Field Notes

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2016 Field Notes Staff

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Editors' Note

Our first assignment as Field Naturalists and Ecological Planners was simple enough: what were we going to eat on our three-day camp-out in Vermont's Northeast Kingdom? We only had one hour to come up with a list, get to the grocery store, and purchase everything we needed. There were nine of us, and we had just met for the first time a few hours before. How were we going to handle this?

Our solution was to divide and conquer. In the van, we brainstormed a list of ingredients and took notes. Once in the store, Hannah manned the shopping cart with the list and handed out assignments: "Can you get a couple packets of tortillas?" "Go and look for the biggest bottle of ketchup you can find." "Get us some apples!" The other patrons probably thought we were crazy, but we made it in and out of the store in record time, with everything we needed. Little did we realize that we would come back to this strategy over and over again, on far more complex and weighty matters than a grocery list—and in our approach to the editing and design of this publication.

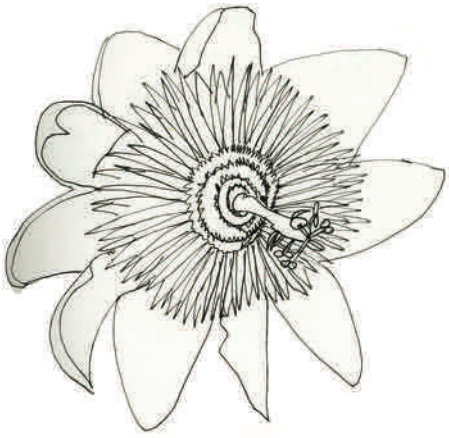
By the time it came to choosing the theme for Field Notes, we were well-versed in the process of group decision making. To no one's surprise, "creativity" topped the list. After all, by that point we'd written songs about black spruce identification and the properties of Pine-Oak-Heath Sandplain Forests. We'd acted out sketch comedies about beavers and bogs, painted landscape diagrams on birchbark, and given multimedia presentations on rock climbing, polar bears, and the Himalaya. Whether we were playing music, writing poetry, drawing plants in the field, or taking photographs, it was clear that all of us had an itch to combine our love of the natural world with our inherent desire to create.

Why creativity? Or, perhaps more importantly, why not creativity? Creativity isn't a bonus, a superfluous concept that can be nice if you have the time. As the writer Elizabeth Gilbert quipped, "If I am not actively creating something, then I am probably actively destroying something (myself, a relationship, or my own peace of mind)." Exercising our creativity is an indispensable part of a healthy, balanced life.

What's more, creative approaches are essential now as we face problems that no one in human history has ever faced. Crises like climate change and mass extinctions cannot be addressed with the tried-and-true alone. Creative thought enables us to approach these challenges with new insights, questions, and solutions, to collaborate with peers in innovative ways and suggest management alternatives to tradition. It also allows us to predict and plan for scenarios that are still a murmur in conversation, and to adapt when our predictions are wrong. The faster the world changes, the more we must innovate in order to maintain the things we value.

In the essays that follow, you'll read varied interpretations of our theme. An eminent naturalist muses on creativity's classical definition and an accordion player asks us to remember the birds that inspire our folksongs. A shorebird specialist pursues conservation through conversation on a Boston public beach. A botanist embarks on a crazy quest to propagate her favorite species. We have used these pages to create what we most want to share. The stories in this edition of Field Notes—and the lessons of our teachers—have helped to turn nine strangers into a colorful, cohesive team. Just as with the spontaneous scavenger hunt in the grocery store, we believe our joined energies far outshine what any one of us could have done alone.

Katherine, Hannah, and Julia



"The faster the world changes, the more we must innovate in order to maintain the things we value."

Illustration by Katherine Hale

The Creative Century

Dr. Deane Wang

We can only be optimistic about how humanity moves through the 21st century—the pessimistic scenarios are too filled with doom and gloom to be an acceptable mindset on a day-to-day basis. A successful human navigation of this century means that the emergent creativity of the seven-plus billion people alive today will find ways to accommodate both humans and the rest of the living planet, allowing all to thrive. So much needs to be invented or reinvented for that 100-year journey to succeed. Thus far, demonstrated creativity has included the reinvention of homes, food systems, and energy distribution. Examples include transition towns; solar energy co-ops; a tiny home movement; organic waste management for large metropolitan areas (in the Seattle area, 3.6 million people participate); organic food production, distribution, and sales estimated at over $35 billion; development of ecological and biophilic design principles; and the creation of B-Corps (benefit corporations).

No doubt our approaches to nature and conservation will be reinvented as well in the coming decades. The conservation easement of the 20th century may sprout new forms and applications. Project goals will continue to shift from the conservation of individual species to that of the entire landscape. Conservation corridors will be designed to include insights from network theories and matrix conservation. The idea of stewardship will include helping both natural and human systems adapt to global climate change and other emerging threats. A new cadre of conservation practitioners will be working in the field to make all this happen.

To prepare for this future, the graduate curriculum needs to be reinvented as well. Ecosystem services, resilience, social-ecological systems, and creative sustainability are just some of the new concepts that we need to be aware of. The Field Naturalist and Ecological Planning program has been working for decades with small and talented groups of graduate students to make them the resilient protectors and planners of the future. The program is a special place for students of the 21st century to prepare and hone their skill sets. If you, too, are interested in stimulating your creative juices, join us on this mission to invent the sustainable planet.

Deane Wang is director of the Ecological Planning Program and associate professor in the Rubenstein School of Environment and Natural Resources.

Imaginative Management

Dr. Jeffrey Hughes

This issue of Field Notes celebrates creative and imaginative critical thinking—a commodity that is a bit lacking in many leaders, but not in UVM's Field Naturalists and Ecological Planners!

It should be obvious to any person having the brains of a dead clam that rational, imaginative thinking should carry more weight in decision making than impulsive, knee-jerk reaction. Right? Well, maybe. A person's enthusiasm for rational, imaginative thinking depends on whether or not the resulting conclusion supports his or her visceral knowledge, i.e., personal convictions that have evolved to become absolute truths in that person's mind.

When visceral knowledge and rationally derived knowledge point in different directions, visceral knowledge almost always wins. But is there anything inherently wrong with that? If you know in your heart that something is right or wrong, should you just push aside that inner knowledge and turn your brain back to zero? What's to be gained by going through the charade of "critical, imaginative analysis" when you already know the right answer?

Accepting your own visceral truths is easy; accepting the visceral truths of someone else is not so easy. Visceral truths are shaped by life experiences, and no two people have had the same experiences. That's why two reasonable people can witness the same event and have entirely different takes on it.

That life experiences mold a person's values, beliefs, and visceral truths is nothing new or earth-shattering, of course, but it's easy to forget those things when analyzing a site and offering management recommendations. All too often the "management recommendations" you offer are really just expressions of your own, personal visceral truths posing as thoughtful, imaginative analysis. Fight the temptation to fall back on pre-formed, unimaginative, cookie-cutter management recommendations that you could have made without ever having visited the site. Make sure that the site's personality does the talking. Make sure that the landowner's objectives wag the dog.

If a management recommendation can't be convincingly defended for the site you're studying, don't recommend it! Generalized "truths" that you present as recommendations can do more harm than good: there are many sites and objectives where seemingly unassailable "truths" would be exactly the wrong recommendations.

In the end, good environmental stewardship comes down to understanding what makes a site tick, and then unleashing your creative, imaginative, critical thinking to meet the landowner's objectives. That's what Field Naturalists and Ecological Planners do, and that's what they teach others to do. Read on for some first-hand accounts of them doing it.

Jeffrey Hughes is director of the Field Naturalist Program and associate professor in the Plant Biology department and the Rubenstein School of Environment and Natural Resources.

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Illustration by Lyra Brennan

Ground Truthing

Hannah Phillips

Searching for *terra incognita* in Vermont is a fool's quest. It seems that every square mile has been walked, parceled, mapped, timbered, grazed, and neglected, sometimes thrice over. Despite this, when time allows, I set out to explore the forgotten corners of the map, those tracts that have dodged the cartographer's pen.

I developed this habit in college, when the desk lights in my dorm room melted me into a study-puddle atop my books. Punctuating class-filled days and book-filled nights, I opened Google Earth and zoomed high above the forests around Saratoga Springs, New York, my 13-inch laptop screen a portal to freedom. I hungrily scoured the earth below for areas that appeared unnaturally dark, indicating a fold in the land or a shaded cove filled with conifers of undetectable girth.

When Saturday arrived, I'd steal away from campus in the early hours of the morning while the dorm was still quiet. In my pocket I carried a hand-drawn map with scribbled notes: "Stream/wetland N to end (~1mi), left at fork. 0.5mi further to massive white boulder/cliff." This haphazard navigation seemed negligent to some. But to me, then and now, it was necessary. Exploring the blank spaces on the map reassures me that wildness still exists, even in a world that seeks obsessively to make the unknown known.

This insatiable compulsion to know drives the Internet Age. We are peppered constantly with new information. Email streams like a dripping faucet into our inboxes; smartphones keep us perpetually on the map; and fitness watches log our activity day and night. The internet threatens to leave no question unanswered, no rock unturned. To curious, science-minded individuals with a penchant for wild places, living in the future can quickly become overwhelming.

Yet even so, technology tempts. ArcGIS gives us the powerful ability to stack bedrock, surficial geology, soils, human history, and hydrology atop a topographic map. Tablets allow us to transport this information into the field, tracking our steps through Bluetooth-enabled GPS units or topo map apps. In most instances, these advancements are received with enthusiasm—revolutionary tools to improve the efficiency and accuracy of data collection.

But the line between just right and too much remains fuzzy. The abundance of information is intoxicating. Not only are guidebooks now downsized and digitized to fit on a smartphone screen, but apps like iNaturalist and Merlin Bird ID take the guesswork out of plant or bird identification. Snap a photo, upload it to a digital repository, and let the experts name the quarry. Suddenly, America's scientists have thousands of field technicians.

It's easy to mistake this data for reality. Data are a security blanket. More information makes scientists feel safe, encourages us that we have done our due diligence, and lends us statistical power. But it can also be a trap.

"Organic processes cannot be captured as point-features or polygons."

Maps, a visual representation of data, can be particularly deceptive. For a field ecology lab this fall, a classmate selected a gradually sloping study plot from a topographic map. When she arrived at the site she found a cliff prominently bisecting the parcel, just shy in height of the 20-foot contour lines. Foiled! Even topo maps with the smallest contour intervals cannot capture all the subtleties of the land, and those that do suggest interpolation on the cartographer's part. Maps make it all too easy to take image for fact, coloring false confidence between the lines of known data.

But while maps reveal patterns, they tell us little about process—about the actual forces that shape the land. I learned this lesson the hard way in my first presentation of graduate school. Clutching a stack of GIS printouts—a "layer cake" of bedrock, surficial geology, soils, and land use history—I tried to explain the story of an acre of woods by simply identifying the components within. Predictably, it only took one furrowed-brow inquisition from my professor for me to realize that my maps did little to explain why the steep-sided ravines terminated in wide, flat valley floors. My maps could not convey the process by which deltaic sands underlain by clay erode. Organic processes cannot be captured as point-features or polygons.

Quite simply, it is only through

Illustration by Hannah Phillips
Photograph by Lyra Brennan

field experience that we can deduce process. Consider a talus slope in Bristol, Vermont: The state bedrock geology map says nothing of temperature gradients and air currents—key drivers of the site's ecological significance—or of the scattered boulders perched at the angle of repose, creating space for air to flow beneath. Only with puzzling over the inverse arrangement of hophornbeam and oaks up high, and boreal species down low, do questions about process or mechanism come alive, and the natural community resolves. This Cold Air Talus Woodland is dynamic: solar radiation warms the talus, driving warm air upslope and cold air to the base, creating a temperature pattern opposite that typically found as elevation increases.

Despite the certainty with which our maps proclaim the known features of the world, mystery remains. In some cases, neither maps nor field exploration can unveil the secrets of a site. The Rich Northern Hardwood Forest near Gleason Brook in Bolton is a prime example. Scrutiny of the site characteristics cannot reveal why this cove contains an embarrassment of rich-site species like blue cohosh and seersucker sedge, while neighboring hollows with similar features lack richness. Our reductionist desire to log, quantify, and describe the pieces of the site is in vain. This combination of factors—the number of earthworms munching, the trickle rate of water through loam, and the precise quantity of calcium entering the site—will never appear elsewhere again. We are forced to accept (nay, applaud!) the degree of unknown that comes with complexity.

I find comfort in knowing that maps will never keep up with the process of landscape change. Even as commercial development around Burlington laps at the edges of farm fields, natural processes prevail: the LaPlatte River still carves deeper curves into its meanders, and the Lake Sand Beach at Alburgh Dunes creeps ever northward, swallowing the *Sphagnum* of the adjacent fen. The land trends optimistically towards chaos, thwarting our best attempts to impose order on the natural world. Slowly, it is reclaiming mystery from the map.

And though I concede that a digital field companion has value, I celebrate the secrets that remain in the space between the topo lines, at the intersection of natural communities, and in the successional models that try in vain to predict the future of a system governed by disturbance. I rejoice in the irreplaceable need for field ecologists to ground-truth the data and the opportunity to put *terra incognita*—"earth unknown"—back on the map.

"The land trends optimistically towards chaos, thwarting our best attempts to impose order on the natural world."

Idioms for the Anthropocene

Gabe Andrews

Nature sustains the scaffolding of our existence and weaves its way into the fabric of our culture. Our affinity for plants and animals infiltrates our lexicon; it enriches our prose and thickens our storybooks with allegory. We thrive on the diversity that surrounds us. When variety vanishes and uniformity prevails, we risk more than a world full of meaningless metaphors.

It's an urban jungle out there. Urban sprawl has swallowed immense swaths of agricultural land and paved the way for habitat loss. In the United States alone, the amount of developed land increased by 48 percent from 1982 to 2003, at an astonishing rate of 1.68 million acres each year.[1] Urban growth is expected to chomp another 45,560 square miles of forestland by 2050.[2] Imagine an additional patchwork of manicured lawns, strip malls, and baseball diamonds covering an area the size of Pennsylvania by mid-century. Urban acreage across the U.S. now accounts for more land than all of the Lower 48's national parks, state parks, and The Nature Conservancy holdings combined. (Mountain) lions, tiger (salamanders), and bears, goodbye!

There are plenty of jellyfish in the sea. Overfishing, warming temperatures, and acidifying oceans appear to benefit the mucilaginous medusozoans. Meanwhile, their predators—tuna, swordfish, and turtles—have succumbed to the seafaring apes. Recent conservation efforts have helped sea turtles keep their heads above water, but other aquatic predators struggle to stay afloat amid the sea of anthropogenic stressors. While global climate change disrupts many marine organisms, jellyfish appear to survive and even thrive in warmer seas. Explosions in populations of jellies may be the new norm—a stinging reality.

Barking up the dead tree. Our forbears witnessed expanses of American chestnut and ubiquitous urban stands of American elm nearly vanish at the hands of non-native pathogens in the 20th century. Despite decades of urban tree plantings and the resurgence of feral forests, other invasive pests threaten to unravel recovered lands. Emerald ash borers have already decimated tens of millions of ash trees and imperil over eight billion more.[3] Asian longhorn beetles put more than a billion hardwoods in danger. Hemlock wooly adelgid, white pine blister rust, beech bark disease, and butternut canker add to a growing list of maladies for our native woodlands. Run, forest, run.

The early warm gets the bird. Earlier springs and later falls could wreak havoc on some long-distance migratory birds. Spring has advanced and created a temporal mismatch between birds and their forage. Some plants and insects may keep pace with the early encroachment of spring, but far-flying fowl could miss the memo. Pied flycatchers in Europe and wood warblers in North America, for example, decide when to migrate based on photoperiod, not temperature.[4] These birds depart their wintering grounds as they have since time immemorial, only to arrive at breeding grounds that saw peak food abundance come and go—bad news for hungry hatchlings. Birds of a feather flop together.

Dropping like bees. Government officials and disquieted citizens have surged to combat the plight of

the honeybee, but few have taken note of wild bee populations that dwindle alongside those of their domestic kin. Bees pollinate close to 80 percent of the world's flowering plants. The diversity of the world's 20,000 bee species wavers under the force of a handful of elements: pesticides (especially neonicotinoids), habitat loss, disease, and climate change. Already half of North America's bumblebees have suffered considerable population declines. Talk about a buzzkill.

We have smaller fish to fry. Fishing tales may get even taller the next time you hear Uncle Jim brag about his angling trip off of Cape Cod. Populations of big predatory fish have sunk by as much as 90 percent over the last century—trophy fish found their way onto too many plaques and dinner plates.[5] The ones that remain don't compare to their gargantuan predecessors. A combination of overfishing and size-selective harvesting has led to this downsizing trend. Seventy-two inch Atlantic cod? Go fish.

Gone the way of the rhino. The age of the Anthropocene has ushered in expedited extinction. Whether charismatic megafauna or unassuming darter fish, few are safe as we proceed through a reduction of life on a scale not seen since the dinosaurs departed. The dodo received its one-way ticket over 300 years ago, and many more wait in line. Plants and animals have been instructed to visit the nearest bipedal hominid for extinction vouchers. In *The Sixth Extinction*, Elizabeth Kolbert forewarns the fate of amphibians who "enjoy the dubious distinction of being the world's most endangered class of animals... [T]he group's extinction rate could be as much as forty-five thousand times higher than the background rate." This gives a whole new meaning to the plague of the frogs.

Come hell or low water. California has its share of both. The last four years have been the state's most severe drought in at least 12 centuries. Record high temperatures coupled with aberrantly low precipitation set the stage for unprecedented wildfires that have ravaged wildlands. Desiccated rivers and wetlands endanger everything from Chinook salmon and delta smelt to Pacific pond turtles and giant kangaroo rats. California is hardly drying and burning alone. In the western U.S., the Colorado Basin—covering seven states—lost 65 cubic kilometers of water between 2004 and 2012.[5] That's enough to fill Lake Mead, the largest reservoir in the U.S., twice over. In 2012, Lake Mead itself shriveled to the lowest point since its Great Depression inception. Mead embodies the story of many western reservoirs: they're damned.

The coast is not clear. Lake shores and oceanic gulfs choke on the glut of phytoplankton and algae. Urban and agricultural areas spill nutrients into watersheds through runoff and excessive fertilization, inadvertently fattening up algal communities downstream. Eventually these societies of slime die off, oxygen-demanding microbes decompose the carnage, and other aquatic biota suffocate without the molecules of life. The affected areas are aptly known as "dead zones." From Lake Champlain and Lake Erie to the Gulf of Mexico and the Black Sea, beachgoers and surf scoters now encounter nutrient-enriched conditions annually. Israel and Jordan may no longer have the only Dead Sea.

Does a bear sh*t in the zoo? Our experience governs what we perceive, and seeing is believing. Every family writhing through clogged urban arteries of asphalt on their way to the nearest zoo can see a tiger. Surely the big cats thrive in the wild. But the captive tiger population in the U.S. exceeds those roaming across their fragmented wild habitats in the Far East. Bears—panda, sun, and spectacled—share a similar fate. Whether in zoos, on fishing charters, woodland wanderings or safari expeditions, we witness wildness and all its derivatives as they are today. We cannot observe or even imagine what our grandparents saw. Look back each generation and you will find an unrecognizable reference point, a shifted baseline.

What will language on Earth look like as habitat loss, invasive species, and climate change transform our landscapes? Perhaps the surviving sardines will talk about the good ol' days when they were packed like humans in colossal schools. The lions can converse about how they had the human's share of the savannah. Of course, the urban foxes will brag as they ravage—sly as humans—through waste bins on Walmart Drive and Google Street. As for the elephant in the room? Well, it may be dead.

With the planet as a giant proverbial coal mine, much of life's diversity fills the role of the smothered canary. We are creative beings, but without forests and ferns, puffballs and pufferfish, seagulls and rattlesnakes, the world is no longer our oyster.

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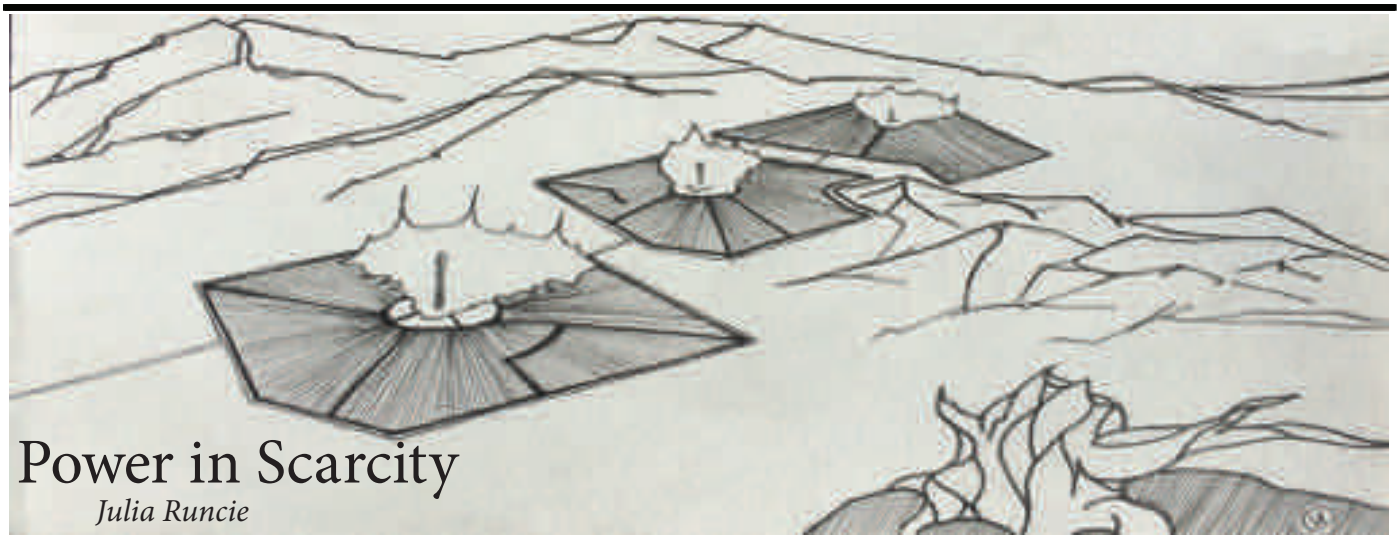
Illustration by Anya Tyson
Photograph by Gabe Andrews



Power in Scarcity

Julia Runcie

The Mojave Desert receives about fifteen centimeters of rain a year: a tablespoon for every square centimeter of soil. Long before the rain touches the earth you can see it hanging in the air. You can smell it as the resinous leaves of the creosote bush release their piquancy to the wind. The rain is as tangible as the granite and the dust. It's the chisel that shapes whatever life can persist in this place.

Raindrops strike the dry ground, quickly filtering through the coarse layers of desert pavement and alluvium. In the lower soil horizons, fine particles of dust and clay trap the water for later use. Ephemeral wildflowers erupt into bloom, barrel cacti expand their pleated trunks, and mesquite trees dip their long taproots into the moisture held deep in the soil. Tiny living sandcastles called cryptobiotic crusts soak up the rain and start to grow. Cyanobacteria send out their sticky filaments to glue together a matrix of soil particles where algae, mosses, and lichens take hold: a miniature fortress guarding the desert floor against erosion.

Water trickles along the pathways etched by earlier storms. Playas fill and washes run. Bighorn sheep and mule deer lean down to gulp the fresh water. Fairy shrimp, desiccated for years, revive to swim in evanescent pools. Spadefoot toads awaken and mate. Desert tortoises crawl from their burrows to scratch shallow basins in the dirt and wait for them to fill with rain.

In the small towns that scatter the desert, the sound of rain wakes people from sleep. They open their doors to the storm; here rainfall is an event, like a parade. The scant resources of the Mojave have always constrained its residents, but somehow living with scarcity has taught us to celebrate excess. For centuries, we have labored to harness the limited wealth of the desert through construction and extraction. Its narrow washes are nothing compared to our canals and aqueducts; its seeps and salt lakes pale beside our monstrous reservoirs. Yet today, these feats of engineering have fallen short. Human communities cannot survive on cleverly contrived water resources alone. We need power. And to get enough of it, many believe we should look toward the desert's most abundant resource: the sun.

Solar energy development in the Mojave began in the 1980s. Today, thousands of acres shimmer with neat rows of reflective panels. Ivanpah, the world's largest solar thermal power plant, began operation in 2014 just outside the Mojave National Preserve. The facility is a vast, gleaming scene from science fiction. Hundreds of thousands of mirrors focus sunlight on 150-meter-high power towers, channeling radiation strong enough to burn birds alive. Despite the ecological and aesthetic drawbacks of industrial solar developments like Ivanpah, governments laud the projects as ingenious alternatives to conventional energy generation.

For decades, land management agencies have approved solar developments on a case-by-case basis. In a recent effort to update this regulatory mechanism, the Bureau of Land Management and several collaborators have designed a Desert Renewable Energy Conservation Plan (DRECP). The plan proposes to balance development and conservation across 22.5 million acres—an area the size of Maine—by identifying appropriate sites for energy generation while safeguarding the Mojave's most prized recreational, cultural, and biological resources. The DRECP group released a Final Environmental Impact Statement in November 2015. The recommended strategy is hardly a blanket endorsement of development—it delineates only 22 tracts of desert for potential solar installations, with a cumulative land area no larger than that already set aside for off-highway vehicle use. But the only type of facility under consideration is industrial solar: rows and rows and rows of panels consuming the desert floor.

My home in Inyo County falls within the area evaluated by the DRECP. The plan labels a 6,000-acre swath at the foot of the county with the ominous words "Development Focus Area." The first time I saw the project map, that pink polygon felt like a punch in the gut.

Like those of many other Mojave residents, my instinctive objections

Illustration by Victor Lawson
Photograph by Julia Runcie

began with the aesthetic. How could I sacrifice that patch of desert? Its sagebrush and roadrunners, its long, unhindered views? How could I tolerate the plowing, paving, crushing, covering up, and construction of that particular piece of ground?

Yet the more I dwelled on that reaction, the more unjustifiable I found it. The plot in question is no wilderness; that view is one I appreciate most often from a four-lane highway. And even the farthest reaches of the Mojave are littered with the relics of human endeavor. A field of solar panels, in all its alien splendor, may be no more out of keeping with the desert's modern character than ghost towns, salt trams, mine shafts, and rusted-out cars.

Perhaps my antagonism to this plan stems not from its potential for environmental and aesthetic degradation of a place I love, but from the philosophy that drives it. We are used to taking what we want from the desert, our extortion built on a scale as vast as the landscape. In our quest for water we have blown up mountainsides, drained lakes, turned rivers into bone-dry furrows in the dirt. And it hasn't worked. Groundwater pumping has depleted underground aquifers, causing the surface of the land to compact and subside beyond repair. Disastrous flooding is commonplace in California cities as mazes of rusting pipes rupture thousands of times a year. What hubris could lead us to expect that this massive scale of engineering will pay off in another iteration?

Landscapes and ecosystems are heterogeneous; if we look only at the big picture, we fail to notice crucial pieces of the puzzle. Industrial solar will likely give rise to many of the same problems that plague industrial agriculture: water waste, destruction of natural resources, and the vulnerability of a monoculture. We know that clearcutting an entire forest is less fruitful than strategic silviculture to ensure decades of sustainable yield. By the same principle, smothering huge valleys with uniform ranks of metal and glass is a shortsighted way to harvest the sun.

Instead, solar power could capitalize on the infrastructure that already exists: panels integrated into rooftops and highway surfaces, shading parking lots and irrigated fields and aqueducts, covering reservoirs to reduce evaporation. Solar installations could be small, even modular, able to evade catastrophic weather events. The greatest volume of energy could be produced in or near the population centers where it would be used, eliminating the need for costly and destructive transmission lines. Those unable to install personal solar arrays could buy power shares from local utilities running small solar farms.

What do we need to implement such an approach? The DRECP does not address solar development at the community level because that would require buy-in from private landowners on property not managed by the federal government. Yet all around the country and the world, small-scale solar operations run by co-ops and utilities are beginning to offer a viable alternative to the conventional electric grid. In Vermont, solar cooperatives are setting up shop in reclaimed gravel pits. Community solar arrays shade farm fields in Colorado and decorate the roofs of churches in Germany. The greatest obstacles to the spread of this model in southern California seem to be the constraints of an archaic power distribution system, the will of politics, and the simple fact that the Mojave Desert is huge and empty.

Those wide open spaces are the desert's most iconic feature. But perhaps they make us think too big. When we can see for miles we start to feel greed: there is room for anything here; there is more wealth of space and sunlight than we could ever deplete. Again and again, we enlarge our schemes to fit these vistas.

If we're going to stay in the desert, perhaps it's time to turn our focus to a smaller stage. Rooftop panels and parking lot solar farms may never generate the volume of power demanded by California, especially given the state's recent pledge to obtain half its electricity from renewable sources by 2030. But by seeking the power we need at the scale of our own backyards, we may avoid repeating the failures of prior industrial ventures.

We have been so burdened by scarcity in this place that the prospect of unlimited sun sways us toward recklessness. Yet we have around us abundant proof that desert survival requires restraint, and we are not exempt from that rule. Unlike industrial solar, the community model could teach us to consider the most infinite resource as ephemeral as a thunderstorm. We could learn, at last, that the desert is not a single entity but a miscellany of winds and shadows and pockets of vibrant life. There is a simple recipe for living here, well known to the Joshua tree and the tortoise. Even as the smell of rain rises in the air, we must remember thirst.

A Song Takes Flight

Anya Tyson

"A good song reminds us of what we're fighting for." Pete Seeger lived by these words. His music strengthened social and environmental movements; his songs created change. When people join together in song, their voices don't simply grow louder; their message reaches people in a way the spoken or written word cannot. The power of song first takes root in lyrics.

As a nature enthusiast and a folk musician, I can't help but notice how often birds sneak into the stanzas of old and new tunes: a folksong about swallows, a hymn about sparrows, or a hillbilly cooing about cuckoos. Even Bob Marley felt compelled to share with the world a message he received from three little birds. Why do birds alight in our songs?

Humans covet flight. Despite airplanes, helicopters, and rocket shuttles, we fly like birds only in our dreams. We often sing about birds because, apart from some obvious exceptions, birds fly and we can't. Birds are symbols of freedom and escape. We can't actually fly away from a difficult situation, but we take solace in imagining our soul as "a bird [that] from these prison walls has flown." Songwriters usually don't specify whether this soul bird has a broken eye ring, a two-toned bill, or a distinctly buzzy flight call.

Other musicians pin a message in their lyrics to a certain type of bird. For example, bluebirds often lend their wings to the theme of joy. When "Mr. Bluebird is on your shoulder," you are content and carefree, but if he flies off you are left pondering the fleeting nature of happiness. If this transition involves love lost, then perhaps you will lie awake all night listening to the whippoorwill.

The whippoorwill's name refers to the emphatic, tri-syllabic calls he makes when keeping the nocturnal company of Bill Monroe or another lamenting lover. In his song *I'm So Lonesome I Could Cry*, Hank Williams could have been talking about present day Vermont when he wrote, "D'ya hear that lonesome whippoorwill?" As it turns out, whippoorwills in Vermont may indeed be lonesome: in widespread population decline, they are state-ranked as threatened.

Which brings us to a big question: as bird species decline and even wink out due to climate change and habitat loss, will we lose them in our songs? Or might birds persist in music as mere lyrical placeholders when avian biodiversity plummets?

For example, Eminem released a song called *Mockingbird* in the early 2000s. Northern mockingbird populations are doing fine, but even if they weren't, this title is merely a reference to lullabies. Eminem has most likely never stopped to watch the living bird (although I bet he would give us the bird).

A doomed species may even elicit musical tributes. The late great David Bowie wrote a song about the late great dodo. But if we wait to sing about birds until they're extinct, we erode our own capacity to express ourselves. We currently use birds in our songs to communicate a sense of place, evoke shared experiences, and capture the essence of powerful emotions. The deeper meaning in these metaphors slips away as more and more people forget about the mockingbird and its song. To keep the birds warbling in our songs and outside our windows, we must recognize that avian references are signposts to the actual source of inspiration—the birds themselves.

So, don't take the Beatles' word for it—listen to your neighborhood blackbird even if it's not the same species that was singin' in the dead of night for Paul McCartney. Spite Eminem and find yourself a mockingbird. Seek out the nuthatches, kinglets, grackles, and even the starlings. If you already love birds, then share your wise ways. Help your neighbor identify the painted bandits gobbling their crabapples as a flock of cedar waxwings. Remind small children that birds are the descendants of the dinosaurs. When people experience birds one way or another, then they remember to care about them. If this concern leads to action, we can prevent bird populations from taking a swan dive and protect a wellspring of human morale.

The cardinal on a snow-laden branch and the chickadee at the bus stop remind us that the world keeps on ticking despite bad weather and calamity, and we can find solace in their unwavering enthusiasm. If you need a symbol for hope in this world, just go out and find a bird, any bird, and watch it hop, chirp, and wing from tree to tree. Better yet, when you are done admiring this bird's plucky charms, sing about it—singing helps you ground your connection to another creature in your own particular human way. If we can reclaim our experience of the whippoorwill's nighttime serenade, of the stunning azure of a bluebird wing, of the wren belting forth at the dawn chorus, we not only snatch moments of beauty from our surroundings, we also nurture our own ability to express ourselves, to carry on, and to sing.

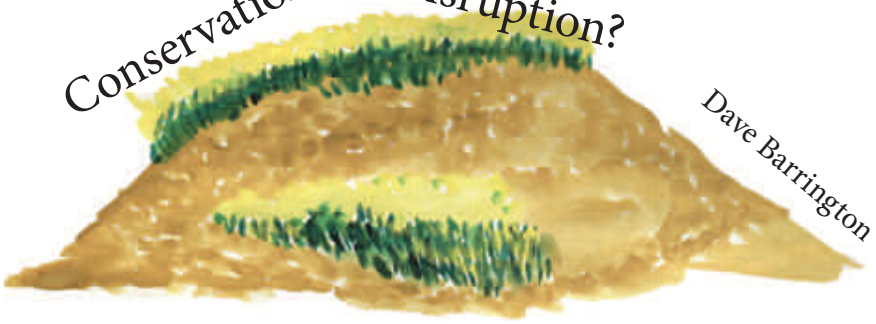
Pete Seeger was known for his audience participation; he created change not with sheer musical genius but by getting people to sing with him. For our benefit, we should sing for the things that move us. For the birds' sake, we must encourage others to join us in song.

Illustration by Anya Tyson

Conservation or Disruption?

Dave Barrington

"What was a denizen of the Atlantic sea beaches doing on the sandy shores of Lake Champlain?"



Quite a few years ago I was driving to Colchester Point along the main road, out where you can see the edge of the big wetland to the east and the lake through the trees to the west. It was a beautiful sunny day in late spring; a group of plant geeks from the University of Vermont were off to see what the new warmth had brought out along the shores of Lake Champlain.

Someone said, "What are those little yellow flowers by the summer cottages?" Sure enough, each of the houses had a striking band of yellow—it looked as though some low herb had been planted all along the road, and it was in its full glory. We pulled over and tumbled out to discover what was blooming so profusely right in the midst of cottages still boarded up from the winter past.

To our surprise and confusion, we found the plants to be the golden heather, *Hudsonia ericoides* var. *tomentosa*. Naming our quarry only made it harder to believe: what was a denizen of the Atlantic sea beaches doing on the sandy shores of Lake Champlain? As we walked through the summer colony, we discovered hundreds of brilliantly yellow cushion plants. We gradually realized that almost all of the plants had seeded in; they had taken advantage of the open deltaic sands deposited here by the Winooski River when the lake was higher long ago.

We wandered around for a while, then thought to cross the street and look towards the bay north of Colchester Bog. Here we found the heather again. A great bowl of open sand was absolutely covered with golden heather in full bloom. We walked through the wide array, mesmerized by the yellow glow. As we walked, someone noticed that the tire tracks of dirt bikes were everywhere in the sand among the heather plants. We were incensed; how could there be a philistine clueless enough to abuse these fine flowers? Our outrage increased later when we discovered that the *Hudsonia* was one of the rarest plants in Vermont, limited to just a few sandy areas along the lake.

In due time the town put up a barrier of sawn-off railroad ties that prevented the bikes from getting into the bowl where we had seen the golden heather thriving. Years went by. Another spring I rallied a bunch of hardcore botanists to head out in search of the *Hudsonia* at the time of year when it blooms. We reached the summer colony and the sandy bowl. No golden glow to be seen! We stepped from the car, walked around the cottages—no golden heather. We crossed the road. Instead of golden heather we found milkweeds, grasses, and staghorn sumac, even a seedling oak. Together these pioneers had halted the sand's constant shifting and destroyed the golden heather's favorite habitat. We searched and searched; finally we found a few plants in an out-of-the-way place in the back of the lot. They looked miserable, and there was barely a single flower to be seen.

The golden heather has suffered a similar decline at Airport Park in Colchester, again because well-meaning conservation-minded folks erected barriers to keep people from disturbing the plants. There is one place where they still thrive. At Colchester Park there is a sandy blowout right in the middle of a mown field; there, where the competition is destroyed and the Winooski sands are still regularly stirred up by the passage of the mowing machines, the golden heather persists.

Sometimes, conservation is disruption. Our small cadre of sea-beach plants, isolated here from the time when the sea stretched all the way into the Champlain Basin, comes from a world of shifting dunes where its conspecifics still thrive. But as we have worked to protect the Champlain shore sands, the viable habitat for the golden heather has dwindled to virtually nothing. Ironically, the attempts to save the plants in recent times have hastened their decline by stabilizing the shifting sands. To keep these fine plants thriving in our flora, we need a more creative approach. Instead of setting aside a museum-like preserve, we need mowing machines and dirt bikes and anything else that keeps the sands shifting. For the golden heather, disruption is conservation.

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

Illustration by Lyra Brennan

Saving All Beings, One Seed at a Time

Katherine Hale

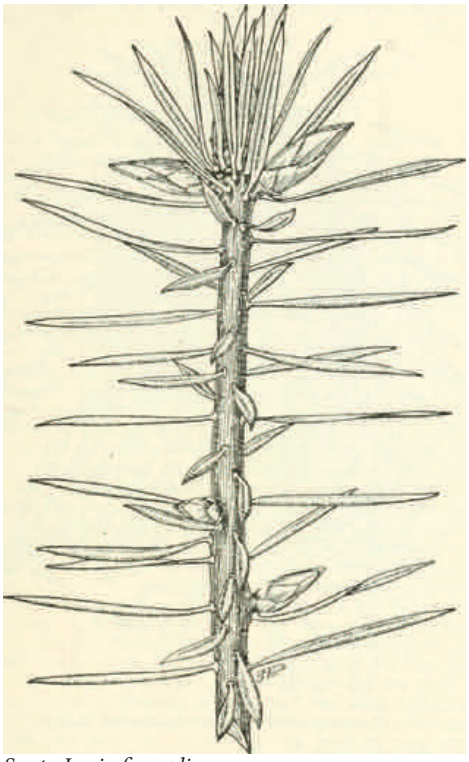
Once upon a time, in a narrow canyon in California, I fell in love with a tree and made a promise I wasn't sure I could keep. Dizzy from the hike across the wilderness and the 100-degree heat, I craned my neck back to stare up at the pointed evergreen spires towering above me. Giddy as I was, I knew I had stepped into something deep and ancient, the old bargain that plants have made with other species for millennia. This was my first meeting with the Santa Lucia fir, and I had quixotically agreed to be a seed disperser.

Certainly, we were one of the odder pairings. The fir is the rarest conifer in North America, a relic from the Miocene when California had a warm, wet climate. Though by no means ill-adapted to the seasonal dry cycles that now prevail, the tree has one fatal quirk: packed with pitch, it inevitably burned in the wildfires that occasionally sweep the Southern Coast Ranges. With only a handful of populations scattered across Monterey and San Luis Obispo Counties, one especially nasty fire could wipe out the species in an explosive funeral pyre.

Even by the generous standards of botanists, the Santa Lucia fir is an odd duck. Unlike every other fir in the world, it decorates its cones with huge bracts that project like a spiky caltrop until they shatter in the wind. Spanish priests loved its resin and burned it for incense during mass, but mostly the fir was ignored by everyone except the occasional plant enthusiast willing to make the pilgrimage to the steep, remote north-facing canyons where the trees abide.

Meanwhile, I am a member of a species that makes dramatic alterations of the biosphere to suit its own needs while simultaneously instigating a mass extinction. In trickles here, in droves there, species are disappearing: plants, birds, insects, microscopic creatures in the soil. Most of them I've never encountered and now I never will, except as museum specimens or ghosts darting at the edge of conscious thought, haunting my dreams. I'd hiked out to the canyon full of Santa Lucia firs in search of botanical curiosities, but the intensity of my reaction to the real thing startled me. Maybe seed dispersal was a way to make amends for the damage I and my fellow humans had done over the course of many lifetimes.

"It takes time to grow a forest, time to learn, and everything starts out small and tender in the beginning."



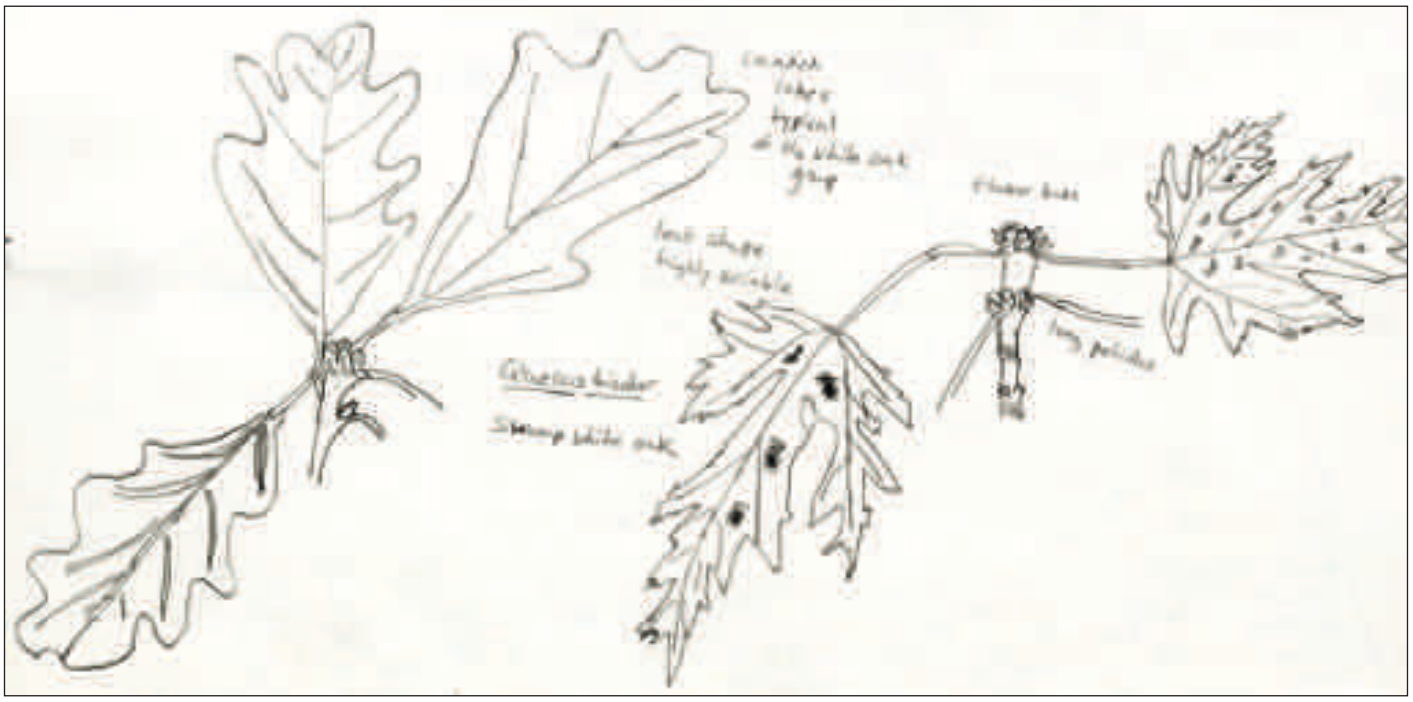
Santa Lucia fir sapling

This wasn't my first experience with impossible promises. A brush with Zen Buddhism in my early twenties exposed me to one vow in particular that would change my life: "Beings are numberless; I vow to save them." Never mind that what the Buddhists actually meant was bringing all beings to enlightenment. I took the phrase literally: beings were dying. I had to save them. What could be simpler than that? Quietly, without any fanfare, I knew I had found my vocation.

On the botanical front, at least, there were historical precedents for saving species. Take the gingko, extinct in the wild, grown for centuries in Asian temple gardens. Its close kin, the dawn redwood, had been propagated in botanic gardens across the world from a small relic population in China. There was the Wollemi pine from Australia, the Franklinia tree from North America—plants rare or extinct in the wild, persisting mainly through our efforts to cultivate them. With habitat in danger, the only possible safety was to scatter the seeds as widely as possible.

My vow to the Santa Lucia fir would send me off into the depths

*"This wasn't my first experience with **impossible promises.**"*



Swamp white oak sketch by the author

of the backcountry and university research archives in fruitless quests, throwing rocks at trees to knock out the fragile cones too high for me to reach and poring over what little literature was available. Despite my earnest commitment to seed dispersal, the trees refused to cooperate, and the papers I found were sparse on the details of propagation and ecology that I needed. My impulsive promise proved to be even more unattainable than I had ever anticipated.

Frustrated in my efforts with the firs, I expanded my repertoire to other species to practice essential seed dispersal skills—learning to speak the language of seed, coaxing bare sticks to grow roots and leaves. "Applied botany," I dubbed this trade on more than one resume. Like a squirrel, I collected things incessantly—leaves in my hair; bits of germplasm rattling around in my pocket; paper envelopes, painstakingly labeled, that rattled when you shook them. Slowly, slowly, I began to find my footing in that nebulous zone where human categories break down: somewhere between botany and gardening, knowledge and intuition, wild and tame.

Ironically, the place where I eventually found Santa Lucia fir seeds was a botanic garden hundreds of miles away from the tree's current habitat. It was further proof, as if I needed any, of the value of spreading seeds across a wider range. Sometimes the only way for a species to come back home is if it travels first. As long as individuals exist somewhere, there's always hope.

Only a handful of firs are alive today because of my efforts. This is as humbling as it is heartening. Far away from the California wilderness, I still dream of gardens dotted with Santa Lucia firs, gardens that don't yet exist but one day will. But like those young saplings, I've encouraged my ambitions to grow slowly and quietly, setting down deep roots and establishing a firm foundation before shooting forth above the surface. It takes time to grow a forest, time to learn, and everything starts out small and tender in the beginning.

The Santa Lucia fir was the first obsession I had that pushed me to challenge accepted opinion about what could and couldn't be grown—not because it was sophisticated and trendy, or because it was a cure for cancer or boasted showy flowers, but because I couldn't imagine the world without it. As a relationship grew between us, I realized that taking care of the firs also meant taking care of myself, that taking responsibility for life was an antidote to despair and disconnection engendered by human destructiveness.

Other plants lure seed dispersers with rewards of nectar and pollen. I am lured by love. There is no good reason for me to love this species, no rational argument I could make to justify my zeal to perpetuate its lineage. Love is not rational. I have not forgotten my promise, my hopeless, impossible vow. I have got the seed-dispersal bug, and in whatever way I can, with this species and with others, I'll keep spreading seeds.

Illustration, Photograph by Katherine Hale
Historical sketch from Wikimedia Commons

Getting to the Center of the World

Ellen Gawarkiewicz

Ice surges and retreats like a living being. It forms, advances, and melts—a constant metamorphosis, sometimes stark and silent and other times crushing and clamorous. Depending on the temperature, the wind, and the sun, ice takes a different path of evolution every winter, every day, every hour. Ice formations coat mountain boulders and decorate apartment eaves, cling to arching branches and hang from cars like teeth.

Despite all this variability in structure, most of us don't note the radiations and transformations as ice grows and shrinks. One reason for this blindness is our lack of varied vocabulary for ice. On a bluebird morning, for example, when a freeze follows a partial thaw, a coating of ice on twigs can illuminate an entire tree against the sunlight. The term for this in Devon, England is *ammil,* "enamel." In the Inuktitut dialect of Nunavik (Arctic Québec) it's known as *igalaujait*, "which looks like windows."

If we can't talk about what we see, then the magnificent diversity of solid water is encompassed in the single word ice. In contrast, other British synonyms bring fresh spirit to the familiar icicle: *aquabob* in Kent, *clinkerbell* and *daggler* in Hampshire, *cancervell* in Exmoor, *ickle* in Yorkshire, *tankle* in Durham and *shuckle* in Cumbria. Specific vocabulary empowers deep knowledge. Researchers are now looking at Inuit languages to understand how natural patterns of place have changed over their recorded history. The book *SIKU: Knowing Our Ice* (2008)[1] gives an overview of indigenous insights into sea ice fluctuations and movement in myths, stories, and historical records. SIKU includes a lexicon of sea ice terminology in Nunavik made up of 93 terms. These include *qautsaulittuq*, ice that breaks after its strength has been tested with a harpoon; *kiviniq*, a depression in shore ice caused by the weight of the water that accumulated on its surface during the tide; and *iniruvik*, ice that cracked because of tide changes and that the cold weather refroze. For many arctic communities, the knowledge of sea ice is central to their identity and resilience, the accumulated wisdom of their ancestors.

More and more this intimate understanding of the local is being replaced by the general and global. In school we learn the names of far-off fauna, focusing on life in the rainforest instead of life in the schoolyard. We know all about the habits of the lion, but do we know the lion-like teeth of the dandelion behind the school (from the French *dent de lion*)? Emergency room visits by pedestrians injured while walking with cell phones tripled from 2004 to 2010, even though the total number of pedestrian injuries dropped during that period.[2] Increasingly we're walking through the world without really

Photographs by Ellen Gawarkiewicz

seeing it, our minds enveloped in the distant places held in our cell phones instead of the present and local.

There is an impulse today to hurry through headlines, travel with urgency, and eat meals in haste to absorb all the information available at our fingertips. Yet going slowly allows us to see less, to really see more. Annie Dillard in *Pilgrim at Tinker Creek* encourages "a healthy poverty and simplicity" in looking at the "pennies" in the world around us. These are the natural phenomena we look at each day, but may not truly see. "What you see is what you get," she advises. It is a simple yet invigorating philosophy. You need not add to get more out of your view of the world, but instead train your eye to change what you see.

When we slow down enough we can find mystery in the most unassuming places. Dillard found perplexity and wonder in suburban Virginia. Henry David Thoreau liked to observe that he had "travelled widely in Concord, Massachusetts." The intense concentration on the local is a creative approach to seeing the world. Small spaces magnify imagination. Closeness deepens vision. The more you look the more you can take on the perspective of a honeybee's compound eyesight—a mosaic of different perspectives. Nan Shepherd writes, "I knew when I had looked for a long time, that I had hardly begun to see."[3]

Perhaps more accessible than the view of a bee is the perspective of a child. Children transform the ordinary and known to the extraordinary and unknown. They can turn a backyard into an entire world. Near my childhood home on Cape Cod there is a small channel between two ponds. I remember paddling through a tunnel of grapevines and arching maples, this small dribble of connection a secret path to an uncharted world. My family has always called this passage Fern Gully, and consequently this hollow in the tangle of pond-side vegetation has always been a hallowed space to me. This was my Amazon, where lily pads silently bowed in our path and the sunning painted turtles were so unaccustomed to humans we could scoop them up with nets.

"Small spaces magnify imagination. Closeness deepens vision."

It was children who inspired my inspection of ice patterns. They pointed out dragon teeth and dogs, cows and cathedrals under my feet. They were just beginning to explore the small patch of woods by the houses to which they recently moved. Their new homes transformed from frightening to refreshing as they learned the names of the trees and track patterns of their neighborhood. They lived on Tall Pines Drive, and became acquainted with the street's namesake, the White Pine. By drinking tea from its needles, rubbing its bark, lying down under it, and climbing its branches, they connected the name with their home and consequently tied themselves to the place. Naming allowed the children to slow down, and they were eager to become keepers of the names, passing them on to the new nature walkers each week.

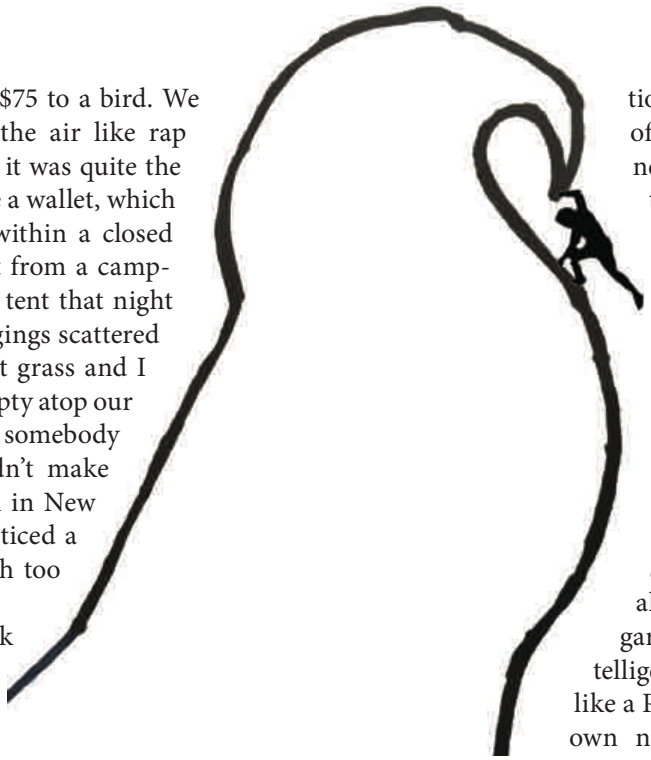
These children were refugees from Somalia, who had most likely never seen ice before they moved from refugee camps in Kenya to the forests of Maine. These children from the other side of the world taught me to see the familiar. What I'd seen all my life became strange and captivating.

Black Elk, a famous Lakota medicine man, said, "Anywhere is the center of the world." Going slowly, equipped with a local lexicon and simple child-like vision, we can get there.

1. Krupnik, I, Aporta, C, Gearheard, S, Laidler, G, and Kielsen Holm, L. Knowing Our Ice.
2. Nasar, J, and Troyer, D. (2013) Pedestrian injuries due to mobile phone use in public places.
3. Shepherd, N. The Living Mountain.

Calling It Even

Jamie Ervin



My friend JP and I once lost $75 to a bird. We weren't waving money in the air like rap stars or anything. Actually, it was quite the opposite: our money was nestled inside a wallet, which was packed into a nylon stuff sack, within a closed backpack, inside my tent, only 20 feet from a campfire where we sat. We returned to the tent that night to find a chaotic scene with our belongings scattered everywhere. My clothes lay on the wet grass and I was missing a sandal. JP's wallet sat empty atop our heaped sleeping bags. I was certain that somebody had broken into our tent, which didn't make sense considering our remote location in New Zealand's Southern Alps. Then, we noticed a hole cut into the side of the tent much too small for a human.

I'll explain more, but first let's back up a bit. At that time, JP and I had just begun a three-month rock climbing trip to New Zealand's South Island. Several months earlier, after seeing a photo of the psychedelic limestone blobs of Castle Hill, we had made a last minute decision to cancel a planned Appalachian Trail thru-hike in lieu of experiencing this otherworldly landscape for ourselves. That photo inspired a powerful mental image of paradise in our imaginations, so powerful in fact that neither of us did any research on New Zealand before getting off the airplane in Christchurch. We simply showed up, bought a map, and started hitchhiking towards the mountains.

New Zealand's landscape is noteworthy for its lack of predacious animals and poisonous plants (unlike the long list of things that can kill you in nearby Australia). JP and I joked about this during one of our first nights out, laughing at how safe we felt in a landscape that seemed like it should be teeming with jaguars and pythons. As usual, though, nature offered up a more complex and sobering experience than we had expected.

Cue the scene with the mangled tent and stolen money. After inventorying our stuff, JP remembered that earlier in the day we'd been warned to watch out for unusual green parrots called keas. These notoriously curious birds are infamous throughout the Southern Alps for harassing humans and tampering with their belongings. We had initially brushed off this warning as overly dramatic, but now as figurative lightbulbs lit up above our heads, we concluded that we'd actually been robbed by birds, not humans. Not only had the keas stolen our money, they had then scattered each individual bill in a different location within a 30-yard radius of our tent. We spent the next hour crawling around the wet, pitch-dark southern beech forest trying to recover what cash we could by headlamp. We went to bed that night exhausted, cold, wet, angry, and annoyed, but I also remember feeling impressed by my assailant's ingenuity.

"Much like a Pokémon, it shrieks out its own name constantly, making its presence known throughout the mountains."

The kea (*Nestor notabilis*) is the world's only alpine parrot and is regarded as one of the most intelligent birds on earth. Much like a Pokémon, it shrieks out its own name constantly, making its presence known throughout the mountains. Keas nest in rock crevices in alpine and subalpine areas, and they have evolved a strong creative capacity and omnivorous stomach in order to survive in harsh mountain habitat.

Perhaps most notably, the kea is known for neophilia, or love of all things novel. Combined with their intelligence and creative capacity, keas have an unending drive to investigate and tinker with the many shiny objects that humans bring into the birds' habitat. Relentlessly self-assured, keas are constantly stealing or destroying people's belongings, sometimes right in front of the victims. In snowy ski resort parking lots, keas have been known to rip the lining out of car windshields, causing the windshield to collapse. Bikers in the Southern Alps can't leave their bikes unattended because keas will tear up bike seats. National Park staff frequently re-inflate car tires because keas enjoy pressing deflate valves with their beaks. I like to imagine a scene where a kea steals a pair of binoculars from

Illustration by Lyra Brennan

a nerdy birder just as the birder remembers the species' scientific name.

It's been nearly seven years since I left New Zealand, and the incident with the stolen $75 still sticks in my mind. This was the first of many novel encounters with keas during our trip, and with each mishap I grew more torn between feeling annoyed and awestruck by the species' boundless ability to tease me in creative ways. To this day, I think of these kea incidents when I want some tangible reminder of what my life was like during that trip. Still, I can't help but feel that these encounters resonate with me for another reason.

New Zealand bears a history of resource extraction much like the rest of the colonized world, but on an accelerated scale. Prior to human settlement, the nation was around 80 percent forested, with the other 20 percent confined to high desert, grasslands, and alpine areas. European settlers cleared all but a fraction of these forests throughout the 19th and early 20th centuries, converting much of the land to agriculture or exotic timber lands. Kiwis voted in 2002 to protect their remaining old growth forests, but modern New Zealand remains visibly divided into contrasting compartments of wild and tamed land.

When I arrived on the South Island, I was learning to view the world through a natural history lens. When I read accounts of the island's historic landscape, I couldn't believe that the open pastures I saw stretching in every direction were once ancient forests. It seemed unfair that a group of foreigners could just show up in boats, claim a place as theirs, and then alter it beyond recognition.

I think that this is why my experience with the keas sticks out in my memory and still makes me chuckle. As a species, we take so much from nature and give ourselves far too much credit for the little that we give back. We complain about small taxes and fees that enable us to support a system that makes our quality of life possible in the first place. I remember being enraged that night when I discovered I'd been robbed by a bird, but in retrospect, I value the irony of nature finally taking something directly from me.

That kea deserved $75 for knowing how to pester me in such a personal way. The lesson and story that I took from that encounter are easily worth the money. And so, seven years after the fact, I salute keas for their creativity, their mischief, and most of all for their total disregard for the concept of property.

"We take so much from nature and give ourselves far too much credit for the little that we give back."

Deforestation in New Zealand

Photograph by Gabe Andrews

Cohort AG: The Class of 2017

Gabe Andrews

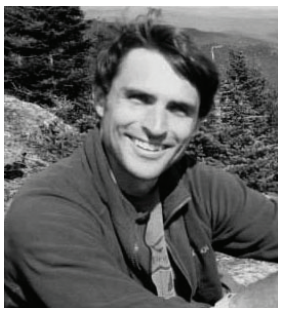
I've gathered many shoreline stories and summer swims, most confined to the lakes and rivers of land-locked Ohio. After graduating from four years of general biology, I made a beeline to the Chesapeake Bay. I spent the next half-decade surrounded by tidal marshes and wrack lines of smooth cordgrass along the Atlantic coast. I deployed diamondback terrapins and loggerhead sea turtles to connect communities and conservation. My passion centers on the dynamic space where aquatic and terrestrial worlds collide. When I paddle cobbled creeks or wander battered shores, Loren Eiseley reminds me that "if there is magic on this planet, it is contained in water." But such a mystic world may also yield unpredictability. This summer, I will partner with the Vermont River Conservancy and the communities within the New Haven River Watershed to understand and build resilience to the volatility that water brings.

Sean Beckett

My appetite for natural history ignited upon hearing my first dawn chorus of tropical songbirds as a teenager. Addicted to unearthing such hidden treasures, I attended Vassar College to study biology and environmental studies and went on to research puffins in Maine, owls in Idaho, and Clark's nutcrackers in Wyoming. I eventually settled in the peripheries of Yellowstone National Park, guiding wildlife safaris and sharing the West's wolves and grizzlies with inquisitive nature lovers for four years. In the winter, when Yellowstone's ecotourism traffic waned, I traversed the Canadian arctic, introducing my guests to polar bears, gyrfalcons, and arctic foxes. Hungry for more knowledge, I have migrated back to my Vermont home to further develop my naturalist toolbox. This summer I will be working with the PLACE Program to deliver a collaborative place-based engagement and education series to connect the Burlington community to its natural and cultural resources.

Lyra Brennan

Whether I'm clambering into the alpine zone or out of tidal pools, I strive to understand the interwoven pieces of the natural world. To that end, I've studied human evolution, biology, and theater; guided outdoor adventures on the Eastern seaboard; and written and directed a play about the wild roots of New York City. My recent work lies in critical habitat and species conservation and includes research on the effects of climate change on marine species. I also spent two years monitoring and managing endangered shorebirds and facilitating interagency cooperation as a Conservation Fellow for Mass Audubon. As an Ecological Planner, I am learning to detect changes as subtle as new streams or as powerful as storm tides. This summer I will assess the wetlands and mountains of the Pond Brook Watershed in Monkton, Vermont. I'll use my observations to encourage stewardship and protection of rare and significant resources by people in surrounding communities.



Jamie Ervin

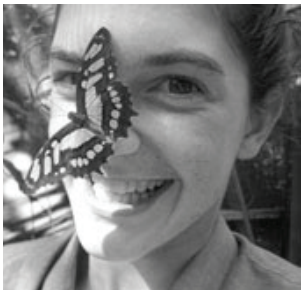
Spontaneity, well-timed indecision, and excessive love for mountains have all guided my seemingly random path. Hailing from the craggy peaks and deep forests of western North Carolina, I grew up rock climbing and backpacking as often as possible. After gaining a B.S. in Environmental Studies from the University of North Carolina at Asheville, I spent several years protecting land with the Southern Appalachian Highlands Conservancy. There, I split my time between ecological and legal work, both of which I enjoyed. So when the time for graduate school came, I faced the odd dilemma of not knowing whether to study environmental law or field ecology. Luckily, I managed to discover a one-of-a-kind dual program in Vermont where I'm pursuing an M.S. in Natural Resources alongside a Master of Environmental Law and Policy degree at Vermont Law School. This summer, I'll be working with a North Carolina conservation group, Mountaintrue, to create a LIDAR-based model for mapping unlogged stands of Appalachian Cove Forests.

Ellen Gawarkiewicz

By age six, I had my life figured out: I would be a naturalist in the summer and a teacher during the school year. Following this path, I've unearthed a passion for connecting people and place through a shared sense of wonder. As I've taught, I've learned—from the salt marshes of Cape Cod to the beaches of Madagascar, the lakeshores of New Hampshire to the rivers of Maine, the forests of Minnesota to the Himalayan foothills of Nepal. I plan to combine my love of learning and teaching by embracing the life of a naturalist/environmental educator and by writing children's books. I invigorate my own sense of wonder by going on long, wandering walks and paddling around ponds, sneaking up on unsuspecting turtles. This summer I'll bring the integrated, place-based FNEP approach to UVM students by crafting an undergraduate field naturalist summer program curriculum.

I grew up rambling through the abandoned fields and regenerating forests of central North Carolina, no matter the weather. Despite falling hard for geometry and rhetoric while studying classics in college, I reengaged with my childhood love of "natural philosophy" and dedicated myself to life as a naturalist-scientist-adventurer. Some adventures thus far: poking in the inner vaults of the Natural History Museum in Washington, D.C., timber framing and wildlife tracking in the woodlands of upstate New York, raising vegetables and hauling irrigation pipes in the Pacific coastal fog belt, and botanizing extensively in the California wilderness. On warm nights, you'll find me under the porch light looking for moths—unless it's raining, in which case I'll be out wandering.

Katherine Hale



Hannah Phillips

My world unfurled the day I first saw a topographic map. Suddenly, the patterns in the woods behind my central Vermont home resolved in two-dimensional space. I am drawn to experiences that similarly shake my view of the natural world. As an undergraduate, I obsessed over social insects, provoking a bullhorn acacia in Costa Rica to watch it writhe with ant defenders. Later, I embraced teaching as an opportunity to take middle and high school science classes on herpetological missions to vernal pools, tracking expeditions to Utah's sandy washes, and spring ephemeral walks in the Alps. Now, as a graduate student, I am experiencing another shift in perspective of topo-map magnitude as I relearn the landscape of home. This summer I'll traverse the Atlas Timberlands in northern Vermont in search of state-significant natural communities, a project sponsored by the Vermont Land Trust and The Nature Conservancy.

I've always struggled with a passionate attachment to place. As a kid roving the Vermont woods I would throw my arms around certain trees, thinking that I would die if they were cut down, that I could never bear to leave them. Yet I did leave, transplanting myself in places as far-flung as Boston, Rome, and Senegal. Each time, no matter how foreign the soil, my roots reached for purchase and took hold. For the last five years I roamed the granite canyons and volcanic tablelands of California's Eastern Sierra; the day I drove away I felt a physical pain. Conservation work is the best way I've found of expressing this almost too-fervent love of home. Knowing a landscape gives you insight into the problems it faces, and a reason to seek solutions. This summer I'll return to California, where I'll write an Environmental Assessment to guide management of a fragile high-desert hot springs. I can't wait to be back among the peaks and valleys where I left my most recent set of roots.

Julia Runcie

Anya Tyson

I have chased lots of wild animals in my adult life—birds, wolves, mountain lions, and adjudicated teenage boys. As a wildlife technician, I followed creatures into the most magnificent corners of Wyoming. Then I traveled deeper into the landscape of the human experience through my work at a residential and wilderness therapy center. I cooked huge family dinners, pointed out winnowing snipes, and reminded the dudes that the score was always "fun to fun." Roaming alpine meadows with my charges, I did my best to combine therapy and botany. Keying out wildflowers keyed me into the Field Naturalist program. I dispersed to Vermont to find excellent habitat for an intellectual generalist like myself. However, my home range remains out West. This summer, I will return to Wyoming to engage the National Outdoor Leadership School and the Teton Science School in a citizen science project investigating Clark's nutcrackers.

Going Places: Alumni Spotlight

Alicia Daniel

When Hub Vogelmann first envisioned the Field Naturalist Program nearly 35 years ago, he dreamed of training an elite corps of men and women who would go out and change the world. Little did he know how profoundly some of these men and women would go on to change the conservation landscape in his home state of Vermont. Field Naturalists and Ecological Planners (FNEPs) approach their work with an emphasis on connections at the landscape level. In this issue of Field Notes, we set out to map how FNEPs in Vermont—nearly 60 graduates—are connected to one another professionally, and how those networks support conservation in the Green Mountain State.

We've heard from graduates who play integral roles in training new FNEPs at the University of Vermont, and others who help to shape the course of powerful organizations like the Vermont Department of Fish and Wildlife, The Nature Conservancy, and the Vermont Land Trust. Graduates have shared with us their innovations, from outdoor education programs like Crow's Path to natural heritage databases like BioFinder 2.0 to far-reaching conservation partnerships like the Staying Connected Initiative. FNEPs stay linked to one another through non-profit boards, gardening co-ops, watershed alliances, education conferences, and environmental consulting projects. This web of connections grows each year.

If you're an FNEP living in Vermont and you don't see yourself on this map, please contact us. We would love to hear your stories. We hope this will be the first of a series demonstrating where FNEPs are now, and how they are carrying on Hub's legacy throughout the world.

Alicia Daniel, Cohort E, teaches courses at UVM on reading the landscape.

Brad Meiklejohn
Field Naturalist
Cohort J

Brad Meiklejohn is Alaska State Director for The Conservation Fund, where he has worked since finishing the Field Naturalist Program in 1994. He served for two years as President of the Patagonia Land Trust, working with Doug and Kris Tompkins to create two million acres of national parks in Chile and Argentina. Brad is also President of the American Packrafting Association and has explored remote wildlands by packraft on six continents.

Creativity implies cleverness, but the root word is "create." For the past 22 years, since leaving the Field Naturalist Program in 1994, I have been working to create a place for wild nature.

For a kid from New England, there is no bigger sandbox than Alaska. I grew up on a tributary of the Connecticut River but never dreamed to go looking for salmon there. As I walked a beach late one night in Alaska's Glacier Bay, small chewed sticks led me face-to-face with five wolf pups and their mom. Now, thanks to that experience with Greg Streveler and the FN program, I can go to the creek below my house here in Eagle River and see spawning king salmon.

Hub Vogelmann hooked me up with The Conservation Fund, and the Fund gave me the license to create space for big wild nature here in Alaska. It has been a fantastic ride with the most creative conservationists I know, advancing hundreds of projects that have protected over 300,000 acres of wild lands in Alaska. At the moment I am working on a dam removal project that, once completed, will open a major river to five species of salmon.

I have come to think of Alaska as the model for how conservation can work. It's the closest place I know to E.O. Wilson's idea of Half-Earth. We still have our salmon, we still have our wolves, we still have our subsistence way of life. Let's not confine wildness to Alaska, though, which to me is like relegating happiness to heaven; you may never get there. We can recreate wildness everywhere.

You don't have to be clever to make a difference. You have to be dedicated and passionate and relentless. Think as big as you can, then go create it.

Kathleen Fitzgerald
Field Naturalist
Cohort O

Kathleen is the Vice President for Land Protection for the African Wildlife Foundation (AWF) in Nairobi, Kenya. She has more than 20 years of experience directing landscape-scale conservation and community engagement. Prior to joining AWF, Kathleen held key positions at the Stowe Land Trust and the Wildlands Project, and she was a co-founder and Executive Director of the Northeast Wilderness Trust. Since joining AWF, Kathleen has helped create community conservancies, secured wildlife corridors, improved management of protected areas, and supported the design of businesses for conservation. Kathleen has lived in Africa since 2007 and recently contributed to Island Press's Protecting the Wild *with a chapter on the role of protected areas in Africa.*

It has been two decades since the O-Team graduated from the Field Naturalist Program. However, Friday Field Walks, a week in the Maine woods with Bernd Heinrich, and identifying ferns with Dave Barrington are still vivid in my memory. Likewise, the overarching theme of the program—using science to inform sound conservation decisions and interpreting a landscape for conservation design—is central to my work today.

A decade after graduating, I moved to Kenya to work for the African Wildlife Foundation. AWF was founded in 1963 and works with the people of Africa to ensure the wildlife and wildlands endure forever. Africa hosts a significant percentage of the globe's biodiversity. Its wildlife diversity and density remain unparalleled on any other continent. From the elephant herds of Botswana to the wildebeest migration in eastern Africa to the mountain gorillas in Central Africa, the continent holds some of the world's most unique and precious wildlife.

Africa is rapidly changing, and it is a fascinating time to work on the continent. Africa hosts some of the fastest growing economies in the world, human population is increasing, agriculture is expanding, and infrastructure development is booming. As a result, Africa's biodiversity is threatened; habitat loss is one of the silent killers. Elephant and rhinoceros are in peril by a severe poaching crisis.

Despite the threats and pace of change, I remain optimistic that with strategic planning and investment, Africa can host productive economies while simultaneously supporting biodiversity. It goes back to what we learned in the FN program: read the landscape—the ecological, social, political, and economic landscapes—and use that information to design smart conservation outcomes. The FN program training equipped me with the skill sets required in my current posts, and for that I am grateful.

That Blinding Flash of Beauty

Bernd Heinrich

It is not easy being a beginning graduate student. It was one of the most frustrating times of my life. I was interested in nearly every living thing, and I also had time and energy. But for a long time I struggled to do something worthy of a thesis problem; I lacked the capacity to "perform."

I suspected that pretty much everything was known and, if not, someone was already working on it. I felt uncreative compared to my peers who were happily humming along on exciting research projects that they would soon publish in scientific journals. I made what I hoped was a creative try at something that seemed new, and I failed. Finally, I hit on a project associated with my childhood love of caterpillars and moths and scored big.

The scientific discovery I made was immediately deemed highly "creative," though it had little to do with wild imagination and less to do with luck. My success stemmed directly from my previous intimate contact with caterpillars and moths, as well as my familiarity with other animals. Strange as it may seem, there appears to be a recipe for this type of creative success.

It is not always obvious what creativity is, much less how to acquire it. Though it may be hard to define, you know it when you see it. The classic example is the ancient mathematician and scientist Archimedes of Syracuse. While reclining in a bath he suddenly knew how to determine if the king's crown had been made of pure gold or diluted with an alloy, and in the joy of his discovery he jumped up and ran naked into the street shouting, "Eureka! Eureka!" Another old favorite is August Kikule, who woke up realizing he had deciphered the carbon ring structure of the benzene molecule from his dream of a snake biting its own tail. Pure luck? Genius maybe? Both Archimedes and Kikule were leading scientists of their age and of the ages.

Prescribing sleeping and saunas to engender creativity is simplistic, but there is some truth to it, though likely it is much less than a half truth. To see what creativity is and how we might more actively acquire it requires going beyond these examples.

Creativity most broadly interpreted means producing the new, a divergence from the tried and true. But this deviation isn't necessarily good or even desirable. "Creativity" is just most famously quoted when it produces improvements, so that it is now generally assumed to be synonymous with good. However, the new can also be ugly, and if the new and the surprising are the only criteria for creativity, they might act like a Trojan horse, distracting the viewer from true creativity, which requires something more.

Archimedes' creative discovery relating to weight and volume not only determined the percentage of gold in the king's crown then; it is applied broadly still. Kikule's insight was highly creative because it solved a long-perplexing riddle and made possible the synthesis of new and useful chemical compounds. Our concept of creativity is so biased to that which we consider good and true that we automatically disassociate creativity from anything that turns out to be unpleasant from our perspective. I adhere to the viewpoint that to be creative does mean to bring forth something that is desired and useful and not just new or different.

The importance of problem solving and utility as components of creativity cannot be over-stressed. The creativity that excites us is in reference to something useful or beautiful. But I posit further that the distinction between the useful and the beautiful is thin: when one engenders something as creative as Kikule's singular insight into the relationship of the six carbon atoms in benzene, this is first of all perceived as beautiful and only second found useful and proven beautiful. Similarly, the running-in-the-street-naked excitement of the mind in reaction to the rare comes from sensing beauty, which is validated not only because it is rare, but also because it is true.

A good friend, an artist bucking a modern trend in art, told me the secret of being creative: "A mind which is creative has to be fully prepared. Know the literature, do the math, know history and the techniques, be prepared just like a runner who trains for a race." As the late runner Steve Prefontaine pointed out, a great race is also a work of art because, as he well knew, talent is required to run fast. But that alone is not enough to win. Mental skills are applied to solve the problem of defeating a particular field and adapting to unique circumstances as the race unfolds. And that, too, is not enough; the unworldly effort is a third term of the equation.

The race as such serves no other purpose. But like a sculpture or a painting it has beauty as a desired product. The degree of beauty arises from how well it is done. It is the rare product of talent, craft, and effort. The sum of these components makes it unique, and this is where beauty is derived. Creativity may require a unique idea, but like salt to the soup, this is just one of the ingredients that make it great—or not so great. A massaged lump of clay may have an original shape, but it took neither craft nor effort to produce and, therefore, cannot compare to fine art like Michelangelo's statue of David. That statue, a rarity carved out of marble, required talent, craft, and effort to produce.

Finally, active involvement in a subject can also involve the unconscious mind, which is best engaged in the absence of distractions. Under sensory deprivations—such as in sleep or in the sauna—our subconscious minds are encouraged to make new connections with previously amassed trivia, perhaps to create a Eureka moment, that blinding flash of beauty. But we won't produce such results without desire, patience, and discipline required to travel the long path in pursuit of excellence.

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

Illustration by Bernd Heinrich

Saxophones and Saxifrage: Where Natural History Meets Jazz

Sean Beckett

In an apocryphal story from the annals of jazz lore, a stranger woke on the floor of a smoky New York hotel room shared by two of the greatest legends in American music. Dim morning light seeping through the blinds illuminated John Coltrane, hunched on the edge of a vinyl chair playing licks on his saxophone, and Thelonious Monk, out cold on the bed. Somewhere between meditation and frenzy, Coltrane drilled imaginative, improvised passages again and again, turning them around and backwards, modulating them through every key and working every tempo. The stranger left to tour the city for the day, returning 14 hours later to find Coltrane in the same place, horn to his lips. The licks were different, but the room was still smoky, the blinds still half-drawn.

Jazz is an improvised, unscripted conversation between the soloist, the band, and the audience. The swirling music evokes a feeling, and the fingers and breath channel what the spirit has to say about it. Those endless practice trances built repertoire that Coltrane retrieved to bare his soul fluently when the moment presented itself. This is called "woodshedding" in the jazz world: chopping and stacking musical ideas for future use.

The naturalist is cut from Coltrane's cloth. I practice bebop scales on a trumpet for the same reason I devour textbooks on bear biology, pore over medicinal mushroom guides, or stare at a coyote track for an hour. It's woodshedding: building the notes and phrases to express something significant when that solo comes around. As naturalists, we are enamored of nature's complexities and captivated by discovering them. That motivation is the product of our own passion, like the enraptured saxophonist playing scales for 14 hours.

Most people are also deeply motivated by a need to express. We want others to understand what makes us tick. "The main thing a musician would like to do is give a picture to the listener of the many wonderful things that he knows of and senses in the universe," Coltrane explained in a 1962 DownBeat Magazine interview. "I think that's one of the greatest things you can do in life and we all try to do it in some way." So we drill scales in that vinyl hotel room chair because expressing our souls on cue takes practice, whatever the vocation.

As naturalists, we often find ourselves in the performer's role, where we can simultaneously realize both of those deep motivations: to exercise our passions and to express ourselves. We should recognize those moments in the woods with an audience as the rare opportunities they are. They're

Photograph by Sean Beckett

the personal and unfettered occasions when layers of pressures and obligations fall away, and we try to deliver simple experiences like those that shaped us.

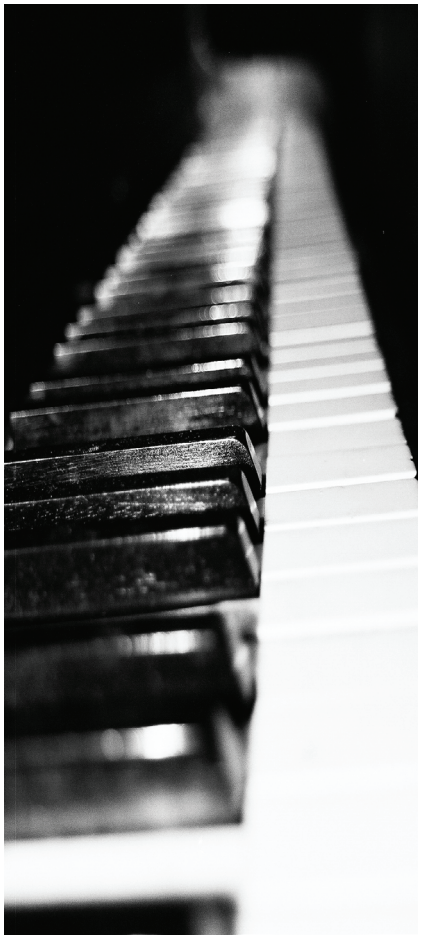
If we trace the origins of our love of nature, we find particular occasions in the woods that rocked and redirected us. I have powerful memories of my father showing me a scarlet tanager in the back yard, and a middle school science teacher bringing me on a mission to catch moths with a UV light. Consider your own similar examples, and you'll often find someone else orchestrating those experiences. Whether it was an enthusiastic park ranger or a loved one nudging you toward something you might otherwise have overlooked, that person set you up to be profoundly affected.

We need to respect these high-stakes opportunities when they arise by knowing what we're trying to deliver. Remember that song—maybe it's your favorite—that came on the radio at a powerful time in your life. All the sounds jibed with the notes and lyrics, just right, and the sound sizzled through you. That feeling satiates and nourishes. It makes you scrunch up your nose, close your eyes, and quietly go, "Yeah!"

And that feeling pervades humanity. It's resonance in its purest form: your insides vibrate because you are exactly in tune with what you're receiving. It's when the baseball connects with the bat just right, it's biting into a PB&J on top of a mountain or a really good phone call with an old friend. Everyone resonates differently, but when we reflect upon these moments, we find that they are the punctuations—or even the chapter breaks—of our lives.

The performing naturalist aims for that resonance. Like a jazz musician, we play the woods as a piano, riffing on improvised arrangements of repertoire and unrestrained enthusiasm to ignite points of resonance that connect our audience with the woods. For the frequent-flyer businessman in the audience, the naturalist plays the arctic tern that flew nearly a million miles in its lifetime. For the real estate agent, the naturalist plays the 150-year-old stone wall, covered in moss, representing the first subdivision in the entire town. For the doctor, it's the willow bark containing the compound that inspired aspirin. For the police officer, it's holding the mushroom that was found in the pocket of a 5,000-year-old murder victim. When treated as an improvisational art, the simple nature walk becomes a most powerful tool.

"When treated as an improvisational art, the simple nature walk becomes a most powerful tool."



This type of sorcery, the conjuring of meaningful experience, was Coltrane's goal. "I would like to bring to people something like happiness," he said. "I would like to discover a method so that if I want it to rain, it will start right away to rain. If one of my friends is ill, I'd like to play a certain song and he will be cured; when he'd be broke, I'd bring out a different song and immediately he'd receive all the money he needed." Likewise, the skilled improv naturalist wields a vast array of tangible and abstract features on the landscape, curating and channeling them to resonate with the very psyche of his audience over the course of a few hours or even a few years.

We rarely look to musicians for professional advice, but Coltrane's philosophy extends beyond earshot of his saxophone. Inspiration is every naturalist's role, whether or not it's written in the job description. We are all driven to express passionately what we find most profound. If we didn't oblige, we'd be jazz musicians who never took the stage. This takes practice, but it especially takes courage. At some point we must take our armload of butterfly chrysalises and saxifrage sprouts, leave that smoky hotel room, and perform.

Photograph by Sean Beckett

Invisible fences

Lyra Brennan

Someone has stolen my hammer off the seawall. I need it to install symbolic fencing for the federally threatened piping plover, *Charadrius melodus*, in Revere, Massachusetts, an urban beach town five minutes outside of Boston. Charismatic and sand-colored, plovers put down their nests—shallow scrapes in the sand—in impressively illogical places, like between a lifeguard station and the water. It's my job to track and protect these birds while they're here for the breeding season from March to September. My work usually begins with locating a nest and shaking my head at the daredevil location.

Revere Beach is hardly a typical shorebird sanctuary. Heralded as the first public beach in America in 1895, bathers once flocked to Revere for carnival rides rivaling Coney Island, rented bathing suits from gilded bathhouses, and visited the dance halls that lined the seawall. Today, Revere holds fast to its reputation as a beach destination for thousands of inner Boston families eager to tan to a crisp, rollerblade along the seawall, or grab a drink at the Shipwreck Lounge across the way. Revere has a long and storied cultural history, none of which has anything to do with threatened shorebirds, even though they historically nested here in great numbers. So how do I make the bronzed masses care about the piping plover?

Hammerless, I set off down the beach hoping to intercept the thief, en route to check on my most fearless brood. Through my binoculars, I see two adult plovers squabbling over territory, and a human couple walking towards me. There's no mistaking Lou's signature leather vest and fedora and Marilyn's impeccably coiffed hair. Surely they'd recognize my hammer if someone had passed them carrying it.

"Whaddaya mean someone stole it?!" Lou is outraged and looks to his wife. "You seen the hammah? You seen anyone carryin' a hammah?" (As a Boston native, I appropriate the accent here with pride rather than derision.)

"It got stolen jus' now!" Marilyn replies indignantly. "Of co-as I haven't seen it!"

But Lou has an idea. "I got tons-a-hammahs 'cause I work construction. What kinda hammah is it? What cullah? Like a basic hammah or a mallet? I'll bring yah a hammah if yah need a hammah."

Lou and Marilyn walk the beach every day, and after learning to identify piping plovers, they never fail to notice the birds—or me. Marilyn has been particularly excited lately about her idea to put facts about endangered shorebirds on cereal boxes. She insists that if younger kids see the birds on Cheerios boxes, they'll "staht to cayah in time." To my delight, every time I see her, she reminds me to call General Mills.

The day creeps towards 100 degrees, and through the haze I spy a pair of adult plovers that return to Revere Beach every year to nest on the same crest of dune. When I reach the intertidal zone, the male struts up to me and cocks his head with a blustery *peep-lo!* While adult plovers seem curious about humans, they transform into hyper-protective parents when guarding their vulnerable young. Young chicks resemble cotton balls with adult-sized legs, running toward the water to feed minutes after they hatch. It's easy to tell when a

hatch occurs, because the chaotic fuss of peeping is audible from half a mile away. Thanks to the vigilance of adult plovers and the agencies working to protect them, chick survival rates are high in Revere. I spend many peak summer days trying to maintain a safe travel corridor for chicks among volleyball games and kite chasing that could easily trample a new hatch.

Though the beach feels littered with fluttering plover wings to me, many residents of Revere have never seen these camouflaged birds, and the plovers' seeming invisibility can exasperate them. Often, I hand over my binoculars to beachgoers, giving them a tiny window into the seaweed-strewn world of these birds. I marvel as comprehension dawns on their faces. Or as Bill, one of my regulars, often remarks, "You gotta be shittin' me—those little clovahs fly all the way up from the Bahamas?" Rather than feel satisfied, though, I feel frustrated on their behalf. How can we feel impatient with anyone for not caring about something they have

> "Revere has a long and storied cultural history, none of which has anything to do with threatened shorebirds."

Photograph by Sean Riley

never been taught to see?

Two miles and one hour later, I have found all the wayward chicks in the middle of the beach, and I count them to make sure they have all survived the night. By this time, I've resigned myself to never finding the hammer. I head up to the seawall to station myself and keep an eye on the chicks—but I'm not alone for long. Someone sneaks up behind me, covers my eyes, and calls out my name.

"Lair-ah, guess who?"

Judging by hands the size of plates over my eyes and the discreet scent of tanning oil and tobacco, this can be only one person. I snap around, my field notebook landing in the sand. Tony beams at me, his reflection glowing in the just-polished wax of his antique brick red Chrysler.

"What ah those little plovahs up to today, huh? They gonna be done by fo-ath of July this ye-ah or what?"

Come Independence Day, this beach transforms into mayhem, as thousands of Boston residents stake out a spot on the beach from which to watch the fireworks. On these nights, plover monitors like me double as bouncers, denying inebriated citizens access to plover territory.

When I first met Tony, I couldn't tell if he was irritated or just testing me. But then he swooped me in for a hug, just like he does now, his round belly socking me in the stomach with force. Tony's a good person to have on

my side when the fourth of July rolls around. People tend to listen to him.

"Nobody giving you a hahd time today, right? Lair-ah," he says, "I saw one of those birds runnin' down to the watah. This big!" Tony holds out a massive hand and sizes the chick, making a tiny gap between his huge fingers. He high-fives me with the other hand.

"Moments like this make me feel part of the community, not someone standing apart, trying to show them what I see."

Tony knows I can't promise when the young birds will fledge or fly off on migration. But people in Revere ask this question often, because eventually the birds will fledge, and the fencing will come down. I try to keep him up to date with our predictions so he can share my thoughts with his neighbors—some of whom are less than pleased about the current state of shorebird affairs and the fencing on their beach. Having him as an unofficial spokesperson does have its perks. It's hard to hide from Tony in Revere.

At the south end of Revere Beach, I look in vain for George. George walks the beach daily in the late afternoon. He has never once failed to invite me in for iced tea in the house he has lived in since the '30s; I have come to rely on this late afternoon break. He'll ask about the birds merely to humor me, but mostly I like to hear about his time fighting in World War II. Moments like this make me feel part of the community, not someone standing apart, trying to show them what I see.

The truth is, most of my work here doesn't involve persuading people to love shorebirds. It involves conversations about how the Red Sox completely blew it the night before (again!) or how high the waves rose during the previous winter's blizzard. It involves gifts of cold water on hot days, stories of visiting Castle Island in Boston as small children, and a shared realization that our stories are inextricably tied to the coastline. Really, we all share the same story—we are people raised on the ocean, dependent on it, just like the plovers.

Shooting the breeze with Tony, George, Lou, and Marilyn helps me recognize that the human role in conservation cannot be understated. By welcoming me to Revere as a neighbor, they realized they'd had another neighbor all along—a shorebird that was in danger of disappearing into history. They accepted this new acquaintance on the condition that plovers would not eclipse what this shoreline meant to them. The wild world demands help and attention after the way we have altered it, but that does not lessen the importance of what it means to be human.

I watch a man jog up the beach from afar, and when he arrives he asks if I am watching over the "little birds." When I confirm his suspicions, he introduces himself as Jonas, a man who immigrated here 10 years ago.

"Thank you," he says, his face thrown into silhouette. "Thank you for watching the things that are too small to watch after themselves."

I smile and tell him that it makes me happy to do so. He thinks for a moment, and as he backs away into a jog, he leaves me with one more thought: "While you are watching the little things, God is watching over you."

I stay on the beach until after the sun goes down, trying to spot an American kestrel that has been harassing the plovers recently. Whether or not God is watching over me, some people in Revere certainly are.

Photographs by Sean Riley, Lyra Brennan

Cohort AF: The Class of 2016

Every summer, Field Naturalists and Ecological Planners collaborate with a community partner for their master's projects. Here the members of the class of 2016 discuss their work.

Sonia DeYoung

Dark clouds loomed one morning last July as I set out on a walking journey from the headwaters of the New Haven River in Lincoln, Vermont, to its confluence with Otter Creek, 25 miles downstream. My sponsor, the Vermont River Conservancy, wanted to engage watershed residents with their river and learn about their attitudes toward flooding issues. Like the dark clouds, my nervousness about approaching strangers quickly dissipated as I met friendly residents who told me stories about the river, invited me into their homes, and let me camp on their riverbank properties. After only a few days, I found I already had a sense of the watershed community, as well as a slew of new friends. But just as the New Haven makes a hard left turn when it flows through Bristol, my graduate trajectory veered in an unexpected direction after the walk. Personal circumstances compelled me to take some time off from school, and I will graduate in 2017 with Team AG. This summer, I'll be working on a second project: a landscape inventory and assessment of a 100-acre property in Chester, Vermont, along with a guide for small landowners in Vermont who want to learn about management options.

Glenn Etter

For the past two years I've served as the first "experimental post-doc" for the FNEP program, and it's been a consistently wonderful experience. My research this year has focused primarily on outdoor education in Vermont and New England. As part of this work, I visited a variety of programs (ranging from kindergarten to adult levels), with the goal of exploring emerging trends and current "best practices." The past two years my son Finn and I have also been regular participants at Burlington's Crow's Path Field School, founded by former FN Teage O'Connor. I deeply believe that people of all ages benefit from both unstructured and thoughtfully structured time outdoors, and my work aims to develop outdoor curricula that combine creative, scientific, and emotional connections to the natural world.

Jessie Griffen

Sweeping views of the Berkshires and miles of trails await guests at Kripalu Center for Yoga and Health in western Massachusetts, yet surprisingly few visitors venture outside. I collaborated with Mass Audubon to transform Kripalu's grounds from a beautiful backdrop to an essential part of the guest experience. To accomplish this, I conducted a rapid ecological assessment of the 125-acre property, mapped its network of trails, and piloted natural history programs for guests. To encourage more guests to venture outside, I collaborated with Kripalu's grounds and marketing teams to design new trail maps, signage, and a plan for increasing awareness of the property's extensive outdoor opportunities. I also piloted outdoor programs about the landscape's rich natural and cultural history, summarized attendee evaluations, and made recommendations that serve as the basis for future programs. Overall, the project catalyzed a mutually beneficial partnership between Kripalu and Mass Audubon, as well as clarified how nature fits in to Kripalu's focus on health and its vision to create a compassionate, connected world.

Ben Lemmond

One morning in 1914, an entire town of granite quarrymen and their families left Hurricane Island and never came back. The island was purchased but lingered in obscurity until Outward Bound came along and established a field station in 1960, which operated until 2006. The Hurricane Island Foundation then transformed the island into a sustainable field station for research, science education, and leadership events.

This is the prevailing narrative of Hurricane Island, one that is told primarily through the lens of human occupation and activity. But what would a story of the island told by a Field Naturalist sound like? My project describes the natural history of Hurricane Island, looking specifically at the effects of geology, glaciers, climate, and human history on the island's present condition. This comprehensive survey of the island's ecology will inform the Hurricane Island Foundation's research agenda, educational programming, and stewardship of this unique place in the future.

Shelby Perry

It is no secret that the timber industry and conservationists have not always seen eye to eye. Recently, however, in the face of an increasingly fragmented forest, the two have realized their mutual goals of preserving large, unbroken tracts of forested land. For my master's project, I played a part in the conservation of a large tract of intact working forest by carrying out an ecological inventory of a 15,335-acre project area known as Worcester Woods in the towns of Elmore, Worcester, and Woodbury, Vermont.

Worcester Woods is one of the few large forest blocks still in private ownership in Vermont, and protecting it with conservation easements will help preserve its ecological and economic values for future generations. Across Vermont, large areas of uninterrupted forest have become increasingly rare, and conservation easements can serve as an important tool to protect these forests and the people and wildlife they support.

Last summer, I had the good fortune to carry out the ecological inventory of this unique property and to recommend easement protections based on my findings. I mapped state significant natural communities and wetlands, sought out significant wildlife habitat features, and took note of rare plants over as much of the property as I could cover on foot. For each feature I found, I recommended a level of easement protection based on the policies of the Vermont Land Trust, which plans to hold the easements on the property. Having grown up in the area, it is especially exciting for me to have helped conserve an area that has been dear to me for some time.

Emma Stuhl

The rolling hills and stunning vistas of New Haven, Vermont, might make the small town a haven for some, but it's far from new. In fact, more than 10,000 years of human habitation and millions of years of geologic and ecological history have molded the town's land and culture. This summer, I examined this history and the contemporary landscape as I brought the PLACE (Place-based Landscape Analysis & Community Engagement) Program to New Haven.

In a collaboration with the local Conservation Commission, I mapped and investigated the rolling hills, interviewed residents, researched the ecology and history of the town, and created a website as a community resource. I also organized a community forum, in which residents articulated what they love and what they are concerned about in their town. Working with Shelburne Farms, one of the project partners, I brought PLACE to the local elementary school by compiling a place-based curriculum for the teachers and leading map-making activities for the third, fourth, and fifth grade students. In the fall, I organized a series of local field trips and evening presentations that explored some of the natural and cultural history of the town; I also presented a talk about how New Haven's landscape has changed over time. Through these many project pieces, the PLACE Program aspired to build community and help New Haven residents better understand and celebrate the place they call home: http://www.uvm.edu/place/towns.

Sam Talbot

Why did the wide-ranging mammals cross the heterogeneous landscape between the Adirondack and Green Mountains? You guessed it—to find suitable habitat, increase genetic variability, and migrate. This past summer, I worked with the Lake Champlain Land Trust and Lake George Land Conservancy to discover more about wildlife movement around Lake George and southern Lake Champlain. With the use of geospatial technology, I conducted a "least-cost path analysis," which identified three discrete swaths of permeable habitat across a matrix of forest, agriculture, and wetland. Although the area has seen limited development over the past decade, it remains vulnerable to fragmentation due to its scenic and recreational value. Additionally, Vermont forests, 80 percent of which are in private hands, are vulnerable to housing and commercial development.

Not only is connectivity within a landscape important to wildlife, it enhances species richness and biodiversity. These maps will help conservation organizations work together to protect a range of ecosystem values. However, making decisions about potential wildlife movement is a difficult undertaking. Therefore, I interpreted the utility and limitations of my approach and highlighted significant conservation and biological value within an area shaped by centuries of anthropogenic and natural processes.

Call for Proposals!

We seek to match Field Naturalists from the class of 2018 with master's projects sponsored by environmental organizations on the cutting edge of conservation science.

Our graduate students investigate the natural world, find answers, and use their intensive training to solve real-world problems. Partnerships with sponsoring organizations blend academic excellence in the natural sciences with practical conservation on the ground: service learning at the highest level.

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

We are now inviting project proposals for the coming year. We expect to link students with projects by January 2017, with planning and details wrapped up in time for the summer field season. Data analysis and report writing continue into the fall semester of 2017. Final products will be delivered to sponsors between December 2017 and May 2018.

If you wish to explore the possibility of enlisting the drive, dexterity, and professionalism of our graduate students to meet your organization's conservation needs, please contact:

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