NEBS Meeting News

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NEBS MEETING NEWS

September 2022

The New England Botanical Society held its 1161st meeting on Saturday, September 23, 2022, in Jeffords Hall at the University of Vermont in Burlington. Grace Glynn introduced the speakers Liz Thompson, Bob Zaino, and Eric Sorenson, who are the authors of *Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont* (The Vermont Fish & Wildlife Department, The Nature Conservancy, and Vermont Land Trust, 2019). Their presentation was titled "Vermont's Natural Communities and a Call to Action."

Liz Thompson is a conservation scientist with Vermont Land Trust and has worked on the classification of natural communities in Vermont since the 1980s. She spoke of Vermont's diversity of bedrock geology types, characterized by a disproportionate amount of calcareous bedrock compared with other New England states. This calcium-rich bedrock supports a wealth of rare natural communities and associated rare plant species. For instance, the Limestone Bluff Cedar-Pine Forest is found only in a narrow band along limestone and dolomite cliff tops along the shore of Lake Champlain. It is characterized by northern white cedar (*Thuja occidentalis*), some of them hundreds of years old, with an understory of calciphilic plants, including many common and rare species, such as ebony sedge (*Carex eburnii*) and ram's head lady's slipper (*Cypripedium arietinum*). Lake Sand Beach communities occur along the shores of Lake Champlain and have largely herbaceous vegetation with rare plants, such as umbrella flatsedge (*Cyperus diandrus*) and Wright's spikerush (*Eleocaris diandrus*). The rare Sand Dune community also occurs along Lake Champlain and supports glacial disjunct species—Atlantic coastal species introduced into the area during a marine invasion forming the Champlain Sea some 9,000 years ago. Champlain beach grass (*Ammophila breviligulata* ssp. *champlainensis*) is a globally rare subspecies of beach grass and an example of a glacial disjunct, *Ammophila breviligulata,* which is mainly a species of Atlantic coastal dunes.

Dry Pine-Oak-Heath Sandplain Forest occurs on deep sand deposits formed as deltas where major rivers emptied into Glacial Lake Vermont or the Champlain Sea. This fire-dependent community occurs in the warmer biophysical regions and is characterized by pitch pine (*Pinus rigida*) and black oak (*Quercus velutina*) with heaths in the understory. Harsh sunflower (*Helianthus strumosus*) is a rare plant of this community.

The Clayplain Forest ecosystem, once extensive on Champlain Valley glacial lake and sea soils, is now represented only by small patches. Williams Woods, a property protected by The Nature Conservancy (TNC), is an excellent example of this rare bottomland forest, with large, shallow-rooted oaks and tip-up mounds.

Another remarkable TNC property is Chickering Bog, a calcareous fen with many interesting species, including showy lady's slipper (*Cypripedium reginae*), grass pink

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(*Calopogon tuberosus*), rose pogonia (*Pogonia ophioglossoides*), and alpine cottongrass (*Eriophorum alpinum*).

Bob Zaino, a community ecologist with the Vermont Fish and Wildlife Department, talked about some natural communities of eastern Vermont. The Northern White Cedar Swamp natural community occupies shallow basins with calcium-rich groundwater seepage. Northern white cedar creates a dense canopy in these swamps, creating low light conditions in the understory. Cedar can reproduce by rooting of down trees and branches (layering). The shaded and moist swamp floor provides abundant habitat for bryophytes, such as the stairstep moss (*Hylocomium splendens*), cedar swamp moss (*Sphagnum warnstorfii*), and others. Northern White Cedar Swamps provide habitat for some extremely rare orchids, such as ram's head lady's slipper and fairy slipper (*Calypso bulbosa*), which has not been seen in Vermont in more than 20 years. Rich Northern Hardwood Forest is relatively common in Vermont, reflecting the abundance of calcium-rich soils. These lush forests are characterized by sugar maple (*Acer saccharum*) and a lush understory with Goldie's wood fern (*Dryopteris goldiana*), giant blue cohosh (*Caulophyllum thalictroides*), large-flowered bellwort (*Uvularia grandiflora*), plantain-leaved sedge (*Carex plantaginea*), and maidenhair fern (*Adiantum pedatum*). In warmer areas in the Champlain Valley, the calcium-rich, shallow soils support Dry Oak-Maple Limestone Forest with diverse spring ephemerals (e.g., bloodroot, sharp-lobed hepatica, large-flowered trillium) and ferns such as bulblet fern (*Cystopteris bulbifera*) and walking fern (*Asplenium rhizophyllum*), which often carpet exposed rock. Boreal Calcareous Cliffs occur on limestone and calcareous schist and typically have small amounts of water flowing through crevices and over the rockface, creating an enriched habitat. Some typical fen species, such as Kalm's lobelia (*Lobelia kalmia*), grass of Parnassus (*Parnassia glauca*), and butterwort (*Pinguicula vulgaris*), are also found on Boreal Calcareous Cliffs. Species characteristic of this habitat include purple mountain saxifrage (*Saxifraga oppositifolia*) and other saxifrages, birds-eye primrose (*Primula mistassinica*), scirpus-like sedge (*Carex scirpoidea*), and fragrant fern (*Dryopteris fragrans*). The rare lance-leaved arnica (*Arnica lanceolata*) was found at Smugglers' Notch about 100 years ago but has not been seen since, though it may yet be present in inaccessible places.

Eric Sorenson is an ecologist, recently retired from Vermont Fish and Wildlife Department. He talked about New England's role in addressing threats to biological diversity as well as recent initiatives. The Wildlands, Woodlands, Farmlands and Communities initiative calls for protecting 80% of New England, with at least 10% wildlands, 60% productively-managed woodlands, 7% farmland, and 3% other preserved land. TNC's Resilient and Connected Landscapes initiative and the associated Land Mapping Tool depict areas that are resilient to climate change, have high biodiversity, and provide landscape connectivity. The Half-Earth Project, founded by E.O. Wilson, uses many features to identify priorities for conserving half of the earth for biodiversity. The Staying Connected Initiative is a regional project that identifies areas to be conserved for landscape connectivity in the Northern Appalachian/Acadian region.

The three speakers—Liz, Eric, and Bob—have worked with many collaborators on Vermont Conservation Design, which provides a practical approach to identifying and conserving the ecologically functional landscape of Vermont. This approach uses easily recognized features (e.g., unfragmented forest blocks, riparian areas) and a set of coarse filters (e.g., physical landscape diversity, natural communities) to identify highest priority areas for stewardship and conservation of their ecological functions. By conserving good examples of all the coarse filter features, the species they support will also be protected. Vermont Conservation Design provides maps that show priorities for conserving the ecological functions of all the coarse filter features. It identifies areas of high value for maintaining biological diversity, ecological functions, and landscape connectivity. Large interior forest blocks, which many species require for survival, are a high priority, as are forest connections and riparian corridors that provide for wildlife movement. Topographically diverse forests provide for climate resilience by allowing movement of plants into new microhabitats. Eric noted that some high-priority features, such as old forests and grasslands, are identified as targets and have numerical goals, but precise locations of where these should be conserved are not yet identified.

The overall objective of Vermont Conservation Design is to maintain an intact, connected, and diverse landscape that conserves biological diversity into the future. Eric noted that working farms and forests, outdoor recreation, and communities seeking to protect their rural character will also benefit by maintaining this ecologically functional landscape. Vermont Conservation Design is a vision for the future of Vermont and will require cooperative efforts by landowners, agencies, and organizations to achieve results. The methods used for Vermont Conservation Design can also be applied to larger geographic areas as a first step toward landscape-scale conservation.

October 2022

Melissa Dow Cullina welcomed all to the 1162nd meeting of the New England Botanical Society via Zoom on Saturday, October 1, 2022, and introduced the speaker, Joanne Glode, who is the Southern New Hampshire Stewardship Ecologist for The Nature Conservancy of New Hampshire. Her presentation was titled “Climate Adaptation Strategies for New Hampshire’s Salt Marsh Habitat.”

The Nature Conservancy (TNC) mission is to conserve the lands and waters on which all life depends. It is currently working in 72 countries to protect biodiversity through land protection, policy, marine science, and community engagement. In New Hampshire, TNC prioritizes protecting resilient and connected lands, comprising more than 300,000 acres of which 30,000 acres are in 31 TNC preserves and 50,000 acres are in conservation easements.

Joanne works with southeast New Hampshire seacoast communities and salt marshes. Salt marshes are unique habitats with high biodiversity that provide habitat for rare species and offer environmental benefits. They filter water, absorb wave energy, stabilize shorelines, provide a high level of carbon storage, and are an important nursery habitat for estuary and off-shore food webs. Climate change is a threat to salt marsh habitats due to rising sea levels. The salt marsh vegetation zones are determined by elevation and flooding. Low marsh floods twice a day with high tide and is dominated by *Spartina alterniflora*, while the high marsh floods only at the moon tide and is characterized by *S. patens*, *Distichlus spicata*, and *Juncus gerardii*. As sea levels rise, the vegetation zones will have to migrate in response. The salt marsh ecosystem naturally builds in elevation by capturing sediment and building peat through accumulation of old roots and leaves, and it increases the rate of elevation gain as sea level rises. An example is the salt marsh of Great Bay, a sediment-rich estuary in the Seacoast region of New Hampshire, which gained in elevation 1.7 mm/yr between 1995 and 1997 and 4.3 mm/yr between 2000 and 2011. Although promising, these gains in marsh elevation have not kept up with sea-level rise; consequently, the salt marsh habitats of New Hampshire are threatened. Current threats to the resilience of these salt marshes include drowning from increased flooding, tidal restrictions blocking the movement of sediment, and barriers that prevent landward migration of marsh vegetation communities.

Joanne described a case study of a 55-acre marsh at TNC's Lubberland Creek Preserve in Newmarket and Durham, New Hampshire. The marsh supports a breeding population of saltmarsh sparrows and seven species of rare plants. Climate change projections and LIDAR data were used to map projected changes in the salt marsh. They determined that with a 6.3-foot rise in sea level, only a narrow fringe of salt marsh would remain at Lubberland Creek, but they also identified the possibility for marsh migration in an area upstream of an existing road crossing. The road crossing was identified as having a perched culvert that formed a barrier to the upstream migration of elvers (baby American eels) and fish and would also prevent expansion of the salt marsh upstream. The road was an evacuation route for the town but flooded in storm events. Beginning in 2015, TNC worked with the town to replace the undersized and perched culvert with a new crossing structure that would provide fish passage at all tides, allow for salt marsh migration, remove the risk of road flooding, allow passage of the area's 100-year flood event, and accommodate the worst-case scenario sea-level rise projections for the life of the structure (75 years). The engineers determined through hydrologic analysis and modeling that the 3-foot culvert needed to be replaced with a 16-foot-wide box culvert and that the road needed to be raised by 3 feet to meet all project goals. The new culvert, installed in 2019, had a constructed streambed and banks for wildlife passage. TNC's monitoring showed that fish (e.g., mummichogs) and elvers are now able to move through the culvert and migrate upstream. Permanent vegetation plots at Lubberland Creek are being monitored to detect changes to the salt marsh as sea levels continue to rise and to detect evidence of marsh migration into the area upstream of the road-stream crossing, which was previously disconnected from the tide. The results will be contributed to the dataset for Great Bay Estuary's long-term vegetation monitoring sites managed by the Great Bay National Estuarine Research Reserve.

The Great Bay National Estuarine Research Reserve has been monitoring the salt marsh at a nearby marsh in the Great Bay Estuary at Sandy Point since 2010 and found that the high marsh is drowning and decreasing in size. As more of the marsh experiences longer periods of flooding, *Spartina alterniflora*, a low marsh indicator, is expanding from the low marsh into the high marsh zones and replacing areas of *S. patens* in the high marsh. Similar results were found at two other Great Bay Estuary sites: Great Bay Farms and Bunker Creek. Bare and dead areas are increasing over time, especially at Bunker Creek.

TNC worked with the New Hampshire Coastal Program and University of New Hampshire Jackson Estuarine Lab to develop a protocol for evaluating tidal crossings based on field and GIS data collection and to prioritize crossings for replacement. The group has evaluated 118 crossings and scored them on six parameters (safety and reliability, flooding, tidal restrictions, tidal aquatic organism passage, salt marsh migration, and community fragmentation) to identify the highest impact opportunities. They identified 23 high-priority culverts where the infrastructure is most at risk and the ecological benefits are greatest. Planning for the next five culvert replacements and a tidal restoration project (Philbrick Pond) is in progress. The culvert assessment report "Resilient Tidal Crossings" (2019) is available at the New Hampshire DES website. There is also a data viewer on the University of New Hampshire (NH Granit Coastal Viewer) that shows the evaluated culverts and associated data.

November 2022

Melissa Dow Cullina convened the 1163rd meeting of the New England Botanical Society on Saturday, November 5, 2022, in the Haller Lecture Hall, Geological Museum, 24 Oxford St., Harvard University, Cambridge, Massachusetts. The guest speaker was Dr. José Eduardo (Dudu) Meireles, Assistant Professor of Plant Evolution and Systematics and Director of MAINE Herbarium, University of Maine, Orono, Maine. Dr. Meireles gave a presentation titled "Plant Diversity Shows Its True Colors" about his research in spectral biology.

To understand biodiversity, one needs to understand evolutionary history and the functional variability of plants. We are seeking new ways to assess the evolutionary and functional diversity of plants on a global scale, across many regions of the world, and through time. Light provides a tool for detecting physical and chemical characteristics of vegetation through reflectance spectroscopy. A spectrometer can detect numerous colors across a wide electromagnetic spectrum from x-ray to microwave. Reflectance spectral data show how leaves reflect light across different wavelengths and can reveal plant traits and physiology. The evolutionary history of plants is written in light.

Dr. Meireles and colleagues are using this technology to map spectral variation on the tree of life and detect phylogenetic lineages based on leaf spectra. They scanned 16,000 leaves in 550 species, and then did phylogenetic reconstruction using DNA. In some taxonomic groups, the phylogenetic lineage allowed predictions about plant characteristics (e.g., cactaceae, succulence). Plants with predictable characteristics based on phylogeny have a high phylogenetic signal. A confusion matrix analysis showed that spectra accurately classify lineages at different phylogenetic scales (e.g., plant orders, families).

Experiments in detecting fine-scale diversity using spectral detection have revealed that spectra may be useful in dealing with species with complex biologies and messy taxonomy. For instance, three species in the *Dryas octopetala* complex in Alaska that are recently diverged are difficult to separate by morphological characters and sometimes hybridize. Two of these, *D. alaskensis* and *D. ajanensi*, grow together and occasionally hybridize. A genetic cluster analysis shows two separate species with some hybrids. Traits in the hybrids are variable and less correlated than traits of the parent species. It was found that spectral data can be used to accurately classify species, hybrids, and even populations in the *D. octopetala* complex.

Dr. Meireles has been looking at leaf spectra using herbarium specimens. Herbaria are the ultimate plant diversity database and can provide a wealth of data. However, scanning herbarium specimens presents challenges. The specimens are mounted on paper and some specimens are very old. Plants age and change color in the herbarium. Dr. Meireles is investigating whether light measurements of leaves on herbarium sheets can be used to identify plants to species. He conducted an experiment in which he collected fresh specimens of 27 species of ferns, conifers, and vascular plants (81 total), identified them, and measured the chemistry. Then he pressed them, leaving some loose, some taped to paper, and some glued to paper, and measured the light. The age and background of the specimens changed the light signature of the leaves compared to the same leaves when fresh. The specimens that were glued to the paper also had different results from those that were loose or taped down. In addition, Dr. Meireles found that thin leaves were more strongly affected by their background than thick leaves. Dr. Meireles used modeling to correct for aging and mounting method, and the resulting graph of the spectral data was fairly close to that of the fresh material. Dried material aged four months could be identified to species with good accuracy, despite color changes. Dr. Meireles notes that standard protocols are needed to deal with the measurement artifacts associated with dried material in order to use spectra from herbarium specimens.

Dr. Mierles concludes that measurements of light will not replace molecular work or botanical field research, but when used they are incredibly powerful tools that will have a role in the challenge of assessing biodiversity. This emerging scientific methodology will rapidly advance our knowledge of phenotypic evolution in plants.

December 2022

The New England Botanical Society held its 1164th meeting on Saturday, December 3, 2022, in the Haller Lecture Hall, Geological Museum, 24 Oxford St., Harvard University, Cambridge, Massachusetts. Vice President Melissa Dow Cullina introduced the speaker, Heather McCargo, Founder and Former Executive Director of Wild Seed Project in North Yarmouth, Maine. Her presentation was titled “Wild Seed Project: Grassroots Seed Propagation of New England Native Plants.”

Heather founded the nonprofit organization Wild Seed Project in 2014 to raise awareness of the beauty and importance of native plants and promote the cultivation of genetically diverse, wild-type native seeds in human-dominated landscapes. Wild Seed Project is working to demystify propagation from native seeds. Heather first learned about seed propagation while volunteering in college with Jack Alexander at the Arnold Arboretum. She was the propagator at Native Plant Trust in the 1990s and continues to develop methods to achieve successful germination and cultivation of a wide range of native species. She shared some of the strategies used to collect and sow native New England plants.

Our native plants have different germination requirements than most domesticated horticultural varieties. There are several slow growing woodland ephemeral wildflower species that can easily be propagated but require timing and patience. Bloodroot, pollinated by bees and fungal gnats, forms a small kayak-shaped capsule that matures in about seven weeks after flowering and then splits open to release tiny brown seeds with eliasomes, which attract ants. The ants find the seeds quickly, carry them off, eat the eliasomes, and bury the seeds. To collect the seeds of bloodroot, trout lily, trillium, and other ant-dispersed plants, one must collect them on the same day the fruits open and before the ants take them away. The seeds of these species are also hydrophilic, having high water content, and so must be sown immediately to avoid desiccation. Once they have germinated, trillium takes seven to eight years to flower and the trout lily takes 12 years. Some plants, such as trout lily and bluets, senesce before the fruits form, making them difficult to find for seed collection.

Violets form fruit capsules in six to eight weeks after pollination that are bent downward (nodding) until they ripen, then turn upward, and open to disperse the seeds. Violets also have cleistogamous flowers that form capsules that burrow under the soil surface like a peanut, then surface and split when ripe. The ant-dispersed seeds must be collected quickly, but then they can be stored dry in a bag or envelope and planted outdoors in the fall. Wild geraniums must also be collected quickly; they turn from green to black and within hours spring off the plant. They can be stored dry in a bag.

Marsh marigold is less challenging to propagate. The fruit forms a star-like cluster that splits open to reveal green seeds that can be sown right away on moist soil in the shade and will germinate within a few weeks. Jack-in-the-pulpit is dioecious, but plants can switch genders from one year to the next. Female plants produce fleshy fruits that ripen to bright red in late summer, and its seeds can be planted immediately or stored dry. Many plants such as the cardinal flower and other lobelias have tiny, dust-like, wind-dispersed seeds that will germinate on damp soil in shady areas after a winter outside (the following spring). These are sown directly on the soil surface with a thin sprinkle of sand and placed in the shade.

Shrub dogwoods, cherries, viburnums, and hawthorns have fleshy fruits with germination inhibitors. The seeds must be removed from the fruits and kept moist. The seed embryos are immature when the fruit ripens and need a month or so to mature (after-ripening). In warmer climates they may sprout the following spring, but in cold climates some species need a double dormancy, germinating the second spring.

Nuts such as hazelnuts, acorns, hickory nuts, walnuts, and butternuts are hydrophilic and need to be kept moist and need cold treatment in order to germinate. Nuts also need to be protected from rodents and insects. If they float in water, they likely have been predated by insects and will not germinate. Nuts can be refrigerated in a plastic bag to keep moist and checked every week beginning in March for germination, and then planted outdoors in a rodent-proof cage.

Tree species with winged fruits, including maple, ash, and elm, must be kept moist and sown right away. They sprout best when sown densely and covered with sand. Some species will germinate right away; others will sprout the following year. Silver and red maple ripen in May or June and often germinate that summer, while striped maple, mountain maple, and sugar maple ripen in September and will not sprout until the following spring.

Many native wildflowers such as wild columbine, blue vervain, iris, and milkweeds are easy to grow from seed but require a period of cold, from a few days to a few months, depending on the species. Asters do not need cold treatment but require a month or two of after-ripening for the embryo to mature before they will sprout.

Wild Seed Project offers seeds for about 90 species that are easy to germinate and provides detailed information in person and online on how to grow native plants. It has recently established a partnership with Cape Elizabeth Land Trust (CELT) to set up a native seed center near Portland, Maine. Wild Seed Project has constructed a native plant growing center on CELT land with a greenhouse for workspace (e.g., seed cleaning, processing) and fenced garden space with plots for growing the seeds. This new facility will allow Wild Seed Project to expand its production of native seed and further its mission. Heather hopes the Wild Seed Project will help to return native plants to the landscape and increase native plant populations by inspiring citizens to plant seed-grown native plants.

—Karen Hirschberg, *Recording Secretary*