The Blazing Star

Spring 2019, Volume 20, Issue 2

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Native Plant to Know

Spanish Moss

Tillandsia usneoides

by Stephen Johnson

Many Native Americans called Spanish moss (*Tillandsia usneoides*) "tree hair." This epiphytic plant does, in fact, look like messy grey hair hanging from trees. During the 16th century, a period of colonization in Florida when Spanish and French forces vied for control of the land, their rivalry often took the form of hurling insults at one another, sometimes derived from *T. usneoides*. The Spanish called their rivals "cabella frances" (French hair) and the French retorted with "barbe espagnole" (Spanish beard).

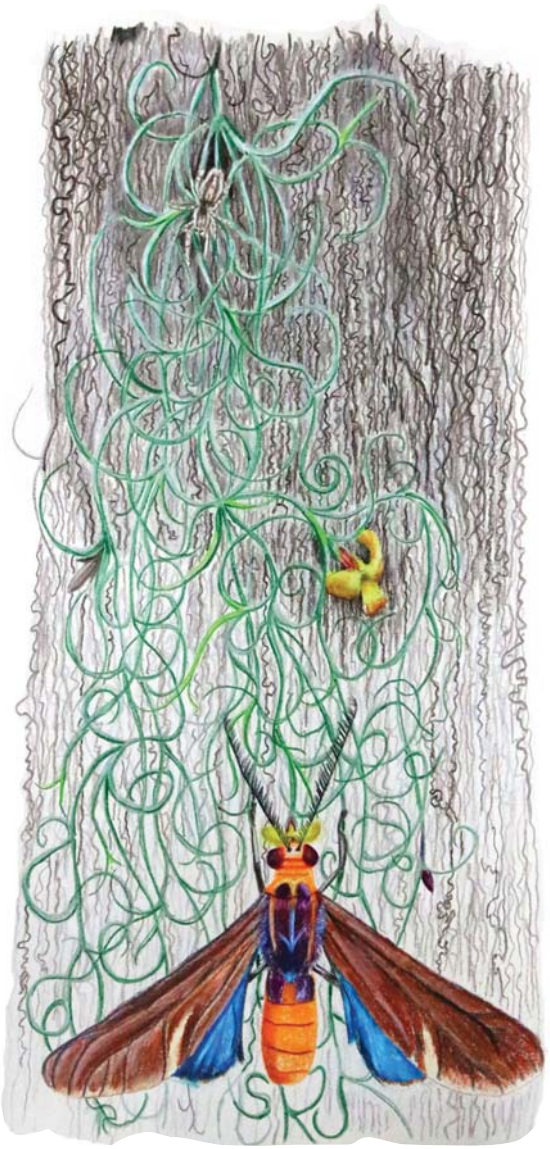
The father of modern plant taxonomy, Carolus Linnaeus, thought Spanish moss looked very much like the dangling lichen of the genus *Usnea*, typically given the name "old man's beard," hence the species name. But he chose a different genus name, the origin story of which goes like this: A young man named Elias Tillander sailed north from Stockholm along the Gulf of Bothnia and became so seasick on the voyage that he walked 2,000 miles (3,200 kilometres) back to Stockholm and renamed himself Tillands (by land). Linnaeus erroneously named the Spanish moss genus *Tillandsia*, meaning "to loathe dampness."

As it turns out, Spanish moss is dampness loving, growing thickly on bald cypress (*Taxodium distichum*) trees in swamps. But it will also grow on coastal live oaks on manicured lawns. Spanish moss is typically found in low-lying, hot, humid country. Plant explorer Thomas Nuttall, in his *Journal of Arkansas Territory* (1819), called it "the long moss, a plant so characteristic of the prevalence of unhealthy humidity in the atmosphere."

For many people in the 1800s, swamps represented places of death and decay, ghosts and mystery; long moss became a significant symbol of those chthonic qualities. A popular painting by Virginia artist John Gadsby Chapman entitled "Lake of the Dismal Swamp" (painted in 1825, redone in 1835) set the mood; the artist bedecked the trees with copious long moss.

This iconic bromeliad can grow in high humidity and high temperatures without functional roots, employing the same photosynthetic apparatus as a desert cactus. Not that this water-saving mechanism is foolproof. Take a look at some clusters and you will see that most of the plant is dead.

In the warmer parts of its range, Spanish moss can flower at



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The Blazing Star is . . .

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LARRY LAMB HONOURED

Larry Lamb, Bachelor of Independent Studies from the University of Waterloo and a founding member, past president and conservation award recipient of the Canadian Wildflower Society (precursor to NANPS), was recently awarded the Lieutenant Governor's Ontario Heritage Award for Lifetime Achievement. And as his five-page CV attests, his has certainly been a lifetime of achievement!

Larry was a lecturer and manager of the ecology lab in the Faculty of Environmental Studies at UofW for 40 years, inspiring legions of students with his love of natural history and his fervour for restoring indigenous landscapes. Larry's list of credentials includes strong involvement with the Ontario Chapter of the Society for Ecological Restoration, the Federation of Ontario Naturalists (now Ontario Nature), Kitchener-Waterloo Field Naturalists, Ontario Tallgrass Prairie and Savanna Association, Field Botanists of Ontario and more! His thesis for his bachelor's degree was titled *A Strategy to Encourage Native Wildflowers within Highway Rights-of-Way in Southern Ontario*.

In 1969, Larry's first work experiences were mapping the historical vegetation from original land survey records for the Norfolk-Haldimand Study and for Erin Mills new town project. He has worked with many municipalities across Ontario, but the Regional Municipality of Waterloo has benefited the most from his expertise. Among his accomplishments: Larry helped designate the region's environmentally sensitive areas (in fact, he coined the term ESA) and co-developed the original set of selection criteria, helped compile a list of significant flora for the region's planners, and co-authored, with C. Campbell, *The Preliminary Flora of Waterloo Region, 1984*.

Larry has worked with many levels of government, non-profit organizations and private companies helping to re-establish native habitats or protect what still exists. He helped determine the worthiest communities on the Walpole Island First Nation for protection consideration in conjunction with the Ministry of Natural Resources, Chatham. He worked with Savannah Golf Links, Cambridge, in partnership with the Nature Conservancy of Canada, to restore and manage savanna and prairie remnants in a conservation easement at the golf course. He helped the Red Cloud Cemetery board manage Ontario's only cemetery prairie, in Northumberland County, a project that received a Cultural Heritage Landscape Award from the Architectural Conservancy of Ontario in 2012. Larry was also involved in the establishment of native plantings at the Erb Street landfill site in Waterloo and other sites across Ontario.

PHOTOGRAPH BY PAT DEACON

From the left, Wayne Buck, Josh Shea and Larry Lamb preparing to scatter seed at the Waynco Prairie.

Not one to hang up his work boots after retirement, Larry has been designing low-maintenance gardens – with a focus on native plants, of course – including a butterfly-hummingbird garden at his new home in Woodstock. He is still involved with restoration projects such as managing the prairie landscape at Ontario Die in Kitchener and the Waynco Aggregates Prairies with the Waterloo Stewardship Council. One of his pet projects is creating Tertiary Relict - "East Meets West" gardens for Renison College's Asian Studies program at UofW. This is a rare instance of North American plant species planted alongside their Asian counterparts that evolved in parallel.

Congratulations, Larry, and many more years of protecting nature!

NANPS SPRING CALENDAR

NANPS ANNUAL SPRING NATIVE PLANT SALE

Saturday May 4, 2019
9:30 a.m. – 2:30 p.m.
Toronto Botanical Garden, 777 Lawrence Ave East, Toronto

Once again NANPS will be hosting Canada's largest native plant sale! Come get your native shrubs, trees, ferns, grasses and wildflowers. Chat with other native plant enthusiasts. Browse the resources available. Visit nanps.org for details.

PHOTOGRAPH BY PETER FULLER

Peter Fuller describes how to grow a mini bog or fen in your own backyard on ***page 4****. This photo shows sundews (*Drosera *spp.) as seedlings.*

PHOTOGRAPH BY ANDY FYON

*Entireleaf mountain avens (*Dryas integrifolia*) is one of a limited number of plant species that grow in geologically inhospitable places on this planet. Here it is found growing on Bellburns Barrens in Newfoundland. To learn more about geological influences on plants, read Andy Fyon's article on* ***page 8****.*

RIVERWOOD NATIVE PLANT SALE

Sunday, May 19, 2019
Riverwood, 4150 Riverwood Park Lane, Mississauga, Ontario

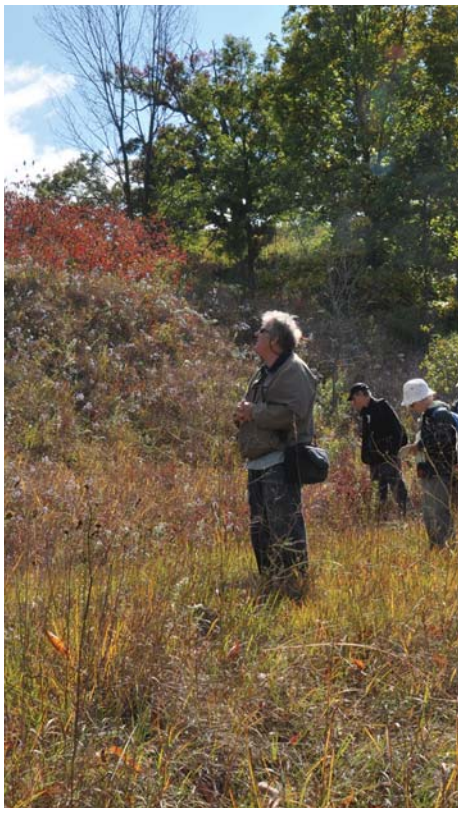
Join us for our first native plant sale in partnership with The Riverwood Conservancy.

CHRISTIE PITS PARK NATIVE PLANT SALE

Sunday, May 26, 2019
Christie Pits Park, 750 Bloor Street West, Toronto, across from the Christie subway station

NANPS will be at the annual Bike with Mike, a family-friendly event that celebrates cycling and environmental issues, at Christie Pits Park.

NANPS volunteers will be on hand to answer questions about gardening with native plants at all our plant sales.



PHOTOGRAPH BY GRAHAM BUCK

Larry Lamb admires an old railway line prairie restoration. Graham Buck describes efforts to restore tallgrass prairies and oak savannas in southern Ontario on ***page 12****.*

Backyard Bogs

by Peter Fuller

One spring day, after an hour of rambling around the Larose Forest wetlands east of Ottawa, peering at plants and anything that flew or crawled by, I looked up and realized I didn't know where I was. One boot was full of water, my knees were wet from kneeling on moss and the sun appeared at an odd angle. I didn't have a watch with me, but my camera recorded the time for each image so I took a photo and discovered that it was well into the afternoon. My "hour" had turned into six or seven without me noticing. I should mention that this was by no means an isolated incident. How easy it is for me to lose myself in a bog!

Satellite shots of wetlands make them seem simple and flat, but up close the exact opposite is true. The intersection of land and water creates a tremendous diversity of micro-habitats so that each pool or mossy mound can hold its own collection of plants and animals, all exhibiting fascinating adaptations. The terrain makes travel slow so you can appreciate the details.

As a gardener I am always scheming about how to enjoy these plants in my garden, but their needs often extend beyond the limitations of my property or the work I am prepared to do. I have found, however, that it is possible, without too much cost or effort, to install a small bog or fen garden that will allow me to enjoy wetland plants close to home.

Bogs are characterized by acidic conditions and low nutrient levels. Sphagnum mosses often dominate. Fens usually have water flowing through them, bringing nutrients. Sedges are typically dominant in fens. Marshes have deeper water with emergent vegetation (cattails and rushes), while swamps are treed wetlands. The four wetland types can exist and transition into one another in a continuous wetland. Plant communities change with each type.

Photograph by Peter Fuller

Installing containers on a slight slope in a low area. Gravel is laid on heavy plastic around containers.

Construction

The easiest way to create a bog or fen garden is to bury a deep container up to its rim. Choose the largest containers you can manage. They should have no drainage holes and be able to withstand freezing. I have used heavy plastic totes and metal or plastic drums cut in half. They should be at least 30 centimetres (one foot) deep but preferably 40-70 centimetres (15-28 inches). The deeper they are the more water they can store, making water management easier and ensuring there's room for the root systems of plants such as cottongrass. If the top few centimetres of the container remain above the surface, drill a few holes around the top so that excess water can flow out at ground level. Bog plants can handle the occasional flooding that happens during spring runoff, but their crowns shouldn't be submerged for extended periods. If you want the container to be flush with the surface of the soil, place it on a slight angle so that excess water will flow out. I use gravel around my containers to hide the rims, make access easy and show off the plants. Clustering a group of containers is a manageable way to create the effect of a larger garden (and make it easier to divide individual clumps or contain overly vigorous plants, should the need arise).

Choose a sunny location and take advantage of a low spot or downspout that will collect rainwater. Fill a container with moistened planting mix, mounding it above the rim of the container since it will settle over time. For a bog (acidic) container, I use peat moss alone or mixed with up to 50% coarse sand (granitic in origin). For a fen (neutral or alkaline) container, I use roughly 40% small gravel, 40% sand and 20% compost. I use a limestone gravel as mulch to maintain a higher pH, but a small dusting of lime in the spring will also do the trick. If you want to monitor water levels in a container, place a perforated tube (such as PVC used in septic beds) vertically inside the container. Once the container is planted and watered, look down the tube and see where the "water table" is. I use this tube for adding water so as not to disturb small plants.

Maintenance

I don't regularly test pH levels but try to maintain a diversity of plants to imitate natural communities. I leave decaying leaves on the surface to recycle nutrients. A constantly moist soil will inevitably allow weed seeds to germinate. Most weeds will be stunted because of the waterlogged soil, but some weeding will be necessary. A gravel mulch around plants can cut down on maintenance and slow evaporation.

In the wild, live sphagnum moss forms the basic medium of a bog. Stick sprigs of sphagnum moss into your containers to grow a living surface. This hasn't always worked for me since birds and rodents tend to remove all the moss (presumably for nesting material) before it can become established. Other mosses will likely arrive in your garden from spores and these can all be left to grow.

Monitoring water levels is the only other regular maintenance job. With a deep container and normal rainfall the top of the soil remains damp. In dry spells I add water, especially to young plants. I use only rainwater for bogs because the plants are sensitive to the chemicals in treated water and the high mineral content in some well water. Fen gardens are less particular, but I still avoid treated water.

I rarely add fertilizer. I might water once or twice in the spring with a half-strength fish emulsion fertilizer. Snow is the best insulator. The only winter problem I have encountered is rabbits browsing on shrub twigs (always the ones with flower buds!) and pitcher plant leaves. Netting can discourage them.

PHOTOGRAPH BY PETER FULLER

Sarracena purpurea *(pitcher plant) in a pot inside a shaded work area with black mesh shade cloth in the background. The flowers had recently opened so the petals were still fresh and red.*

PHOTOGRAPH BY PETER FULLER

Parnassia glauca *seedlings with a Juncus clump in a newly planted container. Seeds from a nearby* Veronicastrum virginicum *(Culver's root) have germinated and need to be weeded out.*

Propagation

The species mentioned below produce many seeds that usually have high rates of germination. All the plants in my bog and fen gardens were started from seed. I give all seeds a cold, moist treatment (mixed with damp vermiculite and stored in the fridge in plastic bags for 90 days). The seeds are tiny and need light to germinate so I surface-sow them in 15-centimetre (six-inch) pots, set the pots in three centimetres (just under an inch) of water and grow the small seedlings together for the first summer in a sheltered spot outside. I avoid watering from above or leaving them in heavy rain so that the seeds are not washed out of the pots. Towards the end of the summer, I pot up large individuals or plant out clumps of seedlings, or I overwinter whole pots of seedlings and divide them up during the second spring. First-year

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plants need a winter dormancy period, but will grow more quickly if not exposed to winter extremes. I keep pots barely moist in a fridge or the north window of an unheated back room where the temperature remains at about 10°C (50°F). In March they can be put under lights or left indoors until temperatures warm outside.

Seeds of many species in the Ericacea (heath) family (*Kalmia, Ledum, Vaccinium, Chamaedaphne* spp.) will often germinate without any treatment, especially if the seeds are fresh, but the cold treatment won't do any harm and may increase germination percentages. Mycorrhizal fungi in the growing medium likely benefit members of this family.

PHOTOGRAPH BY PETER FULLER

Carex grayi

Recommended Bog Plants

Sarracenia purpurea (pitcher plant): Modified leaves form tubes and collect rainwater in which insects drown. As their bodies break down, they release nutrients for the plants to use. The pitchers are green with red veining and persist over winter, often turning dark red. New pitchers gradually replace them the following summer. Clumps increase in size and can eventually be divided. Red flowers on stiff stalks appear in late spring and stay attractive until fall when they shatter and release seeds. Seedlings produce a four-centimetre (one-and-a-half inch) rosette of small pitchers the first year and a flowering clump within three to four years. The pitcher plant is cold hardy and prefers a sunny location.

PHOTOGRAPH BY PETER FULLER

Mimulus ringens *(monkey flower)*

Kalmia angustifolia (sheep laurel): This small shrub has narrow, thick leaves with slightly curled edges. The plant holds many of its leaves over the winter. Bright pink bells flower along the main stems in early summer on the previous year's shoots. Prune lightly after flowering to keep plants compact. The dust-like seed can produce small flowering plants in three or four years. Sheep laurel prefers full sun.

Ledum groenlandicum (Labrador tea): Another small shrub that blooms in late spring or early summer with clusters of fragrant white flowers. The underside of the evergreen leaves is fuzzy and light brown. Labrador tea will grow in full to partial sun.

Eriophorum angustifolium (cottongrass): Strong stems 40-60 centimetres (15 inches to two feet) tall support seed heads that resemble fluffy cotton balls. This member of the sedge family withstands wind and looks attractive all season. The "cotton" will stay intact into winter if seeds are not harvested. The spreading clumps are tightly packed but can be divided in spring. A small group of seedlings will produce a flowering clump in two or three years.

Chamaedaphne calyculata (leatherleaf): This very hardy shrub has small, fragrant, oval leaves along its many spreading twigs. Urn-shaped, white flowers are numerous but inconspicuous in the spring, later forming brown capsules. The plant is evergreen; its texture and form complement other bog plants. Keep

seedlings in their pots for the entire first year; pot up small clumps the second spring. Once established, leatherleaf needs an annual trimming to keep it bushy.

Other bog species to try

Vaccinium spp. (cranberry, blueberry): These plants prefer highly acidic soils. Remove seeds from fruits before sowing.

Drosera spp. (sundew): These hardy plants trap small insects with their sticky pads. They form low rosettes approximately five centimetres (two inches) in diameter and send up delicate white flowers on wiry stems. Preferring flat, sunny spaces with saturated soils and little competition, they can be hard to incorporate into a mixed planting. It may be easier to try them in a separate container.

Photograph by Peter Fuller

Ledum groenlandicum *(Labrador tea) in winter with buds for spring blooms.*

Recommended Fen Plants

Parnassia glauca (grass of Parnassus): Smooth, bright green basal leaves are topped by five-petalled white stars with darker veins in late summer. Seedlings are small the first year and are best planted in small clumps. They quickly fill out in subsequent years to produce blooms.

Juncus spp. (rushes): Although many members of this genus will grow in shallow water, some are equally successful in moist soils. Some species can be a bit weedy, but two species with attractive inflorescences are *J. torreyi* (Torrey's rush) and *J. canadensis* (Canada rush). Division may be necessary every two or three years to keep them from spreading.

Carex spp. (sedges): Sedges come in all shapes and sizes. Many will do well in part sun. For interesting inflorescences try *C. lupulina* (hop sedge), *C. grayi* (Gray's sedge) or *C. crinita* (fringed sedge). They have large seeds and produce vigorous seedlings the first year. *C. lasciocarpa* has a very fine texture and can take frequent flooding.

Caltha palustris (marsh marigold): Bright yellow flowers early in spring add a splash of colour while most other plants are just emerging from dormancy. Bright green, rounded leaves look good all summer. They prefer full sun in spring but can take some shade in the summer.

Mimulus ringens (monkeyflower): Seeds from this species often blow in and germinate on damp ground in my gardens. Rosettes of leaves form the first year followed by 30-50 centimetre (one-foot to 20-inch) spikes the second year with violet flowers emerging from the leaf axils. Once the plant is established, new rosettes are easy to detach in the spring and transplant.

Gentianopsis crinita (fringed gentian): This biennial member of the gentian family has blue-violet flowers at summer's end. It's a good match for *Parnassia* but I have found it more challenging to grow. It needs to self-seed to stay in the garden. Yearly sowing may help.

Spiranthes spp. (ladies' tresses): While most orchid genera need special conditions to grow from seed, it may be possible to introduce species such as *Spiranthes cernua* (nodding ladies' tresses) by sowing seed in the fall. Don't attempt to grow seeds in a sterile medium; instead sow fresh seed directly into your garden. Repeat this over a few years and there is a good chance that the grassy leaves will appear, followed by white spikes.

Bogs and fens open up a world of subtle beauty and detail. Creating a miniature bog of your own allows you to get "lost" in your own wetland, even if it's just for a few minutes a day.

Peter Fuller *is the owner of Fuller Native and Rare Plants in Belleville, Ontario, where he experiments with the propagation of plants native to the Great Lakes region. He combines his love of birding and botany by exploring the woods and wetlands of Eastern Ontario. He welcomes questions and discussions about native seed propagation – info@fullerplants.com.*

Geological Influences on Plant Communities

by Andy Fyon

Most of us threw rocks as children or skipped stones across a lake or stumbled over rocks when hiking. Such experiences may have left us with the impression that rocks were fun, sometimes bothersome objects, but hardly worth a second thought. To plants, rocks and the related soil substrates are important. Rocks and soils define the local geology, which influences the types and locations of some plants. Think of geology as the factor that influences which types of plants grow, or don't grow, in an area when all other factors, like climate, are equal.

Geology is the study of the rocks, sands, gravels and muds that make up the Earth; the processes that created those materials and shaped the Earth; and Earth resources, such as minerals, ground energy and groundwater. Geology affects all life forms on Earth. Decision-makers use geological information to make policy and planning decisions that affect society. But what is the link to plants, you may ask?

A brief geological history of terrestrial plant life

Fossilized plant materials tell geologists that land plants began to colonize the Earth's surface about 475 million years ago. The first land plant was an ancestor of liverwort (*Phylum marchantiophyta*). The transition from surface-clinging liverworts to the 30-metre (100 feet) tall Lycopsid forests took place after a 75-million-year gestation 400 million years ago, long before dinosaurs ruled the Earth. These transitional forests, which included the ancestors of modern club mosses (*Lycopodiaceae*), spike mosses (*Selaginellaceae*), horsetails (*Equisetum* spp.) and quillworts (*Isoetaceae*), formed in great tropical swamps. The remains of transitional forests became the coal deposits that fuelled the Industrial Revolution that started in 1750. Gymnosperm plants appeared 390 million years ago. They were followed by angiosperm land plants, whose lovely flowers have graced the surface of the Earth for the last 125 million years. Fossils tell an amazing geological story of ancient plant history on Earth.

We might think that Earth's climate remained relatively stable over time, but that is far from true. The Earth's climate has fluctuated over its 4,500-million-year history. The Earth was frozen at least five times during ice ages. The most recent Quaternary ice age affected the northern hemisphere. Abrasive glaciers scarred exposed rocks and laid down blankets of ground-up rock called till. When the climate started to warm about 11,000 years ago, the melting ice created great rivers and lakes. This last ice age shaped the land and created the landscapes we see today, including the ancestral Great Lakes Basin. The land was devoid of plants immediately after the melting of the glaciers. We might imagine what the desolate landscape looked like at the end of the ice age if we sit beside Lake Superior and look at the naked, unvegetated rock islands that poke above the cold waters. The land recovered quickly though and plants rapidly moved in to occupy niches released from the icy cover.

Sandstone and Volcanic Ash Substrates

Sandstone rock is composed of grains of the mineral quartz, which consists of the elements silicon and oxygen. This rock does not contain any of the nitrogen, potassium or phosphorus nutrients required by plants. Conversely, ash deposits, formed during volcanic eruptions, are fertile substrates that contain many plant nutrients. Compared to sandstone, volcanic ash rock can sustain lush plant growth. For the last 10,000 years agrarian societies have been attracted to fertile volcanic deposits, where they established farms, communities and cities. While the land was excellent for farming, proximity to an active volcano often came with disastrous, unintended

PHOTOGRAPH BY ANDY FYON

The Badlands near the Cyprus Hills of Alberta host plant species that grow on volcanic ash.

consequences!

A familiar, volcano-loving plant is the grape (*Vitis* spp.). Many fine wine-producing areas around the world grow their vines in volcanic soil. Vineyards in the Kelowna area of British Columbia grow grape vines in volcanic soil produced by the eruption 60 million years ago of the Mount Boucherie volcano. Wines produced in the Similkameen Valley, also in British Columbia, and in the Portland area in Oregon owe their distinctive taste to the volcanic soils produced by now inactive volcanoes in the nearby Cascade Mountains.

Calciphiles and Alvar Substrates

Another distinctive, but globally rare, habitat that sustains unusual plants is the alvar. The International Alvar Conservation Initiative elegantly defined alvars as natural communities centred around open areas of glaciated, flat-lying, calcareous limestone or dolomite bedrock, with thin, discontinuous soil cover and less than 60% tree canopy cover. There are several ways to classify alvars, but one traditional classification scheme is based on plant type and cover: open alvar or alvar pavement, alvar shrubland, alvar savannah, alvar woodland and alvar grassland.

Alvars occur in the North American Great Lakes Basin, the James Bay and Hudson Bay lowlands, Manitoba, Newfoundland and Labrador, Quebec and the Northwest Territories, and parts of Europe.

Limestone and dolomite bedrock were born millions of years ago on the bottom of a warm, tropical ocean close to the equator from the calcareous muds and shells of ancient, dead marine animals. Distinctive corals and other fossils preserved in these rocks attest to that origin. The calcareous chemistry of limestone and dolomite bedrock influences the types of plants that grow on alvars.

Alvar pavements (or barren lands) lack soil and consist of more than 50% exposed bedrock, making it hard for plants to gain a foothold. Temperatures at the rock surface are hot during the summer, but winter freezing breaks up the surface rock layers. Flooding is common in the spring and fall. The alvar rock substrate consists of calcium- and magnesium-carbonate minerals, which are nutrient-poor. Alkaline groundwater is common and does not readily transport scarce nutrients to plant roots. The physical and geochemical characteristics of an alvar pavement discourage most plant growth, but they support specialized plants called calciphiles (also known as calcicoles or calciphytes).

Photograph by Andy Fyon

Lakeside daisy growing on alvar pavement on Manitoulin Island

If you visit an alvar pavement along Lake Huron's shores in the spring, you might enjoy explosions of yellow flowers from the calciphile plant named lakeside daisy (*Tetraneuris herbacea*). It is designated as threatened by the Committee on the Status of Endangered Wildlife in Canada.

On the west coast of the Great Northern Peninsula, Newfoundland and Labrador, the cold Arctic Ocean currents chill expanses of frost-shattered limestone, locally known as limestone barrens. This alvar habitat is an ideal place for the ground-hugging mats of exquisitely lovely Arctic entireleaf mountain-avens (*Dryas integrifolia*), another calciphile plant. Alvars of the Interlake area, Manitoba, also have a number of rare plants, including the imperilled Gastony's cliffbrake fern (*Pellaea gastonyi*), which grows only on the sides of limestone cliffs and boulders.

Serpentine Endemics and Serpentine Substrates

Plants have a lot of evolutionary experience growing on typical surface rocks. But they have had little exposure to rocks that come from a place geologists call the mantle, deep below the Earth's surface, because mantle rocks are rare "up here." Perhaps the quintessential example of bedrock control on vegetation comes from the Tablelands, in the UNESCO World Heritage Site called Gros Morne National Park, in Newfoundland. Here, mantle rocks are exposed on the

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surface. This area is described by Michael Burzynski in his wonderful book *Gros Morne National Park*. Michael's narrative places humans, animals and plants into a 12-month seasonal context, a 5,000-year cultural historical context, a 10,000-year physiographic context and a one-billion-year geological context, during which continents were torn apart and re-combined, oceans were created and destroyed, and mantle rock was thrust up from deep below the Earth's surface onto the edge of the evolving North America continent.

The few plants that can grow on mantle rock are sparse or stunted compared to plants growing on adjacent non-mantle rock. Why is that? The answer lies in the chemical make-up of the mantle rock and the way mantle rock weathers when exposed on the surface of the Earth, where it quickly transforms into the mineral serpentine. Serpentine rocks form unstable slopes with rugged surfaces, where plants have difficulty gaining a foothold. This is the first strike against plants. Serpentine rocks also have an unusual chemistry characterized by very high magnesium and very low calcium concentrations. This creates a "tight" soil where oxygen cannot efficiently diffuse; hence, plant roots and certain soil bacteria are starved of the oxygen needed for healthy growth. Plants also need calcium from the soil to form strong vegetative cell walls. Without adequate calcium, plant cell walls collapse and plants cannot stand upright. This situation is exacerbated by the absence of plant nutrients such as nitrogen, potassium and phosphorus. The low calcium and high magnesium concentrations of the serpentine substrate is strike two against plants. The fatal blow comes from the high concentration of heavy metals, such as copper, iron, cobalt, chromium and nickel, in serpentine rock and soil, since they are toxic to most plants. Together, these geological factors conspire to discourage most plants from growing on serpentine.

But a few specialized plants can grow on serpentine rock. Plants that tolerate the high concentrations of metals are called metallophytes; serpentine endemics are metallophyte plants found only on serpentine substrate.

How do the serpentine-tolerant species survive on a toxic substrate? Some plants tolerate high nickel concentrations in the soils by limiting uptake into their plant systems. Stunted purple pitcher plant (*Sarracenia purpurea*), round-leaved sundew (*Drosera rotundifolia*) and common butterwort (*Pinguicula vulgaris*) tolerate and grow on the metal-rich serpentine soils of the Tablelands. These insectivorous plants acquire supplemental nutrition from the insects they trap, which helps them eke out an existence on hostile, nutrient-poor serpentine substrate. Other plants, called metal hyperaccumulators, concentrate toxic metals in their roots or leaves in a form that is rendered non-toxic by biochemical processes. Alpine catchfly (*Viscaria alpina*), which accumulates high concentrations of copper in its tissues, is one such plant that grows on the Tablelands. Predictably, because of its metal hyperaccumulation property, *V. alpina* has been used by prospectors to find concentrations of copper in rock. Another rare nickel hyperaccumulator plant that grows only on serpentine substrate is serpentine stitchwort (*Cherleria marcescens*). Its delicate, white flowers stand out against the ochre-coloured surface of the Tablelands serpentine substrate.

There is some evidence that metal hyperaccumulation protects a plant from grazing insects.

Mantle rocks on the Tablelands in Gros Morne National Park are home to Viscaria alpina *(alpine catchfly).*

PHOTOGRAPH BY ANDY FYON

Interestingly, metal hyperaccumulator plants have shown promise as agents for remediating soils polluted with metals, through a process called phytoremediation.

Halophytes and Saline Substrates

Landscapes where the surface is covered mostly by salt and alkaline saline lakes are called salt flats. It takes thousands of years to create these fascinating geological features. Some salt flats in Canada occur on the prairies in Saskatchewan and Alberta, in Wood Buffalo National Park in northern Alberta and the Northwest Territories, and in the Yukon.

The Takhini Salt Flats in the Yukon, which are distinguished by white sodium sulphate salt deposits and alkaline, saline lakes, are unusual because of their northerly location. This may be attributed to several geological and climatic factors that conspired to create the perfect "salt storm," including the right sources of salty materials in the buried bedrock; local zones of weakness, such as a fault, that channelled artesian, salt-bearing groundwater to the surface over hundreds or thousands of years; a widespread layer of permafrost that prevents salty surface waters from seeping back into the subsurface; and a summer that lasts long enough to evaporate the salty lakes, leading to the precipitation of salt minerals.

The alkaline, salty conditions discourage most plants, but a number of specialized, salt-tolerant plants, called halophytes, grow in this striking landscape. The red leaves and stems of the succulent boreal saltwort (*Salicornia borealis*) stand in stark contrast to the white salty soil. Historically, the ashes of plants belonging to this genus, informally named glasswort, were a source of soda ash (sodium carbonate) used to manufacture soap and glass. Although common here, *Salicornia borealis* is considered imperilled globally. Another rarity in Takhini is horned seablite (*Suaeda calceoliformis*), also called pursh seepweed. This succulent annual halophyte plant with waxy green to red bicoloured stems can grow up to 80 centimetres (30 inches) long in two forms: erect (typical of lower salinity substrates) and prostrate (typical of higher salinity substrates). In the Yukon, its conservation status is imperilled.

This short geological journey has helped uncover some fascinating intersections between plants and geology. Rather than complaining about slippery rocks the next time you go hiking, or about wet, salty soils that coat your boots with white mud, reflect on the beauty, complexity and variability of the geology beneath your feet, its influences on types and locations of plants and on the bouquet of your glass of wine!

Andy Fyon is a retired geologist with a keen interest in the relationship between local geology and plant life. Visit ontariobeneathourfeet.com/, facebook.com/Andy.wildflowers and instagram.com/andyfyon/ to see more of his work.

Photograph by Andy Fyon

*Horned seablite (*Suaeda calceoliformis*) is a succulent halophyte plant whose status is imperilled in the Yukon.*

Photograph by Andy Fyon

*Boreal saltwort (*Salicornia borealis*) surrounds a log covered in salt in the Takhini Salt Flats in the Yukon.*

The Grand River Plains

by Graham Buck

The Grand River Plains is a name I created for an area in Brant County and southern Waterloo region (in Ontario) where a high concentration of tallgrass prairies and oak savannas existed at the time of European contact with Aboriginal peoples. These tallgrass communities were estimated to cover at least 20,000 hectares (~50,000 acres). I discovered in my initial analysis that fewer than 50 hectares (124 acres) remain, in scattered parcels.

Despite the loss of more than 99.9% of the historical oak savanna and tallgrass prairie vegetation, many of the plants and animals that called this area home for several thousand years still hang on, including at-risk species such as the American badger and eastern hog-nosed snake. Adventurous naturalists can catch glimpses of bird's-foot violet (*Viola pedata*), American columbo (*Frasera caroliniensis*), prairie violet (*Viola pedatifida*) and prairie smoke (*Geum triflorum*) in a few places. However, the northern bobwhite, a species of quail, disappeared in the early 1970s and is designated endangered in Canada and near extirpation from Ontario.

The cataloguing of the tallgrass prairie and oak savanna remnants in the Grand River Plains, which began decades before I started my project, noted the presence of white oak savannas, dominated by *Quercus alba*. Most oak savannas in this province are dominated by black oak (*Quercus velutina*). The rarity of white oak savannas makes it critical that we restore them where possible. It's likely that this unique ecosystem provides a different habitat type, which contributes to a more diverse environment. As the landscape becomes more homogenous, overall biodiversity is lost. This may even be at levels that we have not yet explored; for example, tallgrass communities are known to have unique assemblages of soil microorganisms and arthropods (insects, spiders, mites, etc.), which have been inadequately studied and documented to date.

In my typical savanna restoration program, I would inventory and document as many of the tallgrass indicator plants as possible, clear out and kill invasive species, particularly shrubs, and initiate a prescribed burning program. According to the scientific literature, white oak savannas likely formed in the presence of frequent, but low-intensity, ground fires, which kept invading brush at bay but were not hot enough to kill the above-ground parts of trees. As a result, the trees grew massive from a single trunk with immense spreading crowns. Conversely, black oak savannas burn less frequently, but the fires are typically more intense, sufficiently hot to kill the visible tree parts. The trees respond by suckering, growing back into small, multi-stemmed trees.

Historically, frequent, low-intensity fires were usually

Photograph Courtesy TALLGRASS ONTARIO

The author briefing the volunteer burn crew prior to ignition of a prescribed burn at a white oak savanna site. A sighting of a rare species of lepidoptera called the hornless oakworm moth was recently confirmed at the site.

Photograph by GRAHAM BUCK

Burning along the old railway along Highway 24 in 2009.

caused by humans, in this case local First Nations. In North America, indigenous people used fire as a tool to maintain and manipulate vegetation to suit their needs. In places where the topography, climate and soils were suitable, tallgrass prairie and oak savannas were created; many factors dictated the extent and type of ecosystem formed, including moisture levels, soil type, topography and aspect.

The first prescribed burn of white oak savanna at the Grand River Plains took place in 2007, with a total of five burns completed to date. The burns resulted in a change in the dominant grasses and sedges. Before the first burn, the dominant groundcover was the native Pennsylvania sedge (*Carex pensylvanica*). Apart from a small clump of big bluestem (*Andropogon gerardii*), there were no tallgrass prairie grasses. I discussed the site with Larry Lamb, head of the ecology lab at the University of Waterloo for decades, who had studied this site with his students during the 1970s and early 1980s. Larry informed me that big bluestem had been the dominant grass at the time. The shift to Pennsylvania sedge had occurred largely because the landowner had mowed the savanna. I persuaded the landowner to reduce mowing and eventually stop it altogether, when regular burning began. In 2018, Pennsylvania sedge was still abundant, but the prairie grasses – big bluestem, Indian grass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*) and Canada wild rye (*Elymus canadensis*) – were also flourishing; in places they are now the dominant species.

PHOTOGRAPH BY GRAHAM BUCK

American columbo

Plant diversity has also increased. As part of the restoration project, I maintain a detailed botanical inventory, focusing on tallgrass indicator species. The Grand River Plains site is one of 10 tallgrass prairie and oak savanna remnants where regular inventories have been taken over a 15-year period. The general trend has been a reduction in plant diversity at most of these sites, due to lack of management. As the sites degrade over time, the most conservative species (those that can survive only in unique environments that have not been degraded) disappear first. However, at the white oak savanna site, where management activities have occurred annually, plant diversity is still increasing. Over the past few years the following species were documented for the first time: early buttercup (*Ranunculus fascicularis*), low bindweed (*Convolvulus spithamaeus*), the pretty, umbrella-like yellow pimpernel (*Taenidia integerrima*) and the low-growing, white-flowered shrub New Jersey tea (*Ceanothus americanus*). Many of these species are more abundant at multiple locations throughout the site now.

American columbo, an endangered species in Ontario, has received the most attention. The white oak savanna in Brant County is unique because it is one of only two savannas in Ontario where this species grows. It is the first site with *Frasera caroliniensis* present where fire has been used as part of the habitat restoration. The results have been encouraging; American columbo, like other oak savanna plants, is becoming more numerous and widespread after 15 years. Last year, restoration work – invasive species removal and prescribed burning – began at a second white oak savanna, located 15 kilometres (nine miles) away. We hope for similar results.

The focal habitat of another restoration project, in nearby North Dumfries Township, Region of Waterloo, is a tallgrass prairie remnant. The prairie vegetation had been well documented, with prairie smoke and June grass (*Koeleria* spp.) present historically, but not anymore (neither on the site nor in nearby areas). However, many other tallgrass prairie species are thriving, including big bluestem, Indian grass, little bluestem, the lovely, airy Canada wild rye, New Jersey tea and forbs such as round-headed bush-clover (*Lespedeza capitata*), the mauve-blossomed legume called showy tick-

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trefoil (*Desmodium canadense*) and bright orange butterfly milkweed (*Asclepias tuberosa*).

The North Dumfries site can be divided into two parts: the old railway prairie remnant and a fallow agricultural field adjacent to it. The remnant contains prairie species, which though disturbed by the creation of the railway line have been growing there for thousands of years. The adjacent fallow field supports a newer prairie community that started to grow in the mid-1980s when the farming operation stopped. The site was licensed as an aggregate pit and duly dug up. But from 2007 to the present, the landowner, Nelson Aggregates, with support from the Waterloo Stewardship Council, undertook a restoration project that included prescribed burning, invasive species removal and strategic seeding in the fallow field. These three actions increased the number of prairie plants on site, resulting in a significantly larger area covered by native prairie vegetation where a low-diversity, non-native meadow had been. The site, when fully restored, will be 15 hectares (37 acres) of tallgrass prairie, a sizeable increase from the three hectares (7.5 acres) at the start of the project.

These projects are examples of early attempts to preserve and, as much as possible, expand on two small tallgrass prairie and oak savanna remnants in the Grand River Plains. Fortunately, there are others. The Grand River Conservation Authority has been restoring tallgrass prairie at Brant Park and Dickson Conservation Area for many years, with excellent results. Recently, Tallgrass Ontario initiated a project to recover bird's-foot violet in Brant County, which bodes well for a couple of small but diverse prairie remnants.

Current efforts to restore these beleaguered ecosystems are praiseworthy, but to return them to some semblance of their former glory and usefulness we need projects on the scale of hundreds or thousands of hectares. It seems like a pipe dream in this part of southern Ontario, where the land is mostly privately owned and subdivided into small landholdings, agriculture is the predominant land use and urban areas are rapidly expanding.

David Tillman, a professor of ecology at the University of California, Santa Barbara, proposed using high-diversity tallgrass prairies as a source of biofuel. It would have been an excellent fit for the Brant County agricultural community, but the idea fizzled before it got started. There was interest at the farmer level, but the biofuel industry was concerned that when the pelletized fuel was burned, the machinery would break down sooner, resulting in higher maintenance costs than burning other biofuels. Professor Tillman also pushed for turning tallgrass biofuel into ethanol, but this market continues to be dominated by annual row crops.

The goal of enhancing as many important native vegetation remnants as possible is an ambitious one, but it's key to ensuring that these habitats continue to support wildlife and enrich the lives of future generations of humans. I hope that the next generation can build on this work, maintaining, expanding and connecting the prairie and savanna parcels into a functioning landscape. Who knows, the northern bobwhite may yet return to southern Ontario. As John Lennon so poignantly put it in his song "Imagine": "You may say I'm a dreamer. But I'm not the only one."

Graham Buck *is a native plant enthusiast from Guelph, Ontario with a keen interest in botany, native plant landscaping and ecosystem restoration.*

PHOTOGRAPH BY GRAHAM BUCK

*Hillside of bluestem goldenrod (*Solidago caesia*) in September*

PHOTOGRAPH BY GRAHAM BUCK

Asters and little bluestem at the prairie restoration site in North Dumfries Township.

Continued from page 1 – **Spanish Moss**

any time of the year while in northern Georgia, the Carolinas and southeast Virginia, it flowers only in late spring and summer. Its flowers are fragrant, easily overlooked, yellow-green tubes of three petals, free and recurved at their tips, arising singly from leaf axils. It is thought to be pollinated by long-tongued tiger or hawk moths. In South Georgia and Florida its year-round putative pollinator is the black-winged tiger moth.

PHOTOGRAPH BY WALTER J. TEMPLET

Oddly a relative of pineapple (*Ananas comosus*), Spanish moss is surprisingly utilitarian and easily accessible. It's often found growing densely on most trees in coastal, humid regions from southeastern Virginia to southeastern Texas and up the Mississippi to Arkansas. Native Americans, such as the Houma, living in what is now Baton Rouge, Louisiana, used a decoction of Spanish moss as a treatment for chills and fever. They also used bundles of the whole plant to make ropes and mats. The Seminoles used it to scour grease from cooking utensils. If you pull on the dead stems, you'll discover that its fibres are tough and durable – perfect for these jobs. According to botanist Stephen Elliot, colonists used it too: "The moss, when dried, is beaten until the bark falls off and the cartilaginous hair-like flexible stem used for stuffing mattresses and chairs etc."(*A Sketch of the Botany of South Carolina and Georgia*, 1831).

Many animals rely on *Tillandsia usneoides*. Elliot wrote: "Cattle eat this plant in winter with avidity and sometimes trees are felled during a series of severe frosts to place the moss within their reach." Deer will also eat it in winter. One jumping spider lives only on the epiphyte, attaining the appropriate name of *Pelegrina tillandsiae*. Its grey-green body, with tiny, white, scale-like hairs, imitates almost perfectly a close grouping of *T. usneiodes* leaves. The millipede *Polyxenus fasciculatus*, which masquerades as a moth caterpillar, also lives on Spanish moss. The large clusters of moss also provide hiding places for rat snakes and three species of bats.

Spanish moss produces seed, but it's hard to discern the process by which the seeds land on their host tree's bark and adhere to it or become captured in a position suitable for germination and growth. The plant is also spread clonally by birds that use it for nesting material. William Bartram wrote in his *Travels* (1791) that "it also hangs in streamers waving in the wind…to the length of fifteen to twenty feet. Any part of the living plant torn off will presently take root, grow and increase in the same degree of perfection as if it had sprung from seed."

PHOTOGRAPH BY STEPHEN JOHNSON

Spanish moss growing in Stephen Johnson's basement

The fact that most of a cluster of Spanish moss is dead can have serious consequences in dry times. If it's growing on sand pine (*Pinus clausa*), it might grow from the upper branches all the way to the ground. The dead and dry plant material bridging the gap between the tree crown and a grass fire becomes a fire ladder, transforming a low-intensity ground fire into a high-intensity crown fire.

I have grown *Tillandsia usneoides* at home. In 1982, I brought a clump that had fallen from a live oak tree in South Carolina to my home in Richmond, Virginia. I set up a wooden box lined with plastic wrap and illuminated it with a magnificent grow light. My Spanish moss liked the humidity of eastern Virginia and, with occasional water spraying, it actually flowered! Years later, living in Iowa, I tried again. I collected fallen fragments from the walkway at the Des Moines Botanical Center and found plants for sale at a nursery in Iowa City. For 10 years now, I have had Spanish moss growing beneath grow lights; it is mostly dead, or a little bit alive. It has produced new leaves a few times, but thus far never flowered.

***Stephen Johnson** is attracted to atypical patterns in plant growth and keeps plants inside to watch their development.*

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