NEBC Conference Oral Presentations

Not out of the woods yet: Wild blueberry illustrates that flower removal studies have a ways to go to get mechanical

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Abstract: The consequences of initial variability in reproductive effort on later pollination and fruit development have frequently been investigated with flower removal experiments. Often, plants produce many fewer fruits than flowers, so flower removal might not be expected to alter subsequent growth or development patterns all that much. Yet, many studies have demonstrated such changes even for species with low average fruit set, which begs for an explanation. Many (at least seven, by our count) such explanations have been reported in the literature, but experimental support for most is limited. In summer 2014, we conducted a field experiment on a lowbush blueberry (Vaccinium angustifolium) farm in Maine. In this experiment, we coupled flower removal with three other treatments, each designed to assess the validity of one of three often-cited hypotheses invoked to explain why growth and development changes occur following flower removal: 1) "Short-term nutrient shortages;" 2) "spatiotemporal limitations;" and 3) "the compound interest effect." The three respective treatments—foliar nitrogen fertilization, positionally biased flower removal, and defoliation—were designed to either intensify or weaken the apparent effects of flower removal if the corresponding hypothesis had merit. As in a 2013 preliminary experiment, flower removal elicited several statistically significant growth and development changes in blueberry, including increases in final leaf area, ripe fruit weight, fruit ripening rate, and relative fruit production. The additional treatments also elicited several significant plant responses, though not always with concomitant flower removal effects as well. For example, fertilization generally increased fruit cluster mass by harvest, but flower removal itself had no such effect on cluster mass. Most observed interactive effects between flower removal and the additional treatments either ran counter to expectations, were limited in scope, or couldn't unambiguously interpreted. For at least a few observed changes, none of the additional treatments significantly altered the effects of flower removal. We conclude that current hypotheses for the mechanistic basis for changes induced by flower removal are inadequate, at least for blueberry, a species with frequently low fruit set even when managed commercially. However, strong intellectual and economic imperatives exist to encourage further investigation into this open question.

Horticultural escape and naturalization of *Magnolia tripetala* (L.) L. north of its native range will give tree species a 'head start' on climate change

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Abstract: Plants grown in horticulture or occurring as adventives outside their native range can provide insight into species' fundamental niche requirements that might not be evident from the native range, or realized niche, alone. Such occurrences can also identify conditions that support individual survival, but do not currently sustain positive population growth (i.e., a species' 'tolerance niche'). Further, in the context of rapid climate change, horticultural and adventive occurrences beyond current range edges might circumvent natural dispersal limitations and facilitate species range shifts.

To explore these concepts in the field, we investigated the history and structure of five newly discovered populations of naturalized *Magnolia tripetala* near horticultural sites in western Massachusetts, USA. This tree species is native to the southeastern U.S., but has been grown horticulturally in the Northeast since the 1800s. However, naturalized populations had not been well documented in the region previously, raising the possibility that the species' escape has been triggered by recent climate change. With tree coring and life stage surveys, we asked whether the naturalized populations exhibited synchronous patterns of establishment and expansion, suggestive of climatic release and a shift from tolerance niche to fundamental niche conditions in the region. Across the five sites, we documented 660 individuals, with populations ranging in size from 46 to 396 individuals, including seedlings, saplings, and reproductive trees. Although horticultural specimens of *M. tripetala* have been present near the sites for many decades, the adventive populations showed clear evidence of recent, synchronized escape and naturalization. Dated tree cores from the 10 largest adventive *M. tripetala* at each site showed the average age of establishment was 22.8 years (~1991), with the individual population means falling in a narrow range from 20.6 to 25.3 years (~1989-1993). Three older trees (35-45 years) in 3 of the 5 populations suggested rare establishment of individuals prior to 1980s, but most individuals (88-96%) were seedlings and smaller saplings that have established since the 1990s. Recent escape from old horticultural plantings is allowing *M. tripetala* to rapidly colonize newly-suitable habitat in the Northeast U.S., ~300 km beyond its native range. Recent climate change appears to have released the reproductive potential of horticultural trees that had existed under 'tolerance niche' conditions for many decades, resulting in vigorous new naturalized populations. It is unlikely that natural dispersal from the south would have allowed *M. tripetala* to reach this region anytime soon.

Patterns and changes in the flora of Franklin County, Massachusetts

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Abstract: We initiated a systematic examination of the flora of Franklin County, Massachusetts, in 2010. This geologically and topographically diverse county is home to many rare species, yet no floristic treatment has ever been published. Knowledge of the historical flora came from examination of all Franklin County specimens in herbaria at several institutions, especially the University of Massachusetts and Harvard University, along with several sources in the published and unpublished literature. Thus far, we have compiled 17,400 herbarium records and 8,300 literature records. Knowledge of the current flora comes from 500 field visits occupying a total of 1,500 hours, broadly distributed over seasons and habitats, and including an average of 19 visits to each of the county's 26 towns. The 33,500 field records include an average of 680 species per town, with several of the towns in the Connecticut River Valley having the greatest species richness. Three regions (the Connecticut River Valley and the uplands to the east and west) show distinct floristic profiles. Towns in the western uplands are more likely to contain taxa of rich mesic forest, such as *Asarum canadense*, *Dicentra cucullaria*, and *Carex plantaginea*. Connecticut River Valley towns are more likely to support floodplain species (e.g., *Acer saccharinum*, *Quercus bicolor*), species with southern affinities (e.g., *Quercus palustris*, *Benthamidia florida*) and certain nonnative taxa. The eastern uplands are more likely to support several species of peatlands and ponds, reflecting the greater frequency of such habitats east of the Connecticut River Valley. Although the greater sampling intensity of our recent surveys has resulted in greater recent than historical species lists for most towns, certain taxa show fewer town records today than in the past, especially members of the Orchidaceae and Ophioglossaceae. The percentage of non-native species ranges from 20-27% in different towns and, in part, reflects patterns of recent land use. Mean flowering times of spring-flowering

species have advanced by an average of about a week between the historical (pre-1980) and recent periods, with greater increases among species flowering earlier. In species that have been adequately sampled, the magnitude of the flowering advance in different species is correlated with the amount of advance found in a recent study in neighboring Worcester County.

Examination of pollen profiles and frequency distribution of diatom species, found in 8500 years of peat at Poutwater Pond, Holden, Massachusetts

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Abstract: Poutwater Pond is a "National Natural Landmark." We have listed plants and animals found there and we have collected a core from the peat bog. This core has been radiocarbon dated and pollen, diatoms, other microfossils, and some bacteria have been isolated from the core. The frequency of pollen grains at different depths of the bog (i.e., different ages) tells what trees grew nearby during the past 8,500 years. Differences in diatom species present at different depths may indicate changes in acidity. Microfossils were examined in detail with a scanning electron microscope. Pollen and diatom frequency diagrams have been constructed to show the distribution of common taxa since the last retreat of the ice age. These data were used to deduce fluctuations in climatic conditions that may have occurred at this site during the Holocene, as well as to infer changes in pH.

State of the Plants: Challenges and Opportunities for Conservation of the New England Flora

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Abstract: New England Wild Flower Society recently released a comprehensive, peer-reviewed report that, for the first time, gathers together the most up-to-date data on the status of plants on the New England landscape. From these data, we can discern increases and declines in both rare and common species across all six states. We identify hotspots of rare plant diversity, and discuss factors that foster this diversity. We document the primary ecological and anthropogenic threats to both rare and common species. We discuss activities and initiatives by New England Wild Flower Society and its partner organizations in the New England Plant Conservation Program to conserve and manage rare plants and habitats throughout the region. We articulate a research agenda to bridge gaps in our knowledge of plant species and ecological communities and develop a framework for protecting the viability of thousands of species that together comprise our diverse and vibrant flora.

Local adaptation to environment is observed from genome-wide SNP data in *Populus balsamifera* (L.)

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Abstract: Populus balsamifera has a large geographic range, and local populations occupy distinct locations along strong environmental gradients of climate and photoperiod. Range-edge populations, particularly southern populations, may contain high levels of standing genetic diversity and harbor unique alleles adapted to longer, warmer, and drier growing seasons—environments that may become more

widespread in the future. At the same time, southern populations are likely to be at greater risk of extirpation from climate change. In this study, we characterize the population structure and diversity of southern range-edge versus range-core populations, and identify genomic regions associated with local adaptation. We analyzed 534 individuals collected from 63 core and range-edge populations, and obtained genome-wide SNP data from >150K loci using genotype-by-sequencing at 48-plex. Population structure was estimated using Bayesian clustering (fastSTRUCTURE) and discriminant analysis of principal components (DAPC). Tests for local adaptation manifest as F_{ST} outliers and SNP-environmental associations were estimated with Bayescan, BAYENV, and LFMM. We find genomic regions suggesting novel, locally adapted loci in range-edge populations that likely contribute to their fitness in warmer, drier environments. Loci adapted to longer growing seasons and warm, dry environments may be useful for integrating into poplar breeding programs under future climates.

Adaptation, performance and host-resistance: *Tsuga* spp. research in the Northeast

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Abstract: Exotic insect pests of importance, including Hemlock Woolly Adelgid and Elongate Hemlock Scale, have taken their toll on *Tsuga canadensis* populations, causing widespread decline and mortality of the species throughout southern New England and the mid-Atlantic. In addition to its value as a forest tree, *T. canadensis* is also treasured as a landscape planting—both as a hedge and a specimen tree. For more than 10 years, local researchers have been exploring host resistance to invasive insects using *Tsuga* specimens from other parts of North America and around the world; this research has also included the study of human perceptions and attitudes regarding the acceptance of non-native *Tsuga* in the landscape.

Potential effects of Eastern Hemlock decline on the hemlock-associated liverwort, *Bazzania trilobata*

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Abstract: Bazzania trilobata is a leafy liverwort species that often occurs in association with *Tsuga canadensis* (Eastern hemlock) in New England. The impending loss of hemlock due to the invasive insects *Adelges tsugae* (Hemlock Woolly Adelgid) and *Fiorinia externa* (Elongate Hemlock Scale) raises concerns about the future of this ecosystem and species that might be dependent on its unique conditions, such as *B. trilobata*. Ecological changes already observed in this system include the replacement of evergreen Hemlock with deciduous *Betula lenta* (Black birch) canopies, shifts that are known to increase light exposure and raise temperatures, possibly putting light- and moisture-sensitive understory species at risk of decline. Similar environmental impacts might also be occurring in this system through the forest management technique of salvage logging hemlocks prior to their death due to exotic insects. To test the likely response of *B. trilobata* to these environmental changes, and the species' reliance on hemlock forests, we initiated a multi-year transplant experiment testing survival and growth across a range of physiographic settings and under forest canopies of varying hemlock vs. deciduous tree species composition at Smith College's MacLeish Field Station in western Massachusetts. By exposing *B. trilobata* to a range of novel conditions relative to its natural habitat, we can begin to consider the importance of hemlock to this liverwort. We also executed a second transplant into a recently logged site to consider the potential impacts of salvage logging. Results from the initial transplant suggest that *B. trilobata* can generally survive in areas with modest hemlock canopy decline and mesic forest floor conditions, but declines at both the drier and wetter ends of the soil moisture gradient examined. More

strikingly, solar radiation levels, as determined by local slope and aspect, emerged as a significant predictor of plant decline, raising the possibility that hemlock canopy thinning and death might eventually expose *B. trilobata* to unsuitable, higher light conditions on sites other than north-facing slopes. Nevertheless, preliminary findings from the salvage logging experiment suggest that the vigorous growth of early successional herbs and shrubs might protect *B. trilobata* from excess light and bleaching.

Transatlantic connections: Marsh floras and vegetation along the gradient from freshwater to ocean salinities along the Elbe (northern Europe) and Connecticut (northeastern North America) Rivers

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Abstract: Relationships between the flora and vegetation of northern Europe and the northeastern United States have been long noted but little studied. Here, quantitative sampling of high, low, and mid-marsh zones was carried out in 20 marshes along a gradient from non-tidal freshwater, via tidal freshwater and brackish to salt marshes in each of two large river systems, the Elbe in Europe (Germany) and the Connecticut in North America (southern New England, USA). Overall, species richness was higher in the Connecticut marshes, where the number of species was more than 22% higher than along the Elbe. Species richness declined in both streams along the gradient from non-tidal freshwater to tidal freshwater, brackish and then salt marshes. Only European salt marshes had a slightly higher species richness than their Connecticut equivalents. Twenty-four species occurred in both stream systems, nearly 10% of the total marsh flora. Shared species were found in all four marsh types and occasionally in more than one marsh type. Introduced taxa are not prominent in either river system except for *Spartina anglica* in the salt marshes and *Acorus calamus* in the non-tidal freshwater marshes of the Elbe and *Typha angustifolia* and *Phragmites australis* in the brackish marshes along the Connecticut. Overall, Asteraceae and Poaceae were the largest (most species rich) families in the marshes of both streams. The vegetation of each marsh type in each stream system is briefly described and possible reasons for differences in species richness, non-native species occurrences and the origin of marsh floras are discussed.

Pigeon peas and Pawpaw: Frederick Pursh's plants of Onondaga

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Abstract: For this project, I drew from Frederick Pursh's northern journal of 1807 to create a list of plants observed by the botanist during his four-month stay in the Onondaga Lake area, central New York State. This research is part of a larger initiative to inform the recovery of Onondaga Lake, a major Superfund site, and surrounding lands. Pursh's notes provide insight about plant communities around the lake and the physical setting supporting those plants before the ravages of major industrialization. The objectives of this project are: to list plants Pursh found in the Onondaga and Oswego area; to assign each plant a confidence index indicating likelihood that I have listed the same species Pursh actually saw; to use the plant list thus compiled to make inferences about early Onondaga Lake habitats; and to extract from the Journal data regarding the physical and biocultural setting in the Onondaga Lake area during this time. I listed plant names in a spreadsheet, updating nomenclature based on the International Plant Names Index and The Plant List. To reflect the uncertainty inherent in field identification, I assigned each species a

confidence rank (from 1–5) based on nomenclature recognition, voucher presence, habitat aptness, and other criteria. The final list of about 280 species includes rare plants, weeds, wetland and aquatic plants, timber, medicines, and more. The plants recorded tell us not only about the land, but also reflect changes in land stewardship (from indigenous to Euro-American) in central New York following the American Revolution.

Shifting conservation focus from species occurrence to habitat forming process: The importance of lateral channel migration to persistence of floodplain forest plant populations

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Abstract: Much of the regulations and activities for the conservation of rare or threatened species or communities have traditionally focused on the protection of known occurrences. This approach has led to positive conservation outcomes as far as past occurrence is a reliable indicator of habitat suitability into the future, which is often the case. A notable exception to the long-term success of this paradigm is when species rely on ephemeral habitats. We argue that in such cases, conservation focus should shift toward conserving the processes that create the ephemeral habitats. We will illustrate the need for a process-focused approach to conservation with research from the Connecticut River on floodplain forests, a community type that is ranked as imperiled by many state natural heritage programs in the region. In particular, we show how floodplain forest succession is initiated by lateral channel migration and associated formation of bars and oxbows. Subsequent sediment deposition and erosion creates topographically heterogeneous floodplains with diverse successional habitats, where differences in flood regime act as an ecological filter on species composition. We will draw on results from recent research at over 100 floodplain forest research sites located throughout the Connecticut River basin to support our case. This research includes analyses of historical aerial photos, hydraulic models, dendrochronology, vegetation transects, and other field research.

The impact of invasive Honeysuckle removal on Black-legged Tick density in an exurban residential setting

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Abstract: Ixodes scapularis (Black-legged Tick) is the vector for *Borrelia burgdorferi*, the bacteria that causes Lyme Disease. Elucidating the ecological dynamics of the Black-legged Tick will clarify geographical patterns in Lyme Disease and aid in its management and control. Black-legged Ticks have expanded their range in recent decades, bringing *B. burgdorferi* with them. Our study examined the relationship between *Lonicera tatarica* (Tatarian Honeysuckle) and the Black-legged Tick. Tatarian Honeysuckle is a non-native shrub that invades open forests and fields and crowds out native species. Our study adds to a growing body of research regarding the relationship between ticks and invasive shrubs. We surveyed ticks in two plots, a treatment plot in which Tatarian Honeysuckle was removed and a paired control plot. The density of Black-legged Tick larvae was significantly lower in treatment vs. control plots. Adult and nymphal densities were similar in both plots. Factors that may explain the large reduction of larvae numbers, but not adult numbers, are microclimate, animal transport, and the timeline of the study. The long-term effectiveness of the treatment will depend on whether adult ticks re-establish larval densities in future years, or whether fewer larvae leads to fewer adults. Our results have implications for the extent and duration of invasive species control that might be required by homeowners wishing to limit exposure to tick-borne pathogens.

Combining incidence and demographic modeling approaches to evaluate metapopulation parameters for Furbish's lousewort (*Pedicularus furbishiae*)

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Abstract: Furbish's lousewort (*Pedicularis furbishiae*) is a rare plant endemic to the St. John River that has been continuously monitored since 1976. Metapopulation dynamics are thought to be important for the persistence of *P. furbishiae*; however, estimating key parameters such as colonization rates presents a substantial obstacle to modeling metapopulations in any species. We develop a model that combines incidence-based and demographic-based approaches to build a relationship between observed patch occupancy, habitat turnover rates, and colonization rates. Applying this model to *P. furbishiae*, we predict that observed habitat patches averaging 550m in length receive colonizing seedlings with a yearly probability of 0.4 (95%CI = 0.2 – 0.6). Although the predicted colonization rate rests on several simplifying assumptions, the overall model allows us to understand the impact that increasing rates of habitat turnover would have on the future survival of this species.

The historic flora of Franklin County MA, 1811-1990: Major collectors and collection patterns

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Abstract: To develop a historical flora of Franklin County, Massachusetts, we searched herbaria at the University of Massachusetts (MASS), Harvard University (HUH), Smith College, Michigan State University (MSC), and the Henry M. Flynt Library of Historic Deerfield. We found at least 14,893 specimens collected between 1811 and 1990 by 512 individuals or collecting teams, with 25 individuals or teams collecting at least 150 specimens. The collection effort started early, with a third of the 26 towns in the county represented by 1830. Major peaks of collection activity occurred from 1900 to 1939, and from 1950 to 1989. There were two smaller peaks between 1817 and 1821 and in the 1870s. The earliest collectors were physicians. Dr. Dennis Cooley and Dr. Stephen West Williams of Deerfield account for the peak in collection prior to 1820, with 515 specimens. Other early physician collectors include Dr. George Peirce from New Salem, whose 271-specimen herbarium was collected between 1839 and 1850. It was obtained by C. A. Weatherby, remounted and deposited in the New England Botanical Club (NEBC) Herbarium. In the 1870s, the largest collectors were H. G. Jesup (325 specimens), subsequently Professor of Natural History at Dartmouth, and Elizabeth H. Perry (137 specimens), a teacher in Conway who received botanical training at Mount Holyoke College. Other collectors in this period were at Amherst College or the Massachusetts Agricultural College. About 53% of all Franklin County historic specimens were collected between 1900 and 1939. From 1900 to 1909, major collectors included W. D. Forbes of Buckland, students or faculty at the Massachusetts Agricultural College, and members of NEBC, most notably F. F. Forbes, R. A. Ware, and E. F. Williams. Between 1910 and the early 1920s, the field days of the NEBC organized by M. L. Fernald, C. H. Knowlton, and F. G. Floyd made impressive contributions to the historical flora. Participants on these trips in May of 1912, 1913, 1915, and 1921 were organized into teams and sent out to collect everything identifiable. From the late 1920s and into the 1930s, most of the collecting efforts were headed by A. S. Pease and A. S. Goodale of Amherst College. The latter was working on a flora of the Connecticut River watershed and also collected from areas to be flooded by the Quabbin Reservoir. In addition, W. E. Manning, then at Smith College,

contributed 257 specimens. Collecting increased again after WWII (1950-1989) due largely to the faculty and students of the University of Massachusetts (particularly H. E. Ahles), Smith College, and Bruce Sorrie of the Massachusetts Natural Heritage and Endangered Species Program. However, the largest single collection of this, or any period, was by Roberta G. Poland, physics instructor at Deerfield Academy. Between 1945 and her death in 1989, Poland collected 3,069 specimens, mostly from Deerfield. These collectors—amateurs, professionals, and students—shared a passion for collecting and for placing their specimens in herbaria. They created a rich historical record that now may be used for research.

Changes in the vascular plant diversity of the Monomoy Islands, Massachusetts

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Abstract: The objective of the present study was to determine changes in species diversity at Monomoy National Wildlife Refuge, Massachusetts, and to compile an inventory of the island's vascular flora. Collecting trips were made to the two islands during the growing seasons of 2010 to 2012 for the purpose of collecting and preparing voucher specimens. The vascular flora of the Monomoy Islands comprises 73 families, 199 genera, and 284 species, of which 225 species (79%) are native and 59 species (21%) are non-native.
Flowering plants (Division Magnoliophyta) comprise the majority of the flora and account for 65 families, 172 genera, and 271 species (dicots: 50 families, 142 genera, and 178 species; monocots: 15 families, 30 genera, and 93 species). There are five conifer (Division Pinophyta) species in two genera and two families, and six fern (Division Polypodiophyta) species in five families and six genera. Club-mosses (Division Lycopodiophyta) are represented by *Lycopodiella appressa* and horsetails by *Equisetum arvense*. The largest families are Asteraceae (27 genera, 40 species), Cyperaceae (8 genera, 32 species.), and Poaceae (19 genera, 31 species). The largest genera are *Carex* (13 species), *Juncus* (11 species), and *Eleocharis* (6 species). The islands' active geological history and human habitation in the 19th and 20th centuries have had an impact on the flora here.

Herbarium treasure hunt: Botanical consortium portals as teaching tools for undergraduate research

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Abstract: The increasing availability of herbarium specimen data and images on-line through botanical consortium portals (e.g., Consortium of Northeastern Herbaria, Macroalgal Herbarium Consortium, Consortium of Bryophyte Herbaria) has obvious applications for research in systematics, floristics, and ecology. The ability to rapidly search collections from one or more herbaria allows for broader and quicker access to specimen data, and the ability to define search parameters by factors such as geography, habitat, and time period provides a powerful tool for addressing questions about floristic diversity and biogeography in light of climate change and human impacts. By introducing students to these herbarium consortium portals new interest is generated in herbaria, and in the traditional lab exercise of the herbarium treasure hunt—searching the collections for specimens in order to answer questions about plant morphology, habitat, distribution, and phenology. Once students understand the kinds of information available from specimens, and the capabilities of the portals, they will be able to participate in more

extensive class projects that utilize and possibly add to existing portals. Examples include: compiling a flora of College Woods, a 250 acre University of New Hampshire property used for research, instruction, and recreation; tracking changes in the macroalgal flora along Maine's indented coastline; assessing the threat of invasive species in select habitats; refining georeference coordinates for plant specimens from targeted sites. Ultimately, the students may incorporate these resources in research of their own design.

Digitization of the New York Botanical Garden Herbarium

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Abstract: The William and Lynda Steere Herbarium of the New York Botanical Garden contains about 7.5 million specimens. We began to database specimens in the late 1980's, with the result that today we have information and/or images available through our Virtual Herbarium website for approximately 2.5 million specimens. Due to the availability of funding through the National Science Foundation's Advancing Digitization of Biodiversity Collections program, we are now digitizing specimens at the rate of about 30,000 per month. Sensing that we have nearly maximized the rates we can achieve using manual methods, we are currently considering adopting an industrial approach that will allow us to complete the digitization of the rest of the herbarium within a reasonable timeline. Freed from the need to focus solely on the digitization process, we could begin to think about the wide range of uses to which these data could be deployed for biodiversity studies and conservation. Outreach to potential stakeholders for these data is not just a New York Botanical Garden issue, but is one that the nationwide digitization effort is grappling with as well, and we are hoping that synergy from this effort will help all collections to find the users who most need their data.

***Herpomyces chaetophilus*, a New Record of Laboulbeniales for North America**

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Abstract: The Laboulbeniales are an order of microscopic fungi (phylum Ascomycota, class Laboulbeniomycetes) that obligately parasitize arthropod hosts. They are ectoparasites; they occur externally, on the cuticle of the host. Study of Laboulbeniales can give insight into the life history of their arthropod hosts and the community dynamics of host-parasite interactions. Since insects disperse with their parasites, there is potential for infection of local hosts by infected introduced insect species. *Herpomyces chaetophilus*, found on the American cockroach (*Periplaneta americana*), is a new record of Laboulbeniales for North America. Cockroaches were collected around the Harvard University campus through sticky traps and hand collections. Parasite prevalence was greater than 95%. Sometimes a double infection was reported, with both *H. chaetophilus* and *H. periplanetae* on the same host specimen. Molecular analysis of the rDNA region confirms that these are two separate species. The behavior of *P. americana* may be a key factor to the high infection prevalence with *Herpomyces* spp. The American cockroach prefers moist, dark, and enclosed locations especially during aggregation. Since cockroaches are living together in large numbers, two conditions are fulfilled for continuous infections with Laboulbeniales fungi: (1) Laboulbeniales tend to thrive in moist to damp places and (2) heaviest infections are usually found in densely-populated, older colonies.

The highly invasive grass *Brachypodium sylvaticum* - a candidate for early detection/rapid response in eastern North America?

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Abstract: Brachypodium sylvaticum is a grass native to Eurasia that is known to be highly invasive in parts of North America (NA). Land managers in the Pacific Northwest where it has been established since the 1960s, are actively researching and controlling this species. In eastern North America, it is less well known and has yet to become a high priority for invasive control programs. This is the case even though it is naturalized in New York (since ~1998), Michigan (since 1984), Ontario (since 2011), and Virginia (since 1992). At one known high quality botanical area in western New York it is has become widespread and dominant. At that site it appears to be degrading the habitat and may be causing a decline in the rare plants that occur there. The main purpose of this presentation is to raise awareness and knowledge about this species in eastern NA, and to encourage invasive plant managers to implement an "early detection and rapid response" protocol. We discuss the history of the species in eastern North America, including details regarding the known populations in New York. We suspect that it may be more widespread than is known. We researched the climate and habitat preferences of *B. sylvaticum* in its native range and it appears that much of eastern North America may be suitable for it. In eastern NA, *Brachypodium sylvaticum* has demonstrated great ecological amplitude, growing in deep shade to full sun, in wet to mesic soils, in successional to mature forests, and even in old fields. We provide evidence that this species has been in cultivation from as early as 1933 (1949 in NA) although primarily in botanical gardens. In 2011, at least one eastern NA company offered seeds for sale. We present information on identification of the species and note earlier misidentifications, which have included *Elymus* and *Festuca*. In gross appearance, it superficially resembles a species of *Bromus*. Distinguishing characteristics include its generally pendulous spike-like inflorescence which has 3-12 very short-stalked (≤2 mm long) spikelets each with ≥5 florets; lemma awns 7-15 mm long; pubescent culm nodes; and leaf blades mostly 5-12 mm wide.

Plants of Maine's lakes and rivers

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Maine's Lake and Stream Plants Text
Maine Lake and River Species List

Abstract: Maine has over 6,000 lakes and ponds, and hundreds of miles of rivers and streams. There are 137 species in 50 genera in 31 families of submerged, floating, and open-water emergent, vascular plants (not including ferns and mosses) that have been found in them. Rooted below water surface, at the edge, fringe, 78 species in 47 genera in 27 families, have been found. Three trees and shrubs, 11 ferns, 21 mosses, 3 non-vascular genera, and 29 plants that might be seen in the waters, add to the listing. Five plants are tagged as invasive, and 14 are rare. Based on the surveys of more than 200 entire lakes over 20 years by dozens of state and federal government botanists, professional consultants, and volunteers, species lists average a little over 20 (alpha diversity) per lake (maximum nearly 100) and are influenced by the size of the lake (or perimeter). There is little influence due to elevation (not statistically significant), and no statistically significant correlation with ecoregion, climate, water chemistry, or latitude. However, the local prevalence of several species is influenced by elevation and latitude (presumably climate) and water chemistry, especially alkalinity (and closely related conductivity and pH). We propose a hierarchical botanical classification system of the lake plants, starting at the whole lake

(northern and southern types, with northern types further divided into calcareous and mountain), each lake type having specific indicator species. Drilling down the hierarchy, coves (in large lakes, bays then coves within them) and "sectors" or "sections" between coves usually hundreds of meters long in the littoral zone, classified by the name of the dominant plant(s) within the respective cove (as may be observed by a quick pass-by in a canoe or kayak); down to communities (assemblages) usually no more than a few hundred meters' extent of a contiguous collection of plants; down to individual "patch", "stand", or "colony", mostly a monoculture of one or at most a few species. Communities usually have several stands within them immediately adjacent to each other, with a nearly sterile strip separating communities. The Maine Natural Areas Program classification has six lake communities, and we propose expanding that to include a "deep littoral" or "deep-water bed" community of water depth usually two meters and more, absent of floating and emergent plants, dominated by *Potamogeton robbinsii*, *Nitella* spp., *Chara* spp., and *Elodea* spp. Data analysis methods include logistic regression, ordination (canonical correspondence analysis, detrended correspondence analysis, non-metric multidimensional scaling), cluster analysis using dendrograms, and "heat maps." We propose a new metric for aquatic plant density, species richness divided by lake size, a simplified SPAR (species-area relationship). We have noticed that lakes with a denser littoral zone have more species, but this proposal needs to be validated. Obstacles to the study of botany on Maine's lakes and rivers include missed species, light shimmer on the water surface interfering with the ability to see the plants, need for more professionals to survey more entire lakes, need for more well-trained volunteers, and more plant records in herbaria.

Bud set in temperate woody species: Variation in dormant bud size across species and range, with implications for springtime phenology

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Abstract: Investing in developing a bud before the winter cold may provide competitive or other fitness benefits to temperate woody species during spring leaf-out. However, increased investment in bud development also constitutes increased risk of resource loss to cold damage. Despite this interesting potential trade-off, there is relatively little known about the contents of dormant buds, especially in regard to the inter- and intra- specific variation in bud resource investment. This study presents multiple metrics to assess the resources that woody species invest in their buds via size, mass and developmental phase of leaves and flowers. We then examine the variation in this investment across 27 species (from genera including *Acer*, *Betula*, *Corylus*, *Fagus*, *Ilex*, *Populus*, *Prunus*, *Quercus*, and *Viburnum*, among others) and range (sampling from Harvard Forest, MA, USA and Saint Hippolyte, QC, Canada). Finally, using phenological data from growth chamber clipping experiments, we compare bud investment with relative time of bud burst to evaluate whether the level of investment is related to springtime phenology. Our results suggest there is dramatic variation across species in their investment in overwintering buds, which may influence how species balance risk and reward in cold climates.