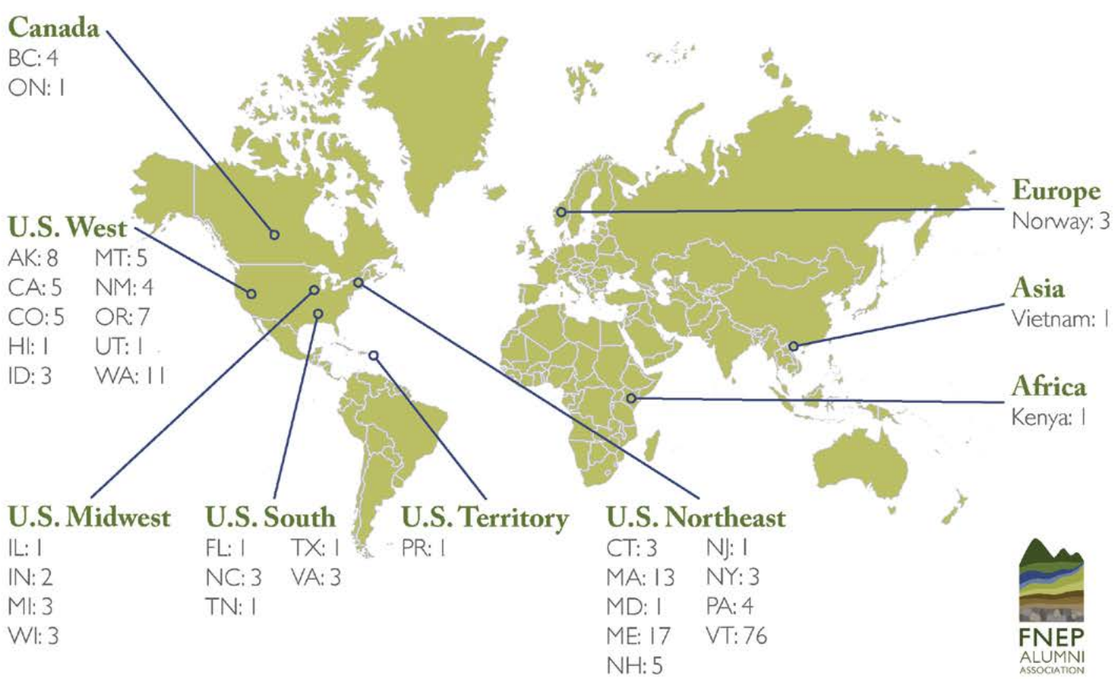
Oregon Broads. Carol is in the top row, third from right.

FNEP ALUMNI JOB FIELDS



45% of alumni hold positions of leadership.

WHERE ARE FNEP ALUMNI?



Thank you to Sean Beckett, Sonia DeYoung, and Hannah Phillips for alumni data. Design by Lauren Sopher.
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Need Professional-Level Assistance?

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