BURTON V. BARNES AS A FOREST BOTANIST

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A cornerstone of Burt Barnes' many contributions to forest botany is the well-known and critically acclaimed course known simply as "Woody Plants." Created in 1965 with Burt's mentor and botanical colleague, Dr. Warren "Herb" Wagner, Jr., and Terry Sharik, then a Graduate Fellow (see Sharik, *this issue*), the course's roots trace to a long-standing, entry-level dendrology class. Previously taught primarily to undergraduate forestry students, the dendrology course was formulaic and limited in scope (as well as reportedly quite tedious). Barnes and Wagner used their new course to reframe forest botany and revitalize its pedagogy with many teaching innovations. Their creativity in organization and instruction vastly broadened the course's appeal and the size and diversity of its audience. In the mid-1970s the course was designated as a university-wide course and accommodated as many as 200 students per term. Many middle-aged Ann Arbor residents fondly tell of taking the class when they encounter current Woody Plants students in the field.

A critical element in the evolution of Woody Plants was fusing the particular specialties that Barnes and Wagner each brought to the course, providing a unique combination of ecological and organismal knowledge delivered via a carefully planned, tag-team teaching format. Herb, a National Academy of Sciences member known widely for his research on pteridophyte systematics, provided the botanical foundation students required. He began the course with several lectures on plant terminology and morphology, then methodically expanded on this to introduce more complex botanical topics such as plant variation, hybridization and introgression, pollination biology, and systematic relationships. At well-chosen intervals Burt lectured, building the ecological underpinnings of Woody Plants by explaining the processes of establishment, competition, succession, and natural disturbance as key ecological components necessary for ecosystem function. Burt then discussed the dominant forest ecosystem types of Michigan, later ranging into forests found elsewhere in North America. Included were lectures on forest ecosystems of the Appalachians, the southeastern Atlantic Coastal Plain, and the Sierra Nevada and Rocky Mountains of the western

United States. The purpose of lecturing on non-Michigan forests was not merely for perspective, but was also by design, since Burt knew that some students would eventually work in these areas. It was thus not atypical for former students to contact Burt Barnes to express their gratitude for the introduction to these landscapes, which helped to orient them in their new "home place." Woody Plant students that continued on into Burt's highly regarded Forest Ecology course (and beyond) would later have the lesson firmly driven home about the need to "know the territory." This was perhaps the unifying concept embedded in all of Burt's teaching efforts over the years.

Burt's Woody Plants lectures were not restricted to purely ecological topics, owing to his strong background in forest botany and the related topics of forest genetics, silviculture, and plant physiology. He lectured on the processes of germination, flushing, growth, reproduction, and dormancy, and on related topics such as frost-freeze tolerance and its effects on range limitation. In addition, Burt artfully incorporated specimens into his lectures, taking particular pleasure in introducing, for example, the southern and western conifers of North America. The latter was the source of a mild ruse, in which Burt displayed the cones of several western conifers putatively leading up to what would be expected as the enormous cones of the continent's largest trees, *Sequoia sempervirens* (coastal redwood) and *Sequoiadendron giganteum* (giant sequoia), the set-up being the penultimate demonstration of the enormous cones of *Pinus lambertiana* (sugar pine) and *P. sabiniana* (digger pine), and especially *P. coulteri* (Coulter or big-cone pine). The actually diminutive cones of coastal redwood and giant sequoia were stored in large grocery bags and revealed last, to the surprise of some and much to the amusement of the graduate student instructors familiar with this skit.

When he initiated active research in China in the 1980s, Burt also began to incorporate a Woody Plants lecture on vicariant species of eastern North American and eastern Asia, a well-known research topic in phytogeography. This presentation was given toward the end of the course, when students would not only appreciate and better understand the topic but would also apply their newly developed plant identification skills. Using specimens collected during his field research in China, Burt presented examples of vicariant species pairs. This made a lasting impression, since it showed students that they were able—through their woody plants training—to detect the similarities and differences between related taxa with widely disparate distributions. The species pairs included the North American *Liriodendron tulipifera* (tulip-tree) and its Asian counterpart *L. chinense* (Chinese tulip-tree); our native *Sassafras albidum* (sassafras) and the Asian *S. tsumu* (Chinese sassafras); and several species pairs within the genus *Carya*.

By the time the Woody Plants class had reached its 40th year, it was a complex and highly orchestrated endeavor, with bi-weekly lectures and multiple field trips, indoor and outdoor labs, a student collector, and several graduate student instructors (GSIs). The class had attained an almost folkloric status (Figure 1). The field sites, landscape descriptions, class notes and identification tools provided an enduring template for the continuation of the class. Perhaps most importantly, the Woody Plants class had developed its own teaching culture that Burt's students sustained after his retirement. One of us (CWD) first taught the course as a new faculty member in the Department of Ecology and Evolutionary

FIGURE 1. The Woody Plants class gives Burt Barnes a standing ovation following his final lecture in the course before his retirement, December 2005. Photo from University of Michigan School of Natural Resources and Environment Flickr page under a Creative Commons Attribution 2.0 Generic license; desaturated, cropped, and straightened from original; original at www.flickr.com/photos/snre/14584134446/.

Biology in 2006, and it was staffed with three GSIs who had either taken or taught the class in prior years. The GSIs were well-versed in plant identification and in the pedagogical style used to teach Woody Plants successfully to over 3,000 University of Michigan students. This included engaging students to use creativity to learn idiosyncratic but important identification characters (for example, the species-specific shape of winter buds or leaf scars) and by making students focus on key characters through observation and discussion in the field. Burt ensured that the class was passed seamlessly to new teachers and a new generation of students following his retirement in 2006. Burt wrote pages of emailed notes as a response to any questions the new instructor posed regarding field sites, glacial history, or Michigan botany. A highlight of the course was Burt's annual guest lecture on aspens and poplars (*Populus*), which featured a humorous skit about the race to describe the world's largest organism—an aspen clone in Utah, which Barnes described long before a second group enjoyed fame by writing about it in the journal *Nature* (Grant et al. 1992).

Michigan Trees and Michigan Shrubs & Vines

Central to teaching Woody Plants was the development of a reliable, illustrated woody plants guide for Michigan. No such current, comprehensive Michigan manual existed during the course's early years. For students in the 1960s and

1970s, there were available for identification purposes only guides that either were outdated, had incomplete coverage, or treated too large an area (thereby containing too many extralimital species) such as *The Trees of Canada* by Hosie (1975), Harlow's fruit and twig keys (1959), the tree and shrub guides in the well-known Peterson field guide series, or the available standard botanical manuals. Among the most applicable field guides was the classic *Trees of Michigan* by Charles Herbert Otis, first published in 1915 by the University of Michigan Press and known through subsequent re-issues (see Otis 1931). Although the Otis manual was considerably out of date, it included accurate and elegantly prepared illustrations, of which the original plates had been preserved. It was thus logical that Barnes and Wagner would choose to write a contemporary field manual of trees by extensively revising and building upon the Otis guide. Applying their considerable botanical and ecological expertise, and heavily influenced by the teaching and training needs of numerous students over the years, Barnes and Wagner produced their first version of *Michigan Trees* in 1981. Following a lengthy collaborative revision prior to Wagner's death in 2000, Burt published the expanded *Michigan Trees* in 2004, adding a detailed introduction to the state's ecoregions, ecosystems, and communities, among several other new features. *Michigan Trees* should perhaps be considered the exemplar of all modern woody plant field manuals based on its superb organization and the extensive, reliable information written for a broad audience of users.

By the time Burt retired, he had still not completed his final contribution to the Woody Plants class—a guide to the shrubs and vines of Michigan. During its first decades, the class used Billington's *Shrubs of Michigan* (1949), and later *Shrubs of Ontario*, by Soper and Heimburger (1981). During the initial stages of writing a guide to shrubs and vines in collaboration with Woody Plants lecturer Melanie Gunn, Barnes had assumed that the illustrations in *Shrubs of Ontario* were in the public domain. When this turned out not to be the case, it almost sank the book project. Burt then invited CWD to become an additional coauthor to help push the project to completion. Burt worked assiduously on the selection of published drawings from over 30 books (Figure 2). He also worked with two local artists to supplement the previously published line drawings, and he collaborated with A.A. Reznicek in a review of herbarium specimens in order to distill essential morphological features from a range of variation. How effectively Burt worked with specimens of these complicated plants was eye-opening to AAR. Even in drawings that looked perfectly acceptable and seemed to represent species well, he would immediately see problems. When Burt pointed them out, the problems became clear, and one could then readily see how they could confuse people. It is that incredibly focused attention to detail that made *Michigan Trees* so helpful, and *Michigan Shrubs & Vines* will follow in the same vein.

Burt and CWD met frequently to discuss the shrubs and vines book. In addition to discussing technical aspects, they had wide-ranging conversations on forest history and ecology. This experience had a profound impact on the new instructor's thinking about Michigan forests and teaching approaches, and many of Burt's ideas were reintroduced to the Woody Plants class. Burt left the writing of the preface to *Michigan Shrubs & Vines* to his coauthors and requested only that the book be dedicated to the students of Woody Plants. As is the case with *Michi-*

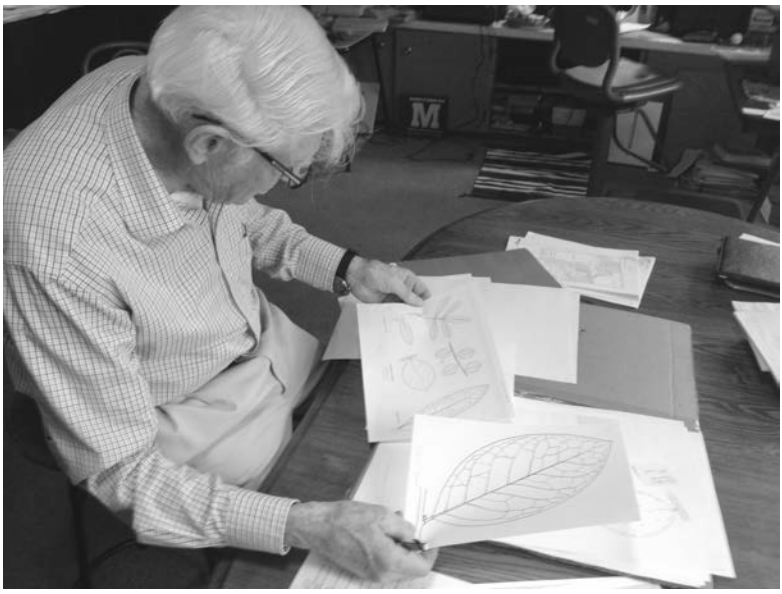

FIGURE 2. Burt Barnes examining line drawings of shrubs at home for the *Michigan Shrubs & Vines* book, May 2014. Photo by Chris Dick.

FIGURE 3. Burt Barnes studies *Ilex mucronata* at the University of Michigan Biological Station for the *Michigan Shrubs & Vines* book, August 2013. Photo by Dan Kashian.

FIGURE 4. Burt Barnes discusses the ecology of red maple in the field at the University of Michigan Biological Station, June 2005. Photo from University of Michigan School of Natural Resources and Environment Flickr page under a Creative Commons Attribution 2.0 Generic license; desaturated from original; original at www.flickr.com/photos/snre/14627178753/.

gan Trees, the book is much more than a field guide; it is a unified perspective on the ecology, evolution, and history of Great Lakes landscapes as viewed through the lens of shrub and vine natural history.

Emeritus Research and Outreach

Burt's research did not slow down with retirement. Along with his persistent work on *Michigan Shrubs & Vines* (Figure 3), Burt continued to mentor young scientists. For example, Burt worked closely with a post-doctoral student from Japan, Ikuyo Saeki, on studies of Japanese and North American maples (see Makino et al., *this issue*). As an extension of Burt's longstanding interest in forest genetics, he traveled with Ikuyo around eastern North America to sample leaf morphology and genetic variation in red maple, *Acer rubrum* (Figure 4). He invited CWD to collaborate and to host Ikuyo in his lab. Because of Burt's interest in hybridization, the authors expanded the study to include co-distributed silver maple (*A. saccharinum*). The paper by Saeki et al. (2011) on the comparative phylogeography of maples had several important results for the interpretation of North American forest history. First, it showed that the phylogeographic patterns in red maple were strongly influenced by the introgression of chloroplast DNA from the regional gene pools of silver maple. The discovery of interspecific gene

flow in Michigan red maple proved especially important, because the genetic variants (chloroplast DNA haplotypes) in the recently glaciated northern range edge had been previously interpreted as a legacy of cryptic Pleistocene forest refuges (McLachlan et al. 2005). The maple research led to comparative studies of North American birches, which showed similar patterns (Thompson et al. 2015) and to a new awareness of the impact of hybridization on the genetic structure of forest tree species.

In addition to his own forestry-oriented work, Burt maintained many other contacts and commitments in retirement. AAR was surprised once when Burt asked him about German language orchid terminology, and learned that Burt was acting as scientific language advisor for the English translation (INULA 2012a) of an innovative German book on orchids (INULA 2012b)—a continuing legacy from his early work in Germany and yet another example of the breadth of his knowledge and influence.

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