Charlotte Rocks!
BY TATE BUSHELL

CHARLOTTE PARK AND WILDLIFE REFUGE

Stone gate pillars at the entrance to the Charlotte Park and Wildlife Refuge on Greenbush Road.

Look closely and you’ll find some of Charlotte’s history written in the rocks. It predates European settlement, the glaciers, and even the existence of mammals. Some of these rocks sit stacked in two pillars at the entrance of Charlotte Park and Wildlife Refuge on Greenbush Road. The stories in these ancient texts tell of both their creation and their current influence on the landscape. Rocks are sometimes difficult to read. I will translate.

The main characters are quartzite and limestone. These two common types of local bedrock were both formed in an ancient ocean, the Iapetus (i-AP-e-tus), around 550 million years ago.

Half a billion years ago the planet looked very different than it does today. First, life was found only in water. Insects, some of the first terrestrial animals, didn’t evolve until 170 million years after the Charlotte rocks were formed.

Also, tectonic plate arrangement was different, and this created a unique set of continents and oceans. There was no Atlantic Ocean, and there was no North America. It’s hard to believe, but the quartzite and limestone rocks, in fact all of Vermont, sat underneath the warm and shallow Iapetus Ocean just below the Equator.

The specific requirements needed for these rocks to form tell us about the environment at the time. First let’s think about the quartzite, the rock with a pink hue. In shallow regions of the Iapetus, sand accumulated and was compressed to make sandstone. This sandstone underwent another heating and compression process (metamorphosis), which turned it into quartzite. It is thought that some of this sand was periodically uncovered by water in an environment such as a tidal flat. Per-
haps this and other ancient environments resembled the sandy beaches and deltas of Lake Champlain today.

The limestone rock is evidence of a different aquatic environment. Deeper, but shallow enough to support light-dependent animal communities, these waters were teeming with shelled organisms. Microscopic zooplankton were most plentiful, followed by clams, mussels, and coral. As these animals died, their shells rained down to the sea floor. Over millions of years, an estimated two miles of calcium rich shells collected on the ocean shelf and, by the collective weight of new sediments over topping them, fused into limestone rock. Scattered among these broken bits of shell were intact clam shells which left impressions visible in the rocks today. A large limestone slab mounts each of the park’s pillars, and with a brief search you will discover clam impressions half a billion years old!

Rocks vary in chemical composition and therefore have unique physical properties that influence our entire landscape. The grey limestone (CaCO₃, or calcium carbonate) is easily eroded by water while the pinkish clear quartzite (SiO₂, or silicon dioxide) is very resistant. Under the influence of rain, wind, or glaciers, this differential erosion produces a variety of landform features. Examples are the sheer walls of limestone sliced by rushing water overlooking the Winooski River and Mt. Philo’s quartzite cap that will persist into future millennia.

Many of our plants and plant communities exist only where limestone is abundant. In water, CaCO₃ breaks down into a calcium atom and a molecule called carbonate, both of which benefit the chemistry of life. Calcium, which is needed for plant growth, acts like a vitamin to promote the growth of plants sensitive to calcium deficiency. For example, our famous sugar maples find their competitive edge in forests that sit over nutrient rich limestone. The carbonate is a natural acid neutralizer which creates a local environment suitable for plants that grow poorly in acidic conditions. Farmers traditionally apply lime (pulverized limestone) to better the soil where they grow crops.

This story is of earth recycling. The quartzite, made from sand, is now slowly breaking down, and will eventually return to the ocean as zillions of sand particles. The limestone started as invertebrate shells and is now slowly feeding nutrients to our forests and wetlands. These non-living pieces of our landscape have complex but direct relationships with the living, often on the molecular level. I marvel at the long journey that say, a cluster of calcium molecules, takes as it moves from a piece of limestone rock to the shell of a chicken egg. Knowing that my own chickens are, in part, made from the stuff of rocks reminds me of the role rocks play in the story of life.

Tate Bushell recently earned an MS degree from the University of Vermont Field Naturalist Program.
The spring chorus from birds and frogs makes us aware of vibrant life stirring anew. Delicate woodland wildflowers are a delight to the eye as they reach their peak bloom in early May. And when the ground thaws in spring, we once again breathe the rich earthy smell of soil. Our senses tell us life is active all around us. Yet we often walk over the ground without much thought for the world beneath our feet. If we looked closely at that below-ground world, what would we find?

Earth opened by a backhoe or even a shovel will reveal a great many things about what is going on below. When examining a soil pit in Vermont, often the first and most startling thing about it is the wide variety of colors. If Crayola made a crayon called “dirt” probably it would be a mud brown. But actually dirt comes in a great many colors! Take for example, one of the dozens of soil types in Vermont, called “spodisoli,” (usually found at high elevation and/or in acidic environments). These spodic soils grade with depth in bright colored bands (or horizons) from a deep chocolate brown to an ash gray to a rich rusty orange. These different colors are evidence of the important chemical, biological and ecological processes occurring over time in soil.

The “earth” part of soils (parent material) in Charlotte is largely the loose material left behind by glacial ice and water. These ground-up bits of rock can be as big a boulder or as tiny as a clay particle (which can’t be seen with the naked eye). They may be jumbled together as “till” laid down under ice, or sorted according to size by flowing water. Flowing water loses energy as it moves from its headwaters down to its mouth. As its energy decreases it will drop large cobbles in its bed, sand at the shore of a lake, and silts and clays in deep water. The parent material helps determines the texture of the soil, which along with topography, dictates how well drained the soil will be.

After looking at the color and texture of the soil, we might start noticing what is living there. Roots will...
crisscross nearly any Charlotte soil pit and the largest ones will belong to trees. Scientists are still learning about the complex role that roots play. What they are finding challenges our above-ground perspective on trees, for example. Above ground, trees look like so many rugged individuals. But below ground there is a great deal of fascinating interconnection. Roots can link individual trees together, interacting in ways that provide not only physical support, and the exchange of nutrients, but they can even function as a chemical alarm system between trees. Sometimes tree roots can even give rise to new trees that are clones of the parent, so that what appears to be a stand of aspens can actually be one genetically identical individual!

It is often through roots that plants exude strong secondary substances like phenolic acids, flavonoids, aromatic compounds, terpenes, steroids, alkaloids, essential oils and organic cyanides—allelopathic compounds which can inhibit other plants. Allelopathic activity in the soil influences the timing and sequence of plant succession in very important ways: direct suppression of one species by another through toxins; indirect suppression by chemical inhibition of key soil organisms; and autotoxicity. Direct suppression is frustratingly clear to anyone who has tried to grow flowers or vegetables near a black walnut tree. Autotoxicity is paradoxical, yet quite common in short-lived successional plant species, where it creates a fairy ring effect with individuals near the center of the population being thinned or dying out due to their own toxins. All of this chemical drama happens quietly and invisibly, underground.

As we continue to examine our soil pit, we may well see signs of burrowing mammals like moles, shrews, and even woodland salamanders. There are much smaller organisms also. Where soils are rich in nutrients, usually there will be earthworms. The common assumption is that earthworms are entirely beneficial organisms, because they digest leaves and fertilize the soil with their castings. But here’s another surprise—not all earthworms are created equal, and in Charlotte, most are not even native. Some of these new-comers are causing serious trouble. One species of earthworm in particular, found along the lake shore, can actually denude forests of leaf litter, contributing to the quick overland flow of water and nutrification (nutrient overload) of the lake. These earthworms roll leaves into “cigars” and pull them into their burrows to create the humidity they prefer.

In addition to current biological and chemical activities, the soil pit may hold clues to the past to wonder about. We all know about the ability of peat bogs to preserve Stone Age bodies of humans and even baby mammoths like the one recently discovered in Siberia. A soil pit near you might contain charcoal from an Abenaki fire pit or from a 19th century logging fire. It might have an arrowhead or chips from a stone ax. It might also have a plow layer (a layer of soil that is evenly mixed that has a sharp line between it and the next horizon between 6 and 15 inches in depth) indicating that the land was once used to grow crops.

Remember that the root system of a tree is as wide and majestic as its crown. And so—like a winter tree reflected in a pond—what’s above is mirrored by what’s below. Next time you’re out walking, stop to ponder the world beneath your feet. Take time to think about, and explore, what all is going on down there!

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Holding What We Need
Basket Shrubs in Your Backyard

By Allaire Diamond

In this time of global financial uncertainty, it’s more apparent than ever that money doesn’t grow on trees. We could learn important fiscal lessons, however, from the woody plants around us. Masters of economy, they increase their net worth (or rather, girth) each year by silently transporting tons of water against gravity and turning sunlight and carbon dioxide into sugar. As they grow, they become more deeply grounded in the soil and charitably provide room and board for thousands of organisms, from bacteria to bracket fungi to black bear. In our four-season climate, woody plants frugally go dormant through lean seasons. And they are dependable trading partners for the vital gases that keep us all alive: plants need the carbon dioxide produced by our lungs, while we rely on the oxygen they produce and expel as a byproduct of their metabolism. They can also absorb some of the carbon dioxide produced by our petroleum-based lifestyle.

Our ancestors also viewed trees and shrubs as reliable long-term economic investments. With care, certain plants yielded materials, regularly, for use in a well-functioning home. Let’s look at two that have solved problems and helped create order for people for thousands of years.

“Paper or plastic?” If they had had convenience stores and supermarkets, ancient Romans, Native Americans, Shakers, and pre-industrial Europeans alike might have asked “Willow or dogwood?” These shrubs are two among many with long basketry traditions in numerous cultures throughout the world. Their stems, twisted together, form strong, lightweight baskets used for harvest, storage, organization, and transport. To find them, follow one of Charlotte’s many streams and brooks. One of these natural corridors will likely lead you to willow and dogwood shrubs along sunny banks or in open wetlands. To spot them from afar, look across fields for lines of person-height vegetation that may be sheltering a stream, or sprawling domes of shrubs in old beaver meadows.

There are 23 native species of willow in Vermont. Most have thin, pointy leaves and distinctive “pussywillow” catkins that softly herald spring. Nearly all are shrubs, with the exception of black willow, whose gnarled trunks grace some Lake Champlain beaches, and weeping willow, a native of Europe. As a group, willows frequently form hybrids, thus diversifying their genetic portfolio with a species for every habitat. Some tiny Arctic willows are only a few centimeters high, avoiding extreme cold and chilling winds higher up, while most
Vermont willow species tolerate the challenges of wet, saturated soils.

The shrub willows you’ll encounter on your Charlotte walk share some intriguing traits. Basketmakers take advantage of the fact that willows exhibit coppice growth, or multiple stems from the same root mass. In any one year, growth from each of these stems will be straight and branch-free, with multiple branches emerging only the next growing season from the previous year’s end buds. And straight, flexible—so flexible you can tie it in a knot—stems are the only ones suitable for baskets. Careful basketmakers tend the same willow plants for decades, cutting the long, straight stems from the previous year’s growth in the spring and weaving baskets right away while the wood is still pliable.

Without pruning—a process that mimics flood disruptions and ice scour—willows will grow gnarly and twisted, with few basket-quality stems and a lower proportion of leaves as years go by. Pruning thus keeps the plants growing vigorously, which enhances their role as stream protectors. They trap soil and take up nitrogen, phosphates, and other nutrients that may be running off nearby fields and prevent those particles from being lost into, or polluting, the stream. Some basketmakers selectively burn individual plants to achieve the same effect.

Master basketmakers give back to the plants they use, and thus maximize another willow success strategy: its ability to sprout roots and shoots from any bud. Ojibwe elders taught students to plant their first willow basket in an appropriate habitat, so that dormant buds along the carefully twisted stems could sprout and provide basket materials for the future. After that first offering, many basketmakers cut the tips of willow stems while harvesting, and either bury those tips or toss them into the stream, which will carry them to a good growing spot. All of these practices spread willows along their watery paths.

Red osier dogwood is a woody shrub that grows alongside willows in streams and wetlands. In winter, its leafless branches make it easy to spot. An osier is a stem, and those of this shrub have a distinctive garnet red hue. Like willow, red osier dogwood has coppice growth, will yield long, straight stems if pruned, and can sprout from buried buds. Its beautiful color makes distinctive baskets. You can recognize this shrub by its opposite branching pattern: branches and leaves grow directly across each other on a stem. Its oval-shaped, pointy-tipped leaves have veins that run along the perimeter of the leaf instead of ending at the edge. Like many dogwoods, from tiny woodland wildflowers to trees, red osier dogwood’s small white flowers have four petals and grow in flat, branching clusters. Basketmakers tend these plants in the same way as willows, and harvest stems at a similar time of year. Human pruning has the same effect as a beaver feeding or ice grinding: stimulating the plant to grow straight shoots.

It’s easy to see why these shrubs have through time been tended for basket materials, in the same way we now tend a rhubarb patch or an apple tree for its tart stems or delicious pie apples: all are examples of sustainable harvest and use. Basketmakers and other creative and practical people have learned to meet their needs by closely observing and then thoughtfully utilizing the structure and growth patterns of the plants around them. While money will probably never grow on trees, the landscape holds many possibilities for nondestructive, elegant solutions to everyday problems.

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Ten or fifteen years ago few of us thought much about the patches of woods scattered throughout the Champlain Valley landscape. However, after more than a decade of research, citizen education, and conservation programs, many residents are now dedicated fans of the Valley’s signature forest type—clayplain forest. Landowners in Charlotte and elsewhere want to learn more about their own clayplain forest patches. Questions people often ask me are: “What exactly is clayplain forest?” “Why is it so important?” and “How should I manage the clayplain patch on my land?” Here’s what I tell them.

Climate forest is Vermont’s most biologically diverse upland ecosystem, in terms of plant species. It is the state’s only dominant ecosystem type that is highly degraded and highly fragmented into tiny patches, and, therefore, the Vermont Nongame and Natural Heritage Program classifies it as threatened. Originally covering over 200,000 acres west of the Green Mountains from the Winooski to the Poultney River, clayplain forest now remains on only 10% of its pre-settlement land base. That 10% occurs as small patches (almost all are 35 acres or less), with many areas very much impoverished from the original natural vegetation. Although the clayplain soils are highly valued for agriculture, clayplain forest patches play important roles, both ecologically and culturally. The Ecological Society of America is convinced that to achieve a sustainable world future, the public must understand these roles (ecosystem functions and services) and their intimate connections to human well-being.

I’ll highlight some of the most apparent functions and services. Being islands of natural area in a human-dominated landscape, clayplain forest fragments are essential habitat for plants and animals, including those game species that are traditional Vermont food sources. Clayplain forest is also home to 30 plant species rare or uncommon in Vermont. Regarding water, the for-
Est fragments help maintain stream flows, recharge groundwater, and purify runoff. Less appreciated, perhaps, is the role these forest patches play in control of insect pests. Lots of research has found that agricultural pests are reduced when patches of natural vegetation grow intermixed with farm fields.

The ecosystem service most apparent to our eyes and hearts is the aesthetic contribution of the clayplain forest patches. Our well-loved Champlain Valley landscape is a patchwork quilt of field, forest and open wetland; without the clayplain forest patches, we’d see woods only on rocky hills and in swamps, and we’d miss out on the diversity of species and habitats comprising our sense of the landscape. On the flats we’d view an expanse of cultivated fields, punctuated by homes and lawns, and we’d miss the colors and textures that forest trees provide. We’d miss, also, a lot of bird song, flower blooms, and fall foliage colors.

In Charlotte you can visit two great examples of clayplain forest—town-owned Burns Woods behind Town Hall, and The Nature Conservancy’s Williams Woods off Greenbush Road. You’ll see that over 20 species of trees are common in clayplain forest, most notably maples, oaks, ashes, beech, shagbark hickory, hemlock and white pine. The tapestry of wetter and drier sites within the woods allows for high shrub diversity, and an abundance of ferns, sedges, and spring-blooming wildflowers carpet the forest floor. It is a complex, species-rich and beautiful forest.

So, how to manage a clayplain woods? Wise management depends on two things: a site’s ecological capabilities and an owner’s desires for the site. Among the things to consider are current condition of the forest, tree types and growth rates, invasive species, and landscape pattern.

Above all, clayplain forest conservation depends on retaining forest patches that still exist. Steady attrition due to construction of new houses (and to a much lesser extent to expansion of farm fields) is the biggest threat.

Of maximum conservation importance are the more mature examples. So forest ecologists like myself recommend that clayplain forest fragments that have a mix of characteristic trees over 100 years or so old and an intact flora on the forest floor be left to natural dynamics. These are the remaining jewels of the ecosystem, and although quite widely scattered, they’re the hope for the future, providing the seed source and genetic diversity essential if forests are adapt to changing environments (think about climate change, species extinctions, mercury deposition). Most patches have been quite manipulated in the past century, and these can be managed in various ways, depending on landowner objectives.

In deciding about tree cutting, it is important to know about site characteristics and species life histories. On most clayplain sites, tree growth is pretty slow. For species such as the oaks, hickory, sugar maple, and beech, annual increase in diameter is slower than on lighter soils. Beech and the oaks are slow to mature, but when they begin to produce nuts, the food resource for wildlife can be immense and can continue for centuries. (Yes, I said centuries!)

The Champlain Valley has an unfortunate plague of invasive alien species, which hinder nutrient cycles, regeneration of native plants, and wildlife food resources. Buckthorn, honeysuckle, and garlic-mustard are currently abundant, with barberry, multiflora rose and other species possibly able to cause even more harm. Tree life-history characteristics and threats of invasives suggest a careful approach to tree harvest in
clayplain forest. Large openings should be avoided, as they provide major entry points for invasives. If cutting for firewood or timber, harvest rotations often need to be longer than on better drained, loamy soils; and individual tree harvest is more advisable than group selection harvests.

The key word at the landscape scale is connectivity. Our use of the clayplain for farming and residential development has broken connections in a formerly continuous expanse of forest. Thus, anything we can do to promote connectivity of woods benefits forest plant and animal populations. Broken connectivity translates to local extinctions, genetic impoverishment and loss of resilience to respond to natural or human-caused disturbances. Simple things like retaining rows of trees and shrubs along field and road edges, allowing wet swales to return to trees and shrubs, and allowing forest patches to expand outward, all improve the interconnections and increase natural ecological functions within the landscape. Most important of all, consider the larger context of your bit of clayplain forest; become familiar with the ecosystem services it provides, its individual characteristics, and its role within the landscape. The once-vast clayplain forest natural community now exists in a highly fragmented patchwork; survival of this rich forest and its ecosystem functions and services depends on the cumulative impact of small-scale land management decisions by individual like you and me.

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WIN TER MAK ES LI FE A B IT M O RE challenging for us humans as we are forced to wear more clothes, drive more slowly in the snow, split, move and stack wood, and clear our steps of ice. However, these are mere setbacks in our daily lives—extra actions that mark a usually pleasant and often magical season. For our animal neighbors, winter is a much more serious matter. It is a strenuous and demanding time for animals when they are subjected to frigid temperatures and a scarcity of food.

Each species of animal has its own way of navigating through the long, cold winter. Some, like the groundhog and black bear, enter into a state of decreased activity called torpor. Red and gray squirrels spend the fall hoarding acorns and conifer cones to be eaten when winter food becomes less available. Fall skies are filled with migrating birds who seek insects in the south, while most insects of the north either die or overwinter in their own inactive states. Of the birds that stay in Charlotte all year, there is one whose wintering behavior and physiological adaptations are particularly well known among ornithologists.

We know the black-capped chickadees’ call of “chick-a-dee-dee-dee-dee” and recognize them by the black forehead and bib. They are a common bird at our feeders. And they are an extraordinary winter time success story. Haven’t you ever wondered how this tiny bird (weighing just over a third of an ounce) survives sub-zero nighttime temperatures and manages to find food when the forests appear so empty?

Like humans, the black-capped chickadee’s first step toward staying warm is insulation. Its feathers hold in body heat generated from a high metabolism and physi-
cal activity. The chickadee can expand the volume of its body by puffing up its feathers which trap more warm air than when they are flattened against the bird’s body. No insulating system is perfect however, and heat is inevitably lost to the surroundings, mostly from around the eyes and beak. To minimize this loss they tuck their heads into their back feathers during sleep.

The chickadee is at greatest threat of freezing during the long winter nights and employs a number of amazing strategies to keep its body warm. It has a remarkable internal engine which burns calorie rich fat throughout the night keeping its body temperature regulated against the frosty winter air. Studies have shown that chickadees in winter contain around 7% body fat in the afternoon and only 3% in the morning. Astonishingly they have to put on fat during the day so they can burn it at night! Their constant daily forage for food is responsible for this nightly crescendo of fat. Come morning there is no excess fat and they are forced to forage regardless of weather conditions. They spend every waking moment searching for their primary winter foods, seeds and berries, and will feed on fat from dead animals or suet hung by a human if they are lucky.

One study from Wisconsin showed that populations of chickadees are limited by abundance of food and that supplemental food sources (bird feeder) increased winter survival rates. Establishing a feeder on your property can help increase the chances of survival for some lucky birds and gives you a look at their voracious feeding habits! Keep those feeders filled on extra cold days, as the birds will increasingly incorporate your generosity into their feeding schedules.

Interestingly, chickadees announce to one another when a food source has been located. But why would they share precious calories with the group? Many ornithologists consider this to be an evolutionary means of keeping groups foraging together, providing extra eyes to look out for predators like the Cooper’s hawk.

To a chickadee fat is survival, so in order to use it more efficiently they have adapted a physiological response to very cold nights. To minimize the amount of fat burned they drop their body temperature from 108° F to 90° F. This reduction of internal temperature operates on the same principle as the heat in your home. It takes more energy to keep your house at 70° F than it does to keep it at 65° F. By dropping their temperature they save energy.

Good luck finding a sleeping chickadee. They stay tucked away from the wind by sleeping in a variety of concealed places such as tree cavities, crevices found in wood, or in the dense foliage of coniferous trees. Think about that as you pull your down blankets over your head at night!

The black-capped chickadee is not the only animal that is prepared for a difficult winter life. Each species out there has a history that has shaped its adaptations and strategies. Their stories of survival and physical capabilities move me and when I consider nature’s power I feel grateful to be a part of it, for it shows that anything is possible!

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AST JANUARY, AS I WAS FOLLOWING porcupine tracks in the snow, I came across another set of tracks that sent me on a detour. It was an average cold winter day at the Charlotte Park and Wildlife Refuge, preceded by a day of above freezing temperatures. My hope was to find some fresh tracks laid down since the change in weather. What I found weren’t that fresh, but they intrigued me. The mystery prints were fairly large, perhaps 3 inches long by 4 inches wide and widely spaced. I followed this animal’s trail as it crisscrossed the landscape, moving up hills, under thickets, and across frozen wetlands. My mind began narrowing the possibilities: cat, weasel, canine?

In Charlotte, we are fortunate to have a diversity of mammals ranging from thumb-sized pygmy shrews to half-ton bull moose. One rarely sees most of these neighbors however, and if so, usually only briefly. Of the approximately 55 native mammals found here, only 10 or so are commonly encountered; the majority are nocturnal and skittish. Tracking is a fun way to play detective and learn more about these elusive critters. The first thing a detective needs is clues, and tracks are great clues.

For good tracks, you need good substrate (the material that animals step on). It’s no coincidence that most of the world’s best animal trackers honed their skills in environments with really good substrate: sand, snow, and mud. Here in Charlotte we have great tracking substrate about half the year—snow. However, as any winter sport enthusiast will tell you, not all snow is created equal. The quality of tracks a rodent, ungulate, or carnivore, might leave is profoundly affected by the quality of snow, as well as the weather history and age of tracks. And of course, the quality and quantity of snow can change how that animal moves.

I’m often disappointed when tracking early in winter to find the snow too fluffy to leave clear footprints.
That was the sort of the day I was having at the Park and Wildlife Refuge. Contrast that to a mid-winter cold snap that hardens snow cover to ice-like consistency. A light dusting of dense snow on top of this provides tracking delight; most animals don’t break through the harder sub-surface and their light tracks may even freeze solid if there is calm, cold weather. And best of all, the light dusting doesn’t provide much impedance to travel, so the pattern of movement or gait is probably characteristic.

Every animal has a preferred gait. Hares prefer bounding, canines prefer trotting, for example. Of course, any animal is capable of a wide variety of motions. However, for comfort and energy efficiency (paramount during lean winter months), most critters stick to predictable gaits under normal circumstances. For many species of wildlife, the pattern of prints can be almost as useful as clear footprints in identification. For example, a raccoon’s gait of choice is a distinctive waddle walk in which the front and hind legs on the same side move almost simultaneously then alternate to the other side (2x2 walk). This may be difficult to visualize, so I recommend actually trying it—perhaps in a private place. Now try how a house cat might leisurely walk, with each leg moving independently and the hind legs falling exactly where the front legs were in what’s known as a direct register walk. These patterns feel very different and the tracks they leave can be very different. 2x2 tracks are literally two by two (· · · · · ·), while direct register walking follows a zigzag pattern (· · · · · ·).

What makes snow tracking so fascinating is that the substrate varies tremendously and can cause animals to use atypical gaits. For example, coyotes don’t typically bound like a rabbit unless they are afraid or pursuing prey. However, in deep snow it is not surprising to find coyotes bounding into the tracks of another animal rather than trudging through in order to conserve energy. Even the raccoon is known to abandon its preferred 2x2 gait in deep snow for a more efficient cat-like walk.

This was not deep snow, so I assumed the animal I tracked was using its preferred gait. It was relying on a 3x4 lope (a slow gallop). Ah-ha! That gait, in combination with the large print size (3”x4”), is tell-tale of one Vermont weasel in particular. Then I found a clue that sealed the deal: a beautiful set of tracks with 5 clear digits perfectly frozen in ice along the margin of a wetland. This animal must have been here during the warm spell yesterday just as the water was freezing. Mystery solved —this was a fisher! All weasels leave 5 toe prints, compared to canines and cats which typically leave only 4.

Fishers are the second largest weasel found in Charlotte (after otters). They generally avoid trails or roads, instead preferring to blaze their own way, just as this one was doing. Fishers typically stick to coniferous forest, but I’ve often found their tracks in deciduous forests and fields like this during winter months.

Many factors lead to successful and satisfying tracking. Clear tracks and good weather history certainly help a lot. Yet, even in poor substrate conditions it’s possible to deduce a species based on its gait. Most important to success is knowledge gained through experience. Each adventure provides new insight which will help you understand the next set of tracks. One need not even leave the yard. It’s surprising how much can be learned by tracking your pet cat or watching a squirrel re-discover its acorn cache then studying the tracks left behind. I encourage you to become a detective, and look for the clues of wildlife tracks in the snow!

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Specks on the Snow

Part 1: Seeds

The winter wind howls all night. Branches creak and break. The old windows rattle. Morning finally brings calm, and the sun warms the air. A great day for a walk in the woods. I head for Williams Woods Natural Area, one of my favorite places in Charlotte. It is old. Wizened. Touched and tumbled by the winds of time. (Williams Woods, off Greenbush Road in southwest Charlotte, is a Nature Conservancy preserve, open to the public for walking, nature study and contemplation.)

I strap on the snowshoes and head into the woods. Just moments after leaving the edge of Greenbush Road, my pace is slowed. My eyes are drawn almost immediately to the ground. The snow is anything but pure white. After the night’s rampage, it’s littered with all kinds of stuff.

What are all these specks on the snow? There are plenty of twigs and branches that have come down in the wind, but there are also thousands, perhaps millions, of tiny birdlike flecks about a third of an inch long. These are bracts, or cone scales. Each of these is accompanied by an even tinier winged nutlet, each containing a single seed. The bracts and nutlets, before they flew apart and landed here on the snow, were arranged in catkins, or cone-like structures, that hung from the tips of yellow birch branches.

I look up into the crown of a yellow birch nearby. The tree is still full of catkins, in spite of the heavy wind that has sent so many of them to the forest floor. Each catkin contains dozens of bracts and nutlets, and each tree can produce thousands of catkins in a good year. So a single tree can produce hundreds of thousands of these tiny winged nutlets (about 28,000 to the ounce, or about two tablespoons, according to Harlow and Harrar’s Textbook of Dendrology). They are released over the course of many months, beginning in late summer when the fruits mature, and ending in early spring when new catkins and leaves force the hangers-on to finally fall. The birdlike bracts catch the wind, which carries the nutlets away from the tree. When the nutlets separate from the bracts, their own papery wings can help them travel much greater distances.

I continue my trek until I reach a place where a number of hemlocks are growing. Hemlocks are characteristic of mature clayplain forests like Williams Woods. The ground under the trees is littered with tiny cones. Each cone is about ½ inch long. Although these cones differ botanically from the birch catkins, they are superficially similar in structure. The cone is made up of many cone scales, and on each cone scale there is a winged seed. The cones fall whole, but as they open the seeds are released and can be carried away on the wind. There are
 dozens of them here in my view. They are a bit heavier than birch nutlets – an ounce contains some 12,000 seeds compared to birch’s 28,000 – so they don’t travel as far. Hemlock seeds can germinate on logs and mossy rocks just as yellow birch seeds can, so they may compete for the same space. And there are plenty of fallen logs in Williams Woods, a testament to the winds that have howled here.

A while later I see some white pine cones on the ground, with their seeds scattered about. These seeds are much larger (about 1,700 to the ounce), and they are an important source of food for small mammals such as squirrels and chipmunks. I begin to make a mental inventory of the seeds on the snow, and compare it with the trees I see.

As I come around a bend, I see some old friends – three or four huge old oaks with smaller trees underneath. I am near the edge of a field, and it’s likely that years ago, cows grazed in these woods, enjoying the shade of the oaks. Where the wind has blown snow away, I see empty acorn caps. Some are fringed, and they belong to the bur oak, which thrives in the clay soils of the Champlain Valley. The nuts themselves are nowhere to be found – they have been stored away underground by busy squirrels, perhaps to be found later, perhaps to be forgotten and to become new oaks. Squirrels are notoriously poor at remembering where they have cached food.

The diversity of trees in Williams Woods is amazing – twenty-three species have been documented in this 63 acre patch of ground. As I walk along, I see a white ash, a basswood, a sugar maple, and three or four black cherries. Where were the seeds of these trees? White ash produces a winged fruit in early summer. These seeds were scattered by the wind months ago, and like the maple, are under the snow. I do not find a single one. Basswood’s fruit is a dry capsule attached by a stalk to a leaf-like bract. Another wind-dispersed fruit. I look around and finally find a single basswood fruit. They fall from the trees in mid-summer, so most of them they are under the snow, too.

What about black cherry? This is one of the few trees of the northern hardwood forest whose dispersal strategy involves birds. Black cherry blossoms in early spring, before the leaves are fully expanded, and produces small black fruits in mid to late summer. When a bird eats and digests one of these fruits, the seed passes through intact, to be deposited perhaps miles away.

I make my way back toward the car, continuing my mental inventory. Wind, mammals, birds. These seem to be the forces that move seeds around in the clayplain forest. I hear a familiar howl in the distance. The wind is picking up again, and the birch seeds are flying once more.

Liz Thompson is an Ecologist with The Vermont Land Trust and The Nature Conservancy and co-author, with Eric Sorenson, of Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont. She teaches Botany at the University of Vermont. Portions of this article first appeared in Northern Woodlands Magazine.
Specks on the Snow

Part 2: Snow Fleas

By Liz Thompson

On one of those tantalizing fifty-degree days this winter, I returned to Williams Woods for more exploration. What a pleasure to don the snowshoes but leave the parka behind! The sun was warm, but there was still plenty of snow in the woods. I was happy to have the snowshoes, because the snow was soft, like partly melted ice cream. As I walked, I saw those same seeds as on my previous walk—birch seeds and their winged scales, hemlock cones and seeds, white pine cones and seeds, and the occasional basswood fruit.

But today there is more bare ground exposed, and I am curious to see what it might reveal. Mostly, the bare ground is found in circles at the bases of trees. It’s tempting to think that the warmth inside the trees is melting the snow, but I rather think the melting really has to do with dark and light. White snow reflects light, but the dark bark absorbs light and the heat that comes with it. So the bark warms up and re-radiates the heat, melting the snow next to it. The same thing happens next to a rock, or any dark object.

I peer into a ring of bare ground at the base of a sugar maple. I see partially decayed maple leaves, oak leaves, and a few hemlock needles that must have blown here from a tree 50 feet away. And there is moss, green through the winter and taking advantage of light whenever it appears. And bits of bark and broken twigs.

My gaze moves to the snow nearby, where there are lots of tiny specks, all the same size. They look like ground pepper, though I know I can’t be seeing ground pepper out here! Bits of bark, brushed off the tree by a climbing squirrel? A kind of seed I don’t recognize? Dust on the wind?

I poke at the specks. Perhaps I could pick one up. But as my finger gets near one, it disappears! I poke and prod at the specks, and soon realize they are not disappearing.
They are jumping! They are alive! No mere dust or detritus these, but living, jumping creatures.

Snow fleas! Of course! I’ve seen them in winters past, but, intent as I have been on studying seeds this year, I’d quite forgotten about snow fleas. As I watched them, lessons came back to me from other naturalists, and my Entomology class at the University of Maine.

Snow fleas are not fleas at all—not even closely related to those little jumpers you find on your cat or dog. These are springtails, an order of arthropods formally known as Collembola. Snow fleas are technically not even insects. Their mouths are internal, in contrast to the external mouths of true insects, and that, it seems, is enough to set them apart.

Springtails get around by jumping. They have forked tails which are tucked under their bodies and hooked there. When a springtail needs to move (for example, when it feels threatened by an approaching giant’s finger), it releases the spring-loaded tail and the force is enough to send the whole animal several inches up into the air. It can’t control where it lands, but at least it gets away. Maybe.

Springtails are ancient. Fossils from the famous Rhynie chert in Scotland reveal a history dating back at least 400 million years. Today, there are about 6,000 species of springtails worldwide. These tiny creatures live wherever there is soil and vegetation, and they are among the most abundant non-microscopic animals on earth. A five-gallon bucket of topsoil is likely to contain about 2,000 springtails. They thrive on decaying plant matter, mites, rotifers (small aquatic animals abundant in stagnant water), algae, bacteria, and fungi. Because of their thin skins, they need moisture. In fact, some snow fleas can walk on water, and stay there most of the time.

The thought of 2,000 springtails per five-gallon bucket of soil might make an insectophobe quiver, but these creatures are not at all harmful to humans. In fact, springtails are immensely beneficial. Living as they do in soil or leaf litter, they are crucial to the functioning of ecosystems. They aid in the movement of beneficial fungi and bacteria, they assist in the breakdown of organic matter, and they help maintain a healthy balance of microorganisms. There are a few species that can be agricultural pests, but generally they are beneficial to agriculture and cause no harm to human health.

This walk gives me a renewed admiration for the creatures that jump before me—our local heroes of the World of Collembola. Snow fleas are probably the most visible and well known springtails in northern climates because of their habit of jumping on the snow. And how is it that they are able to be so active on a frozen surface? Scientists have been pondering this for years, and have discovered an unusual kind of antifreeze inside their tiny bodies. Just recently, researchers reported that they have managed to create, in the laboratory, that same unique, nontoxic antifreeze, by copying what they saw in the springtail bodies. They envision using this antifreeze to store donor organs—kidneys, livers, and hearts waiting to be transplanted—and to make better ice cream.

My trudge back through the soft, melted-ice-cream snow, gives me time to think about these humble little specks and all they do. The sun is dropping in the sky. Colder weather is coming in. More snow is due. Where will the snow fleas go? Where will they be tomorrow?

Liz Thompson is an Ecologist with The Vermont Land Trust and The Nature Conservancy and co-author, with Eric Sorenson, of Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont. She teaches Botany at the University of Vermont.
Fun in the Forest

Winter Tree Identification

BY ANA RUESINK

SAPLINGS IN WINTER MAKE MARVELOUS slingshots. My eight year old daughter likes to bend them back deeply, hold a piece of bark or a Y-shaped twig against the sapling near its tip, and then let go. If she’s lucky, her woody missile will launch gloriously through the woods. If she’s unlucky, it will flop comically to the ground and we’ll have a good laugh. It’s one of the joys of winter outdoors, when trees are leafless and the woods are uncluttered. Stripped of summer’s color and bounty, things simplify.

But when it comes to identifying deciduous saplings in winter—if you want to know your slingshot’s name, for example—things are not so simple. Without leaves, woody residents of the northern forest can be hard to tell apart.

In deciduous forests of the Northeast, you could encounter roughly 70 species of trees. Considering woody shrubs as well adds another 80 species to the list. Daunting? Just be glad you don’t live in the tropics, where woody plant species number in the thousands (and you’re stuck with 12 months of bad skiing).

Luckily, woody plants have many identifying features.

Buds and their corresponding twigs can be arranged in opposite pairs (left) like maples, ashes, and dogwoods; in an alternating pattern (middle) like hop hornbeam and many others; or in sub-opposite pairs (right) like common buckthorn. All of these tree species make great slingshots.

A moment’s scrutiny reveals details, distinctions, and marvelous diversity. Winter tree identification can be almost as much fun as launching missiles with a sapling slingshot. And it’s a great antidote to the first impression of dull uniformity that so often attends our visits to the winter woods.
Examine your saplings closely, and consult your winter field guide. This time of year, my rucksack includes *Winter Keys to Woody Plants of Maine*, by Campbell, Hyland, and Campbell, and Harlow’s *Fruit Key and Twig Key to Trees and Shrubs*. For your first outing, try walking the trail in the Charlotte Town Forest off Flat Rock Road at Thompson’s Point, where more than 20 common trees have been labeled with English and Latin names. Learn to identify those 20 and you’ll be well on your way.

Here are some useful features to focus on in winter:

**Twig and bud arrangement:** On most trees, twigs and buds are attached in an alternating pattern along each branch. A few notable exceptions occur, in accordance with the so-called MAD Honey Rule. Woody plants in these groups—Maple, Ash, Dogwood, and the Honeysuckle family—arrange things opposite to each other in pairs. There are spoilers in every kingdom, of course, and a small handful of woody plants have discarded the simple elegance of opposite vs. alternate in favor of a “sub-opposite” arrangement. Look at common buckthorn for an example.

**Bud size and shape:** Fat ones (American basswood), skinny ones (American beech), tiny ones (black locust), hairy ones (apple): buds exhibit a remarkable variety of shapes and forms. The buds of most woody plants are protected by scales, but in a few, such as witch hazel and hobblebush, the buds are naked.

**Bud or twig color:** Even in winter, the plant world has its share of flashy dressers. Look for the distinctive sulfur-yellow buds of bitternut hickory or the characteristic blotchy green twigs of box elder.

**Overall tree architecture:** Just as an expert birder can identify a bird by its silhouette alone, a savvy student of winter trees can recognize distinctive shapes and growth forms, especially for older trees and shrubs. Look for the graceful, vase-shaped form of American elm, the contorted branches of pignut hickory, or the irregular, zigzag branching pattern of black cherry. White ash generally sports a small number of chunky twigs and branches, while gray birch grows clumps of numerous slender twigs.

Unusual features: Several woody plants can be identified with a quick scratch-and-sniff. Black and yellow birch both smell sweet like wintergreen when their twigs are bruised, while cherries have an aroma like rancid peanut butter. Other unusual features include thorns (hawthorn, for example), spines (prickly ash), catkins (beaked hazelnut), persistent leaves (American beech), persistent fruit (high-bush cranberry), sticky, aromatic buds (balsam poplar), and monkey-faced leaf scars (butternut).

So go ahead—embrace the fun sport of winter tree identification. Nature’s fine details will astound you. Stripping trees down to the bare branches beneath frees us to look for nuance and subtlety, to invest all our senses in close examination, and to marvel at the deep blend of form, function, and beauty that is a tree. And even if you can’t figure out a sapling’s name, you can always use it as a slingshot. Just ask my daughter.

*Ana Ruesink is a Burlington-based Naturalist. Portions of this article first appeared in *Northern Woodlands Magazine.**
Let the Symphony Begin
First Sounds of Spring

BY ROSE GRAVES

The Charlotte spring symphony begins in the mornings as northern cardinals sing their clear, slurred whistles from the treetops—“purdy, purdy, purdy...whoit, whoit, whoit.” These birds manage to survive the cold winter in our part of Vermont, and seem to voice the joy that we all feel with the return of warm sunshine. Their renewed activity actually depends less on the warming temperatures and more on length of daylight. As days grow longer, the birds establish territories and sing their courtship songs. The early songs of the cardinal are joined by black-capped chickadees’ familiar songs that sound like their name, the tufted titmouse calling “peter, peter, peter,” and the nasal “yank, yank, yank” of the red-breasted nuthatch—all of whom have stayed in our area through the quiet winter.

The next section of the spring symphony begins with a loud “conk-a-reee!!” emanating from the lake shore, cattail marshes, and the shrubby vegetation around our many wetlands. It is the sound of the red-winged blackbird. This familiar migrant prefers to spend the winter in warmer regions, returning early to set up breeding territories. Early males have an incentive to claim the “best” habitat; they can have up to 15 females nesting in their territories! As days lengthen, other migra-
tory songbirds arrive and add to the concert. Soon we hear the killdeer call its name from fields, as well as the American woodcock’s repeated nasal “peent,” and the eerie “whoop whoop whoop” made by the wings of courting snipe. The eastern bluebirds’ soft but melodious “cheer, cheer cheerful charmer” can be heard near nestboxes. Add the percussion of ruffed grouse drumming their wings on hollow logs, and the symphony is in full swing.

In April singing birds are our daytime companions, and amphibians are their nocturnal counterparts, extending the spring serenades into the evening hours. We hear the first frog call “Krak! Krak! Krak!” Wood frogs have returned to the forest pools where they were born, often sitting in water close to freezing temperatures as they croak their duck-like quacks. Wood frogs breed in these vernal pools after they have dug themselves out of hibernation where they spent the winter—often frozen solid under a blanket of leaves. Soon, the wood frogs are joined by spring peepers, tiny little tree frogs that create a deafening clamor of high-pitched peeps resembling sleigh-bells. How can these little creatures, no bigger than my thumb, make so much noise? Peepers call from under clumps of grass or in crevices, which allows them to both amplify their voices and act as ventriloquists. Finally, as the wood frogs’ songs trail off, the American toad joins the fun with a series of high-pitched, drawn out trills.

All this singing is a courtship ritual which leads to breeding and egg-laying. After hearing the frog choruses for a few evenings, I like to venture out to a wetland and look for the gelatinous blobs and jewel-like strings of eggs in the water, each unique to the species that laid it.

The dramatically different seasons in Vermont provide an excellent opportunity to notice and savor cues that signal the coming shifts. Without the natural quiet imposed by fall and winter, I might not appreciate the exuberant sounds of spring so much. Would the sounds of moving water and birdsong be so welcome to our ears if they hadn’t been absent for some time? Pause to take in the hope and joy of spring this month when you sit on the porch, or walk through nearby fields and woods. Think your own spring thoughts as you enjoy the return of the sweet spring melodies of nature’s music.

Rose Graves recently received an MS degree from University of Vermont in Ecological Planning.

This reflective essay about exploring Nature’s wonder close to home, was originally published in The Charlotte News as part of the “WILD LIFE” series June 2008-December 2010, sponsored by Charlotte Conservation Commission and coordinated by Linda Hamilton and Alicia Daniel. Send questions or comments to Conservation Commission, c/o Town Clerk 425-3071.
A SURE SIGN OF SPRING IN VERMONT IS the return of wild water. It returns noisily with the drumming of rain on the roof, waves sloshing on the beach, and waterfalls roaring above favorite swimming holes. Water also returns silently as drifts of snow melt deep in the woods becoming vernal pools where wood frogs and salamanders lay their eggs.

On a recent Sunday, I had the pleasure of leading fourteen adventurers on an exploration of woodsy water and other signs of spring on the Town-owned land known as the Burns Property. We walked in the beautiful Burns Woods on a natural scavenger hunt. Burns Woods is a Clayplain Forest. As the name suggests, these rare woodlands have clay soils and are very flat. The clays were deposited about 10,000 years ago while the land was under glacial Lake Vermont (and later the Champlain Sea.) Clays are small particles that hang in suspension for a long time drifting a long way out in deep, still water. This is one of the best examples of Clayplain Forest remaining in Charlotte and is naturally rich in biological diversity.

These clay soils are fertile, so early settlers cleared most of these forests for farming and grazing livestock. And, as any Champlain Valley farmer can tell you, clay soils also hold water. Consequently they are very wet in the spring and can support vernal pools that persist well into the summer. This is the type of habitat that wood frogs and salamanders prefer. The pools need to last through the early stages of development of the eggs and...
young, but the fact that they eventually dry out limits the number of predators—chiefly fish—that would prey on the tasty and vulnerable eggs and young. So even the most active pools are dry by late summer.

The April 20 walk, the first in this year’s series of regular nature outings called Charlotte Walks sponsored by the Charlotte Conservation and Recreation Commissions, took us through a forest of shagbark hickory, bur oak, black ash, and red maple. The early spring wildflowers including hepatica, wild leeks with their pungent aroma, and bloodroot (named after its red root sap) flecked the understory. These woodlands wildflowers bloom so early to capture the full energy of the sun before the trees leaf out and cover them in shade. They are perennials that flower year after year using the energy store in their roots to get an early start. This strategy works well in a woodland environment. However, if plowing or other human activities disturb the soils, it takes longer for these flowers to recolonize a site than annuals.

Marsh marigolds lined the bed of Thorp Brook (which originates nearby and flows all the way from here to southwest Charlotte where it empties into Lake Champlain). Kids found American Robin and Northern Oriole nests. One of the robin’s nests had cherry pits that had been partially eaten by a mouse, who no doubt had recognized the value of the abandoned nest as a winter food storage place.

We finally reached a charming spot where there were several vernal pools. Kids and adults alike stripped off our shoes and went in hunting for wood frogs. Tapioca-textured egg masses (the size of tennis balls and attached to sticks) floated throughout the pool. In the 78-degree heat, the cool mud and water gave our feet a soothing bath.

Spring—like the babbling brook the name suggests—really is a time to get out and get wet in search of newly emerging animals and plants. By the time you read this, spring ephemeral wildflowers will be in full bloom. I’ll be out in the woods enjoying the show. I hope you will, too. Watch for announcements of future Charlotte Walks!

Alicia Daniel is a Burlington-based Field Naturalist who teaches graduate students in the University of Vermont Field Naturalist Program. She is former Co-Director of that Program.
S P R I N G T I M E I S A W E L C O M E S H I F T of natural rhythms. As winter relinquishes its cold grip on the Vermont landscape, many animals travel great distances to take advantage of summer’s coming abundance. Our most ostentatious migrants—the birds—garner the most attention with their showy plumages, vocals, and courtships. However, birds are not the only species that “return” to Charlotte. Spring also marks the return of another class of creatures: the amphibians. And just like the beautiful scarlet tanager which travels to Vermont from South America, these small animals also undertake dramatic journeys to reach their specialized breeding grounds and food.

Amphibians include the frogs and toads, salamanders, and caecilians (found in tropical climates). Some features which define the group are: moist skin, no claws, and underwater reproduction. These are guidelines with quite a few exceptions, however. For example, red-backed salamanders don’t require water to breed and eastern newts can have skin dry—both are small salamanders found in Charlotte. In general, amphibians are pretty distinctive creatures and you know one when you see, hear, or feel it. For most people, the word amphibian first conjures images and calls of frogs and toads. These two subgroups are similar, yet differ. Toads are warty and largely terrestrial. Salamanders don’t make calls like frogs and toads.

According to the Vermont Reptile and Amphibian Atlas Project, twenty-one amphibians occur in the state, and eleven can be found right here in Charlotte. This diversity ranges from the common, tiny spring peeper with its distinctive and very familiar early spring “peeper” call, to the blue spotted salamander, which is almost exclusive to the Champlain Valley. All of our amphibians share one common challenge—the Vermont winter. Unlike birds and retirees, amphibians cannot leave for Florida during the many months of subfreezing temperatures. And like reptiles, they are exothermic, which
means they can’t regulate their temperature like mammals and birds. So instead they migrate downward, beneath earth and water, where they hibernate using different strategies.

Some, such as the wood frog, burrow very shallowly under leaf litter and are able to actually freeze. Amazingly, the space between cells turns to ice, but the cell tissue itself is protected because water is replaced by an antifreeze agent. These frogs are among the first to return in early spring and can be identified by their masked faces and duck-like breeding call. Or if you’re lucky, you might come across one in midwinter…probably frozen solid.

Most of Vermont’s amphibians meet winter’s challenge by migrating from their wetland breeding grounds to drier uplands where they burrow. Refuting a common misconception, the majority of our frogs and salamanders spend more time on land than in water! For them, water is principally a place to reproduce and lay eggs. Underground they hibernate for months, waiting for the cue to return—warm, rainy nights with above freezing temperatures. In early to mid-April, they begin to awaken from their hibernation and migrate downhill to wetlands in search of mates. Different species come in waves because each has a specific temporal niche. The spotted salamander is one of the first to make this journey, which can be more than a half-mile. This may not seem far, but considering their very small size and clumsy locomotion, it is quite impressive. Like many other species, spotted salamanders migrate to small ephemeral pools of water (woodland vernal pools), which are free of predators such as fish because they dry up in the summer. Here amphibians can safely mate and lay eggs. After a short few weeks, the adults leave the pools and return to burrow in the uplands and are rarely seen again till next spring. Predictably, adults return year after year to the same vernal pools.

Unfortunately, many of our amphibians are experiencing serious decline, largely due to habitat loss. Traffic presents a particular hazard because roads often bisect wetlands and uplands, and road kill can be quite high on “big nights.” These occur early in the season when weather conditions are optimal, and many frogs and salamanders make the journey from upland to wetland. Thankfully some people help by aiding their crossings—slowing traffic and physically moving amphibians on these key nights. It’s not uncommon to see and be able to help hundreds of these little creatures make the crossing within a few hours on a good “big night”!

If you’re interested, Charlotte is a great place to give them a hand. Keep an eye on the weather for the first few nights of warm rains and visit the following website for more info: http://community.middlebury.edu/~herpatlas/index.html. Or join the Shelburne Farms email alert list for their Seasonal Field Excursions program. Outings with naturalist Matt Kolans are timed to experience special natural events such as amphibian migration, spring wildlife flower bloom, and more. Call 985-0341 to be notified the time and location of these free outings.

Even if you don’t see them, you are sure to hear and enjoy the rich chorus of amphibians’ distinctive songs which herald the arrival of spring in Charlotte.

James Barnes recently earned an MS degree from the University of Vermont Field Naturalist Program.
EACH YEAR IN SPRING, I AM REMINDED of an encounter in the woods many years ago that set in motion a whole web of discoveries. My opposite in this encounter was a small bird, no more than six inches tall and sitting high up in a tree top.

With its eye-popping red and black plumage, identifying the bird as a scarlet tanager was not particularly difficult. In the process, my previous catch-all mental category for birds became painfully insufficient. Now I had to know what other birds were out there. What was that tiny yellow streak over there? What about that majestic-looking creature scanning the surface of the pond for movement from its perch on a dead tree? From then on, getting to know the birds gave me a whole new way of discovering trees—not only as individuals, but as “the woods”—and not just generic woods, but microcosms of particular plants, soil conditions and topography where birds and other animals don’t just appear randomly. One “Aha!” experience was noticing that wherever I could hear the song of the hermit thrush, I could also count on smelling the scent of balsam firs.

Another discovery I have the scarlet tanager to thank for is the kind of flower show many trees put on each spring. Botanically speaking, the particular flower that opened my eyes to this annual phenomenon turned out not to be a flower at all—but it might as well count as an honorary one, with its pastel tones of orange and cream and its petals elegantly curved back, reminiscent of a Georgia O’Keeffe painting. It belonged to an enormous shagbark hickory, and the supposed flower was actually made up of the bud scales that unfurl with the hickory’s

A Different Kind of Flower Show

By Kerstin Lange

Shagbark hickory bud scales unfurl with spring’s new leaves and remind us of a Georgia O’Keeffe painting.
new leaves. Shagbark hickory, I later came to learn, is one of the major tree species in clayplain forests. Charlotte is fortunate to harbor a prime example in Williams Woods.

Flower or bud, of a natural community of hickories from the day of my shagbark hickory encounter on, I looked much more closely at both on my walks in the woods and around the neighborhood. Noticing the flowers on the various species of maple became an exhilarating spring hobby, and I had to be quick about it. The flowers on some trees last only a few days.

Beyond the sheer fun of getting to know the trees better by their flowers, this new hobby tuned me in to patterns in time: when do the sugar maples begin to flower? compared to red maples? compared to boxelders? Noticing these things also helped me notice that this year, the red maple in front of my house flowered two weeks earlier than last year.

This may or may not be meaningful, but it is certainly not a random observation. Records kept by regular people with a knack for observation have been analyzed by the National Phenology Network and show that the first flowering of some species now occurs an average of 5 days earlier than it did in 1955.

These kinds of observations have meaning beyond the personal. Considering how closely events in the natural calendar are intertwined, we should pay attention to such changes. Think only of the fact that at least one-third of the world’s agricultural crops depends on pollination by insects or other animals.

To notice these kinds of things about birds, trees and flowers, to transition from knowing the pieces of the natural world to noticing patterns, takes time, just as getting to know people does. People with an interest in the natural world can begin taking notes on the plants in their backyards or in their surroundings. A manual for plant phenology observers has been compiled by David Weinstein at Cornell University and can be downloaded from the Web at budbreak.tc.cornell.edu/downloads/BudBreak_manual.pdf.

As with getting to know people over time, the reward in getting to know our natural surroundings lies in never-ending discovery and wonder.

Kerstin Lange is a Writer, Naturalist and Travel Planner, based in South Burlington. This essay is adapted from a commentary she wrote for Vermont Public Radio which aired on April 28, 2010.
AlTHOUGH mosT CharLOTTers drive, walk, and bike past hayfields everyday, I’ll bet most are not aware of the dramas unfolding there. These fields are alive with sex and cuckoldry, posturing and displaying, birth and death. These acts are played out each year May to August by a collective group of species known as grassland birds.

Grassland birds are habitat specialists, dependent on hayfields, pastures, and fallow fields to successfully feed, roost, and raise young. Common grassland birds in Vermont include the bobolink, meadowlark, Savannah sparrow, and harrier. Less common are upland sandpiper, grasshopper sparrow, sedge wren, horned lark, vesper sparrow, and short-eared owl. Specific habitat needs have led to development of complex behaviors, including extraordinary migrations (bobolinks migrate approximately 6,000 miles between North and South America twice each year), and unusual mating systems (a male Savannah sparrow can support up to three females on his territory).

Hayfields may seem like simple places, but in fact, they can be bustling with deception, intrigue and theatrics. Countless eyes (males!) are watching from perches atop tall blades of grass, and others’ ears (females!) are listening, while buried deep in the grass, incubating 4-5 eggs snug in nests of dried grass. Yes, these eyes and ears are watching for predators. But they are also looking for mates—many mates. Male bobolinks, jet black with a bright yellow nape, and white tuxedo-like markings on their backs soar into the air, singing so wildly they almost seem confused, landing like they were butterflies. Sleek female bobolinks, golden and bronze with delicate stripes on top of their heads, like to test their mates and neighbors (who too could be a mate!), making a whine-like call and rocketing into the sky to see which male can keep pace. These behaviors, importantly, prove character and quality for all. The result is

**Birds in the Grass?**

BY NOAH PERLUT
often mixed paternity. Remember, I started this article with the words sex and cuckoldry. That’s right—a bobolink nest of 5 young will often include one or more sired by a male other than the social mate.

Grassland birds help define the character of our agricultural landscape, but sadly their populations are declining faster than any other bird group in North America. In Vermont 1966-2006, grasshopper sparrows declined 8% per year, bobolinks and meadowlarks 3% per year, and Savannah sparrows 0.25% per year. For the last 7 years, I have studied these declines and what we can do to reverse them.

Two main factors in Vermont contribute to their population decline. First, Vermont has been largely reforested, thereby decreasing the amount of available grassland habitat. Second, the processes of hayfield management have changed since the 1960s; hay is now cut earlier and more frequently. In the 1960s haying began in early July. Today, it often begins in late May in order to capture the higher protein content and thus increase dairy cow production. Hayfields that are cut early are cut more frequently, often in 35-40 day intervals.

These changes significantly affect breeding grassland birds. As ground-nesters, their nests are directly exposed to haying machinery. Consequently, 100% of nests active at the time of haying fail, with 80% destroyed by the machinery and 20% eaten by gulls, crows, and mammals.

Much of Charlotte’s landscape is grassland. In 2005, Charlotte had 10,547 acres of potential grassland bird habitat. This gives Charlotters a unique and meaningful opportunity to support grassland birds through bird-friendly management practices in hayfields, pastures, and especially in residential open-space areas.

My research has focused on building grassland management plans that balance landowners’ economic objectives, and birds’ reproductive needs. Past guidelines only encouraged delaying mowing until approximately August 1. Indeed, mowing in August and picking up the hay is the best way to manage for grassland birds. However, most hayfields are now harvested earlier in the summer. For intensive dairy farms the best bird-friendly management strategy is to cut as early as possible (before June 1, although cutting before May 25 is ideal) and delay the second harvest for 65 days. This provides enough time for birds to reproduce between harvests. For more information, including ways to offset costs associated with some of these practices, see the new Charlotte Conservation Commission publication, Grassland Birds in Charlotte: Our Role in Their Future (available at Town Hall).

By incorporating grassland birds’ needs with other land management objectives, Charlotters can play an important role in stabilizing these species’ populations. Hopefully in 10 years I can write an article describing how the bobolink population increased rather than decreased another 3% per year—and thank Charlotters for leading the way.

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This reflective essay about exploring Nature’s wonder close to home, was originally published in *The Charlotte News* as part of the “WILD LIFE” series June 2008-December 2010, sponsored by Charlotte Conservation Commission and coordinated by Linda Hamilton and Alicia Daniel. Send questions or comments to Conservation Commission, c/o Town Clerk 425-3071.
How Does a Caterpillar Turn into a Butterfly?

By Teage O’Connor

Long-awaited spring draws us out of our winter cocoons and into the now-sweet air. All around us, farms and gardens are humming with activity; cyclists and boaters, walkers and runners, birdwatchers and botanizers are enthusiastically out and about. The natural community seems to have jolted into activity as well. Most notably for me, the butterflies are beginning to enjoy the big, bright early-spring ephemeral wildflowers.

It was on Mt. Philo this year that I saw my first butterfly of the season, a stunning mourning cloak (Nymphalis antiopa) flittering in the warm afternoon sun. (The underside of its wings looks like dead leaves, while the upper side has a distinct yellow margin with blue dots.) When I began to see cabbage whites (Pieris rapae) every-

where I knew that spring was in full bloom. While cabbage whites and most other butterflies overwinter as pupae, mourning cloaks overwinter as adults, hibernating beneath leaf piles or under bark. Because of these long periods of inactivity, they have the longest lifespan of any adult butterfly in North America, up to eleven months long. Most adult butterflies survive only two weeks!

As the mourning cloak floated by, I wondered how it came to be here. I knew it had not migrated south for the winter as some butterflies do. Monarchs, for example, will migrate an astounding 2,000 miles or more, in a cross-continent relay extending six to seven generations. I wanted to know how butterflies undergo their metamorphosis from a lowly caterpillar into a majestic butterfly. Many who write about the magic of this metamorphosis will pause briefly to reflect on the symbolic similarities between insects and Kafka’s novel Metamorphosis, while skimping on the details of what unfolds behind that seemingly quiet and still chrysalis.

So what unfolds in that magical stage between caterpillar and butterfly? Butterflies undergo a complete metamorphosis, transforming between two distinct forms within the confines of a pupa (a chrysalis for butterflies, cocoon for moths). It is in this “inactive” stage
that their entire body plan is restructured from their larval (caterpillar) to their adult (butterfly) form.

Caterpillars are little more than liquid-filled bags with a voracious appetite. Their growth rate is astounding, nearing exponential rates; mourning cloak caterpillars feed in groups and can defoliate small willows and poplars. As they rapidly develop in size, the fluid part of the bag puts pressure on the rigid exoskeleton and the brain responds by releasing what is called juvenile hormone. This alerts the body to deal with the stress by molting. When molting, the caterpillar first digests the hard part of its exoskeleton, incorporating this into the proceeding exoskeleton; it then literally walks out of the remainder of its shell. After a set number of molts, which differs by species, the brain ceases to produce juvenile hormone (it is not known what causes the brain to stop producing this), and the process of pupation begins.

At this point, the caterpillar spins a silk pad with its spinneret, a tube-like structure on the caterpillar’s lower lip, affixing this pad to the surface on which it will pupate. With its head hanging downward, it latches the little hooks protruding from its tail-end onto the pad. Some sulphur, swallowtails, and gossamer-winged caterpillars will stand their bodies upright with a threadlike silk girdle strapping its body to a branch. The caterpillar then molts a final time, giving it an entirely different appearance, one we would recognize as a chrysalis.

Each caterpillar instar, the phase between molts, passes along paired imaginal discs. Each disc is made of immature cells with the potential to develop into a predetermined group of adult cells. That is, an imaginal disc genetically programmed to develop into adult legs, even if transplanted to another part of the body, will always develop into adult legs. Inside its chrysalis, the caterpillar mostly dissolves itself, ingesting and reappropriating cells from larval tissues and organs into these imaginal discs. These ultimately give rise to their corresponding adult tissues and organs (eyes to eyes, legs to legs).

This allows the caterpillar to retool itself to accommodate a completely new life style. For example, while a caterpillar’s chewing mandibles are generally suited for eating fibrous leaves, these mandibles are useless to adult butterflies that need a denser energy source to support their active lifestyle. For this, butterflies utilize a long, slender proboscis to extract sugary nectar from flowers.

During pupation, some butterflies will make noises. Mourning cloaks, which pupate in small clusters, will slam their bodies against whatever the chrysalis is affixed to, making an audible noise. Another 150 species of butterflies produce variety of noises by rubbing together tiny rasp-like appendages along their abdominal segments. These sounds may ward off predators or act as an auditory cue to other pupae, but their exact purpose is unknown.

As the butterfly prepares to emerge, it releases enzymes that digest the chrysalis’s seams allowing the butterfly to push its way out of the pupa with relative ease. And just like Gregor Samsa in Kafka’s novel, it emerges an entirely different creature.

It is no surprise that the ancient Greeks used the same word, psyche, for soul and butterfly or that in 1680, Irish law forbade the killing of white butterflies because they thought these were the souls of children, for butterflies are captivating and whimsical, almost magical in their metamorphosis. In this metamorphosis we can read our own transition from life to death and death to life. Or we can just appreciate the beauty and wonder of it.

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In Charlotte, August is Prime Berry time both at the berry farms and in the wild, where with just a bit of careful looking, you can find ripe blueberries, raspberries or blackberries. We are at the peak of cultivated berry growing, a season that opens in June with strawberries and lingers into October when the last of the raspberries succumb to frost. Wild berries often out-shine the cultivated ones with their sweetness (and you can’t beat the price!) but for convenience and quantity the farms win hands down.

If you want to supplement your farm supply with wild berries here are a few tips. Raspberries and blackberries are both pioneer species that come in after a disturbance and can be found along the edges of hedges and fields and in other open places. Blueberries are a type of heath, adapted to low moisture and acid conditions. They grow in with pines on exposed, rocky bluffs, in sandy soils, and in bogs. Low moisture in bogs? That may sound oxymoronic since bog walkers often find their feet sinking into water, but in reality the water table rises and falls and that coupled with a shallow rooting zone (roots need oxygen) makes these environments prone to drought and seasonal fires. Blueberries are fire adapted to and are managed with fire where their growth is encouraged. People tend to have their favorite foraging places, which they may be reluctant to reveal. But it never hurts to ask!

That said, most of the fruits we think of as berries are not “berries” in a botanical sense. Botanically speaking a berry is a fruit in which both the inner and outer ovary walls are fleshy and the seeds are distributed throughout. So blueberries are berries, but blackberries, strawberries, and raspberries are compound fruits made up of many small units called drupelets. “Drupes” are
fruits in which the outer wall is fleshy and the inner wall is hard and bony. Other types of fleshy fruits include “pomes” like apples and pears, where the outer wall is fleshy, but the inner wall is papery. Think of the core of an apple with the seeds surrounded by sharp, cartilage-like bits. Still, knowing all this, not even a botanist says “let’s go berry picking” and means grapes or sumac.

So back to the “berries” that we all love, loaded with sugar and so ephemeral. The berries that are so enjoyable in summer are just one end of the edible berry spectrum. And let’s distinguish here: many things are edible that are not palatable. Except for special cases like kids and spinach, we rarely find ourselves having to eat things that simply don’t taste good to us. That is not true of many birds and animals in the wild. Given a choice most animals and birds will choose the same blueberries and raspberries that we covet. Bears gorge on berries this time of year until their scat is solidly packed with seeds, which they conveniently “plant” in the woods with a dollop of bear manure to fertilizer them.

Since it is true that plants produce fruits to encourage the dispersal of seeds, why isn’t the planet covered with sweet berries and lacking in others kinds? Sweet sugary berries just don’t have the “branch life” of some of the others and summer lasts only a few weeks a year.

Naturalist Bernd Heinrich in his book Winter World deftly tells the story of berries and seasons. A fruit’s nutritional content depends on the season for which its dispersal is tailored. He says that only nine of the thirty-eight species of berries that grow locally ripen and rot quickly. Berries are either adapted for quick consumption (raspberries, blueberries) or to hang around to be eaten as a last resort (sumac, buckthorn). The highest quality and highest energy content fruits contain fat and sugars, but these (especially fat) spoil rapidly due to microbes. Low fat and sugar content, high acidity, and low water content all help to prolong branch life. Staghorn sumac is an extreme manifestation of this strategy, with its tightly packed, small, dry fruit. People do brew sumac berries into a lemony-tasting tea, but I don’t know anyone who eats them. By contrast, in the middle of winter, Bohemian waxwings will eat highbush cranberries even though they are quite sour, because it’s what they’ve got.

So enjoy this sweet berry season while it lasts. And be grateful when the time comes in late February when birds turn to eating dried up, shriveled buckthorn berries (which are known for their cathartic effect)—you can opt out. Not every animal or bird is so lucky, and some plants depend on desperate foragers who are hunting for berries in seasons of scarcity to disperse their seeds.

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Nearly everyone is familiar with bumblebees, those furry insects that make loud, clumsy visits to flowers of all kinds. Larger than most other bees—European honeybees included—and hairier than similar insects like wasps, in northern places like Vermont people of all ages know a bumblebee when they see one. But our encounters with bumblebees are almost all at flowers, which gives us a skewed perspective on their lives. It is as if we knew a person only from our haphazard encounters in the grocery store, where we watch them hurrying down the aisles, comparing prices and filling their cart.

Some of the most interesting—and most important—events in the life history of these bees take place underground in complete darkness, far from our curious eyes. Bumblebees are social insects, meaning that individuals live in family groups, communicate, divide labor, and, in most cases, forgo reproduction in order to help their mothers, sisters, and brothers reproduce. Evolution has favored such social behavior presumably because it is an effective way to pass on one’s genetic material to future generations. (However, there are many social animals—human beings included—that do not have this form of genetic inheritance, and there are also many kinds of bees, including some bumblebees, in whom social behavior has evolved, then been abandoned in favor of the solitary life.)

Bumblebee colonies are founded in spring by female bees who matured the previous summer, mating with one or more males before going into a state of dormancy during the winter. These “queens” are the large bees one sees on the first warm days of April, gathering nectar and pollen to feed their first brood of daughters. After these workers are born, they take over the business of collecting food for successive broods of young bees developing from eggs laid by the queen, who now stays in the colony. The queen lays only female eggs at this point, and she assures that they will develop into workers—rather than new queens—by secretion of a pheromone. The number of workers in this all-female society increases as the growing season progresses.
In its early stages, a bumblebee colony is a seemingly harmonious place. But as the season wears on, workers become increasingly hostile to each other and the queen, their mother. As the colony nears the point at which it will shift from production of workers to production of males and new queens, the interests of the workers and their mother come into conflict. Because of a complex form of genetic inheritance known as haplodiploidy, worker bees ‘want’ different outcomes than their mothers do. In this system, unfertilized eggs—whether laid by the queen or her workers—are destined to become male bees, while females come only from the fertilized eggs laid by the queen. Female bees—the workers included—share more of their genes with their sisters than they do with their own female offspring, which favors the development of a social system where workers help to raise their sisters rather than reproducing themselves. On the other hand, females are more closely related to their own sons than they are to their brothers; in the world of the selfish gene, this situation works against cooperation. (To further complicate matters, workers are actually more closely related to their nephews than to their own brothers, giving them a vested interest in the reproductive activities of the other workers in the colony.)

The result is a midsummer family drama in which the daughters help raise their sisters, but may actively destroy their mother’s male eggs—eating them even as she is laying them; larger workers may lay eggs of their own, which the queen will try to destroy. Open aggression in bumblebee colonies sometimes leads to the death of workers or their mother.

This situation is complicated by the intervention of the many parasites that rely on bumblebees as hosts. One group of flies has a larval stage that takes place inside the bodies of living bees. The parasite’s development not only kills some bees, but also changes the behavior of those that survive, causing less efficient foraging and changing sex ratios of eggs laid by the queen. Bumblebees carry a host of internal parasites, and these too may alter colony life. One protozoan parasite slows foraging and colony growth, but also limits ovary development in workers. This means that workers may not be able to produce any sons, changing the dynamics of their relationship to the queen.

All of this activity taking place within the walls of the bumblebee colony has consequences for what bees do when they are not at home. It is the food gathering efforts of bees that result in their most significant impact on other organisms—the pollination of plants. Bumblebees are the dominant pollinators of many plants in temperate ecosystems, and without them many natural systems would probably be diminished or impaired. They are also key pollinators of many agricultural crops, including apples, blueberries, squash, and tomatoes. As the commercial honeybee industry continues to suffer declines due to the mysterious colony collapse disorder (as well as diseases, parasites, pesticide exposure, and other problems), native pollinators like bumblebees are critical to the health of natural and agricultural systems.

That bee in your garden is thus more than just a noble pollinator (or harried shopper). Whether bees know it or not, they are individuals pulled by competing interests at home and at work, not unlike the people who so admire them. As bumblebees now face unprecedented challenges of their own from pesticide exposure, habitat loss, and disease, we would do well to consider both their importance as pollinators as well as the more hidden aspects of their life histories.

Leif Richardson is an Ecologist with the Vermont Non-game and Natural Heritage Program. He lives in Marshfield. For more information on bees, see “The Buzz on Pollination” by Leif in the May 26, 2009, issue of Northern Woodlands, available at www.northernwoodlands.org.

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On a warm October day when sunlight filters through the dazzling fall leaves, it may be tempting to lie down and take a nap on the dappled forest floor. However, if your forest contains oaks, your nap may well be interrupted by the frenetic rustling noises of gray squirrels harvesting and burying acorns for winter. You may also see them carrying leaves and shredded paper up to the tops of trees to line their nests or drays.

Charlotte tree squirrels (red and gray), flying squirrels and ground squirrels (chipmunks) must work hard this time of year in order to survive the harsh winter season. A typical squirrel diet consists of a variety of foods such as seeds, nuts, berries, some leaves, buds, mushrooms, acorns, flowers, fruits, fungi, lichen, sap, carrion, insects and sometimes bird’s eggs. But each species tends to specialize, especially when it comes to caching food for winter. With a bit of luck and some finely tuned behaviors these small animals will live to greet the spring. And as they go through fall and winter they leave a trail of clues about how they manage to survive.

From your prone position on the ground you may see bouquets of oak leaves still attached to straw-sized twigs cascading down from the tops of oaks. Gray squirrels snip the ends of thinner branches to get acorns from the edges of trees where the fine branches cannot support their weight. (Similarly, you will see branch ends of white cedar lying around the base of the tree that red squirrels clip in order to get at the cones.)

Gray squirrels hoard acorns, hickory, and other large nuts by scattering them in different places throughout the woods within a roughly one-acre home range. The squirrels find these buried nuts by using their acute sense of smell, not by remembering where they put them. This winter when you walk in the woods, you can look for plum-sized holes scattered in the snow where some of the duff has been pulled to the surface. Sometimes if you look closely you will see the acorn shaped depression frozen in the dirt at the bottom of the hole. Then you will know that a gray squirrel ate lunch where you are standing.
And chances are good that the acorn he ate was a red one. Gray squirrels tend to store red acorns, which are higher in tannins, both because they preserve better and because they are less palatable than the white oak acorns. Squirrels tend to eat the tasty white oak acorns immediately. Red oak acorns also germinate in the spring instead of the fall so they don’t sprout before the squirrels can recover them.

Unlike gray squirrels who are scatter hoarders, red squirrels are larder hoarders. Red squirrels are more dependent on seeds than nuts for their winter food. They tend to pile food up into little hills called middens. These middens consist of cone cores and old bracts under which fresh cones are stored. The cool moist temperature keeps the cones from opening and the seed from being released. Also look for winter sign of red squirrels feeding where there are pinecone cores and bracts in the snow near the base of a stump or tree.

Vermont Naturalist, Bernd Heinrich, has recorded another interesting squirrel behavior. He has observed red squirrels tapping into the sweet sap of red maple trees. Bernd saw squirrels biting the bark of sapling maples and returning to lick the sugary popsicles once most of the water had evaporated. Look for wet slicks of sap on maple saplings. And if you look closer, you will see bite marks that show where the red squirrel bit the tree.

Signs of flying squirrels are more subtle. Flying squirrels are nocturnal so much of their winter preparation happens under the cloak of darkness. Unlike the other squirrels, lichen and fungi are a large portion of the flying squirrels’ diet. These foods leave less winter evidence than nuts and pinecones. One way to observe their presence is that they tend to nest in cavities made by birds such a woodpeckers and chickadees. Look for a hole that has teeth marks all around the edge. I once opened a blue bird nest box that had the opening enlarged by gnawing and startled a pair of sleeping flying squirrels. Some naturalists will bang on the trunks of trees where there are nest cavities to flush the squirrels. (I recommend you don’t make this a regular habit, especially at the same tree, since it stresses the animals.) Because of their large eyes and draping skin flaps, flying squirrels have a sweet, soft appearance. And yes, they really do fly—or really they glide—from tree to tree as a way to conserve energy. When they end their glide by landing in snow you can see a distinctive skid mark.

In the fall, chipmunks are easy to spot scurrying in and out of crevices in stone walls and running up and down the trunks of trees caching their winter stores. They have internal cheek patches for carrying food. Their bulging cheeks, bold stripes, and flashy strobe motions add to their charm. Of the Charlotte squirrels, they are the only true hibernators so winter signs of them are scarce. Unlike most ground squirrels, which store fat for energy during dormant periods, chipmunks have large underground caches of food for the occasional periods of waking and for use in early spring in areas still covered by snow.

Did you finish your nap? Or did the squirrels keep you awake? Well, brush yourself off and look around the forest floor for signs of the nuts the squirrels just buried. You won’t find any. Squirrels are masters of disguising where they have buried nuts by scuffing and fluffing the leaves. But if you return here come spring, you will see evidence of their work. Inevitably, some buried acorns escape detection and germinate. Oak seedlings will be unfurling their delicate leaves. The massive oaks they will become will feed the descendents of the squirrels you watched all those years ago in these October woods.

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As the weather shifts to cold drizzles and many of us finish laying in firewood for the winter, we have a wild companion in Charlotte who is also building up a cache of winter wood—though the wood is to eat not burn. Around the time of November full moon, aptly called Beaver Moon, beavers cut copious amounts of hardwood trees and saplings. They use the limbs to shore up dams and lodges and the twigs are cached for food under water near their lodge. Beavers are more elaborate in their winter preparations than any other wild Vermont animal. Unlike migrants who fly south or residents who hibernate or forage on sparse winter fare, the beaver overwinters with her clan—cozy in the lodge she has built, living on a pond she helped create, and eating food she has stored.

Beavers create the conditions they need to survive winter. Beavers use water for cover, transportation, and refrigeration. They will emerge above the ice to feed (near an escape hole), repair a dam, and seek food in case of emergency. Not fast runners on land and further hampered by snow, a beaver on foot in winter is very vulnerable to predators like coyotes.

They need a body of water deep enough that it will not freeze to the bottom. Using sticks, mud, and even stones, beavers build dams across flowing rivers and creeks to create a pond or series of ponds. After a beaver builds a dam and the pond freezes, they may adjust the water level, dropping it by a few inches to create a layer of air under the ice for breathing.

According to Vermont naturalist Bernd Heinrich, beavers build “dams that may stretch a hundred or more yards long, and they impound acres of pond where water levels are raised five or more feet. The results of their collective work, often performed over generations and presumably hundreds of years, can be stunning.” Bernd knows of a record-breaking dam in New Hampshire.
which was over three quarters of a mile long and the pond it held up had 40 lodges! Lodges are an adaptation of dam building and are piles of sticks that are later hollowed out and used as homes. People have been known to enter abandoned beaver lodges and fit quite comfortably.

Beavers accomplish their engineering feats in groups. They mate for life and a clan may have an adult pair and several yearlings along with kits born in the winter in the lodge. The young tag along with parents, learning survival skills and even food preferences. Beavers are rodents, a group of animals distinguished by their incisor teeth. (Close relatives include squirrels, mice, porcupines and muskrats.) These teeth are covered with enamel in front but not behind, so chewing wears away the back side, sharpening the teeth like chisels. Beavers turn their heads sideways to bite into standing trees and you can see their distinctive teeth marks meeting together on a stump. Charlotte Town Beach has some fine examples near the covered bridge.

In Vermont, if a tree falls in the forest, there’s a good chance that a beaver will hear it. Not only are beavers abundant and widespread throughout the state, they are also a primary reason that trees do fall. And not just any trees. Beavers use their chisel teeth to selectively cut hardwoods that grow in close proximity to water. And in the process they alter landscapes at a scale second only to humans.

The ponds beavers create are important habitat for many plants and animals. An interesting one, for example, is the red eft, a small slow-moving bright orange amphibian commonly seen in Charlotte woods in the fall. This is the immature stage of the red spotted newt. And though the same species is distributed throughout the southeastern U.S., the terrestrial stage only exists in the Northeast. One hypothesis is that the red spotted newt is very dependent on beaver ponds for breeding habitat in its northern range, and the “life span” of a beaver pond is generally only 15-20 years. These newts have an eft stage so that they can disperse from the pond if necessary to find other habitat, like a new beaver pond.

Another significant landscape feature created by beavers is the beaver meadow. As silt accumulates behind a beaver dam, a flat plain is created. When the beavers run out of food or die and the pond is abandoned, this new soil regenerates into a wet meadow—great habitat for animals like moose. You may not see any moose there, but a good example of a beaver meadow is along the lower portion of Charlotte Park and Wildlife Refuge nature trail. Another common pattern that results in the forest from beaver activity is a signature ring of softwoods that persists even after the beavers have moved on. By cutting only hardwoods, beavers leave a circle of uncut spruce and fir that surround many an alpine pond, while lower elevation ponds have white pine and hemlocks around them.

When European explorers and colonists arrived in North America, beaver populations were estimated between sixty and two hundred million. Sadly, by the late 1800s, they had been hunted to near extinction for their pelts (which were popular in Europe for hats). Beavers were reintroduced into Vermont in 1921, and now have reestablished healthy populations.

You have a good chance of seeing beavers at this time of year, especially at dusk. Check out ponds in your neighborhood, looking for tree stumps with that characteristic sharpened-like-a-pencil shape. They’re probably out there, busy as…well…beavers!

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Tell-Tale Fall Colors of Our Forest Trees

BY ALICIA DANIEL AND LINDA HAMILTON

Fall is a natural time to look at the patterns trees create as they blanket the landscape in their oranges, purples, greens, yellows, browns and reds. And while it is enjoyable to look at the different tree colors as you would look at a quilt or a painting, just drinking in the sheer beauty, you can also add a dimension to what you are seeing by recognizing different tree species and knowing what their distribution tells you about their ecology.

In Charlotte, as elsewhere in the Champlain Valley, Vermont nurtures its greatest diversity of tree species. The thirty-five or so native tree species in Charlotte dwindles to a mere four (red spruce, balsam fir, mountain ash and heart-leafed birch) as you climb toward treeline on Mount Mansfield. Gardeners know full well that the Champlain Valley is the “banana belt” of Vermont; we are a whole hardiness zone warmer than Central Vermont.

If you study range maps for some of the Charlotte native trees like red oak, American beech, sycamore, butternut and shagbark and bitternut hickories, you will find that the center of their ranges is in the West Virginia or Tennessee area. These species with a “southern affinity” grow all over those southern states. However, as trees start to reach the northern extent of their range (as red oak does here in Charlotte), they become very limited as to where they can germinate and grow. So look for red oaks on rocky bluffs, where the shallow soils warm
up quickly in the spring and/or on sites that are south or southwest facing, where the sun can heat the air temperature longer and warmer. Oaks turn a distinctive red brown (almost a wine color), in the fall and once you recognize the color they are very easy to pick out on hillsides.

Later in the year when you are out in the forest, you’ll notice that the oaks and beeches are still hanging onto their leaves well into winter. Most members of this family (Fagaceae) have their centers of origin in the subtropics and tropics. One theory is that members of Fagaceae don’t form a good abscission layer (the layer that allows a leaf to fall off), because most of them were originally not deciduous—not having had to adapt to harsh winter conditions as they evolved.

In contrast to oaks, northern white cedars grow well into Canada and flourish along the Niagara Escarpment. They hug the lakeshore in Charlotte, prospering on the limestone bluffs. And they can be found elsewhere, most noticeably in acid swamps in association with red maples; and they were traditionally planted in cemeteries in our area, perhaps as a symbol of eternal life. In the fall northern white cedars are …well….green. Cedars and most of our other evergreens like pines, firs and spruce don’t change color, and so they are especially easy to pick out in the fall when they contrast beautifully with those species that do lose their chlorophyll and brighten up, like the maples. We have a few tamarack (also called larch) in Charlotte, and what are they doing? Although they are conifers, they are not exactly “ever-greens”, since in the fall they turn a rich golden yellow, and then drop their needles!

What about our two most common maples? Besides having leaves with fewer points (teeth) and rounder indentations (sinuses), the sugar maples are especially easy to identify when they turn orange, while the red maples are turning…no surprises here…red. Red maples are generalists and tell you very little about a site they are growing on. It can be poorly drained/swampy, or a somewhat dry upland site. Sugar maples, however, thrive in rich, upland soils, growing vigorously on sites where the soil pH is approaching neutral.

The most purple of our fall trees is, hands down, the white ash. (Purple?? Yes, purple.) Its presence and distribution the Charlotte is indicative of deep fertile soils.

The hickories will soon be turning a deep golden color, and the poplars and willows a soft pale yellow. Quaking aspen (a poplar) and paper birch are often found near White pines since the three are common pioneer species, coming into an area after disturbances such as logging, land clearing, blow-downs, or fire. These pioneers will also colonize fields released from agriculture. So while they may not tell you much about the soil or bedrock, they do indicate that there has been something “disturbing” in the site’s recent history.

Basking in the radiant colors of fall is a highlight of this time of year. Fall also offers us a unique opportunity to advance our tree identification skills by recognizing trees by their color, and to learn more of the stories that trees can tell us about the forests near our homes.

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The leaves are down and after recent hard frosts they form a crunchy mat over my favorite forest trails. The mat is woven from the leaves of sugar maple, red oak, hophornbeam, white birch, and white pine. If you’re like me you’re not too bad at identifying trees by their leaves, but not too great at identifying trees by their bark once the leaves have all fallen.

Though I can’t always identify a tree by its bark, I do recognize the great variety of barks present in our winter woodlands. But why are we even able to identify trees by their bark? That is, if bark is characteristic to each species then what does the appearance of the bark tell us about that tree’s natural history?

One of the easiest trees for me to identify by bark is the luminescent white birch (*Betula papyrifera*). In a hardwood forest in winter, the leaves have all fallen to the forest floor and now the winter sun is able to reach the bark of our deciduous trees, shining brilliant against the birch’s white surface. What is its smooth papery bark telling us about the tree’s adaptations to its environment?

When I go out in the woods on a brisk January day I wear black. When the sun shines on me, it almost feels like a warm summer day (well, almost); stepping into a shadow the temperature drops precipitously. Likewise for trees, darker bark will absorb heat, warming up the wood and stored sap. This presents a problem when the sun sets and the temperature drops sometimes to sub-freezing temperatures in just a few short seconds—something white birch’s white, reflective bark helps it avoid.

When water, the main constituent of sap, freezes it expands unlike a tree’s woody bark which contracts when cooled. With the opposite forces of a tree’s insides
pushing out and outsides pulling in, the tree can “pop” with a loud shotgun crack after the sun sets. Black Elk, the famous Lakota healer, stated that he was born “in the moon of the popping trees” (December); for many generations we have experienced frost cracking damaging trees ill-prepared to handle quick temperature changes.

If this is indeed the function of the bark’s color, then we would expect other species with this coloration to have a similar ecology. I often think “Paper birch!” when I see quaking aspen from a distance. Both tend to grow in disturbed, open areas that receive full sun, both have smooth white bark, and among Charlotte’s deciduous hardwoods, both aspen and birch’s range extends the farthest north.

As black cherry (Prunus serotina) will attest to, there are other means of solving this hot/cold problem. With its dark, flaky, potato chip-like bark it can easily be discerned from a paper birch. The word stegosaurus conjures up images of a sluggish prehistoric creature ambling about with those large, mysterious pentagonal plates lining its back. Because dinosaurs were so big, they generated lots of heat even when just ambling about. The added surface area of those plates would have served like the contours of a radiator to dissipate heat and prevent the animal from overheating. The added surface area in those potato chips allows black cherry’s bark to keep from heating up to the point where sap would contract and bark expand in the harsh winter sun. Similarly, black locust has deep grooves rather than flakes to dissipate heat—different suites of adaptations all serving the same function.

But to explain all the adaptations of bark as serving the tree for winter survival would be to sell the tree short on the complexity of its bark’s adaptations. Bark must also contend with fire (pitch pine has latent buds in its bark that can sprout after a fire; shagbark hickory bark is highly flammable and burns at a temperature lower than the inner wood), epiphytes (the ancestors of our beech evolved in the tropics where epiphytes, plants that grow on other plants, might weigh down and snap branches off; rain water on smooth bark washes off fungal spores and epiphyte seeds), and parasites (red pine bark is thick with resin, an antimicrobial compound that prevents fungal and bacterial infestation).

Looking closely at tree bark and understanding its functions is not only interesting, but also a good way to increase your ability to recognize different tree species. This works at any time of year, since the bark is always there, even when the leaves are not! Makes me wonder how I might identify trees when their bark has rotted away.

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