

Minutes of the 2016 annual meeting of the Consortium of Northeastern Herbaria

The 2016 annual meeting of the Consortium of Northeastern Herbaria was held June 29-30 in Providence, R.I., hosted by Erika Edwards and Timothy Whitfield, director and collections manager, respectively, of the Brown University Herbarium. Following welcoming remarks by Edwards and Whitfield, CNH President Patrick Sweeney kicked off the meeting by providing a brief introduction to the consortium's history and recent activity. He said the consortium represents an area with 138 herbaria with 24 million specimens; of the total, 67 herbaria are consortium members, representing nine U.S. states and four eastern Canadian provinces. Sweeney said one of the consortium's missions is to provide online access to specimen data in the region's herbaria, and 1.1 million records are now being shared through the CNH portal.

Patrick Rashleigh, data visualization coordinator at Brown, gave the first talk of the morning, a demonstration of a recently installed high-tech way to display large numbers of herbarium specimens or very large images of specimens to a roomful of people. On a wall-size array of 12 large monitors, Rashleigh first projected images of more than 20,000 herbarium specimens, arranged by family. He demonstrated that the 16-foot by 7-foot display can be changed quickly by searching the specimens database to filter them by species, collection date, collector identity, location or some combination of these values. Using specimens of two *Viburnum* species, he showed how useful it can be to display specimens of closely related species side by side in order to compare their traits. He invited consortium members to walk up to the "display wall" so they could see the detail in each of the images. He explained that the images are displayed on the monitors by the computer system and are not projected, so the images retain excellent detail, and indeed details of the plants' morphology were apparent that might not be visible without the use of a hand lens or dissecting microscope. Rashleigh said Brown expects to use the display wall to illustrate talks about the herbarium for the general public, and it has been suggested that it would be useful for large groups of botanists working collaboratively on research on a particular set of specimens. He said the university is looking for additional ideas on how the display wall might be used.

Sweeney provided an update on an NSF grant to database specimens in a number of smaller collections in New England. The goal of the project is to digitize specimens in 18 herbaria to support research on the consequences of climate change in the past 200 years. So far, Sweeney said, data and images of more than 700,000 specimens have been made available. In the final year of the grant, the work will focus on enhancing the data already in the database, in particular by entering information on the phenology of the plants – whether the specimens have flower buds, open flowers, are in fruit or are in some other phenological condition.

Charlie Willis, a post-doc at Harvard, talked about Curio, a crowdsourcing tool for specimen data and phenological research. He said Harvard has imaged 340,000 specimens so far, and data on those specimens are useful in studying range shifts, herbivory, the history of invasives in the region, and changes in plants' phenology over

time. Willis said he has been involved in a recent study to assess the accuracy of specimen data on flowering time compared with actual written records of when plants flowered in the past. The study found that specimens often were collected about two weeks after plants began to flower but that written records and herbarium specimens show the same trend to earlier flowering over the past 100 years. He said similar studies have been done with larger numbers of specimens in the past, but the value of this study is that phenology is being classified into more narrow categories, so the results of the study will be qualitatively superior. Willis said crowd-sourcing is one way to increase the number of specimens available for such studies, and he discussed a recent study in which specimens' phenology was scored by both botanical experts and novice citizen scientists working online. One goal was to determine if novices who were inconsistent or inaccurate could be identified so their work could be eliminated in order to improve the precision of the overall scoring. In general, he said, there was strong agreement between the citizens scientists and the experts in terms of the phenological condition of specimens.

Nicole Tarnowsky and Amy Weiss of the New York Botanical Garden spoke about the work they are doing to move "legacy collections" out of storage and into the general collection. Individual botanists have collected large numbers of specimens that have never been identified. For example, Bassett Maguire, who studied Clusiaceae, collected almost 40,000 specimens from 1944 to 1966, primarily on the Guiana Shield in South America; of the total, about 1,650 remain unidentified. About half of the approximately 30,000 specimens now in storage were collected by researchers who are still active, and these tend to come and go quickly as they are sent out to experts to be identified. On the other hand, some specimens remain in storage for decades if they are in large or difficult groups for which expertise doesn't yet exist. Collectors often collect duplicates of their specimens, and the botanical garden does not distribute them until they have been identified to species. They also keep track of where duplicates are sent so those herbaria can be informed of any future changes.

Thomas Serre, a professor in the Department of Cognitive, Linguistic & Psychological Sciences at Brown, spoke about the use of machine learning and the development of new algorithms to recognize plant species based on leaf traits. Serre said they start with large numbers of images and select various traits to be measured so variation in the traits can be assessed and patterns can be identified. These patterns then are linked with particular plant families or orders. Serre said one recent project began with 7,600 images of cleared leaves, in which the petioles and most of the tissue had been removed, leaving only the leaf margin and the veins. Half of the images were used to develop pattern recognition algorithms, and the remaining specimens were used to test the ability of the algorithms to correctly identify the plant family of the specimens. They achieved a 72% accuracy in the initial testing, he said. It appeared that the leaf venation patterns were much more useful in identifying the families than was the general shape of the leaves.

Megan King and Rebekah Bucynski from Rutgers gave the final presentation of the morning, talking about their work with undergraduates in the Chrysler Herbarium. Students have been involved in many activities, including collecting and mounting specimens, repairing and identifying specimens, producing a flora of the campus and, most ambitiously, working on reorganizing the herbarium, replacing the Cronquist classification with the APG3 taxonomy. They said 15 students were involved in herbarium work just in the past semester. More than half of the plant families have been reorganized so far, and a number of students have agreed to continue their work as volunteers in the fall. The students also have been helping with various digitization projects, including a nationwide project to digitize microfungus specimens. This work led to some excitement in the past year, when an anthrax specimen was discovered, resulting in the forced closing of the herbarium by hazardous materials officials. Ultimately, the specimen was shipped to the CDC and destroyed, and the herbarium was reopened and returned to business as usual.

Whitfield, Sofia Rudin and Dave Murray of Brown opened the afternoon session with a talk about work they did in an effort to expand the use of vascular plant specimens beyond traditional systematics and taxonomy. They reported on the use of Brown Herbarium specimens to document changes in heavy metal content as a result of Rhode Island's industrial heritage, asking whether metal concentrations declined as the result of environmental legislation intended to reduce the release of industrial wastes. Rhode Island is a particularly good venue for such a study because Providence County alone has eight Superfund sites. Their study focused on three sites near Providence and three on Block Island, where there probably would have been less pollution historically. They pooled species across genera so they would have enough specimens to provide useful statistical analyses and compared specimens collected before 1916 with newly collected specimens, focusing on concentrations of lead, zinc and copper. They found a significant drop in lead levels at four of their study sites but no significant decline in zinc or copper concentrations. They concluded that herbaria specimens of herbaceous plants can be useful in assessing change in environmental conditions over time and that, by carefully selecting the species examined, even small herbaria should be able to do this kind of analysis.

Megan Bender and Dorothy Allard of the Pringle Herbarium at the University of Vermont gave a talk on an annotation label generator. They use a web application that works with their Zebra printer – a high-resolution, archival printer. The process of generating annotation labels is inexpensive after the initial purchase of the printer, they said, and anyone with the printer can use the software or Word to produce custom annotation labels.

At the conclusion of the presentations, Sweeney conducted the CNH business meeting, which began with a discussion of where next year's meeting should be held. A number of people suggested that the consortium should meet in Canada since it has been several years since the last meeting there. Sweeney said he would approach herbaria in

New Brunswick and Nova Scotia to see if they would be willing to be host for the meeting. Pam Polloni said she would be willing to host the meeting at Woods Hole if Canadian herbaria willing to welcome the meeting cannot be found. Consortium members also discussed the possibility of creating lists of rare plants for each state and province so information on the precise location where specimens were collected can be masked on the consortium's online database portal. Each state now has a list of rare plants, but it is not thought necessary to suppress information and images on all of these species because many would be unlikely to be collected for horticultural or medicinal purposes. A number of consortium members volunteered to work with other officials in their states to come up with state-specific lists of vulnerable species. At Mike Donoghue's suggestion, consortium members discussed other projects they might propose for funding. A number of ideas were proposed, including seeking grants to digitize additional small herbaria in the region, to support data-cleaning efforts with information already served by the portal (imposing uniform taxonomy, for instance), using the data to answer some ecologically important question or using the data to identify areas where additional collecting needs to be done. Much support was expressed for the idea of getting support to do additional collecting in the region, since the numbers collected each year are lower than they were early in the 20th century. Sweeney said he would ask a number of people to serve on a working group to discuss this issue further.

The day concluded with a tour of the Brown University Herbarium, which is housed in a new, climate-controlled space in the Biomedical Center.

The second day of the meeting was devoted to a field trip to freshwater, coastal plain kettle ponds. Much of the Matanuck Hills area that was visited is owned by The Nature Conservancy, which is trying to protect the unusual habitat in and around the ponds, where remnants of a formerly extensive coastal plain flora remain. The field trip was led by Doug McCready, who pointed out a number of uncommon plants around Long Pond and Spectacle Pond, including *Juncus militaris*, *Lobelia dortmanna*, *Myriophyllum tenellum*, *Rhexia virginica*, *Sagittaria teres* and *Rhododendron maxima*.

Submitted by Bob Capers