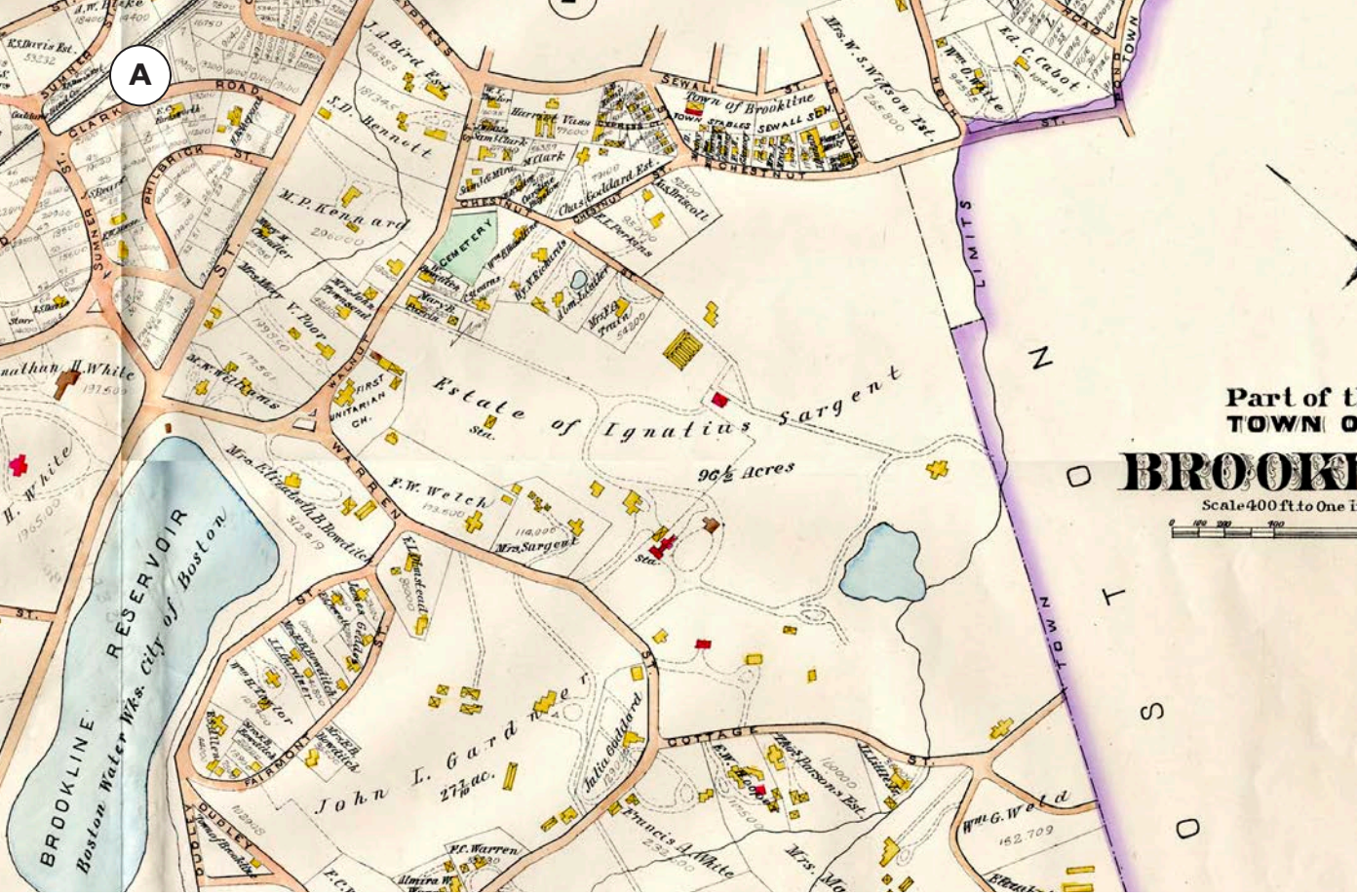
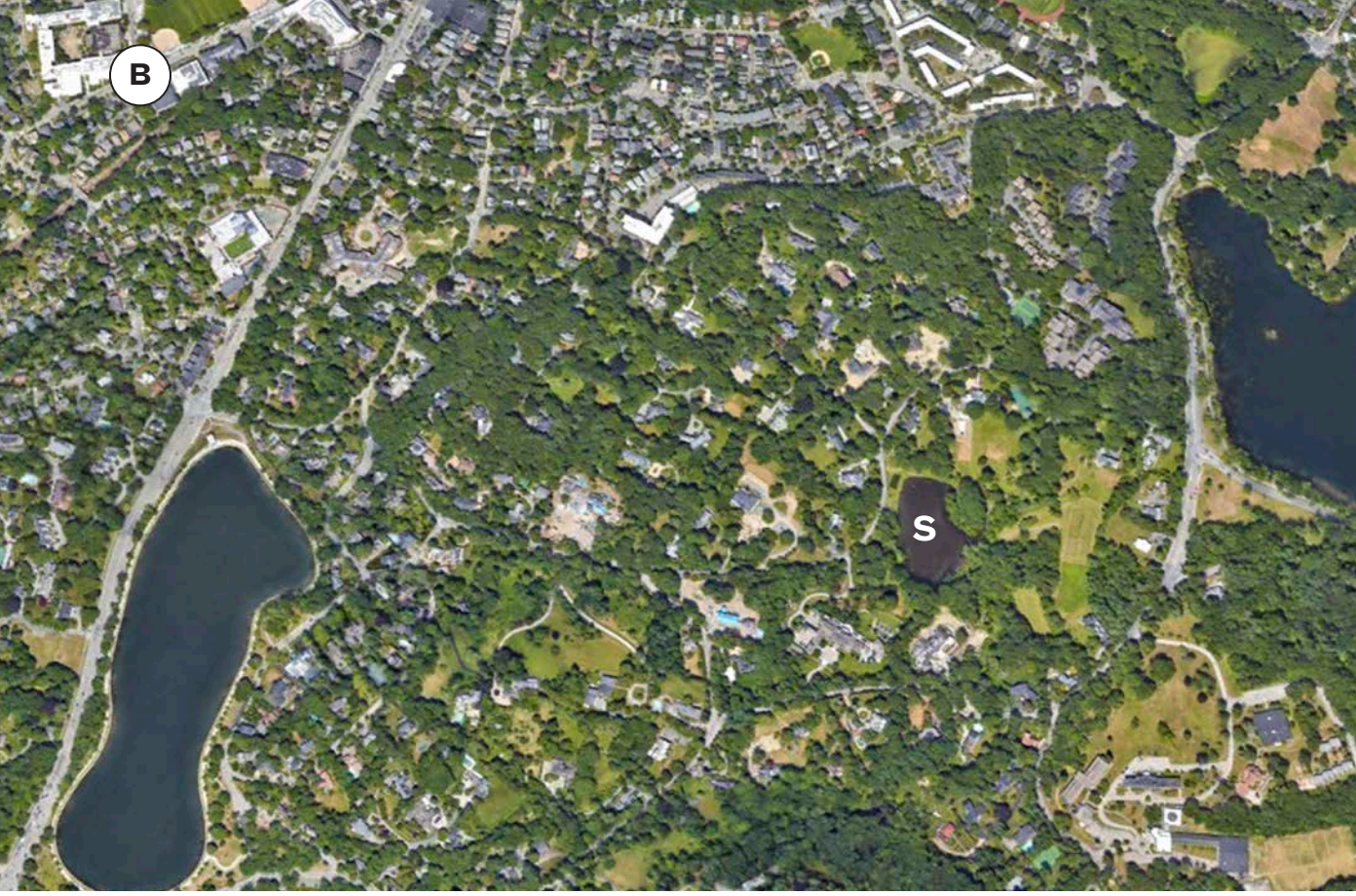


LANDSCAPE HISTORY

Reconstructing 150 years of Vegetation History on the Holm Lea Estate

By Wyatt Oswald, Ella Mastroianni, and Yoshiko Slater



We go about our lives surrounded by vegetation—forests, farms, wooded parks, suburban lawns and gardens, street trees, athletic fields, weedy roadsides. We may pay attention to year-to-year variability in these plants, like the early flowering of magnolias during a warm spring, or discolored leaves due to drought or insect stress, or a particularly abundant crop of tomatoes one summer. But the rhythms and lengths of our lives are such that we may not notice changes in vegetation over timescales of decades and longer.

In this case study we reconstruct changes in the vegetation of a southern New England landscape over the last 150 years. We analyzed pollen in a sediment core from Sargent's Pond, located on the former Holm Lea estate in Brookline, Massachusetts, to generate a continuous record of vegetation composition and structure since the 1870s. Additionally, we explored the papers of Charles Sprague Sargent in the archives of the Arnold Arboretum, yielding historic images and descriptions of Holm Lea that complement the pollen record with snapshots of the landscape from the late nineteenth and early twentieth centuries.

The 60-hectare Holm Lea estate (Figure 1) was established on former farmlands in the 1840s by Ignatius Sargent, a Boston banker, merchant, philanthropist, and horticulturist (Meehan 1884). Charles Sprague Sargent (Figure 2), the third child of Ignatius and Henrietta Sargent, was born in 1841 and grew up on Holm Lea. After graduating from Harvard, serving in the Union Army in the Civil War, and traveling in Europe, the younger Sargent returned to the family estate in 1868 and took over the management of

Figure 1. (A) Map of Brookline, Massachusetts in 1888 (Robinson 1888), centered on Holm Lea, the estate of the Sargent family (B) Google Earth image of the same area from June 2022. S=location of Sargent's Pond.

Figure 2. Charles Sprague Sargent in 1904 in the library of the Arnold Arboretum.
Photograph by T.E. Marr

its grounds. He inherited his father's interest in gardening and was influenced by other family members and neighbors who were prominent horticulturists (Sutton 1970). In 1873 Charles Sprague Sargent was appointed the first Director of the Arnold Arboretum, located not far from Holm Lea, and shortly thereafter he began collaborating with Frederick Law Olmsted on the Arboretum's layout, including its botanical collections, its network of roads and paths, and the naturalistic design of the overall landscape (Zaitzevsky 1982). Sargent led the Arnold until his death in 1927. His legacy includes not only the living collections of the Arboretum, which were augmented by Sargent's own collecting and his support for botanical expeditions, such as to east Asia in the early twentieth century (e.g., Wilson 1913), but also his work on the scientific study of trees and the conservation of forests (e.g., Sargent 1884; Sargent 1891–1902).

Charles Sprague Sargent stewarded Holm Lea, like the Arnold Arboretum, as a naturalistic, pastoral landscape, with open fields and woods, with a great variety of native and introduced species, and with few formal gardens (Figure 3). The property was described as "the most inspiring estate in New England" and "the best specimen of landscape-gardening in America, because every department of country life is here represented in due proportion, without extravagance or faddism, and all are blended into a beautiful and useful picture which is nothing short of exquisite" (Greene 1908). After a visit to Holm Lea in 1893 the conservationist John Muir wrote: "This is the finest mansion and grounds I ever saw. The house is about two hundred feet long with immense verandas trimmed with huge flowers and vines, standing in the midst of fifty acres of lawns, groves, wild woods of pine, hemlock, maple, beech, hickory, etc., and all kinds of underbrush and wild flowers and cultivated flowers—acres of rhododendrons twelve feet high in full bloom, and a pond covered with lilies, etc., all the ground waving, hill and dale, and clad in the full summer dress of the region, trimmed with exquisite taste" (Badè 1923-1924).

The lily-covered pond mentioned by Muir is Sargent's Pond, created by Sargent in the 1870s and described by the architectural critic Mariana Griswold Van Rensselaer in this way: "The whole shore

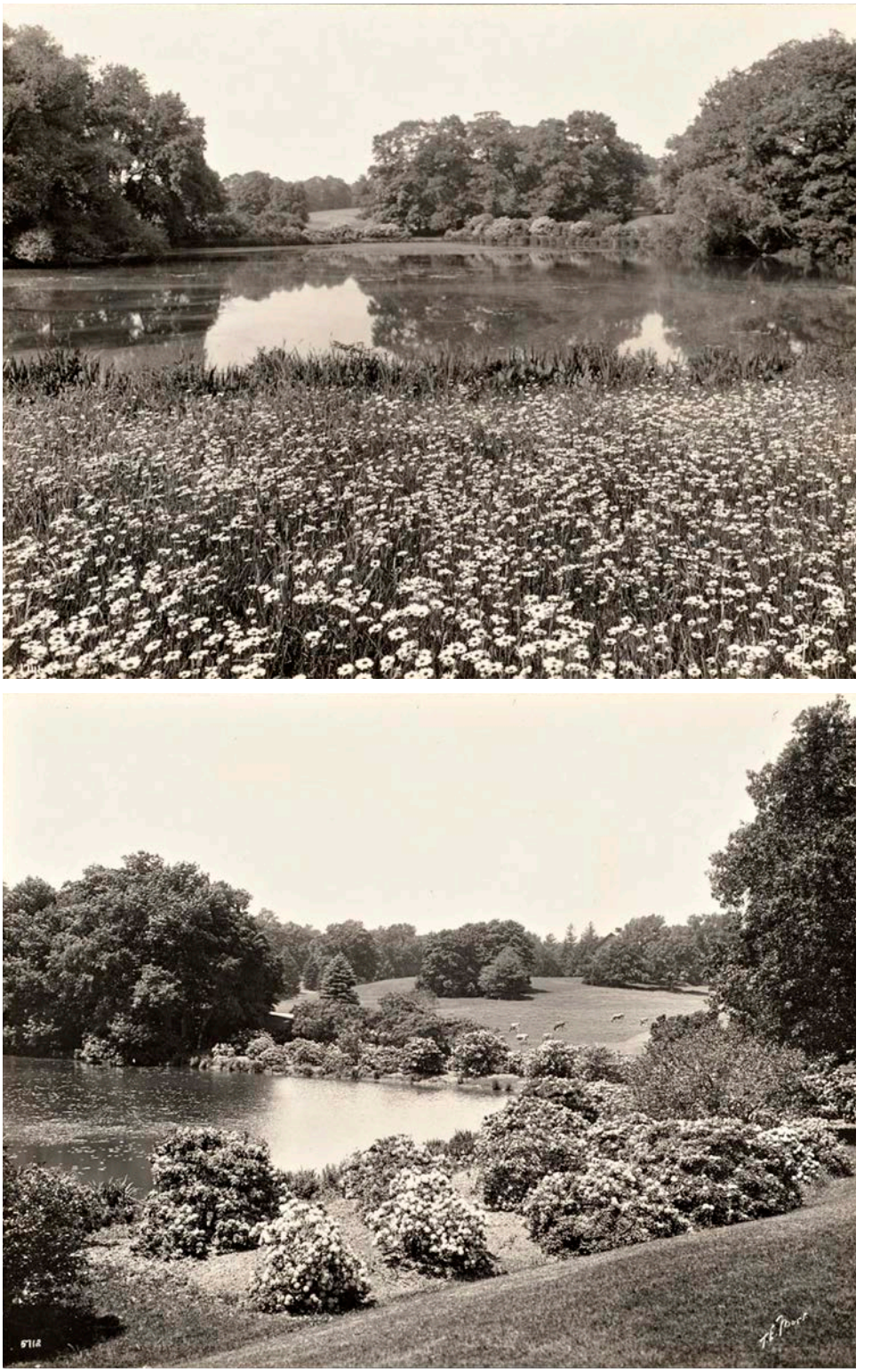


Figure 3. Sargent's Pond, Holm Lea estate, Brookline, Massachusetts, June 1911. *Photograph by T.E. Marr.* Figure 4. Sargent's Pond, Holm Lea estate, Brookline, Massachusetts, June 1902. Note rhododendrons in foreground and cows grazing on far side of pond. *Photograph by T.E. Marr*

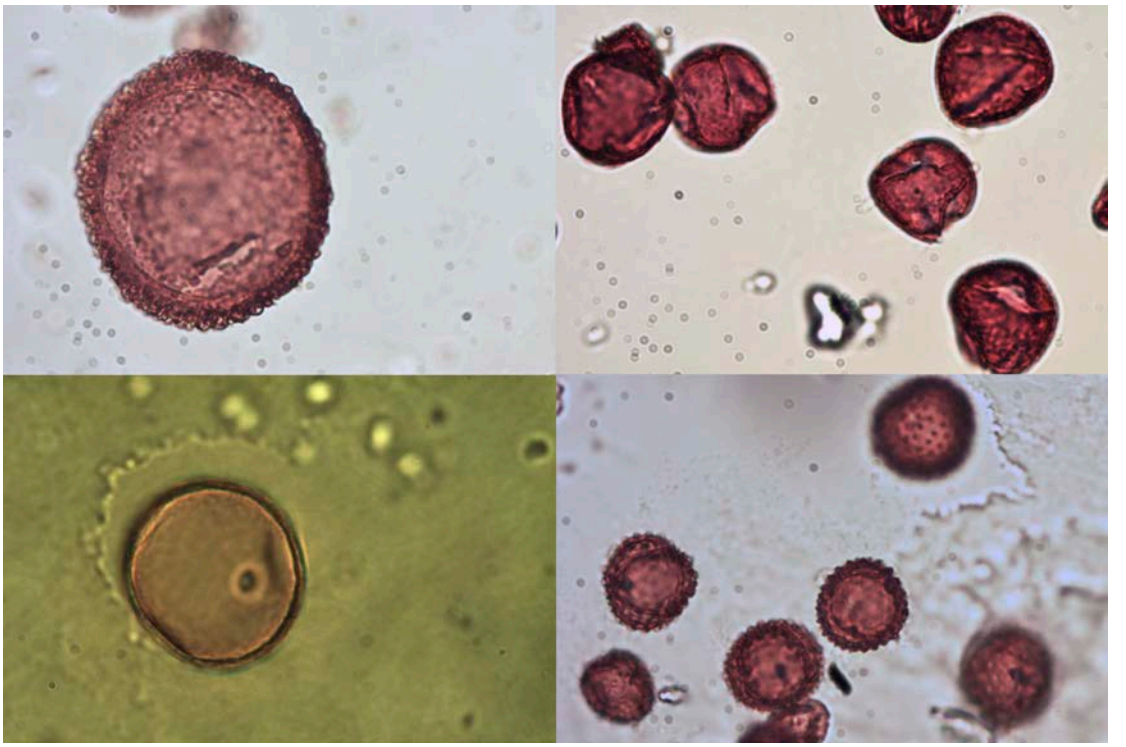


Figure 5. Pollen grains, clockwise from upper left: hemlock, oak, ragweed, and grass. *Photographs by Katherine J. Willis, 2019. globalpollenproject.org*

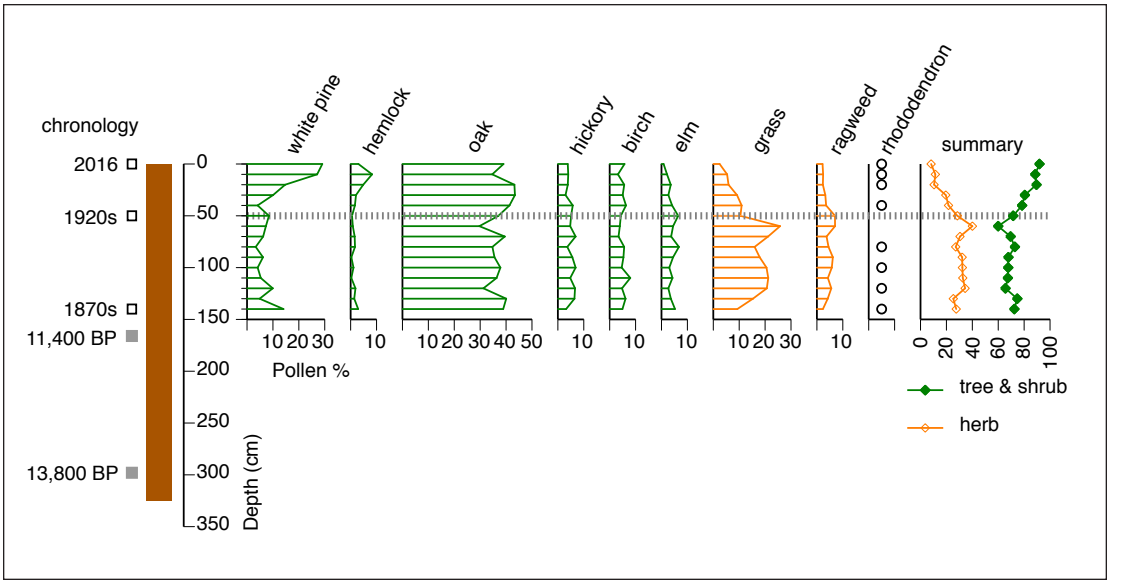


Figure 6. Analyses of a sediment core from Sargent's Pond, Brookline, Massachusetts. Chronology of the core determined with radiocarbon dating (gray squares, BP=before present) and historical dates (white squares). Selected pollen types graphed for the upper 150 cm of the core, with trees and shrubs in green and herbaceous plants in orange. Circles indicate presence of rhododendron pollen.

The rhododendrons that surrounded Sargent's Pond ... attracted tens of thousands of visitors to Holm Lea on the annual Rhododendron Sunday, when the Sargents opened the estate to the public.

of the pond is fringed with ornamental water-plants, which seem as spontaneous as the marsh-marigolds in a country brook; and certainly the edge of this meadow—white and yellow with butter-cups and daisies, exquisitely contrasting with the richer splendor of the rhododendrons on the opposite shore—does not look as though the hand of man has touched it" (Van Rensselaer 1897). The rhododendrons that surrounded Sargent's Pond (Figure 4), mentioned by both Muir and Van Rensselaer, attracted tens of thousands of visitors to Holm Lea on the annual Rhododendron Sunday, when the Sargents opened the estate to the public (Sutton 1970).

Van Rensselaer (1897) offered this interpretation of the origin of Sargent's Pond: "Yet no part of these banks is natural, for the pond itself is not natural. Its basin was excavated some twenty years ago, and the water was supplied by damming a little brook. Every foot of the shore has been artificially outlined and adorned." Based on our assessment of the sediment core from Sargent's Pond (described below) and the topography of the surrounding landscape, we surmise that Sargent dredged and enlarged an existing small pond or wetland, apparently piling up the excavated sediments on the east side of the basin.

Following Charles Sprague Sargent's death in 1927, Holm Lea was sold and subdivided, and since then Sargent's Pond and the surrounding gardens have been managed by a neighborhood association. Over time the pond filled with silt and became eutrophic, prompting the association to embark on a project to re-dredge the pond. In June 2016, before dredging got underway, we were invited by members of the association to raise a sediment core from Sargent's Pond. We used piston samplers (Wright et al. 1984) to collect a sediment core 335 cm in length. We isolated pollen from the sediments using standard methods (Faegri and Iversen 1989), then analyzed pollen grains at 40X magnification using a compound microscope. Pollen grains can be identified to family, genus, or sometimes species based on their size, shape, and ornamentation (McAndrews et al. 1973; Figure 5). At selected depths in the core we counted at least 300 pollen grains and calculated the relative abundance (pollen percentage) of each taxon based on that denominator.

Radiocarbon analysis of the core showed that sediments below 160 cm dated to >11,400 years before present (Figure 6). Apparently those sediments were left behind when Sargent dredged the pond in the late 1870s. For this study we analyzed pollen at 10-cm intervals above 150 cm, which we assume represents the period after the pond was modified by Sargent.

Pollen assemblages (Figure 6) from 140-60 cm are dominated by oak (30-40%) and grass (10-25%), with lower abundances of other tree taxa (e.g., white pine, hemlock, hickory, birch, and elm) and herbaceous plants (e.g., ragweed). Above 60 cm there is a decline in grass pollen (to <10%) and higher oak abundance (35-45%), as well as rising pollen percentages of white pine and hemlock above 20 cm. We interpret the transition at 60 cm as changes in vegetation associated with the subdivision of Holm Lea in the late 1920s, when Sargent's pastoral landscape of woods and open fields was converted to a suburban neighborhood with trees on each property and higher tree cover overall. Recent satellite images of the neighborhood around Sargent's Pond show open fields to the south and east of the pond, but in general the area is largely wooded (Figure 1). Rising abundances of white pine and hemlock pollen in the upper sediments likely signify increasing pollen production as nearby conifer trees matured. A subtle decline in elm pollen in recent samples may reflect the loss of elms due to Dutch elm disease. Rhododendron is not a prolific pollen producer, but the regular occurrence of rhododendron pollen in the sediments represents its past and ongoing presence in the landscaping around the pond (Figures 4 and 6). Other pollen types identified in the Sargent's Pond record but not plotted in Figure 6 include spruce, fir, poplar, willow, hop-hornbeam, black ash, green ash, sugar maple, red maple, basswood, butternut, black walnut, sycamore, chestnut, black gum, sweetgum, holly, alder, bayberry, buttonbush, mugwort, aster, chenopod, bistort, dock, plantain, bracken, cattail, and sedge.

In many ways the vegetation changes observed in the Sargent's Pond pollen record for the last 150 years mirror the ecological transformation that took place across southern New England starting in the mid 1800s. After European colonization and deforestation of the region in the early seventeenth century, the landscape was largely agricultural until the mid nineteenth century, at which point a confluence of factors, including the westward shift of farming as transportation networks developed and the proliferation of factory work in industrializing northeastern cities, led to the region-wide collapse of agriculture (Raup 1966). With the cessation of grazing and tilling, the landscape reforested naturally, and over the ensuing decades the maturing forests of southern New England have experienced successional changes in structure and composition (Hall et al. 2002). Reforestation of Holm Lea lands has taken place, too, though several decades later than was the case more broadly thanks to Charles Sprague Sargent's horticultural preferences. As streetcar suburbs spread out from Boston (e.g., Maggor and Warner 2019), and as the wider region filled in with trees, Holm Lea remained, by design, a pastoral landscape.

How will the vegetation of southern New England change over the next 150 years? As was the case for Holm Lea over the last 150 years, future shifts in vegetation characteristics will be influenced by environmental variability, including rising temperatures, fluctuating precipitation, and tree mortality due to insect pests and pathogens (e.g., D'Amato et al. 2023), and by human decisions about which plant species and vegetation types to promote or disfavor. It would behoove us to maintain the region's forests—including in urban areas—that have recovered over a period of many decades. Abundant and diverse tree cover creates attractive and engaging landscapes that benefit society in many ways, including mitigation of extreme heat and storage of carbon (e.g., Faison 2021).

ACKNOWLEDGMENTS

We thank Claire and Meir Stampfer for the introduction to Sargent's Pond and for their support of this project. David Foster and Anna Guerrero assisted with fieldwork. This research was funded by a Sargent Award for Visiting Scholars from the Arnold Arboretum.

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REFERENCES

Badè, W.F. 1923-1924. *The Life and Letters of John Muir*. Houghton Mifflin.

D'Amato, A.W., Orwig, D.A., Siegert, N.W., Mahaffey, A., Benedict, L., Everett, T., Daigle, J., Johnson, L., Catanzaro, P., Cusack, C. 2023. Species preservation in the face of novel threats: cultural, ecological, and operational considerations for preserving tree species in the context of non-indigenous insects and pathogens. *Journal of Forestry* 121:470-479.

Faegri, K., Iversen, J. 1989. *Textbook of Pollen Analysis*, Fourth edition. John Wiley and Sons.

Faison, E.K. 2021. Backyard climate solutions. *Arnoldia* 78:28-37.

Greene, N.C. 1908. The most inspiring estate in New England. *New England Magazine* 38:137-143.

Hall, B., Motzkin, G., Foster, D.R., Syfert, M., Burk, J. 2002. Three hundred years of forest and land-use change in Massachusetts, USA. *Journal of Biogeography* 29:1319-1335.

Maggor, N., Warner, S.B. 2019. Streetcar suburbs, 1870-1900. In *The Atlas of Boston History* (N. S. Seasholes, editor). University of Chicago Press.

McAndrews, J.H., Berti, A.A., Norris, G. 1973. *Key to the Quaternary Pollen and Spores of the Great Lakes Region*. Royal Ontario Museum.

Meehan, T. 1884. Ignatius Sargent. *The Gardeners' Monthly and Horticulturalist* 26:318-319.

Raup, H.M. 1966. The view from John Sanderson's farm: a perspective for the use of the land. *Forest History* 10:2-11.

Robinson, E. 1988. *Atlas of the Town of Brookline*, Plate 4. G.W. Bromley & Co.

Sargent, C.S. 1884. Report on the Forests of North America (Exclusive of Mexico). US Government Printing Office.

Sargent, C.S. 1891-1902. *The Silva of North America: A Description of the Trees Which Grow Naturally in North America Exclusive of Mexico.* Houghton, Mifflin and Company.

Sutton, S.B. 1970. *Charles Sprague Sargent and the Arnold Arboretum*. Harvard University Press.

Van Rensselaer, M. 1897. A suburban country place. *The Century Magazine* 54:3-17.

Wilson, E.H. 1913. *A Naturalist in Western China with Vasculum, Camera, and Gun: Being Some Account of Eleven Years' Travel, Exploration, and Observation in the More Remote Parts of the Flowery Kingdom*. Doubleday, Page & Co.

Wright, H.E. Jr, Mann, D.H., Glaser, P.H. 1984. Piston corers for peat and lake sediments. *Ecology* 65:657-659.

Zaitzevsky, C. 1982. *Frederick Law Olmstead and the Boston Park System*. Harvard University Press.