FALL 2015

Field Notes

VERMONT CENTER FOR ECOSTUDIES | *Uniting People and Science for Conservation*

IN THIS ISSUE

VERNAL POOLS

Cooperative Conservation

The Vernal Pool Data Cooperative: Building a Regional Framework to Achieve Conservation

Over the last decade or so, technological advances have provided ecologists with a much more sophisticated understanding of what habitats exist and where they occur. For example, the Northeast Terrestrial Habitat Classification Map (NTHCM) depicts the distribution of 121 different terrestrial habitats across the North Atlantic region (from VA to the Maritime Provinces), including 40 different types of wetlands. Such region-wide habitat data are extremely valuable for a variety of conservation and scientific applications, from informing conservation planning through landscape-scale habitat modeling, to providing researchers with information that can lead to improved study design and more robust sampling procedures.

Despite this increase in spatial habitat information, lack of a regional database of vernal pool locations remains a glaring blind spot in our knowledge of critical habitats in the Northeast. This has greatly limited development of regional conservation applications for a whole suite of vernal pool-dependent species, including frogs, mole salamanders, turtles, and invertebrates, many of which are conservation priorities.

This data gap is not unwarranted, however, as vernal pool mapping presents real challenges. First, vernal pools are small. In Vermont, 92% of pools documented during *(continued on page 6)*

Marbled Salamander

FIELD NOTES

Fall 2015 • Volume 8, No. 2

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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 citizen 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

Few would argue that we conservationists face a more urgent task than shaping the next generation of our peers. The crisis facing our planet's vulnerable wildlife, and its resolution, will truly play out during their lifetimes, far more so than during ours. Engagement of amateur naturalists, VCE's citizen scientists of all ages, will always underpin our conservation achievements and define our core legacy. We're equally proud of a lineage of young professionals whose careers we have helped to launch.

Over two-plus decades of studying Bobolinks, bumblebees, salamanders, and sparrows, we've seen a stellar procession of young biologists cycle through our field projects. Many are now high-achieving colleagues, some close collaborators, who are making enduring marks in the conservation science arena. A surprising number trace their trajectory to experiences with VCE. For many, their immersion as fledgling biologists sparked a passion that continues to burn.

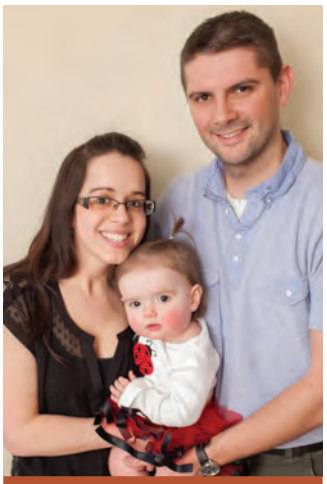
Case in point: Isobel Curtis, who typifies the spirit of young people we have been fortunate to mentor. A Bates College junior, double majoring in biology and environmental science, Isobel joined us as an intern this past summer. From dawn bird censuses on remote peaks, shoreline searches for hidden loon chicks, and yes, painstaking error-checking of Mountain Birdwatch data in the office, Isobel's internship was—by her account—transformative. There is little doubt she's on a path of no return, and we'll eagerly follow her career as it unfolds. To have played a small part in catalyzing it is VCE's greatest reward.

Whether in Vermont or on Hispaniola, VCE will continue to mentor aspiring professionals like Isobel, Haiti's Françoise Benjamin, and longtime local friend Spencer Hardy, a student at Middlebury College. This is additive work whose payoffs multiply, and it's more crucially needed than ever. In the months ahead, we'll establish an annual conservation internship in memory of our dear friend, Alexander Dickey. There is no more important undertaking for VCE than to help the next generation of wildlife conservationists take flight.

Chris Rimmer
EXECUTIVE DIRECTOR

STAFF NOTES

VCE WELCOMES SHELLY MELENDY



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VCE's new administrative assistant, Shelly Melendy, with her husband and daughter.

We're delighted to welcome Shelly Melendy as VCE's administrative assistant. A born multitasker, Shelly is helping Chris, Susan, and Melissa orchestrate our increasingly diverse operations. Her steady hand, range of competencies, and personable style make her a great fit for VCE. As Chris quips, "If anyone can whip me into shape, Shelly can!"

A native New Englander, Shelly's fascination with nature has grown steadily since childhood. Her recent experience as a patient access support specialist at Dartmouth Hitchcock Medical Center equips her well to help the VCE office run smoothly. Shelly spends her non-VCE time volunteering at the local humane society, walking her two dogs, working on home improvement projects with her husband T.J., and enjoying their 1-year-old daughter, Aubrey.

–Chris Rimmer

Loon volunteer Mike Korkuc enjoys a sunny day on his boat, "Loonatic."

© ROSIE SPAHN

CITIZEN SCIENTIST AWARD

Mike Korkuc

Lake Dunmore Loon Volunteer

The Julie Nicholson Citizen Scientist Award honors Julie Nicholson's extraordinary passion and commitment to birds and wildlife conservation through her many years of tireless work as a citizen scientist. It is given annually to an individual who exemplifies Julie's dedication to the cause of citizen science and conservation.

Growing up in southeast Massachusetts, I was always an outdoors kid. My father was an avid fisherman and hunter who taught me enough that I was comfortable fishing by myself at an early age. I was hunting from the time I could get a license. Any thoughts of conservation I may have had would have been directed solely at protecting the things I could eat. I could in no way have been described as a "bird person."

My first loon encounter was during a hunting trip in Maine. While camped on a small lake, I awakened in the middle of the night to the wail of a loon. I had no idea what was making that haunting sound. After being told, then searching unsuccessfully for a glimpse, I came to learn that I would hear a lot more loons in my life than I would ever see.

Fast-forward 20 years to a three-season camp on Lake Dunmore. I hadn't thought about loons at all during those intervening years; I don't remember seeing any either. Then, in 1985, an adult loon popped up about 30 feet from us at the camp. I remember pointing and exclaiming "Wow, that's a loon!" At the time, that statement summed up my total knowledge about the species.

For many years I noticed loons passing through during migration but never considered those fleeting encounters a call to action. That all changed in 2007 when my neighbors and I discovered a loon pair and their chick floating dangerously close to boat traffic. We shifted into protective grandparent mode, circled the boats, and warned people away as we handed out educational material provided by VCE's Loon Biologist, Eric Hanson. We floated with those loons for hours, and "our" chick survived. Soon after, we started planning for the following season. With Eric's guidance, we installed loon nesting sign buoys and stationed volunteers nearby to educate boaters. Our vigilance continues today, and we're proud that over eight years, Lake Dunmore has supported seven loon nests, six of them successful, and eight chicks that have survived to migrate in late fall.

In addition, we monitor four nearby lakes and were thrilled when a new loon pair nested last year on Silver Lake. We placed a nesting raft on the lake to compensate for the lake's fluctuating water levels, and the pair used it successfully. The loons chose not to reuse the raft this year, instead nesting on the shoreline. Despite heavy rains in June, Green Mountain Power stabilized water levels below the nest, allowing the loons a second successful year.

I started an email list in 2007 to coordinate efforts between the original volunteers; it continues today, but has grown to 275 people—all sharing a love of loons. Mailings are often daily during nesting season, and though less frequent in the off-season, continue all year long.

My photographs of that first chick sparked a new hobby. I've since captured over 40,000 photos, most of loons, and most not very good. I share these photos in mailings to fellow volunteers, and also include photos from others who are kind enough to share their best images.

I never really "volunteered" for this; my involvement just happened. Rosie, my significant other, deserves special mention—not only for her active help, but for her support of the many hours I devote to the loons. I truly appreciate every email or phone update on the loons, the ten sharp sets of eyes that come out for LoonWatch each July, and especially everyone's help with signs and rafts. Thanks to the efforts of so many, loons on Lake Dunmore and Silver Lake now face a bright future. *—Mike Korkuc*

CITIZEN SCIENCE OPPORTUNITIES

© KENT MCFARLAND

What lives here? Where is it? What's common? What's at risk? The Vermont Atlas of Life brings over 150 years of accumulated knowledge of the biodiversity of Vermont into currency for science and society. It's a bidoversity warehouse where anyone, anywhere, anytime, can explore, learn and share Vermont's unique biodiversity.

We hope you'll join our efforts!

iNaturalist Vermont

From backyards to mountain summits, hundreds of citizen naturalists and biologists document and share biodiversity at iNaturalist Vermont. Join the Fun!

www.inaturalist.org/projects/

Vermont eBird

Vermont eBird has revolutionized the way the birding community reports and accesses information about birds. Submit your observations or view results at Vermont eBird.

www.ebird.org/content/vt/

eButterfly

e-Butterfly is providing a new way for the butterfly community to report, organize, and access information about butterflies in North America.

www.e-butterfly.org

To learn more about the Vermont Atlas of Life and its projects, visit www.vtecostudies.org/projects/vermont-atlas-of-life/

Sarah Carline and Sara Zahendra listen for Whip-poor-wills in West Haven, VT.

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WHIP UPDATE

The Goatsucker Challenge

© GARY J. WEDGE/USFWS

On the nocturnal road, conducting surveys throughout the state in search of the elusive Whip-poor-will

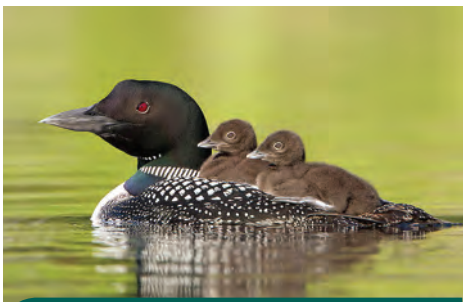
Whip-poor-will surveys are not for the faint of heart. These aerial insectivores feed actively at dawn, dusk, and throughout bright nights, but only during certain phases of the moon.....and only when it isn't raining....and the wind isn't blowing too hard.....and the cloud cover isn't too thick. With this finicky list of criteria, "Whips" test the mettle of any birder or ornithologist.

In 2012, after years of decline, the Eastern Whip-poor-will was listed as Threatened in Vermont. Enter Team Sara(h). Since 2014, Sarah Carline and I have traveled many miles of Vermont roads in search of this elusive night bird. Funded by Vermont Fish & Wildlife and armed with records collected by volunteers in previous years, we were tasked with conducting nocturnal, road-based surveys throughout the state.

2014 found us in West Haven, the Whip-poor-will hot spot of Vermont. Night after night we surveyed from West Haven to Benson and down to Fair Haven. Population declines noted across much of the species' range certainly weren't in evidence here, as we found 74 calling birds. Good news!

However, 2015 presented a challenge. From Concord south to Hartland, then across to Salisbury, Brandon, and Wells, we did find "Whips," but not in the numbers we had hoped, and not in several locations where they had been observed in past years. We located birds in small numbers near Brandon and Salisbury, but they had disappeared completely from the Hartland Dam area. Power-line cuts provide makeshift Whip-poor-will habitat when more favorable natural habitat is in short supply, and along our Concord route, with its miles of brushy/semi-open power-line cuts, we were able to find eight birds in one short stretch. Most heartening was our first record of a calling Whip-poor-will on the Peacham route: cause for much celebration and hope that next year, he will return with others. —*Sara Zahendra*

June Rains and Thieving Eagles



A RECORD 103 CHICKS HATCHED THIS YEAR IN VERMONT, AND 68 SURVIVED THROUGH AUGUST, A CHICK SURVIVAL RATE OF 70%.

An update on loon nesting activity and conservation efforts for the 2015 season

Loon nesting started slowly this year with super dry weather in May followed by record rains in June, forcing loons to either find higher nest sites or wait for water levels to stabilize. Eventually, pairs got down to business and set yet another statewide nesting record. VCE's Vermont Loon Conservation Project (VLCP) and our dedicated volunteers identified 87 nest attempts, of which 65 were successful. Eleven nests flooded in June's rains. A record 103 chicks hatched, and 68 survived through August. For context, Vermont's highest recorded chick survival occurred in 2009 when 74 of 83 chicks survived, an unprecedented 89% survival rate; this year's chick survival was a more typical 70%.

Comparing the past five years to the late 1990s and 2000s, nest success and chick survival have declined ~5%. However, Vermont's overall loon productivity is still well above the North American average. While loon chicks succumb due to many causes, Bald Eagles have become an increasing threat, though not all loon-eagle encounters are purely predatory. In August, Chris Owen observed an eagle on Holland Pond repeatedly harassing an adult loon that was in the process of ingesting a relatively large fish. The loon finally dove to safety, abandoning its meal for the "thieving" (kleptoparasitic) eagle.

VLCP, Vermont Fish & Wildlife, and our volunteers rescued four adult loons and one chick from various predicaments this summer, including two entangled by fishing line. We confirmed eight adult loon mortalities, several of which are undergoing necropsies at Tufts University. One chick had to be euthanized after a boat strike on Lake Dunmore. Fortunately these events are still rare in Vermont, but they underscore the need for continued outreach.

As our loons undertake their annual fall migration to coastal wintering locations off Cape Cod and points south, stay tuned for VCE's full report on the record 2015 nesting season. *—Eric Hanson*

VERNAL POOL DATA COOPERATIVE

continued from page 1

VCE's statewide Vernal Pool Mapping Project were less than a quarter acre in size, which means most were smaller than the scale at which habitats were mapped for the NTHCM. They literally slipped through the cracks, or pixels, to be precise. Second, vernal pools are ephemeral, only holding water for a portion of the year, making it even more challenging to pinpoint their occurrence on the landscape. And third, only three states in the North Atlantic region (MA, NJ, and VT) have attempted to systematically map vernal pools within their boundaries.

While information about vernal pool locations in other states may exist, these data are scattered among state agencies, conservation organizations, land trusts, municipalities, and others. Assembling these disparate data into a single, comprehensive regional dataset is desperately needed—and is exactly what VCE has been doing for the last 16 months.

Thanks to a grant from the North Atlantic Landscape Conservation Cooperative (NALCC)—a partnership between federal and state agencies, non-governmental organizations, universities, and conservation organizations—VCE initiated the Vernal Pool Data Cooperative (VPDC). We began by hosting two regional workshops in MA and DE to introduce the project to potential cooperators and provide a forum for their participation in its development. After numerous discussions about what data fields to include, how to provide data access at multiple levels, and how to define "vernal pool" accurately but broadly enough to encompass various ephemeral wetland types, the database was finally ready to accept submissions.

A vernal pool-breeding Marbled Salamander discovered on a field trip during a VCE-led workshop in Delaware.

© STEVE FACCIO

Currently, the VPDC holds over 57,000 vernal pool records from eight states and provinces (MA, NJ, NH, NY, VA, VT, Nova Scotia, and Quebec's Gaspe Peninsula), with significant datasets expected from ME and MD. Later in 2016, the VPDC will be available online at the NALCC's Conservation Planning Atlas, a platform for high-quality geospatial datasets and maps. Not only will this greatly enhance our ability to advance vernal pool conservation on a landscape scale, but it will reveal data gaps where further vernal pool mapping is needed.

In another component of the regional database project, VCE is collaborating with the University of Vermont Spatial Analysis Lab to develop a method for identifying vernal pools remotely using LiDAR. A blending of the words "light" and "radar," LiDAR is a remote-sensing technology that uses laser pulses from an airborne sensor to create highly detailed, three-dimensional "maps" of the earth's surface.

Focusing on two pilot study areas from very different bioregions—Addison County, VT and Cumberland County, NJ—the modeling effort first used LiDAR data to locate depressions on the landscape that might be pools. Then, a sophisticated software program called eCognition was used to reduce those initial depressions to a subset with the highest probability of being vernal pools.

The final step is to produce maps of the two pilot areas displaying potential vernal pools in four classifications, highlighting sites most likely to serve as functional pools while also showing the distribution of lower-probability depressions on the landscape. The LiDAR models will be publicly available so other Geographical Information System labs can use them to efficiently map locations of potential vernal pools.

In developing the VPDC framework and collaborating on the LiDAR models, VCE has taken a first step in advancing regional conservation for these small but critical habitats. Moving forward, VCE and our collaborators are committed to developing a long-term strategy for the VPDC that will support landscape-scale decisions and help ensure that vernal pools don't continue to slip through the cracks. —*Steve Faccio*

© KENT MCFARLAND

ATTENDEES AT A VCE-LED VERNAL POOL MAPPING WORKSHOP EXPLORE A DELMARVA BAY, A TYPE OF EPHEMERAL WETLAND FOUND ON THE COASTAL PLAIN OF DELAWARE, MARYLAND, AND VIRGINIA.

© STEVE FACCIO

From hawk watching to the friendly competition of the Vermont County Bird Quest, there are opportunities aplenty for birdwatchers in Vermont.

Helping Lead the Flock

VCE's citizen science projects are potent tools for wildlife conservation and also enhance life for birdwatchers in Vermont.

At VCE, we've long recognized the potential for crowdsourcing and citizen volunteers to support our research on—and conservation of—insects, amphibians and, of course, birds. Along the way, citizen science has also enhanced life for birdwatchers, fostering a suite of what we might call "VCE birding services" here in Vermont.

It begins with Vermont eBird, a website meticulously maintained by VCE in collaboration with Cornell Lab of Ornithology and a crew of dedicated volunteer editors. The hub of birdwatching data collection and sharing, eBird gathers reports from birders, maintains their various lists, and offers a living, growing source of data on bird distribution and abundance. But eBird is much more.

A prime example is eBird's Hot Spot Tool (**ebird.org/ebird/vt/ hotspots**), which guides birders to productive sites nearly anywhere. New to Northfield? Visiting Victory? Meeting a Facebook friend in Ferrisburgh? eBird's Hot Spot Tool directs you to the best birdwatching nearby. It's one of eBird's greatest and most popular innovations.

Vermont eBird also anchors what has blossomed into another VCE birding service: the Vermont County Bird Quest. It began as a spirited competition—county vs. county, birder vs. birder—to find the most birds in a given county in any calendar year. Our notion was to tap the innate human drive for competition to generate more bird sightings for science and conservation, and to promote birding camaraderie. It worked. The competition in Vermont County Bird Quest has not only produced the elite "150 Club" among birders (150 species in a county in one year), but has generated a ton of invaluable data for Vermont eBird.

Meanwhile, Vermont LoonWatch and its legion of volunteers not only gather annual midsummer census data on Common Loons, but feed data to eBird. The more data collected, the better we can conserve loons—and the more readily birders themselves can find this iconic lake dweller.

For decades, our biologists and volunteer birders have assembled and reviewed reports on rarities under the auspices of the Vermont Bird Records Committee, which is also supported by VCE. Each year, the VBRC rigorously evaluates all reports of vagrant and accidental birds and publishes the findings. One outgrowth, another "birding service" now in the works, will be the "Annotated List of Vermont Vagrant, Out-of-Season, and Rare Nesting Birds"—the most authoritative source for Vermont's avian oddities ever assembled. Watch for it on the VCE web site.

Recreational birders shouldn't forget the Vermont Breeding Bird Atlas. This atlas is an essential guide to the distribution and biology of the state's nesting birds—and a prized resource for any birdwatcher. Available here: **upne.com/1611683486.html**

Finally, VCE conservation biologists field phone calls and emails on everything from eagles to egrets, warblers to woodpeckers. And when various birding queries or debates hit the news or one of the birding email listserves, our eBird guru Kent McFarland often responds with on-the-spot data analyses to field questions and help birders find birds.

FOR MORE ON VCE'S BIRDING SERVICES, VISIT THE WILDLIFE WATCHING PAGE ON OUR WEB SITE : VTECOSTUDIES.ORG/WILDLIFE/ WILDLIFE-WATCHING

In the end, Vermont might not boast the impressive state bird lists of, say, New Jersey, Texas, or California, but we suspect that no other state uses research and citizen science for the benefit of its birders the way we do here in Vermont. In that sense, we all give so that birds—and birdwatchers—can receive.

—Bryan Pfeiffer

The globally-endangered Jamaican Blackbird

Birding and Beauty in Jamaica

IT WASN'T ALL SCIENCE—WE MANAGED TO SPEND ONE DAY OUTSIDE BIRDING AND ENJOYING JAMAICA'S SPECTACULAR MOUNTAIN LANDSCAPES.

Conservation, science, and birding highlight VCE's participation in the 2015 BirdsCaribbean meeting in Jamaica.

Every two years, ornithologists, birders, naturalists, and conservationists from across the West Indies and beyond converge for the BirdsCaribbean meeting. The biennial conference allows this far-flung community to gather, learn about ongoing research and conservation projects, and rekindle valued professional relationships. Chris Rimmer and I represented VCE at the 2015 BirdsCaribbean meeting, held during late July in Kingston, Jamaica. Over the course of five days, we updated our fellow Caribbean ornithologists on VCE's research on the ecological value of migrant birds in the Caribbean, population trends in Hispaniolan endemic birds, our efforts to conserve threatened montane forests in both Haiti and the Dominican Republic, and our ongoing surveys for wintering Bicknell's Thrush on Puerto Rico.

But it wasn't all science; we managed to spend one day outside birding and enjoying the spectacular mountain landscape of Jamaica. I opted to head to Ecclesdown Road, a narrow track that follows the Drivers River Valley into the far northeastern slopes of the John Crow Mountains. The road offers exceptional access to one of the wettest, most biodiverse forests on the island. Indeed, a Black-billed Streamertail greeted us almost immediately upon our arrival. Among males of this spectacular and aptly named hummingbird, endemic to Jamaica, the next-to-outermost tail feathers are modified to form absurdly long pennants, apparently a sign of virility for potential mates. Nearby perched a Jamaican Blackbird, a globally-endangered species of which fewer than 7,000 individuals remain. Seeing this dwindling icon of Jamaica's remote mountain forests reminded me of the vitally important role that VCE can play through our work in the Caribbean. We can help prevent extinctions by conducting rigorous science, by uniting and empowering local partners, and by broadly communicating the value and beauty of these birds and the landscapes they inhabit.

—John Lloyd

Drones, dummy anti-personnel mines, and concertina wire are all part of a day's work while surveying for grassland birds at Fort Riley, Kansas.

© JASON HILL

Biology Meets Combat Training

This year's field season featured its fair share of the wild and bizarre, with drones, rifles, and anti-personnel mines.

© ERIC HYNES

Sometimes wildlife biology can be a little too wild—even for our biologists. Like the time Sara Zahendra and Leif Richardson, studying bees in northern Vermont, unwittingly strayed into Canada, only to be confronted by an armed border guard who ordered the two back onto U.S. soil through the customs gate. Or when VCE research associate Bryan Pfeiffer, surveying for butterflies in Groton, cut short his field work when two rifle shots from a nearby landowner whistled low over his head.

This year's field season featured its fair share of the wild and bizarre.

Take the voice that haunted Sarah Carline and Sara Zahendra in western Vermont. They were standing near a dairy farm at dusk, about to begin a survey for Whip-poor-wills. Only five minutes earlier, a stomping, huffing deer had given them a start, while the deserted farm and looming darkness already had them sufficiently skittish.

But as nightfall's approach marked the start of the survey, there came from somewhere behind a deep, chilling voice.

"I hurt myself today."

Sara and Sarah's hearts thumped and sank. Gripped with fear, they spun around, expecting to see a large, angry man coming for them. But there was nothing—only crickets and pasture and more darkness.

That's when Sara realized the voice was coming from her backside.

"I had stuck my phone in my back pocket and inadvertently opened my music playlist to Johnny Cash's cover of the song *Hurt*," Sara recalled. "I had butt-dialed a Johnny Cash song, and it was terrifying!"

VCE biologist Jason Hill doesn't strike us as any kind of national security threat. Nonetheless, a drone seemed to follow Jason and other VCE biologists while they surveyed for birds at Fort Riley in Kansas, part of VCE's exciting project to study grassland bird migration in cooperation with the Department of Defense.

Flying high, and hard to see against the prairie sky, the drone came into view only twice. It dragged a huge parachute behind so it could, presumably, fly in place. But the drone was so loud that the VCE team could no longer hear the bird recordings necessary for their fieldwork. Jason and his team had to throw in the towel for the day.

"Walking out to our car, I stepped onto a hard object in the grass and heard two disturbing metallic clicks," Jason recalled. "We all froze."

No guard. No rifle. Not even Johnny Cash with a guitar.

"Slowly turning around to investigate the source of this sound, I realized that I had just tread on a dummy anti-personnel mine used for training."

Drones. Rifles. Anti-personnel mines. Sometimes, as we study birds, bees, butterflies, and the like, it can seem like a war zone out there. But we'll keep visiting our study sites and walking our transects. Or, as Johnny might have said, "Because you're mine, I walk the line." —*VCE Staff*

© KENT MCFARLAND

Attack of the Wriggling Invaders

In northern hardwood forests it is becoming clear that earthworms are a problem.

Earthworms fascinated Charles Darwin. In the 19th century, most people thought worms were pests. But Darwin believed they provided an important yet unrecognized agricultural service: they slowly turned over the soil, enhanced decomposition, and provided nutrients through their castings.

Darwin conjured up an experiment to prove that worms were major soil movers. He placed pieces of coal across a field behind his country estate outside London and waited patiently. Decades later, he discovered that the coal was completely buried. As Darwin theorized, earthworms added a layer of digested matter on the earth's surface, bit by bit.

While all this might have been beneficial for Darwin's agricultural field where earthworms were native, modern-day scientists have found that here in the forests of the glaciated Northeast, earthworms are an invasive pest.

After the last continental ice sheet retreated 12,000 years ago, not an earthworm was to be found in our region. Today, native worms inhabit only areas beyond the extent of the ice sheet. Other forms of life quickly returned to the bare land, but earthworms were able to advance only about five yards per year.

Enter the European invasion. Earthworms hitched a ride from the Old World, most likely in the soil used as ballast in ships. Today, humans are still transporting them to new areas—through dumping unused fishing bait, transporting compost and mulch, and moving topsoil. Researchers have found that New England forests now host as many as 15 species of European and Asian earthworms. Biologists are just beginning to understand the ramifications of this colonization, but already it has become clear that earthworms are negatively impacting forests.

BIOLOGISTS ARE JUST BEGINNING TO UNDERSTAND THE RAMIFICATIONS OF THIS COLONIZATION, BUT ALREADY IT HAS BECOME CLEAR THAT EARTHWORMS ARE NEGATIVELY IMPACTING FORESTS.

© KENT MCFARLAND (2)

The worms eat fallen leaves that otherwise would turn into the spongy, nutrient-rich layer of material known as "duff." Duff sustains native forest plants, along with a whole host of fungi, bacteria, and other detritivores who depend on it for food and shelter.

Earthworms also consume the duff itself and can then mix it deep into soil layers, making duff unavailable for the plants that need it. The extent of soil mixing depends on the earthworm species involved. There are three groups: epigeic worms reside mainly in the duff layer and cause only limited mixing, endogeic worms reside in the mineral or mixed soil layers and often enhance the mixing of organic and mineral soil layers, and anecic worms (including the common night crawler) can dig burrows up to six feet deep, moving leaf litter deep into the soil and bringing mineral soil to the surface.

The duff layer protects seeds from predators, shelters them from extreme cold and drought, and provides nutrients critical for growth. Studies in the upper Midwest suggest that sugar maple seedlings won't sprout in soils worked over by worms and that a second generation of maples is unlikely to grow in affected areas. Experimental plots with and without earthworms look dramatically different. Worm-free plots support a thick, lush growth of understory plants, including seedlings, while those with worms are almost barren.

Earthworms can profoundly affect some species of wildlife. Red-backed salamanders, usually the most abundant small vertebrate in northern hardwood forests, at first experience increased reproduction rates in areas with earthworms—because they benefit from a high-protein worm diet. But the salamanders' offspring need a thick duff layer with a healthy population of tiny invertebrate prey items, both of which decline as worm densities increase. Ultimately, as offspring fail to survive, salamander populations diminish.

In their native habitat, the work of earthworms might have pleased Darwin, but in our northern hardwood forests it has become clear that these wriggling invaders are a big problem.

—Kent McFarland

© ALISON NEVINS

Alison Nevins prepares to release a male Grasshopper Sparrow wearing a geolocator in Fort McCoy, Wisconsin.

Grassland Birds and Geolocators

This past summer was a complete success with 180 of our geolocators safely deployed.

How do you track migratory Grasshopper Sparrows between their breeding and wintering grounds? Step 1: acquire 0.5-gram geolocators that record light levels throughout the day. These devices (smaller than a postage stamp and affixed like backpacks on the birds) will help us reveal migratory routes and timing, stopover areas, and wintering grounds of Grasshopper Sparrows across their breeding range. Step 2: get a rental car contract with unlimited miles and hire an eager group of field biologists who function well on little sleep. Step 3: find the birds, capture them in nets, and attach the geolocators. We found 180 cooperative male Grasshopper Sparrows on their breeding grounds at six different military bases in six states (MD, MA, WI, MN, ND, and KS) in two months this summer. Step 4: get some sleep, then wash and vacuum the rental car before returning it. Step 5: try not to think obsessively about "where are they now?" until the birds return next May.

Even with a snowstorm, 40-mph winds, and constant military exercises that kept us on our toes, this past summer was a complete success. We safely deployed all 180 of our geolocators, and we made a lot of friends on the military bases. We even got some soldiers to come out with us into the field to see the "little brown birds." Next summer, we'll return to these sites and reach out to citizen scientists and birders to help us locate the returning Grasshopper Sparrows. We will also launch an effort to attach similar tracking devices to Eastern Meadowlarks and Upland Sandpipers. *—Jason Hill*

FIELD NOTES
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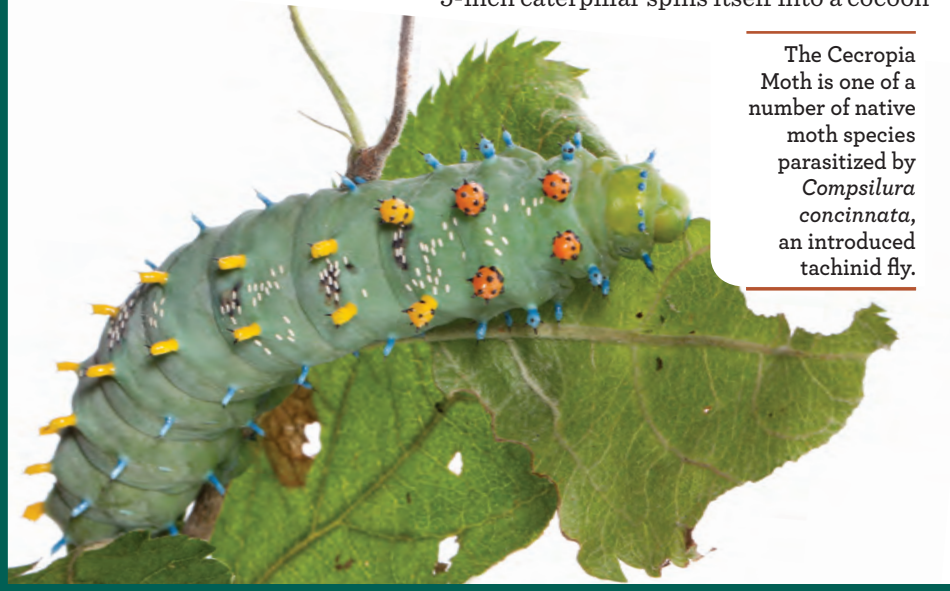
Cecropia Moth {*Hyalophora cecropia*}

IT'S NOT EASY TO FIND THE CECROPIA'S WELL-CAMOUFLAGED COCOON, WHICH MIMICS A DEAD LEAF.

With a wingspan of nearly six inches, the richly colored, nocturnal Cecropia Moth is North America's largest silkmoth. Zadock Thompson, Vermont's pioneering naturalist, described this species as a "butterfly" when he found a cocoon in March 1840 in Burlington and watched it eclose in captivity a month later.

With an adult life span of just a few days, there's little time to waste. Females waft a pheromone capable of attracting males from over a mile away. Each lays more than 100 eggs in rows of 2-6 eggs on both sides of the leaves of host trees—among them, box elder, sugar maple, apples, and willows.

Two weeks later, the tiny black caterpillars hatch and feed together in groups. As they grow and molt, changing from black to yellow to green, they become solitary. At summer's end, the massive 5-inch caterpillar spins itself into a cocoon attached along the length of a twig and emerges as a moth the following spring.



The Cecropia Moth is one of a number of native moth species parasitized by *Compsilura concinnata*, an introduced tachinid fly.

Found scattered throughout Vermont, the Cecropia Moth is neither common nor abundant, and recent signs point to declines. Over 30 species of parasitic flies and wasps are known to attack Cecropia Moth caterpillars. One tachinid fly alone, the non-native *Compsilura concinnata*, may be largely responsible for giant silkmoth population declines in the Northeast. In an experiment done in Massachusetts, this parasitic invader attacked and killed roughly 80% of the giant silkmoth caterpillars in the study. This fly was repeatedly introduced by the USDA between 1906 and 1986 to control multiple pest species, including non-native Gypsy Moths.

There are over 1,000 tachinid fly species in North America, all of which have a parasitic lifestyle. Females typically lay an egg on the host insect, and the hatching larva then bores into the body of the host. In other cases, the host consumes the fly egg as it feeds. *C. concinnata* gives birth to live larvae which the female injects directly into the host. The fly larvae feed on the caterpillar, usually killing it when it pupates.

It's not easy to find the Cecropia's well-camouflaged cocoon, which mimics a dead leaf. Once the leaves have fallen in late fall and winter, look for a large brown clump parallel to a small branch. If you find one, make sure to share your sighting with iNaturalist Vermont!

—Kent McFarland