Field Notes

VERMONT CENTER FOR ECOSTUDIES | Uniting People and Science for Conservation

The Sounds of Science

Community scientist feedback enhances mountain bird monitoring

PETE KERBY-MILLER

S quelching, dripping, splashing, sloshing: the soundtracks to my morning walks are dominated by wet four-part harmonies. Mud season is upon us. Soon, trails will dry out and breeding birds will add their voices to the dawn chorus. When they do, VCE's Mountain Birdwatch (MBW) observers will be listening, clipboard in hand.

While the worst of the mud will have dried by the time our participants set out in June, conditions for making careful, accurate avian observations can remain tough-and noisy. MBW observers have often reported that intrusive background noise has made it difficult for them to hear the birds they are striving to count. Rushing streams are usually the main culprit, however, strong wind can pose problems too. Separating the birdsong signal from background noise can be frustrating, especially considering the substantial effort our community scientists invest in simply getting to mountaintop survey locations, often hiking several hours and camping overnight to begin their *(continued on page 10)*



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FIELD NOTES

Spring 2021 • Volume 14, No. 1

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The Vermont Center for Ecostudies (VCE) is a nonprofit organization whose mission is to advance the conservation of wildlife across the Americas through research, monitoring, and community engagement. With a reach extending from Canada and northern New England through the Caribbean and South America, our work unites people and science for conservation.

Field Notes is VCE's biannual newsletter and is free to our constituents.

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VCE VIEW



In case you didn't know, I'm an unabashed bird fanatic. I can't hide it, and I don't try. As proud as I am of the outstanding work my VCE colleagues do on other taxonomic groups—and as much as I thrill to migrating Monarchs, ambling Ambystoma, darting darners, and buzzpollinating bees—I'm unapologetically enamored of birds. So, I'll occupy the bully pulpit of this column to remind VCE readers about some fundamentally simple actions that we all can—and must—take to counteract the staggering loss of nearly 3 billion birds across North America over the past half-century.

For the many among us who devote a large share of our waking hours—some of us even our professional lives—to watching, celebrating, investigating, and conserving birds, population declines on such a scale bend the mind. As our planet warms, human populations grow, and native habitats shrink, we must all take individual actions, large and small, to restore ecological balance and healthy bird populations.

Below are a few hand-picked measures that will help stem the tide. This list is by no means exhaustive, or the actions ground-breaking. They just make sense.

1. Make windows safer—collisions with glass cause up to 1 billion avian deaths annually in the U.S. Many options exist to reduce collisions with existing windows, design bird-friendly buildings, and influence legislation.

2. Keep cats indoors—the scientific data are indisputable: cats kill more than 1 billion birds annually in the U.S. Keeping cats indoors, or safely contained outdoors, results in a safer and healthier environment for cats, birds, and people.

3. Reduce lawn and plant natives-lawns

are biological deserts. Leave unmanaged areas around your home, plant native species, and watch biodiversity flourish.

4. Avoid pesticides—more than 1 billion pounds of pesticides are applied in the U. S. each year. The widely used insecticides called neonicotinoids or "neonics" are especially lethal to birds and the insects they consume. Eliminate pesticide use around your home and garden.

5. Drink Bird Friendly[®] coffee—talk about a no-brainer! See the article in this issue.

6. Watch birds, record your sightings, share your passion—enjoy birds while contributing to both science and conservation. Use eBird. Become a VCE community scientist. Mobilize and inspire others to watch birds. Get youth involved.

7. Stay informed and take action—pay attention to laws that affect avian welfare. Contact local officials, state and federal legislators, and speak out on behalf of birds. Urge measures that promote responsible civic action and legislation.

Of course, you've heard all this before. Consider, however, that while we need birds far more than they need us spiritually, recreationally, ecologically their future is inextricably tied to ours. Our actions, or lack of them, will dictate the future of bird conservation. Time is short, the odds long. You're reading this because you already care deeply, but we must all do more, for birds and all wildlife. Please join us and learn more at our Call to Action web page: vtecostudies.org/ resource-center/take-action. Then, get outside and enjoy discovering our returning spring migrants!

> Chris Rimmer EXECUTIVE DIRECTOR

The globally rare Parnassia Miner (Andrena parnassia), annotated with features useful for general bee identification.



Learn to Identify Bees

The Bees of Vermont online guide helps naturalists make sense of the mind-blowing bee diversity found in Vermont. | BY SPENCER HARDY

This online web atlas will offer species accounts for each bee found in the state, with photographs, live maps, natural history notes, and identification tips.

CE officially launched the Vermont Wild Bee Survey nearly two years ago. At that time, we lacked a comprehensive list of known native bee species in Vermont, and had only a vague notion of the effort required to create such a list. For the past two seasons, VCE biologists and trained volunteers have scoured the state from our highest peaks to the depths of natural history museum collections in search of every bee species we could find. So far, we have documented 316 species and provided 29,247 Vermont bee records to the Global **Biodiversity Information Facility** (GBIF.org), an international research infrastructure funded by the world's governments and aimed at curating

data about all life on Earth. Currently, with the help of bee expert colleagues, another ~15,000 bee specimens are in the process of being identified and shared.

There are certainly more Vermont bee species to be found, and we need your help-even if you're not a bee-identifying aficionado! The Vermont Atlas of Life on iNaturalist has quickly become the most efficient and cost-effective way for naturalists to amass biodiversity data over large geographic areas. At this time, the platform has more than 10.000 bee observations from 870 observers, representing 132 species. While a large number of Vermont's 300+ species are simply not identifiable from photos, we estimate that 175-200 species could be confidently identified from photos of live bees. The lack of universally accessible identification resources is a major barrier that prevents backyard naturalists from taking next steps to becoming proficient bee watchers.

To this end, VCE is excited to introduce "The Bees of Vermont" online field identification guide (val.vtecostudies.org/projects/ vtbees/bees-of-vt). Once completed, it will be the most comprehensive source for information on Vermont's wild bees ever assembled. This online web atlas will offer species accounts for each bee found in the state, with photographs, live maps, natural history notes, and identification tips. Designed for the casual bee watcher, the guide limits specialized jargon and highlights key identification features. Recognizing that learning a new taxon is time-consuming and challenging, we recommend that this resource be used in conjunction with iNaturalist (www.inaturalist.org/projects/ vermont- atlas-of-life), whose online community is eager to confirm identifications or suggest alternatives. Check out "The Bees of Vermont" and let us know what you think!



Birds & Beans: Conservation in your Coffee Cup

With so many beneficiaries, from birds to farm families to VCE, drinking Birds & Beans coffee is an absolute win-win.

BY KAREN BOURQUE

A nticipating a glimpse of a rare avian visitor or reveling in the dawn chorus is enough to launch most birders out of bed long before sunrise; but greeting daybreak with a steaming cup of fresh coffee makes early rising far more enticing. Birding and coffee go hand-in-hand, and in more ways than one.

Research has repeatedly shown that shade-grown coffee plantations provide vital wintering habitat for many of the migratory songbirds we all know and love. Based on those studies, the Smithsonian Migratory Bird Center (SMBC) created a certification program that sets the gold standard for ecologically sustainable coffee businesses: Bird Friendly[®] coffee. SMBC coffee beans come from family farms throughout Latin America that provide suitable forest-like habitat for birds, rather than originating on farms that have been largely cleared of natural vegetation. Bird-friendly coffee plantations provide the diverse ecological conditions that both migratory and resident birds need to thrive.

But, in order for bird-friendly coffee farms to prosper, they must be economically sustainable. Enter Birds & Beans Coffee (www.birdsandbeanscoffee.com). Birds & Beans buys beans from Bird Friendly® certified farmers at top prices so the farmers can support their workers and families. Beans are expertly roasted by a B-Certified* roaster in Maine and sold online, through nonprofit organizations and food co-ops nationwide, and





SMBC coffee beans come from family farms throughout Latin America that provide suitable forest-like habitat for birds. Bird-friendly coffee plantations provide the diverse ecological conditions that both migratory and resident birds need to thrive.

through local "coffee clubs." And, Birds & Beans donates 5% of sales to its conservation partners-like VCE!

Thanks to two local Birds & Beans Coffee "All Stars," VCE has been the beneficiary of these profit-sharing contributions for more than a decade. Local coffee club leaders Doug Hardy of Norwich and Li Shen of Thetford are devoted to promoting bird conservation and great coffee right here in the Upper Valley of Vermont and New Hampshire. In 2020, their combined efforts resulted in the sale of a whopping total of just under 2,000 pounds (a literal ton!) of Bird Friendly®/Fair Trade/Organic Birds & Beans Coffee from farms in Central America and Peru. Their commitment to this cause and to supporting VCE through their year-round coffee clubs is truly astounding. As Doug notes, "I derive great satisfaction from helping people buy the best-tasting, most responsibly-sourced coffee available. With so many beneficiaries,

from birds to farm families to VCE, this is an absolute win-win; we'd love to see similar groups started around the state, and are happy to help launch them." (Contact VCE at (802) 649-1431 or via email at info@vtecostudies.org if you are interested in learning more about starting a coffee club!)

If you live or work in the Upper Valley and would like to join us in "sipping for songbirds," you can find Birds & Beans Coffee at your local Hanover, Lebanon, White River Junction, and Upper Valley Food Co-op stores. For those who live outside the area, visit www.birdsandbeanscoffee.com to locate a retailer near you. Through thoughtful consumption, coffee drinkers can help save songbirds and small family farms, one cup at a time.

*B-Certified businesses meet the highest standards of social and environmental performance, public transparency, and accountability to balance profit and purpose.

COMMUNITY SCIENCE OPPORTUNITIES



You don't need a background in science to be a Community Scientist!

From backyards and bogs to mountains and meadows, you'll find many ways to get involved and make a real contribution to wildlife conservation. If you'd rather not muck around a swamp or hike to a summit, you can still volunteer for VCE even from the comfort of home.

We hope you'll join us!

iNaturalist Vermont

Volunteers share observations of all Vermont biodiversity in this digital project of the Vermont Atlas of Life.

www.inaturalist.org/projects/ vermont-atlas-of-life

Mountain Birdwatch

Each June, volunteers hit the trails to complete bird survey routes on 123 mountain ridgelines across the Northeast.

vtecostudies.org/projects/ mountains/mountain-birdwatch

Vernal Pool Monitoring

In April, May, and September each year, volunteers visit and collect data to monitor "adopted" vernal pools following standard protocols and using VCE-provided equipment.

vtecostudies.org/projects/forests/ vernal-pool-conservation

To learn more about the Vermont Atlas of Life and its projects, visit vtecostudies.org/volunteer

Translating Science into Conservation Action

Grupo Jaragua staff and community volunteers plant small islands of trees to help restore deforested land and promote landscape connectivity for wildlife

"Nucleation": restoring Bicknell's Thrush winter habitat in Sierra de Bahoruco

BY YOLANDA LEÓN & CHRIS RIMMER



A fter 25+ years of field surveys, targeted research, and advocacy work, Grupo Jaragua and VCE are now translating science into conservation action, as we collaboratively restore vulnerable forest habitat for Bicknell's Thrush (BITH) and a host of other biota in the Dominican Republic's Sierra de Bahoruco National Park.

A true jewel on the Hispaniolan landscape—and a biodiversity hotspot that has earned it international biosphere reserve status—Bahoruco provides crucially important overwinter habitat for BITH. While the Sierra features large tracts of well-conserved mid-elevation, dry broadleaf forest and intact Hispaniolan pine forest at its highest reaches, most BITH occupy an intermediate narrow band of wet broadleaf forest at 1,000-1,500 m elevation. Unfortunately, this zone is also coveted by farmers for its higher humidity and milder temperatures.

VCE's pioneering studies in the 1990s and 2000s clearly established the importance of Bahoruco's remote and relatively secure northern cloud forests for overwintering BITH. However, in 2013, after discovering that the species also inhabits fragmented and degraded forests on Bahoruco's southern slope, Grupo Jaragua set out to understand the drivers of deforestation there. We quickly learned that farming is the culprit, with two primary forms occurring inside the national park: large-scale export avocado plantations and small-scale sharecropping for local food crops. Both are illegal under the Dominican Republic's current protected area laws; however, authorities have failed to act, as legal enforcement would be complicated and carry political, if not safety, risks. First, laborious research is needed to document the legitimacy of farmers' claims (currently estimated at 100), since many pre-date the park's 1983 establishment. Second, any farmers with legitimate claims would be entitled to financial compensation. Third, and most significantly, enforcement—requiring eviction to be meaningful—would necessarily entail conflict and result in political backlash.

In 2018, facing realities of the ~2,000 hectares occupied by illegal avocado plantations and the powerful, politically influential players-unopposed by governmental authorities-involved in this local industry, Grupo Jaragua and VCE (with funding from Environment and Climate Change Canada) embarked on a project to restore degraded BITH habitat on Bahoruco's southern slope. We targeted Las Abejas, a broadleaf cloud forest site known to support BITH and other montane forest birds. This biodiverse site has steadily lost ground under a regime of shifting "slash and burn" agriculture, whereby local farmers cultivate crops every two to three years after removing and burning regrown vegetation.

One local plot "owner" we identified was Manuel de la Cruz, a retired farmer in his 80s from the nearby town of Pedernales. With no pension system for self-employed Dominicans, Manuel relies on his ten children for survival. While most have no interest in farming, all counted on someday cashing in on their father's land from the government for its value inside the national park. However, knowing the implausibility of such a transaction, we feared that, in desperation, the family might revert to sharecropping the property, as they did in 2013-14, employing Haitian migrant workers. Grupo Jaragua undertook a bold step and offered to compensate the family at a mutually acceptable price, via a contract in which Manuel and his heirs permanently waived their farming claims. Although there could be no formal land title in exchange, the "return" on this investment lay in amicably restoring precious habitat on Bahoruco's beleaguered south slope, breaking a longstanding deadlock between farming and conservation. We envision this unconventional transaction as a crucial first step-and a model for similar measures-towards locally-based, sustainable conservation.

After visiting the 55-hectare prop-



Momentum appears to be shifting for restoration and recovery of Sierra de Bahoruco's forests, which are a crucially important winter habitat for Bicknell's Thrush.

erty several times with two of Manuel's sons, Grupo Jaragua learned that large sections had not been actively farmed for over 20 years; scattered old avocado trees enveloped by forest provided the only trace of agricultural history, providing real hope for natural forest recovery. Our optimism was boosted by an abundance of trogons, parrots, parakeets, forest pigeons, and fruit bats, all consuming fruits and dropping seed everywhere! Conversely, nearly onethird of the property lacked any tree cover and was dominated by an exotic, invasive grass that formed dense mats, preventing growth of native plants. We knew nature needed a strong hand through an active program of propagation and transplanting.

With over 2,000 plant species known from Bahoruco (and new ones still being described), we wanted nature to have the dominant say in forest restoration at Las Abejas. We settled for planting small islands of trees (10 x 10 meters) throughout degraded portions of the property, aided by field assistants from local communities. This approach, termed "nucleation," while labor-intensive and gradual, enhances natural vegetation succession and promotes landscape connectivity. By sourcing "plantules" from the nearby forest undergrowth and removing invasives prior to transplanting, the resulting islands attract seed dispersers and trap wind-blown seeds; the technique has proven highly effective in similar settings. During the coming

months and years, Grupo Jaragua will carefully tend these islands, removing invasive grass, replacing failed plantings, and documenting the recovery of both vegetation and wildlife, including BITH. We hope to scale this effort up to other areas of the Sierra—in fact, with outside donor support, Grupo Jaragua recently secured a second property nearby, with a goal of connecting the two someday.

It is too early to tell if our innovative approach will succeed, especially under changing climatic patterns, chronic economic instability, and recent restrictions imposed by the COVID-19 pandemic. However, our progress to date, while preliminary, is tangible and encouraging. After years of determined effort, momentum appears to be shifting for restoration and recovery of Sierra de Bahoruco's forests.

LATE-BREAKING NEWS FROM THE FIELD

On 28 February, a raging fire broke out at Las Abejas, and, despite valiant efforts from the Ministry of Environment fire team, was only extinguished four days later, after torching ~900 hectares. Satellite imagery suggested that our project site had been burned, so a Grupo Jaragua team visited Las Abejas as soon as conditions were safe. To our surprise and great relief, the moist forest was virtually unscathed by flames, although the fire ravaged neighboring pine and grassland habitats. Sadly, our recently planted nucleation islands, lodged in grassy areas, burned badly. However, the broadleaf forest proved to be a very effective firewall, additionally confirming the ecological importance of restoring Bahoruco's montane forests (and controlling invasive grasses on fallow farming plots). The Jaragua team was overjoyed to see Hispaniolan Parakeets still coming and going from their cavities, and to hear the typical assemblage of forest birds, including a BITH that responded briefly to playback. The resiliency of these forests provides inspiration and fuels our optimism!

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To learn more, contact Susan Hindinger VCE Associate Director shindinger@vtecostudies.org 802-649-1431 x 203

www.vtecostudies.org/give

NEW FACES AT VCE

Director of Conservation Science RYAN REBOZO

We are pleased to introduce our new Director of Conservation Science, Dr. Ryan Rebozo. In this role, Ryan will coordinate VCE's wide-ranging conservation science programs and seek collaborative opportunities to transform our findings into conservation action. Before joining VCE, Ryan served as the Director of Conservation Science for the Pinelands Preservation Alliance in New Jersey. He completed his PhD in ecology at Drexel University and received his BS in ecology from Rutgers University. Ryan is an ecologist whose interests include disturbance ecology, plant-insect interactions, mycology, and rare plant demography.



We are equally pleased to welcome Laura Prothero as our first Development Manager. Laura recently moved back to New England from Washington State, and brings 10 years of fundraising experience helping organizations develop deeper relationships with their partners and supporters. Her favorite part of development work is witnessing the transformative, powerful change for good that comes when people connect over their shared interests.



Data Scientist MICHAEL HALLWORTH

In yet another key addition, Dr. Michael Hallworth joined VCE as our first Data Scientist. In this role, Mike will reveal insights and elucidate patterns within the Vermont Atlas of Life's burgeoning biodiversity datasets through statistical data analysis, modeling, and visualization. Prior to joining VCE, Mike served as a Postdoctoral Research Associate at the Cary Institute for Ecosystem Studies. He completed his PhD in Environmental Science & Public Policy at George Mason University, and received his BS and MS in Biology at Plymouth State University. Mike is a wildlife ecologist who takes a full annual cycle approach to understanding the interplay between the environment and population demography.



Eastern Meadowlark Blitz

Help VCE and New Hampshire Audubon document an imperiled grassland bird

BY KEVIN TOLAN

Join us in raising awareness of the issues facing Eastern Meadowlarks, and help ensure that they remain fixtures on the Vermont landscape.

Tt has a bright yellow breast, a black necklace, and is perched on a fence post: there's no doubt about it, you're looking at a meadowlark. A bird of open farmlands and prairies, Eastern Meadowlarks breed from southern Ontario through the northern tip of South America. The species historically bred throughout Vermont in the 1800s, when only 15% of the state was forested, but its populations have dwindled as forests reclaimed the landscape. Additionally, as Vermont's agricultural emphasis transitioned from sheep to cattle, corresponding grassland management practices intensified, leading to diminished breeding productivity for meadowlarks and other grassland-dependent species.

Across the Northeast, similar agricultural landscape transformations have led to rapid declines in Eastern Meadowlark populations. Based on the latest USGS Breeding Bird Survey results, the species has undergone estimated annual declines of 8.7% and 8.8% in Vermont and New Hampshire, respectively. With the imminent designation of meadowlarks as Threatened in Vermont and their current Threatened listing in New Hampshire, this is an opportune moment for a targeted regional survey effort. Towards that end, we are encouraging community scientists to survey grassland habitats with the goal of documenting meadowlark distribution and abundance. Additionally, this spring VCE will partner with New Hampshire Audubon to launch the bistate "2021 Eastern Meadowlark Blitz" —we hope that many of you will join us!

Participating is easy; simply sign up for a predetermined survey "block," and visit your block at least three times over the course of the spring-summer field season. These targeted surveys will provide data on meadowlark presence and presumed absence across the region by focusing survey efforts in areas of prime habitat, rather than simply where meadowlarks have been observed in the past. This approach may uncover previously unreported populations or individual birds holding territory.

In addition to conducting bird surveys, we'll ask participants to document field management practices along their survey routes. Meadowlarks are ground-nesters, therefore, timing and frequency of haying play a major role in their reproductive success, and can reduce prolonged site occupancy. Data on field management, which aren't collected during a typical survey, will provide invaluable information to guide future outreach and conservation efforts.

We encourage you to visit the Meadowlark Blitz website at

val.vtecostudies.org/projects/ eastern-meadowlark-blitz to learn more and adopt a local block. Join us in raising awareness around the issues facing Eastern Meadowlarks, and help ensure that they remain fixtures on the Vermont landscape. For more information on the Blitz and grassland bird conservation, please reach out to us via email at grasslands@vtecostudies.org.



pre-dawn surveys.

If we had a magic wand to wave, guaranteeing perfect survey conditions for our dedicated volunteers would be right at the top of the list. Lacking that, however, VCE's MBW team put on our data hats to provide the next best solution: collect more field data. In June 2019, we asked MBW observers to assess the background noise at each site in addition to their usual data-taking protocol. We tried to understand the acoustic environment both by recording noise levels on a smartphone app and via a simple, observer-reported 1-10 scale. We quickly learned that the app couldn't distinguish between sites that were loud because of a raging stream from those that simply had a cacophony of singing

Winter Wrens that drowned out the Blackpoll Warblers. Our community scientists, of course, could. As is often the case, simple was better, and it is the observer noise rating that we continue to include on datasheets.

Collecting those background noise data empowered us to improve our montane bird monitoring program. This winter, Emily Anderson, VCE's Citizen Science Outreach Naturalist emerita, teamed up with VCE staff scientists to spearhead an analysis into how that background noise affects MBW data. Her analysis shows that MBW observers were really onto something. By adding background noise measurements to our bird population models, the estimated total population size increased for each of our focal species, implying that some singing birds went uncounted at noisy sites. Importantly, though, just including a simple background noise rating in our models can account for how that noise might substantially obscure birdsong. "Survey conditions are never quite perfect," says Anderson, "As project managers, we should really focus on controlling for adverse conditions so observers can trust that all their hard work will yield accurate data."

Listening to community scientistsas well as the birds they monitor-is nothing new at VCE. Their participation and feedback are invaluable. In January we committed to changing the wording around our volunteer-fueled research from "citizen science" to "community science." We did this to explicitly include <u>all</u> people in our work, regardless of their citizenship status. It is also a nod to the nature of our research; folks who analyze crowdsourced research draw a distinction between citizen science, where research programs are designed with no public input, and community science, which encourages broader participation in planning from the people who ultimately gather data. We have always valued the insight of the community naturalists who share so importantly in our research and want the language we use to reflect that.

The practical feedback that MBW observers shared with us was critical to launch this analysis. We now have strong evidence that background noise is an important factor affecting the data quality of bird surveys, and one that can be controlled for with simple changes to protocol. "We hope that this encourages folks to participate," Anderson remarks. "Ultimately, it's not perfect data, but instead getting more people involved, that is essential." Working together, we can help make montane bird conservation science more robust and effective.



Big Biodiversity Data Now at Your Fingertips

Explore over 5.3 million records of Vermont plants, animals, and fungi with the new Vermont Atlas of Life Data Explorer.

BY THE VAL TEAM

VCE recently launched an innovative, ambitious online project that allows anyone at a computer to explore vast amounts of biodiversity data across the Green Mountain State. The Vermont Atlas of Life (VAL) Data Explorer is the newest implementation of the Living Atlas platform, powerful software first developed in Australia and now being implemented around the world.

The VAL Data Explorer (val.vtecostudies.org/data-explorer) offers users-free of charge-multiple ways to explore over 5.3 million records of plants, animals, and fungi found in Vermont. Accessing an ever-growing statewide biodiversity database, the VAL Data Explorer is a collaborative, open, digital platform that harmonizes Vermont biodiversity data from many different sources. VAL's digital platform supports access to species information, data downloads, online mapping and analysis tools, data collection, upload, aggregation, sharing, and more.

"As our activity profoundly alters the map of life on local and global scales, our response requires knowledge of plant and animal distributions across vast landscapes and over long periods of time," said Kent McFarland, VCE conservation biologist and project leader. "The VAL Data Explorer is a tool that will bring us closer to that goal."

With the VAL Data Explorer, users can explore biodiversity records on maps using addresses and locations or by drawing a polygon around an area, explore predefined areas such as biophysical regions or wildlife management areas, or search for a species or group.

Vermonters have long upheld a tradition of documenting biodiversity. Biologists and community scientists have completed major statewide atlases of breeding birds, butterflies, and bumble bees; new biodiversity information is added every day by volunteers via Vermont eBird, eButterfly, and the Vermont Atlas of Life on iNaturalist. Yet, these efforts represent a mere fraction of the state's biodiversity data. The VAL Data Explorer bridges critical gaps in the loose network of naturalists, scientists, organizations, and governments who collect biodiversity data here in Vermont and across the planet.

The Vermont Atlas of Life is a member of the Living Atlases, an open community created around the Atlas of Living Australia platform. Jason Loomis, VCE project software developer, works closely with the Living Atlas community to implement the software and mobilize data for the VAL Data Explorer.

"I'm fortunate to be part of a team of developers around the globe who are continuously evolving the Living Atlas software, which comprises many interlinked databases and toolsets based entirely on free and open-sourced software," notes Jason. "The software and data mobilization are fairly complex, but they work remarkably well. The community's evolution has nicely kept pace with the needs of its members. We couldn't have implemented this without such a gracious community of people helping us along the way."

The Vermont Atlas of Life also links Vermont to worldwide biodiversity projects, and has been an official Global **Biodiversity Information Infrastruc**ture (GBIF) biodiversity data publisher since 2018. GBIF is an international network and research infrastructure funded by the world's governments and aimed at providing anyone, anywhere, open access to data about all types of life on Earth. The GBIF network includes hundreds of institutions that publish biodiversity data, like the Vermont Atlas of Life. As a small fish in a huge global pond, VCE is punching far above its weight in this arena.

FIELD NOTES

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Jack-in-the-Pulpit {Arisaema triphyllum}



© KP MCFARLAND

Found in moist to wet woods, the highly variable Jack-in-the-Pulpit exemplifies a spring ephemeral.

BY RYAN REBOZO

arly spring triggers the growth, flowering, and fruiting of many forest floor plant species. These spring ephemerals take advantage of high levels of sunlight hitting the forest floor to grow and reproduce before canopy trees leaf out. Found in moist to wet woods, the highly variable Jack-in-the-Pulpit exemplifies a spring ephemeral. This member of the Arum family (Araceae) is found throughout the eastern U.S. and has four recognized subspecies, two of which can be found in Vermont.

Jack-in-the-Pulpit's most memorable feature is its distinct inflorescence, which includes a spadix (a spike-like protrusion) made up of many small flowers and a spathe, a large leafy bract that encompasses the spadix. Since this species has a short window of time in which to collect sunlight and store energy, individuals often do not flower until they are five years old (individual Jack-in-the-Pulpit plants have been recorded living over 25 years). In the first year they flower, these plants produce staminate (male) flowers. In subsequent years, the flowers can be staminate, pistillate (female), or monoecious (containing both male and female flowers). Research has shown that on average, approximately 10% of any given population

is monoecious, with the rest being made up of all male or all female inflorescences (dioecious). The presence of monoecious individuals is advantageous in small populations where there may be a limited number of potential mates. Sex ratios in populations can change with habitat conditions, as female plants make up the majority of individuals at sites with less shade, higher pH, and more soil nutrients.

Jack-in-the-Pulpits depend on fungus gnats for pollination to produce viable seeds. Fungus gnats are flies in either the Sciaridae or Mycetophilidae families that typically lay eggs on fungi and are attracted to the faint scent that Jack-in-the-Pulpits produce. Once inside the flower, a gnat is prevented from flying or climbing out by the overarching shape of the spathe. In male inflorescences, the gnat can escape through an opening at the bottom, but only after passing over pollen-laden stamens. The pollen-dusted gnat then visits a female plant to deposit pollen on receptive stigmas-but this time, there is no escape route and the gnat remains trapped in the spathe. This odd pollination service results in red berries that each contain one to five seeds, and are a food source for some species of birds and rodents.

