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The Arnold Arboretum
125 Arborway
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Nancy Rose, Editor
Andy Winther, Designer

Editorial Committee
Peter Del Tredici
Michael S. Dosmann
Jianhua Li
Richard Schulhof

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Inside front cover: Groundnut (Apios americana), a North American native vine with edible tubers, is part of the well-documented flora of Concord, Massachusetts. Photo by Abraham Miller-Rushing and Richard Primack.

Inside back cover: Kyle Port, Manager of Plant Records, profiles one of the few Arboretum accessions that hails from Africa: a Moroccan fir (Abies pinsapo var. marocana) growing in the Conifer Collection. Photos by Nancy Rose.

Back cover: Colorful Chinese lanterns dangle from a linden (Tilia sp.) at Tivoli, Copenhagen’s 165-year-old public pleasure garden. Photo courtesy of Tivoli.
The Impact of Climate Change on the Flora of Thoreau’s Concord

Abraham J. Miller-Rushing and Richard B. Primack

Climate change is driving major shifts in ecosystems all over the world, including here in the United States. Tree swallows and many other bird species are breeding earlier, forest edges are extending up the sides of mountains, and the distributions of pest insect species such as the hemlock woolly adelgid are shifting northward. Notably, most of the evidence for biological responses to climate change, including these examples, is based on studies of one or a few species. The number of examples is large, but it is difficult to know how representative they are. How is climate change affecting entire natural communities of plants and animals? Are all of the species within a community changing, or are just a few? Are most species in a location changing in the same way, or are there substantial differences among species? Are there ways to predict how species within communities might change and what the consequences of these changes will be? Despite the obvious importance of these questions, we do not really know the answers. We know many changes are happening, some of them major, but thus far our knowledge is limited to a relatively few species in a few places.

To help answer the question of how plant communities are responding to climate change, we turned to one of the best-documented floras in the country—the flora of Concord, Massachusetts. The flora has been inventoried five times since 1830, a huge effort for the flora of a single town. During two of these inventories, the botanists collected observations not only of plant occurrences, but also of flowering times. One of these two botanists was the well-known philosopher and naturalist Henry David Thoreau, and the other was a local shopkeeper, Alfred Hosmer. Between them, they recorded the flowering times of over 700 plant species in Concord.
We know of no other climate change study in the United States that has recorded observations on as many species in a single location for as long a period as Thoreau and Hosmer. These observations have major scientific value because we can use them to examine the response of an entire flora to climate change. Their value is further enhanced because changes in the timing of phenological events—those biological events like flowering, fruiting, and migrations that recur on a seasonal basis—are among the most sensitive biological responses to climate change.

Many phenological events in different places in the world are now occurring earlier than in the past. However, it is clear that species’ phenologies are changing at different rates. For example, in England some species are flowering more than a month earlier than they did 50 years ago, while other species’ flowering times are advancing more slowly, or are not changing at all. In some instances, plants are even flowering later than they did in the past. This variation has the potential to alter important relationships among species, such as those between plants and pollinators. If a plant is flowering much earlier now than it did in the past, but its preferred pollinator is active at the same time each year, the plant and the pollinator could be mismatched in time, to the disadvantage of both. Similarly, variation in changes in timing could affect relationships among plants competing for resources, between plants and herbivores, and between predators and their prey. In the Netherlands, pied flycatcher populations are already declining because they are breeding too late to feed on their caterpillar prey. More broadly, the populations of European migratory birds species that are not migrating earlier in response to warming temperatures are declining, possibly because of temporal mismatches between their migrations and breeding and their environments.

Thus, we are left to question, why do species respond differently to climate change? What species are most (or least) sensitive to changes in climate? Are there characteristics that make a species particularly sensitive? The observations of Thoreau and Hosmer provided an opportunity to make headway in answering these questions.
The Remarkable History of Botanical Investigation in Concord
The surveys of Concord’s flora since 1830 are remarkable not only for their number, but also for their intensity. Aside from simply noting species occurrences, in some cases the surveyors recorded species abundance and the presence of invasive species, and noted botanically important areas. Building on the extraordinary historical base of previous surveys of Concord’s flora, over the past five years we have conducted our own survey of the flora. All of the previous surveys provided interesting data, but the precise observations of flowering times by Thoreau and Hosmer proved to be the most important for our study.

In the 1850s, after a decade of observing nature and four years after his experience of living on

How suddenly the flowers bloom! Two or three days ago I could not, or did not, find the leaves of the crowfoot. To-day, not knowing it well, I looked in vain, till at length, in the very warmest nook in the grass above the rocks of the Cliff, I found two bright-yellow blossoms, which betrayed the inconspicuous leaves and all. The spring flowers wait not to perfect their leaves before they expand their blossoms.

From the journal of Henry David Thoreau
the edge of Walden Pond, Thoreau began recording flowering times of plants in Concord. He cared deeply about the seasonal changes, as can be seen in his many observations in *Walden*. In describing his activities at Walden, Thoreau states, “I want to go away soon and live away by the pond ... But my friends ask what I will do when I get there. Will it not be employment enough to watch the progress of the seasons?”

One might say he was obsessed with the progress of the seasons. From 1852 to 1858, he hiked around Concord and made regular observations of the first flowering times of over 500 different species of plants in an effort to create a calendar of the natural events in Concord. His intention was to write a book about the seasons in Concord. Unfortunately, he died before he was able to complete his project. His friends also wrote about his obsession with the seasons, as Ellery Channing did after a walk with Thoreau on March 6, 1859: “Our round of walks is as regular as the seasons; now to low spots to look for early spring plants, also for early birds. Nature is an eternal provision and repetition. H[enry] says there is nothing but the seasons.”

His efforts to record flowering times were followed by another botanical enthusiast, Alfred Hosmer, who recorded the first flowering times of over 700 species of plants in 1878 and from 1888 to 1902. We do not know exactly why Hosmer made these observations, but we are quite thankful that he did. His records can all be found in precisely organized notebooks, presently housed in the Special Collections Section of the Concord Free Public Library.

The idea of tracking phenological events was not new at the time of Thoreau and Hosmer’s work. The practice is said to be as old as agriculture, if not older. Well-known Americans such as Thomas Jefferson kept records of flowering and bird migrations. But the incredible effort and continuity of the observations that Thoreau and Hosmer made was exceptional. They made observations across an entire town (without the aid of a car) several days each week for many consecutive years. In the processes, they created a list of flowering phenology for more species in a single location than any other of which we are aware.

**Linking Historical Observations with Climate Change Science**

When we learned about these flowering time observations from the late Thoreau scholar, Brad Dean, and the active New England botanist, Ray Angelo, we recognized that we had an opportunity to test whether climate change had affected the flowering times across the entire community of flowering plants in Concord. We immediately set out ourselves to document the current flowering times of as many species as we could throughout the town. From 2003 to 2006 we visited Concord two to three days each week throughout the flowering season, from March to October, and recorded the plants we saw in flower each day. We deliberately sought out locations of difficult-to-find species, such as Britton’s violet (*Viola brittoniana*) and rose pogonia (*Pogonia ophioglossoides*), with hopes
of observing as many of Thoreau’s and Hosmer’s species as we could. Eventually, we made observations of the first flowering dates, in addition to recording the entire period of flowering, of over 500 species. Many of the species we observed, and even the places where we saw them, were identical to those that Thoreau and Hosmer had seen.

With these data in hand, we set out to test whether first flowering dates had changed in Concord, and whether species differed in their response to a warming climate. To simplify things, we started by analyzing changes in the first flowering dates for 43 of the most common spring-flowering species that Thoreau, Hosmer, and we had all observed in nearly every year we looked. These species were abundant and widely distributed, and probably reflected fairly the changes in flowering times that had occurred more broadly in the Concord flora. On average, these 43 species were indeed flowering about a week earlier in recent years than they had in Thoreau’s day, with Hosmer’s observations right in the middle. Some of these species’ flowering times changed dramatically. For example, highbush blueberry (Vaccinium corymbosum), a shrub of wetlands, and yellow wood sorrel (Oxalis stricta), a native herb of fields and roadsides, are now flowering 21 and 32 days earlier, respectively, than they did 150 years ago.

This trend toward earlier flowering corresponded with warming temperatures in the Concord area. Temperature records from the Blue Hill Meteorological Observatory in Milton, Massachusetts showed 2.4°C (4.3°F) warming from 1852 to 2006. Most of this warming occurred because of urbanization and development in the greater Boston area, while some of it occurred because of global climate change. (For comparison, the average global temperature warmed by about 0.7°C (1.3°F) over the past 100 years.) The relatively large warming in Concord, boosted by urbanization, makes this flora a good example for how floras in the rest of the country, away from cities, may respond to future warming. Global temperatures are predicted to warm by about 3°C (5.4°F) in the next 100 years. Of course, the responses of plants in a developed area may be different from rural areas for a variety of reasons, pollution and the rate of warming among the most important. However, pollution is thought to have a negligible effect on flowering times relative to temperature. And although the rate of warming could alter how quickly flowering responses to temperature might evolve, evolution is likely to be slow in a flora, such as Concord’s, dominated by long-lived perennials and should have little impact on flowering responses to temperature on the time scales with which we were working.

We found a strong relationship between temperature and flowering times in Concord; temperatures in January, April, and May explained most of the variation in flowering dates. (More on why those months later.) On average, plants flowered about three days earlier for each 1°C warming. When we examined a much larger list of 296 species, we found the same response of flowering dates to temperatures.

Because plant flowering dates respond to temperatures at particular times, we examined the relative importance of temperatures in each month. Temperatures in January, April, and May were by far the most important for most species; warmer temperatures in all three months were linked to earlier flowering dates. April and May were important because they were the temperatures immediately preceding flowering for most species. Why January temperatures were so important was more of a mystery.

Winter temperatures are typically understood to influence flowering times in temperate plants through a process known as vernalization. Plants have biochemical methods to keep track of how cold it is and for how long. Once it has been cold enough for long enough, plants are said to be competent—that is, their dormancy is nearly complete and they are ready to start developing leaves and flowers as soon as it warms up. If it never gets cold enough for long enough, the plants may still flower when temperatures warm in the spring, but it will take longer to flower; the colder it gets, the closer the plants come to being fully competent, the faster they flower in the spring. The need to track the cold is a defense against abnormally warm temperatures in mid-winter. Plants in New England are adapted to avoid flowering in January or February, even when the weather is
warm. Under this scenario, plants should flower earlier in the spring after cold winters, because they should become more fully competent. However, we found that plants flowered later after particularly cold Januaries. Vernalization was apparently not responsible for the response we saw. Instead, we suspect that it gets so cold in Concord in January that in the coldest years plants suffer physical damage to the vascular tissue that delays flowering. We found support for this hypothesis in a subsequent project of ours in which we looked for this sort of damage in birches at the Arnold Arboretum.

Variation Among Species
With data on all these species, we looked for patterns of variation. Which species were the most sensitive to temperatures? Did particular traits seem to be associated with strong responses to temperature?

The flowering responses of plants from different habitats (e.g., aquatic, forest, grassland, roadside, and wetland) did not differ, nor did the responses of natives and non-natives differ from each other. However, season of flowering seemed to matter a great deal. The flowering times of early-season plants were on average strongly correlated with temperature, whereas the flowering times of late-season plants had a much weaker link with temperature. If this pattern continues, the flowering season may lengthen as temperatures warm. Spring species may flower ever earlier and the flowering times of summer species may not change much at all. As a result, the degree of overlap in species’ flowering times may be reduced.

Growth form seemed also to matter, although in a more indirect way. Among perennial herbs, the flowering dates of late-season plants varied a lot from year to year compared to the flowering dates of early-season plants. However, the variation in flowering time was not related to temperature. We are still unsure of what is driving the year-to-year variation in the flowering dates of late-season perennial herbs; it might have do with soil moisture, degree of shading,

Rose pogonia (Pogonia ophioglossoides) is an elusive native orchid found in fens and other damp sites. Cardinal flower (Lobelia cardinalis) grows in moist soils and produces spikes of bright red flowers in mid to late summer.
or land use. Meanwhile, woody plants showed the pattern we expected—lots of climate-driven variation in flowering dates for early-season plants and relative stability in the flowering of late-season plants.

Lastly, we noted that the flowering responses of several closely related species varied substantially. For example, sweet birch (*Betula lenta*) and gray birch (*Betula populifolia*), which occur in many of the same habitats in Concord and elsewhere, showed very different responses to temperature. Sweet birch flowered about three days earlier for each 1°C increase in January, March, and April temperatures, whereas gray birch flowering dates were unrelated to temperature. In an even more dramatic example, rough-stemmed goldenrod (*Solidago rugosa*) flowered 11 days earlier for each 1°C increase in temperature, whereas the flowering dates of lance-leaved goldenrod (*Solidago graminifolia*) and most other goldenrods were unrelated to temperature. These varied responses to climate change could lead to increased hybridization among closely related species, if flowering times that previously occurred at distinct times began to overlap. It could also cause more competition for pollinators; if plants that share pollinators and have historically flowered at different times begin flowering at the same time, they may start competing for the pollinators’ services. Competition for nutrients and water needed at critical times in plant development could also increase.

**The Big Picture**

Our study found that the plant community in Concord is responding to climate change in dramatic ways. Spring is coming earlier on average, but there is a lot of variation among species. Highbush blueberries are flowering three weeks earlier than they were in Thoreau’s day, yet the flowering times of other species are not changing at all.

Ecologically, these results reflect the complexity of plant response to climate change. The flowering times of early-season plants are shifting more quickly than those of late-season plants. Perennial herbs and woody plants respond differently. Habitat and nativeness do not seem to affect flowering responses to climate change. With such a wealth of data from this single location, we found surprising patterns, leading to questions that still must be answered. For example, why do the flowering times of closely related species respond so differently to warming temperatures? How will species interactions change as a result? Given the remaining uncertainty, it is difficult to assess how exactly flowering times will shift in the future and what the changes will mean for plants and animals. Thoreau was also aware of the effects of climate on plants and animals and their interactions more than 150 years ago when he wrote, “Vegetation starts when the earth’s axis is sufficiently inclined; i.e. it follows the sun. Insects and the smaller animals (as well as many larger) follow vegetation … The greater or less abundance of food determines migrations. If the buds are deceived and suffer from frost, then are the birds.”
The results of our study show how perceptive he was and suggest likely impacts of a warming climate. Interactions among species—e.g., predators and prey, competing plants, plants and herbivores—will certainly change. Most plant species can be pollinated by many animal species or by the wind, and most pollinators can feed on various flowers. For them, the relationships will shift, but they will probably continue to persist. However, shifts in the timing of specialist interactions, like those between hummingbirds and plants with long flower tubes, will probably lead to more dire consequences for the species involved. If a plant with a specialist pollinator flowers before its pollinator is active, its chances of reproducing may decline significantly. Additionally, as the flowering times of early-season plants continue to advance and pull away from the flowering times of late-season plants, there may be times of low floral resources for pollinators like bumblebees. Undoubtedly, some species will do well and thrive under the changed circumstances, while others will do poorly and may even go extinct.

**What’s Next?**

Research efforts are underway to solve these unanswered questions, but more data are needed. Known sets of phenological observations like those of Thoreau and Hosmer are quite rare. Yet scores of people have recorded observations—flowering dates in gardens, birds’ spring arrivals at feeders—that now sit in boxes in attics and basements. The newly formed USA National Phenology Network (www.usanpn.org) is beginning to collect these valuable “shoebox” data sets to make them freely available to the research community and the public. There is great potential for these phenological observations to shed light on ecological responses to climate change.

In addition, evidence of changes in phenological events can improve public awareness of the effects that climate change is already having on biological systems. People can see changes in phenology in their back yards, neighborhoods, parks, and forests. We believe that building on the observations of a well-known figure such as Thoreau can further increase the potential for public outreach.

Thoreau was keenly aware of the importance of educating people about environmental issues. He helped Concord's citizens to appreciate wild nature, and he encouraged them to protect it. He wrote, “I think that each town should have a park, or rather a primitive forest of five hundred or a thousand acres, either in one body or several, where a stick should never be cut for fuel, nor for the navy, nor to make wagons, but stand and decay for higher uses—a common possession forever, for instruction and recreation.” Residents of Concord and the government have followed this advice; about 40% of Concord’s land is preserved in parks and protected areas, such as Walden Pond State Reservation, Great Meadows National Wildlife Refuge, and the Estabrook Woods. With the help of these protected areas, we have been able to continue the same observations of flowering times made by Thoreau at many of the same localities in Concord. We now hope that Thoreau’s observations and our own work will promote broad discussion of the effects of climate change on biological systems.

**Resources:**


USA National Phenology Network. www.usanpn.org

Abraham Miller-Rushing and Richard Primack completed this research together while working at Boston University. Dr. Miller-Rushing is now the coordinator of the Wildlife Phenology Program, a collaboration between the USA National Phenology Network and The Wildlife Society. Dr. Primack is a professor at Boston University.
Popular taste is not a criterion that those who serve our public can respect.” So said Mariana Van Rensselaer, the distinguished New York art critic and first biographer of architect H.H. Richardson. That remark, made in 1888, fueled the controversy that erupted over her criticism of flowerbeds in Boston’s Public Garden. Describing them as crude hues in false situations, she took particular offense at ‘Crystal Palace Gem’ geraniums: “The cherry colored blossoms with yellow-green leaves are the most hideous products of recent horticulture.” William Doogue, the Irish-born horticulturist in charge of the Garden’s plantings, took exception to her criticism and also rebuked her social position, personal gardening habits, and Harvard-connected friends. Doogue defended his work as accommodating the general taste of the public, who loved his plantings. He protested to the local newspapers and the Mayor, and anyone else who would hear him out.

Was all of this brouhaha caused by some ill-placed geraniums, or was it indicative of a deeper division in how we imagine our public parks? This division is illustrated by the well-known story of the 1858 design competition for New York’s Central Park, won by Frederick Law Olmsted and architect Calvert Vaux with a plan titled “Greensward.” Their proposal offered a picturesque landscape evocative of the English countryside, combining rustic structures with meadows punctuated by groves, rock outcroppings, and sinuous water bodies. “Sylvan” and “verdant” were words used by the designers to describe their design as “a constant suggestion to the imagination of an unlimited range of rural conditions.” The contrast with the majority of proposals from competitors—engineers, landscape gardeners, and talented amateurs—represented a remarkable shift toward the narrative of the picturesque. Other more traditional plans presented highly embellished gardens with formal promenades, fountains, arches, statues of Greek deities and New York politicians, bandstands, and extensive formal layouts of flowering plants.

By the mid nineteenth century, the educated public understood that the picturesque landscape was the aesthetic ideal for public parks, allowing the mind to wander along with the body. Among others whose opinions counted, economist and social critic Thorstein Veblen pointed to an upper-class predilection for public parks that were rustic and natural. Enlightened park advocates rejected the pleasure garden model with its emphasis on flowery display, theatricality, sociability, and amusement, believing its artificiality and “claptrap and gewgaw” lacked moral uplift and tasteful restraint.

Like sin and grace, the picturesque park and the pleasure garden are mutually defining. Olmsted used medical metaphors to promote his
notion of the park ideal: parks should be an antidote to urban ills, healing places for damaged minds. Calvert Vaux's famous comment on Americans' intuitive love of the country was at the core of learned park discussions. Vaux spoke of an "innate homage to the natural in contradistinction to the artificial, a preference for the works of God to the works of man." Supporters of the pleasure garden model rejected the imposition of rural scenery on the city and embraced the seductive lure of sensual sound, color, and light—a sustained Fourth of July celebration, an extended summer fête.

The Origin of the Public Pleasure Garden
The public pleasure garden originated in London in the eighteenth century with extensive public gardens established at Ranelagh, Marylebone, and Islington. But Vauxhall Gardens on London's South Bank most completely and intensely captured the public's imagination. A favorite watering hole for Samuel Johnson, it was frequently used as a fictional backdrop by novelists. It offered grand promenades, open-air temples imitating ancient buildings, an array of dining and drinking pavilions, small theatres, bandstands, tea gardens, and private bowers for romantic interludes. Linking the attractions were elaborate flower displays of local and foreign blooms selected for color, fragrance, and mood-evoking exotic origins. There were fireworks and beguiling night-lighting in an era when both were rare. In its heyday, Vauxhall Gardens attracted aristocracy, royalty, and anyone who wished to mingle and immerse in an environment designed to please.

New York entrepreneurs transported the Vauxhall Gardens concept, name, and menu of

Central Park's Sheep Meadow reflects the pastoral, naturalistic theme inherent in Olmsted and Vaux's winning design for the park.
attractions to New York in 1805, to the area around Broadway and East 8th Street, which is now known as Astor Place. At the same time, even the less than sybaritic Hoboken, New Jersey created Elysian Fields, a popular waterfront park that offered ferry service from Manhattan, and where, some say, the first organized game of baseball took place. The last of the New York pleasure gardens, Palace Gardens, opened in 1858 (the same year as the Central Park competition). It offered the usual array of dining pavilions, water features, and elaborate night-lighting.

Legacy of the Pleasure Garden

Today, the tradition of the pleasure garden continues to influence the way we think about urban parks. Certainly the questions posed 150 years ago continue to resonate: Who owns the parks? The planners? The middle class? The working class having no other options? And just as important: What is the purpose of a park?

The success of the public pleasure gardens was due to diligent management by entrepreneurs who owned them and developed new attractions: balloon launches, water gondolas, music commissioned for special occasions. The eventual demise of the public pleasure garden was due in part to competition from new urban amenities: restaurants, concert halls, theatres, tearooms, and cafes dispersed throughout the city. It was due as well to the growth of petty crime that, then as now, often attaches to public venues that draw huge crowds. And some plea-
Pleasure gardens, having contributed to the growth and desirability of the city, became victims of their own success and were lost to real-estate development pressures. The prototypical evocation of a pleasure garden that survived is Copenhagen's Tivoli, which opened in 1843. Patterned on London's Vauxhall and named for the beautiful resort town near Rome, it still offers families a complete pleasure garden experience with attractions interspersed among flower displays appropriate to the season.

The horticultural display of pleasure gardens, with its emphasis on seasonal flowering, evolved into civic horticulture—embellishment of city-spaces that are not within the purview of the professional landscape architect and most often maintained by gardeners trained through apprenticeship and guided by trade magazines. These plantings typically feature massing of large numbers of flowers of strong color contrasts arranged in geometric or pictorial patterns. Some traditions, such as the theatrical display of plants in graduated tiers, evolved from the eighteenth-century English estate garden into the public pleasure garden, as still seen in Boston’s Public Garden today. Civic horticulture draws on a rich planting tradition that evokes admiration of both the beauty of the plantings and the ingenuity of the gardener. The immense popularity of the Rose Garden in the Fens section of Boston’s Emerald Necklace, of the planted borders in downtown Boston’s Post Office Square, and the grand flowerbeds at Copley Square are fine examples of horticulture that enlivens the city, akin to Pop Concerts on the Esplanade.

Although theme parks and amusement parks are obvious descendents of the pleasure garden, recent trends in urban public parks suggest that the pleasure garden is enjoying a renaissance.

Modeled on public pleasure gardens such as Vauxhall, Tivoli opened in Copenhagen, Denmark, in 1843. Tivoli’s exotic Moorish-styled Nimb building is shown in 1910 (left), one year after being built, and as it appears today (right).
Arnoldia 66/3

of sorts. We are in the midst of defining a new urban park discourse, one that rejects the picturesque and encourages new kinds of urban engagement—drawing in the city, making use of technology, and embracing theatricality. Chicago’s Millennium Park, an assemblage of cultural attractions and elaborate planting displays, lists “theatre consultant and lighting designer” as part of the design team. The team of Kathryn Gustafson and Crosby, Schlessinger and Smallwood have developed a highly ornamental planting plan for the North End Park of Boston’s Rose Kennedy Greenway. The Dutch horticulturist Piet Oudolf is acting as a consultant for a number of new urban parks in the United States, bringing his skill at highly textured perennial planting in changing seasonal patterns to a new audience. Yet, we still drag issues of public taste behind us, although now couched in concerns for environmental suitability, often with the same moral overtones that characterize the Central Park discussions of the mid-nineteenth century.

We lay a huge responsibility on our urban parks. They must be didactic, educate about ecology, unify communities, and convey history. They must exhibit good taste and local values. But if we are to sustain parks in cities, they must embrace the imagination of the public. The term “Disneyfication” is now an indictment, but one suspects that William Doogue would have welcomed Walt Disney’s words: “We are not trying to entertain critics. I’ll take my chances with the public.”

Phyllis Andersen is a landscape historian and the former director of the Institute for Cultural Landscape Studies of the Arnold Arboretum. She is currently working on a book on public pleasure gardens scheduled for publication in 2010.

This article originally appeared in ArchitectureBoston.
All that glitters isn’t gold. Sometimes it’s silver, especially when it’s the rare Cathay silver fir (Cathaya argyrophylla). It is now over 50 years since the discovery of this “living fossil”, yet it remains largely unknown. Access to this conifer has been tightly controlled by China; reportedly, even the offer of a Trident jet in exchange for a single plant during the late 1970s was not sufficient to entice the Chinese to release their grip on this endemic “treasure tree,” whose fir-like leaves reflect their silvery undersides when they catch the sunlight.

This offer may not sound so far-fetched when compared with the more recently discovered Wollemi pine (Wollemia nobilis) of Australia, which has grossed millions of dollars in worldwide sales since its public release in early 2007 following a well-orchestrated marketing and publicity campaign highlighting its ancient origins. Earlier, a pre-release auction of the first Wollemi pines realized over one million Australian dollars with an average of A$3,627 per tree, and this without any American bids because of U.S. import restrictions on trees over 18 inches (0.5m) tall. So for China, the Cathay silver fir—mass produced and properly marketed to the west—had the potential of being a similar financial success story.

Described as another “living fossil” when it made world headlines in the 1950s, the Cathay silver fir did not make it out of China prior to its official release by Chinese authorities in the 1990s. In contrast, dawn redwood (Metasequoia glyptostroboides), the previous world-renowned “living fossil”, was introduced into western cultivation from China in late 1947, a mere six years after its discovery. This was thanks in large part to the efforts of Elmer D. Merrill, then Arnold Professor of Botany at the Arnold Arboretum and previously the Arboretum’s director.

By the time of the discovery of Cathaya argyrophylla just eight years later, the changing political landscape in China and the cutting of ties with the west meant that this botanically interesting tree, which Chinese botanists have described as “The Giant Panda of the Plant Kingdom,” was to languish in near obscurity for over thirty years. Even with the gradual lifting of the bamboo curtain post-1972, it still took many years before the Chinese allowed the tree to be taken out of the country, or distributed any seeds.
to overseas botanical institutions. Consequently, the Cathay silver fir is still little known even today, more than half a century after its scientific discovery.

**A New Plant is Found**

This discovery occurred in 1955 during a botanical exploration of the remote Huaping region of northern Kwangsi province [now Guangxi Zhuang Autonomous Region] in southern China. Deng Xianfu, a member of the Kwangfu-Lingchu Expedition, literally unearthed the first Cathay silver fir when he dug up a seedling of what he thought was *Keteleeria fortunei*. Following a closer inspection of the seedling, expedition leader Professor Zhong Jixin found that it didn’t resemble Fortune’s keteleeria. He also knew that *Keteleeria fortunei*, while occurring naturally in Kwangsi province, could not survive there at above 1400 meters (4600 feet) in the Tianping Mountains, and so considered that it might be a new species of *Keteleeria*.

Upon receiving further information that a tree had been seen in these mountains with some resemblance to both a pine (*Pinus*) and a fir (*Abies*), Professor Zhong realized that they should be looking for something special. He directed expedition members to intensify their efforts to find the parent plant(s) of the unfamiliar seedling.

Continued searching of the precipitous, mist-shrouded mountains led to the discovery of a mature tree on the southern slopes of Mt. Hongya on May 16, 1955. Herbarium specimens were collected by expedition members, with further specimens collected from the same locality by H.C. Lei, H.C. Chung, H.L. Hsu and H.F. Tan from May to July the following year. All these specimens were deposited at the herbarium of the South-China Institute of Botany, later renamed Kwangtung Institute of Botany [now held at Guangxi Institute of Biology].

Here they were seen by the Soviet botanist Sugatchey [likely a mistranslation of the name Sukachev] who advised that they resembled plant fossils previously found in the Soviet Union and Europe dating back to the Pliocene of the Tertiary Period, and hence the newly discovered tree represented a “living fossil”. *Cathaya* fossils found since then include fossil pollen in Asia and North America dating back to the Cretaceous.

Chun Woon Young [Chen Huanyong] and Kuang Ko Zen [Kuang Keren] published a description of the new genus and species in 1958. They also described a second species, *Cathaya nanchuanensis*, discovered in 1955 on Jinfo Shan (Golden Buddha Mountain) in southeastern Sichuan. However, this name was reduced to a synonym of *Cathaya argyrophylla* in 1978.
Natural Occurrences of *Cathaya* in China

<table>
<thead>
<tr>
<th>PROVINCE/REGION</th>
<th>NUMBER ON MAP</th>
<th>LOCATION (Reserve area in ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(previously part of Sichuan Province)</td>
<td>8</td>
<td>Wulong County.</td>
</tr>
</tbody>
</table>

The generic name *Cathaya* derives from the historic place name Cathay, a dominion of the Mongol Emperor Kublai Khan at the time of Marco Polo’s travels during the late thirteenth century, and now the northern section of today’s China. However, the areas of the present day natural occurrence of *Cathaya* are actually outside the realm of what was known as Cathay in Marco Polo’s time. Instead, they fall within another of Kublai Khan’s dominions known as Mangi or Manzi, now the region of China south of the Yangtze River. So perhaps in a historical context the name Mangia would have been more appropriate, although without the appeal of implied antiquity in the name *Cathaya*.

Guarding the Silver

The significance of the discovery of the Cathay silver fir in 1955 was considered by the Chinese to be so important that they established Huaping Nature Reserve in 1961 to protect the first found population of the trees. This was one of the earliest nature reserves created in China. Since 1976 many more nature reserves have been established throughout China, and around 4,000 Cathay silver firs presently occur in about a dozen of these (see map).

Even when China opened to the west in the late 1970s, these nature reserves were generally off-limits to most foreigners. As late as 1997, I and my colleague S.K. Png of the Australian Bicentennial Arboretum, during a visit to Guizhou Botanical Garden in Guiyang, were steered clear of the natural stand of *Cathaya argyrophylla* growing in the forest reserve of the garden. A similar situation befell the authors of *Southwest China, Off the Beaten Track* while they were researching their book during the mid-1980s, and were discouraged from visiting Huaping Nature Preserve in Longsheng County,
where *Cathaya argyrophylla* was first found. As they commented, “Longsheng County has a nature preserve, though what is there is anyone’s guess since we could never get a straight answer.” [Ed. note: William McNamara of Quarryhill Botanical Garden also had a challenging experience trying to see *Cathaya*—read his account on page 24]

Ultimately, China must have realized that one way to protect these rare and endangered trees in their natural habitat is to make them available for cultivation elsewhere. The earliest record I’ve found for *Cathaya argyrophylla* introduced outside China is a 1993 accession at the Royal Botanic Gardens, Sydney, Australia. The accession’s exact fate wasn’t recorded, but as of May, 2003, it was listed as “no longer in the nursery”. However, since plants which had lost their identification labels in the botanic garden’s nursery were sometimes sold at the annual Friends of the Garden’s plant sales, it is at least possible that the oldest *Cathaya* in cultivation outside of China is growing unrecognized in a yard somewhere in Sydney.

The next earliest year for introduction of definitely surviving *Cathaya argyrophylla* is 1995 when seeds were received by the Royal Botanic Garden, Edinburgh, Scotland from Shenzhen Botanical Garden in China. These seeds were then redistributed by Edinburgh’s Conifer Conservation Program to various other gardens,
including 50 seed sent to the Arnold Arboretum, where none germinated. The Arnold Arboretum received further seed in 1998 from Fairy Lake Botanical Garden in China, with excellent germination [Ed. note: Read more about Cathaya at the Arnold Arboretum on page 22].

Finally, seed was allowed out of China in commercial quantities in 1998. Worldwide, apart from botanical gardens, arboreta, and rare plant collectors, relatively few private individuals appear to have acquired this desirable conifer, although many have expressed interest in obtaining the plant if and when it becomes available.

Cathaya in the landscape

Although not yet widely grown, Cathay silver fir certainly has potential as a landscape plant. It is beautiful as a young plant, and ultimately develops into a noble tree of about 20 meters (65 feet) or more tall with a columnar trunk and horizontal branching. Its long, narrow, evergreen leaves are about 4 to 6 centimeters (1.4 to 2.4 inches) long (sometimes longer), and 2.5 to 3 millimeters (.08 to .11 inches) wide. Leaf color is deep green. On the underside, two prominent silvery-white stomatal bands are separated by the midrib. This flash of silver provides the species with its specific epithet, argyrophylla, “with silvery leaves”.

Surviving as it does in Chinese botanical gardens at Shanghai near the coast and Wuhan in central China, which experience minimum winter temperatures of -12°C (10°F) and -18°C (0°F) respectively, this rare and endangered tree should be hardy in USDA zones 7 or warmer. In slightly colder regions it may be suited to cultivation provided it is given a sheltered microclimate where it is protected from extremes of winter cold and freezing winds. In its native range Cathay silver fir experiences cool summers, winter snow, high humidity, and plen-
Two Living Fossils and the Arnold Arboretum Connection

*Cathaya argyrophylla* co-author Chun Woon Young (Chen Huanyong) had undertaken dendrology courses with Professor John Jack at the Arnold Arboretum from 1915 to 1919 while completing graduate studies at Harvard’s Bussey Institution. He was to comment that it would take him a lifetime of travel to learn as much about Chinese trees as he did while studying at the Arnold Arboretum for a few years.

Hsen Hsu Hu (Hu Xiansu), who was the lead author with W.C. Cheng in naming and describing the dawn redwood (*Metasequoia glyptostroboides*), also studied under John Jack from 1923 to 1925. Thus, both the monotypic “living fossil” conifers endemic to China, *Cathaya argyrophylla* and *Metasequoia glyptostroboides*, were named and described by pioneering Chinese botanists who undertook forestry courses at the Arnold Arboretum.

In this 1917 photograph, Professor John G. Jack studies a black maple with several students, including Chun Woon Young (Chen Huanyong) at right.
tiful rainfall. When planted in the landscape it should grow best if it receives plenty of moisture, particularly in summer, and is situated in a sunny, well-drained site.

The Cathay silver fir is one of the most notable in a long line of rare, endemic, and endangered plants to come out of China, Ernest Wilson’s “Mother of Gardens,” and I suspect that there remain others yet to be discovered. We can only hope that they are found before human population pressure and the resultant clearing of ever-diminishing forested areas forces them to extinction, as is sadly happening throughout the world.

References and Further Reading


(continues on page 25)
On October 21, 1998, like a bolt out of the blue, the Arnold Arboretum received an unsolicited packet of nearly 600 seeds of the extremely rare Chinese conifer *Cathaya argyrophylla* from the Fairy Lake Botanical Garden in the city of Shenzhen, Guangdong Province, China. We were excited about getting these seeds for two reasons: first, *Cathaya argyrophylla* is an endangered species endemic to China, with only limited distribution outside that country, and second, we had received seeds three years earlier, in 1995, but to our great disappointment they had failed to germinate.

When the *Cathaya* seeds arrived at the Arboretum they had no markings other than the name of the plant and the return address. It was all rather mysterious, and it wasn’t until nearly three years later, during a chance encounter at the New York Botanical Garden, that I met Dr. Li Yong who told me that the seeds had been collected from wild trees growing in Zi Yuan County in Hunan Province, and that he had sent them to the Arnold Arboretum. Needless to say, I thanked him profusely for the wonderful gift.

The day after the seeds arrived at the Arboretum, Jack Alexander and I counted and divided them up into various lots to test their germination following various periods of moist stratification in the refrigerator. Because we could find no written information about the dormancy requirements of the seeds, and because the species is native to a warm temperate–subtropical area, we made the assumption that the seeds probably required minimal chilling. Table 1 lays out the parameters and results of the seed germination experiment we set up in the Dana Greenhouses.

<table>
<thead>
<tr>
<th>Number of days of chilling</th>
<th>Number of seeds</th>
<th>Percent germination (Number of seedlings)</th>
<th>Number of days to first seed germination</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>200</td>
<td>6 (12)</td>
<td>170</td>
</tr>
<tr>
<td>57</td>
<td>100</td>
<td>21 (21)</td>
<td>24</td>
</tr>
<tr>
<td>70</td>
<td>100</td>
<td>31 (31)</td>
<td>29</td>
</tr>
<tr>
<td>112</td>
<td>159</td>
<td>74 (118)</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 1. Germination of seeds of *Cathaya argyrophylla* which were sown or moist stratified on October 22, 1998.

Despite our best guess, the seeds which received four months of cold stratification germinated much faster and in much higher percentages than seeds which received less than seventy days of chilling. So much for a propagator’s intuition. By the time the experiment ended in July 1999, we had potted up a total of 182 seedlings, which made for an overall germination rate of 32.6%.
On April 5, 2000, the Arboretum distributed 79 seedlings to various botanical gardens throughout the United States, keeping about a dozen plants for ourselves. Several of our plants grew well; by spring of 2006, after eight growing season, the three biggest plants were 1.2, 0.8, and 0.7 meters (4, 2.6, and 2.3 feet) tall. Five of the biggest seedlings were moved from the shade house to the nursery in June of 2006, but three of them failed to survive the transplanting. Only one plant was still alive by April 2008, when it was planted out on the grounds. Our fingers are crossed that it will survive its first winter out on the grounds. As for the seedlings that we distributed back in 2000, the Mendocino Botanical Garden and the University of California Botanical Garden in Berkeley have both reported having plants that are still alive.

Peter Del Tredici is a Senior Research Scientist at the Arnold Arboretum.
An Excerpt From: Three Conifers South of the Yangtze

William McNamara

Our final goal was to reach the Jinfu Shan, the mountainous home of the extraordinary conifer *Cathaya argyrophylla* . . . After a good night’s rest in a fairly decent hotel in Nanchuan, we eagerly headed to the jeeps for the drive up into the Jinfu Shan. To our surprise, blocking the gate to the hotel were at least a dozen people arguing with Dr. Yin and Professor Zhong. Apparently several of them were determined to keep us from visiting the Cathaya. There was a representative from the local police, the local tourist bureau, the forestry department, the public security bureau, the Chinese army, the mayor’s office, and who knows what else. All were yelling and throwing their arms up in the air. Finally they agreed that we could go see the trees but stated emphatically that we would not be allowed to touch or photograph them. At this point the argument was on the verge of getting seriously out of control. Dr. Yin then made a phone call to the governor, who told the troublemakers that we could indeed visit and photograph the valuable resource Yinshan, the Chinese name for *Cathaya argyrophylla*, as we were important scientists from England and America.

Two and a half hours later our jeeps, with an escort of six Chinese to keep us under control, were climbing up steep, mist-covered mountains. We stopped at about 1700 meters (5600 feet) elevation in an area of dense bamboo . . . We then hiked in a light rain for about 20 minutes, slightly uphill, to a large limestone outcrop about 15 meters (50 feet) high and wide. Our Chinese escorts pointed to the top of the outcrop and said, “There they are.” Through the mist we could barely make out several conifers growing on the top. As we stood there wondering if they would let us climb up to view them closer, we noticed that someone had already rendered that nearly impossible. Everywhere that it might have been possible to climb, the limestone outcrop had been
altered to prevent that possibility. Cracks that might have been footholds had been filled in with concrete, rough areas that might have served as grips were smashed smooth, and in areas of easy accessibility, barriers of rock and concrete had been installed. Someone was undoubtedly determined to keep people away from the Cathaya. As we looked around, clearly frustrated and not trying very hard to disguise it, the Chinese surprised us all by picking up a small fallen tree and leaning it against the outcrop. They then found another similar log and together with the other, they created a makeshift ladder. Several minutes later, after pushing and pulling each other up onto the top of the outcrop, we were standing in a grove of Cathaya. Our hosts further surprised us by telling us that it was all right to climb the trees and to take an herbarium specimen.

The dozen or so trees averaged about 10 meters (33 feet) in height and superficially resembled short-needled pines... After a good half hour of climbing, examining, and photographing the trees, we slowly made our way back down the outcrop. The rain intensified as we walked back to the road. While getting into the jeeps, our escorts told me that I was the first American to see Cathaya argyrophylla in the wild. Though very suspect of that statement, and rather cold and wet, I was nonetheless very happy to have seen, photographed, and even climbed the Cathaya.

William McNamara is Executive Director at Quarryhill Botanical Gardens in Glen Ellen, California. Full article at: http://www.quarryhillbg.org/page16.html

(continued from page 21)


Christopher B. Callaghan is a plant researcher and Curator of Living Collections at the Australian Bicentennial Arboretum.
The largest *Ginkgo biloba* tree in the world, the Li Jiawan Grand Ginkgo King, is located about a hundred kilometers west of Guiyang, the capital of Guizhou Province, China. The tiny hamlet of Li Jiawan (26°39’ N and 107°25’ E) is too small to appear on any maps. Administratively, Li Jiawan is part of Lebang Village, which is part of Huangsi Town in Fuquan County.

The Grand Ginkgo King is growing at an altitude of 1,300 meters (4,265 feet) in a narrow valley where it towers over the surrounding bottomland vegetation, which consists mainly of cultivated crops (Figure 1). It is a male tree, about 30 meters (98 feet) tall, with a ground level trunk diameter of 460 centimeters (181 inches) in the east–west orientation and 580 centimeters (228 inches) in the north–south direction. Its circumference at breast height is 15.6 meters (51 feet) and its canopy shades an area of roughly 1,200 square meters (13,000 square feet). The primary “trunk” is completely hollow and encloses an area of 10 to 12 square meters (108 to 130 square feet), more than enough for seating a dinner party of ten people. Indeed, during the 1970s, an old man by the name of Pan Shexiang, accompanied by his cattle, lived in this natural tree cave for two years.

The inside of the trunk—up to a height of about 5 meters (16 feet)—is charred black from lightning-ignited fires (Figure 2). The outside of the trunk shows no signs of fire, but has a ragged appearance caused by the excessive amount of callus tissue that has formed between the new branches and old trunks. In addition, large hanging chichi (downward growing shoots that look something like stalactites) have developed in response to various wounds and breaks, adding more confusion to the convoluted woody excrescences that cover the trunk. As battered as the outside of the tree appears, however, it maintains a vigorous hold on life, as attested to by the presence of numerous young shoots sprouting out all over the tree (Figures 2 and 3).

Chinese investigators have determined that the Grand Ginkgo King is a “five-generations-in-one-tree” complex. In other words, the first generation was a normal seedling which—as a result of repeated sprouting from the base over the course of several millennia—produced four succeeding generations of trunks, each of which has continued the tree’s growth and development after the preceding generation was damaged or died (Figure 4). The tree, as we know it today, is the result of at least five generations of stems produced over the course of thousands of years. There are five distinct trunk sectors which are separate at ground level but are partially merged at the height of about a meter (3.3 feet) above the ground, and new branches often sprout from the tissue between trunk sectors. While each trunk section seems to be physiologically independent, the secondary fusion creates the appearance of a single tree (Figures 2 and 3).

**Age Estimation**

Extensive field work has shown that the Li Jiawan Grand Ginkgo King is the biggest (in terms of trunk diameter) ginkgo tree in the world, a fact what was recognized by the Guinness Book of World Records in 1998. The question of how old the tree might be is unclear given that its internal tissues—with all their growth rings—are totally gone. What we do know, however, is that ginkgo trees of different ages have very different appearances and growth characteristics, and that different generations of ginkgo trunks typically have different growth rates and different longevities. We have come up with a rough estimate of the Grand Ginkgo King’s age based on what we know about the ages of other ancient ginkgo trees in China with a similarly complex developmental history: the first generation stem(s) can typically reach up to 1,200 years of age, the
second generation stems live for about 1,000 years, the third 800 years, the fourth 600 years, and the fifth about 400 years. According to this highly theoretical formula, the Li Jiawan Grand Ginkgo King has a maximum estimated age of around 4,000 to 4,500 years.

Legends and Romance
The Grand Ginkgo King has been living for thousands of years without an official record in the history books of the local government. However, there are many folk legends surrounding this tree. Writer Shixian Xu described one of these legends:

During the Tang dynasty there was a scholar named Bai who had recently gained a governor’s position by winning a national competition. At some point after taking office, Bai had a fight with a treacherous court official who had done a lot of bad things to the ordinary people. Given that bad officials typically protect each other, the scholar Bai was punished for his actions and sent off to an isolated army camp. On the way there, he was severely beaten and eventually died from his wounds. His body was buried at Li Jiawan by the local people, who deeply loved this scholar who tried to help ordinary people. Soon afterwards, a huge tree grew out from the tomb. This tree was considered the avatar of scholar Bai and given the name “bai guo tree” (one of the Chinese names for Ginkgo biloba).

Another story about the origin of the tree dates from the Ming dynasty and holds that the Li Jiawan Grand Ginkgo tree transformed itself into a scholar and entered a national competition. The tree-scholar won the championship and was appointed to be a high official by the king. When the tree-scholar failed to show up for the position, the king sent two messengers to find him, both of whom were killed when they came back empty handed. The third messenger that the king sent was worried about his own safety since he too could find no trace of the mysterious scholar. During his disturbed sleep one night, he had a dream in which a person appeared calling himself “Bai.” At this point
Figure 2. The Li Jiawan Grand Ginkgo King.
Figure 3. The multi-generational trunk of the Li Jiawan Grand Ginkgo King.
the messenger woke up and saw an official's hat hanging on the top of a nearby ginkgo tree and immediately understood that the scholar and the tree were one and the same.

This story—that the ginkgo tree had changed to a spirit—is an astonishing, age-old story, and there are lots of “big tree changed to spirit” stories in the south of China. Luckily, people usually worship such “spirit trees” and don’t dare to damage them. Many of these trees grow in temple courtyards or on sacred mountains and are preserved out of respect for the spirits that inhabit them but, unfortunately, this kind of conservation is not good enough to protect trees in the modern world.

What the Future Holds

The Li Jiawan Grand Ginkgo King was seriously damaged and its overall appearance dramatically changed by a storm in July, 1991, in which the biggest trunk on part 2 was broken off (Figure 4). The stem was pruned off below the break, but the resulting scar still looks fresh with no sign of callus growth to cover it over. It is also worth noting that for eighteen years there have been no new sprouts from part 3. Such a loss of normal regenerative function suggests that the Li Jiawan Grand Ginkgo may be losing its vigor. Based on what we have seen of other multigenerational trees, it is predictable that the Li Jiawan Grand Ginkgo will get smaller over time rather than bigger and that in 50 to 100 years or so it will be dead.

References


Zhun Xiang is Research Assistant at Guizhou Academy of Science in Guizhou and Graduate Student at South China Agriculture University in Guangzhou. Yinghai Xiang is Professor of Ecology at Guizhou Academy of Science in Guizhou. Bixia Xiang is Assistant Professor of Genetics at the University of Miami. Peter Del Tredici is a Senior Research Scientist at the Arnold Arboretum.
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Fireworks for the New Year: *Hamamelis × intermedia* 'Jelena'.

NANCY ROSE
The Arnold Arboretum’s Conifer Collection offers visitors an opportunity to explore gymnosperms collected from around the world. While Eastern Asian, European, and North American species dominate the collection, a solitary Moroccan fir, *Abies pinsapo* var. *marocana*, stands as an exceptional North African taxon.

Grown from seed collected by former Arboretum plant propagator Rob Nicholson on Mt. Tisouka near Chefchaouen, Morocco, in 1982, specimen 1435-82-A has thrived undamaged in the landscape for 15 years. It is one of two plants of accession 1435-82 that were moved from the Arboretum’s Dana Greenhouse to the grounds on September 21, 1993. One plant did not survive transplantation and was noted as dead in the spring of 1994. The lone survivor, which was approximately 4.3 feet (1.3 meters) at the time of transplant, is now a stunning exemplar at 28 feet (8.5 meters) tall with a DBH (diameter at breast height) of 12.6 inches (32 centimeters).

Conical in youth, the tidy habit of this specimen has opened slightly over the years to reveal smooth gray bark. Radially arranged needles persist for 11 to 13 years, giving even older branches an armored appearance. The dark green needles are streaked with 7 to 11 silvery stomatic lines on the upper surface; the lower surface is marked with two pronounced stomatic bands on either side of the midrib. Unlike the characteristically soft-to-the-touch foliage of most *Abies*, the needles of *Abies pinsapo* var. *marocana* have sharply pointed apices, making the foliage far less friendly to fingers. The upright cylindrical cones typical of the species have not yet been observed on this specimen but can be expected soon; sexual maturity for Moroccan fir is typically reached when the trees are between 25 and 35 years old.

Described by French botanist Louis Charles Trabut in 1906 as *A. marocana*, the Moroccan fir is confined to the Rif Mountain Range of Morocco, growing at altitudes between 4,600 and 6,900 feet (1,400 to 2,100 meters). The calcareous soil of this region supports associated taxa, and notes from the Arnold Arboretum’s collecting trip detail an open fir forest containing *Cedrus atlantica*, *Acer* (*A. opulus* ssp. *hispanicum*, *A. campestre*, *A. monspessulanum*), and *Paeonia* (*P. coriaceae* var. *maroccana*).

Rare in cultivation, the International Union for Conservation of Nature and Natural Resources considers *Abies pinsapo* var. *marocana* to be a “near threatened” species, an indicator that it could become threatened in the wild in the near future. Human activities (logging, expansion of cultivated areas, population growth) and climate change may further restrict the range of this taxon. However, preservation efforts are ongoing and the establishment of the Talassemtane National Park, which contains the only remaining Moroccan fir forest, was celebrated by conservation organizations in 2004.

**Related species:**

*Abies pinsapo* ‘Glauca’, blue Spanish fir, is also represented in the Arboretum’s collection (accession 192-42-A, obtained from W.B. Clarke and Company, San Jose, California). Planted in the fall of 1954, this blue-hued cultivar is topped with dozens of cones this year. Separated from the Moroccan fir by the Straits of Gibraltar, the Spanish Fir (*Abies pinsapo* var. *pinsapo*) is endemic to the Sierra de Ronda in Southern Spain.

Kyle Port is Manager of Plant Records at the Arnold Arboretum.