



THE NATIVE ORCHID CONFERENCE JOURNAL



VOLUME 18.2



The Native Orchid Conference, Inc.

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THE NATIVE ORCHID CONFERENCE JOURNAL

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Message from the President:

Early June in Edmonton, Alberta and things are looking up. Orchid season is (finally) in full swing and yes, it appears that progress is being made against Covid-19. People are traveling again. Lots of reports circulating of great orchids being found. Our NOC 'mini field-trips' are being well-attended (even over-subscribed), and our monthly native orchid talks have been a great success. Both of these events will continue over the summer, and we look forward to hearing back about all the adventures and wonderful plants that people encountered.

This issue of the Journal (Volume 18.2) contains articles on a mix of different orchids. First, Paul Catling and Brenda Kostiuik present the results of their scientific study on sheathing bract pubescence in *Cypripedium parviflorum* and *candidum*. Anyone who has tried to differentiate the "large and small" Yellow Lady's-slippers should read this article closely. Next, Tom Sampliner writes about a visit with some Florida Dancing Ladies (orchids: *Tolumnia bahamensis*). No camera equipment was harmed during the encounter. Third, John Horner details the botanical history, distribution, and unusual vegetative and floral strategy of the Puttyroot Orchid (*Aplectrum hymale*). If this plant grows in your area, but you haven't been able to see the flowers, this treatise will help. Finally, Joseph McMullen and colleagues describe a 300-350 mile range expansion of Fragrant Ladies'-tresses (*Spiranthes odorata*) in central New York state. Persistence is key in the orchid hunting business.

Once again, we thank each of these authors for their superb contributions, and we hope that you enjoy their efforts. Please consider contributing your own article to the Journal; we can't do it without you.

Enjoy your orchid season. Stay safe and healthy. Take care of yourselves, your family and your friends.

Ben Rostron
Edmonton, Alberta
June, 2021

Correction in Volume 17.3 on page 37: photo on right is <i>Platanthera stricta</i> , not <i>Platanthera huronensis</i> .
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DISTALMOST SHEATHING BRACT PUBESCENCE IN *CYPRIPEDIUM PARVIFLORUM* AND *CYPRIPEDIUM CANDIDUM* IN EASTERN ONTARIO

Text and photos by Paul M. Catling & Brenda Kostiuk, brenda.kostiuk@gmail.com

The “abaxial surface of the distalmost sheathing bract” was first used as character for distinguishing varieties of *C. parviflorum* Salisbury (Yellow Lady’s-slipper) by Sheviak in 2002 and most recently by Coleman in 2018. Although the character was suggested by renowned and meticulous experts, it has not received the attention that it deserves. This may be because it seems technical, is qualitative, and getting down to examine a soil level stem bract seems difficult and unpleasant. What else is down there? Can I get up again?

USING THE CHARACTER

Other than gravity and unspeakable new acquaintances, it is an easy character to use. The difference is pronounced (Figures 1-5), although qualitative. See also Sheviak’s (2010, Fig. 6, p. 14) illustrations of glabrous (smooth) and sparsely-pubescent sheathing bracts in the western *C. parviflorum* var. *exiliens* Sheviak (Northwestern Yellow Lady’s-slipper). The difference between presence and absence can be seen easily with the unassisted eye. Although we prefer to call the character under consideration the “uppermost bladeless stem bract,” we use the “distalmost sheathing bract” because the latter is a shorter term and is also the original proposed terminology for use in identification and classification.

HOW WELL DOES IT WORK? - SOME METHODS

We tested the bract character on plants along a prairie roadside ditch in Manitoba during a NOC field trip in 2017. The plants included *C. parviflorum* Salisbury var. *pubescens* (Willdenow) Knight (Large Yellow Lady’s-slipper) with yellow lips and pale greenish-yellow or brownish-yellow petals and sepals, *Cypripedium candidum* Muhlenberg ex Willdenow (Small White Lady’s-slipper) with white lips and pale greenish-yellow petals and sepals, and hybrids referable to *Cypripedium* × *andrewsii* A.M. Fuller (Andrew’s Lady’s-slipper) with creamy-colored lips and mostly greenish-yellow petals and sepals. The character was flawless in correlation with flower color and the hybrids were all intermediate between *C. candidum* (no hair) and *C. parviflorum* var. *pubescens* (much hair). It was a small sample from a single site, and thus lacked statistical reliability, so we gathered data on *C. candidum* and the two varieties of *C. parviflorum* from some eastern Ontario sites.

Although there were no apparent hybrids between the species here, we identified three taxa on the basis of flower color at four locations including six groups and 262 plants overall. The flower color groups included *C. candidum*, *C. parviflorum* var. *makasin* (Farwell) Sheviak (Northern Yellow Lady’s-slipper), and *C. parviflorum* var. *pubescens*. We compared differences between flower color groups in distalmost bract

pubescence using Analysis of Variance (ANOVA) and created histograms to compare frequencies of flower color groups with respect to distalmost sheathing bract conditions. The distalmost sheathing bract was defined as the uppermost bract lacking a lamina and sheathing for more than half its length and canaliculate at tip. For each plant sampled, one of the following conditions was assigned: 1 = smooth; 2 = very slight pubescence; 3 = short and local pubescence; 4 = moderate pubescence (shorter and more local than 5); and 5 = very dense and continuous pubescence.

SOME RESULTS

The first two of the three groups, *C. candidum* and *C. parviflorum* var. *makasin*, had smooth or sparsely and minutely hairy bracts. These two differed markedly in the bract character from the third group identified as *C. parviflorum* var. *pubescens* which had yellow lips with largely pale sepals and petals (Figures 1-4). The difference was highly significant based on One-way Analysis of Variance which gave an F-ratio of between group to within group variance of 112.97, a significant result with $P < 0.0001$. The nature of the data here violates the assumption of normality and homogeneity of variance but the procedure is robust to violations of these assumptions and the significant difference is accepted and clear in the histograms below.

The histograms (Figure 6) including all of the 262 sampled plants at four locations portrays two major groups: histograms with sheaths mostly smooth or slightly pubescent (*C. candidum* and *C. parviflorum* var. *makasin*) and one with densely pubescent sheaths (*C. parviflorum* var. *pubescens*). These two major groups are connected by a small number of intermediates which we consider to be possible hybrids of *C. parviflorum* var. *makasin* and *C. parviflorum* var. *pubescens* from a fen (Figures 5).

VALUE OF THE CHARACTER

In eastern Ontario, the fen ecotype of *C. candidum*, and *C. parviflorum* var. *makasin* are similarly essentially smooth on the outer surface of the distalmost sheathing bract, whereas *C. parviflorum* var. *pubescens* is very hairy, but so what? Based on limited observations, we suspect that this is also the case elsewhere. There are some implications.

1. Firstly this is another character for distinguishing var. *makasin*, which differs from var. *pubescens* in flower size and color, habitat and in some places also flowering time. Although the two are a challenge to distinguish in some areas (Sampliner 2020), they seem quite distinct in others. Future studies will take this character into account.

2. It may be possible to identify herbarium specimens, ... for example: (1) a plant completely lacking flower color information but with a hairy distalmost sheathing bract may be expected to be var. *pubescens*, or if with a very smooth distalmost sheathing bract, to be var. *makasin*, but if it was intermediate in distalmost sheathing bract hair, it may be a hybrid. Although Worley et al. (2009) have shown that the identification of hybrids using flower color is usually correct, flower color is not always available; (2) a plant said to have had white flowers, or still with intact apparently-white flowers, but also with hairy distalmost sheathing bracts, perhaps should be considered a hybrid since it is not likely *C. candidum*.

3. A white-flowered plant with very hairy distalmost sheathing bracts, is a white-flowered form of either *C. parviflorum* var. *parviflorum* or *C. parviflorum* var. *pubescens*, and is neither *C. candidum* nor a white-flowered *C. parviflorum* var. *makasin*. The character may enable a better understanding of the occurrence of the white-flowered var. *pubescens*.

4. Its use improves a key to the hybrids that may contribute to an understanding of their variation and origin. Although it may be possible to determine whether a hybrid with *C. candidum* involves either var. *makasin* or var. *pubescens*, only one hybrid can be recognized between two species. Three hybrid names have been published involving *C. candidum* and *C. parviflorum* (listed and discussed by Cribb (1997: 270-279), the correct one being *C. Xandrewsii* A.M. Fuller.

5. The combination of small flowers and a densely hairy distalmost sheathing bract distinguishes *C. parviflorum* var. *parviflorum* (Small Yellow Lady's-slipper) of the mid-Atlantic and midwestern states and will assist in establishing its geographic limits, particularly its northern limit. For example, a large plant with relatively small flowers (unlike var. *pubescens*) and hairy distalmost sheathing bracts, found in southern Canada, may be the first Canadian record of var. *parviflorum* moving north.

6. Using this character, it might be possible to support the idea that the parentage of *C. Xandrewsii* nothovar. *landonii* involves var. *makasin*, not var. *parviflorum* as perhaps incorrectly stated [by the eds] in Flora of North America. If var. *makasin* was accorded specific rank we then have a name for its hybrid with *C. candidum*. Furthermore, this hybrid origin may be further supported if there are smooth uppermost non-sheathing bracts as well as more madder purple in the flowers. Nothovar. *landonii* was originally named as a hybrid of *C. parviflorum* var. *makasin* (then *C. calceolus* var. *parviflorum*) and a hybrid of *C. candidum* and *C. parviflorum* var. *pubescens*.

A key for hybrids and parents employing outer surface of distalmost sheathing bracts:

1a. Lip yellow ... 2

2a. Sepals at least partly greenish or greenish-yellow;
distalmost sheathing bracts densely and obviously hairy *C. parviflorum* var. *pubescens*

2b. Sepals madder purple, distalmost sheathing bracts
smooth or sparsely and minutely hairy *C. parviflorum* var. *makasin*

1b. Lip creamy or white ... 3

3a. Lip pure white ... 4

4a. Sepals madder; possibly extensive lip spotting *C. candidum* × *C. parviflorum*
var. *makasin* (*C. ×andrewsii*)

4b. Sepals greenish ... 5

5a. Distalmost sheathing bracts moderately hairy;
lip 20-30 (40) mm long *C. candidum* × *C. parviflorum*
var. *pubescens* (*C. ×andrewsii*)

5b. Distalmost sheathing bracts glabrous or sparsely
and minutely hairy; lip 17-27 mm long *C. candidum*

3b. Lip creamy (may become white with age) ... 6

6a. Distalmost sheathing bracts glabrous or sparsely
and minutely hairy *C. candidum* × *C. parviflorum*
var. *makasin* (*C. ×andrewsii*)

6b. Distalmost sheathing bracts moderately hairy *C. candidum* × *C. parviflorum*
var. *pubescens* (*C. ×andrewsii*)

We may not always be looking at bracts, or even the color of flowers. Eventually we will have an inexpensive pocket tricorder for plants, like the one used by Spock on Star Trek in the Golden Days (Earthdate 1966). Since 2003, we have made substantial progress with DNA barcoding. Spock used his handheld tricorder to identify any organism, plant or animal, anywhere in the galaxy. Ours will be pulled out to identify any plant taxon on Earth in seconds. In the meantime, might we be the last to thoroughly enjoy biodiversity (see Larson 2007)? We will keep looking for new relationships and new characters, and happily accepting the challenge of using our own knowledge to figure out what it is (some of the time).

REFERENCES

- Coleman, R.A. 2018. The genus *Cypripedium* of the United States and Canada, part 1. Native Orchid Conference Journal 15(1): 2-25.
- Cribb, P. 1997. The genus *Cypripedium*. Timber Press, Portland, Oregon. 301 pp.
- Larson, B.M.H. 2007. DNA barcoding: the social frontier. Frontiers in Ecology and Environment 5: 437-442.
<https://doi.org/10.1890/060128.1>
- Sampliner, T. 2020. The Yellow Lady's-slippers of eastern North America as a continuum rather than three varieties of one species, or who deh? Native Orchid Conference Journal 17(1): 63-68.
- Sheviak, C.J. 2002. *Cypripedium*. in *Flora of North America North of Mexico* vol 26. Oxford University Press.
http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242101551
- Sheviak, C.J. 2010. *Cypripedium parviflorum* in the Northwest, with the description of a new variety. Native Orchid Conference Journal 7: 1-9; 13-15; cover 1
- Worley, A.C., L. Sawich, H.Ghazvini, and B.A. Ford. 2009. Hybridization and introgression between a rare and a common lady's-slipper orchid, *Cypripedium candidum* and *C. parviflorum* (Orchidaceae). Botany 87(11): 1054-1065.
<https://doi.org/10.1139/B09-053> <https://www.nrcresearchpress.com/doi/full/10.1139/B09-053#.Xta95HdFzIU>



Figure 1. Sheaths and flower (same plant) of the fen form of *C. candidum* in eastern Ontario.



Figure 2. Sheaths and flower (same plant) of *C. parviflorum* var. *makasin* from a fen in eastern Ontario.



Figure 3. Sheaths and flower (same plant) of *C. parviflorum* var. *pubescens* from a fen in eastern Ontario.



Figure 4. Sheaths and flower (same plant) of *C. parviflorum* var. *pubescens* from a limestone woodland in eastern Ontario.



Figure 5. Sheaths and flower (same plant) of a possible hybrid of *C. parviflorum* var. *makasin* and *C. parviflorum* var. *pubescens* from a fen in eastern Ontario. Note the intermediate amount of sheath pubescence.

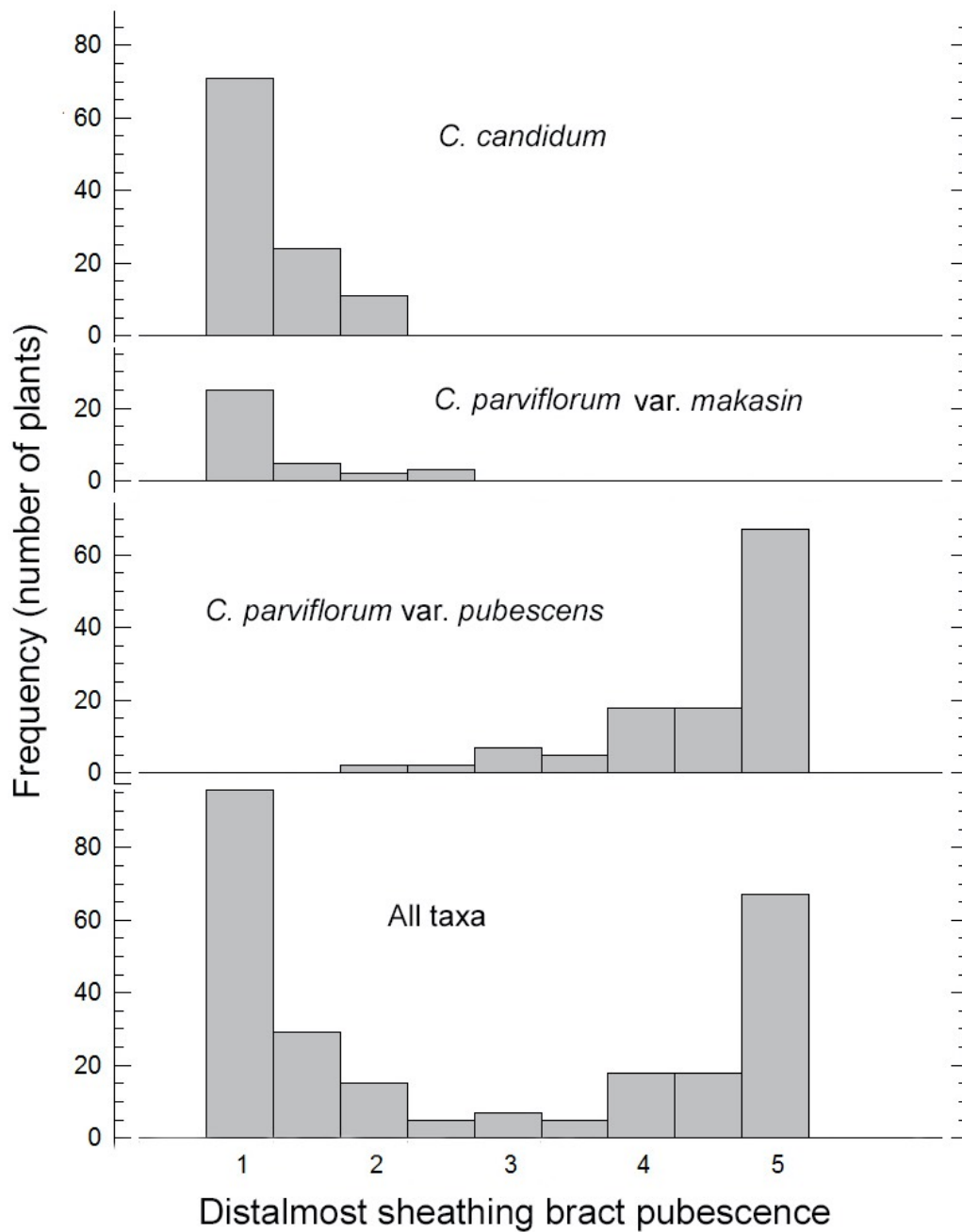


Figure 6. Histograms showing frequency of pubescence values for uppermost bladeless stem bract in eastern Ontario plants of *C. candidum*, *C. parviflorum* var. *makasin*, and *C. parviflorum* var. *pubescens*. More pubescence is indicated by higher numbers. Pubescence conditions were: 1 = smooth; 2 = very slight pubescence; 3 = short and local pubescence; 4 = moderate pubescence (shorter and more local than 5); and 5 = very dense and continuous pubescence.

A NATIVE *ONCIDIUM* IN FLORIDA:
TOLUMNIA BAHAMENSIS, THE FLORIDA DANCING LADY

Text and photos by Tom Sampliner



The Florida Dancing Lady, *Tolumnia bahamensis*

Even among the dedicated orchid hobbyists, few know that we have a member of the *Oncidium* group of orchids native to Florida. It is rare, endangered in Florida, and unless you know what the habitat is and exactly where to go to see them, you cannot expect to find them. That is probably a good thing for the preservation of these handsome orchids.

Without giving away the exact site where they occur, I will merely set forth their habitat as encountered in Florida. The Florida Dancing Lady (*Tolumnia bahamensis* (Nash ex Britton & Millspaugh) Braem) - also ranges into the Bahamas. Plants occur amidst sand pine and scrubby rosemary or palmetto bushes that arise out of sandy dune formations along a very narrow portion of southeastern Florida slightly inland from the actual coast. Using the shrubs as a trellis the vining orchid plants wind their way upward. A thin rhizome arises from tiny pseudobulbs emerging from the substrate often littered with scrub pine needles. Fans of 4-8 leaves with serrated edges occur along each rhizome. Up to 50 flowers less than one inch wide are found in an inflorescence. Each flower has a basically white background with colorful bands of yellow and brown. The overall configuration is typical of an *Oncidium* group member. Their pollinator is believed to be *Centris* bees which are tricked into attacking the flower and perhaps also into trying to get oil from the flower which in many ways resembles oil-yielding flowers of the native Locust Berry shrub (*Byrsonima lucida*, in the *Malpighiaceae*). Pollinia are attached to the bee's head. As I hope my pictures show, these colorful orchids present quite a striking and aesthetically-pleasing image.



The Florida Dancing Lady, *Tolumnia bahamensis* and habitat

Tolumnia bahamensis became threatened by a combination of habitat destruction (Sauleda 1986), illegal collecting, and perhaps loss of pollinators. However, it has been propagated extensively and “enrichment reintroduction” has been used to increase the restricted South Florida populations. Strategic planting of the Locust Berry shrubs upon which the pollinators depend has also been recommended (Pemberton & Liu 2008).

Now comes the personal story of one of my encounters with these orchids. It was a bright sunny spring day with the temperatures not as hot nor the conditions as humid as local weather can easily attain. We had walked into the scrubland and located some hills in the dunes upon which the rosemary shrubs were growing. A careful look in and among the shrubs disclosed the racemes of showy white background flowers of typical *Oncidium* shape with rich colors favoring the oranges, yellows and browns of this species. The orchids were in the shrub tangle, but one could maneuver to a position to isolate at least a portion of the orchid display. Here comes the unexpected excitement. As I mounted my camera upon my sturdy tripod and fiddled with my adjustments in composing shots of the orchid spray, I heard loud thrashing about. The weather was calm so it could not explain what I heard. I resumed my adjustments. The thrashing about resumed and seemed closer and louder. It stopped shortly so I resumed my photography. Then it started again. Now it had my attention. Something was going on and quite close by. I left my camera equipment and began to explore the surroundings to isolate and identify the source. Found it! A wide girth snake having a diameter the size of the largest portion of a human arm and perhaps 8-10 feet long was crashing around quite nearby in the shrubs. I am afraid of snakes and this guy by my standards was a monster. I decided to leave my equipment unattended and moved away a good distance to hopefully allow the serpent to vacate the area. It could have my equipment if it wanted. Well, I guess I needed a break. Finally, Mr. or Ms. serpent had other appointments to keep and slithered off so I could return to my equipment and resume orchid photography. Any encounter with an endangered orchid in the wild is exciting. This unique visit had a lot to remember it by.

REFERENCES

- Pemberton, R.W. and H. Liu. 2008. Potential of invasive and native solitary specialist bee pollinators to help restore the rare Cowhorn Orchid (*Cyrtopodium punctatum*) in Florida. Biological Conservation 141: 1758-1764. [doi:10.1016/j.biocon.2008.04.016](https://doi.org/10.1016/j.biocon.2008.04.016) ([usda.gov](https://www.usda.gov))
- Sauleda, R. 1986. The current status of *Oncidium bahamense* in Florida. Florida Orchidist 29(2): 83-85. [\(PDF\) The Current Status of Oncidium bahamense in Florida | Ruben P Sauleda - Academia.edu](#) [there are also valuable articles about the history and occurrence of native *Oncidium* and *Tolumnia* in Florida in the in the AOS Bulletin (now “Orchids”) written by Chuck McCartney, Ruben Sauleda and Ralph Adams.]

PUTTYROOT: STRIPED DENIZEN OF THE FOREST

Text and photos by John H. Horner, JHorner@addisoncw.com

Aplectrum hyemale (Muhl. Ex Willd.) Torr.

Common Names: Puttyroot, Adam and Eve Orchid

Basionym: *Cymbidium hyemale* Muhl. Ex Willd.

Synonyms: *Corallorhiza hyemalis* (Muhl. Ex Willd.) Nutt.

Aplectrum spicatum (Walt.) B.S.P.

Introduction: *Aplectrum hyemale* is one of the truly unique orchids of the eastern North American flora. I will review its taxonomy, phylogeny, and pollination biology, but also discuss its vegetative phenology and associated physiological adaptations. I have also included short biographical sketches of the botanists responsible for naming this species.



Left: Flowering raceme of *Aplectrum hyemale*.

Right: Closeup of a single flower showing typical coloration (green petals with maroon tips)

Aplectrum hyemale is one of the more curious orchids of the deciduous forests in eastern North America. It is unique, easily identifiable, and in parts of its range locally common. It is in fact so distinct that botanists have segregated it into its own genus. *Aplectrum* is monotypic, containing only a single species. The two common names, Puttyroot, and Adam and Eve Orchid, both relate to properties of the root system, which produces large distinctive corms. Each year a new corm (Eve) is produced that is connected to the corm of the previous year (Adam) by a short rhizome. The name Puttyroot comes from the mucilaginous putty-like substance produced by the corms when they are crushed.

The word *Aplectrum* comes from Latin meaning without a spur. The species epithet *hyemale* is derived from the Latin word *hiemalis* meaning wintry, or of winter, in reference to the large green, silver-striped leaf that emerges in the fall, as the surrounding deciduous trees shed their leaves. This phenology is a key survival feature. Through the cool days of late fall, the chilly or even frigid days of winter, and then the warmer days of spring, the leaves bask in the bright sunshine that reaches the forest floor through the open canopy. They may be covered with snow for some time but exploit the spring and fall light periods of the canopy forest like so many other plants including hepatica and Christmas fern.

Alas, for *Aplectrum*, its time in the sunshine must end; in the cycle of life that drives the forest, the surrounding trees once again leaf out. As the canopy fills in, light levels on the forest floor drop precipitously. For a closed canopy with minimal gaps, this can be a 10-fold or more reduction in light levels. The *Aplectrum* leaf responds by decaying away. By the time the canopy has fully leafed out, only a withered husk remains.

In my experience, the best time to search for Puttyroot is in early to mid-fall. As the Puttyroot leaves emerge, they tend to stand erect, sometimes almost perpendicular to the ground, apparently as a defense against being covered by leaves falling from the surrounding trees. During this brief period, they can be spotted from some distance away. As fall and winter progress, they become appressed to the ground, and become more difficult to spot. Unless a plant produces a flowering stem that successfully produces fruit capsules, no trace remains above-ground until fall, when a new leaf will be produced.



Left: Newly emerged *Aplectrum* leaf standing erect above recently fallen beech leaves.

Center: Large (15 cm) nearly round specimen

Right: Tight cluster of leaves showing variation in shape from broadly lanceolate to ovate to obovate to almost round. Note what appears to be insect herbivory on several leaves.

As the leaves decay, some of the plants will produce flowering stems. The percentage of plants blooming in any particular year is highly variable. I once experienced the ultimate “*Aplectrum* high,” observing 47 plants in bloom along a half-mile section of a trail in an Indiana State Park. Hoping for a repeat performance a year later, I was disappointed to find only three plants in bloom.

Photosynthesis and Temperature: Photosynthesis is an amazingly complex process with several hundred unique chemical steps. This complexity allows different species to adapt to variations in light level and temperature. The plasticity built into the photosynthetic system allows plants to adapt to habitats from the arctic and subarctic to the tropics, and from swamps to deserts. To see where *Aplectrum* falls on the photosynthetic scale one needs to compare Puttyroot to other orchid species, both warm- and cold- adapted. Fortunately, for the armchair botanist, who doesn’t have a research lab at his disposal, others have done the heavy-lifting and reported their findings in the botanical literature. Four pertinent studies were located. The first is a study of *Aplectrum* that examined both cold-adapted and warm-adapted leaves as a function of temperature (Adams 1970). A second study looked at *Tipularia discolor*, another winter-leaf producing orchid, that often co-occurs with *Aplectrum*, and is on the phylogenetic tree of life a “first cousin” (Tissue 1995). The third looked at *Cypripedium guttatum*, a true cold-weather species that is adapted to carry out photosynthesis through the long, but often less-than-balmy days of the arctic summer (Zhang 2007). Finally, a fourth study looked at *Dendrobium* orchids native to tropical and subtropical Asia (Wu 2014). All of the studies measured the uptake of CO₂ as a function of temperature. Since the data in the papers were not presented in tabular form, it was necessary to manually measure data point positions on each graph with a ruler, and where necessary convert the data to a common Y-scale of $\mu\text{moles CO}_2 \text{ m}^{-2} \text{ sec}^{-1}$. The resulting response curves taken from the four papers have been plotted together in Figure 1.

Adams studied photosynthesis in *Aplectrum* leaves under laboratory conditions. He compared warm adapted plants that had been collected in autumn and overwintered in a greenhouse (25°C days, 17°C nights), with cold adapted plants that had overwintered outdoors in southern Wisconsin and then been moved to the greenhouse and maintained at low temperatures (5°C days, 2°C nights). The cold adapted leaves had a broad photosynthetic maximum near 15°C, and appeared to be able to conduct significant photosynthesis from 5°C up to 35°C, while the warm adapted leaves had an ill defined maximum between 15 and 25°C. Thus it seems clear that *Aplectrum* leaves are able to adapt to intense cold and to more moderate conditions.

Somewhat surprising is the curve of *Tipularia discolor*. *Aplectrum* and *Tipularia* can often be found growing together, often within a few feet of each other. Both produce leaves in autumn that photosynthesize through the winter. Based on this similarity, one might expect *Tipularia discolor* to exhibit a photosynthetic profile similar to *Aplectrum*. Surprisingly this appears not to be the case. The study by Tissue of plants growing under natural conditions (Tissue 1995) showed that the photosynthetic optimum for *Tipularia* is

near 26°C, about 10°C higher than cold-adapted *Aplectrum*. Unlike *Aplectrum*, *Tipularia* leaves did not adapt to seasonal variations in temperature; during the study, average air temperature varied by 15°C with minimal effects on the optimum photosynthetic temperature. A rapid falloff in photosynthesis was observed below 20°C, with minimal photosynthesis below 10°C, where *Aplectrum* still did well. This lack of ability to photosynthesize well at lower temperatures, may be one factor contributing to the more southerly distribution of *Tipularia*, which except for scattered disjunct populations is limited to the southern and central USA.

A second way of dealing with photosynthesis in cold environments is exemplified by *Cypripedium guttatum*, a cold-adapted arctic species. It has a broad response curve, with a maximum between 18-20°C. The rate remains high over a broad range, remaining within 90% of the maximum value, between 13 and 28°C.

A sharp contrast to the temperate and arctic species just discussed is provided by the tropical *Dendrobium nobile*. As expected, it is clearly adapted to warm temperatures; achieving maximum photosynthetic rates between 28° and 30°C. Cold tolerance appears minimal, with photosynthetic rates dropping to near zero below 20°C.

Of these species, *Aplectrum* appears uniquely adapted to take advantage of the abundant sunlight falling on the forest floor on chilly winter and spring days. The ability to adapt its photosynthetic output with temperature allows it to hedge its bets, facilitating its adaptation to both southern Canada, and the southern United States.

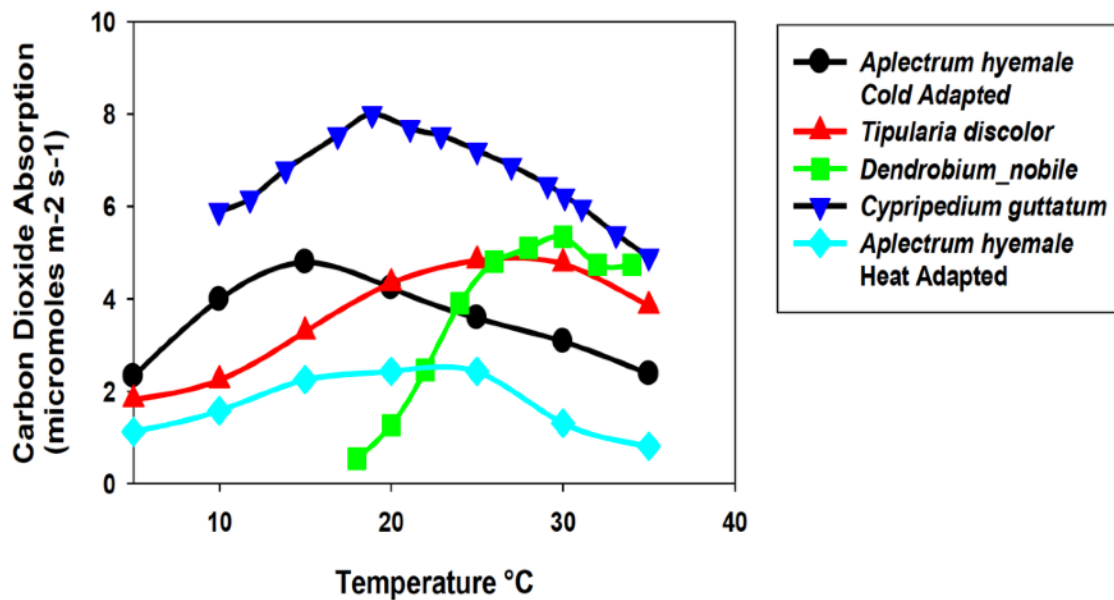


Figure 1. Photosynthetic temperature response curves for four orchid species taken from Adams 1970, Tissue 1995, Wu 2014, and Zhang. 2007.

Description: The flowering stalk of *Aplectrum hyemale* grows to a height of 20 to 50 cm and bears a raceme of 6 to 20 small flowers. The stem arises from the base of a large, distinctive silvery green leaf, which begins to wither as the scape emerges from the ground. The scape is initially enclosed in a papery sheath. By the time the flowers open, the attractive leaf, with its distinctive silver stripes, has decayed to a shriveled husk.

The two petals form a hood over the column creating a tunnel like effect when the flower is viewed from the front. The three sepals are oblong to slightly oblanceolate. Each is about 1.5 cm long by 0.4 mm wide. In open flowers they are slightly recurved backwards. When fully expanded the flowers are about 2 to 2.5 cm across. The lip has a central ridge and two lateral ridges (lamellae) on the upper side near the base. It is most typically white, spotted with purple, with a highly convoluted margin and undulating surface. The flattened, curved column is often spotted with purple. It arches over the lip and bears four yellow pollinia at its end, hidden under an anther cap. The stigma is located on the underside of the column, just behind the anther cap and pollinia. The most commonly encountered color form has green petals and sepals suffused with maroon.



Aplectrum flower with scale. (Small divisions = 1 mm.)

Flowering begins in April in the southern parts of the range and extends to early June in the north. By late spring no trace remains above ground of those plants in the population that did not flower. The leaves emerge in fall and remain through the winter until they wither in mid-spring. They can be up to six inches (15 cm) long and are strongly marked with parallel white or silvery white veins. They can grow singly, but sometimes cluster together in groups. Leaf shape is somewhat variable (see photos, page 19); some leaves can be almost round, with a length to width ratio approaching one to one, while others are oval, obovate, or broadly lanceolate, with length to width ratios up to three to one.



Left: Plant lacking any hint of maroon coloration. The sepals and petals of these plants are a bright apple-green, with a pure white unspotted lip. This color form was originally named as *Aplectrum spicatum* var. *pallidum* House (House 1903). House also later published the form as a new combination under *hyemale*. Thus it should be *Aplectrum hyemale* f. *pallidum* (House) House (House 1924).

Right: Flower strongly suffused with maroon.

Pollination: I have observed stipe rotation, analogous to that seen in self-pollinating coralroots such as *Corallorhiza trifida* or *C. maculata* (see accompanying photo, page 24). The anther cap, which initially covers the pollinia either decays, or is removed by an external agent to expose the pollinia, which sag downward over the edge of the rostellum, until they come into contact with the stigma, located on the underside of the column. Catling described this process in detail (Catling, 1983).

The most comprehensive study of *Aplectrum* pollination was published by Hogan, who studied plants in an Illinois woodland (Hogan, 1983). He determined that the flowers lacked any floral reward, and as is typical of most rewardless flowers, insect visitation was low, with no effective pollinators attracted to the flowers. The few small bees that did visit, most likely encountered *Aplectrum* as a result of random foraging. They examined the flowers, found nothing interesting and moved on. Under natural conditions, with no manipulation or bagging to exclude pollinators, fruit set was 82%. Bagging to exclude pollinators, reduced fruit set slightly to 71%. Removal of pollinia and bagging, which should have eliminated fruit set, only reduced capsule formation to 47%. This indicated that apomixis (fruit set without pollination) may be occurring in *Aplectrum*, but was not proven, since pollination before pollinia removal was not rigorously ruled out. Argue summarized Hogan's work in detail (Argue 2013).



Left Above: Flower with anther cap intact, still shielding pollinia.

Above right: Flower with decayed anther cap showing pollinia sagging downward via stipe rotation over the lip of the rostellum.

Lower left: Flower with anther cap intact with pollinia removed, presumably by an insect visitor.

Lower Right. Flower missing both anther-cap and pollinia.



Left: *Aplectrum hyemale* fruit capsules in midsummer
Center: Mature *Aplectrum hyemale* fruit capsules with scale.
Right: Mature *Tipularia discolor* capsules with scale.

The fruit capsules are large; 2.5-3.0 cm long, and about 1 cm in diameter. Before they mature, the green coloration of the capsules and stems allow them to be distinguished from those of the larger coralroots (*Corallorhiza maculata* or *C. striata*), which lack chlorophyll and thus are typically shades of reddish brown. The capsules of *Tipularia discolor*, another woodland orchid that sometimes co-occurs with *A. hyemale*, are at most half the size, typically only 1.0 to 1.5 cm in length and 0.5 cm in diameter.

Taxonomy: The first valid description of *Aplectrum hyemale* was a collaborative effort between the American pastor and botanist Henry Ernest Muhlenberg and the German botanist Carl Ludwig Willdenow. Together they published the name *Cymbidium hyemale* (Figure 2). Their species epithet “hyemale” is still accepted as the basionym of *Aplectrum hyemale*. The specimen sent by Muhlenberg to Willdenow still exists in the Willdenow collection of the Botanical Garden of Berlin (Figure 3).

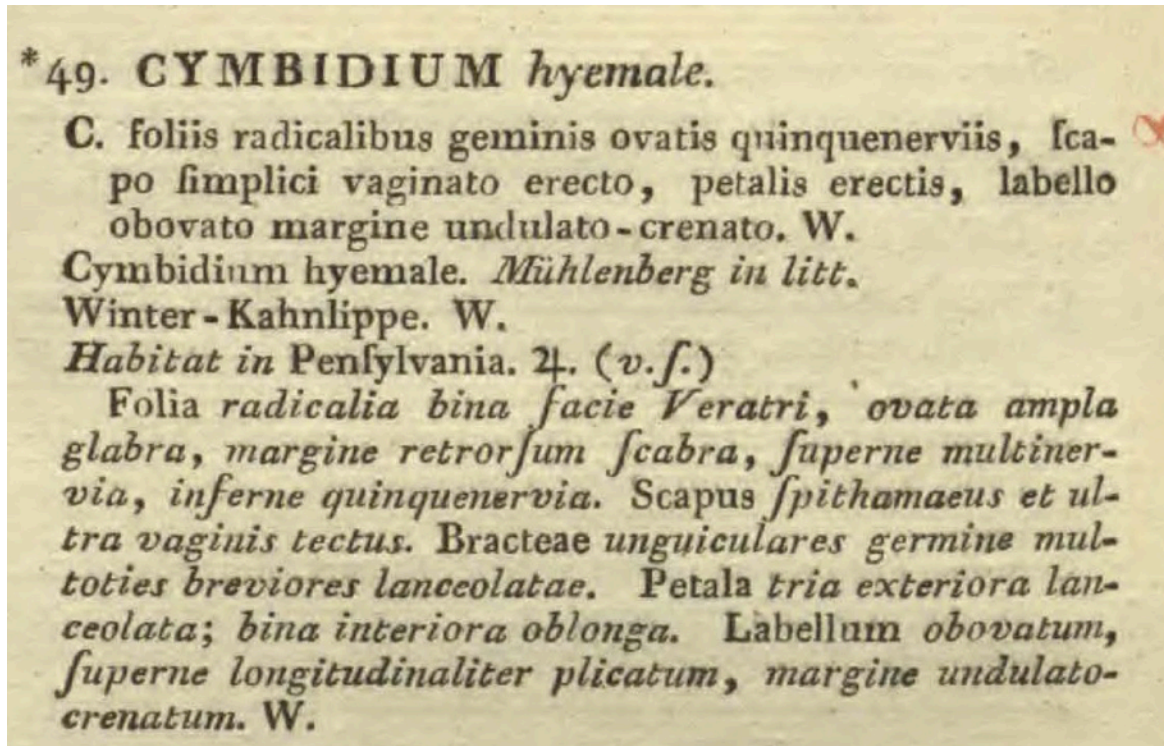


Figure 2. First valid description of the species now known as *Aplectrum hyemale*, from Species Plantarum, by Carl Ludwig Willdenow (Willdenow 1805). The line “Muhlenberg in litt.” means that Willdenow received specimens from Muhlenberg, accepted Muhlenberg’s name, and likely contributed the Latin description that made “*Cymbidium hyemale*” a validly published name. The author citation for this collaboration is Muhl. ex Willd.

Berlin Herbarium: The Berlin Herbarium was founded in 1815 at the Berlin Botanical Garden, three years after the death of Willdenow. As was common for botanists of this era, Willdenow had maintained a large personal herbarium. His collection was purchased for the newly founded herbarium in 1818 by Friederich Wilhelm III, King of Prussia. Over the next 125 years the Berlin Herbarium amassed one of the premier botanical collections of the world, rivaled only by Kew, Paris, and St. Petersburg. Although it is only a minor sidebar in the long list of tragedies coming out of WWII, the destruction of the Berlin Herbarium in an Allied bombing raid on March 1, 1943 was one of the great scientific calamities of the twentieth century. Only the Willdenow collection, and 20,000 type specimens from the general collection survived, as they had been moved to a safe location outside Berlin (Hiepko, 1987).



Figure 3. Downloaded image from the Willdenow collection of the Botanical Garden of Berlin, of a specimen labeled *Cymbidium hyemale* Muhl. Ex Willd. Although most of the label is unreadable, the name Muhlenberg is clearly legible. This specimen almost certainly was sent by Muhlenberg to Willdenow, and at the very least was one of the specimens that served as the basis for the description of “*Cymbidium hyemale*,” and ultimately for the species now known *Aplectrum hyemale* (Muhl ex Willd.) Torr.

Curators Herbarium B (2000+). Digital specimen images at the Herbarium Berolinense. [Dataset]. Version: 22 Sep 2019. Data Publisher: Botanic Garden and Botanical Museum Berlin. <http://ww2.bgbm.org/herbarium/> [<http://herbarium.bgbm.org/object/BW16999010>, image ID: 394975.]

The morphological similarity of *Aplectrum* to *Corallorhiza* was noted by Thomas Nuttall, who in 1818, created *Aplectrum* as a subgenus under *Corallorhiza*, including in it, a single species, *Corallorhiza (Aplectrum) hiemalis* (Figure 4) (Nuttall 1818). In 1826 John Torrey raised *Aplectrum* to the status of an independent genus, and created the name *Aplectrum hyemale* that we have today (Figure 5, Torrey 1826). The work of Nuttall and Torrey has led to some confusion in the botanical literature as to which deserves the authorship citation for *A. hyemale*. To this day botanical works can be found citing one or the other. The Kew World Checklist of Plant Families and the USDA plants database both cite Torrey, while many others cite Nuttall.

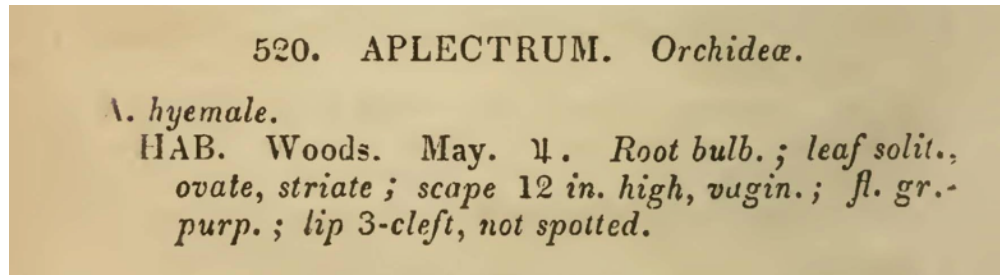


Figure 4. John Torrey's description of *Aplectrum hyemale*, recognizing that it was sufficiently different from *Corallorhiza* (Torrey 1826).

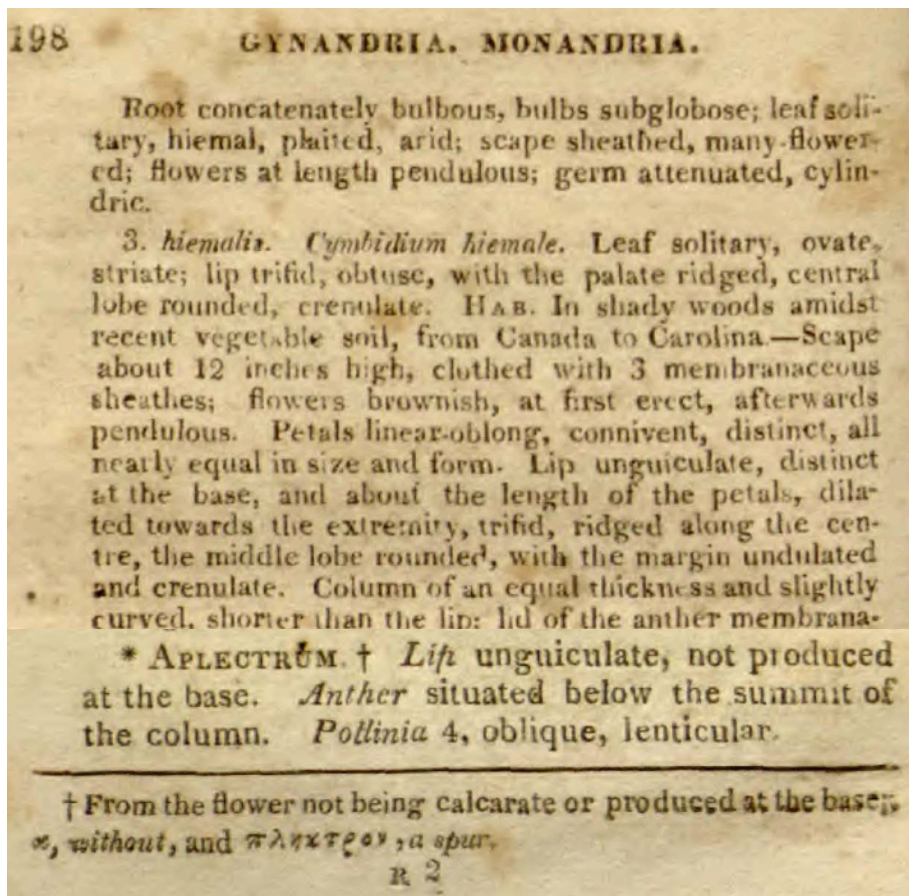


Figure 5. Thomas Nuttall's description of *Aplectrum hyemale* (Nuttall 1818). He considered *Aplectrum* to be a subgenus under *Corallorhiza*, and clearly equated it with *Cymbidium hyemale* of Muhlenberg and Willdenow. The spellings "*hyemale*" and "*hiemale*" are known as orthographic variants. The letter "y" is rarely used in classical Latin, except in loan words. Botanical authors are required to follow the gender and case rules of Latin. They are not necessarily required to spell Latin like Tacitus or Cicero. Thus even though "*hiemale*" is a properly spelled Latin word and "*hyemale*" is not, the spelling *hyemale*, originally applied by Willdenow has been retained.

The name *Aplectrum hyemale* was diverted onto a nomenclatural sidetrack for a few decades in the late 1800's and early 1900's when Britton, Stearns, and Poggenburg published the name *Aplectrum spicatum*. This name was accepted by many authors and was in use until the middle of the twentieth century. The tale of how this derailment of a perfectly valid name occurred begins in 1788, seventeen years before Muhlenberg and Willdenow published the name *Cymbidium hyemale*. In that year the American botanist Thomas Walter described a plant in *Flora Caroliniana* that he named *Arethusa spicata* (Figure 6). It is now generally agreed that he was naming the plant we now know as *Hexalectris spicata*. This interpretation was generally accepted for a century until 1888, when Britton, Stearns, and Poggenburg mistakenly came to the conclusion that Walter had actually been describing *Aplectrum hyemale*. Since Walter's description had been published almost two decades before Muhlenberg and Willdenow, his basionym *Arethusa spicata* should therefore have precedence, and they transferred Walter's species epithet to *Aplectrum* and published the name *Aplectrum spicatum* (Walt.) B.S.P.

In 1904, the name *Aplectrum spicatum* was challenged by John Hendley Barnhart of the New York Botanical Garden (Barnhart, 1904). His argument was apparently persuasive. In the original 1896 edition of Britton and Brown's "Illustrated Flora of the Northern United States, Canada and the British Possessions," Britton uses *A. spicatum*, which he had proposed eight years earlier. In the second edition published in 1913, he reverts back to *A. hyemale*, apparently accepting his error (Britton and Brown 1896, 1913).

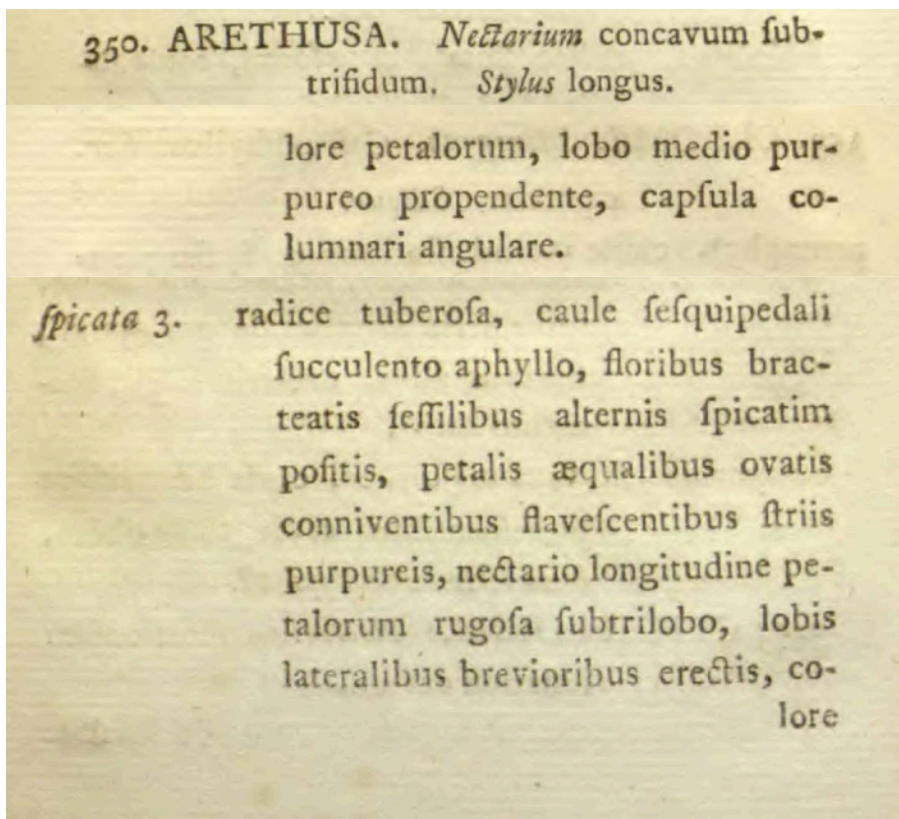


Figure 6. Thomas Walter's original description from 1788 of the plant now known as *Hexalectris spicata*. The text was copied from pages 222 and 223 of his work *Flora Caroliniana*. His description was sufficiently succinct that *Arethusa spicata* now serves as the basionym of *Hexalectris spicata*

Phylogeny: It is always nice to know who your relatives are (even if you don't like them very much). Based on morphology, the close relationship of *Aplectrum* to *Corallorhiza* has been long recognized (see previous section on taxonomy). Dressler assigned *Aplectrum* to Subfamily Epidrendoideae, Tribe Calypsoeae, along with eight other genera: *Calypso*, *Corallorhiza*, *Cremastra*, *Dactylostylix*, *Ephippianthus*, *Oreorchis*, *Tipularia*, and *Yoania* (Dressler 1993). Before PCR (Polymerase Chain Reaction), all one could say is that this collection of genera consisted of brothers, sisters, and close cousins, but could not really say how they were related. PCR analysis has added three new genera (*Changnienia*, *Govenia*, and *Danxiaorchis*) to the original core. The culmination of this work is outlined in two recent papers (Freudenstein and Chase 2015, Freudenstein et al. 2017). The major change in this classification was to subsume Calypsoeae into the tribe Epidendreae, and create a new subtribe Calypsoineae. A simplified cladogram from Freudenstein's work is given in Figure 7. *Aplectrum* is a part of a small clade that includes *Corallorhiza*, three Asiatic genera (*Cremastra*, *Danxiaorchis*, and *Oreorchis*), plus a single genus from central America (*Govenia*). The other main branch includes *Calypso* and *Tipularia*, and four genera exclusive to Asia. This analysis must be taken with a small grain of salt. As PCR technology continues to evolve, and whole genome sequencing becomes more and more feasible, the relationships within Calypsoineae may again change.

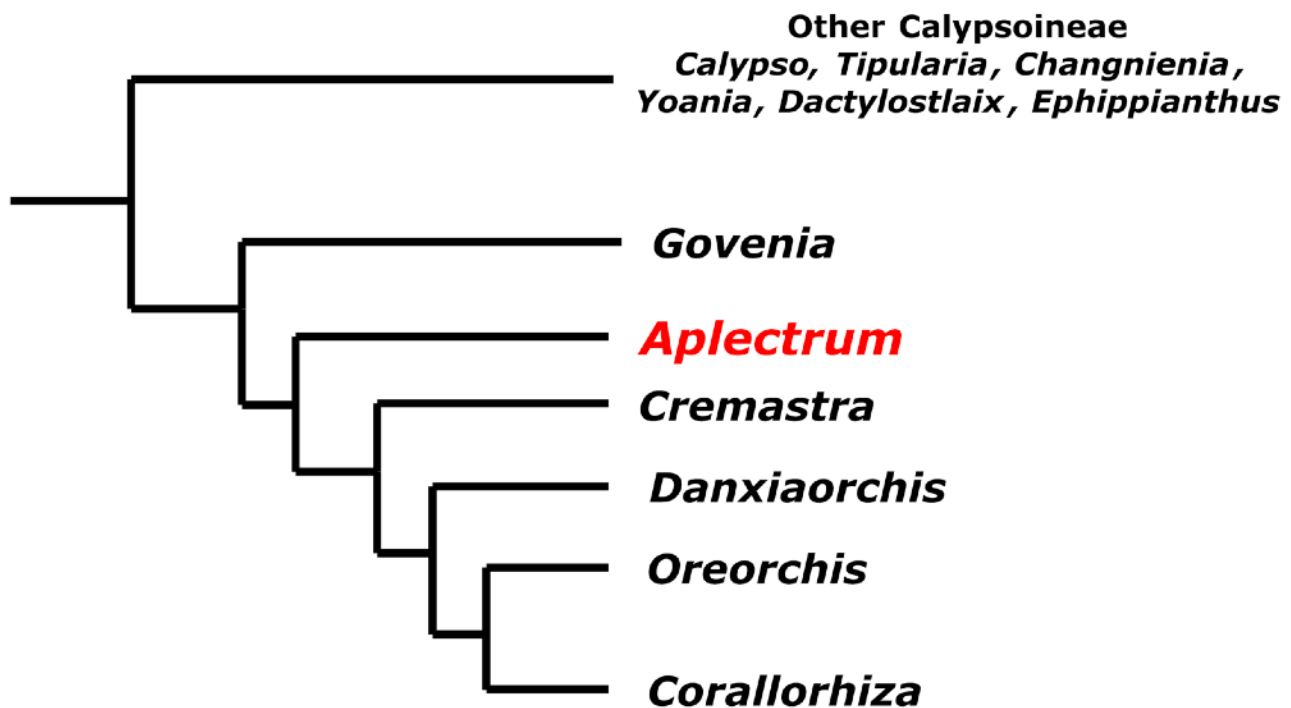
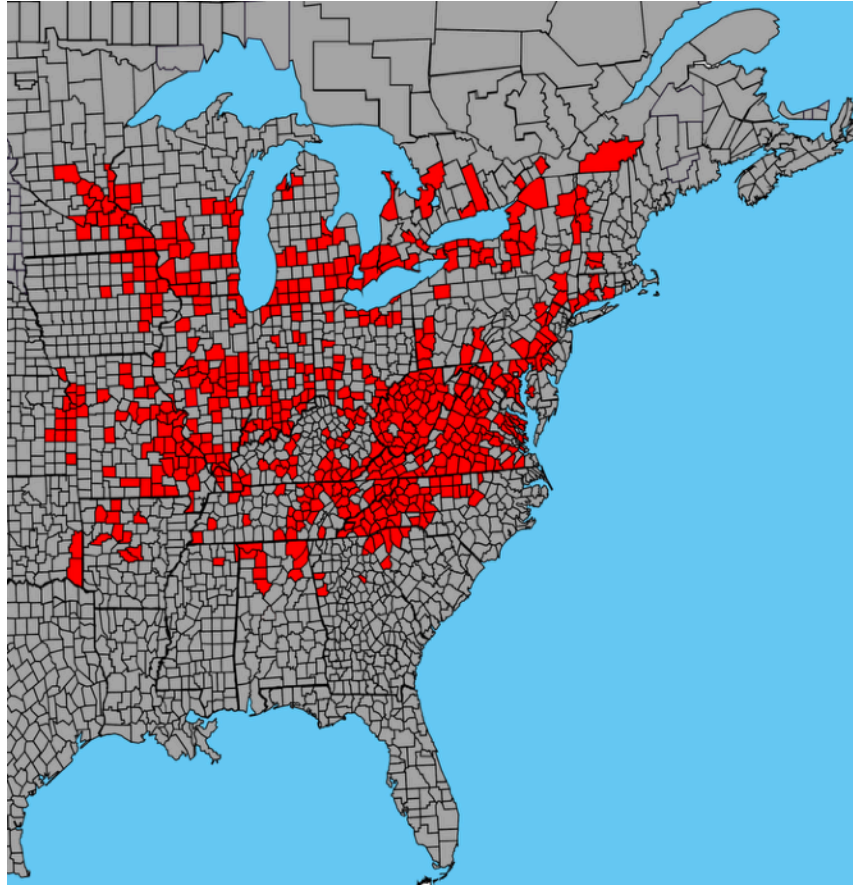


Figure 7. Simplified phylogenetic tree of tribe Calypsoineae, based on the work of Freudenstein (Freudenstein et al. 2017)



Above: County level distribution map of *Aplectrum hyemale*:

The county level distribution map was constructed using books, journal articles, and online herbaria.

Books: (Bentley 2000), (Case 1987), (Fowler 1993), (Homoya 1993), (Sheviak 1974), (Smith 2012), (Summers 1996), (Whiting 1986). Journal Articles: (Angelo 2000), (Magrath 1971, 2001), (Niemann 1986), (Reed 1964). Online herbaria: (Alabama Plant Atlas at University of West Alabama Website), (Digital Atlas of the Virginia Flora), (Flora of the Southeast at University of North Carolina Herbarium), (SERNAC, South Carolina Plant Atlas), (Weldy 2002).

Distribution: *Aplectrum hyemale* occurs primarily in rich deciduous forests of eastern North America, most often occurring in mature forests of beech and maple. It is distributed from New England, southern Quebec and southern Ontario through the Great Lakes region to Minnesota (Case 1987; Whiting and Catling 1986). It reaches its northwestern most limit in the upper Mississippi River Valley in southeastern Minnesota (Smith 2012). The range extends as far west as eastern Kansas where it is found along the Missouri River (Stevens and Dill 1942). The southwestern limit is reached in the Ouachita Mountains of southeastern Oklahoma (Magrath 2001). Its stronghold appears to be in the Appalachians, from North Carolina to Virginia and West Virginia (Bentley 2000). It is conspicuously absent from the Gulf and Atlantic Coastal Plains, from the Mississippi to South Carolina.

Per Axel Rydberg, a prominent botanist of the late nineteenth and early twentieth centuries reported *Aplectrum* from Saskatchewan, and Arizona (Rydberg 1917). Donovan Stewart Correll, one of the leading orchid botanists of the mid-twentieth century, also ascribes *Aplectrum* to Saskatchewan, and to the Santa Rita Mountains of Arizona, most likely based on the reports of Rydberg (Correll 1950).

These reports are almost certainly in error! An extensive search of online herbaria has revealed no specimens that support these claims. Likewise no additional reports of *Aplectrum*, in either referenced botanical literature, or in popular literature, can be located. A search of iNaturalist and online photo-sharing sites reveals no locations in either Arizona or Saskatchewan. Ron Coleman in “The Wild Orchids of Arizona and New Mexico” (page 19) specifically excludes *Aplectrum* from Arizona and New Mexico. Thus, a fair conclusion is that *Aplectrum* does not, and did not ever, occur beyond the boundaries of eastern deciduous forest. The reports by Rydberg and Correll are probably based on misidentified specimens of *Corallorhiza maculata* (most likely in fruit). Unfortunately, these reports of Rydberg and Correll have developed a life of their own, with web pages propagating erroneous information, as a result of minimal fact checking. As an example, the Wikipedia entry for *Aplectrum*, contains the following sentence; “Isolated populations are also reported from Arizona” (“Aplectrum 2021).

REFERENCES

- Alabama Plant Atlas Editorial Committee. 2014. Alabama Plant Atlas. [S.M. Landry and K.N. Campbell (original application development), Florida Center for Community Design and Research. University of South Florida]. University of West Alabama, Livingston, Alabama. Database assessed 11/11/2019.
- Adams, M.S. 1970. Adaptions of *Aplectrum hyemale* to the Environment: Effects of Pre conditioning Temperature on Net Photosynthesis. Bulletin of the Torrey Botanical Club 97: 219-224.
- Angelo, R. Boufford, D. 2000. Atlas of the Flora of New England: Monocots Except Poaceae and Cyperaceae. *Rhodora* 102, 1-119.
- Anon. Biographical Notice of the Late Thomas Nuttall, 1860. Proceedings of the American Philosophical Society, 7: 297-315.
- Aplectrum (2021, February 4), In *Wikipedia*. <https://en.wikipedia.org/wiki/Aplectrum>
- Argue, C.L. 2013. Seed Production in *Aplectrum hyemale* (Adam and Eve Orchid, Putty-Root). Native Orchid Conference Journal, 10(1), 1-4, 13.
- Auclair, A.N. 1972. Comparative Ecology of the Orchids *Aplectrum hyemale* and *Orchis spectabilis*. Bulletin of the Torrey Botanical Club 99: 1-10.
- Barnhart, J.H. 1904. The Nomenclature of *Hexalectris* and *Aplectrum*. *Torrey* 4: 119-121.
- Bentley, S.L. 2000. Native Orchids of the Southern Appalachian Mountains. University of North Carolina Press, Chapel Hill, NC.
- Britton, N.L., E.E. Stearns, and J.F. Poggenburg.. 1888. Catalogue of Anthophyta and Pteridophyta reported as Growing Within One Hundred Miles of New York City. Torrey Botanical Club, New York.

- Britton, N.L., and A. Brown. 1896. An Illustrated Flora of the Northern States, Canada and the British Possessions. Vol. 1, Charles Scribner's Sons, New York, pp 481.
- Britton, N.L., and A. Brown. 1913. An Illustrated Flora of the Northern States, Canada and the British Possessions. Vol. 1, 2nd Ed. Charles Scribner's Sons, New York, pp 573- 574.
- Case, F.W. 1987. Orchids of the Western Great Lakes, Cranbrook Institute of Science Bulletin 48.
- Catling, P.M. 1984. Distribution and Pollination Biology of Canadian Orchids. In Kiat W. Tan (Ed.) , Proceedings of the Eleventh World Orchid Conference, March 1984, Miami Florida. pp 121-130.
- Coleman, R.A. 2002. Wild Orchids of Arizona and New Mexico, Cornell University Press, Ithaca and London.
- Correll, D.S. 1950. Native Orchids of North America, Chronica Botanica Company, Waltham, Ma, pp 317.
- Digital Atlas of the Virginia Flora. Virginia Botanical Association Blacksburg, VA <http://vaplantatlas.org/> Database assessed 11/11/2019.
- Dressler R.L. 1993. Phylogeny and Classification of the Orchid Family, Cambridge University Press, Melbourne, Australia.
- Flora of the Southeast. <http://www.herbarium.unc.edu/seflora/about.htm> University of North Carolina Herbarium Online Search, Database Assessed 11.19/2019.
- Fowler, J.A. 2005. Wild Orchids of South Carolina. University of South Carolina Press, Columbia, SC
- Freudenstein, J.V., and D.M. Senyo. 2008. Relationships and Evolution of *MTK* in a Group of Leafless Orchids *Corallorhiza* and *Corallorhizinae*; Orchidaceae: Epidendroideae). American Journal of Botany 95: 498-505.
- Freudenstein, J.V., and M.W. Chase. 2015. Phylogenetic Relationships in Epidendroideae (Orchidaceae), one of the Great flowering Plant Radiations: Progressive Specialization and Diversification. Annals of Botany 115: 665-681.
- Freudenstein, J.V., T. Yukawa, and Y. Luo. 2017. A Reanalysis of Relationships among Calipsoinae (Orchidaceae: Epidendroideae): Floral and Vegetative Evolution and the Placement of *Yuania*. Systematic Botany 42: 17-25.
- Gorniak, M., O. Paun, and M.W. Chase.. 2010. Phylogenetic relationships within Orchidaceae based on a low copy nuclear coding gene, *Xdh*: Congruence with organellar and nuclear ribosomal DNA results. Molecular Phylogenetics and Evolution 56: 784-795.
- Gray, A. 1877. Memoir of John Torrey 1796-1873. National Academy of Sciences Biographical Memoirs. 1: 265-276.
- Homoya, M.A. 1993. Orchids of Indiana. Indiana University Press, Bloomington, In.
- Hiepko, P. 1987. The Collections of the Botanical Museum Berlin-Dahlem (B) and their History. Englera 7: 219-252.
- Hogan, K.P. 1983. The Pollination biology and breeding system of *Aplectrum hyemale* (Orchidaceae). Canadian Journal of Botany 61: 1906-1910.
- House, H.D. 1903. Notes Upon the Orchids of Central New York. Torreyia, 3: 49-54.
- House, H.D. 1924. New York State Bulletin 254: 251.
- Linnaeus, C. 1805. Species Plantarum, Volume 4, part 1, pp 107.
- Magrath, L.K.1971. Native Orchids of Kansas. Transactions of the Kansas Academy of Science ,74, 287-309.
- Magrath, L.K. 2001. Native Orchids of Oklahoma, Oklahoma Native Plant Journal, 1: 39- 66.
- Nelson, J. 2015. Thomas Nuttall Brief life of a Pioneering Naturalist 1786-1859. Harvard Magazine, May-June

- Niemann, D. 1986. The Distribution of Orchids in Iowa. Proceedings of the Iowa Academy of Science 93, 24-34.
- Nuttall, T. 1818. Genera of North American Plants A Catalogue of the Species to the year 1817, Volume 2, Philadelphia, pp 197-198.
- Nuttall, T. 1835. Collections Toward a Flora of the Territory of Arkansas. Transactions of the American Philosophical Society, 5(New Series), 134-203. pp 161.
- Reed C.F. 1964. Orchidaceae of Maryland, Delaware and the District of Columbia .Castanea 29, 78-109
- Reveal, J.L 2014. John Torrey: A Botanical Biography. Phytoneuron 100: 1-64.
- Rydberg, P.A., 1917. Flora of the Rocky Mountains and Adjacent Plains. New York. pp 184
- SERNEC (Southeast Regional Network of Expertise and Collections). <http://sernecportal.org/portal/collections/index.php> Database accessed 11/11/2019
- Sheviak, C. J. 1974. An Introduction to the Ecology of the Illinois Orchidaceae. Illinois State Museum Scientific Papers XIV.
- Sheviak, C.J. 2001. A role for water droplets in the pollination of *Platanthera aquilonis* (Orchidaceae). Rhodora 103: 380-386.
- Smith, C.E. 1962. Henry Muhlenberg-Botanical Pioneer. Proceedings of the American Philosophical Society, 106: 443-460.
- Smith, W.R. 2012. Native Orchids of Minnesota, University of Minnesota Press, Minneapolis, London.
- South Carolina Plant Atlas. <http://herbarium.biol.sc.edu/scplantatlas.html>, A. C. Moore Herbarium Department of Biological Sciences, University of South Carolina, Columbia, SC 29208. Database Accessed 11/11/2019.
- Stevens, W.C., and F.E. Dill. 1942. *Aplectrum spicatum* in a Kansas Woodland. Transactions of the Kansas Academy of Science 45: 138-151.
- Summers, B. 1996, Missouri Orchids. Missouri Department of Conservation Natural History Series No. 1
- Tissue, D.T., E.P. Skillman, and B.R. Strein. 1995. Photosynthesis and Carbon Allocation in *Tipularia discolor* (Orchidaceae), a Wintergreen Understory Herb. American Journal of Botany 82: 1249-1256.
- Torrey, J. 1826. Compendium of the Flora of the Northern and Middle States. Stacy B. Collins (J.& J. Harper), New York, pp. 322.
- Walter, T. 1788. Flora Caroliniana, pp. 222.
- Weldy, T. Mitchell, R. Ingalls, R. 2002. New York Flora Atlas (<http://nyflora.org/atlas/atlas.htm>). New York Flora Association, New York State Museum, Albany, NY.
- Whiting, R.E. and P.M. Catling. 1986. Orchids of Ontario, CanaColl Foundation, Ottawa, Canada.
- Willdenow, C.H. 1805. Species Plantarum, Volume 4, Part 1, Berlin, pp107.
- Wu, G.-Y., J.-A. Hui, JZ.H. Wang, J. Li, J., and Q.S. Ye.. 2014. Photosynthetic Characteristics of Four Wild *Dendrobium* Species in China, HortScience 49: 1023-1027.
- Zhang, S.-B., H. Hong, Z.R. Li, and Y.-P. Yang. 2007. Flexible and Reversible Responses to Different Irradiance Levels During Photosynthetic Acclimation of *Cypripedium guttatum*. Journal of Plant Physiology 164: 611-620.

Appendix: Botanists involved in naming *Aplectrum hyemale*

Gotthilf Heinrich Ernst Muhlenberg (Henry Ernst) (1753-1815) was an American clergyman and botanist. His father Heinrich Melchoir Muhlenberg emigrated to Pennsylvania in 1742 from Germany and established the first Lutheran Church in North America. Henry Ernst was sent to Germany for education, finishing his studies at the University of Halle-Wittenberg in 1769. He was ordained and returned to Philadelphia in 1770. He served as a clergyman in Pennsylvania and New Jersey for the remainder of his life. His interest in botany led him to collect and describe numerous plants from the northeastern United States. He communicated with, and exchanged specimens with many prominent American and European botanists of the day. One of his most productive collaborations was with Carl Ludwig Willdenow (1765-1812), who was director of the Botanical Garden of Berlin from 1801 until his death in 1812. Muhlenberg sent numerous specimens to Willdenow, who then frequently added Latin descriptions to create a validly publishable name. In addition to *Aplectrum hyemale*, two other orchid names accepted today still bear the author citation Muhl. ex Willd.; *Cypripedium candidum* Muhl. ex Willd. and *Dactylorhiza viridis* var *virescens* (Muhl. ex Willd.) Baumbach (basonym *Orchis virescens* Muhl. Ex Willd.). The grass Genus *Muhlenbergia* was named by Willdenow in honor of Muhlenberg.

Carl Ludwig Willdenow (1765-1812) was one of the most prominent European botanists of the late 1700's and early 1800's. He was born in Berlin, the son of a pharmacist. He initially studied pharmacy in Bad Langensalza, and then medicine and botany at the University of Halle-Wittenberg. After finishing in 1789, he took over his father's pharmacy business. Although trained in medicine and pharmacy, his real passion was botany. As a student he made extensive collections of German plants and in 1787 published *Florae Beroninensis Prodrum* (*Flora of Berlin*), which was well received by botanists of that day. He became director of the Botanical Garden of Berlin in 1801. Although Willdenow only left Germany twice, once to travel to Italy and once to Paris, his knowledge of plants from beyond the borders of Europe was extensive. He communicated with and received specimens from numerous botanists either living or traveling in North and South America, the Caribbean, and India. His most influential work was *Species Plantarum* published in six volumes in the late 1700's and early 1800's. His descriptions of orchids are in Volume 4 part 1, published in 1805. He was responsible for creating the genus name *Habenaria*; the name *Habenaria macroceratidis* Willd. is still accepted today. He was the first to validly describe *Corallorhiza odontorhiza*, under the name *Cymbidium odontorhizon*, which was transferred to *Corallorhiza* by Nuttall in 1818.

Thomas Nuttall (1786-1859) was an Englishman who spent much of his adult life in North America. His formal education appears to have been quite limited. He served an apprenticeship as a printer, and then chose to move to America. He arrived in Philadelphia in 1808, knowing almost nothing of botany. He soon met Benjamin Barton, a leading American botanist and scholar, who mentored the young Englishman over the next few years. Nuttall's true passion was to be in the field, collecting anything new he encountered (plants, birds, minerals, even sea shells). He can be described as the "Indiana Jones" of American botany, on several occasions risking life and limb on collecting trips on the American frontier of the early 1800's. His descriptions typically were thorough and detailed. For two years he travelled along the east coast, from Philadelphia to North Carolina, collecting and preparing specimens for Dr. Barton's herbarium. From 1810-1812, he collected extensively in the Great Lakes region, and along the Missouri River from St. Louis to North Dakota. After returning to England during the War of 1812, he returned to America, and from 1818-20 explored Arkansas and Oklahoma. While on this expedition, he collected and later validly described the orchid now known as *Platanthera leucophaea*, giving it the name *Orchis leucophaea* (Nuttall, T. 1835). In the 1820's he settled down a bit, assumed a professorship at Harvard, and became curator of the Harvard Botanical Garden. In 1834 he resigned his position and joined an expedition that travelled widely in the American west. The expedition traveled through Kansas, Wyoming, Idaho, and eventually down the Columbia River to the Pacific. After a winter side trip to Hawaii, he returned to the Pacific Northwest in April of 1835, for another season of collecting. He eventually made his way south to San Diego, from where he returned to Philadelphia in 1836 via ship (Nelson, J. 2015, Anon. 1860). In 1841 he was forced to return to England, under the terms of an inheritance that required him to remain in England for nine months of the year. He was responsible for creating names for two orchid genera, *Triphora* and *Tipularia*. Three of his orchid names, *Habenaria repens*, *Tipularia discolor*, and *Corallorhiza odontorhiza* are still accepted today.

John Torrey (1796-1873) was an American botanist, chemist, and medical doctor. He was born in New York City. As a teenager he came under the tutelage of Amos Eaton, an early leader in the field of natural history education, who taught him the basics of botany. In 1815 he began the study of Medicine, finishing his medical degree in 1818 (Gray, A. 1877, Reveal, J.L. 2014). In 1817, while still a medical student, he completed his first major botanical work "Catalogue of Plants Growing Spontaneously within Thirty Miles of the City of New York." Its publication in 1819 gained him recognition as a botanist. After working as a physician in New York City for several years, he took a position as professor of chemistry and geology at the United States Military Academy at West Point in 1824. In 1828 he took a position as professor of chemistry and botany at Columbia University, which he held until 1855. From 1830 to 1854 he was also a professor of chemistry, mineralogy, and botany at Princeton University. His second major botanical work was "Compendium of the Flora of the Northern and Middle States" published in 1826.

In 1836 he assumed the position of Botanist to the State of New York, and in 1843 as part of his duties completed, “A Flora of the State of New York,” a massive thorough description of the plants then known to be growing in the State of New York. In his botanical work, he befriended, and worked closely with, Asa Gray, who aided him immensely in his botanical endeavors. Asa Gray eventually secured a position as professor of botany at Harvard, and became one of the preeminent American botanists of the nineteenth century. Unlike his contemporary and friend Thomas Nuttall, Torrey did not risk life and limb collecting plants, he instead relied on individuals like Nuttall, and many others to provide him with novel botanical specimens from the Great Plains, Rocky Mountains, and the West Coast. Two of the more notable plants named by Torrey are Honey Mesquite (*Prosopis glandulosa*), and the California Pitcherplant (*Darlingtonia californica*). The name Torrey lives on in American popular culture. John Torrey is the “Torrey” of Torrey Pines Golf Course, that regularly hosts major PGA tournaments. Built in 1957, the course is named after the Torrey Pine (*Pinus torreyana*), a rare species of pine, endemic to the California Coast, just north of San Diego. The tree was named in 1855 by Christopher Parry, one of Torrey’s former students, in honor of Torrey, while Parry served as botanist to the California-Mexico Boundary Commission, working to delineate the southern border of the newly established State of California.

Thomas Walter (1740-1789) was born in Hampshire England and emigrated to South Carolina in ca. 1769. He acquired tracts of land in the Charleston area, including 500 acres in Berkley County along the Santee River, where he built a home and maintained a botanical garden. He participated in revolutionary activities against British rule, and was ultimately elected to the South Carolina State Assembly in 1788, shortly before his death. He avidly collected plants from South Carolina and adjacent regions. His botanical work culminated in *Flora Caroliniana*, published in 1788. This was the first major flora describing North American plants to use the Linnean system of classification. In it he described about 1060 plants; about 80 of his names remain valid today. He was the first to describe and validly name *Cypripedium reginae*. Four other orchid species, now known as *Hexalectris spicata*, *Spiranthes praecox*, *Ponthieva racemosa*, and *Calopogon barbatus* were validly described by Walter, but transferred to their current genera by later authors.

DISCOVERY OF *SPIRANTHES ODORATA* (NUTT.) LINDL.
(FRAGRANT LADIES'-TRESSES) IN CENTRAL NEW YORK

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Abstract

A population of *Spiranthes odorata* (Nutt.) Lindl. (Fragrant Ladies'-tresses) was discovered in the vicinity of Onondaga Lake, Town of Geddes, Onondaga County, New York. Species identification was confirmed by genetic and morphological analysis. This finding is the first confirmed record for NY and the most northern location for the species in the US. It is disjunct from the nearest verified populations in Delaware and Virginia, about 300 to 350 miles to the south. Habitat of this inland population was a shaded forested wetland in an active floodplain, with muck soils that are inundated or saturated for much of the year. Among the associated species are *Fraxinus pennsylvanica*, *Peltandra virginica*, *Lysimachia nummularia*, *Saururus cernuus*, and several other herbaceous species.

In September 2014, the senior author and Catherine Landis participated in a bio blitz of the Onondaga Lake vicinity in Onondaga County, New York. During this effort, they found a small population of a different looking *Spiranthes* sp. in an unusual habitat situation. The overall size, especially the height of the plants, was striking and the habitat conditions were a shaded forested wetland within an active floodplain, much different than others they had observed.

With only eight to ten plants originally found, photographs were taken and just a portion of the inflorescence from one of the plants was collected. The photographs were sent to various individuals for their input as to the plant's identity. Among those contacted was Dr. Charles Sheviak, a retired expert on orchids, especially the genus *Spiranthes*, who formerly worked as the Curator of Botany at the New York State Museum. His detailed response (Sheviak personal communication, September 18, 2014), which turned out to be rather prescient, was as follows:

Your photos are consistent w/ *Spiranthes odorata*. This would be a state record, and an extreme inland and northward disjunction for the species, which is almost exclusively limited to the Coastal plain from NC southward. There are two bona fide records from Tennessee and Kentucky; I've seen

the KY station and grew the plants I collected there for many years. They are indeed *S. odorata*, so the species is known from some inland sites. But identification can be extremely difficult in the group, due to the proclivity of *S. cernua* to incorporate genes of related species. I have seen specimens of *S. odorata*-like plants from coastal sites as far north as Delaware Bay, but when I've been able to pin-down a determination, they've proven to be *S. cernua*. I was able to get some live plants from coastal Virginia that looked like *S. odorata*, but they proved to be tetraploid, apomictic *S. cernua* and in fact grew on to be typical *S. cernua* when removed from their coastal marsh habitat.

In the case of your plants, the first thing that jumped out at me was the impossible habitat: *S. cernua* simply doesn't grow in swampy woods. The water it can handle to some extent, but not the shade. At least I've never seen it manage to bloom under such conditions. The flower morphology in your photos is beyond the range I've seen for *S. cernua*, and in fact those in the photo of the paired inflorescences... are a good expression of *S. odorata*.

So are the plants *S. odorata*? Well, I can't say that. If I were still in the business, I'd pin-down the matter w/ a chromosome count, but short of that, I wouldn't want to say. Whether *S. odorata* or *S. cernua*, however, it is a remarkable, and in my experience, unique, population.

Note that this response was prior to more recent studies of the *Spiranthes cernua* species complex, in particular the detailed treatment by Pace and Cameron (2017).

At that time no one could be located in a timely manner to perform genetic work on the population. Since 2014, the senior author persisted in visiting the area each September, but no plants were found, until August 29, 2020 when plants in the area of the original population were observed and more intense searches discovered additional plants. Field searches were performed by the senior author and David Werier on September 5, and with Michael Hough and Matthew Young on September 12. A total of 30 plants were found in small patches in four subpopulations within an area approximately 50 meters by 100 meters. Photographs and measurements were made during each field survey, and collections made for genetic analysis by Michael Hough.

Location, Habitat, and Associated Species

Location of the population is in the vicinity of Onondaga Lake, Town of Geddes, Onondaga County, NY. It is within a forested wetland in an active floodplain to a major freshwater waterbody (Fig. 1). Soil in the area is the histosol Palms muck, a very deep, very poorly drained soil formed in herbaceous organic material. The soil is slightly acidic and is inundated or saturated for much of the year. Periods of severe

flooding occur primarily during the winter and early spring months, with water marks evident on trees to a height of about 0.5 meter in places.



Figure 1. Habitat setting of Onondaga population of *Spiranthes odorata* (in foreground)
Photo by J. McMullen

Tree canopy cover in the area ranges from 60% to 90%; the dominant tree species is *Fraxinus pennsylvanica* (Green Ash), with mixes of *Acer saccharinum* (Silver Maple), *Salix × fragilis* (Crack Willow), and *Ulmus americana* (American Elm). Cover in the shrub layer varies and is primarily provided by Green Ash seedlings and *Cephalanthus occidentalis* (Buttonbush). Dominant herbaceous species associated with *Spiranthes odorata* were: *Peltandra virginica* (Arrow-arum), *Lysimachia nummularia* (Moneywort), *Saururus cernuus* (Lizard's Tail), *Iris pseudacorus* (Yellow Iris), *Toxicodendron radicans* (Eastern Poison Ivy), *Boehmeria cylindrica* (False Nettle), and *Leersia oryzoides* (Rice Cutgrass). Other herbaceous species noted in the area included: *Lobelia cardinalis* (Cardinal Flower), sedges (*Carex crinita*, *C. grayii*, and *C. lupulina*), *Apios americana* (Groundnut), *Symphyotrichum lanceolatum* (Lance-leaved Aster), *Sium suave* (Water Parsnip), *Phragmites australis* subsp. (Reed Grass), and *Persicaria coccinea* (Swamp Smartweed).

Gross Morphology

The striking morphological trait of the plants in this population is their size, with observers often saying: *they are huge*. Height of the plants average from 40 to 60 cm, with the smallest being 33 cm and the largest 76 cm (Fig. 2). Specimens of *S. cernua* and its northern relatives including *S. incurva* (hereafter included in the *S. cernua* species complex), *S. arcisepala*, *S. magnicamporum*, *S. casei*, and *S. oroleuca* rarely exceed 50 cm, while *S. odorata* ranges in height from 10 to 100+ cm (Sheviak and Brown 2002).



Figure 2. Height of largest plant (increments in inches).
Photo by J. McMullen



Figure 3. Large spreading leaves of *Spiranthes odorata* (ruler is a little over 15 cm).
Photo by J. McMullen

At the time of flowering, there are five to seven (usually six) alternate, strap-shaped leaves, which decrease in size up the stem. The lower basal leaves are the largest (generally 20 cm to 30 cm long and about 2.5 cm wide), the lowest of which are usually rigidly spreading (Fig. 3), not ascending or flaccidly spreading as in the *S. cernua species complex* (Sheviak and Brown 2002). The basal leaves of the *S. cernua species complex* are typically at most 26 cm long \times 2 cm wide, while those of *S. odorata* have blades up to 52 cm long and 4 cm wide (Sheviak and Brown 2002). Upper leaves are very reduced and appressed.

The inflorescence varies in size, but was up to 17 cm long in some individuals (Fig. 4). The perianth of the flowers average about 1 cm long with the largest to 1.5 cm long, with straight lateral sepals that were often upturned at the ends. The perianth of the *S. cernua species complex* is typically 0.4 to 1.1 cm, while that of *S. odorata* is (0.4) 1 to 1.8 cm, except in young or depauperate plants (Sheviak and Brown 2002). The flowers are primarily white, but with the lip centrally yellow (Fig. 5). The lip margin is undulate rather than lacerate and crisped as it is in most northern members of the *S. cernua species complex* except *S. magnicamporum* (Pace & Cameron 2017). Matthew Pace (Pace personal communication, December 9, 2020), in a review of the 2014 specimen, indicated that the labellum and column are diagnostic and the size, shape, and color of the leaves support the *S. odorata* identification.



Figure 4. Inflorescence of *Spiranthes odorata*. Size of larger inflorescence (in centimeters) on left. Photos by J. McMullen (left) and M. Hough (right)



Figure 5. Closeup of flowers showing fleshy lip with undulate margins.
Photo by M. Hough

Another striking trait of the plants is their fragrance, which although not observed during the initial survey, was especially strong during the September 12 surveys. Their pleasant fragrance was evident from 10 meters away.

Genetics/Microscopic Analysis

Michael Hough performed the following genetics/microscopic assessment to verify the plants as *S. odorata*.

An inflorescence was pressed as a voucher and a basal leaf from the same plant was dried in silica gel. Photographs were taken of the inflorescence and basal leaves in situ, while seeds were examined under a compound light microscope with water at 100× magnification. Individual flowers were dissected and photographed under a dissecting microscope.

Genomic DNA samples were obtained from approximately 20 mg of dried tissue using a DNeasy Plant Mini Kit (Qiagen, Valencia, California, USA). The chloroplast region *ndhJ-trnF* was selected from Pace (2015) to best capture sequence divergence at the interspecific level for the *Spiranthes cernua* species complex. The sample was amplified by PCR for this region using the primers *ndhJ* and *TabE* listed in Shaw et al. (2007). The PCR product was cleaned using a GeneJET PCR Purification Kit (Thermo Scientific) and used to set up forward and reverse sequencing reactions using the same primers used for PCR. These were sent to Cornell's Biotechnology Resource Center for sequencing on an ABI 3730xl genetic analyzer (Applied Biosystems, Foster City, California, USA). The resulting electropherograms were aligned using MUSCLE and assembled into a single contig in the program MEGA X (Kumar et al. 2018) and added to Pace and Cameron's dataset of sequences available through GenBank (NCBI 2020). Genbank accession numbers for the sequences used are listed in Appendix 1.

Alignment of sequences was performed using MUSCLE in MEGA X and phylogenetic analysis of the final data matrix was made using Bayesian Inference with MrBayes 3.1.2 (Ronquist and Huelsenbeck, 2003) using the graphical user interface siMBa (Mishra and Thines 2014). MrBayes was run with the GTR + G (general time-reversible with a gamma distribution) model. A 50% majority-rule consensus tree was constructed using the "sumt" option in MrBayes and edited using the program FigTree 1.4.4 (Rambaut, 2018). The tree was displayed as a phylogram to show relative branch lengths, with posterior probabilities added as branch labels.

The resulting phylogram strongly supports that the plants at this site are *Spiranthes odorata* (Fig. 6). The results also rule out the commonly sold cultivar of *S. cernua* 'Chadds Ford', which has had the names *S. odorata* and *S. cernua* var. *odorata* misapplied to it in the past (Dueck et al. 2014, Pace and Cameron 2016). The genetics are supported by the presence of monoembryonic seeds evidenced by an ovoid embryo enclosed within the testa (Fig. 7), which suggests the plants are diploid (Sheviak 1982), and morphology of the flowers that includes a yellow, thickened labellum with an undulate margin and elongate nectar glands (Pace and Cameron 2017).

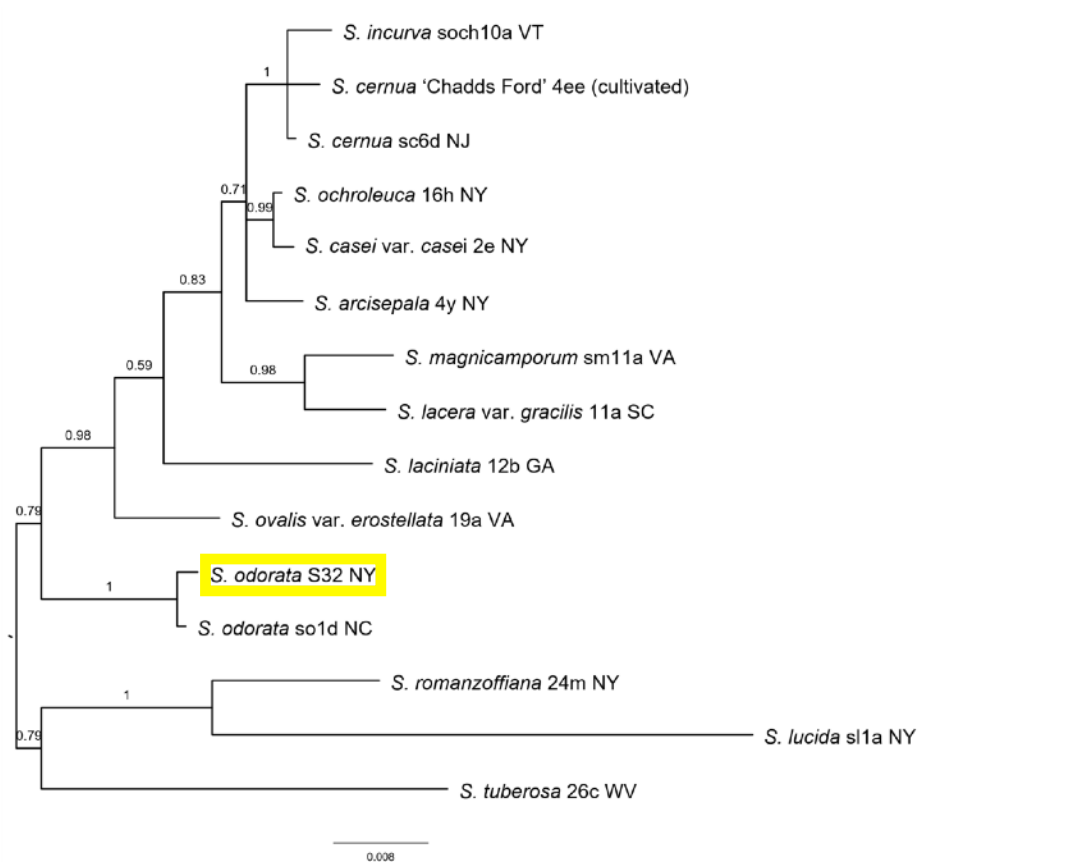


Figure 6. Bayesian phylogenetic tree reconstruction based on *ndhJ-trnF* chloroplast data. The sample from this study is highlighted. Numbers are posterior probabilities.

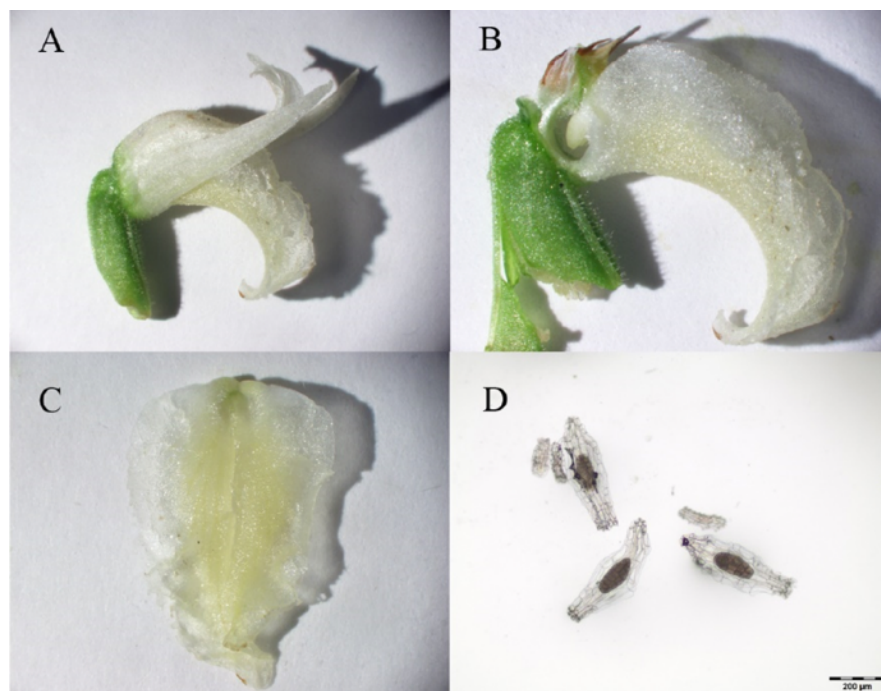


Figure 7. Parts of flower: A) flower, B) labellum and column, C) labellum and D) seeds. Photos by M. Hough

Distribution Information

Geographic distribution of *S. odorata* as provided by Sheviak (1982), with more recent records added, is shown on Fig. 8. As indicated by Sheviak (1982), it is generally distributed from Texas and Louisiana northeast in all the coastal states to Delaware and Maryland. It is primarily found in coastal areas, although there is one inland population shown for Kentucky. More recent distribution maps by USDA, NRCS (2020) and BONAP (Kartesz 2015) indicate additional populations from Arkansas and Tennessee, as well as southern New Jersey and one location on Long Island, NY.

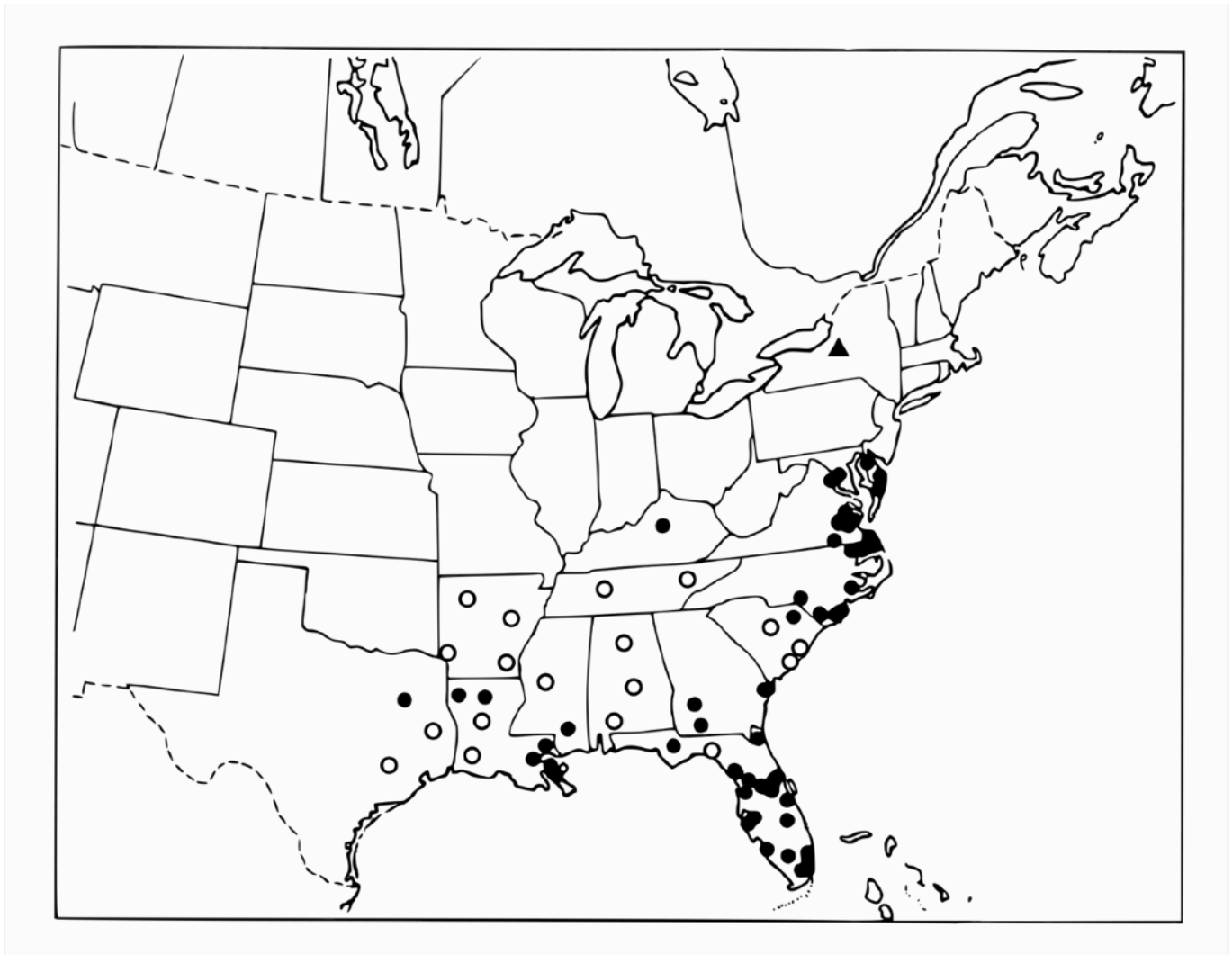


Figure 8. Geographic distribution of *Spiranthes odorata* with symbols representing locations where specimens have been collected or photographed. Data sources are separated to illustrate how the understanding of the distribution of this species has changed over time, starting with Sheviak (1982) (●), with additions from *iNaturalist* (California Academy of Science and National Geographic Society 2020) which includes states mapped by Kartesz (2015) (○), and the most recent collection in Onondaga County (▲).

Source for the NJ records on the more recent maps is reported as the NJ Natural Heritage Program, with no other published citation provided. David Snyder of the NJNHP (Snyder personal communication, December 8, 2020) indicated that there are several locations in southern NJ in the collection at the Academy of Natural Sciences of Philadelphia Herbarium (PH). Photographs of these specimens were obtained using the Mid-Atlantic Herbaria Consortium portal. The specimens were annotated as *S. cernua* var. *odorata* by Catling in 1979 prior to Sheviak's (1982) refinement of the complex. Based on many features (size of leaves and perianth and noted polyembryonic seeds) they do not appear to be *S. odorata*. While *S. odorata* may occur in southern NJ, herbaria searches turned up nothing confirmed north of Delaware, with the northernmost record being one from Kenton, Delaware at the Searle Herbarium at the Field Museum, Chicago (F 374801). The specimen was confirmed and annotated by both Sheviak and Pace.

The Long Island, NY record shown on both the USDA, NRCS and BONAP maps is reported to be based on the New York Metropolitan Flora database, which they reference as Glenn (2013). This record is apparently based on collections in 1896 and 1905 from Hempstead Long Island, Nassau County by Fanny Mulford. The specimens are now at the NY Botanical Garden. What the NYMF (Science Staff 2020) actually states regarding the 1905 specimen is ..."*may represent S. odorata, confirmation is pending.*" Sheviak (1982) discussed this collection as a possible indication of gene flow. He annotated the 1896 specimen as *S. cernua* and on the 1905 specimen states that it suggests *S. odorata* in gross morphology but is certainly not typical and that it may be this species at its northern limit or the result of gene flow from *S. odorata* to *S. cernua*. Pace later annotated both specimens as *S. cernua*. Neither the NY Flora Atlas (Weldy et al. 2020) nor Werier (2017) include *S. odorata* in the state, and Pace (2015) did not include NY or NJ in his range for *S. odorata*.

Significance of Current Finding

With the prior discussion, it is evident that the current finding of *S. odorata* in Onondaga County in central NY represents a state record and a considerable range extension for the species. It is the northernmost record in the US, and an inland population of considerable disjunction. The straight-line distance from this Onondaga, NY population to Kenton, DE is about 300 miles (486 kilometers), and to the next closest population in northeastern VA about 350 miles (567 km).

This population of *S. odorata* is not considered to be planted because of the scattered nature of the plants, wet habitat, and inaccessible location. The fact that this site is next to a major freshwater waterbody that attracts waterbirds, is a plausible link in the chain of how this population became established at such an inland disjunct location. Onondaga Lake is a hotspot for staging migratory waterbirds and is due north of

Delaware Bay, another such hotspot staging area, where the nearest confirmed population of *S. odorata* can be found. Although the flora of New York is generally well-documented, this is the third new *Spiranthes* sp. to be found in the state in the last seven years, the other two being *S. magnicamporum* (Brunton 2015) and *S. ovalis* var. *erostella* (Daniel and Johnson 2017), both of which are considered to be native (Weldy et al. 2020).

Although it took six years of persistence to sort out the identity of this species, it turned out to be a rather significant find.

Voucher and Photograph Details

The original 2014 specimen collected by J. McMullen was recently verified by Pace as *S. odorata* and forwarded to the NY Botanical Garden Herbarium (NY). A specimen collected by M. Hough, M. Young, and J. McMullen was deposited at the SUNY Cortland Herbarium (CORT 14802), and one collected by J. McMullen submitted to the Bailey Herbarium at Cornell University (BH 284040). Photographs presented in this manuscript were taken by Hough or McMullen between September 5 and 21, 2020.

Acknowledgements

Thanks to Chuck Sheviak for his initial insight and permission to use his information. David Werier reviewed this population in the field, and provided helpful comments on the manuscript. Matthew Pace verified the original specimen and provided characteristic traits. Thanks to Dale Grinolds, Jr. of Onondaga County Parks for providing permission to collect specimens; Daniel Atha for locating specimens at NY; David Snyder for information on NJ records; Tricia Conklin for the use of her genetics lab at SUNY Cortland; and Jordon Teisher and Tatyana Livshultz at PH.

Literature Cited

- Brunton, D.F. 2015. Great Plains Ladies-tresses (*Spiranthes magnicamporum*) in the lower Great Lakes region and a new record for New York State. *Canadian Field Naturalist* 129(2):183–188.
- California Academy of Science and National Geographic Society. 2020. iNaturalist. <https://www.inaturalist.org>. (accessed December, 2020).
- Daniel, S. and Johnson, A. 2017. *Spiranthes ovalis* var. *erostellata* (Orchidaceae) new to New York. *Phytoneuron* 2017-72: 1–5. Published 25 October 2017. ISSN 2153 733X.
- Dueck, L.A., Aygoren, D., and Cameron, K.M. 2014. A molecular framework for understanding the phylogeny of *Spiranthes* (Orchidaceae), a cosmopolitan genus with a North American center of diversity. *American Journal of Botany* 101: 1551–1571.

- Glenn, S.C. (ed.) 2013. New York Metropolitan Flora database. New York Metropolitan Flora Project, Brooklyn Botanic Garden, Brooklyn, NY.
- Kartesz, J.T. The Biota of North America Program (BONAP). North American Plant Atlas. (<http://bonap.net/napa>). Chapel Hill, N.C. (maps generated from Kartesz, J.T. 2015. Floristic Synthesis of North America, Version 1.0 Biota of North America Program (BONAP). (in press).
- Kumar, S., Stecher, G., Li, M., Knyaz, C., and Tamura, K. 2018. MEGA X: Molecular Evolutionary Genetics Analysis across computing platforms. *Molecular Biology and Evolution* 35:1547–1549.
- Mishra, B. and Thines, M. 2014. siMBa—a simple graphical user interface for the Bayesian phylogenetic inference program MrBayes. *Mycological Progress* 13:1255–1258.
- National Center for Biotechnology Information (NCBI)[Internet]. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; [1988] – [cited 2020]. Available from: <https://www.ncbi.nlm.nih.gov/>
- Pace, M.C. 2015. Evolution, species boundaries, and biogeography of *Spiranthes* (Orchidaceae): Uncoiling Ames's "most perplexing orchid genus in our flora". Dissertation. University of Wisconsin-Madison.
- Pace, M.C. and K.M. Cameron. 2016. Reinstatement, redescription, and emending of *Spiranthes triloba* (Orchidaceae): Solving a 118 year old cryptic puzzle. *Systematic Botany* 41(4): 924–939.
- Pace, M.C. and K.M. Cameron. 2017. The systematics of the *Spiranthes cernua* species complex (Orchidaceae): Untangling the Gordian Knot. *Systematic Botany*, 42(4):1–30.
- Rambaut, A. 2018. FigTree v. 1.4.4, released 2018–11–25. <http://tree.bio.ed.ac.uk/software/figtree/>
- Ronquist, F. and Huelsenbeck, J.P. 2003. MRBAYES 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics* 19:1572–1574.
- Science Staff. 2020. Orchidaceae. New York Metropolitan Flora. <https://nymf.bbg.org>. (accessed Dec. 5, 2020).
- Shaw, J., Lickey, E.B., Schilling, E.E., and Small, R.L. 2007. Comparison of whole chloroplast genome sequences to choose noncoding regions for phylogenetic studies in angiosperms: The tortoise and the hare III. *American Journal of Botany* 94(3): 275–288.
- Sheviak, C.J. 1982. Biosystematic study of the *Spiranthes cernua* complex. New York State Museum Bulletin No. 448.
- Sheviak, C. J. and Brown, P.M. 2002. Orchidaceae, vol. 26, *Spiranthes*. In *Flora of North America* Editorial Committee [eds.], *Flora of North America north of Mexico*, 498, 499, 530, 537. Oxford University Press, NY. Available at: http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=131021 [accessed 2 December 2020].
- USDA, NRCS. 2020. The Plants Database (<http://plants.usda.gov>, 24 November 2020). National Plant Data Team, Greensboro, NC.
- Weldy, T., Werier, D., and Nelson, A. 2020. New York Flora Atlas. (original application development by S. Landry and K. Campbell, USF Water Institute, Univ. of South Florida). New York Flora Association, Albany, NY. [accessed 27 November 2020].
- Werier, D. 2017. Catalogue of the Vascular Plants of New York State. *Memoirs of the Torrey Botanical Society*, Vol. 27: 1–543.

APPENDIX 1.

GenBank accession numbers for samples used in this study: Taxon name, origin, GenBank accessions (ndhj-trnF).

- Spiranthes arcisepala*; Oneida Co., NY; MF460848.
- Spiranthes casei* var. *casei*; Hamilton Co., NY; MF460855.
- Spiranthes cernua*; Cape May Co., NJ; MF460859. 'Chadds Ford' (cultivated); White Flower Farm, CN; KU935563.
- Spiranthes incurva*; Orleans Co., VT; MF460869.
- Spiranthes lacera* var. *gracilis*; Pickens Co. SC; KU935566.
- Spiranthes laciniata*; Charlton Co., GA; KU935568.
- Spiranthes lucida*; NY; MH913382.
- Spiranthes magnicamporum*; Russell Co., VA; KU935578.
- Spiranthes ochroleuca*; Oneida Co., NY; MF460892.
- Spiranthes odorata*; Carteret Co., NC; KU935588. Onondaga Co., NY; MW140015.
- Spiranthes ovalis* var. *erostellata*; Giles Co., VA; MF460894.
- Spiranthes romanzoffiana*; Oneida Co., NY; MH913393.
- Spiranthes tuberosa*; Monroe Co., WV; KU935603

Join us for our virtual Annual Meeting & Speaker Series, 2021

Tentative Schedule:

March 30

My Three Decade Affair With the Ghost Orchid
Mike Owen - Biologist, Florida Department of
Environmental Protection

April 27

Orchids of the Plumas National Forest
Linnea Hanson - President, Northern CA Botanists;
USFS (retired); Secretary, NOC

May 25

Orchids of Madagascar
Rick Burian- World traveler; writer, NOC Director

June 15 (Annual Meeting)

Aggregated Pollen ... Why and Why Not?
Tatyana Livshultz, Ph.D. - Philadelphia Academy of
Natural Sciences

September 28

Seed Collection and Germination of Platanthera dilatata
Doug Martin, Ph.D. - Case Grant Chair & Linnea Hanson

October 26

*Protecting Cypripedium candidum and
Platanthera leucophaea in Illinois*
Cathy Bloome - Citizen Scientist; NOC member

November 23

*Where is Newfoundland &
Why Would a Botanist Go There Anyway?*
Bob Sprague - Vice-president, NOC

Meetings will be conducted via Zoom starting at 6 PM
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Organization registered as 501(C)(3)
with Federal EIN number 20-0216770

Native Orchid Conference Journal
registered with ISSN 1554-1169

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ISSN 1554-1169