

By the Numbers: Twenty Years of NACPEC Collections

Anthony S. Aiello and Michael S. Dosmann

Beginning with the initial feasibility expedition in 1991, NACPEC has conducted a total of 12 botanical expeditions to China (Table 1). These represent a concerted effort to systematically investigate and explore varying climatic areas, habitats, and ecosystems across a wide geographic range. Although quite comparable in land mass, China has much greater plant diversity than the United States. Target areas for NACPEC expeditions were determined based on climate information and cover a broad arc from central China where the Qinling mountain range forms the continental divide separating north and south China (the Yellow and Yangtze River systems), through the mountain ranges west of Beijing, to the far north and northeast of the country in the provinces bordering Russia and North Korea. Although there is a fascinating and diverse flora in Sichuan and Yunnan, these provinces have not been primary targets because plants from this warmer region of China have not performed particularly well in the climates of most NACPEC members.

The goals of each NACPEC trip have varied—on many trips we collected broadly, working from a large list of target plants, while on other trips we focused on specific taxa (e.g., *Tsuga* in 1998 and 1999, and *Fraxinus* in 2008). (See map on page 26 for locations covered on each trip.) The contributions from these trips have resulted in a wealth of knowledge about the characteristics and ecology of Chinese plants, represented by copious collection notes and herbarium specimens. And, by bringing germplasm back to North America and integrating it into the living collections spread among all of the members of the consortium, we collectively learn how these individuals respond under cultivation to our diverse growing conditions. The expeditions are summarized in separate trip reports that are housed in the libraries of the participating institutions and generally consist of two parts: a trip journal and the field notes.

The journal recounts the daily activities of the trip and also sets out the context for the various plant collections. The detailed field notes provide extensive information on all of the collections for an expedition. These trip reports provide a resource for current and future exploration efforts.

Sifting the Statistics

As more NACPEC collections were propagated, distributed, and evaluated, it became clear that we should report on the results of the NACPEC expeditions. Our goal with this article is to provide information on the successes and challenges of collecting in this modern era, and to evaluate the significance



PETER DEL TREDICI

Detailed notes are taken for each collection. Here, Paul Meyer records a collection location from a GPS (global positioning system) device.



Sunrise in Xia Ban Si (Cloud Sea), Shaanxi. The photograph was made at an elevation of over 9,000 feet (2,743 meters), the highest point reached on the 2008 expedition. Photo by Anthony Aiello.

of NACPEC collections to botany, plant conservation, and ornamental horticulture. A similar case study was published by Dosmann and Del Tredici in their review (2003) of the 1980 Sino–American Botanical Expedition (SABE), another collaborative trip that yielded abundant herbarium and germplasm collections from Hubei. We wanted to know if there were any similarities or differences between the SABE and the NACPEC trips, and if there were lessons learned that could be applied not only to future collecting trips, but to living collections management in general.

NACPEC members regularly combine and update lists of their expedition holdings into a complete plant survey, and this was most recently completed in late 2009 (for online access to this information see the Data Base of Asian Plants in Cultivation [DAPC] <http://www.quarryhillbg.org>, the BG-Base Multi-Site

Search page <http://www.bg-base.com>, and the individual institutions' websites). This combined inventory aids curatorial decisions among the collaborating institutions, helps to find missing or unusual collections, and focuses future collecting efforts. We used this combined inventory as the basis for the descriptive statistics provided in this article. These statistics include all of the collections made on the 12 NACPEC expeditions, as well as seeds collected in 1994, 1997, and 2001 by Professor Cui Tiecheng (formerly of the Xi'an Botanic Garden), and a few sets of seeds received as exchanges. Living germplasm data came from the NACPEC institutions, plus the holdings at the Dawes Arboretum. A very recent inclusion in this survey is the University of Idaho Arboretum and Botanical Garden, which received a seed distribution following the 1993 Heilongjiang and 1994 Beijing expeditions (see page 24).

NACPEC: Who We Are and What We Do

SINCE its inception, NACPEC's efforts have been motivated by a number of goals, including:

- Broadening the genetic pool of species already in cultivation, with particular emphasis on extending cold hardiness and increasing vigor, improving adaptability to stressful environments, and increasing insect and disease resistance.
- Conserving rare species.
- Selecting improved ornamental forms.
- Evaluating and introducing appropriate new species.
- Increasing our understanding of botanical diversity throughout China.
- Collaborating with key institutions in the national and international botanical community.

NACPEC consists of eight member institutions plus partner organizations that contribute to the success of our collecting efforts and the wide distribution of valuable germplasm. Each location not only has unique growing conditions that are favorable for certain types of taxa or those from specific parts of China, but the individual missions and collections policies of each institution are novel. Such diversity is truly an asset. The NACPEC members are:

- The Arnold Arboretum of Harvard University, Boston, MA
- The Holden Arboretum, Kirtland, OH
- Longwood Gardens, Kennett Square, PA
- The Morris Arboretum of the University of Pennsylvania, Philadelphia, PA
- The Morton Arboretum, Lisle, IL
- United States National Arboretum, Washington, DC
- University of British Columbia Botanical Garden, Vancouver, BC
- USDA Woody Landscape Plant Germplasm Repository, Beltsville, MD



Viburnum betulifolium

KRIS BACHTELL

Other partners in these efforts include the Dawes Arboretum in Newark, OH as well as several Chinese botanical institutions listed in Table 1.

What's a Collection?

VISITORS to public gardens may associate the word “collection” with groups of living plants, often labeled with signs such as “Maple Collection” or “Conifer Collection.” But on NACPEC expeditions, we use the word collection in a different way. A *collection* results from one specific act of collecting and may comprise one or more products. Each NACPEC collection receives a unique alpha-numeric code for identification. For example, on the 2005 trip to Gansu we collected seeds from a *Cercidiphyllum japonicum* and also collected herbarium specimens from the tree. A single collection number, NACPEC05-059, was assigned to both the seeds and herbarium specimens, and any associated data also carry that collection number.

Once a NACPEC collection (in the form of seeds, cuttings, plants, or herbarium specimens) arrives at a botanical garden or arboretum, it is typically assigned an *accession* number unique to that institution. The *Cercidiphyllum* collected in Gansu is accession AA # 126-2007 at the Arnold Arboretum and MOAR # 2005-192 at the Morris Arboretum, but both institutions can track their accessions back to the original NACPEC collection, which makes ongoing evaluation and reporting easier and more accurate. Any institution that receives clonally propagated plants of that NACPEC collection in the future may give it their own accession number but will also retain the original NACPEC collection number in their records.



This *Cercidiphyllum japonicum* growing at the Arnold Arboretum is identified by the Arnold Arboretum accession number 126-2007-A (letters identify individual specimens within the accession group), but the label information also includes the original NACPEC collection number, NACPEC05-059.

There have been a total of 1,350 unique NACPEC collections since 1991 (Table 2). Of these, 71% (961 collections) are represented by herbarium specimens and 93% (1,250 collections) were originally collected as germplasm (primarily seeds but occasionally seedlings or cuttings); most collections comprised both germplasm and herbarium vouchers. Of the 1,250 germplasm collections made, more than half (56%) are currently represented by living plants among the various member gardens, a percentage somewhat greater than the 1980 SABE (258 of initial 621, or 41%).

Certainly, as in the 1980 SABE, an inability to successfully propagate some germplasm collections led to their initial failure. For example,

in the case of some taxa such as *Acer* (maples), seeds collected may be empty and therefore not viable. Similarly, seeds of other taxa may germinate but only grow into weak plants that do not make it out of the propagation/production phase. And there are also those taxa that make it out onto the grounds only to perform poorly and eventually die. Thus, a “success rate” of around 50% is not uncommon. In directly comparing the NACPEC and SABE collections, we wondered what the contributing factors might be for the slightly higher rate among NACPEC collections (56% versus 41%). Certainly, some of the more recent NACPEC collections are still going through the pivotal propagation/production phase, which contributes to the higher



A number of NACPEC collection plants grow on the vine arbor at the University of Idaho Arboretum and Botanical Garden, including, *Clematis mandshurica* HLJ-073 and *Vitis amurensis* BJG-039, top, and *Actinidia arguta* BJG-025 (male flowers), bottom.

Got NACPEC Plants?

WHILE writing this article, we happened upon information that added significantly to our inventory and the compilation of our statistics. Charles Tubesing, curator at the Holden Arboretum, forwarded to me a newsletter from the University of Idaho Arboretum and Botanical Garden. In that newsletter, Paul Warnick wrote about the development of an arbor to hold vines that they had grown from seeds collected by NACPEC. In further correspondence with Paul, I learned that their institution holds 246 NACPEC plants representing 55 taxa and 64 collections. These include 5 collections that previously existed at only one institution, 3 collections that previously existed as a single plant at a lone institution, and 2 collections that we previously thought were dead altogether.

While we knew that NACPEC collections had been distributed far and wide, this one instance illustrated just how pivotal distributions outside the NACPEC network can be. In light of this information, we would be very interested in hearing if any other organizations have NACPEC collections in their gardens. If so, please contact Anthony Aiello at aiello@upenn.edu. We would be happy to include your records in future NACPEC inventories. —ASA

success rate. However, we believe that the overwhelming reason for the greater success is due to the unique nature of NACPEC: wide initial distribution of germplasm—and continuing distribution of surplus plants and vegetative propagules—to a network of gardens and arboreta with unique growing environments. Lighty (2000) described several barriers to successful expeditions, one of them being the “too-rapid rate of entry of plants into the system” that then overwhelms staff and facilities. Because of its distributive and collaborative nature, NACPEC may have found a way to break this barrier.

Notable Successes

There are some remarkable success stories from the trips of the early 1990s, with 62% of the 1993 Heilongjiang collections and 69% of the 1994 Beijing expedition plants still alive today. What might have contributed to these successes? Germplasm from these trips was widely distributed to numerous NACPEC institutions, and by and large it was well-adapted to these varying climates. And even though the 1999 trip to Sichuan has a fairly low percentage of living germplasm (40%), significant collections resulted from this expedition, most notably *Tsuga chinensis* var. *oblingisquamata* (Table 3).

Another important statistic revealed in our assessment is the level of duplication among collections. Of those unique germplasm collections that are currently alive, approximately 60% grow in at least two different institutions. This duplication insures against the loss of valuable material and also provides opportunities for broader evaluation and study across a number of different growing sites.

The numbers do not always tell the whole story, however. For example, there are only 15 living collections (out of an initial 30) from the 1995



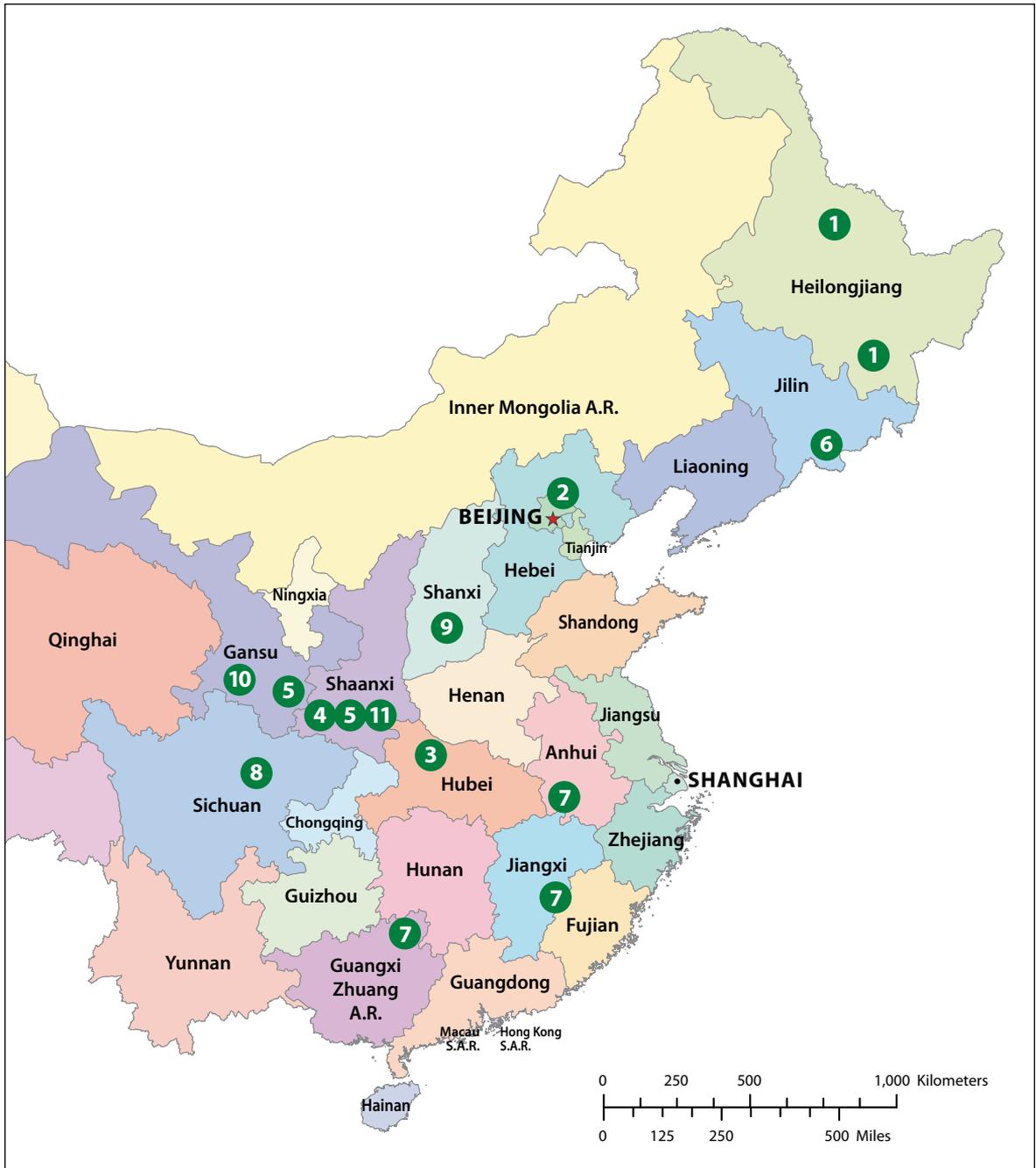
NANCY ROSE

Collaborative distribution of seed and plant collections helps prevent individual NACPEC member institutions from reaching “propagation overload.”



ERIC LA FOUNTAINE

Chimonanthus praecox (the cultivar ‘Grandiflorus’ is seen here) bears fragrant yellow flowers in late winter or early spring.



NACPEC EXPEDITION LOCATIONS

- | | | |
|----------------------------|--|------------------------|
| 1 1993 Heilongjiang | 5 1996 Shaanxi and Gansu
(Qinling Mountains) | 8 1999 Sichuan |
| 2 1994 Beijing | 6 1997 Jilin (Changbai Shan) | 9 2002 Shanxi |
| 3 1994 Hubei | 7 1998 Anhui, Guangxi, and Jiangxi | 10 2005 Gansu |
| 4 1995 Shaanxi | | 11 2008 Shaanxi |

Shaanxi expedition. One of these is *Chimonanthus praecox* (SHX033), a shrub noteworthy for its fragrant flowers in early spring. This plant is well known horticulturally, but as far as we can determine, this is the *only* wild-collected collection in North America. It is represented by only five plants at the Morris Arboretum and is an example of a collection growing at only one institution.

This type of collection, held at only one institution, illustrates one of the challenges facing NACPEC as well as others engaged in germplasm acquisition. Forty percent of the NACPEC collections grow in just a single place. Even though most of these exist as multiple plants

(as in the *Chimonanthus*), they are potentially at risk and need to be prioritized for distribution. But at even greater risk are those collections that exist as just a single plant in a single institution. For the NACPEC collections, 15% fall into this category. While they are clearly the most tenuous collections and the highest targets for propagation and distribution, this is considerably lower than the 45% of single-plant collections surviving from the SABE. Again, the unique collaborative and distributive nature of NACPEC contributes to this lower number. The annual inventory of combined holdings is the first step in alerting NACPEC members of the rarity of their own holdings.

A PRIME example in the category of a single plant is *Magnolia biondii* (QLG062A) collected in 1996 in the Foping Nature preserve in Shaanxi. This rare magnolia is a close relative of *Magnolia stellata* and is growing as a single individual at the Morris Arboretum. In light of its high conservation value and its rarity in cultivation, it becomes a very important target for propagation and distribution to other botanic gardens.



These photographs show the distinctive long carpel (in center of flower) and long fruit structure with red-ariled seeds of *Magnolia biondii* specimens growing at the Arboretum Wespelaar in Belgium.

In contrast to these sparsely represented taxa, there are a number of collections that are widely held among the NACPEC members. There are 13 collections grown in at least seven institutions, making them ideal candidates for further evaluation for broad adaptability as well as uniformity. Topping this list is *Acer pictum* ssp. *mono* BJG141, held by nine institutions, followed by *Acer davidii* ssp. *grosseri* (BJG017) and *Corylus fargesii* (QLG231), each held at eight gardens. It is difficult to know why some plants are grown more successfully and widely compared to others, but factors include initial quantities, broad original distribution, seed viability, curatorial interest, and broad adaptability to an array of growing conditions.

In combined NACPEC holdings, *Acer* is the most frequently collected genus—not surprising given that China is the center of diversity for maples, with 99 of the 129 species worldwide occurring there. Keen member interest in *Acer* (five of the NACPEC members and partners—the Arnold, Dawes, Morris, and Morton Arboreta, and UBC Botanic Garden—are members of the North American Plant Collections Consortium’s multi-site *Acer* collection), combined with the great natural diversity has led to the extensive holdings in this genus. There have been 106 distinct collections of maple, representing 33 taxa. Of these, 73 (10% of all living NACPEC collections) are represented by living germplasm for a total 29 taxa and 585 plants among all of the member institutions. Among these are garden-worthy plants such as *Acer davidii* (including ssp. *grosseri*), *A. pictum* ssp. *mono*, and *A. triflorum*; plants rarely grown in North American botanic gardens such *A. ceriferum* and *A. sterculaceum* ssp. *franchetti* (*A. tsinglingense*); and plants of high conservation value, including *A.*

griseum, *A. miyabei* ssp. *miaotaiense*, and *A. yui*. These collections represent a significant increase in the diversity of maples collectively held not only by NACPEC members, but among other North American institutions due to redistribution.

After *Acer*, other frequently collected taxa include *Viburnum* (20 taxa), *Quercus* and *Euonymus* (15 each), and *Rhododendron* (13). Of special significance are the 26 total collections representing 11 taxa of *Fraxinus*. Some of these ash taxa, such as *F. insularis* and *F.*



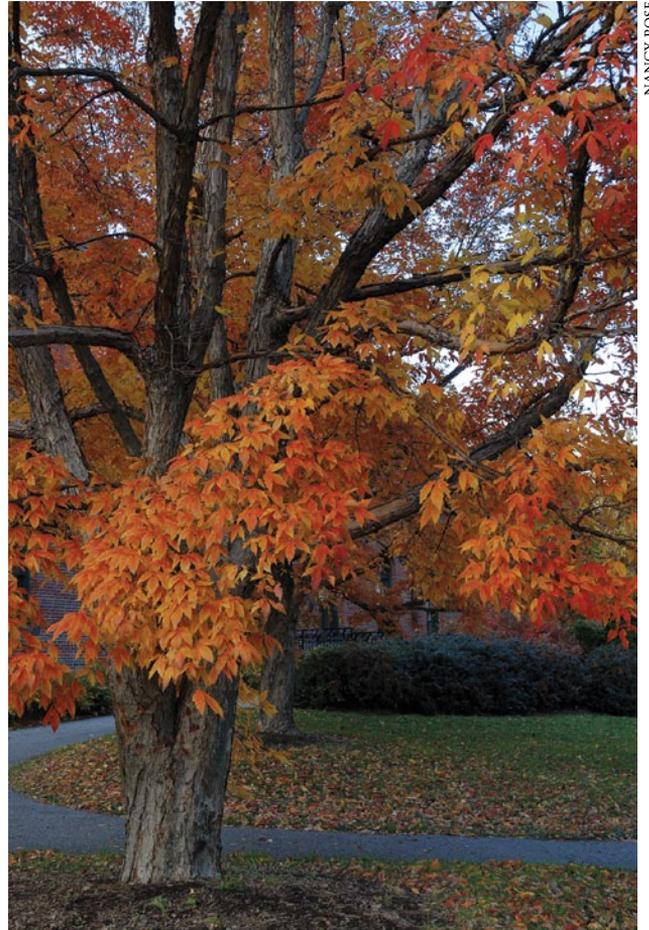
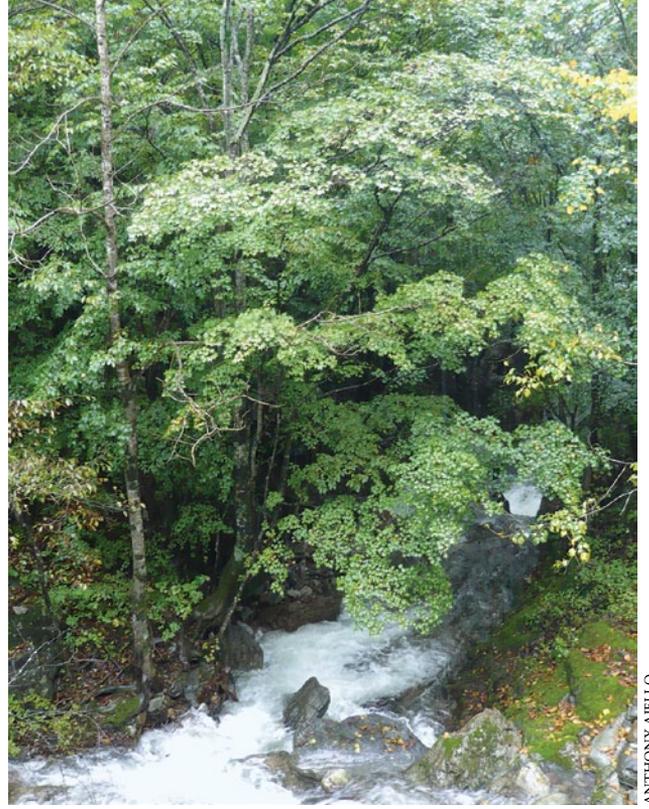
A large specimen of *Acer pictum* ssp. *mono* growing in Heilongjiang.



Upper left, Rick Lewandowski measures the diameter of an impressively large specimen of paperbark maple (*Acer griseum*); upper right, *Acer ceriferum* growing in the wild in China; lower, A cultivated specimen of three-flowered maple (*Acer triflorum*).

paxiana, may eventually hold the key to solving the emerald ash borer epidemic that is devastating native and planted populations of North American ash species.

Tsuga is another genus that stands out among the collections, not because of the diversity of taxa but for the number of collections made. Representing a classic case of a genetic bottleneck, *T. chinensis* had been introduced as a single individual into the United States in 1910. Starting in the 1990s, *Tsuga chinensis* became a prime target for NACPEC collecting expeditions because of the immediate threat to North American hemlocks by hemlock wooly adelgid (*Adelges tsugae*). A total of 33 collec-





Chinese hemlock (*Tsuga chinensis*) in its native habitat. Photo by Kris Bachtell.

tions of the adelgid-resistant *T. chinensis* and its varieties were made from across its native range, 19 of which are represented by living plants (Table 3). The original collections—mostly by seed but in some cases as seedlings or even cuttings—were made from several provinces from southeast China through the northwestern limit of its range in southern Gansu. Of the 18 seed collections, 17 are represented by at least one plant; none of the cuttings and few of the seedling collections are extant. Because of their high priority, these plants have been widely distributed among the NACPEC members and show that targeted collecting (instead of broad, opportunistic collecting) can greatly increase the diversity of germplasm among our collective holdings. These plants have been widely distributed among other North American botanic gardens, aiding in research on and wider introduction of Chinese hemlock.

What Have We Learned?

After nearly 20 years of collecting germplasm and herbarium specimens, we can draw a number of important conclusions. Overall these

statistics point out the importance of collaboration in sustaining the NACPEC collections. Without the combined efforts of the member organizations, it is difficult to imagine how these expeditions would have occurred, let alone how the plants would have been subsequently propagated and maintained over a period of time. In total the herbarium specimens and living collections represent material of horticultural, botanical, and conservation significance. The sum of the consortium work is certainly greater than its individual parts, leading to significant scientific contribution and a deeper understanding of the Chinese flora as well as its horticultural potential. This is an important point to emphasize—NACPEC's goals are broader than simply introducing garden-worthy plants. First and foremost is the primary scientific documentation of botanical diversity.

Additional lessons learned include the need for sustained and repeated collecting within varied geographic, climatic, and ecological ranges, and the importance of vision and long-term planning. Looking forward, this analysis will prove a useful tool as we focus on additional

Table 1. List of NACPEC expeditions, abbreviations, participants and dates.

Trip Name	Abbreviation	Participants	Dates
1991 Initial Feasibility Expedition (Beijing, Heilongjiang, Jilin, Shaanxi, Jiangsu)	LL	Bristol, Peter; Holden Arboretum Lee, Lawrence; U.S. National Arboretum Meyer, Paul; Morris Arboretum	10 Oct – 2 Nov 1991
1993 Expedition to Heilongjiang	HLJ	Bachtell, Kris; Morton Arboretum Bristol, Peter; Holden Arboretum Meyer, Paul; Morris Arboretum Gao Shi Xin; Heilongjiang Academy of Forestry Jin Tae Shan; Heilongjiang Academy of Forestry Liu Jun; Heilongjiang Academy of Forestry	25 Aug – 28 Sep 1993
1994 Expedition to Beijing	BJG	Bachtell, Kris; ; Morton Arboretum Lewandowski, Rick; Morris Arboretum Garvey, Edward; U.S. National Arboretum Tubesing, Charles; Holden Arboretum Liu Mingwang; Beijing Botanical Garden IBCAS	13 Sep – 3 Oct 1994
1994 Expedition to Hubei	WD	Conrad, Kevin; U.S. National Arboretum Del Tredici, Peter; Arnold Arboretum Meyer, Paul W.; Morris Arboretum Thomas, R. William; Longwood Gardens Hao Riming; Nanjing Botanic Garden Mao Cailaing; Nanjing Botanic Garden	6 Sep – 11 Oct 1994
1995 Expedition to Shaanxi	SHX	Garvey, Edward; U.S. National Arboretum Lewandowski, Rick; Morris Arboretum Cui Tiecheng; Xi'an Botanic Garden	31 Mar – 17 Apr 1995
1996 Expedition to Shaanxi & Gansu (Qinling Mountains)	QLG	Ault, James; Longwood Gardens Conrad, Kevin; U.S. National Arboretum Lewandowski, Rick; Morris Arboretum Kim Kunso; Norfolk Botanical Gardens Cui Tiecheng; Xi'an Botanic Garden	30 Aug – 18 Oct 1996
1997 Expedition to Changbai Shan (Jilin)	NACPEC97 (CBS)	Bachtell, Kris; Morton Arboretum Del Tredici, Peter; Arnold Arboretum Lynch, Jeffrey; Longwood Gardens Meyer, Paul W.; Morris Arboretum Tubesing, Charles; Holden Arboretum Wang Xian Li; Shenyang Institute of Applied Ecology Cao Wei; Shenyang Institute of Applied Ecology Sheng Ning; Nanjing Botanical Garden	25 Aug – 27 Sep 1997
1998 Expedition to E. & SE. China (Anhui, Guangxi, Jiangxi)	NACPEC98 (TS98)	Lewandowski, Rick; Morris Arboretum Garvey, Edward; U.S. National Arboretum Li Weilin; Nanjing Botanical Garden Wang Qing; Nanjing Botanical Garden	5 Oct – 22 Oct 1998
1999 Expedition to Sichuan	NACPEC99 (TS99)	Belt, Shawn; U.S. National Arboretum Garvey, Edward; U.S. National Arboretum Stites, Jerry; Longwood Gardens Wang Qing; Nanjing Botanical Garden	1 Oct – 20 1999
2002 Expedition to Shanxi	NACPEC02	Aiello, Anthony; Morris Arboretum Bachtell, Kris; Morton Arboretum Bordelon, Carole; U.S. National Arboretum Bristol, Peter; Holden Arboretum (Chicago Botanic Garden) Tang Yudan; Beijing Botanical Garden IBCAS	9 – 30 Sep 2002
2005 Expedition to Gansu	NACPEC05	Aiello, Anthony; Morris Arboretum Bachtell, Kris; Morton Arboretum Scanlon, Martin; U.S. National Arboretum Wang Kang; Beijing Botanical Garden Sun Xue-gang; Forestry College of Gansu Agricultural University	14 Sep – 12 Oct 2005
2008 Expedition to Shaanxi	NACPEC08	Aiello, Anthony; Morris Arboretum Bachtell, Kris; Morton Arboretum Carley, Chris; U.S. National Arboretum Wang Kang; Beijing Botanical Garden	16 Sep – 8 Oct 2008



NANCY ROSE

Acer davidii is much admired for its striped bark. This specimen at the Arnold Arboretum (AA#666-94-A) was grown from seed collected during the 1994 expedition to Hubei (NACPEC collection #WD 040).

Table 2. Collections totals for formal NACPEC expeditions and other associated collections. Trip abbreviations follow Table 1.

TRIP	Year	Total	Herbarium collections		Germplasm		Living germplasm		Exists at only one institution*		Exists as a single plant**	
			#	%	#	%	#	%	#	%	#	%
LL	1991	25	0	0	24	96	9	38	5	56	3	33
HLG	1993	112	96	86	102	91	63	62	20	32	5	8
BJG	1994	144	130	90	138	96	95	69	26	27	11	12
WD	1994	194	149	77	171	88	83	49	40	48	21	25
SHX	1995	33	0	0	30	91	15	50	11	73	5	33
QLG	1996	263	235	89	234	89	120	51	48	40	22	18
NACPEC 97	1997	143	122	85	139	97	91	65	22	24	7	8
TS 98	1998	42	0	0	42	100	19	45	17	89	11	58
TS 99	1999	33	29	88	27	82	11	41	6	55	1	9
NACPEC 2002	2002	78	71	91	71	91	48	68	20	42	2	4
NACPEC 2005	2005	90	85	94	85	94	60	71	29	48	4	7
NACPEC 2008	2008	51	44	86	45	88	43	96	20	47	4	9
Expedition total		1208	961	79	1108	91	657	59	264	40	96	15
Other***		142	0	0	142	100	47	33	36	77	15	32
Grand Total		1350	961	71	1250	93	706	56	294	42	109	15

* A germplasm collection that exists at only one institution; may be of one or multiple plants

** A germplasm collection that is represented by a lone plant at one institution

*** Include collections made during tourist visits, as well as those collections made through contract



NANCY ROSE

Acer pseudosieboldianum is another garden-worthy small maple collected on several of the NACPEC expeditions.



Bai Genlu (back to camera), Wang Kang (white hat), Li Jianjun, and Anthony Aiello examine *Acer caesium* ssp. *girdii* (NACPEC08-014) in Hong He Gu Forest Park, Shaanxi.

collecting efforts, and will allow us to focus our efforts on propagating and distributing plants of horticultural, botanical, and conservation significance.

Lastly, and perhaps most importantly, we acknowledge the cultural exchange that has occurred among the American and Chinese institutions and the individuals involved. Without these lasting relationships none of these expeditions or the resultant collections would have occurred. The end result is a mutual affinity and deep appreciation for the relationships that have ensued.

Bibliography

- Aiello, A.S. 2006. Plant collecting on the eaves of the world. *The Plantsman* 5 (4): 220–225.
- Aniško, T. 2006. *Plant exploration for Longwood Gardens*. Timber Press, Portland, Oregon.

Del Tredici, P., P. Meyer, R. Hao, C. Mao, K. Conrad, and R. W. Thomas. Plant Collecting on Wudang Shan. *Arnoldia* 55(1): 12–20.

Dosmann, M. and P. Del Tredici. 2003. Plant Introduction, Distribution, and Survival: A Case Study of the 1980 Sino–American Botanical Expedition. *BioScience* 53 (6): 588–597.

Lighty, R.W. 2000. An assessment of ornamental plant introduction in the not-for-profit sector. In: J. R. Ault (ed.) *Plant Exploration: Protocols for the Present, Concerns for the Future* (Symposium Proceedings). Chicago Botanic Garden, Chicago, Illinois. pp. 14–22.

Meyer, P. W. 1999. Plant Collecting Expeditions: A Modern Perspective. *The Public Garden* 14 (2): 3–7.

Anthony S. Aiello is the Gayle E. Maloney Director of Horticulture and Curator at the Morris Arboretum of the University of Pennsylvania, and Michael Dosmann is Curator of Living Collections at the Arnold Arboretum.

Table 3. List of NACPEC *Tsuga* collections.

Taxon	Coll. #	How Material was Collected	Province of origin	Collection alive?	Number of Institutions growing this collection	Total plants among all institutions
<i>Tsuga chinensis</i>	Cui 97-053	Seed	Shaanxi	yes	4	24
	Cui 97-054	Seed	Shaanxi	yes	4	26
	NACPEC05022	Seed	Gansu	yes	3	12
	NACPEC05063	Seed	Gansu	yes	4	12
	QLG013	Seed	Shaanxi	yes	3	7
	QLG188	Seed	Shaanxi	yes	6	20
	QLG190	Seed	Shaanxi	yes	7	18
	QLG193	Seed	Shaanxi	yes	6	23
	QLG216	Seed	Shaanxi	yes	2	9
	QLG217	Seed	Shaanxi	yes	3	17
	SHX017	Seedling	Shaanxi	yes	1	1
	XBG s.n.	Seed	Shaanxi	yes	1	5
Subtotal	12			12 living (100%)		174
<i>Tsuga chinensis</i> var. <i>oblongisquamata</i>	TS 99-018	Seed	Sichuan	yes	4	22
	TS 99-022	Seed	Sichuan	yes	5	11
	TS 99-025	Seed	Sichuan	yes	2	22
	TS 99-026	Seed	Sichuan	yes	3	9
	TS 99-027	Seed	Sichuan	yes	4	9
	TS 99-033	Seed	Sichuan	no	0	0
Subtotal	6			5 living (83.3%)		73
<i>Tsuga chinensis</i> var. <i>tchekiangensis</i>	TS 98-046F	Seedling	Jiangxi	yes	1	2
	TS 98-058B	Seed	Guangxi	yes	1	1
	TS 98-035E	Seedling	Jiangxi	no	0	0
	TS 98-036E	Seedling	Jiangxi	no	0	0
	TS 98-040H	Seedling	Jiangxi	no	0	0
	TS 98-042C	Seedling	Jiangxi	no	0	0
	TS 98-043E	Seedling	Jiangxi	no	0	0
	TS 98-044F	Seedling	Jiangxi	no	0	0
	TS 98-051B	Seedling	Guangxi	no	0	0
	TS 98-051C	Cuttings	Guangxi	no	0	0
	TS 98-052B	Seedling	Guangxi	no	0	0
	TS 98-062B	Seedling	Guangxi	no	0	0
	TS 98-066B	Seedling	Guangxi	no	0	0
	TS 98-066C	Cuttings	Guangxi	no	0	0
TS 98-069	Seedling	Zhejiang	no	0	0	
Subtotal	15			2 living (13.3%)		3
Grand Total	33			19 living (57.6%)		250