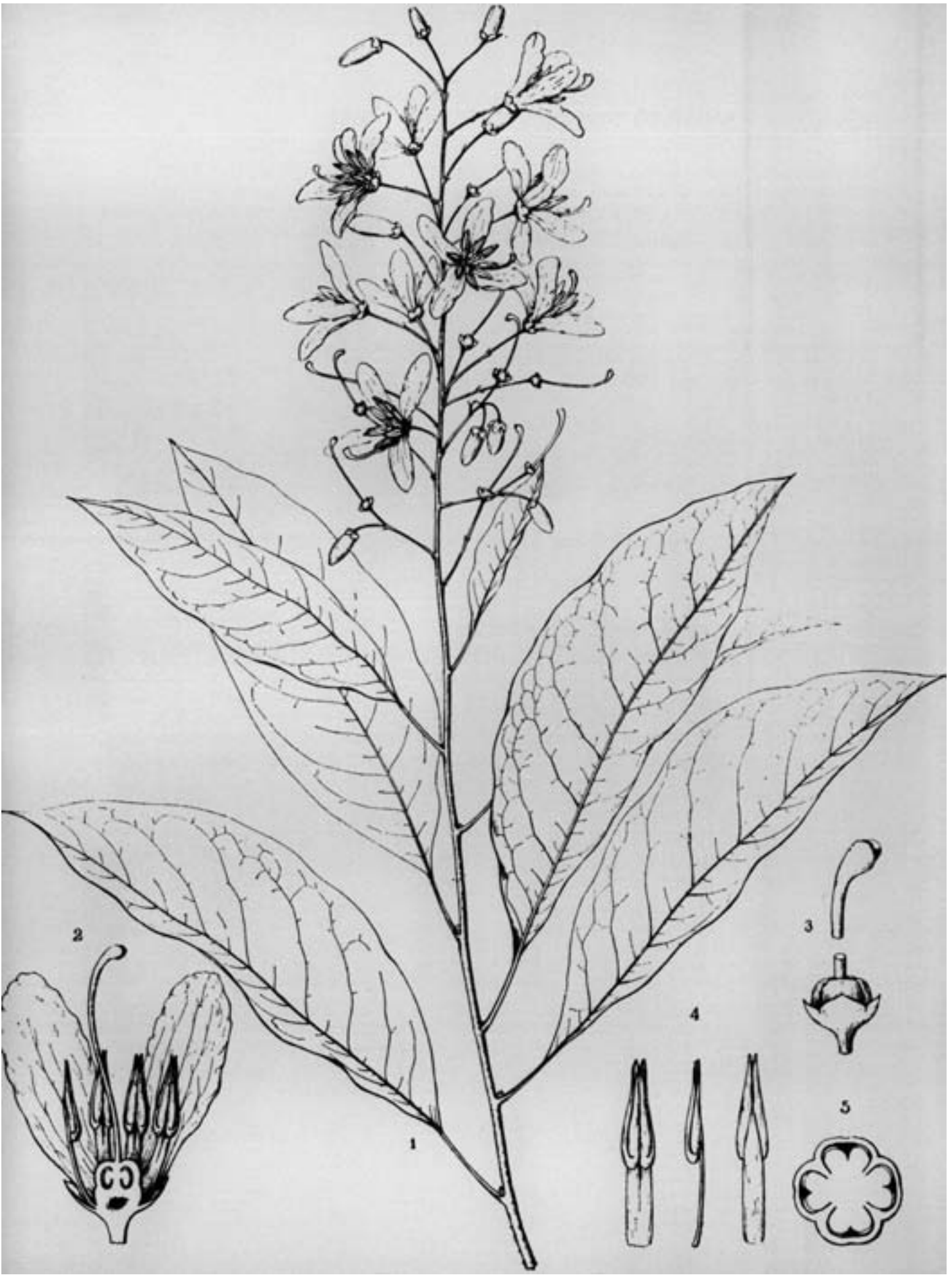
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Lost and Found: *Elliottia racemosa*

Peter Del Tredici

More common than once thought, the Georgia plume is slowly yielding its secrets to persistent biologists

When a plant has a limited distribution in the wild, one is tempted to think either that it has some highly specific habitat requirement that is not often met or has traits that limit its ability to compete successfully with other plants. One can never predict, however, how a rare plant will respond to cultivation outside its native range. A case in point is *Ginkgo biloba*, a tree native to China that, although extinct in the wild, is ubiquitous in cultivation throughout the temperate regions of the world. In North America, the pink shell azalea, *Rhododendron vaseyi*, has a very limited range in the southern Appalachian Mountains yet is widely and successfully cultivated throughout the East Coast.

At the opposite end of the spectrum is *Elliottia racemosa*, the Georgia plume, a small tree with a very limited range both in the wild and in cultivation. Its native habitat is in the sandhills of eastern and south-central Georgia. This unusual member of the Ericaceae can reach heights of up to thirty-five feet (10.7 m) and have a trunk up to twelve inches (30 cm) wide. It is strikingly beautiful when in bloom, its pure-white racemes standing high above the bright-green foliage. The flowers are remarkably unericaceous in appearance, having four or five free petals that are *not* fused to form a corolla tube, a trait that marks it as more "primitive" than other members of the family (Bohn *et al.*, 1978). In its native Georgia, *Elliottia* blooms from the middle of June to the end of July. The plant comes into flower progressively later as one moves farther north.

In spite of all its positive horticultural attributes—its beautiful flowers, good fall color, and hardiness to minus ten Fahrenheit (–23 C)—*Elliottia* is very rare in cultivation. This neglect is all the more amazing when one considers that the plant was first discovered over two hundred years ago, in 1773, by William Bartram (Ewan, 1968) and was described by Gotthilf Muhlenberg in 1817, who named it in honor of Stephen Elliott. A cursory perusal of the literature quickly reveals the source of the problem: in the wild, *Elliottia* is very shy about forming fruit, so shy, in fact, that until 1903—one hundred thirty years after Bartram's discovery—no mature capsule had been found in nature or in cultivation, and then only an empty one. More amazing still is the fact that no ripe seeds were discovered until 1934, and even these seeds contained only "imperfect embryos" (Wherry, 1936).

On top of this difficulty with seed production, the plant is considered difficult to transplant, and early efforts to collect specimens from the wild generally failed, with the notable exception of "three or four plants" collected by Asa Gray near Augusta, Georgia, in 1875 and planted out on the grounds of the

Elliottia racemosa *Muhlenberg* ex *Elliott, the Georgia plume:—A flowering branch (1); vertical section of a flower (2); a flower with its corolla and stamens removed (3); front, side, and rear views of a stamen (4); and a cross-section of an ovary.* From Garden and Forest, *Volume 7 (1894), page 205.*

P. J. Berckmans's Nursery outside that city (Sargent, 1902). For many years, these were the only known cultivated specimens of *Elliottia*. They were last reported alive, but in poor health, in 1923 (Trudell, 1926). This difficulty with transplanting is somewhat surprising, given the fact that in the wild the plant suckers freely from its roots, particularly in response to injury or disturbance, such as fire. The early propagations of *Elliottia* probably involved digging up just such young root sprouts.

In the early 1900s botanists renewed the search for *Elliottia*, discovering several new colonies (Harper, 1903; Trudell, 1926, 1929). Their finds stimulated the interest of horticulturists, and cultivated plants were reported growing at Kew Gardens, England, in 1902 (sent there by Berckmans's Nursery) (Prain, 1912); at the Biltmore Forest in Asheville, North Carolina, in 1934 (Knight, 1938); and at the Henry Foundation in Gladwyne, Pennsylvania, in 1936 (Henry, 1941). No doubt many other specimens have been and still are in cultivation, but these are among the oldest and historically most significant.

Portrait of Stephen Elliott. From the Archives of the Arnold Arboretum.

Ecology

While early botanical authors considered *Elliottia* to be "one of the rarest North American trees" (Sargent, 1902), more modern research has shown this not to be the case. Since the 1950s, Dr. George Rogers of Georgia Southern College and Dr. John Bozeman of the Georgia Department of Natural Resources have discovered about thirty new locations where the plant grows. In all, Bozeman estimates, there are about seventy distinct sites for *Elliottia*, all in Georgia. Some stands are as small as twenty feet by twenty feet, while others cover many acres. Almost all of them are located along the Altamaha, Ocmulgee, and Canoochee rivers or their tributaries. The Big Hammock Natural Area in Tattnall County, containing nearly four hundred acres of *Elliottia*, is one of the best places to see the plant. Currently, *Elliottia* is considered too common to be granted "rare and endangered" status by the United States Fish and Wildlife Service, but the state of Georgia classified it "endangered" in 1977 and has protected it ever since.

As far as seed production in the wild goes, Dr. Bozeman has found that the smaller the colony the less the likelihood that it will produce seed. The large colonies he is familiar with "all produce seed on a regular basis." According to Bozeman, the root-suckering habit of *Elliottia* may partially explain the vagaries of seed production. He postulates that those populations that set viable seed (generally speaking, the large ones) consist of more than one genetically distinct clone, while populations that don't (the small ones) are monoclonal. This lack of genetic diversity inhibits outcrossing and therefore limits their seed

Elliottia racemosa. *From* Curtis's Botanical Magazine *(1912).*

production. Over time, these smaller, inbreeding populations would become homozygous for a wider variety of recessive traits, including self-incompatibility, than the larger, outcrossing populations.

Another factor that probably affects *Elliottia*'s ability to produce viable seed was discovered by Dr. Frank S. Santamour. *Elliottia* pollen, he reported in 1967, was only five to six percent viable when the flowers were opening. He postulated that this low viability may be due to the accumulation of recessive lethal or sublethal genes as a result of extensive inbreeding.

Seed Germination

The first break in the propagation of *Elliottia* came in 1941, when Mary Henry, of the Henry Foundation, published the first illustration of ripe *Elliottia* fruit (a photograph of ripe fruit produced by a plant growing in her garden at Gladwyne, Pennsylvania). Accompanying the picture is the cryptic caption: "It has been considered sterile to its own pollen but no other *Elliottia* was growing near this plant." Unfortunately, Henry does not mention fruit formation in the body of her article or whether she ever tried to germinate the seeds it contained.

The first successful germination of *Elliottia* seed was reported by Alfred J. Fordham of the Arnold Arboretum (Fordham, 1969). He was able to raise five seedlings from wild-collected seeds sent to him in 1964. At the time, however, he could not determine the nature of their seed-dormancy mechanism. In another article, published in 1981, Fordham cleared up the problem. He reported that *Elliottia* seed required a chilling period in order to germinate and recommended three months's cold stratification in order to break their dormancy. Unfortunately, he did not publish data on the percentages of germination.

Fordham also reported success in rooting the young shoots that sprouted from pieces of *Elliottia* roots removed from a large plant in March and planted in a warm greenhouse. This propagation technique takes advantage of the natural tendency of the plant to produce root suckers in the wild.

In 1985, I undertook a series of germination tests to determine exactly how much chilling the seeds required. The seeds that I used in the tests were produced by the Arnold Arboretum's lone plant, #977-62, which Henry Hohman of Kingsville Nurseries, Kingsville, Maryland, had donated to the Arboretum in 1962, when it was nine feet (2.75

m) tall. Because it was the Arboretum's only plant and was of questionable hardiness, it had been moved indoors each winter for nearly ten years before being planted out-of-doors in 1972. Since then, the plant has grown well and is now a healthy, single-trunked specimen, still nine feet (2.75 m) tall and four feet (1.2 m) wide. While this plant has often produced seed capsules, seed collected from these capsules generally have failed to germinate. However, in 1985, an unusually heavy crop of fruit was produced, and these were harvested on 21 October for a series of germination tests. The test was set up with only the viable seeds—that is, seeds having large embryos. All seeds lacking embryos were discarded.

From our one plant, we collected three hundred sixty viable seeds, dividing them into four lots of ninety seeds. On 28 October, we either sowed seeds directly in a greenhouse kept at a minimum temperature of sixty-five Fahrenheit (18.5 C) or placed them in small polyethylene bags containing moist stratification medium (fifty percent sand and fifty percent peat moss) and chilled them in a refrigerator at thirty-six Fahrenheit (2 C). At intervals, we removed the bags from the cold and sowed the seeds they contained in a warm greenhouse (sixty-five Fahrenheit) (21 C), with the following results:

Lot*	Days of Cold Stratification	Days to First Germination	Number of Seeds Germinated	Percentage Germination
1	0	56	1	1
2	42	19	64	71
3	66	21	66	73
4	64	21	74	82

*Ninety seeds per lot.

Elliottia seeds require a moist chilling period of about one month to stimulate germination. This stands in contrast to the behavior of the seeds of most species of *Rhododendron*, which require light but not chilling for germination. In this regard, however, it should be noted that tests with the seeds of various *Rhododendron* species have shown

Mature fruit capsules and viable seeds of Elliottia racemosa *collected from the wild in Georgia on October 6, 1987, by Dr. George Rogers. The scale at the bottom of the figure is in millimeters. Photographed by Peter Del Tredici.*

that, while they don't absolutely require a chilling period to germinate, subjecting them to one month's stratification before sowing both accelerated the rate and increased the percentage of germination.

It is not clear what the significance is of the fact that isolated specimens of *Elliottia* in cultivation have often been reported to set viable seed (Henry, 1941; Fordham, 1981). Obviously, one cannot simply say that low seed-set in the wild is entirely due to self-incompatibility. It is important to realize that both the Arboretum's plant, which set close to four hundred viable seeds in 1985, and the plant investigated by Frank Santamour in 1966, only 5.5 percent of whose pollen was viable, came from Henry Hohman of Kingsville Nurseries in Maryland.

While it is not known whether these two Hohman plants are sibling seedlings or identical vegetative propagations, they probably have very similar genetic backgrounds. Assuming this to be the case, it seems likely that climatic factors during bud set in the fall or floral development in the spring might inter-

Elliottia racemosa *flowering in the Arnold Arboretum. Photographed by Peter Del Tredici.*

act with genetic factors to determine pollen viability. This would mean that in the year Santamour did his testing, pollen viability was low, while in 1985, when the Arboretum plant set copious seed, viability was considerably higher than that. Obviously, more studies of the matter are called for.

Cultivation

Given the fact that the proper treatment of *Elliottia* seeds is now known, one is tempted to say that the last impediment to its wider cultivation has been removed, but sadly this is not the case. Propagators throughout the East Coast have reported that, even when seed is available, many seedlings die from *Phytophthora* fungus infection (damp-off).

Luckily, we did not experience such losses to damp-off with our seedlings at the Arnold Arboretum. This may be due to the fact that at the time of their potting up in May 1986, I collected several handfuls of soil from under the mother plant with pieces of *Elliottia* root included. I forced this soil through a screen and then mixed it with the sand and peat moss mix used for potting the seedling into.[1] Losses have been minimal, and most plants are now about four to five inches tall. I did this based on the assumption that *Elliottia* was no different from many other members of the Ericaceae in being dependent on "ericoid" mycorrhizae for their proper growth and development. All of our container-grown plants show extensive mycorrhizal development, which is undoubtedly involved in the uptake of a wide variety of mineral nutrients—in particular phosphorus and nitrogen—from the sterile, sandy soils in which it naturally grows (Read, 1983).

These seedlings are now being offered for sale to the readers of *Arnoldia* for $25 each. The plants are all between four and six inches tall and will be shipped in the spring of 1988. If possible, the plant should have another year or two in a container before planting out. Any site with at least fifty percent sun and well drained, sandy soil enriched with peat moss or leaf mould will do fine. Like other members of the Ericaceae, *Elliottia* must have acid soil.

How To Order Seedlings

Please do ***not*** prepay orders; send payment only after your seedling arrives. Direct your order to:

Elliottia Distribution
Arnold Arboretum
Jamaica Plain, MA 02130–2795.

Endnote

1. The idea to do this was stimulated by discussions with the late Edmund Mezitt of Weston Nurseries, in Hopkinton, Massachusetts, who told me that his secret to successful germination (and subsequent growth) of *Rhododendron* seed was to mix a handful of screened soil taken from under a wild-growing *Rhododendron* with the standard peat–sand seed-germination mix used in the greenhouse.

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