

Mohonk Preserve, Inc.

Research Report

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Some Flowering Plants Which Lack Chlorophyll
in the Northern Shawangunks

(A Contribution to the Flora of the Northern Shawangunks)

by

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Introduction

Chlorophyll is one of the essential compounds utilized by most plants in the complex process of energy conversion (light to chemical) or photosynthesis, which for the most part occurs in leaves. It is also responsible on the aesthetic side for the basic green color in plants. It indicates an independent means of "energy" manufacture necessary for life. Some flowering plants, however, partially or completely lack chlorophyll and follow a parasitic or saprophytic mode of existence, using other plants or dead and decaying parts of plants in obtaining organic materials for their energy needs. Seed-bearing plant parasites generally are "organically united to and (are) more or less dependent" on another plant (host)" (Skene, 1924). Saprophytes on the other hand usually depend on "decaying organic matter... for a supply of carbon compounds" (Skene, 1924). These plants have much reduced, apparently functionless scale-like leaves.

In the Shawangunks, we have records of eight native species of plants belonging to four families that are parasites or saprophytes. They are:

Parasites

Convolvulaceae (Morning-glory Family)	
<i>Cuscuta gronovii</i> Willd.	Gold Thread Vine or Dodder
Orobanchaceae (Broom-rape Family)	
<i>Conopholis americana</i> (L.f.) Wallr.	Squawroot
<i>Epifagus virginiana</i> (L.) Bart. (parasitic or saprophytic)	Beechdrops
<i>Orobanche uniflora</i> L.	Broom-rape, One-flowered Cancer-root

Saprophytes (or partial parasites)

Ericaceae (Heath Family)	
<i>Monotropa hypopithys</i> L.	Pinesap
<i>M. uniflora</i> L.	Indian Pipe, Corpse-plant
Orchidaceae (Orchid Family)	
<i>Corallorhiza maculata</i> Raf.	Spotted Coral-root
<i>C. odontorhiza</i> (Willd.) Nutt.	Autumn Coral-root

Biology and Shawangunk Species Records

Review of the Mohonk Preserve Herbarium collection and card file records has revealed an interesting picture of the distribution, habitat, and abundance of these eight species. From this search, probably six species -- Squawroot, Beechdrops, Broom-rape, Pinesap, Spotted Coral-root and Autumn Coral-root -- should now be considered as rare.

Cuscuta gronovii Willd. - Dodder

The following discussion of the biology of this vining parasitic plant is from The Biology of Flowering Plants by Macgregor Skene, 1924 (pp. 235-236):

"The seed of *Cuscuta* germinates on the soil, usually, so far as European species are concerned, late in the spring, when other vegetation has sprouted, and young shoots of host plants are therefore available. The late germination may be determined by high temperature or light requirements. The root leaves the seed coat first and pushes slightly into the soil, from which it absorbs water. Cotyledons are absent or rudimentary. As the young shoot, a fine yellow thread, grows, it appears to creep forward on the soil. The tip is raised above the surface and circumnutates. If it fails immediately to meet a host it may grow forward for some time at the expense of the basal parts, which wither away, but it ultimately dies. Spisar (1910) found the maximum term of life without a host to be seven weeks in *Cuscuta Gronovii*; in smaller species it is less. If it meets a living plant it commences to twine round it, behaving in turn like a twining plant and like a tendril; that is, it alternates a series of loose elongated coils with a series of close tight ones. Peirce (1894) agrees with older investigators that the seedling dodder can only twine round living plants, though the mature parasite can twine round any support, living or dead. More recently, Mirande (1900) and Spisar (1910) have found that the seedlings of the small species, e.g. *C. Epithymum*, can twine round a dead object if it is moist, while seedlings of the large species, e.g. *C. Gronovii*, can twine indifferently on wet or dry, dead or living, supports. On the surface of the tight coils, in contact with the host, epidermal adhesive discs, attached by papillae which grow between the cells of the host, are formed in response to the contact stimulus. The papillae also function as absorbing organs. From these discs suckers are sent down into the host tissue, which is dissolved away by secreted enzymes. The suckers spread out inside the host; vascular tissue is formed and connects up with the wood and bast; prosenchymatous filaments penetrate the cortex and even the pith, and tap living cells.

The nature of these suckers is not clear. Some botanists regard them as modified adventitious roots, and in some species, e.g. *Cuscuta Europaea*, they are produced endogenously.

After connection has been made with a host growth is very vigorous. The stem passes from shoot to shoot, branching freely; the parasite may completely exhaust and smother the host plant, and may do extensive damage to crops of clover and flax. The little bunches of flowers are produced abundantly."

Cuscuta gronovii occurs quite commonly in the Shawangunks in moist soils - in many cases forming extensive masses of orange-colored "threads" on many host species. For example, it is common to abundant on Purple Loosestrife at Duck

Pond and at Brook Farm Pond. It first appears in Shawangunk records in "Flora of Mohonk" (1895) and Minnewaska's Flora (1896). In the early 1940s Dan Smiley recorded it as "rare," giving rise to speculation that it may have increased in frequency in the last 40 years. Specific locations of records are as follows:

24 July 1943 (1943)	Van Leuven Place Mossy Brook; Bonticou
2 June 1941	Elting Harp Lot (in bloom)
21 August 1968	Mossy Brook Path - <u>collected</u>
17 May 1975	Bonticou Lodge Pond
15 August 1979	Log Cabin (Mossy Brook) on Aster - <u>collected</u>
26 August 1979	Oakwood Drive, South of Rhododendron Bridge on Black- berry - <u>collected</u>
2 August 1984	Mohonk Garden - on Tansy - <u>collected</u>

Conopholis americana (L.f.) Wallr. - Squawroot
Epifagus virginiana (L.) Bart. - Beechdrops
Orobanche uniflora L. - Broom-rape

These three parasitic species (Figure 1) are members of the Family Orobanchaceae - the Broom-rapes. Macgregor Skene (1924, pp. 231-232) describes the family as follows:

"The seeds of the Orobanchaceae are minute, with an undifferentiated embryo embedded in an endosperm. Scattered by the wind, they are washed into the soil by rain, and germinate only in contact with living roots of host plants. A chemical effect must be involved, but of what nature we do not know. A filamentous embryo 1 mm. long is produced, in which only relative position distinguishes a root end from a shoot end; the latter remains in the seed coat, the former comes in contact with the host root and sends a sucker down to the wood. Vascular tissue then develops in the seedling, and an extremely intimate connection is made with the host, wood with wood, bast with bast, cortex with cortex, and epiderm with epiderm. The upper part of the seedling now grows into a tiny tuber with a lumpy surface, and the apical portion usually withers away. From this tuber arise adventitious outgrowths which extend to other host roots and produce secondary suckers. They arise exogenously, and, if a root cap is present, it is much reduced. They may, perhaps, be looked on as adventitious roots of an aberrant nature. The flowering stem arises as a rule singly and adventitiously from the tubers. Flowering stems may also arise from the adventitious roots. The plant may be annual or may take several years to produce its flowering shoot. After flowering it usually dies."

F. Schuyler Mathews (1927) reports that the flowers of these species are "visited by various flies and bees." The "upper flowers (of Beechdrops) are cross-fertilized by bees." Broom-rape is "cross-fertilized mostly by the smaller bees (Halictus) and the bumblebees."

The occurrence of each of these species in the Shawangunks is somewhat different due primarily to the presence of host species. For instance, Squawroot is found frequently in Oak woods. Mixed Oak woods are a dominant Shawan-

gunk slope forest cover type. Beechdrops, on the other hand, use the Beech (*Fagus grandifolia* Ehrh.) as the principle host, and is considered rare. Beech is a relatively infrequent species in the Shawangunks - occurring as widely scattered individuals or clones in the more northern-type habitats.

Specific Shawangunk records are as follows:

Conopholis americana - Squawroot

All of our present Shawangunk records of this species are from the east side of the mountain in mixed oak woods on shale substrate. The first record, and only collection, is from 26 May 1974 in the area of the Yellow Lady Slipper station along Oakwood Drive. Plants have been observed frequently on this slope from 1974 through this past growing season. Beginning in 1982 in the area of Chestnut Spring along Forest Drive several colonies have been observed. Nearby, along the upper Duck Pond Trail, plants were reported this year. A station near Bonticou Lodge was reported on 5 June 1986 by Mohonk Preserve Educator Ann Guenther.

In 1915, Norman Taylor (*Flora of the Vicinity of New York*) listed this species as "rare" - with stations known only from extreme southeastern New York.

Epifagus virginiana - Beechdrops

We have only three records of this species. The earliest is from 18 September 1931 in the area of the steep-sided stream gully southeast of Mountain Rest on shale substrate. Just over 50 years later, plants were observed and collected on 21 October 1981 on the east slope of Dickie Barre at about 900 feet in elevation (MSL) on shale substrate. By chance, on 17 December 1987 while on the Christmas Bird Count in the area of Farm Road at Duck Pond, two plants were discovered in a small beech stand.

Orobanche uniflora - Broom-rape, One-flowered Cancer-root

We know of five records of this species. The earliest reference is found in the "Flora of Mohonk" (1895). On 16 June 1946 plants were observed in the vicinity of Mohonk Spring. A plant was collected on 26 May 1968 north of the spring at Home Farm. On 29 May 1968 six (+) plants were noted at the same location. A second collection was made there in June, 1970. In the area of Duck Pond, a station was found west of the Brook on 30 May 1969. These stations are all on shale substrate. On 8 June 1974, Alice Jones reported discovery of a station along Eagle Cliff Road in the area of Lambdin's Glen. This area is on conglomerate substrate, however the exact location and relation to road and path shale is unknown. In the last 13 years we have had no observations of this species.

Monotropa hypopithys - Pinesap
M. uniflora - Indian Pipe, Corpse-plant

Although early investigators considered these species of the Heath Family (Ericaceae) as complete saprophytes, they recognized that "all saprophytes are symbiotic with mycorrhizal (sic) fungi which evidently play a part in their nutrition" (Skene, 1924). It is now known that some mycorrhizal associations can actually make these species parasitic. Douglass B. Elliott, in his book - Roots (1976) - describes the genus as follows:

"These fungi have remarkable associations with certain plants. The genus Monotropa, of which the ghostly Indian pipe is a member, lacks chlorophyll and depends entirely on a mycorrhizal fungus for its organic compounds. This fungus forms ectomycorrhizal association with nearby tree roots, links up endomycorrhizally with the roots of Monotropa, and transmits nutrients from the tree to the Monotropa. This makes Monotropa a parasite by proxy, sometimes called an epiparasite. Parasitic or not, it seems that each party benefits by the association! the trees in the ways mentioned previously, the Monotropa by receiving its essential nutrients, and the fungus, it is believed, by obtaining a growth promoting factor from the Monotropa.

In the Shawangunks, Pinesap is generally found in Oak woods, and as the records indicate is seen much less frequently than Indian Pipe. The latter is commonly found in coniferous and deciduous woods starting about the second week in July and persisting through October. Both species are associated with shale and conglomerate substrates.

Specific Shawangunk records of the genus Monotropa (Figure 2) are as follows:

Monotropa hypopithys - Pinesap

The earliest records of this species are found in "Flora of Mohonk" (1895), and Minnewaska's Flora (1896). The first photographic documentation was made on 10 July 1960 in Oak woods at "Bonticou." Another was made on 25 August 1960 in Oak woods at Rock Rift. The first collection was from north of Middle Mud Pond on 16 October 1969. Two other specimens were collected--one from the Smiley-George Vegetation Transect west of Oakwood Drive on 5 August 1971, and another from the area of the Trapps, west of the steel bridge over Route 44/55. The most recent observation was of a small colony at the southwest end of Rhododendron Swamp on 2 October 1987.

Monotropa uniflora - Indian Pipe

The earliest mention of this species is found in the 1892 article "Shongum," found in the journal Garden and Forest (Vol. 5:484) by M. H. Pike. Pike describes it in the vicinity of Minnewaska Lake, "unusually large and beautiful in shady places..." It is also found in "Flora of Mohonk" (1895), and Minnewaska's Flora (1896). More recent specific locations and annotations are as follows:

20 August 1959	Long Cedar - pink-colored ones seen. In bloom here on 20 October 1975
3 October 1960	Bonticou Camp - in bloom; had been a "year of abundance"
21 July 1968	Rhododendron Swamp - <u>collected</u>
20 August 1971 and 2 August 1972	South of Rosendale in Hemlock woods - <u>collected</u>
1972, 1974, 1975	Plants listed as "many" and "abundant" at various locations by Dan and Virginia Smiley. "After a very wet spring" ('72).
13 July 1982	Forest Drive at Home Farm
14 July 1983	Lower Laurel Ledge Road at Archaeological Dig
11 July 1984	Vicinity of Hermit's Hut
11 July 1986	Mohonk Spring
10 July 1987	Vicinity of Lake Minnewaska Golf Course; also along Old Stage Road

Corallorhiza maculata - Spotted Coral-root
C. odontorhiza - Autumn Coral-root

A number of species of orchids (about 50 of some 7000 worldwide) are to some extent saprophytic (complete or partial). All apparently harbor some mycorrhizal fungus associations. Skene (1924) reports that in the genus *Corallorhiza* (coral-roots) the "fungus occupies the external layers of the (root) cortex as a host region, and the middle layers are digestive; numerous hyphae pass into the soil." C. J. Hylander, The World of Plant Life (1936), reports that members of this genus are sometimes parasitic on roots.

Specific Shawangunk records of Coral-roots (Figure 3) are as follows:

Corallorhiza maculata - Spotted Coral-root

There are six locations where this species has been documented. The earliest historical record is found in the "Flora of Mohonk" (1895). On 20 August 1929 the species was recorded by Dan Smiley as observed by "'Happy' Davis on Terrace Drive." Alice Jones reported plants on Undercliff Road between stations #6 and #7. It was collected on the Smiley-George Vegetation Transect on 5 August 1971. On 12 July 1976 a plant was collected near the NOAA Mohonk Weather Box. On 8 August 1977 the species was noted on Spring Path at Forest Drive. The latest collection was of a large plant northwest of the Mossy Brook Pump-house on 24 July 1981. These observations and collections are mostly on shale substrate, or where there may be an influence from shale (ex. roadside).

Corallorhiza odontorhiza - Autumn Coral-root

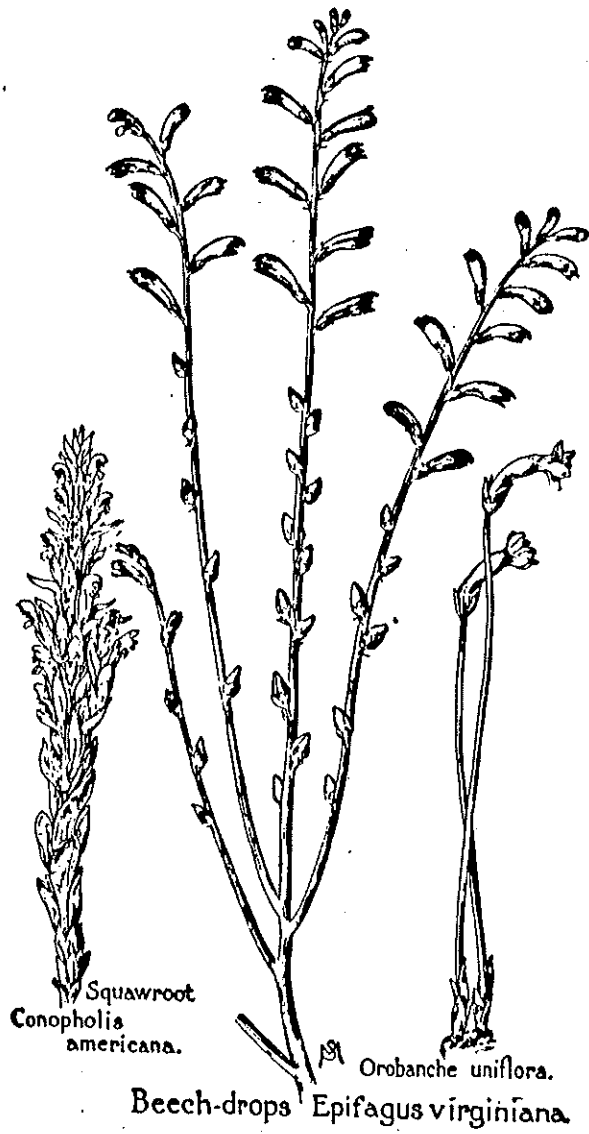
We have only one record of this species in the northern Shawangunks. This station was from west of the Trapps, on shale substrate. A plant was collected on 1 October 1969. We have no subsequent observations. McVaugh, Flora of the Columbia County Area (1958), suggests it is a calciphilous species. Mathews (1927) indicates the species prefers evergreen woods.

In the "Flora of Mohonk" (1895), a third species of Coral-root, C. striata Lindl. (= C. macraei A. Gray), Striped Coral-root, is listed. A New York State record of this species is reported from Monroe County in 1896 (House, 1924). The flower of this species is distinct enough to expect that its inclusion in the Mohonk list may be legitimate. Unfortunately, locations of these plants are unknown. It is also considered a calciphilous species.

Plant Uses

It is clear from a look at the colloquial names of several of the above species (ex. convulsion-root, cancer-root) that they have had medicinal uses (either alone or mixed with other plants). Some are listed in pharmacopoeias. One (Indian Pipe) has even been considered as an edible wild plant (par-boiled it was thought to taste like asparagus!).

Figure 1.



from: F. Schuyler Mathews
1927

Figure 2.

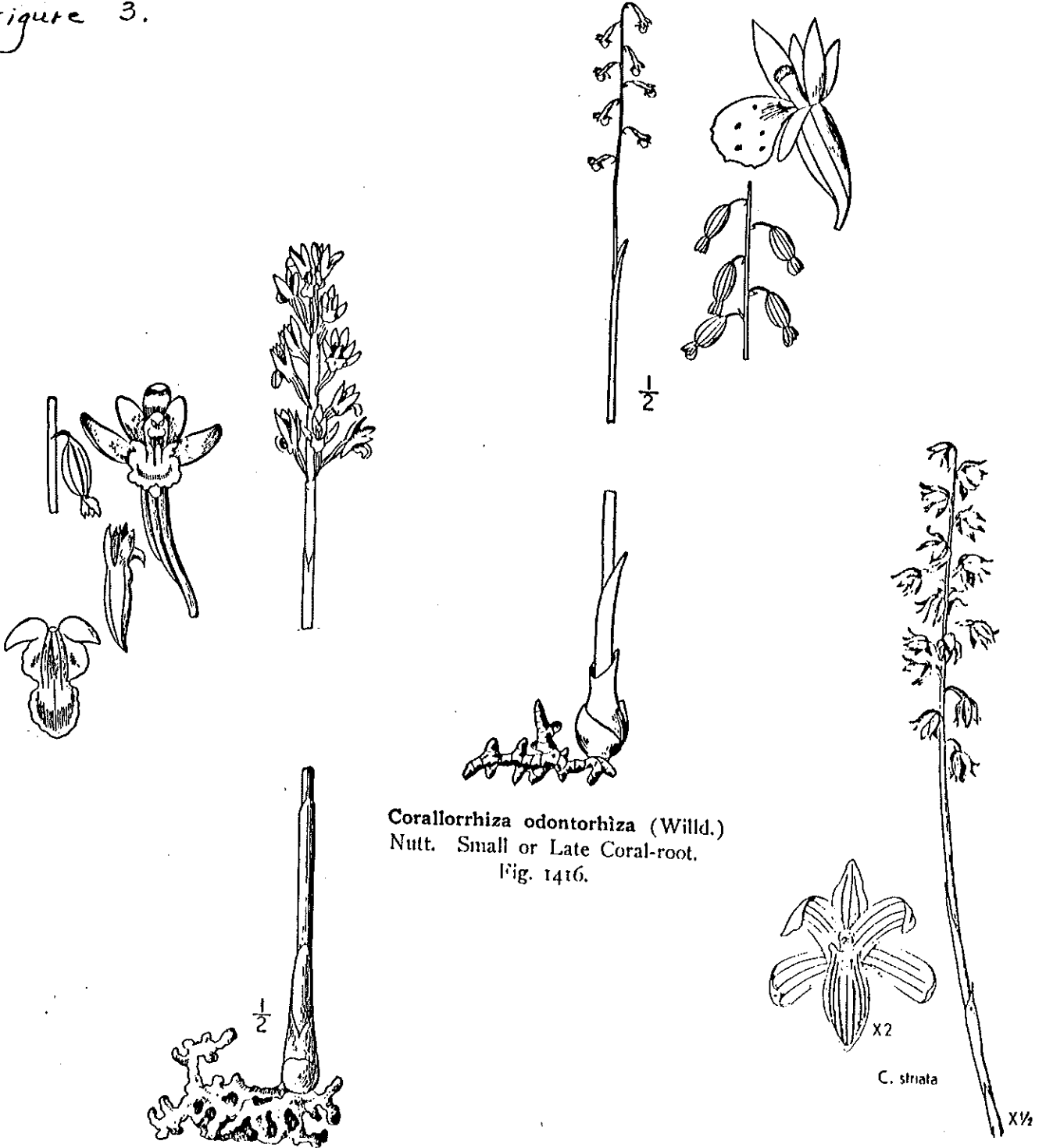


Indian Pipe.
Monotropa uniflora.

False Beech-drops.
Monotropa Hypopitys.

From: F. Schuyler Mathews
1927

Figure 3.



Corallorrhiza maculata Raf. Large
Coral-root. Fig. 1414.

from: Britton and Brown
1936 & 1963