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The ARNOLD ARBORETUM of HARVARD UNIVERSITY

CONTENTS

Front cover: Shrubs—like golden current (*Ribes aureum,* 1119-83*A)—are important components of pollinator-garden designs. Photo by Danny Schissler.

Inside front cover: Ernest Henry Wilson photographed this Ussurian pear (*Pyrus ussuriensis*) near Unsan, North Korea in 1918.

Inside back cover: Ussurian pear (*Pyrus ussuriensis*) at the Arnold Arboretum, clockwise from bottom right: flowers on 391-85*A, leaves on 788-84*A, and size of *P. ussuriensis* var. *hondoensis,* 11728*A. Photos by Danny Schissler (lower) and Kyle Port (upper).

Back cover: Chinese photinia (*Photinia davidiana,* 1993-80*C) displays striking fruit in the Bradley Rosaceous Collection. Photo by Michael Dosmann.

What the Rose Knows: Navigating Rosaceae at the BRC

Erica Bowman

Taken literally, Gertrude Stein's famous phrase "Rose is a rose is a rose" might have raised the collective eyebrows of a few scholars of the rose family (Rosaceae). After all, more than four thousand species and one hundred genera make up this complex family of woody and herbaceous plants. Robert Frost rendered these botanical relationships more accurately, writing, "The apple's a rose, / And the pear is, and so's / The plum, I suppose," yet even he failed to mention less-lyrical genera like *Spiraea, Cotoneaster,* or the elusive *Prinsepia,* not that anyone could blame him. Frost was no more a taxonomist than Stein, or, ahem, a lot of landscape designers. Like poets, we landscape designers are primarily artists. When we develop botanical collections, plant specimens are the stars, and the genius lies in their artful and memorable arrangement. Strict taxonomic accuracy has never been our primary role.

When the Julie Moir Messervy Design Studio (JMMDS) was hired to help redesign the Arnold Arboretum's Bradley Rosaceous Collection (BRC) in 2007, the objective was simple. We wanted to improve upon the sense of space in the existing garden without disturbing the living collection or dishonoring its legacy. We wanted the garden to be lightly educational, a place where visitors could experience taxonomic order in a beautiful, satisfying setting. We were determined to use an organizational

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Gertrude Stein's famous line "Rose is a rose is a rose" first appeared in the 1913 poem "Sacred Emily." Robert Frost co-opted part of the phrase to open "The Rose Family," a poem published in 1928. This specimen of Macdougal's rose (*Rosa nutkana* ssp. *macdougalii,* 516-78*MASS) was wild-collected in British Columbia.

DAVID BASLER AND MARGARET KOSMALA, HARVARD UNIVERSITY

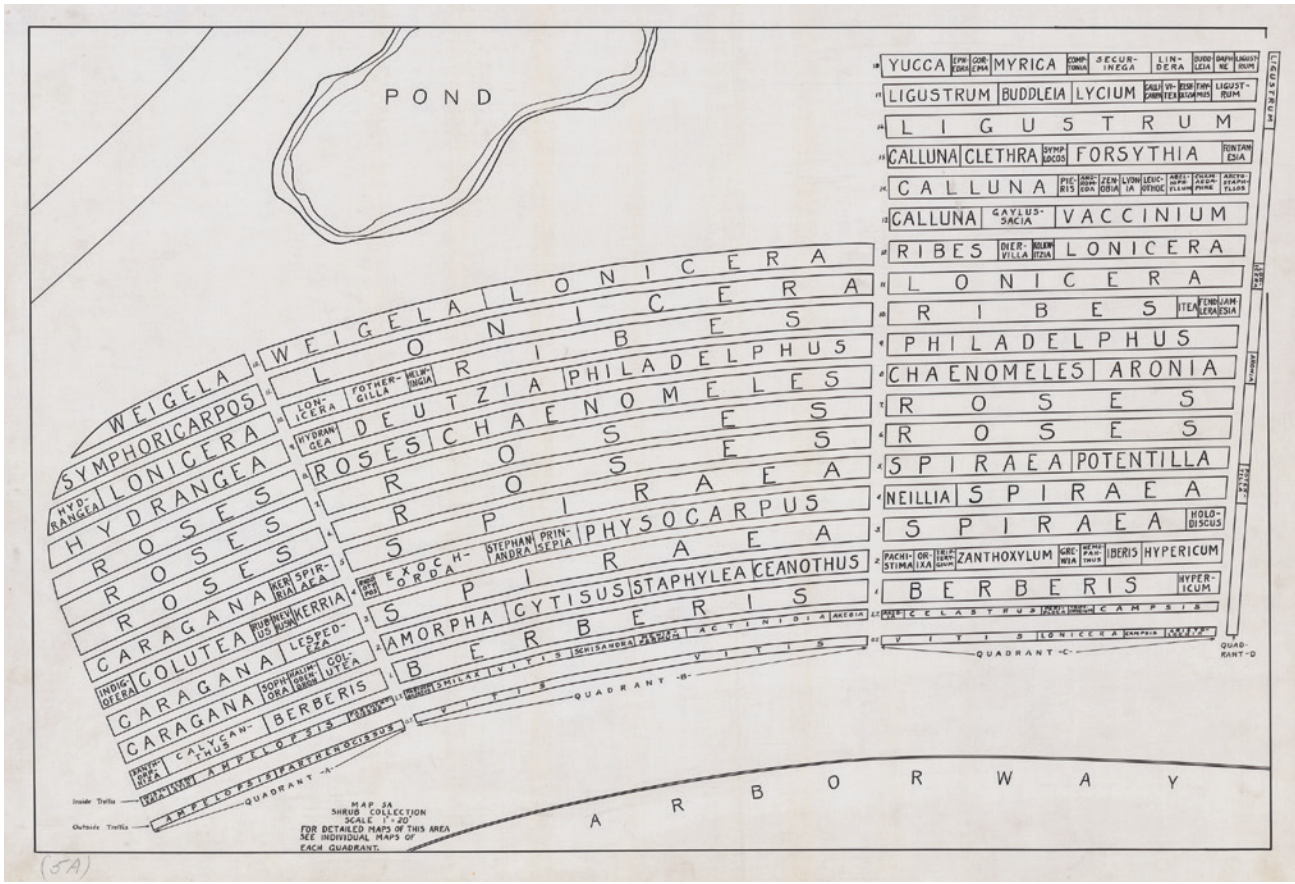
Swooping bed lines in the BRC demonstrate Olmstedian sensibilities. In this photograph, taken above the east beds in May 2017, elements of the original 1980s layout can be detected as swaths of darker turf. The main flowering specimens shown in each bed, clockwise from the bottom left, are Wilson spirea (*Spiraea wilsonii,* 545-93), Henry spirea (*S. henryi,* 1121-86), another Wilson spirea (953-85), and smooth oriental photinia (*Photinia villosa,* 934-85). Dawson Pond brims with spring rain on the left.

structure that visitors could intuitively understand through passive experience, whether or not they were botanical scholars. Mostly, we hoped that the garden would appear rejuvenated, while still reverent to the surrounding landscape that was developed by Frederick Law Olmsted and Charles Sprague Sargent, the first director of the Arboretum.

All of this—simple as it initially seemed—was no minor responsibility. The list of stakeholders was vast and intimidating. There were donors to consider and staff to please. We had to be respectful of the Arboretum's legacy, honoring the institutional position within both Harvard University and the City of Boston. We even had to consider the reputation of the esteemed plants themselves. Julie Moir Messervy had already been inducted into the Arnold's folds. In addition to lecturing there on numerous occasions, she designed the Linda J. Davison Memorial Path that winds along Bussey Brook. She also planned the landscape surrounding the granite bench that overlooks the BRC.

Despite my role as project manager, I was a relative newbie on this scene, having just started working with JMMDS. I completed my MLA at Cornell in 2003, where, under Professor Don Rakow, I studied some of the world's most hallowed gardens: Longwood, Kew, and the Arnold Arboretum. My arrival at the BRC felt monumental to say the least. I knew I was on sacred grounds.

ARNOLD ARBORETUM ARCHIVES



The location now occupied by the BRC was formerly known as the Shrub Collection, a series of long, straight rows that existed from 1885 through about 1982. By the time the Arboretum was first systematically mapped in the late 1930s, roses—that is, specimens of *Rosa*—occupied the center of the Shrub Collection, the most dominant genus growing there.

When we began our work, the BRC contained over forty Rosaceous genera and up to four hundred different taxa. Keeper of the Living Collections Michael Dosmann (who then held the title of Curator) provided a "desiderata" of seventy-five additional taxa that the Arboretum wanted to incorporate into the design. The existing collection was not presented in an obvious order within the family itself. According to feedback from gardeners and staff, many visitors didn't understand the taxonomic connection between woody Rosaceous genera and plants in the Arboretum at large. Some plants were duplicated; others were overgrown. And visitors and staff both complained that most of the *Rosas* had a very short season of bloom, primarily in the month of June, and that even then, many of their differences were subtle and hardly obvious. Much of the time, the roses presented themselves as a sea of thorny stems. Each rose in the vast collection could be mistaken as just another rose. A rose was a rose was a rose.

Moreover, although the beds were clearly defined, we wanted to improve upon the overall sense of place and intensify the experience of journey. We use "sense of place" to mean everything that defines a unique and recognizable landscape. Take Central Park, for example: A visitor can look up at the skyscrapers and then look down to see the Reservoir, the Great Lawn, and the stony bridges. Even with eyes closed, they will experience the sounds and smells that define the iconic city park. All of

this contributes to their sense of being located in a memorable place in the world—exactly what we wanted for the BRC.

Our creative process always involves iteration, beginning with the development of an overarching "big idea." We considered a wide range of thematic concepts for the BRC. We envisioned the botanical structure of a rose flower, for example, with its five petals and sepals as a template for bed shape and placement. We compared contemporary and classic interpretations of the rose in folklore, religion, literature, and romance. These ideas were manifested in overlays of pencil upon tracing paper, often times starting and ending as scrawled words in the margins: "What Rosaceous plants are mentioned in Shakespearean plays? What was the significance of the rose in world religions? How are Rosaceous plants used medicinally?"

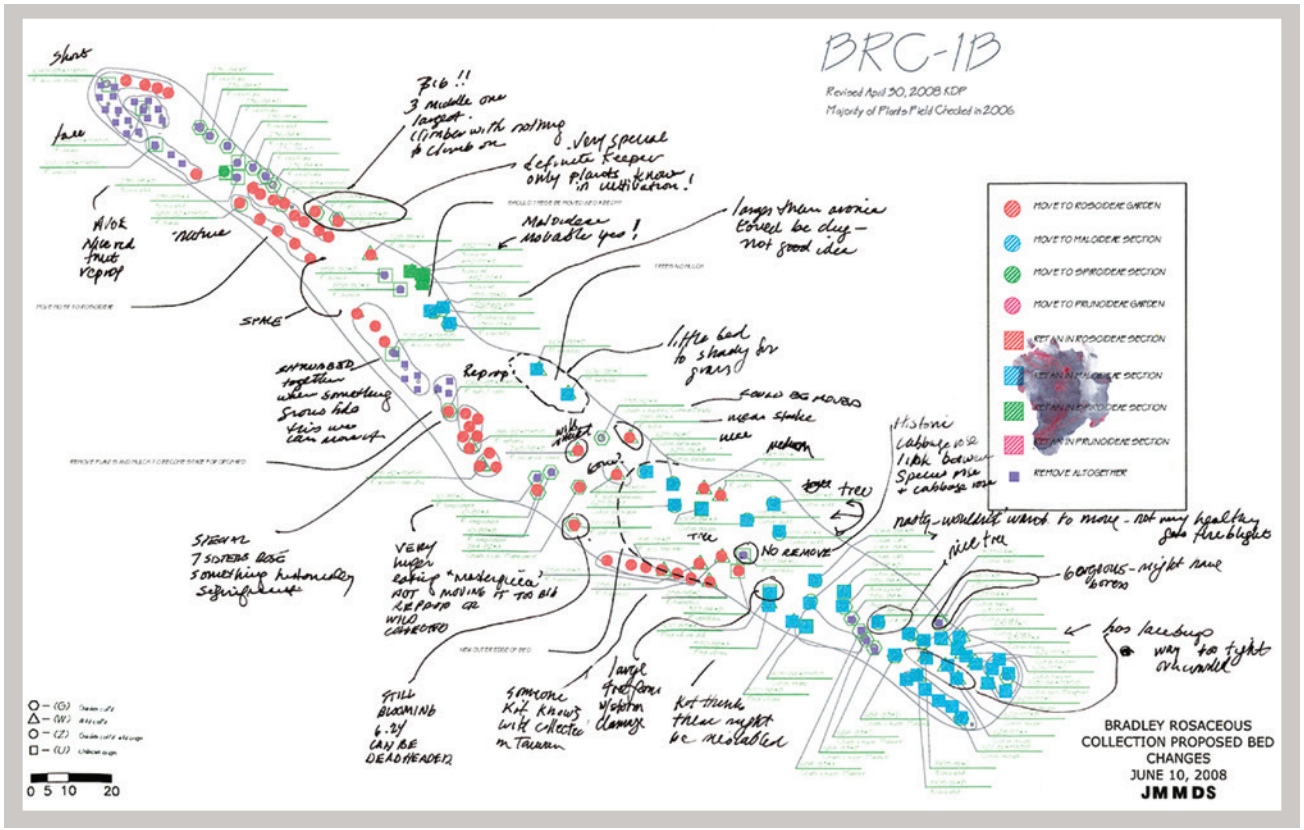
We sketched routes and journeys for the pedestrian to travel from place to place, borrowing inspiration from Olmsted's pastoral style. We sketched potential bed outlines, envisioning new outdoor rooms and meeting spaces, new places to sit, and new views to see. The resulting documents were beautiful but chaotic, a palimpsest of possibilities. Still, the big idea hadn't taken hold.

At JMMDS, we recognize that a big idea can evolve from many places. When Julie worked with Yo-Yo-Ma on her design for the Toronto Music Garden, they used Bach's Suite no. 1 in G Major for Unaccompanied Cello as a musi-

ARNOLD ARBORETUM ARCHIVES

The BRC was endowed by Eleanor Cabot Bradley, pictured in white at the dedication ceremony on June 12, 1985. Her daughter Elizabeth Cabot Sluder is shown planting a ceremonial rose. Arboretum Director Peter Ashton stands second from the right, beside Horticulturist Gary Koller, who crafted the original garden design. In 2007, Sluder graciously supported the garden renovation.

JULIE MOIR MESSERVY DESIGN STUDIO



This 2008 renovation map uses color codes to indicate which plants were included in each of the old Rosaceous subfamilies. Rosoideae is shown in red, Maloideae in blue, and Spiroideae in green. (This particular bed had no members of Prunoideae.) Marginal comments describe horticultural characteristics and backstory for specific accessions.

cal template. The resulting garden is a celebration in six movements—prelude, allemande, courante, sarabande, minuet, and gigue—all rhythmically expressed as wooded paths, great spiraling landforms, bee-filled plantings, and oversized grass steps. JMMDS's design for the Inspiration Garden at the Shore Country Day School in Beverly, Massachusetts, on the other hand, took the feel and form of the school's mascot, the beaver. We recreated habitat with native plantings and erected an outdoor classroom shaped like a beaver lodge.

While brainstorming the big idea for the BRC, we looked again at a base map the Arnold had provided. It included a key with four subfamilies: Rosoideae, Spiroideae, Maloideae, and Prunoideae. As it turned out, these subfamilies had already become outdated, yet from a design perspective, the groupings created a useful ethnobotanical order. Rosoideae traditionally included, among other things, roses and brambles (*Rosa* and *Rubus*), so for that subfamily, we imagined a classic rose garden with arbors, benches, and other ornamental features. Maloideae contained apples (*Malus*) and hawthorns (*Crataegus*), along with a number of larger tree species, so we thought of an orchard planting. Prunoideae inspired us to think of ornamental trees blooming at a Japanese *sakura* festival, because the most dominant genus in the group includes cherries and plums (*Prunus*). Spiroideae—with members like nine-bark (*Physocarpus*), pearl-bush (*Exochorda*), and spirea (*Spiraea*)—brought to mind a well-ordered shrub collection.

Obsolete or not, this historical classification helped us organize a series of places, each with their own beauty and meaning, and all connected by a journey through the larger family. We tentatively named these components the

Rosoideae Roundabout, the Maloideae Meander, the Prunus Promenade, and the Spiroideae Stroll. Keeping this old taxonomic organization had the added benefit of allowing us to maintain the larger, less-movable trees in their place, given that many were grouped taxonomically already. This allowed the greatest amount of transplanting and bed realignment to happen with the more manageable roses and shrubs. It also made the plant groupings easy to comprehend on a basic level. We hoped that a visitor might be able to travel from area to area and immediately sense order within the groupings.

The Arnold staff and donors tried to help us make this plan work. They steered us away from the literal interpretation of the old subfamilies and suggested slight verbiage shifts that would allow for a sort of compromise of ideals between taxonomy and design.

"Let's call it a 'collection of arborescence' rather than a literal orchard," one person offered.

"*Fruiting* arborescence?" we countered.

To that they agreed.

By "arborescence," of course, we meant "trees." That is the way botanists and landscape designers talk. Sometimes we pontificate in French, Latin, and Greek, other times in ultra-syllabic versions of regular English ("fenestration" instead of "windows," "rectilinear" instead of "rectangular").

Yet, to communicate with the rest of the normally speaking world, we needed to tone down our jargon. So we retracted the place names

KYLE PORT

JMMDS imagined a section of flowering cherries that would invoke the spirit of *hanami*, the Japanese tradition of celebrating the transient beauty of spring. Here, visitors gather in the Prunus Promenade on April 30, 2013.

Maloideae Meander and Spiroideae Stroll, which were a mouthful anyway, but we maintained the idea of shrub- and orchard-like collections. Rosoideae Roundabout seemed to work, especially since this subfamily was still legitimate, but the name was reduced to the Rose Roundabout for good measure. The Prunus Promenade was too lyrical to abandon. We had found our big idea.

Cost, availability, and establishment time almost always influence plant selection and expectations. When we design a garden, we make plant choices based on nursery catalogs and availability lists. We're also used to waiting a bit before our designed landscapes grow into themselves. That is just part of the practice. For a perennial garden to reach its prime, three years is the normal window. Most practitioners plan for a fifteen-year grow-in period for trees. These establishment times assume that, at installation, perennials are gallon-sized and trees have a 1.5- or 2-inch caliper trunk. Even this can be too small and slow for some clients. In those cases, we can crane in mature twenty-foot trees with six-foot root balls for an immediate impact. This is costly but instantly satisfying.

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MICHAEL DOSMANN

Provenance is important for plants in the BRC, whether a specimen of Japanese kerria (*Kerria japonica*, 237-2008*B), which was wild-collected in Gunma Province, Japan, or a 'Donald Wyman' crabapple, propagated from the original specimen on Peters Hill (23254*A).

The BRC is no average garden, however, and the Arnold certainly doesn't require instant satisfaction. As part of the larger living collections, every plant in the BRC has a standardized accession number, and all new acquisitions must meet the requirements laid out in the Living Collections Policy. Many new accessions are wild-collected as seed and then grown in the Arboretum's nursery. Even the addition of new cultivars can take time. For instance, the crabapple *Malus* 'Donald Wyman,' which the Arboretum introduced in 1970, was repropagated from the original tree, even though a large specimen could have been purchased from a commercial nursery. With these considerations in mind, it made sense to tackle the Rose Roundabout first, because those plants were the quickest growing and most easily movable. The completion of the Prunus Promenade and orchard collection could wait.

New and unfamiliar plant material was another obstacle for our team to clear. Few genera in the BRC were completely new to us, but more

often than not, we were in the practice of working with more widely available, commercially propagated plants. We have had much less experience dealing with straight (and often obscure) species like the ones that fill the BRC. Delving into Rosoideae was particularly demanding with a large number of plants that seemed, at first glance, to have similar outward characteristics in the off-season: almost all were thorny and shrubby. We needed to learn more about the specimens in order to make design decisions. As the resident plant person at JMMDS, I was sent to the Arnold to receive some additional schooling.

I spent days walking around with Kit Ganshaw, the long-time BRC horticulturist, discussing the particulars of each plant. Within Rosoideae alone, I learned that the Arnold had a large planting of *Rosa* 'Justine Mee Liff', a cultivar named for the first woman to serve as Boston parks commissioner. The cultivar 'Duchesse de Montebello' was an important gift from the Bradley family and needed to be preserved, especially as we ultimately reduced the garden in that location to make way for a new path. While the yellow-flowered incense rose (*R. primula*) is the first rose to bloom in the garden, the single specimen of climbing prairie rose (*R. setigera*) was significant in that it blooms in July, after most other species are done. The apple-scented blossoms of the sweetbrier rose (*R. eglanteria*) feature in the writings of Shakespeare. The white-stemmed bramble (*Rubus cockburnianus*) provides great winter interest with its showy stems, and Sweginzow's rose (*Rosa sweginzowii*) is noticed for its glorious hips. Mount Omei rose (*R. omeiensis*) grows up to twelve feet tall, has bright red thorns and an atypical arrangement of four petals to its flower. A trellis-worthy cultivar of Scotch rose (*R. spinosissima* 'Plato') was deemed a very special plant because it came from the Duke of Buccleuch's estate garden—considered one of the premier rose collections when Sargent received a shipment of cultivars in 1914—and it may be the only specimen of 'Plato' remaining in cultivation. The claim of fame for serafin rose (*R. serafinii*), according to Kit, is that is has the "nastiest hooks" in the whole collection. Whew!

MENG LI

MENG LI

Other plants with known wild origins include this Henry spirea (*Spiraea henryi*, 302-84*A), which was repropagated from an accession Ernest Henry Wilson collected in western Hubei, China, and this specimen of *Rosa zalana* (928-78*G), which was collected north of Budapest, Hungary.

Rose by Rose, Cobble by Cobble: A Garden Renovation

Michael S. Dosmann and Stephen Schneider

It was January of 2007, Michael's first week as Curator of Living Collections, when former Arboretum Director Bob Cook presented three immediate curatorial priorities: reenvision the Arboretum's Living Collections Policy, implement environmental monitoring systems (including GIS), and "do something about the rose garden." Despite several decades of care and attention since its intentional design in the early 1980s, the Bradley Rosaceous Collection (BRC) had become overgrown and lost its focus. Both the addition *and* subtraction of plant material had been limited. From a curatorial perspective, the dense plantings were a nightmare to label and keep authentic. It was time to make things right for a family with deep ties to the Arboretum by holding ourselves accountable to high levels of care and curation.

In crafting a new vision for the BRC, we wanted to celebrate plant diversity writ large: not just botanical diversity provided by wild-collected woody species, but also cultivated diversity so richly illustrated by old and new cultivars. Accessions in the BRC, like those elsewhere in the Arboretum, would be valued based upon their full documentation and provenance, not simply a hierarchy of wild over cultivated origin. The attention to cultivated diversity would also solve a problem for us: come midsummer, few things in the garden bloomed. By adding new cultivars of roses (and other species), we could increase the garden's display potential.

Around this time, we were dramatically rethinking how we deployed resources for horticulture. Under the leadership of former Deputy Director Richard Schulhof, the Arboretum launched an initial Landscape Management Plan (LMP) in 2007. The LMP prescribed expectations for arboricultural and horticultural care throughout the collections, including the BRC. Simultaneously, we undertook a curatorial review of all plants in the BRC to determine which lineages to preserve. The garden was packed, and the last thing we wanted was to renovate again in ten years.

Even so, we still lacked the perspective that only a garden designer could provide. We needed innovative ways to organize plants that would maximize display potential (including for "BIO" plants that possess "botanical interest only"). We also needed to improve the visitor experience. Without a formal entrance, the garden lacked a sense of arrival. Circulation also demanded attention. While the existing bed configuration (full of tall, dense shrub masses) created intimate garden rooms, it also inhibited visitor exploration due to fear of the unknown or even concerns for safety. In Julie Moir Messervy Design Studio, we found technical expertise to help us tackle these and other problems. Erica and Julie provided both creative genius and sensitivity to the project (and its idiosyncratic client). Although we didn't intend to completely redo the five-acre site, we were seeking a major renovation.

Shortly after the project launched in 2008, the Great Recession hit, forcing us to adjust the initial timeline that had called for a single season of renovation using contracted labor. The budget also caused us to rethink aspirations for formal paths and benches, at least initially. Instead, we used our in-house team of horticulturists and interns for the renovation, extending the bulk of the project from one year to three. With JMMDS's new plans in hand, we completely deconstructed some beds, while others were reshaped or constructed anew. This involved handling some 10,000 double cobbles, and a parade of pallets formed along Forest Hills Road.

MICHAEL DOSMANN

Shifting stones. Double cobbles were installed around a new bed in September 2010, while exposed soil remained visible in the footprint of an old bed (at right).

The new plans identified plants to remove, as well as plants that could shift to new locations in the BRC. In some cases, the move could occur instantly, but because of the renovation's phased approach, other plants were transplanted to a temporary location near the Dana Greenhouse and Nursery's south nursery until new beds could be created. This intricate dance kept staff on their toes as they ensured plants were labelled and documented at all times. The greenhouse and nursery staff maintained these, while repropping important accessions from the BRC and beyond.

Before we knew it, old beds morphed into turf and new beds appeared. Fresh rose cultivars extended the bloom season in the Rose Roundabout as well as other spaces in the garden. The Prunus Promenade materialized as trees were planted out (including additional cultivars). By the spring of 2011, most of the work was completed, including the installation of Peter Andruchow's beautiful arbor in the Roundabout. This destination for climbing roses was dedicated to Elizabeth Cabot Sluder (daughter of Eleanor Cabot Bradley) during an event with family and staff on June 18.

We continue to implement elements of the JMMDS plan for the Bradley Rosaceous Collection. The orchard, comprising a diversity of harder-to-acquire germplasm, has taken some time to fill in, but as of this spring, we are about three-quarters of the way there. In 2013, we hired Peter to construct a second arbor, identical to the one in the Roundabout, which serves as an entry portal between two new beds along Meadow Road. We have also installed granite seating—akin to the bench Julie helped design above the BRC years before—as part of the Arboretum's new Commemorative Bench Program. Gardens, ever changing and dynamic, evolve and grow. The nearly 150-year history of this location, near the Forest Hills Gate, is a perfect example.

Michael S. Dosmann is Keeper of the Living Collections and Stephen Schneider is Director of Operations at the Arnold Arboretum.

ARNOLD ARBORETUM GIS/HARVARD PLANNING AND PROJECT MANAGEMENT

This 2015 photograph shows the BRC as redesigned by JMMDS, while the yellow outlines depict contours of the original 1980s design. The Rose Roundabout is located on the left, while the beds to the right primarily showcase Rosaceous shrubs. Notice that cherries are flowering pink and white in the Prunus Promenade. The orchard collection is located in the lawn near Willow Path, which runs along the top side of the collection.

Additionally, we identified problem plantings. Some masses like prickly rose (*Rosa nipponensis*) needed reduction. Others, like wood rose (*R. gymnocarpa*) needed increasing. *R.* × *nitidula* was too tall for the front of the garden, while interior rose (*R. woodsii*) and an unusual Taiwanese species (*R. transmorrisonensis*) were too short for the back. Species like red-spined rose (*R. nitida*) and swamp rose (*R. palustris*), both wet-loving, might have been better suited near the ponds, and longtooth rose (*R. longicuspis*) needed a trellis. Some of the catalogued plants were even missing from the field, including the namesake Arnold rose (*R.* × *arnoldiana* 'Arnold').

Clearly, reorganization was in store. Ultimately, we would suggest removal of sick and duplicated plants, reduction of colonies, and organization by height, habit, and bloom period to create densely alluring focal points throughout the summer. We fine-tuned the shape of the beds to improve circulation, pauses, and views. We also designed a main entrance and a circumferential route around the garden. Still, even with restructuring, we were concerned that some distinctions between plants might be too subtle for the average visitor.

Our instincts wanted to make the whole collection more photogenically engaging. We wanted to intersperse herbaceous rose family

JULIE MOIR MESSERVY DESIGN STUDIO

This illustration shows the initial design concept for the entrance arbors.

KYLE PORT

***Rosa* 'New Dawn' (712-2010*A) grows over the Rose Roundabout entrance.**

plants, like lady's mantle (*Alchemilla mollis*), meadow sweet (*Filipendula rubra*), and avens (*Geum* spp.), between colorful rose hybrids. The Arnold pushed back on that idea, favoring a more dignified, uncomplicated (if not staid) order to things. Our mixed-garden proposal also complicated the maintenance practice at the time, which emphasized a clean contrast between mulch and woody specimens. That approach is easier to maintain, since any invading plant can easily be identified as a weed. Our compromise was to integrate longer-blooming hybrid roses like 'Radtko' (Double Knock-out®), 'Chuckles', 'Bucbi' (Carefree Beauty™), and 'AUSbord' (Gertrude Jekyll). We still dream of incorporating more herbaceous members of the rose family. In the very least, we want to eliminate views of mulch.

To honor philanthropist Elizabeth Cabot Sluder, we designed a new arched entrance to the Rose Roundabout and put metal artist Peter Andruchow of Wovensteel to work. JMMDS designer Jana Bryan incorporated features from the Arboretum's wrought-iron main entrance into the design, and she also added hallmark puddingstone boulders at its base. We selected a delicate, pink climbing rose (*Rosa* 'New Dawn') to clamber across the archway, a departure from the shrubbier citizenry of the Roundabout. The plants were shielded within the protective hollow of the arch's tri-scrolled feet.

When we evaluated existing plants in other parts of the garden—the orchard, the Prunus Promenade, and the shrub collection—it was mostly for location, health, quantity, and appearance. Unlike the *Rosas,* few of these plants came with noteworthy

S. A. PFEIFFER

The BRC redesign includes two wrought-iron arbors, one at the entrance to the Rose Roundabout, the other, pictured here, along Meadow Road.

backstories, other than a rare Chinese species of mountain ash, *Sorbus yuana,* which was one of the first accessioned in the United States.

We identified some plants as stand-out ornamental specimens, including Toringo crabapple (*Malus sieboldii*), intermediate shadbush (*Amelanchier intermedia*), and petalless cherry (*Prunus apetala*), along with the grove of quince trees (*Cydonia oblonga*). We noted that the trio of Siberian crabapples (*Malus baccata*) were beautiful trees that could offer a transition between the orchard and shrub collections. We also catalogued a large and beautiful cultivar of black cherry (*Prunus serotina* 'Cartilaginea'), a tall and stately example of Gray's chokecherry (*P. grayana*), and an early blooming favorite of visitors, cyclamen cherry (*P. cyclamina*). One unconventional hybrid, (× *Sorbaronia* sp.) × (× *Sorbocotoneaster* sp.), was so appealing that Julie marked it as something we should find in the trade. We haven't seen it yet.

In order to create distinct areas within these portions of the landscape, we needed to move a lot of plants around. One of our aims was to remove mulch beds around large standard trees, allowing the trees to spring directly from the lawn, while reserving beds for shrub groupings. Additionally, we wanted to improve upon the beauty and understandability of the space by reducing clutter, redundancy, and confusion. This meant moving plants like Nantucket shadbush (*Amelanchier nantucketensis*) out of the Prunus Promenade, despite their beauty. To give more space to the handsomely fruited medlar (*Mespilus germanica*), it was necessary to remove a Wilson spirea (*Spiraea wilsonii*)

MENG LI

This highland drophip rose (*Rosa oxyodon,* 295-2008*A) was wild-collected on the north side of Lake Sevan, Armenia.

KYLE PORT

Double Knockout® (*Rosa* 'Radtko', 709-2010*A) was among the showy cultivars that extended the bloom season. It was photographed here on October 22, 2013.

that had invaded its folds. This was fine by Kit, who was very comfortable reducing size and clutter through pruning.

It was actually Kit who introduced me to the term *rejuvenation pruning,* the process of pruning a shrubby plant to the ground in order to bring about a new and improved flush. While I was not in the practice of making such sudden and brutal cuts on slower-growing plants, the Arnold, on the other hand, is a practical institution and nothing if not patient. This willingness to wait and withstand the awkward stages actually freed up decision making. Rather than removing a rangy or overgrown plant, we could opt to rejuvenate it instead. Specimens of Laland firethorn (*Pyracantha coccinea* 'Lalandei'), flowering quince (*Chaenomeles*), and spirea (*Spiraea*) were all candidates for this treatment.

Some plants were outright deaccessioned because of age, disease, redundancy, bad form, or incorrect placement. While a one-hundred-year-old dwarf Siberian peashrub (*Caragana arborescens* 'Nana') escaped the chopping block, several large and lovely Kousa dogwoods (*Cornus kousa*) did not. Their removal from along Willow Path was perhaps the most painful part of the demolition phase for me. Although their execution papers were signed in the effort to purge non-Rosaceous plants, I mourn their loss to this day.

Renewal of the BRC opened spaces for planting new specimens. Since we were not in the position to know the exact plants for future accessions, we designed plantings by genus and habit (e.g., "*Malus,* arborescent species.") This allowed Arnold staff the freedom to grow and add new

MENG LI

Cyclamen cherry (*P. cyclamina*, 706-31*B) is native to south-central China.

specimens as we moved into the future. In this respect, our role at the Arboretum has been different from other design jobs: We were not the most qualified plant experts on the team. We had to cede that role.

It may be many more years before all of the plants have grown to maturity and our vision of the new BRC is realized. By then, scholarship surrounding plant classification will have continued to shift, as will the garden. This is the challenge faced by gardeners and taxonomists alike: constant momentum. The art of a garden is never static. It sprouts weeds and seeds, and begins to seek its own expression. This is why most garden designers like to remain involved in order to see their plans to fruition. Otherwise we are at the whim of nature, or to whomever holds the pruning shears.

Erica Bowman is a senior landscape architect for Julie Moir Messervy Design Studio, where she manages projects in New England and beyond. She holds an MLA from Cornell University. She also writes for *Horticulture Magazine*.

Shrubs and the Pollinators Who Love Them

James Gagliardi and Holly Walker

Pollinators are an essential part of our gardens, the ecosystem, and the United States economy. One in three bites of food you eat depends on pollinators. Honeybee pollination adds more than $15 billion to the value of agricultural crops in the United States each year, with another $9 billion coming from pollination by other species. Pollinator populations have been declining after decades of stress related to loss, degradation, and fragmentation of habitat; reduction in the number and quality of food sources; a lack of sites for breeding, nesting, and roosting; and improper use of pesticides and herbicides. Gardeners can be part of the solution to pollinator loss by creating landscapes that support pollinator health.

From butterflies and bees to beetles and birds, many different kinds of pollinators have evolved within their ecosystems, building unique relationships with plants. When gardeners think of designing landscapes for pollinators, they may imagine plantings of floriferous herbaceous beds; however, trees and shrubs are essential components of the habitat required to support a wide variety of pollinators.

For successful pollination, a pollinator must find a flower with a structure that matches its body. Consider a butterfly feeding on a daisy-like composite flower. The butterfly will gracefully land on the inflorescence and elegantly unfurl its proboscis, which it precisely inserts through the long narrow tube of a central disc

WILLIAM (NED) FRIEDMAN

This congregation of honeybees (and one beetle) was spotted on bigleaf magnolia (*Magnolia macrophylla* ssp. *macrophylla*, 961-89*B).

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Pollen loads the hind legs of this honeybee, which was noticed on the early spring flowers of an Ozark witch-hazel (*Hamamelis vernalis,* 6099*D).

flower to drink nectar hidden inside. During this process, a cleverly positioned anther (male flower part) rubs against the butterfly depositing pollen. After drinking nectar, the butterfly flutters away to the next bloom where the pollen will be brushed against the stigma (female flower part).

Now consider beetles, which are sometimes referred to as "mess and soil" pollinators because of how they blunder their way through blossoms searching for food. Beetles are important pollinators for flowers like those of magnolia species, often arriving early in the season when temperatures are still too cool for most other pollinators. Since beetles did not originally evolve as pollinators, plants had to adapt to find a way to lure these insects. Most early-season beetles are attracted to rotting materials, as many beetle grubs are decomposers of decaying wood and plant tissue. The strongly fruited or slightly fetid smells associated with magnolias play on these preferences.

Beetles don't possess special pollen-collecting features. Instead, with magnolias, they get covered in pollen while chewing on anthers and tepals (the term for undifferentiated petals and sepals). They then carry the pollen to the next flower. The process may not be as refined as that of a butterfly, but it is just as necessary for certain plants. Beetles are ancient and rank among the earliest evolving pollinators. Therefore, their correlation as the pollinator of ancient plants like magnolias makes evolutionary sense. Beetles and magnolias existed before bees and butterflies, and though bee pollination has been observed on several mag-

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At Smithsonian Gardens, the Urban Bird Habitat is located on the south and west sides of the National Museum of Natural History, not far from the Pollinator Garden.

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Virginia sweetspire (*Itea virginica* 'Henry's Garnet') is an exceptionally adaptable shrub in the Smithsonian's landscape.

nolia species at the Arnold Arboretum (see Juan Losada's 2014 article in *Arnoldia*), the unique connection between these beetles and plants was developed well before other players arrived to the pollination game.

At the Smithsonian Pollinator Garden in Washington, DC, we showcase trees, shrubs, and herbaceous plants that support a wide array of pollinators and other wildlife. The garden occupies a relatively small footprint in the urban landscape. In a 400-by-40-foot space, we cultivate more than two hundred types of plants, including many woody species. Diversity and seasonality are among the most important factors when choosing plants for pollinators. Plants with high wildlife value and great aesthetics help our public landscape achieve our goals of creating a healthy ecosystem, while both attracting and educating our visitors.

Selecting Shrubs for Pollinators

The evolution and lifecycle of shrubs make them a particularly important part of a wildlife garden. All of the shrubs on this list are tough and adaptable in Mid-Atlantic gardens and often beyond. In addition to producing beautiful pollinator-attracting blooms, many have multi-season horticultural impact. When choosing the best combination of plants for the landscape, be sure that you plan for a garden that serves pollinators throughout the seasons. Include shrubs that flower early in spring, as well as others that will attract heavy pollinator activity in summer or during the

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Large fothergilla (*Fothergilla major,* 968-88*A) attracts pollinators from April to May, much like its smaller-statured relative (*F. gardenii*).

KYLE PORT

Japanese spicebush (*Lindera obtusiloba,* 376-86*A) produces early spring flowers like its American counterpart (*L. benzoin*).

bustling fall when pollinators are building their winter reserves.

Witch-hazel species bookend the pollination season in our gardens. Common witch-hazel (*Hamamelis virginiana,* USDA Hardiness Zone 3–8) is one of the last plants that will bloom each year. When the days grow short and little else is flowering, the strap-like petals and strong fragrance of witch-hazel flowers draw pollinators like owlet moths, and potentially gnats and late-season bees scavenging for food. At the start of the year, Ozark witch-hazel (*Hamamelis vernalis,* Zone 4–8) is one of the first blooms to greet pollinators.

Virginia sweetspire (*Itea virginica,* Zone 5–9) is another versatile spring-blooming shrub in the Smithsonian's landscape. It is prominently featured at the entrance to the Pollinator Garden in the shade of a black gum tree (*Nyssa sylvatica,* Zone 3–9). We have also used it in a full-sun planting, where it retains a slope along a parking lot. It thrives in both locations, but the blooms are best in full sun. Its spires of fragrant white blossoms appear in early summer and draw nectar-loving insects like butterflies and bees, including native bumblebees and sweat bees. Best planted in a mass, the plant's rich red to purple fall color will persist into the winter in southern areas as a semi-evergreen plant. If some of the foliage has been damaged by insects, it might be a sign of more pollinator activity, as this plant is a host to the American holly azure butterfly (*Celastrina idella*).

Dwarf fothergilla (*Fothergilla gardenii,* Zone 4–8) has showy bottlebrush inflorescences that emerge from March to May before their leaves. They attract bees with their white color and pleasant scent, and then offer their pollinators a sweet nectar reward for those that get past their dense tangle of anthers. Ornamentally, it is a great three-season plant with nice foliage that becomes particularly attractive in fall, when it turns brilliant shades of yellow, orange, and red. Consider pairing fothergilla with oakleaf

ANSEL OOMMEN, BUGWOOD.ORG

The caterpillars of spicebush swallowtail (*Papilio troilus*) feed predominantly on the foliage of northern spicebush (*Lindera benzoin*).

The Pollinator Garden

In 1995, Smithsonian Gardens opened the Butterfly Habitat Garden, along the east side of the National Museum of Natural History in the heart of Washington, DC. After twenty-one years, this popular landscape was rededicated as the Pollinator Garden. The new theme helps visitors discover the *who, what, when, where, why,* and *how* of pollination by interpreting the unique relationship between pollinators and flowers.

The garden's title change and our extended educational efforts reflect the growing importance of supporting pollinator health (not just butterflies alone), as championed with a task force formed by President Barack Obama in 2014. Furthermore, the garden is part of the Million Pollinator Garden Challenge, launched by The National Pollinator Garden Network. This effort is a partnership between conservation organizations, gardening groups, volunteer civic associations, and participating federal agencies. It aims to inspire people and organizations to create more pollinator habitats by registering a million public and private gardens and landscapes that support pollinators.

As a key advocate for pollinators, the Smithsonian's reinterpretation of the Pollinator Garden on the National Mall educates millions of visitors on the wide diversity of pollinators and the types of plants that support them.

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James Gagliardi, below, helped with redeveloping the Pollinator Garden to showcase an evolving national awareness of the importance of all pollinators. The garden was officially dedicated in June of 2016.

hydrangea (*Hydrangea quercifolia,* Zone 5–9), which likes similar growing conditions along a woodland edge. Its flowers appear from May to July, after fothergillas have finished, and draw later-emerging wasps and flower flies, along with the aforementioned bees.

Not all plants will contribute as much to the aesthetics of your landscape as they will to pollinators. Spicebush (*Lindera benzoin,* Zone 5–9) is not often the focal point in a garden, but it offers a full package of horticultural benefits. It is tolerant of deer, drought, heavy shade, and clay soil. Green-yellow flowers appear in early spring before leaves emerge, and while the flowers are small, they have garnered enough attention for this native woodland understory shrub to be called the "forsythia of the wilds." The plants are dioecious, requiring small bees and

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The drupes of northern spicebush (*Lindera benzoin*) are popular with bird species, including gray catbird (*Dumetella carolinensis*), snacking here even before the fruits were completely ripe.

various flies to move pollen from the larger, showier flowers on male shrubs to those on the separate females, providing a critical resource for native pollinators when many food sources are not available on the landscape. Once pollinated, the female shrubs produce red drupes that are a good food source for birds and a possible nutmeg substitute for bakers. The plant also features aromatic leaves that turn an attractive yellow in the fall.

Spicebush is one of the few host plants used by the spicebush swallowtail (*Papilio troilus*), a well-recognized visitor of gardens and natural landscapes in the eastern United States. The adult female spicebush swallowtail has evolved to recognize specific compounds on the surface of its host plant before laying eggs, to ensure a suitable food source for maturing larvae. Other related hosts to spicebush that can support the native spicebush swallowtail include sassafras (*Sassafras albidum,* Zone 5–9) and redbay (*Persea borbonia,* Zone 7–11).

Red chokeberry (*Aronia arbutifolia,* Zone 4–9) supplies a great deal of value to wildlife in our gardens. Butterflies and native bees, such as mason bees, mining bees, and bumblebees, visit its clusters of white flowers from March to May. Chokeberry foliage turns stunning shades in fall and provides a food source to some hairstreak butterflies and moths, including bluish spring moths (*Lomographa semiclarata*) and praeclara underwings (*Catocala praeclara*). This herbivore activity can be observed as typical chewing damage along leaf margins. True to their name, red chokeberry fruits (though actually pomes and not berries) have a dry, astringent taste for birds and humans alike. The fruits persist from summer into the winter, and after a long period of exposure to cold weather, the fruit becomes more palatable. This makes chokeberries an important late-season native food for birds after other food sources are exhausted. The fruit's persistence through late winter also makes it a beautiful ornamental plant in the winter

SUSAN HARDY BROWN

JAMES CAGLIARDI

Attractive throughout the seasons, red chokeberries (*Aronia arbutifolia*) flower in mid-spring and bear lustrous red fruits well into winter.

KYLE PORT

Flowers of inkberry holly (*Ilex glabra* 'Compacta', 745-69*D) are tucked within dense evergreen foliage.

garden. Both red chokeberry and black chokeberry (*Aronia melanocarpa,* Zone 3–8) are useful for mass plantings or for mixing into a naturalized perennial border. Running serviceberry (*Amelanchier stolonifera,* Zone 4–8) is another plant that provides showy white blooms for pollinators in May, edible berries in summer, and striking fall foliage.

Hollies (*Ilex* spp.) are a strong draw for pollinators in late spring and early summer. Their small scented flowers often go unnoticed by garden designers, but they effectively draw the attention of bees and flies. The prolific and showy fruits of winterberry holly (*Ilex verticillata,* Zone 3–9) are another credit to good cross-pollination required for these dioecious plants. At the Pollinator Garden, we recently installed a grouping of dwarf American holly (*Ilex opaca* 'Maryland Dwarf', Zone 5–9), which provides the classic evergreen holly appearance in a more compact space. Other hollies like inkberry (*Ilex glabra,* Zone 4–9) may not have showy flowers or fruits, but you'll still find them covered in bees and later with birds looking for a snack. The same is true for the common wax myrtle (*Morella cerifera,* Zone 7–10).

Shrubs can also fill a flowering lag in the summer landscape. Buttonbush (*Cephalanthus occidentalis,* Zone 5–9)

Pollinator Syndromes

The combinations of floral characteristics associated with particular types of pollinators are known as pollinator syndromes. Other than bat pollination, which most often occurs in tropical and desert ecosystems, all of these syndromes can be observed in the Smithsonian Pollinator Garden. The Smithsonian team has adapted this information to create seven "pollinator profiles" for bees, beetles, butterflies, hummingbirds, flies, moths, and wind (along with special references to bats and water).

Using a field-journal theme, each profile in our *Pollination Investigation* describes the pollinators' favorite flowers based on floral characteristics. The panels teach pollination on a general level and are not designed for our garden alone. On May 20, 2018—the United Nation's first World Bee Day—the panels were unveiled at University of Ljubljana Botanical Garden in the Republic of Slovenia, in recognition of Slovenia's leadership proposing the new celebration. Additionally, our *Pollination Investigation* panels are available to educators in gardens around the world free of charge through the Smithsonian Gardens website.

POLLINATOR SYNDROME TRAITS

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TRAIT	BATS	BEES	BEETLES	BIRDS	BUTTER-FLIES	FLIES	MOTHS	WIND
COLOR	Dull white, green, or purple	Bright white, yellow, blue, or UV	Dull white or green	Scarlet, orange, red, or white	Bright, including red and purple	Pale and dull to dark brown or purple; flecked with translucent patches	Pale and dull red, purple, pink, or white	Dull green, brown, or colorless; petals absent or reduced
NECTAR GUIDES	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent
ODOR	Strong musty; emitted at night	Fresh, mild, pleasant	None to strongly fruity or fetid	None	Faint but fresh	Putrid	Strong sweet; emitted at night	None
NECTAR	Abundant; somewhat hidden	Usually present	Sometimes present; not hidden	Ample; deeply hidden	Ample; deeply hidden	Usually absent	Ample; deeply hidden	None
POLLEN	Ample	Limited; often sticky and scented	Ample	Modest	Limited	Modest in amount	Limited	Abundant; small, smooth, and not sticky
FLOWER SHAPE	Regular; bowl-like; closed during day	Shallow; have landing platform; tubular	Large bowl-like; magnolia	Large funnel-like; cups, strong perch support	Narrow tube with spur; wide landing pad	Shallow; funnel-like or complex and trap-like	Regular; tubular without a lip	Regular; small and stigmas exerted

Who pollinates?

Plants and pollinators evolved side by side over millions of years. Natural selection has resulted in **physical adaptations in both plants and pollinators**. Plants have developed many complex ways of attracting pollinators.

Similarly, pollinators have evolved with specialized physical traits and behaviors that enhance their pollination efforts. Each participant, plant and pollinator, usually **gains a benefit** from pollination.

Look for. . .

Pollinator Profile Panels
Each pollinator has "**Favorite Flowers**" that are the links between the pollinator and its plants. Check out each pollinator profile for clues to how a pollinator acts and what plants they visit.

Most plants need help from wind, water, and a diverse group of animals called pollinators to **fertilize their flowers and reproduce**. Pollinators have **distinct preferences** for the flowers they visit.

Favorite Flowers

- **Flower Color**
- **Nectar Guides**
- **Odor**
- **Nectar**
- **Pollen**
- **Flower Shape**

Do you know bees and flowers have secrets?

Bees and a few other pollinators can **see the ultraviolet (UV) part of the light spectrum.**

Flowers like Black-Eyed Susans that look uniformly yellow to humans actually have **nectar guides** that help pollinators quickly locate the center of each flower.

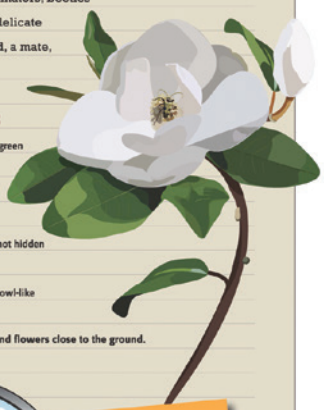
Pollinator Profile: **Beetles**

Beetles are referred to as "mess and soil" pollinators. Less elegant than other pollinators, beetles blunder their way through delicate blossoms searching for food, a mate, or perhaps the bathroom.

Favorite Flowers

- **Flower Color:** Dull white or green
- **Nectar Guides:** Absent
- **Odor:** None to strongly fruity or fetid (stinky)
- **Nectar:** Sometimes present; not hidden
- **Pollen:** Ample
- **Flower Shape:** Large and bowl-like

Beetles frequently visit magnolias and flowers close to the ground.



Do you know beetles are abundant and ancient?

There are almost **four times as many species of beetles** as animals with backbones. Beetles were among the **very first pollinators.**

Pollinator Profile: **Flies**

Some flies act just like bees, visiting sweet-smelling flowers. Others have more disgusting tastes. They are attracted to flowers with **putrid odors, meat-like colors, or fur-like textures** that lure them in by pretending to be the **fresh dung or dead animal** that flies desire.

Favorite Flowers

- **Flower Color:** Pale and dull to dark brown or purple; flecked with translucent patches
- **Nectar Guides:** Absent
- **Odor:** Putrid
- **Nectar:** Usually absent
- **Pollen:** Modest amount
- **Flower Shape:** Shallow; funnel-like or complex and trap-like

Flies frequently visit Dutchman's pipe, pawpaw, and some viburnums.

Do you know we can thank flies for chocolate?

Tiny flies called **midges** that inhabit the damp, shady rainforest are the only pollinator able to navigate the complex cacao flower.

is a captivating and attention-grabbing plant for sun to part shade. Planted at the entrance to our Pollinator Garden, buttonbush draws the interest of visitors with its unique round flower heads. The flowers are also a magnet to bees and butterflies in June, just as our hot DC summers begin to peak. Additionally, the flowers of American beautyberry (*Callicarpa americana,* Zone 6–10) often go unnoticed by gardeners in June and July but draw bees and butterflies for pollination, enabling the glossy purple fruit that gardeners and birds adore. In full sun, bluebeard (*Caryopteris* × *clandonensis,* Zone 6–9) and leadplant (*Amorpha canescens,* Zone 2–9) are other great summer pollinator plants and can mix nicely into a perennial border due to their smaller habits.

Carolina allspice (*Calycanthus floridus,* Zone 4–9) is also called sweetshrub and strawberry bush because of how the bloom fragrance combines hints of pineapple, strawberry, and banana. Similar to magnolias, Carolina allspice has tepals and evolved long before bees and butterflies entered the landscape. As such, its flowers are predominantly pollinated by sap beetles, though they are attractive to other local pollinators as well. The beetles are drawn by the scent of sweet fermentation, and they work their way into the shade of the overlapping tepals to find food from April to July. The flowers are easy to enter but difficult to depart. Once trapped inside, the beetle picks up pollen. After the flower further matures, the inner parts of the flower fold back to release the beetle. By that point, the stigmas will have already withered, and the beetle will move on to another flower in search of more food, unknowingly ensuring cross-pollination.

Summersweet (*Clethra alnifolia,* Zone 3–9) attracts a diverse group of pollinators, including butterflies, bees, and hummingbirds, which have evolved to take advantage of narrow, tubular flowers. It is one of the few blooms you can find in late-summer shade in our Pollinator Garden. Similarly, bottlebrush buckeye (*Aesculus parviflora,* Zone 4–8) draws butterflies, bumblebees, and hummingbirds from July to August with its big showy panicles of flowers that occur in part to full shade. Note that the ruby-throated

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Summer shrubs for pollinators include, top to bottom, buttonbush (*Cephalanthus occidentalis,* 123-78*A), Carolina allspice (*Calycanthus floridus*), and summersweet (*Clethra alnifolia* var. *alnifolia* 'Rosea', 239-47*MASS).

hummingbird (*Archilochus colubris*) is the only breeding species of hummingbird on the East Coast each summer. It usually arrives in Washington, DC, in April, after migrating north from Mexico and Central America.

Summer pollinators also love Chenault coralberry (*Symphoricarpos* × *chenaultii* 'Hancock', Zone 4–7). We planted a large grouping of it at the National Museum of Natural History to retain a steep slope, and it may attract the greatest density of pollinators of any shrub in the collection. The plants are thriving and often need to be trimmed, but because they are so popular with honeybees from a hive in the museum's insect zoo, located a few hundred feet away, our gardeners refrain from working with the plants during the summer months, preserving our record of being sting free.

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Bottlebrush buckeye (*Aesculus parviflora,* 558-2003*C) produces feathery panicles from July to August.

Both native and non-native viburnums (*Viburnum* spp.) work as powerhouses in the landscape, as they attract an exceptionally wide range of pollinators with strong scents that promise either a nectar or pollen reward. Scarab beetles of the genus *Cetonia* are particularly interesting viburnum pollinators, possessing branched hairs on their bodies that are similar to pollen-collecting hairs found on bees. These hairs ensure a better chance of cross-pollination for self-sterile viburnum species. Beetles, however, are only one of myriad pollinators that are necessary for the successful reproduction of viburnums. As Michael Donoghue reported in *Arnoldia* in 1980, viburnums with long corolla tubes and sweet scents are more often pollinated by species belonging to the order Lepidoptera, while viburnums with shorter corolla tubes and muskier odors receive frequent visits from flies and small bees. This relationship corresponds to the size of the insect mouthparts. It is important to note that most viburnums produce very little nectar despite the wide range of pollinators associated with the genus. It is thought that the primary reward, at least for bees, is not nectar but pollen.

More than Flowers

Flowers are not the only consideration when creating a garden for pollinators. We must consider the needs of pollinators throughout their entire lifecycle. Creating a habitat means maintaining gardens that provide shelter and food. At the Pollinator Garden, we wait to cut back plants and remove dead foliage until spring, if at all.

To accommodate the full lifecycle of pollinators, we must cater to caterpillars and other immature insects. In Eric Carle's book *The Very Hungry Caterpillar,* generations of schoolchildren have learned that we will not have beautiful butterflies without munching caterpillars. Caterpillars can be picky eaters, so we plant a wide variety of host plants in the Pollinator Garden. Pollinators often rely on specific trees, shrubs, perennials, and annuals as

food sources. Some plants, like spicebush (*Lindera benzoin*), the host plant of the spicebush swallowtail butterfly, have pollinator-friendly flowers. But even wind-pollinated species can be important for pollinators. The foliage of smooth alder (*Alnus serrulata,* Zone 4–9), for instance, provides a significant food resource for beetles, aphids, moth caterpillars, and other insects.

When planting a garden for pollinators, we need to be okay with leaves being eaten. It is also best to acquire plants from nurseries that have not treated their plants with systemic insecticides. In the 180 acres maintained by Smithsonian Gardens, we do use insecticides, but only as a last resort. Our preferred methods of control are mechanical, cultural, and biological. The plants in the Pollinator Garden are in good health, in part because maintaining a diverse plant inventory supports a balanced garden ecosystem. During our tenures at Smithsonian Garden, neither of us can recall spraying insecticides in the Pollinator Garden or in the preceding Butterfly Garden. In the extreme case that we ever need to apply an insecticide in the future, we would certainly make sure that the product would not affect beneficial insects and pollinators.

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Horticultural care is an important factor when gardening for pollinators. At the Pollinator Garden, horticulturists wait to remove winter foliage, which is necessary for insect habitat.

In the end, pollination is all about survival and sex. The insect and the plant both require something. The pollinator is often drawn to a plant with an offer of food. In turn, the plant uses the pollinator as a vector to move its pollen to the stigma of another flower. Plants have evolved with particular traits, and pollinators select blooms for their preference for color, odor, nectar, nectar guides, pollen, and flower shape. These traits, combined with bloom period and location, make for a variable matrix of pollinator and plant interactions. Therefore, it is important to grow a large selection of plants, including shrubs, to support the needs of a great variety of pollinators.

James Gagliardi is a supervisory horticulturist with Smithsonian Gardens in Washington, DC. After President Obama released a memorandum to promote pollinators in 2014, he worked on a task force with the Council on Environmental Quality to draft *Supporting the Health of Honey Bees and Other Pollinators.* He is honored to be the editor of the Smithsonian's first gardening book, *Encyclopedia of Garden Plants for Every Location.*

Holly Walker is the Plant Health Specialist at Smithsonian Gardens in Washington, DC. With a diverse background in integrated pest management (IPM), biological control, and native pollinator conservation, she works to educate the public in environmentally responsible pest management in both urban and rural landscapes. She recently completed her PhD in entomology at the University of Delaware.

2017 Weather Summary: A Year of Recovery

S. A. Pfeiffer

As an Arboretum horticulturist, my daily routine always starts with the weather forecast. The forecast dictates priorities and deadlines for horticultural tasks. As the forecast shifts, new goals arise and others are eliminated. Pests and diseases come and go with seasonal turns in the weather, and access to our plant collections is determined on a daily basis, especially in the wet and muddy weeks of spring.

Past weather conditions, however, also play an important role in directing our horticultural care. By the start of meteorological winter in December 2016, concern over the health of the collections was mounting. Following an exceptionally dry 2015 season, record-breaking heat and drought made 2016 an especially tough

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Spring colors swept down Oak Path on May 11.

year for plants. From June through October, hundreds of feet of hose were dragged through the collection, and every water tank on hand was filled and refilled in an effort to alleviate drought stress. Water cannons pumped six million gallons of water into the landscape, and irrigation systems were on a tight overnight schedule. The efforts of the horticulture crew to carefully monitor and provide supplemental irrigation in the searing heat of 2016—the hottest summer on record for the city of Boston (but the second hottest according to Arboretum data)—cannot be overstated. As we entered 2017, what would it take to end the drought?

Temperatures warmed during the winter months, and according to thirty-year averages calculated by the National Oceanic and Atmospheric Administration, precipitation during January and February of 2017 was well above normal for the Boston area. Due to the severity of the ongoing drought, expectations of major

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Abundant rain brought abundant turf. Arboretum gardener Brendan Keegan is pictured mowing on Peters Hill in early May.

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Our 218-day growing season enabled vibrant growth throughout the Arboretum. This view shows the North Meadow in mid-August.

plant dieback and death were on the forefront of our minds as we awaited spring leaf out. Abundant rains fell during March and April, amounting to more than five inches above normal. Buds swelled, leaves emerged, and a green landscape was a welcome sight. Rains continued to fall. Soils were plenty moist, and the recovery of the collections was exceptional. Not only did the accessioned trees, shrubs, and vines flourish during the growing season but turf and weeds also seemed to grow exponentially, keeping horticulture crews busy. Arboretum staff, always attentive to the impact of weather on plant health, could not have asked for a better year following the preceding drought.

Our annual weather summary tracks the four meteorological seasons and reveals, at least in part, moments when weather demanded adjustments in horticultural care. For ease of interpretation and statistical analysis, meteorological seasons are broken into three-month periods based on annual temperature. Winter is defined as the three consecutive months with the lowest average temperatures, corresponding with December, January, and February in the Northern Hemisphere. Spring, summer, and autumn follow accordingly, each comprising the next three-month series.

Winter: December 1, 2016 to February 28, 2017

December was seasonable with slightly mild temperatures. Highs dropped below freezing on only four occasions. An outbreak of arctic air on the fifteenth and sixteenth forced temperatures to a low of 3°F, and on the seventeenth, we received five inches of snow. Most melted away as conditions rebounded to 57°F on the eighteenth. The majority of precipitation fell as rain during seven major events.

The month of January brought unusual warm conditions. Despite a three-day cold spell that brought single-digit temperatures from the seventh through the

ninth, January's average temperature was 7.1°F above normal. We hit a record-breaking 62°F on the twelfth, far above the average high of 36°F for that day. Precipitation was abundant throughout the month with seventeen days of recorded rain or snow. Of this, 3.65 inches fell as rain. Another 9.8 inches arrived as snow, which mostly fell during the three-day cold spell. Major rain events were long, steady, and light, allowing moisture to infiltrate into the soil and recharge groundwater levels. A high-powered coastal storm arrived on the evening of the twenty-third, bringing prolonged rain over the next twenty-four hours. Gusts reached 39 mph, scattering limbs throughout the landscape and completely destroying an oak and a willow. Overall, the warm and snowless month allowed access into more remote areas, providing opportunities for horticulture teams to prune deadwood in the beech collection and thin trees in Central Woods.

Warm conditions continued into February, as temperatures averaged 6.1°F above normal. The horticulture crew took advantage of snowless days early in the month by pruning and rejuvenating most accessions in the Bradley Rosaceous Collection. We ultimately received above-average precipitation, including 19.2 inches of snow that mostly fell between the seventh and the thirteenth. A nor'easter blizzard, the first since January 2015, delivered 11.5 inches of this total on the ninth. Conditions remained cold and cloudy in the immediate aftermath. With this deep snow cover, horticultural priorities shifted to scouting for signs of invasive insects in the collection. A warm spell sent temperatures soaring between the twenty-third and the twenty-fifth. We reached 74°F on the twenty-fourth, the highest February temperature ever recorded in Boston since record-keeping began in 1872. Daily records were also hit on the neighboring days (69°F on the twenty-third and 72°F on the twenty-fifth). All remaining snow melted

KYLE PORT

The horticulture crew began mulching the Bradley Rosaceous Collection in late January.

DANNY SCHISSLER

Chinese witch-hazel (*Hamamelis mollis*, 215-2000*A) was spotted flowering on February 23.

over this period, and the horticulture crew returned to the rose collection, mulching all sixteen beds. Early spring blooms appeared on red and silver maples (*Acer rubrum* and *A. saccharinum*) and on hybrid witch-hazel cultivars (*Hamamelis* × *intermedia* 'Arnold Promise', 'Diane', and 'Jelena').

Spring: March 1 to May 31, 2017

March was colder than normal with an average temperature below both January and February. Early in the month, lows dipped into single digits on three occasions. Precipitation was abundant and consistent throughout the month, although we experienced some of the driest air of the year between the third and sixth, when relative humidity levels remained in the teens and low twenties. On the fourteenth, a late-season blizzard brought high winds, gusting at 47 mph, our highest of the year. Heavy snow amounted to 6.5 inches and turned to heavy rain that fell at a rate of 0.50 inches per hour. Temperatures plummeted to the teens overnight, turning roads and sidewalks into a veritable skating rink by the morning of the fifteenth. The storm brought down limbs in the conifers and toppled an apricot (*Prunus armeniaca*). Temperatures remained cool until vernal equinox on the twentieth brought sunny conditions and a high of 51°F. We ended the month with plenty of rain. Buds that had begun to swell due to warm February temperatures suspended their development, waiting to open, while cooler temperatures extended the bloom time of many witch-hazels. The lack of snow cover allowed the horticulture crew to pursue diverse projects: mulching the beech collection, installing new paths, removing invasive plants in natural areas, and cleaning winter storm damage (including a giant willow that was pulled from the meadow).

DANNY SCHISSLER

Always among the first to brave the spring, Zen magnolia (*Magnolia zenii*, 430-91*A) was zapped by cold weather on March 5.

Abundant rainfall continued into April, further reducing the water deficit from 2016. Temperatures were above average for the month. A storm that lasted from March 31 to April 1 delivered 2.82 inches of precipitation, most falling as rain. We began the third with our last spring frost, which melted as temperatures warmed to 60°F later that day, marking the beginning of the growing season. Excessive rain and melting snow saturated soils, especially in low-lying areas, leaving those areas inaccessible. Ponds filled, brooks flowed, and the forsythia began to bloom. Nursery digging for spring plantings began on the tenth. Warm conditions persisted as we hit 86°F on the eleventh and sixteenth, causing katsuras (*Cercidiphyllum japonicum*), magnolias (*Magnolia*), and cherries (*Prunus*) to burst into flower. Despite seasonal dreary conditions, the landscape looked alive as turf greened up and trees leafed out. Horticulture crews were busy with mowing

KYLE PORT

Low-lying portions of the Arboretum, including the lindens, flooded as the growing season began in early April.

Pests and Pathogens Mind the Weather Too

Not all collections escaped the 2016 drought unscathed. Oaks on Peters Hill, defoliated for many years by winter moth (*Operophtera brumata*), were among those that continued to languish, as were hemlock specimens that had been struggling from infestations of hemlock woolly adelgid (*Adelges tsugae*) and elongated hemlock scale (*Fiorinia externa*). Effects of drought stress on older beeches became apparent mid-summer as leaves browned and black-timber bark beetles (*Xylosandrus germanus*) invaded. Royal azaleas (*Rhododendron schlippenbachii*) in the Explorers Garden experienced major stem dieback. The arborist crew devoted a month to removing deadwood from older oaks and other large trees, while horticulturists did the same in the understory.

Both powdery mildew and anthracnose, a general term for many fungal leaf diseases, erupted throughout the grounds. From the Arborway to Peters Hill, from May through October, anthracnose was ubiquitous due to frequent precipitation, overcast skies, and warm temperatures. Sycamores (*Platanus*), maples (*Acer*), and dogwoods (*Cornus*), which are typically affected

MENG LI

MENG LI

Crabapples on Peters Hill presented an extraordinary spring display, including Magdeburg crabapple (*Malus* × *magdeburgensis*, 544-66*A) and Chinese pearleaf crabapple (*Malus asiatica*, 341-86*B).

by anthracnose, were especially hard hit. Other deciduous trees, including ashes (*Fraxinus*), beeches (*Fagus*), hophornbeams (*Ostrya*), hornbeams (*Carpinus*), oaks (*Quercus*), walnuts (*Juglans*) and stewartias (*Stewartia*), were certainly not immune. Severe infestation on sycamores and crabapples caused premature defoliation.

Fortunately, however, winter moth populations were greatly reduced. Warm temperatures in January and February led to early bud break for red and silver maples (*Acer rubrum* and *A. saccharinum*), simultaneously causing winter moths to hatch early. The newly emerged caterpillars could wiggle between bud scales on those maple species and begin feeding, but subsequent cold temperatures delayed bud swelling for later-flowering host plants, notably apples and crabapples (*Malus*). With no access to the inner buds of those species, many caterpillars didn't survive through the spring. In recent years, Arboretum staff have also released tachinid flies (*Cyzenis albicans*) that prey on winter moths. The combination of these biotic and abiotic factors significantly lowered the population of winter moths, allowing the crabapple collection on Peters Hill to put on its best flowering show in years.

operations throughout the grounds. We ended the month with temperatures hovering just above 80°F, pushing lilacs (*Syringa*) into bloom.

May was slightly warmer than average, but we began the month with below-seasonal temperatures and lows in the thirties. A number of fast-moving downpours accounted for over an inch of rain during the first week. According to the United States Drought Monitor, soil moisture returned to normal conditions on May 9, officially ending the drought that had begun on June 7, 2016. Overcast conditions prevailed for the week leading up to Lilac Sunday on the fourteenth. These cooler temperatures extended the blooms of many plants, especially lilacs, but with the threat of soaking rain on the fourteenth, Lilac Sunday activities were held on Saturday the thirteenth. True to forecast, a nor'easter arrived that evening, and by the afternoon of the fourteenth, we had received over 1.5 inches of rain. Temperatures soared over the following days, hitting highs in the nineties from the seventeenth to the nineteenth and peaking

ANDREW GAPINSKI

Arboretum horticulturists Mark Walkama (left) and Scott Grimshaw (right) prepare a ball-and-burlap specimen in the East Nursery. This year, 378 plants graduated into the collection.

ANDREW GAPINSKI

Arboretum arborists worked along Meadow Road on May 8, the day before the United States Drought Monitor officially announced an end to the drought that began on June 7, 2016.

DANNY SCHISSLER

Japanese pagoda tree (*Styphnolobium japonicum,* 216-35*A) showcased the lush greenness of this recovery year, pictured on August 2.

at 96°F. This heat wave was one of the earliest for the area, as the most recent with an earlier date occurred May 2–4, 2001. A fast-moving cold front brought a heavy downpour on the evening of the nineteenth: within fifteen minutes, 0.30 inches of rain had fallen and temperatures had plummeted by 10°F. We ended the month with typical spring weather fluctuations and steady precipitation. Soils remained moist, plants were lush and floriferous, and turf continued its rapid growth. Horticulture crews were busy mowing and finishing spring cleanup.

Summer: June 1 to August 31, 2017

A lingering cold front in early June brought temperatures in the fifties. Four days of rain accounted for 2.0 inches of precipitation, almost half of the monthly total. Moist soil conditions made it difficult to access low-lying areas for mowing operations. We experienced our second heat wave of the year between the eleventh and thirteenth, once again hitting 96°F. High soil moisture and hot temperatures led to an explosion of turf and weed growth throughout the grounds. The plant collections flourished, easing concerns over last year's drought as plants continued to recover. A fast-moving system brought an additional 1.78 inches of rain on the evening of the sixteenth. Conditions stabilized as temperatures remained in the high seventies to mid-eighties for the remainder of the month. Drier conditions were prevalent, and despite seven short rain events, we accumulated only one additional inch of rain. Nonetheless, compared to June 2016, we received almost four times more rain in 2017.

July temperatures were seasonable with slightly below-average precipitation. We began the month with comfortable conditions, highs in the eighties and lows in the high fifties. Two fast-moving thunderstorms on the seventh and eighth brought downpours and a total of 0.94 inches of rain. Thunderstorms returned

What Factored into the Drought Recovery?

The Arnold Arboretum's primary weather station is located at the Weld Hill Research Building, where it takes measurements for temperature and precipitation every fifteen minutes. Snow measurements are taken once a day at the Dana Greenhouse. In 2017, three environmental factors played key roles in drought recovery for the plant collections.

First, precipitation was plentiful in 2017, with a monthly average of 3.98 inches, compared to 2.84 inches in 2016 and 3.09 inches in 2015. Excess precipitation during the first six months of 2017 caused the United States Drought Monitor to announce that Boston had reached normal conditions by early May. During that time, light- to moderate-intensity rainfall occurred frequently. These conditions sustained soil moisture, allowing roots to consistently uptake water for plant growth and metabolic processes.

Second, temperatures were mild from January through February and remained seasonable throughout subsequent months, except for a warm spell in October. While New England heat waves typically occur between July and September, when soil moisture levels are predictably low, two of the three heat waves that occurred in 2017 arrived early: one in May, another in June. During these heat waves, plants were not set back to the extent normally expected. Precipitation during both months was greater than expected, supplying relief from the effects of high temperatures. Likewise, despite normal high temperatures during summer months, frequent rain minimized plant stress.

Third, we experienced an exceptional 218-day growing season, beginning April 3 and ending November 8. (The growing season is typically defined as the number of days between the last spring frost and the first in the fall.) The season was more than three weeks longer than the average growing season since 2009. Even more astonishing, it was thirty-five days longer than 2016. Moreover, because severe and extreme drought conditions persisted from July 26, 2016, through the first fall frost, the actual period of active plant growth that year was far less than the 183 days recorded between frosts.

DANNY SCHISSLER

The Linda J. Davison Rhododendron Path was festooned with lavish pinks on June 5.

Arnold Arboretum Weather Station Data • 2017

	Avg. Max. (°F)	Avg. Min. (°F)	Avg. Temp. (°F)	Max. Temp. (°F)	Min. Temp. (°F)	Precipitation (inches)	Snowfall (inches)
JAN	40.9	27.1	34.0	61.8	4.7	4.27	9.8
FEB	45.4	27.1	36.2	74.2	9.1	3.81	19.2
MAR	41.3	25.1	33.2	63.0	7.8	5.52	11.1
APR	61.2	42.9	52.1	86.4	30.1	5.66	1.2
MAY	63.8	47.8	55.8	95.7	34.0	4.17	
JUN	78.8	58.1	68.5	95.8	45.7	4.56	
JUL	81.8	62.1	72.0	93.0	52.2	2.82	
AUG	80.9	59.8	73.3	90.8	49.5	2.43	
SEP	76.1	57.6	66.9	87.9	43.0	3.61	
OCT	69.5	50.3	59.9	79.4	37.5	5.96	
NOV	51.3	33.2	42.2	75.5	20.5	1.98	
DEC	35.3	22.0	28.7	59.3	0.2	2.98	10.4

Average Maximum Temperature . . . . . **60.5°F**
Average Minimum Temperature . . . . . **42.8°F**
Average Temperature . . . . . **51.7°F**
Total Precipitation . . . . . **47.77 inches**
Total Snowfall in 2017 . . . . . **51.7 inches**
Snowfall During Winter 2016–2017 . . . . . **47.5 inches**
Warmest Temperature . . . . . **95.8°F on June 12**
Coldest Temperature . . . . . **0.2°F on December 29**
Strongest Wind Gust . . . . . **46.9 mph on March 14**
Last Frost Date . . . . . **30.1°F on April 3**
First Frost Date . . . . . **29.5°F on November 8**
Growing Season . . . . . **218 days**
Growing Degree Days . . . . . **3104 days**
Days at 90°F or Above . . . . . **11 days**
Days Below Freezing . . . . . **23 days**

from the eleventh through the thirteenth, followed by a cold front that brought temperatures in the sixties for a couple days. Temperatures returned to expected highs, and we experienced our third heat wave of the year from the nineteenth to the twenty-first, with temperatures topping out at 93°F. Conditions continued to fluctuate as a slow-moving storm materialized, bringing prolonged soaking rains and temperatures in the sixties on the twenty-fourth and twenty-fifth. Because this addition of 1.47 inches of rain kept soils moist, we had yet to irrigate the collections (except for new plantings). We ended the month with partly cloudy conditions, high humidity, and temperatures in the seventies and eighties.

Seasonable temperatures continued in August. High humidity and warm temperatures over the first couple of days culminated in violent thunderstorms that brought heavy downpours, hail, and high winds on the third and the fourth. Almost two inches of rain fell, scattering the landscape with fallen leaves and causing erosion (even in mulched beds) and flooding. A cold front brought conditions in the seventies from the fifth through the eighth, but otherwise, typical New England heat and humidity returned for the remainder of the month. We received only five additional rain events over the remaining four weeks, totaling a mere 0.38 inches. Soils dried, leading to dusty conditions in open grassy areas. Newly established turf began to go dormant, and supplemental irrigation began mid-month. Clear skies were ideal for viewing the partial eclipse, which peaked at 2:48 p.m. on the twenty-first. We reached 91°F on the twenty-second, the single incident of temperatures in the nineties for the month. Although very humid, temperatures were seasonable, remaining in the eighties mid-month and dropping to the seventies during the last week. Serviceberries (*Amelanchier*), which typically begin to drop their leaves early in the season, remained green and lush throughout the month.

Autumn: September 1 to November 30, 2017

September brought average rain that fell predominantly as quick downpours. The month began with temperatures in the sixties and seventies as remnants of Hurricane Harvey delivered a quarter inch of rain on the third. An additional inch arrived as heavy overnight downpours on the sixth, including 0.30 inches that fell over a fifteen-minute period, the first significant rainfall since August 3. Soils were moist and temperatures favorable when autumn planting began on the eleventh. Hot and humid conditions returned mid-month leading to pop-up thunderstorms on both the fourteenth and the fifteenth. Conditions did not improve as Hurricane Jose approached on the seventeenth, bringing dense morning fog that was followed by wind and sporadic rain. Dreary weather persisted with minimal precipitation until the twenty-third, after which the sun and heat returned. Temperatures rose to the mid-eighties between the twenty-fourth and twenty-seventh, 15 to 20°F above average for this time of year. Summer conditions, however, would not last. Temperatures dropped to a more seasonable 56°F when a storm delivered over half an inch of rain on the thirtieth. With the abundance of precipitation in the latter half of the month, irrigation was limited to recent plantings.

October was the third warmest on record. Highs shot above 70°F on seventeen occasions, exceeding average monthly temperatures by over 7°F. We began the month with warm and dry conditions, reaching a high of 79°F on the fifth. Two small showers arrived on the eighth and ninth. Warm temperatures continued and precipitation remained minimal. By the seventeenth, we entered moderate

MICHAEL DOSMANN

This green ash (*Fraxinus pennsylvanica* var. *subintegerrima* 'Marshall's Seedless', 626-54*A) numbered among ten trees destroyed during an overnight nor'easter on October 29.

drought, mirroring conditions last experienced in late March. Conditions were ideal for the horticulture crew, which spent these weeks seeding renovated areas, clearing the natural area behind the hickory collection, mulching new paths, and planting meadow natives. The dry pattern broke when a slow-moving system dropped over two inches of rain between the twenty-fourth and the twenty-sixth. An overnight nor'easter arrived on the twenty-ninth, bringing heavy rain and strong winds with 37 mph gusts. By the morning, 3.41 inches of rain had fallen and the collections experienced moderate damage; ten trees were lost, and many branches dropped throughout the grounds. Low-lying areas were flooded from the 5.5 inches of precipitation that had fallen over the previous six days, and the drought ended as quickly as it had arrived. We ended the month with highs in the sixties, having yet to receive our first frost.

November temperatures were seasonable, despite large fluctuations, and rainfall was below average. We started the month with a continuation of the warm temperatures experienced in September and October, hitting 76°F on the third. These warm temperatures forced a number of spring-blooming shrubs into flower, including Smirnow rhododendron (*Rhododendron smirnowii*). This would mark the end of an unusually warm autumn; temperatures dropped into the sixties from the fifth through the seventh, before settling in the forties and fifties for the remainder of the month. We finally received a frost when temperatures dipped to 29.5°F on the eighth. This ended our growing season at 218 days. Low temperatures continued to drop as we sunk into the twenties for six straight days, reaching 21°F on the eleventh. These freezing conditions, well lower than expected for this time of year, caused leaves on many trees to freeze and die before abscission cells

SUZANNE MROZAK

This specimen of Japanese maple (*Acer palmatum* var. *matsumurae,* 148-57*B) was among the maples that carried an abnormal cover of marcescent leaves through the winter.

What Happened to Autumn Foliage?

Autumn color was poor at the Arboretum due to a series of meteorological factors. Ample moisture and favorable temperatures during the growing season precluded a typical summer drought, encouraging trees to bear lush foliage at the beginning of meteorological autumn. Conditions remained hot and moist through late September and October, and plants showed no signs of slowing down. Because nighttime temperatures remained relatively high, most plants failed to trigger leaf senescence (the final stage of leaf development, which leads to fall color and eventual drop). When arctic conditions descended in November, nighttime temperatures plummeted into the twenties for six straight days. Plants were unprepared for this sudden freeze, which slowed foliage change for some specimens and ended it for others, causing leaves to freeze before developing the abscission layer needed to separate and drop. This phenomenon, called marcescence, left many trees—notably the Asian maples—holding onto their brown, crispy leaves. This slowed leaf drop and prolonged autumn leaf cleanup.

DANNY SCHISSLER

Fall color began late and ended with little finale. This view shows leaves in the oak collection.

could fully develop. Temperatures remained unseasonably cool with consistent rainfall. The largest storm delivered 0.88 inches of rain on the twenty-second. Sustained cleanup efforts continued throughout the month, as the crew progressed into leaf cleanup after completing storm-damage removal early in the month.

Early Winter: December 2017

Cold temperatures extended into December. Highs dropped below freezing on the twenty-sixth and then sunk into the teens from the twenty-eighth through the end of the month—the four coldest days of 2017.

Moving Forward

The Arboretum experienced an optimal growing season in 2017, yet we cannot close the chapter on the preceding drought before considering the long-term effects of such a prolonged water shortage. Symptoms of persistent plant stress are more often observed years down the road, ultimately causing slow decline and possible death. As plants recover from drought, their ability to defend against disease and insect attacks remains compromised. Bark beetle invasions can be linked to drought stress, as can the onset of *Diplodia* tip blight and *Cytospora* and *Nectria* cankers, but connecting future disease and pest outbreaks to past drought events often proves difficult. Internal plant damage is hidden, and the cumulative effects of long-term drought stress may impact tree health for many years. As we move into 2018 and beyond, vigilance and regular observation will be critical to the overall preservation of the collections.

Sue A. Pfeiffer is an Arboretum Horticulturist at the Arnold Arboretum.

The Pear to End All Wars: *Pyrus ussuriensis*

Matthew McDermitt

One of my favorite things about the annual plant inventory at the Arnold Arboretum—the process of field checking each plant—is that you discover interesting specimens that many overlook. On a windy Halloween afternoon, I encountered a Ussurian pear (*Pyrus ussuriensis,* accession 11302*C) growing in dense woods along South Street. The tree was struggling for light and space under a canopy of old oaks and would not impress the average observer, but like all plants at the Arboretum, it has a story that is documented in our plant database.

When the First World War began in 1914, Ernest Henry Wilson was busy collecting plants in Japan. Charles Sprague Sargent, the Arboretum's director, was travelling in England, and when he realized the gravity of Europe's political conflict, he asked Wilson to cut his trip short. Upon returning to Boston in 1915, Wilson was shocked to learn about the sinking of the *RMS Lusitania* and the rapid expansion of Central Powers across Europe. At the Arboretum, tensions began to rise between Wilson (an Englishman) and his friend and colleague Alfred Rehder (a German taxonomist). Wilson and his wife, Ellen, began only speaking to the Rehder family in a professional context. Relief came when Sargent sent Wilson on his sixth plant-collecting expedition in January 1917. Just before Wilson's departure, Sargent wrote to a correspondent of "bad times," but he noted that "there is no use thinking about them when there are trees to think of."

Wilson spent the next two years collecting plants throughout territory that was then occupied by Japan. In 1918, he collected seed from a Ussurian pear in the Gyeonggi Province of South Korea (then known as Keiki-do, Japan), giving rise to accession 11302.

The specific epithet for *Pyrus ussuriensis* refers to the Ussuri River, which flows from eastern Russia into northeastern China, forming part of the border between the two countries. The species inhabits this region—the coldest and most northern range of any pear species (it is hardy to USDA Zone 3)—along with portions of Korea and Japan. While not of global conservation concern, the species is endangered in Japan. The Arboretum also holds *P. ussuriensis* var. *hondoensis*—a Japanese variety, currently listed as vulnerable in Japan—along with the regional cultigens 'Pin-li', 'Shinchu', and 'Shu-li'.

The flowers of the Ussurian pear are among the most attractive of the genus: the immature buds are tinged deep red, and the color initially remains as the five petals unfurl. Once fully open, the flowers measure 3 to 3.5 centimeters (about 1.25 inches) in diameter and have beautiful dark red anthers that pop against the white petals. The flowers are similar to those of the Callery pear (*Pyrus calleryana*), but are notably larger and open earlier in the season. The Callery pear became a wildly popular street tree in North America, but it fell from grace when it escaped into natural areas, not to mention limbs that would drop with the slightest wind. In contrast, *P. ussuriensis* hasn't demonstrated invasive tendencies or structural flaws.

Besides the beauty of the flowers, Sargent was impressed by the size of the species. In the *Bulletin of Popular Information,* Sargent noted that the Ussurian pear is the tallest and largest of all pear species, citing a specimen that Wilson photographed in Korea, which was 18 meters (60 feet) tall with a trunk diameter of 1.4 meters (4.5 feet). He was also excited that *Pyrus ussuriensis* appeared resistant to fire blight, a plant disease that plagues many members of the rose family, but unfortunately, minor fire blight has been observed on Arboretum accessions within the past decade.

Wilson returned to the Arboretum in early 1919, several months after the First World War had officially ended. Although the original pear that grew from his South Korean collection is hidden in a natural area, an exceptional example of *Pyrus ussuriensis* var. *hondoensis* (accession 11728*A) grows on the northern side of Poplar Gate Road. This tree was grown from seed Wilson collected in Nagano, Japan, on the same expedition.

Matthew McDermitt is a former curatorial assistant at the Arnold Arboretum.

The ARNOLD ARBORETUM of HARVARD UNIVERSITY