The Sino-American Botanical Expedition of 1980: A Retrospective Analysis of Success

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Abstract. The 1980 Sino-American Botanical Expedition (SABE) to the Shennongjia Forest District, Hubei Province, China was the first botanical collecting trip by American scientists to that country since 1949. This collaborative venture with Chinese botanists yielded 2085 herbarium and 621 germplasm collections from the species-rich region. Our analysis tracked the fate of the SABE germplasm after its introduction to North America and represents one of the few case studies of its kind. Two hundred and fifty-eight of the original germplasm collections still survive and are in cultivation in at least one of 18 botanical institutions. Yet 115 of these (45%) are represented by a single accession growing in a single location, which suggests that the plant introduction process is more tenuous than is generally assumed. The scientific value of documented wild germplasm warrants that careful measures are in place to ensure that significant collections do not vanish. This case study outlines steps that can be taken throughout the introduction process (from propagation to distribution and follow-up) to prevent any such loss. In particular, the role of data sharing among institutions is highlighted as a means of identifying collection uniqueness, and assessing environmental adaptability and invasiveness.

Williams (2005) describes plant exploration conducted under the auspices of the U.S. National Plant Germplasm System, and in particular highlights steps to take during the planning and acquisition stages to ensure expedition success. Upon completion, however, much still must be done to ensure that success continues, for the germplasm still needs to be propagated, distributed, and evaluated. Although individual collections of germplasm may undergo significant evaluation, very few retrospective analyses of entire collecting trips have been conducted, particularly in the medium- to long-term (see Cunningham, 1984; Farrington, 1931; Hymowitz, 1984; Rosengarten, 1991). We recently conducted a case study that evaluated the success of a modern collecting trip: the 1980 Sino-American Botanical Expedition (SABE). Complete details of our work, including photos, maps, and a comprehensive literature search, can be found in Dosmann and Del Tredici (2003).

The 1980 SABE was the first collecting trip involving U.S. and Chinese botanists since 1949, and took place in an area of high botanical significance, the Shennongjia Forest Region of Hubei Province. It was conducted from 15 Aug. to 15 Nov. 1980 under the joint auspices of the Chinese Academy of Sciences and the Botanical Society of America (see Bartholomew et al., 1983a, 1983b, 1983c) and Bartholomew et al. (1983), with some additions and corrections. We then extracted information on all living and dead SABE collections from the four original institutions (AA, NYBG-CA, NA, UCBG) and nearly 30 additional institutions that we suspected were cultivating SABE material. We also solicited requests through the March 2001 newsletter of the American Association of Botanical Gardens and Arboreta (AABGA), reviewed archival records from numerous institutions, and searched various online databases (e.g., the USDA Germplasm Resource Information Network).

Fate of SABE Collections

Of the 621 SABE collections, 258 (42%) were found to be alive in November 2002. We were startled to find that 115 (45%) of these existed as a single accession growing in a lone botanic garden, arboretum or USDA facility (typically as a single plant). These values caused us concern (particularly the latter statistic), and prompted us to find out what may have happened to the lost collections and what contributed to their demise. Upon reviewing propagation and archival records, we found that 158 of the 363 lost collections were questionable to begin with. This includes those collections which failed to survive transit (particularly the vegetative material), were discarded upon inspection, consisted of inviable seeds, had extremely low germination, and/or had unknown germination requirements, hindering successful propagation. Correcting for these 158 questionable collections increased the observed survival percentage from 42% to 56%. The records also demonstrate that distributing replicate propagules of the same collection to multiple institutions increased the likelihood of propagation success (and thus survival); where one institution was unable to germinate a particular collection, oftentimes another was.

Distribution of material, after successful propagation, is an equally critical stage. After exchange among themselves, each of the four primary institutions determined what to keep and what to distribute to other interested parties, typically on a ad hoc basis. There was, however, a large distribution that took place during the 1983 AABGA Annual Conference, where more than 3300 plants (representing 85 unique collections) were distributed. This essentially represented the entire quarter share belonging to the NYBG-CA (NYBG was evaluating its relationship with the CA, which went on to become the Institute of Ecosystem Studies the following year). While many institutions and individuals received material, no distribution records were kept from this event. Some of the living collections detected in this survey remain alive solely as a result of this mass distribution, yet we cannot help but wonder how many others exist, unbeknownst to their curators. We recommend that institutions maintain better distribution records and also provide collection information along with their distributions, particularly when high-profile expeditions similar to the 1980 SABE are involved.

To further understand how critical distribution is to future survival, we examined some...
of the institutional distribution records. Of the 90 collections that the AA distributed, 82% are extant; and of the 169 collections distributed by the NA, a similar amount (79%) remains alive. At the AA, there were 74 collections that were successfully propagated, yet are no longer alive (at the AA or any other institution). Interestingly, a majority of these (78%) were never distributed, essentially because of low yield; the retention of all individuals that result from low-yielding seed lots is a common practice for botanical gardens. However, because their risk of loss may be greater, we feel that more than less emphasis should be placed on their vegetative propagation (if possible) and distribution to other institutions. The practice of distribution has its drawbacks as well, for if genetically distinct individuals are not maintained and monitored as part of a comprehensive plan, then collections may still be at risk of loss (e.g., *Ilex shennongjiaensis* T.R. Dudley & S.C. Sun, below).

### Implications for Curators and Germplasm Managers

We are very concerned with the erosion of genetic resources maintained *ex situ*, particularly those collected on this and many other expeditions. It appears as if conservative approaches to plant distribution (particularly in low-yielding collections) can contribute to such loss. For example, one of the species new to science and discovered during the 1980 SABE, *I. shennongjiaensis*, was found alive in but two institutions—and then represented only by staminate individuals. We have no way of knowing for certain what transpired, but somewhere along the line it seems as if females were (unknowingly) culled from the seed lot. When single-accession or low-yielding collections are encountered, various tactics can be employed to conserve them and improve their management. A targeted audit and action plan, such as outlined by Radford et al. (2003) for *ad hoc* conservation-status species, may be an approach to adapt for these collection types.

Collection records are nearly as important as the plants themselves, and we advocate that the original collection number and notes accompany every plant distributed, and that they are preserved by institutions postdistribution. Many suspected that they were cultivating SABE material, but they had no records to provide verification. Only with the collection number can all the associated provenance data be retrieved; without such information, the material loses nearly all of its unique value. The sharing of records among institutions also has an array of benefits. Perhaps our most important realization is that curators can only ascertain the uniqueness or rarity of their own collections in the context of comparing them with the holdings of other institutions. Many curators had no idea that they were cultivating a rare, single-accession collection (it is easy to assume that material widely distributed remains extant over time in multiple sites). Thus, a system to track collections and their subsequent distribution is a sound investment that may go a long way in preventing their loss. Since the publication of our original report (Dosmann and Del Tredici, 2003) and the posting of the online database (www.arboretum.harvard.edu/plants/sabe.html) in June 2003, we have discovered 7 additional lost collections. More importantly, the percentage of single-accession SABE collections has dropped from 46% to 39% and continues to decrease due to their vegetative propagation and subsequent distribution. Of particular note is the identification of additional SABE material, including several lost or single-accession collections, at the Royal Botanic Gardens Edinburgh, which has affected both statistics. While our online database tracks only the 1980 SABE material, Quarryhill Botanic Garden has gone one step further and recently established a Database of Asian Plants in Cultivation (www.calacademy.org/research/botany/quirkyhill/index.asp). This searchable index includes the 1980 SABE collections in addition to wild-collected material from an array of other recent expeditions to Asia. Tools such as these will become invaluable not only to curators and collection managers, but researchers who seek material of known provenance.

If the 1980 SABE represents a typical expedition in the modern era, do we believe it was a success? Despite the loss of some collections of value, our answer remains yes. Not only did the 1980 SABE help jump-start collaboration between American and Chinese botanists, but it resulted in an invaluable floristic catalogue of an ecologically sensitive region. And, a number of ornamentals were introduced to cultivation as a result of this expedition including *Heptacodium miconioides* Rehrl., *Magnolia zenzi* Cheng, *Rubus lasiostylus* Focke var. *hubeiensis* T. T. Yu et al., and *Sorbus yunnanica* S. A. Spongberg; additional species and unique genotypes are under further evaluation (*Cercocarpus* monitors, Rehrl. & E.H.Wilson) *Ilex* frenzii Franch., *Malus baccata* (L.) Borkh., *Sorbus hupheishensis* Schm., *Viburnum hupheishen* Schneid., *Viburnum prunifolium* Rehrl. among others). However, we strongly feel that judging expedition success or germplasm value based solely upon the introduction of material as an ornamental or crop plant is limiting and narrow-minded. Germplasm (particularly of known wild origin) possesses value to an array of biological sciences beyond plant evaluation, including phylogenetics, physiology, and ecology. Plant explorers and curators should strive to consider the wide breadth of contributions that their collections can make to science.

In this day and age, no discussion on plant exploration and introduction is complete without addressing the contentious issue of invasive species. Numerous authors (Mack et al., 2000; Mooney and Hobbs 2000) have discussed this issue in great depth, and we agree with those viewpoints that state that a relatively small percentage of plant introductions become problematical invasives, including those presented by Baskin (2002) and Reichard and White (2001). Given the low likelihood that a new introduction will become invasive, we strongly encourage that the ecological, botanical and horticultural communities make every effort not to “throw out the research baby with the invasive bathwater.” We cannot lose sight of the intrinsic scientific value possessed by plants of documented wild origin, regardless of their potential to naturalize. In fact, we see constructive research and evaluation roles for botanical gardens, arboreta and similar institutions in the invasive plant arena. Such institutions are ideal for this work because of their confined area of cultivation, conservative approach to distribution, noncommercial orientation, and perhaps most importantly, their long-term commitment to record keeping, data collection and research. Short of banning the introduction of all new exotic species, there is no effective alternative to modeling and the type of long-term evaluation work currently practiced by research-oriented botanical gardens, arboreta and USDA germplasm repositories.

This case study has shown us that while successful, plant introduction is a more tenuous process than generally perceived. Meticulously documenting collections and systematically distributing seeds, vegetative propagules, and whole plants postpropagation can dramatically minimize the loss of valuable germplasm. Maintaining the collection and distribution records over time is also essential, as is the sharing of records among institutions. These steps will retard erosion of these genetic resources and enable their further characterization and research potential.

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