Conservation Assessment
for
White Adder's Mouth Orchid (Malaxis B Brachypoda) (A. Gray) Fernald

Photo: Kenneth J. Sytsma

USDA Forest Service, Eastern Region

April 2003

Jan Schultz
2727 N Lincoln Road
Escanaba, MI 49829
906-786-4062

This Conservation Assessment was prepared to compile the published and unpublished information on Malaxis brachypoda (A. Gray) Fernald. This is an administrative study only and does not represent a management decision or direction by the U.S. Forest Service. Though the best scientific information available was gathered and reported in preparation for this document and subsequently reviewed by subject experts, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if the reader has information that will assist in conserving the subject taxon, please contact: Eastern Region, USDA Forest Service, Threatened and Endangered Species Program, 310 Wisconsin Avenue, Milwaukee, Wisconsin 53203.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

Outside Reviewers
We would like to thank our academic reviewers and agency reviewers outside of the United States Forest Service for their helpful comments on this manuscript.

Fred W. Case, botanist, author of *Orchids of the Western Great Lakes Region.*

National Forest Reviewers
We also thank our internal National Forest reviewers for their suggestions and corrections and for providing element occurrences from the respective National Forests. Jan Schultz (Hiawatha), Alix Cleveland (Huron-Manistee), Steven Spickerman and Steve Janke (Chequamegon-Nicolet) and Ian Shackleford (Chippewa / Ottawa).

Herbarium and Heritage Data
We appreciate the sharing of occurrence information for this species from Heritage personnel both in the United States and Canada, along with the helpful assistance from Herbarium personnel. (See Appendix C, Contacts, for a complete list).

Editorial Committee
We thank Jan Schultz, Hiawatha National Forest, for her suggestions and patience through numerous revisions.

Also appreciated was the editorial assistance of the following contract employees working with the Hiawatha National Forest:

Beverly Braden, contract botanist; Janet Marr, seasonal botanist; and Elizabeth Nauertz, Ecologist, North Central Research Station.

Literature Search
We thank Laura Hutchinson, North Central Research Station Library Services, for performing initial species inquires and sending us relevant research articles.

We thank Jan Schultz, Hiawatha National Forest, for use of her extensive library of materials to begin to compile information on this species.

We also thank Janet Marr, contract botanist, for additional literature searches at Michigan Technological University in Houghton.

Initial Draft
We are grateful to Janet Marr, seasonal/contract botanist on the Hiawatha, for her efforts in providing us with an original draft for this Conservation Assessment.

EXECUTIVE SUMMARY

Malaxis brachypoda (A. Gray) Fernald is considered rare throughout much of its range. It is a small, inconspicuous, one-leaved orchid that occurs in the Great Lakes region, New England, west from Newfoundland across Canada to British Columbia and southern Alaska, with disjunct populations in Colorado and California. *Malaxis brachypoda* is known to occur in four National Forests in the Eastern Region (Region 9) of the Forest Service (USDA 2000): Chequamegon-Nicolet (Wisconsin), Chippewa (Minnesota), Hiawatha (Michigan), and Huron-Manistee (Michigan).

In Wisconsin and Minnesota, *Malaxis brachypoda* is a state listed, special concern species. It is reported to occur in the state of Michigan, but it is not considered to be a species of concern and is not tracked. This species occurs in wetlands such as bogs, swamps, swales, and wet meadows, as well as in crevices of shady wet cliffs and ledges. It often grows in shaded areas, but occurs in the open as well. Some of the major threats to this species are hydrological disturbances and canopy removal due to logging.

Very little is understood about the life cycle, ecology, or population biology of *M. brachypoda*. Some information may be generalized with caution from other orchid species, including *M. paludosa*. More research needs to be done specifically on *M. brachypoda*, including the mycorrhizal association upon which it is dependent. Long-term monitoring of populations of this species and its habitat are needed to assess population viability and stability in order to help make wise management decisions.

INTRODUCTION/OBJECTIVES

One of the conservation practices of the United States Department of Agriculture (USDA) Forest Service is designation of Regional Forester Sensitive Species (RFSS). The Eastern Region (R9) of the Forest Service updated its Sensitive Species list on 29 February 2000 (USDA 2000). Part of that process included identification of priority species for conservation assessments and strategies. *Malaxis brachypoda* (A. Gray) Fernald, white adder's-mouth orchid, was one of those priority species. This species is listed as a Regional Forester Sensitive Species (RFSS) on the Hiawatha National Forest in the Upper Peninsula and the Huron-Manistee National Forest in the northern Lower Peninsula of Michigan. It is also a RFSS on the Chequamegon-Nicolet National Forest in Wisconsin and the Chippewa National Forest in Minnesota (RFSS 2000). This species is also listed as a RFSS in the Rocky Mountain Region (Region 2).

The objectives of this document are to:

1. Provide an overview of current biological, ecological, systematic, and other knowledge for this species.
2. Provide a summary of the distribution and status of this species, both range wide and within the Eastern Region of the USDA Forest Service.
3. Provide the available background information needed to prepare a subsequent Conservation Strategy.

NOMENCLATURE AND TAXONOMY

Scientific Name: *Malaxis brachypoda* (A. Gray) Fernald
Family: Orchidaceae; orchid family
Common Name: White adder's-mouth orchid
USDA Plant Code: MABR5
Synonyms: *Malaxis monophylla* (L.) Sw. var. *brachypoda* (Gray) Morris
Malaxis monophyllos (L.) Sw. var. *brachypoda* (A. Gray) Morris and Eames
Malaxis monophyllos (L.) Sw. subsp. *brachypoda* (A. Gray) A. Löve and D. Löve
Microstylis brachypoda A. Gray

Malaxis comes from the Greek word meaning soft or delicate, referring apparently to the leaves of that genus (Smith 1993). *Brachypoda* is a Greek word meaning "short-pedicilled" (Fuller 1933) or "short foot" apparently referring to the pedicel length (Wisconsin State Herbarium). In 1830, Lindley (Luer 1975) assumed that North American plants of this orchid were identical to *Microstylis* (*Malaxis*) *monophyllos* growing in Europe. However, in 1835, Asa Gray concluded that the North American plants differed enough from their European counterparts to warrant naming a new species, *Microstylis brachypoda*. One of the main differences between the European and North American plants is the degree of twisting of the pedicel. The North American plants have flowers whose pedicels are twisted 180° (resupinate) resulting in the lip being in the lowermost position in the flower. The flower of the typical variety of *Malaxis monophyllos* growing in Europe is twisted 360° so that the lip returns to the uppermost position in the flower (Ames 1938). In 1926, Fernald reinstated Gray's *Microstylis brachypoda,* considering it to be synonymous with *Malaxis brachypoda* (Fuller 1933; Ames 1938). Morris and Eames (1929) reduced *Malaxis brachypoda* to a variety of *Malaxis monophyllos* (= *M. monophyllos* var. *brachypoda*).

Current floras use the scientific name *Malaxis brachypoda* (Brown 1997; Chapman 1997), as does the USDA NRCS Plant Database. Other synonyms used in the literature include *Malaxis monophyllos* var. *brachypoda* (Luer 1975; Correll 1978; Gleason and Cronquist 1991; Smith 1993; Catling and Magrath 1997), and *Malaxis monophylla* var. *brachypoda* (Brackley 1985; Case 1987). *Monophyllos,* and not *monophylla,* is the correct epithet, as the specific epithet must agree in gender with the genus (rules of nomenclature). *Malaxis brachypoda* is the species name listed on the R9 Regional Forester List (USFS 2000), and is used throughout this conservation assessment (even when a particular cited work refers to one of its earlier synonyms).

DESCRIPTION OF SPECIES

There are about 250 *Malaxis* species worldwide, mostly in Asia and the East Indies (Catling and Magrath 1997). There are ten species of this genus north of Mexico in North America (Catling and Magrath 1997). The three species in the Great Lakes region are *Malaxis brachypoda, M. unifolia* Michx., and *M. paludosa* (L.) Sw. (Case 1987).

Malaxis brachypoda is a small one-leaved orchid that blends in with its surroundings. Case (1987) describes *Malaxis brachypoda* as "nonaggressive and noncompetitive." The description

below for *Malaxis brachypoda* is a composite of descriptions from various sources (Luer 1975; Smith 1993; Catling and Magrath 1997). Measurements are from Catling and Magrath (1997) unless otherwise noted. Measurements from Catling and Magrath (1997) are taken from the draft *Flora of North America* manuscript for the genus *Malaxis,* and as a result, some measurements may differ from those that will appear in the published volume (#26) of the *Flora of North America*.

Plant:	Glabrous, 3-30 cm.
Roots:	Few, fibrous.
Stems:	Swollen at stem base into a pseudobulb.
Leaf:	Leaf, ovate-elliptic, solitary (rarely 2), with a strongly sheathed base 1.5 - 9.5 cm long and 1.0 - 5.0 cm wide.
Inflorescence:	Elongate spicate raceme, 4.0 - 11.5 cm long and 0.4 - 0.9 cm wide at base (Smith 1993).
Flowers:	Up to 50 (Luer 1975), green or greenish white flowers; resupinate. Pedicellate ovaries are twisted 180° so lip is in lowermost position.
Floral bract:	Lanceolate, 1.5 - 2.0 mm long (Luer 1975).
Petals:	1.4 - 2.5 x 0.3 - 0.5 mm; very slender and reflexed.
Lip:	Lowermost, broadly triangular, 3-lobed [with two basal auricles (small lobes) and an abruptly narrowed tip].
Pedicels:	2.0 - 4.5 mm long
Ovary:	Short pedicel, about 2.5 mm long (Luer 1975).
Sepals:	Dorsal sepal 1.5 - 2.5 x 1 - 1.4 mm. Lateral sepals 1.5 - 2.5 x 0.5 - 1.2 mm
Column:	0.4 - 0.6 mm
Capsule:	Ascending, ellipsoid; 5.0 x 3.0 mm (Luer 1975).
Chromosome no.:	2n = 28

Identification notes: *Malaxis brachypoda* is similar to *Malaxis unifolia*. However, *M. brachypoda* has a very slender inflorescence and the apex of the lip is not toothed, while *M. unifolia* has a thicker inflorescence that is rounded or flat at the apex and has a lip that is 3-toothed (Voss 1972; Smith 1993). An immature *Malaxis brachypoda* or *M. unifolia* plant without a fully developed flower spike may be difficult to positively identify. Smith (1993) points out several other species that may be confused with *Malaxis brachypoda. Malaxis paludosa*, which *M. brachypoda* could be confused with, has two to five leaves; *M. brachypoda* has one leaf. *Listera cordata*, which can appear similar to *Malaxis brachypoda,* has a pair of opposite leaves as compared to the one leaf of *Malaxis brachypoda.*

There is a two-leaved form of *Malaxis brachypoda,* forma *bifolia* (Mousley) Fernald, in the northeastern United States (Brown 1997). Whiting and Catling (1986) found a plant of *Malaxis monophylla* forma *bifolia* in Ontario, Canada, with the second smaller leaf almost opposite the regular one. In Ontario, Canada, Reddoch and Reddoch (1997) observed that there was rarely a second leaf and there was always one leaf on plants that were not flowering. Voss (1972) points out that Fred Case collected a plant with two leaves in Michigan's Presque Isle County. Whiting and Catling (1986) discussed occasional occurrences of extra leaves on orchid species.

LIFE HISTORY

Much of the following information is from research done on *Malaxis paludosa* by Reeves and Reeves (1984, 1985) on a Minnesota population of this species found in 1981; the first seen in that state since 1938. Reeves and Reeves studies covered various aspects of the life history and reproduction of this species including pollinator exclusion studies, determination of flowering and fruiting periods, flowering production, and nectar production. Some of this information that applies to *M. paludosa* may or may not apply to *M. brachypoda*. There are morphological, physiological, chemical, and habitat differences between these two species, so caution must be taken in assuming whether or not a characteristic of *M. paludosa* applies to its relative *M. brachypoda*. For example, in *M. paludosa* the pedicillate ovary twists 360° back to its original uppermost position in the flower while *M. brachypoda* only twists 180° to the lowermost position (Ames 1938). This difference in lip orientation between the two species could result in differences in species of pollinator.

Seeds

In general, orchid seeds are very tiny (dust-like) and are dispersed by wind or water (Case 1987). Case (pers. comm.) notes that *Malaxis brachypoda* depends greatly upon reseeding for its survival. Some *Malaxis brachypoda* plants from the Ottawa District in Ontario/Quebec, Canada, released their orange-white seeds in early October (Reddoch and Reddoch 1997). Information about the length of time necessary for *Malaxis brachypoda* to progress from seed to flowering was not found in the literature. However, Case (pers. comm.) noted that if conditions are very favorable, plants of *M. brachypoda* might flower in as short a time as 1 – 3 years, or even less. If conditions are not as good, then flowering is likely to take longer.

Orchids need to produce a large number of seeds, as only a small proportion will probably find a suitable microhabitat (Catling 1980). According to Correll (1978), astronomers at England's Greenwich Observatory counted 3,770,000 seeds contained in a single capsule of a tropical orchid species. Reeves and Reeves (1984) counted 873 seeds in a single *Malaxis paludosa* capsule. Numbers of seeds per capsule will vary, even within a single species; depending on the vigor of that particular individual (Case 1987). No reports for seed counts in *Malaxis brachypoda* capsules were found.

Mycorrhizal relationship

Smith (1993) summarizes the symbiotic (mycorrhizal) relationship between orchid and fungus as follows: Fungal strands called hyphae enter an orchid seed's embryo before or in the early stages of germination and expel its contents. The orchid then absorbs these contents. This mycorrhizal relationship benefits the orchid, which lacks endosperm (stored food) in its seed. It is unknown whether or not the fungus benefits.

Following inoculation of the seed by the mycorrhizae, a protocorm forms and may survive for several years underground obtaining nourishment from the fungus. Under the proper natural

conditions, the orchid protocorm will send up a photosynthetic shoot and leaves. Although the mycorrhizal relationship may still remain, these structures produce most of the nourishment. No reports were found that identified the mycorrhizal fungi associated with *Malaxis brachypoda.*

Psuedobulb (corm)

Although *Malaxis brachypoda* reproduce by seed, the plant may also produce an annual shoot arising from a perennial corm (asexual). Case (1987) noted that corms of the past year are often still present. According to Case (pers. comm.), "it is not uncommon to find plants in early spring before growth, lying loose on the ground with the living pseudobulb attached to the old previous year's dead seed stalk." Case (pers. comm.) further noted that he has never seen the pseudobulb "embedded in living sphagnum, although sphagnum may be only a few inches away." Instead it occupies "neutral to alkaline microhabitats, and is either buried in muck, alkaline loving mosses, or perched atop the substrate of such."

An explanation of how an orchid can avoid being overgrown by its moss substrate is shown by the following example of *Malaxis paludosa*. Each spring, the withering *Malaxis paludosa* pseudobulb produces a new stem and leaves (Reeves and Reeves 1984). After flowers are no longer produced, a new pseudobulb develops on the new stem above the position of the old pseudobulb. This allows the plant to move upwards in its mossy substrate each year and not become deeply buried.

Zettler (1997) cited Gaddy (1983) and Gill (1996), who reported that *Isotria medeoloides* and *Cypripedium acaule* have been known to remain underground for several years. Case (1987) cited Summerhayes (1951), who suggested that this is perhaps due to unfavorable environmental conditions. Case (1987) also suggests that when an orchid reappears above ground after years of supposed dormancy, it is more likely that the original plant perished and the plant appearing above ground was from seed. Other reasons for not finding an orchid plant where it would normally annually appear is that the plant could have been damaged by frost, grazing, insects, or trampling. When the growing bud of a northern native orchid is damaged or destroyed by the aforementioned or other factors, then there is no further growth to that plant until its other now-dormant buds experience a prolonged cold period (vernalization), which breaks their dormancy (Case 1987). Case (pers. comm.) suggests that *Malaxis brachypoda* also may have this built-in dormancy factor; in which case, dormancy is caused by trauma to the growth bud and is not a typical "skip a season" behavior due to unfavorable environmental conditions.

Flowering

Flowering is indeterminate for *Malaxis brachypoda,* beginning with the lowermost bud and continuing up the inflorescence. This is also true for *Malaxis paludosa* (Reeves and Reeves 1984). Reeves and Reeves (pers. comm.) observed in Minnesota that both *Malaxis paludosa* and *M. unifolia* bloom one week before *Malaxis brachypoda* blooms. Reeves and Reeves (1984) noted that flowering one year in *Malaxis paludosa* was earlier than the previous year, perhaps due to a wetter spring and higher water table than usual. Fruit set times for both those years appeared to be unchanged. Although it is difficult to generalize, earlier flowering in wetter years might

apply to *Malaxis brachypoda* as well.

Reported flowering times:

- 5 June to 20 August, northeastern U.S.; (Brown 1997).
- 8 June to 29 July [average 23 June – 15 July (38 records)], Ottawa District in eastern Ontario/western Quebec, CA; (Reddoch and Reddoch 1997).
- Mid-June to mid-July, New Hampshire, U.S.; (Brackley 1985).
- Mid-June to late-July, Ontario, CA; (Whiting and Catling 1986).
- 20 June to 29 July, Minnesota, U.S.; (Smith 1993).
- 20 June to 1 August, Wisconsin, U.S.; (Fuller 1933; Orchids of Wisconsin, Web 2001).
- Third week of June to third week of July, a few into late August (fourth week of June to second week of July), northeastern U.S.; (Chapman, 1997).
- Late June to July, Maine U.S.; (Wallace 1951).
- June to August, British Columbia, CA; (Szczawinski 1959).
- Summer, North America north of Mexico; (Catling and Magrath 1997).

In their two year *Malaxis paludosa* study in Minnesota, Reeves and Reeves (1984) observed that flowering began in late June/early July and went until late July. About one week after the last flower opened in early August, all of the flowers' lips wilted which indicated that the flowers were no longer available to pollinators. However, the sepals and other two petals still remained green and continued to photosynthesize, perhaps an important contribution in such a small plant with tiny leaves. *M. brachypoda* and *M. unifolia*, which also grew at the study site, had flowers which did not last beyond the receptive period for pollinators.

Pollination

Reeves and Reeves (pers. comm.) suspect that the pollinator of *Malaxis brachypoda* is a moth due to various characteristics of the flowers. Others speculate that fungal gnats, and possibly small flies, are the pollen vectors for *M. brachypoda* (Brackley 1985). Brackley (1985) cited Nilsson (1979) reporting that "gnat flower" is the common name for the typical variety of *M. monophyllos* in Europe**.** "Based on the small size of the flowers, their color, and habitat, it is suggested that pollination of *Malaxis brachypoda* might be by fungus gnats" (Orchids of Wisconsin, Web 2001). As the buds swell in *Malaxis brachypoda*, the pedicels twist 180° to the left or right (Ames 1938), which orients the lip in the lowermost position (resupinate) likely providing a place for insect visitors to land (Correll 1978). According to Chapman (1997), most orchid lips secrete nectar that is eaten by pollinating insects. Flowers of *Malaxis paludosa* have a sweet smell and produce nectar at the base of the lip near the column base (Reeves and Reeves, 1984). According to Reddoch and Reddoch (1997), no fragrance was detected in *M. brachypoda* flowers in Canada.

Reeves and Reeves (1984) observed in their study of *Malaxis paludosa* pollinators in Minnesota, that in order for pollination and fruit set to occur, an outside pollen vector was necessary. Catling and Catling (1991) cited that Hagerup (1941) found the *M. paludosa* they had studied in Europe had obligate outbreeding. Catling (1983) defines autogamy as "self-pollination in the absence of animal pollinators followed by seed development, implying self-fertilization." Catling (1983)

noted no evidence of autogamy in his examination of Canadian plants of *M. brachypoda, M. unifolia,* and one of *M. paludosa* since the "rostellar tissue was sufficiently well developed to prevent the pollinia and the stigma from coming into contact." It seems likely that *M. brachypoda*, like *M. paludosa,* is not capable of self-fertilization and requires an external pollen vector for pollination.

As an insect probes for nectar in an orchid flower, the pollinia sticks to the insect and is carried to the next flower. Reeves and Reeves (1984) cited Darwin (1862), who reported that nearly all of the pollinia are taken from *M. paludosa* flowers, indicating that the flowers seem to be effective pollinator attractors. Reeves and Reeves (1984) also noted that almost all of the pollinia from *M. paludosa* flowers in their Minnesota study were gone by the end of the season. Although Reeves and Reeves (1984) observed various dipterans and even a mosquito (*Aedes* sp.) visiting *M. paludosa* flowers, they only saw a single fungus gnat (*Phronia digitata* Hackman (Diptera, Mycetophilidae) actually carrying *M. paludosa* pollinia.

Catling (1983), referring to orchids in general, suggests that some areas may have local races that are autogamous. An example of this might be found at range limits and disjunct sites where autogamy would offer a selective advantage. He suggests that further study is necessary throughout the range of an orchid species to determine if particular plants of that species may actually be autogamous in some geographical locations.

Capsules – Fruiting

Brackley (1985) and Reddoch and Reddoch (1997) suggest the light brown capsules of *Malaxis brachypoda* are easier to spot than the inconspicuous flowers. Also, the current year's capsules are quite a bit larger than the flowers (Minnesota County Biological Survey, 1998). The fruiting stem and capsules from the past year are often present during the current year's flowering of *Malaxis brachypoda* (Catling and Magrath 1997; Connecticut EOR #001).

Reddoch and Reddoch (1997) found that the flower to fruit yield was variable (average of 40%) when they looked at capsule production in 29 plants of *Malaxis monophylla* from the Ottawa District (eastern Ontario/western Quebec, CA). In their two-year study of *Malaxis paludosa*, Reeves and Reeves (1984) determined that there was a high degree of fruit loss (39.22% in the first year and 34% in the second) due to predation, probably by rodents and insects. No studies were found on predation rates for *Malaxis brachypoda* fruits.

HABITAT AND ECOLOGY

Elevation

Malaxis brachypoda occurs at various elevations throughout its range. In the U.S. it is reported to occur at up to 2743 m (= 9000 ft) in California (Correll 1978) and 2463 m (= 8080 ft) in Colorado (Jennings 1989). It occurs up to 168 m (= 550 ft) in Vermont (Correll 1978) and 231 m (= 760 ft) in Connecticut (Connecticut EOR #004, Appendix B).

Soils

Case (1962), referring to orchid species in general, noted that the main factors that assure their survival are soil that is acid or sterile enough to prevent soil fungi from taking over the plant and its symbiotic mycorrhizae, and the absence of competition. *Malaxis brachypoda* occurs mainly in "circumneutral, more or less calcareous swamps" (Correll 1978), and is listed as a "typical species of drier, more acidic, usually old beach ridges or low dunes… growing usually in superficial layers of sphagnum moss overlying alkaline soils" (Case 1987). In the western Great Lakes region it occurs in "cold, wet soils, mainly neutral in reaction and usually shaded" and "although it occurs in many sphagnous-acid situations, it does not grow in strongly acid soil, but rather in pockets or 'microhabitats' of neutral reaction" (Case 1987). In swamps of *Thuja*/*Abies*/*Picea*, *M. brachypoda* occurs over marly soils, growing with mosses or sedges (Case 1987). Case (pers. comm.) noted that *M. brachypoda* does not occur in "pot-hole peaty sphagnum bogs or on sphagnum mats surrounding glacial pothole lakes, in soils called on soil-survey maps 'Greenwood Peat'. Such peats are entirely too acid for this plant." Fuller (1933) noted that *M. brachypoda* is found in bogs and moist woods in minimacid soil.

Moisture

Correll (1978) contends that the most critical factors that determine the distribution and survival of all orchid species are moisture and temperatures, although soil and topography are influential as well. Many orchids occur so frequently in the wettest of bogs that it is natural to assume they require large amounts of water. Yet these same species sometimes grow in damp sand or even on dry sand dunes. Bogs are the most important habitat for native orchids (Fuller 1933). Often they frequent the bogs not for the water, but for the sterile, acid conditions of the soil in these areas (Case 1962). According to Case (1987), many orchids and other species occurring in dune/shoreline ridges (habitat for *Malaxis brachypoda*) and adjacent habitats in the western Great Lakes region "seem indifferent to the amount of water present provided the pH, humus, and competition requirements are met."

The U.S. Fish and Wildlife Service (1988) has classified *Malaxis brachypoda* as a facultative wetland plant in the United States, a plant species that "usually occurs in wetlands (estimated probability 67% - 99%), but is occasionally found in non-wetlands" (US Fish and Wildlife Service, 1988). According to the USFS (2000), in USFS Region 9, *Malaxis brachypoda* occurs in cedar swamps, wet conifer or hardwood (black ash) along with black spruce and tamarack, and often in peat. It may require a "certain proximity to water." It is often found at the base of hummocks, near water, however, this species is probably "not enhanced by fluctuations in water levels." In a Minnesota cedar swamp, plants were found in pools located at the base of a steep incline surrounding the swamp [USFS (2001b) cited in Minnesota County Biological Survey, 1998]. Case (1987) mentions that *Malaxis brachypoda*, in the Great Lakes region, often occurs in the "very wettest deer trails."

Temperature

Case (pers. comm.) contends that cool soil is a more critical factor than shade in the habitat of *Malaxis brachypoda.* In the Great Lakes region, the necessary soil temperature is "best met in shaded habitats cooled by extensive evaporation. That water, per se, is not the main requirement can be seen from the fact that the plant occasionally occurs in upland habitats, on shaded cliffs, on north facing sand banks and enclosed dunes woods close to Lake Superior in habitats that are much drier than bogs."

Correll (1978) states that *Malaxis brachypoda* is "completely winter hardy**"** and is not tolerant of soil warming in summer. Reeves and Reeves (1984) noted that *M. paludosa* is covered by several feet of snow during Minnesota's winter months which likely protects the plants from temperatures as low as -40° C. This is undoubtedly true for *M. brachypoda* in Minnesota and other states with snow cover throughout the winter.

Habitats

The habitats of *Malaxis brachypoda* are listed below by region, state, country, or province. Additional habitat information can be found in Appendix B (EO records and reports).

United States

Western Great Lakes Region

Malaxis brachypoda is associated with a variety of forest types ranging from northern wet-mesic forest to mixed conifer-cedar-black ash swamps (Appendix B). It is usually found under closed canopy (over 50%) and acid or rich soils (USFS 2000). Case (pers. comm.) points out that in the western Great Lakes region, *Malaxis brachypoda* grows mostly in treed fens, which are commonly called "cedar swamps" in the region. These are dominated by *Thuja occidentalis* with *Abies balsamea*, *Larix laricina*, and *Picea mariana*, and also include small open glades. "Ground cover in these swamps is often a shallow cover of various *Sphagnum* moss species, but with other moss species interspersed, especially in the wetter areas. Underlying soils are highly organic, decomposed humus mixed with black or white marl mineral solid. While the sphagnum moss may be acidic, most of the underlying material is in the neutral to alkaline pH range." Case (1987) notes that *M. brachypoda,* in addition to growing in moss, may grow amongst sedges.

Case (pers. comm.) explained, "Preferred habitat *for Malaxis brachypoda* is mostly in heavily shaded portions of these cedar swamps although it can occur in fully exposed open sunlight as well, especially northward. It shuns competition from other vegetation and grows often where the soil has recently been disturbed, as on crumbling logs, wash and muck deposit areas along streams or when muck has boiled up from below after downpours. A favorite location for the plant is in and on the edges of well-worn deer trails through deep shade. Its common occurrence in deer trails or their edges, at the high

water mark of springtime puddles in the swamp, and on deteriorating logs, suggests that the plant's seed germination is favored in such spots by the raw conditions without competing vegetation." According to Case (1987), "the simplest way to locate this diminutive plant for the first time is to search in the very wettest deer trails or rabbit runs, or in very wet wells about the roots of old cedars for it thrives in such situations."

In addition to cedar swamps, Case (1987) points out that, if borders are wet enough, *Malaxis brachypoda* sometimes occurs in hardwood margins of coniferous swamps and along streams or on edges of mossy springs. Habitats where *M. brachypoda* occur in the northerly Great Lakes region include dry non-deciduous woods, wet sandstone ledges, and damp cliff crevices. Elsewhere in the North, Case (pers. comm.) notes that it occurs in swamps on "hillside seep areas, and as stream headwater areas or flood plain swamps." Case (1987) included *Malaxis brachypoda* on a list of species typical of "drier, more acidic, usually wooded old beach ridges or low dunes; if found in wetter situations it usually grows in superficial layers of sphagnum moss overlying more alkaline soils. These species grow most often in shade or filtered sunlight."

National Forests in Michigan, Wisconsin, and Minnesota

There is one occurrence on Michigan's Huron-Manistee National Forest in Ogemaw County in Maltby swamp under cedar (A. Cleveland, pers. comm.). There are three other occurrences within the Huron-Manistee Forest in Alcona, Oscoda, and Manistee (historical data, 1880) counties (Voss, University of Michigan Herbarium specimens). On the Hiawatha National Forest in Michigan's Upper Peninsula, *M. brachypoda* has been found in Alger County in Dukes Research Natural Area, at six sites in Mackinac County near Moran and near Hessel (1992-1999), several occurrences in the Trenary area, and another at Peninsula Point in Delta County (Hiawatha National Forest TES Plant Atlas).

On the Chequamegon-Nicolet National Forest, *Malaxis brachypoda* typically occurs in coniferous woods which are frequently cold, wet, shady, and moss-filled; mixed conifer-hardwood forests; and *Thuja* or *Larix* swamps (USFS 1999 cited Judziewicz 1983). *Malaxis brachypoda* is documented on the Chequamegon-Nicolet National Forest in Oconto and Taylor counties. It occurs in wet cedar, tamarack, and spruce swamps. On the Chequamegon-Nicolet National Forest, abundance and distribution is listed as being at moderate risk, while population vulnerability is listed as high risk because of its scattered distribution leading to poor reproductive potential (USDA FS Risk Factors, 1999). The Chequamegon-Nicolet National Forest has documented occurrences in Florence and Forest counties as well, although these counties do not show as occurrences on the Wisconsin Herbarium maps.

There are 24 known locations on the Chippewa National Forest, mostly in cedar swamps. It is not known to occur on the Superior National Forest (Shackleford, pers. comm.).

65% (34 of 52) of the EOs listed for Wisconsin, and 54% (41 of 76) of the EOs listed for Minnesota specifically mentions cedar as a habitat component (Appendix B). Michigan

does not track *Malaxis brachypoda*.

Great Lakes States

Michigan

The Michigan Natural Features Inventory does not track the occurrences of *Malaxis brachypoda* as it is not a State listed or a special concern species. Voss (1972) noted that *Malaxis brachypoda* is reported for 27 Michigan counties; it is "local, and seldom noticed. It occurs in mixed woods and swamp forests (often on hummocks or mossy logs), coniferous swamps and thickets by shores, jack pine and mixed woods on sandy soil along Lake Superior dunes, boggy places (seldom on sedge mats), especially along trails."

In Washtenaw County, which is near the southern border of Michigan's Lower Peninsula, Case (pers. comm.) has observed a few scattered plants of this species "under shrubby willow bushes in a highly disturbed *Larix* fen" growing in moss (not *Sphagnum*) at bases of willow. In Newaygo County, a county in the western-central part of the Lower Peninsula, Case (pers. comm.) has noted this species in "mucky areas along banks of disturbed cedar swamps" rarely occurring in moss. Case (pers. comm.) notes that *M. brachypoda* occurs in most of the cedar swamps in 15 counties in the northern part of the Lower Peninsula.

In Mackinac County, in Michigan's Upper Peninsula, Case (pers. comm.) notes that *Malaxis brachypoda* is infrequent in "many of the interdunal cedar swamps and fens from Gros Gap eastward to Detour, especially in the older cedar thickets." Case (pers. comm.) has seen this species in wooded cedar swamps on either side of M-28 in Luce, Alger, and Schoolcraft Counties as well. More specific sites noted by Case (pers. comm.) for this species in the Upper Peninsula are included in Appendix B.

At Pictured Rocks National Lakeshore, this species occurs in moist mixed woods (Chadde 1996). On Isle Royale National Park, this orchid grows among sedges in bogs and in the margins of moist swamps and lakes (Johnsson 1963).

Minnesota

In Minnesota, Smith (1993) notes that *Malaxis brachypoda* is "typically on *Sphagnum* hummocks in coniferous swamps, under white cedar (*Thuja occidentalis*), black spruce (*Picea mariana*), or tamarack (*Larix laricina*). It is also found growing in peat soil in hardwood swamps." Shubat and Walton (1997) include *Malaxis monophyllos* var. *brachypoda* as a rare plant in the Minnesota Arrowhead region. They note that it "inhabits damp woods, conifer swamps and bogs usually of a calcareous nature. Also in woods near shores."

Reeves and Reeves (1985) reported that at one site in Minnesota there are three *Malaxis* species: (*M. monophyllos = M. brachypoda, M. paludosa*, and *M. unifolia*) occurring

together. This was the only known North American site, at least in 1985, where these three species occurred in the same place. In the Great Lakes region, Case (pers.comm.) noted that, although *M. brachypoda* and *M. unifolia* sometimes occur in the same bog, *"M. unifolia* prefers strongly acid substrates and grows up on acidic rotting logs in sphagnum and such, while *M. brachypoda* never does." In addition, *M. unifolia* tolerates a wide range of soil temperatures occurring from north of Lake Superior south to Cuba, while *M. brachypoda* does not occur in warmer climates or soils. Case (pers. comm.) also noted that the habitat of *Malaxis brachypoda* differs from that of *M. paludosa* as well. *Malaxix paludosa*, mostly a more northern species, occurs in more open areas than *M. brachypoda.* Case (pers. comm.) observed that another orchid species, *Platanthera obtusata*, unlike *M. unifolia* and *M. paludosa,* occurs regularly with *M. brachypoda* and has a similar distribution.

Fifty-four percent (41 of 76) of the EO records listed for Minnesota (Appendix B) specifically mention cedar as a habitat component. In addition, 26% (20 of 76) of the EO records listed for Minnesota includes lowland or mixed conifer swamp in the habitat description, while 26% (20 of 76) include a description of being on the edge of a lowland to upland transition, a pool, or a riverbank (Appendix B).

Site description information: Compiled from the Minnesota Natural Heritage Program EO data (cited in USFS 1999) and EO records for U.S, Appendix B. The typical habitat for this species is in bogs on *Sphagnum* mats under *Thuja* and *Abies* trees. *Sphagnum* or other mosses are typical and abundant in most sites with *Malaxis brachypoda.*

1. Composition of the overstory: a tree canopy of lowland and/or hardwood conifers generally shades sites. Species primarily include *Thuja occidentalis, Fraxinus nigra, Abies balsamea, Picea mariana,* and *Acer rubrum*.

2. Composition of the shrub/understory: *Alnus incana, Acer spicatum, Ledum groenlandicum, Lonicera villosa, Rubus pubescens, Cornus canadensis, Mitchella repens, Linnaea borealis.*

3. Composition of ground flora:

   Dicots: *Mitella nuda, Asarum canadense, Caltha palustris, Halenia deflexa, Scutellaria galericulata, Trientalis borealis, Coptis trifolia, Aralia nudicaulis, Saxifraga pensylvanica, Aster puniceus, Smilacina trifolia, Pyrola asarifolia, Impatiens capensis, Thalictrum dioicum, Aralia nudicalis.*

   Monocots: *Platanthera orbiculata, Platanthera obtusata, Platanthera hyperborea, Carex intumescens, Carex leptalea, Arisaema triphyllum, Liparis loeselii, Listera cordata, Malaxis unifolia, Cypripedium reginae, Cypripedium calceolus var. parviflorum, Corallorhiza trifida, Goodyera repens, Clintonia borealis, Maianthemum canadense.*

Ferns and fern allies: *Lycopodium lucidulum, Onoclea sensibilis, Athyrium filix-femina, Botrychium virginianum, Equisetum scirpoides, Dryopteris cristata, Gymnocarpium dryopteris, Osmunda cinnamomea, Osmunda regalis.*

Wisconsin

According to the Heritage Program element occurrences from Wisconsin (cited in USFS 1999), populations of *Malaxis brachypoda* grow in wet conifer woods in ± closed canopy of often 50% or higher. This orchid often occurs on the lower parts or sides of mossy hummocks or right above water-filled pools and on the shaded ground of conifer swamps.

Sixty-five percent (34 of 52) of the EO records listed for Wisconsin specifically mentions cedar as a habitat component (Appendix B). Many of the EO records have lowland, low woods, wet woods, bog, and mixed conifer swamp included in their habitat description (Appendix B).

Sixteen counties in Wisconsin have EO records for *Malaxis brachypoda* (EOR, U.S. and Canada, Appendix B). According to the Wisconsin State Herbarium, *M. brachypoda* is known from 13 counties within the state; 8 counties (17 occurrences) are along the shore of Lake Michigan. The other five counties have one to two known occurrences each and are more scattered in distribution.

Site description information: Compiled from the Wisconsin Natural Heritage Program EO data (September 24, 1999 cited in USFS 1999) and EO records for U.S, Appendix B. The typical habitat for this species is in bogs on *Sphagnum* mats under *Thuja* and *Abies* trees. *Sphagnum* or other mosses are typical and abundant in most sites with *Malaxis brachypoda.*

1. Composition of the overstory: a tree canopy of lowland and/or hardwood conifers generally shades sites. Species primarily include *Thuja occidentalis, Larix laricina, Abies balsamea, Picea mariana,* and *Acer rubrum.*

2. Composition of the shrub/understory: *Rubus pubescens, Cornus canadensis, Alnus incana, Alnus rugosa, Acer spicatum, Betula pumila, Gaultheria hispidula, Gaultheria procumbens, Rhamnus alnifolia, Vaccinium oxycoccos.*

3. Composition of ground flora:

Dicots: *Symplocarpus foetidus, Circaea alpina, Coptis trifolia, Aralia nudicaulis, Laportea canadensis, Trientalis borealis, Mitella nuda, Pyrola secunda, Caltha palustris, Smilacina trifolia, Menyanthes trifoliata, Saxifraga pensylvanica, Moneses unifolia, Polemonium occidentale, Valeriana sitchensis, Drosera rotundifolia.*

Monocots: *Malaxis unifolia, Platanthera dilatata, Platanthera obtusata,*

Platanthera hyperborea, Listera cordata, Amerorchis rotundifolia, Arethusa bulbosa, Cypripedium reginae, Clintonia borealis, Goodyera repens, Maianthemum canadense, Carex disperma, Smilacina trifolia.

Ferns and fern allies: *Osmunda cinnamomea, Osmunda regalis, Onoclea sensibilis, Dryopteris cristata, Thelypteris palustris, Botrychium virginianum, Gymnocarpium dryopteris, Lycopodium lucidulum.*

Western United States

California

Malaxis brachypoda has been found in two counties in SE California, San Bernadino and Riverside [http://www.calflora.org/ (Accessed: Dec 20, 2002)]. Hickman (1993) notes that in California, *Malaxis brachypoda* occurs in wet meadows, shady sites, and coniferous woods between 2200-2700 m in elevation.

Colorado

Malaxis brachypoda is a Regional Forester Sensitive Species in Region 2. It occurs in Colorado along shaded streams in mosses and is kept moist by stream spray [Steve Tapia, Region 2, (pers. comm.) cited Ryke *et al*. 1994; updated 1999].

Northeastern United States

Fernald (1950) described the habitat of *M. brachypoda* in the northeastern U.S. and adjacent Canada as "damp calcareous gravels, talus, peats, swales, and bogs." Gleason and Cronquist (1991) describe it as "damp woods and bogs." Brown (1997) described the habitat of *Malaxis brachypoda* in New England, New York, and adjacent Pennsylvania and New Jersey, as northern white cedar swamps and thickets, cool mossy bogs, fens, calcareous ledges and seeps, and wet ledges on marble outcrops. Chapman (1997) notes its habitat in the northeastern U.S. as "moist and shaded woodlands, often near flowing water."

Connecticut

The extant occurrences of this species occur in mucky substrate of a brook and springs and in a seepage swamp (Connecticut EO records, Appendix B).

Maine

Malaxis brachypoda occurs in "damp, calcareous gravels, talus, peats, swales, and fens (forested wetland)" according to the Maine Department of Conservation (2000) and moist shaded woods, *Thuja* swamps, and river flats at alkaline sites (Wallace 1951).

Massachusetts

Malaxis brachypoda occurs in shady wet areas such as swamps and bogs, usually growing in sphagnum moss, with little else. It also favors "coniferous forested fens and peatland communities dominated by coniferous trees and influenced by highly calcareous water" (Massachusetts Natural Heritage Program).

New Hampshire

Malaxis brachypoda has been found in a transitional hardwood/softwood forest on a rock edge near a vernal stream, and historically in bogs in New Hampshire (New Hampshire EO records, Appendix B).

Pennsylvania

At one site in Pennsylvania, *Malaxis brachypoda* occurs in a coniferous/deciduous swamp in a *Sphagnum*-filled depression (Steve Grund, 2001, pers. comm., Pennsylvania Natural Diversity Inventory - West).

Canada: *Malaxis brachypoda* occurs in moist woods and bogs (mainly calcareous) (Scoggan 1978).

Alberta

Malaxis brachypoda occurs on banks, in bogs, and in moist woods (Argus and White 1978), including balsam-aspen stands (Moss 1932).

British Columbia

According to the Illustrated Flora of British Columbia (Volume 7, 2001), *Malaxis brachypoda* may be found in moist forests, mudflats, fens, stream banks in the lowland and montane zones; rarely on the coast or in north British Columbia (B.C.). It may occur in shaded areas, edges of mountain streams, wet cliff crevices, moist cool woods, bogs, and muskegs (Szczawinski 1959). Szczawinski (1959) reported that it has even been collected on mud flats at tidewater. Although most of the occurrences are along the coast, *Malaxis brachypoda* occurs 250 miles inland, in wet moss at the edge of a large hot spring-fed shallow pool (Kott and Kott 1974) in a *Larix laricina* fen area (Kott & Kott 1974 cited Porsild & Crum 1961). It probably occurs there because of similarities in climate (warmer temperatures and more humidity) with the coastal areas (Kott & Kott 1974).

Case (pers. comm.) said, "At Liard Hot Springs, northern British Columbia on the Alaskan Highway near the Yukon border, it grew in some numbers in full sunlight on mossy tufts in an extensive warm-springs marly fen. But it occurred in areas where the warm water had cooled to that normal for the latitude."

Manitoba

Malaxis brachypoda occurs in a black spruce bog (Johnson 1981).

New Brunswick

This orchid species occurs in *Thuja* stands, sprouting from rotting logs (Low Impact Forestry, Web 2001).

Newfoundland

Case (pers. comm.) observed *Malaxis brachypoda,* which was not common, growing in a *Larix-Picea mariana* fen with *Cypripedium reginae* among bushes of *Potentilla fruticosa*.

Nova Scotia

Maher *et al.* (1978) reports that *Malaxis brachypoda* occurs in wet mossy sites.

Ontario

In the Ottawa District of eastern Ontario and western Quebec, *Malaxis brachypoda* occurs in shaded, moist/wet swamps and low woods (Reddoch & Reddoch 1997). Most calcareous swamps dominated by *Thuja occidentalis* and *Fraxinus nigra* have at least a few individuals of this orchid. *M. brachypoda* also occurs in swamps dominated by *Acer saccharinum*. In swamps, its pseudobulbs are embedded in leaf mold or in moist/wet organic soil, frequently with mosses. Only a few plants of this orchid species occur in fens correlating with rock that is calcareous (Reddoch & Reddoch 1997). Reddoch and Reddoch (1997) sometimes found it growing in association with *M. unifolia*, in which case, *M. brachypoda* occurred more often in lower and moister areas than *M. unifolia*. *Malaxis brachypoda* occurs in coniferous fens with mosses, especially in calcareous sites (Whiting and Catling 1986). Morris and Eames (1929) found this species growing on a wall of liverwort and in a moss-covered ditch that had been cut through a peat bog in order to drain the moisture away.

Typical associated species are: *Osmunda cinnamomea, Gymnocarpium dryopteris, Arisaema triphyllum, Corallorhiza trifida, Cypripedium reginae, Platanthera hyperborea, Mitella nuda, Tiarella cordifolia, Geum rivale, Oxalis acetosella, Moneses uniflora, Orthilia secunda,* and *Linnaea borealis*. *Malaxis brachypoda* also sometimes occurs in moist/wet sites in *Salix* swales, *Alnus incana* var. *americana* thickets, stream edges, and on drier sites in moist coniferous and mixed forests (Reddoch & Reddoch 1997).

Quebec

Morris and Eames (1929) reported finding *Malaxis brachypoda* "in a moist but open

meadow in full sun" on the Island of Bonaventure off the shore of the Gaspé Peninsula, Canada. See the description under Ontario for occurrences of *Malaxis brachypoda* in the Ottawa District (eastern Ontario and western Quebec).

Translated from de Repentigny (1978), *Malaxis brachypoda* occurs at the limit of extreme tides at Cabbage Willows Bay, which is at the south end of James Bay, and is a plant of moist places. Its associated species are: *Menyanthes trifoliata* L., *Potentilla palustris* (L.) Scop., *Calamagrostis neglecta* (Ehrh.) Gaertn., Mey. & Scherb., *Carex paleacea* Wahl., *Pedicularis macrodonta* Richards et *Galium trifidum* L. According to Marie-Victorin (1947), this species occurs in moist woods, peat bogs, and coastal meadows.

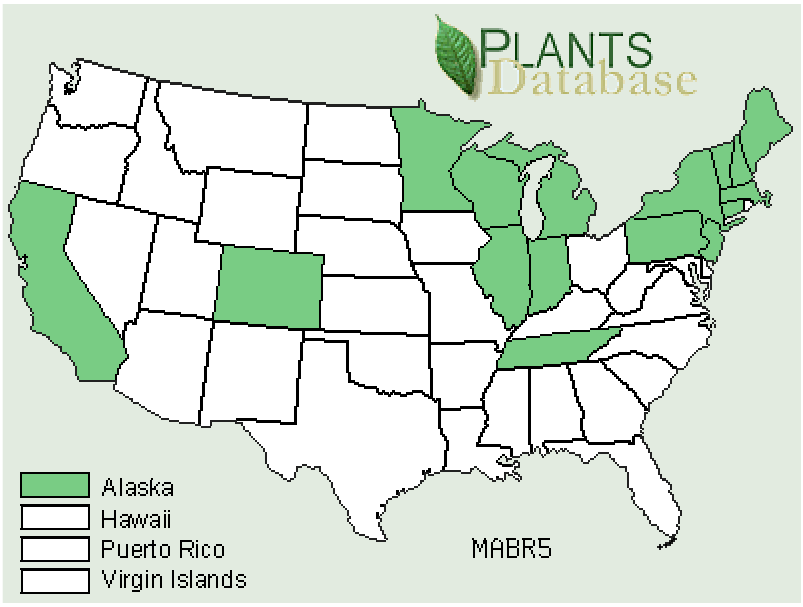
Saskatchewan

In Saskatchewan, *Malaxis brachypoda* occurs in "moist to wet black spruce-larch boggy woods and treed bogs, or wet peaty sedge-fens" (Harms 1984).

DISTRIBUTION AND ABUNDANCE

Malaxis brachypoda occurs in the Great Lakes region, New England, and west from Newfoundland across Canada to British Columbia and southern Alaska, with disjunct populations in Colorado, California, and Japan (Illustrated Flora of British Columbia, 2001). In the United States, *Malaxis brachypoda* occurs in or has been reported in Alaska, California, Colorado, Connecticut, Illinois, Indiana, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Pennsylvania, Tennessee, Texas, Vermont, and Wisconsin (NatureServe 2000). Catling and Magrath (1997) do not list it for Tennessee, Texas, Connecticut, and New Jersey. See the discussion below for occurrences in each of these states, in addition to Illinois, and Indiana.

US range map from USDA NRCS Plants Database
(http://plants.usda.gov/cgi_bin/topics.cgi)



© Image generated using gd 1.8

Plant Distribution by State

***Malaxis brachypoda* (Gray) Fern.**

MABR5

See county distributions for the following states by clicking on them below or on the map.

CA* IL WI*

* Offsite source.

Alaska	Connecticut	Maine	Minnesota	New York	Vermont
California	Illinois	Massachusetts	New Hampshire	Pennsylvania	Wisconsin
Colorado	Indiana	Michigan	New Jersey	Tennessee	

According to Case (1987), in the western Great Lakes region, *Malaxis brachypoda* is "always local or spotty" and "plants are scattered, seldom in clumps." Case (pers. comm.) states that when they do appear in groups, the clumps may be small to large. Although not tracked in Michigan, existing EO records mention *Malaxis brachypoda* to occur as scattered individuals typically in twos and threes. Minnesota EO records note that a few to 20 plants exist at any one site, while for Wisconsin the EO records note the occurrence of a few individuals to 50 plants widely scattered over a site with no more than a few stems at any one point (EO records, Appendix B). *Malaxi brachypoda* plants are "not evenly dispersed over suitable cover" in swamps. Based upon much fieldwork, Case (pers. comm.) contends that *M. brachypoda* is "one of those species which is continually moving about because, although perennial, its best germination sites are highly ephemeral due to rapid succession after minor disturbance."

The four U.S. Fish and Wildlife Service Regions in which *Malaxis brachypoda* occur are Region 1 (Northeast), Region 3 (North Central), Region O (California), and Region A (Alaska). *Malaxis brachypoda* occurs in Colorado in either one or both regions (5 and 8). When Colorado is included, *M. brachypoda* occurs in five (or six) regions of the United States.

According to NatureServe (2000), in Canada *Malaxis brachypoda* has been reported in Alberta, British Columbia, New Brunswick, Manitoba, Labrador, Newfoundland Island, Nova Scotia, Ontario, Quebec, Saskatchewan, and Yukon Territory. According to Catling and Magrath (1997),

this orchid species also occurs in the Northwest Territories and Prince Edward Island. Bruce Bennett (Yukon Renewable Resources, pers. comm.) cited Bill Cody (Flora of the Yukon) that *Malaxis brachypoda* is not known in the Yukon.

Several authors report that, in their search for *Malaxis brachypoda,* it was found in unexpected habitats or microhabitats. Morris and Eames (1929) reported that while in the Lower Rideau (Quebec), they stumbled across plants of this species on wet rocky shelves and terraces on a rocky hillside, occurring in a totally different habitat than the shaded, mossy thicket habitat they were expecting. Coleman (1990) rediscovered *Malaxis brachypoda* in California after it had not been seen for 42 years in that state. He was expecting to find it in a meadow in full sun, but instead he located plants of this orchid species in moderate/heavy shade at the side of a stream. Perhaps widening the search for *Malaxis brachypoda* to other habitats/microhabitats will result in discovery of more occurrences of this illusive species.

Table 1 lists the states and provinces in which *Malaxis brachypoda* occurs (and for which there is some occurrence information), as well as the number of occurrences and numbers of governmental units (e.g., counties, districts, etc.). Information was received from Heritage Programs in the U.S. and Canada and from other sources as well. Further occurrence information could likely be obtained if various herbaria were searched for pertinent label information on verified *Malaxis brachypoda* specimens or other pertinent literature was found. The occurrence numbers given in Table 1 may not be accurate for some states/provinces and should only be considered estimates. In some states/provinces (*e.g*., Michigan, New York, and Quebec) this species is not particularly rare and is not tracked by their respective Heritage programs; therefore, the actual occurrence numbers are likely much higher than the estimates given. As a result, the total number of occurrences (423) for *Malaxis brachypoda* in the United.States and Canada is probably quite a bit lower than the actual number of occurrences since botanists may not report new occurrences to a central data agency.

Table 2 lists the approximate number of element occurrence records (EORs) of *Malaxis brachypoda* in the U.S. National Forests. Public lands are more thoroughly inventoried than private lands; therefore the percentage of total occurrences is probably less than the 13.5% reported within National Forests.

Table 3 lists the sites of *Malaxis brachypoda* EORs by state/province indicating whether the site, when known, is public (USFS, State, other), private, protected, or unprotected.

Appendix A contains Heritage Status Rank Definitions based on global, national, and sub-national levels.

Appendix B is a list of element occurrence records (including information on habitat, date last observed, associated species, etc.) from states and provinces.

Appendix C is a list of database managers or other contacts at the various natural heritage programs or their equivalents in the United States and Canada. U.S. Forest Service personnel and other contacts are listed in Appendix C as well.

California and Colorado

Malaxis brachypoda populations in California and Colorado are disjunct from the main part of the range of this species and may be relicts of a moister, cooler period when *Malaxis brachypoda* may have occurred over a wider area (Coleman 1990). According to Correll (1978), *M. brachypoda* likely survived the Ice Age near the edges of the ice sheet and migrated north into Canada after melting of the ice.

California range map (*Malaxis brachypoda*).

Connecticut

Several occurrences of *Malaxis brachypoda* are documented in Connecticut (Connecticut EORs, Appendix B).

Illinois

According to Bill McClain (Illinois Natural Heritage Division, pers. comm.), *Malaxis brachypoda* "apparently is not recognized as part of the Illinois flora. The only confirmed record for Illinois is from the hanging fen in Elgin, Kane County. There have been no additional records of this plant since the Vasey collection (year unknown)." Sheviak (1974) suggests that this species may still grow in Illinois in hanging fens or calcareous bogs (Fox River Valley in Lake and McHenry Counties).

Illinois range map (*Malaxis brachypoda*)
(http://plants.usda.gov/cgi_bin/county.cgi?state_name=Illinois&statefips=17&symbol=MABR5)

Indiana

According to Homoya (1993), although *Malaxis brachypoda* has been reported from at least three different sites in Indiana, two of the localities were without vouchers to verify the occurrences, and the other had a specimen that may have been incorrectly labeled and may actually have been collected outside of Indiana. Homoya (1993) cited Pepoon (1927) and Peattie (1930), who reported that *Malaxis brachypoda* occurred "in a cold tamarack swamp" in Porter County. Homoya (1993) concluded that although the site may have harbored this species, it has been destroyed.

Michigan

In Michigan, because it is not a listed or special concern species, the Michigan Natural Features Inventory does not track *Malaxis brachypoda*. Therefore, no element occurrence records are available for this species. In Michigan, *M. brachypoda* occurs most frequently in the northern Lower Peninsula. Case (pers. comm.) observed that, where suitable habitat exists north of West Branch (Ogemaw County), *M. brachypoda* "almost certainly occurs." South of West Branch its occurrence is much more localized due to "destruction and drainage of the land, lack of suitable cover, and in open habitats with over warm soil temperatures."

It has been documented in at least 21 counties in Michigan's Lower Peninsula (Case 1987). In the Upper Peninsula, it is less frequent and is known in Keweenaw (including Isle Royale), Menominee, Delta, Alger, and Mackinac counties (Case 1987).

New Jersey

Although *Malaxis brachypoda* is not included in Catling and Magrath (1997) as occurring in New Jersey, it is included in other floras such as Correll (1978), Brown (1997), and Chapman (1997).

Tennessee

Malaxis brachypoda is listed as SR (reported in state) by NatureServe (2000). It is also attributed to Tennessee in the USDA Plant Database (2001) and by Fernald (1950). According to Carl Nordman (Div. of Natural Heritage, pers. comm.), *Malaxis brachypoda* is listed as SRF (State Report False) in Kartesz (1999), (CD-ROM). Nordman found no specimens from Tennessee at Harvard or the New York Botanical Garden, so he is "now confident that it has never been collected in Tennessee."

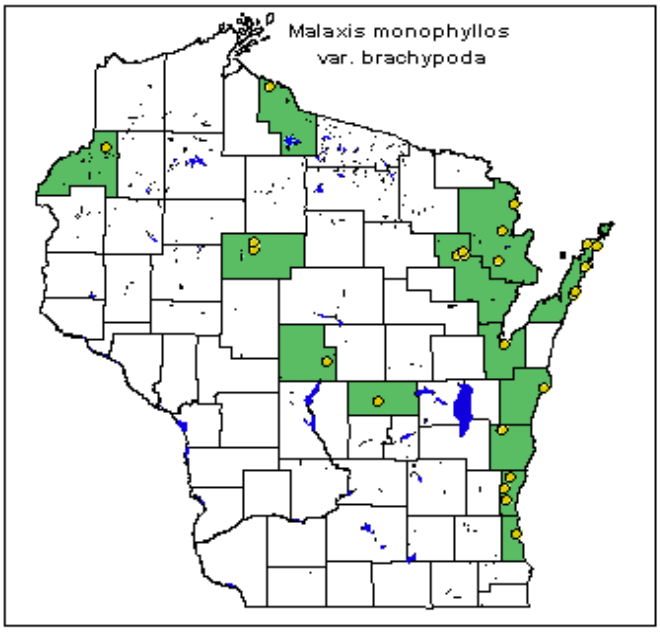
Texas

Malaxis brachypoda is listed as SR (reported in state) by NatureServe (2000). However, according to Bill Carr (The Nature Conservancy of Texas, pers. comm.), this species does not occur in Texas and he does not know where the Texas report originated. Case (pers.comm.) suggests that the report may have been the result of a misidentification of a Central American species. The Central American species occurs in the mountains of Arizona and possibly had some occurrences in the mountains of Texas, as for example, in Big Bend National Park.

Wisconsin

Distribution of *Malaxis brachypoda* in Wisconsin is primarily in eastern and northern counties (Fuller 1933).

Wisconsin range map (Wisconsin State Hebarium)
(http://www.botany.wisc.edu/wisflora/dots/MALMONvBRA.gif)



PROTECTED STATUS

Current conservation status ranks for *Malaxis brachypoda* from federal, state, and private agencies are listed below (NatureServe 2000). Definitions for the various ranks are included in Appendix A. Natural Heritage data centers usually assign National (N) and Subnational (S) ranks; otherwise scientists from the Association for Biodiversity Information will do this. A Global (G) ranking is assigned by either the Association for Biodiversity Information or by a "designated lead office " in the Natural Heritage Networks.

Global Conservation Status Rank:	G4Q	(17 March 1996)
United States: National Conservation Status Rank:	N3	(12 December 1997)
Canada: National Conservation Status Rank:	N4	(2 February 1995)

United States Status Ranks: (NatureServe 2000)

Alaska	SR	Minnesota	S3
California	S1	New Hampshire	S1
Colorado	S1	New Jersey	SR
Connecticut	S1	New York	SR
Illinois	S1	Pennsylvania	S1
Indiana	SR	Tennessee	SR
Maine	S?	Texas	SR
Massachusetts	S2	Vermont	S2
Michigan	SR	Wisconsin	S2

Canadian Conservation Status Ranks: (NatureServe, 2000)

Alberta	SR	Nova Scotia	S1
British Columbia	S2S3	Ontario	S4
Labrador	SU	Quebec	SR
Manitoba	S2?	Saskatchewan	S1S2
New Brunswick	S1	Yukon Territory	SR
Newfoundland	SR		

In New York (NatureServe 2000), *Malaxis brachypoda* is ranked as SR (reported; see Appendix A for definition). The rank, according to Nick Conrad (New York Natural Heritage Program, pers. comm.), is not SR. Since it is considered common in New York State, Heritage botanists have not had occasion to assign it a state rank; if they did, it would presumably be S4 or S5. Conrad pointed out that SR has a specific meaning for Heritage ranks, which is known from the state through reports only. This is certainly not the case of *Malaxis brachypoda* (= *M. monophyllos* var. *brachypoda* in New York). Michigan is a similar case where it is has an SR (state reported) rank (NatureServe 2000), but it should have a more specific rank, as its occurrence within the state is well documented.

U.S. Forest Service:

Malaxis brachypoda is included on the Regional Forester Sensitive Species List for Region 9 for four National Forests; Hiawatha (MI), Huron-Manistee (MI), Chequamegon-Nicolet (WI), and Chippewa (MN). It also occurs in Region 2 on the Pike-San Isabel National Forest (CO) in shaded streamsides and mossy wet areas between 7200 to 8000 feet (USDA, Region 2, TES Plant Management Strategy, 1999).

United States (endangered, threatened, or special concern):

States in which *Malaxis brachypoda* is endangered, threatened, or of special concern are listed below. Its status in Canadian provinces is included as well.

State endangered:

Connecticut (http://dep.state.ct.us/cgnhs/nddb/plants.htm) 2001.

Maine (Maine Department of Conservation, Natural Areas Division)

New Hampshire (http://www.nhdfl.org/formgt/nhiweb/) 2002.

State proposed endangered/threatened:

Pennsylvania (TU=tentatively undetermined; PE=proposed endangered) (http://www.dcnr.state.pa.us/forestry/pndi/fullplants.asp) 2001.

California, *Malaxis brachypoda* is on their List 2 (Plants rare, threatened, or endangered in California, but more common elsewhere) and has a Red code of 3-3-1 [Rarity=3 (distributed in one to several highly restricted occurrences, or present in such small numbers that it is seldom reported); Endangerment=3 (endangered throughout its range); Distribution=1 (more or less widespread outside California)]. (http://www.cnps.org/rareplants/inventory/6thEdition.htm) 2001.

State threatened:

Massachusetts (http://www.state.ma.us/dfwele/dfw/nhesp/nhrare.htm) 2001.

Vermont (http://www.anr.state.vt.us/fw/fwhome/nnhp/vt_plant.html) 2001.

State special concern:

Minnesota (http://files.dnr.state.mn.us/ecological_services/plant_list9-25-02.pdf) 2002.

Wisconsin (http://www.dnr.state.wi.us/org/land/forestry/Look/assessment/09.pdf) 2000. (http://www.dnr.state.wi.us/org/land/er/nhi/nhimain.htm) 2002.

Canada (rankings):

Alberta: S2, not currently on provincial list, but within a year or so update on status will likely be determined (Joyce Gould, Alberta Natural Heritage Information Centre, pers. comm.).

British Columbia: G4, S2 S3, on provincial Blue-list (http://srmapps.gov.bc.ca/apps/eswp/search.do?searchType=PLANT) 2002. (http://wlapwww.gov.bc.ca/wld/documents/PMORC1R010.pdf) 2002. (http://www.for.gov.bc.ca/research/becweb/standards-species.htm) 2002.

Labrador: SU (10/31/00), (Sean Blaney, Atlantic Canada Conservation Data Centre, pers. comm.).

New Brunswick: S1, may be at risk (Sean Blaney, Atlantic Canada Conservation Data Centre, pers. comm.).

Newfoundland: S3, rare to locally common (http://www.chebucto.ns.ca/~ae050/orchids.html) 2001.

Nova Scotia: S1 (10/31/00), (Sean Blaney, Atlantic Canada Conservation Data Centre, pers. comm.).

Ontario: S4 (03/31/00), species is not tracked because it not considered rare, NHIC List of Ontario Vascular Plants, 2002. (http://www.mnr.gov.on.ca/MNR/nhic/elements/el_report.cfm?elid=39074)

Saskatchewan: S1, S2, provincially rare (http://www.sfn.saskatoon.sk.ca/science/dore/1-4.html) 2001.

Quebec: Not tracked; estimate of 50 occurrences from distribution map (Rousseau 1974), therefore a ranking of S3 seems reasonable (Jacques Labrecque, botanist at Minister of Environment, Quebec pers. comm.).

Yukon: No Conservation Data Center, along with a very remote area, leads to incomplete tracking. SR rating considered being reasonable since actual numbers not known (Bruce Bennett, biologist at Yukon Renewable Resources pers. comm.).

THREATS AND POTENTIAL THREATS

Threats of habitat loss or alteration.

USFS (1999) suggests, "The major threat to *Malaxis brachypoda* appears to be changes to the wetland hydrology of sites supporting this species, either from human-caused drainage, or from fluctuating water levels due to beaver or climatic changes." The hydrology can be affected by agricultural drainage (e.g., Connecticut EOR # 001, Appendix B), gravel mining (e.g., Wisconsin EOR #026, Appendix B); wetland drainage for residential development (e.g., Wisconsin EOR # 048, Appendix B); plus peat mining, and draining and infilling of *Sphagnum* peat lands (USFS 1999). Flooding of wetlands as a result of road construction can also adversely affect orchid habitat (Reddoch & Reddoch 1997).

Case (pers. comm.) observed that *Malaxis brachypoda* occurrence is much more localized due to "destruction and drainage of the land, lack of suitable cover, and in open habitats with over warm soil temperatures." It is a species that prefers stable water levels and is not enhanced by fluctuations of any amount (USFS 2000). USFS (1999) suggests that "on national forests in Minnesota, the peat land habitat supporting *Malaxis brachypoda* receives defacto protection from most destructive impacts, therefore the habitat is largely apart from natural water-level fluctuations." On the Hiawatha National Forest in Michigan, fisheries projects that involve spring dredging and associated road access, spoils removal, etc. could impact this orchid (Jan Schultz, Forest Plant Ecologist, Hiawatha National Forest, pers. comm.). Case (pers. comm.) suggests that

drainage of swamps is a "major disaster for most of these tiny surface rooting orchids." Case (pers.comm.) notes that for *Malaxis brachypoda*, although a perennial, "its preference for unstable microlocations within the swamp I suspect means adult plants do not persist for many years and the population depends upon constant reseeding. Such behavior is going to make estimating the effects of disturbance by man or animals difficult to assess."

According to the USFS (2000), in Region 9, 50% or more canopy cover is best for *Malaxis brachypoda.* A major threat to *Malaxis brachypoda* is logging (USFS 1999), which removes or reduces canopy cover through clear-cuts and heavy thinning. The resulting increase in sunlight and drying of the soil is likely to adversely affect *Malaxis* plants. *Malaxis brachypoda* "has been known to disappear following logging" (Maine Dept. of Conservation, Natural Areas Division). Clear-cutting prevents orchids from regenerating because they are left with "no shade, no pollinators, no parent stock, and a lack of favorable microclimates" (IUCN/SSC Orchid Specialist Group, 1996)

Ground disturbance can be detrimental as well. Intensive recreational use, such as heavy foot traffic, can lead to increased soil bulk density. Trampling of trails and off –trail areas by large numbers of recreational users, or even by cattle in some areas, can accelerate erosion in a forested watershed. Conventional timber harvest methods also disturb and compact the forest floor, especially in areas along skid trails and at landings where logs are piled and loaded (Brady and Weil 1999). Use of heavy logging equipment or excessive trampling can have an added effect, particularily on wet fine-textured soils. Forest management practices that affect bulk density will also affect soil porosity (Klock *et al*. 1984).

Case (pers. comm.) believes that clear-cutting, especially when heavy equipment is used, "creates havoc for many years before the habitat can partially recover." However, Case has seen many *Malaxis brachypoda* plants in "cutover swamplands after some regeneration has occurred, if the habitat is cool enough." Near Bemidji, Minnesota, Case (pers. comm.) has observed this species in not only undisturbed mature *Thuja-Abies-Larix* swamps, but also in highly disturbed and previously lumbered *Thuja-Abies-Larix* swamps.

Potential threats to the population viability of *Malaxis brachypoda* that have a "medium" likelihood of happening within the next 100 years include "habitat fragmentation (including loss of connectivity)" as well as "changes in vegetation composition" (USFS 1999). Global warming would likely adversely affect *Malaxis brachypoda* with habitat loss and increased risk of fire (USFS 2000). Also, infestations of spruce budworm may result in new canopy openings (Wisconsin EOR #46, Appendix B) and could adversely affect populations of *Malaxis brachypoda*.

Threats from herbivores

Deer (Reddoch & Reddoch 1997; Wisconsin EOR # 34, Appendix B) and other foraging animals, as well as trampling by animals and humans, may threaten plants of *Malaxis brachypoda* (California EORs # 1-3, Appendix B) and other orchid species. If any bud growth or stem is eaten, crushed, frozen, etc., growth for the season is finished until the next cold period has passed

(Case pers. comm.). In their two-year study, Reeves and Reeves (1984) determined that there was a high degree of fruit loss (39.22% and 34%) in *Malaxis paludosa* due to predation probably by rodents and insects. It may be that rodents and insects eat *Malaxis brachypoda* fruits as well. Case (pers.comm.) notes that when voles and mice are abundant during the winter, they have been known to drastically reduce populations of the orchid *Liparis lilifolia* that have a surface/subsurface pseudobulb.

Threats from non-native invasive species

Invasive plants are replacing diverse natural ecosystems in some areas, and may pose a direct threat to native fauna (Westbrooks 1998). Case (1987) notes that *Malaxis brachypoda* is "nonagressive and noncompetitive"; therefore, competition from an invasive species such as glossy buckthorn (*Rhamnus frangula*) could adversely affect populations (e.g., Wisconsin EOR # 048, Appendix B). In the Great Lakes region, buckhorn may invade open grassy fens and form thickets. It competes for nutrients and light with native flora and may nearly completely eradicate other species (IUCN/SSC Orchid Specialist Group, 1996). Case (pers. comm.) doubts that "invasion of swamps by buckthorn species has too much effect upon *M. brachypoda*, as its relatives, *Liparis lilifolia* and *L. loeselii* persist under buckthorn, and even may enjoy a population explosion in the open soil created by their shade." USFS (1999) notes that *Cirsium palustre* and other noxious weeds may also invade areas where *Malaxis brachypoda* occurs. Canopy removal and ground disturbance can contribute to an increase in the number of exotic plant species.

USFS (2001a) cited Peterson and Dixon (1971) and Alban and Berry (1994) as reporting that exotic earthworms in Minnesota and other Great Lakes states alter soil layers, reduce litter and duff soils, and potentially alter water relations particularly near the soil surface in upland forests. Cindy Hale, currently a Biologist with University of Minnesota, Department of Forest Resources, Natural Resources Research Institute in Duluth, has studied earthworm migration across north central forests and has worked to help establish the Minnesota Worm Watch Program. According to Hale (pers. comm. 2003), they think that changes to the mychorrizal community may be important for impacts to many native plants, especially things like orchids. However, there is no research on that in particular. Lawrence, et al. (2003) found that in the Arnot National Forest in central New York the organic horizon in no-worm reference areas had higher mychorrizal colonization rates and higher colonized root length than did surface layers in areas with active earthworm populations. Also, some general work has been done that has shown that worms cause a shift from a fungally dominated to a bacterially dominated decompositional system (Hale, pers. comm. 2003). The fungal/bacteria ratio decreases with earthworm activity in a variety of habitat and litter types (Devliegher and Verstraete 1997).

It would seem that *Malaxis brachypoda* plants would unlikely be affected by earthworm invasions as they are unlikely to grow in upland forests except in isolated wetland pockets. Case (pers.comm.) noted that when exotic earthworms invaded a southern Michigan mature beech-maple forest, a large population of *Triphora trianthophora* was almost completely destroyed by removal of all of the humus and litter needed by that orchid. Case (pers. comm.) suggested that many orchids of northern boreal cedar swamps might be threatened if exotic earthworms should invade those soils.

Threats from collecting/transplanting

USFS (1999) suggests that since many populations of *Malaxis brachypoda* are small, local extinctions may occur due to over-collecting. Correll (1978) mentions that this species has been cultivated in northern gardens. According to Smith (1993), "essentially all of the native orchids that are sold commercially are taken from the wild" as "terrestrial orchids are nearly impossible to propagate artificially." Referring to orchids in general, Catling (1980) suggests, "In some cases orchids are endangered by horticultural collectors." Collecting *Sphagnum* for gardens and craft projects could also be a threat to *Malaxis brachypoda* (USFS 2000).

Transplanting rare plants is not a reliable method of conserving rare species according to the Canadian Botanical Association (CBA) (Fahselt 1988). The natural area from which the plant was taken becomes disturbed, and often the rare plant dies because the new microenvironment is unfavorable. The CBA contends that the rare plant's habitat is as important as the plant itself and transplanting of orchid species should normally be avoided.

POPULATION BIOLOGY AND VIABILITY

Population Biology

Little is known about the population biology of *Malaxis brachypoda.* More information is available about other orchid species, such as *M. paludosa*. Various aspects of the life history and reproduction strategies of *Malaxis paludosa* are discussed in the Life History section of this report. However, caution should be taken in applying life history attributes for *M. paludosa* to *M. brachypoda.* More research specifically on the biology and the ecology of *Malaxis brachypoda* is needed to support assumptions on similarities between the species.

According to USFS (1999), *Malaxis brachypoda* grows as scattered populations within its range due to the discontinuous patterns of its required wetland habitat. Correll (1978) contends that the most important factors that determine the distribution and survival of all orchid species are temperature and moisture. Also limiting the range of this species might be its "nonagressive and noncompetitive" nature (Case 1987) as well as its small size. USFS (1999) suggests that a very small proportion of the progeny of *Malaxis brachypoda* survive to reproductive age.

In order to increase one's chances of finding this species, the ideal time to search for it is when the plants are in fruit, rather than in flower. Brackley (1985) and Reddoch and Reddoch (1997) suggest that the light brown capsules of this species are easier to spot than the inconspicuous flowers. Most of the specimens Brackley (1985) had seen were collected in fruit. The current year's capsules are quite a bit larger than the flowers [Minnesota County Biological Survey (1998) cited in USFS (2001b)].

There are very likely many more populations of *Malaxis brachypoda* than have been documented, but this species "is so well camouflaged by its surroundings that it is surprising that this species is

ever found by orchid hunters" (Brackley 1985). Case (pers. comm.) says that *M. brachypoda* is the least conspicuous of any of our native orchids. It is small, has obscure coloring, may possibly not appear above ground every year, may be eaten by herbivores (Brackley 1985; Case 1987), and has the thinnest flower spike of any of our native orchids (Case pers. comm.). *Malaxis brachypoda* plants are seldom in clumps, but are scattered (Case, 1987), which also tends to make them more difficult to find. Kott and Kott (1974) suggest that *Malaxis brachypoda* is "probably more often overlooked than rare." Based upon much fieldwork, Case (pers. comm.) suggests that *Malaxis brachypoda* "is continually moving about because, although perennial, its best germination sites are highly ephemeral due to rapid succession after minor disturbance."

POPULATION VIABILITY

Viability has been defined as "the persistence of a population or species into the future" (Elzinga *et al.* 1998). *Malaxis brachypoda* is "apparently declining" in eight states of the northeastern United States (Brown 1997). USFS (2001b) cited the Minnesota County Biological Survey (1998) as suggesting that, in Minnesota, "a historic population decline cannot be documented from the available data, but it is vulnerable to wetland drainage, logging, and land conversion." Threats, either naturally occurring or human-induced include, but are not limited to, habitat loss or alteration, mechanical damage, competition, over collection, and herbivory. Long-term population monitoring is needed to more accurately determine whether populations of *Malaxis brachypoda* are decreasing, increasing, or stable.

Viability of *Malaxis brachypoda* depends on assuring that tracts of land with suitable habitat continue to exist. "Most orchids have survived so far through the random accidents of being in places not yet accessible to, or economically viable for, development" (Reddoch and Reddoch 1997). Establishment of large publicly-owned areas, as the Ottawa District of Canada (eastern Ontario and western Quebec), have played a significant role in protecting some orchid populations (Reddoch & Reddoch 1997). Long-term viability for orchids will best be realized by protecting entire ecosystems (Reddoch & Reddoch 1997). Regional Forester Sensitive Species are protected on federal land in the United States, and the USDA Forest Service has policies to maintain viable populations of all native plant species (Forest Service Manual 2670.5.22).

The majority of the Element Occurrence Records (EORs) for *Malaxis brachypoda* (Appendix B) that listed stem counts were in the range of 1 - 5 plants. In Wisconsin's EOR #022 (Appendix B), it was noted that even though there were 50 flowering plants over the whole site, "no more than 2 plants seen together; individuals of this species are likely scattered throughout much of the site." Reddoch and Reddoch (1997), in their study of 117 colonies of *Malaxis brachypoda* in the Ottawa District of Canada (eastern Ontario western Quebec), observed that the colonies are typically less than 50 (ranging from 1 - 275) flowering plants, usually occurring as scattered individuals. "The aerial extent of these populations is small, with each known population occupying less than about one acre" (USFS 1999).

Monitoring at known sites will help botanists understand normal population fluctuations relative to actual long-term declines. Only by following marked individuals periodically throughout the

growing season and over a number of years in sufficient populations can it be determined if *Malaxis brachypoda* undergoes a dormant period. Case (1987) contends that, when an orchid reappears above ground after years of supposed dormancy, it is more likely that the original plant perished and the plant appearing above ground was from subsequent seed. Other reasons for not observing an orchid plant where it would normally appear annually, according to Case (1987), is that the orchid plant could have been damaged by frost, grazing, insects, or trampling.

RESEARCH AND MONITORING

More information is needed about *Malaxis brachypoda* concerning its (1) basic life cycle (e.g., germination, establishment, growth requirements, life span, pollinator identity, and phenology) and (2) ecology and habitat (e.g., soil/substrate chemistry, nutrient requirements, light and moisture requirements, and distribution of mycorrhizal fungi).

Rasmussen (1995) suggested, "The orchid-fungus symbiosis remains one of the least studied aspects of orchid biology" and should be of great concern in orchid conservation (Zettler 1997). In addition, it is important to continue inventorying and locating new populations of *Malaxis brachypoda* and collecting detailed information for each occurrence. Long-term monitoring of populations of *Malaxis brachypoda* and their habitats are critical in assessing viability and in making wise management decisions. Reeves and Reeves (1984, 1985) are planning to continue making observations on the life history of *Malaxis brachypoda* and *M. unifolia* at their study site in Minnesota as well as studying pollination biology of these two *Malaxis* species.

Case (pers. comm.) suggests that it is impossible to monitor *Malaxis brachypoda* and obtain an accurate estimate because, even in undisturbed natural habitat, marked plants often fall prey to mice, etc. and do not reappear another year. This species does not go dormant underground and skip a season as a normal behavior, but rather may go dormant due to damage done to initiating growth (Case pers. comm.). In Pennsylvania, some informal monitoring is being carried out on one population of *Malaxis brachypoda* (Steve Grund, Pennsylvania Natural Diversity Inventory, pers. comm.). In several EO records (e.g., Connecticut EOR # 001; Maine EOR # 001, Appendix B), counts of *Malaxis brachypoda* were made during three to four non-consecutive years.

Habitat monitoring is also needed for *Malaxis brachypoda*. It is possible to track habitat changes through time by using permanent photo points (Elzinga *et al.* 1998; USFS 2001a). Information obtained from monitoring, such as "correlation between changes in habitat and reproductive success" and "percent canopy preference or level of competition tolerated" (USFS 2001a) can be used to make wise management decisions.

In order for viability to be adequately addressed, it is necessary to obtain more information than just habitat characteristics, associated species, and counts of *Malaxis brachypoda* plants. To get an indication of viability, it would be beneficial to set up a long-term monitoring program where permanent plots are carefully established in a population, locations of orchid plants at each of the stage-classes (juvenile, flowering, etc.) are mapped, and the individuals and their stage-classes are followed from year to year. Information on lifespan, recruitment, dormancy, and long-term

population trends could be obtained from long-term monitoring of populations of *Malaxis brachypoda*.

LITERATURE CITED

Ames, O. 1938. Resupination as a diagnostic character in the Orchidaceae with special reference to *Malaxis monophyllos*. Botanical Museum, Cambridge, Massachusetts.

Argus, G.W. and D.J. White. 1978. The Rare Vascular Plants of Alberta. Syllogeus 17, National Museums of Canada, Ottawa, National Museum of Natural Museum. 46 pp.

Bennett, B. Personal communication. Biologist at Yukon Renewable Resources.

Blaney, S. Personal communication. Atlantic Canada Conservation Data Centre.

Brady, N.C. and R.R. Weil. 1999. The Nature and Properties of Soils. Twelfth Edition. Prentice Hall. Upper Saddle River, New Jersey.

Brackley, F.E. 1985. The orchids of New Hampshire. Rhodora Vol. 83:1-117.

Brown, P.M. 1997. Wild Orchids of the Northeastern United States. Comstock Publishing Associates, Div. of Cornell University Press, Ithaca, New York. 236 pp.

CalFlora Digital Website. Accessed: December 20, 2002. UC Berkeley Digital Library Research Project. (http://www.calflora.org/)

Carr, Bill. Personal communication. The Nature Conservancy of Texas.

Case, F.W., Jr. 1962. Growing native orchids of the Great Lakes Region. American Orchid Society 31:437-445.

Case, F.W., Jr. 1987. Orchids of the Western Great Lakes Region. Cranbrook Institute of Science Bulletin 48. 251 pp.

Case, F.W. Jr. 2002. Personal communication.

Catling, P.M. 1980. Endangered orchids? Another viewpoint. American Orchid Society Bulletin 49:220-222.

Catling, P.M. 1983. Autogamy in eastern Canadian Orchidaceae: A review of current knowledge and some new observations. Naturaliste Can. (Rev. Écol. Syst.) 110:37-53.

Catling, P.M. and V.R. Catling. 1991. A synopsis of breeding systems and pollination in North American orchids. Lindleyana 6:187-210.

Catling, P.M. and L.K. Magrath. 1997. *Malaxis*. In Flora North America Editorial Committee, Flora of North America, vol. 26. Unpublished.

Chadde, S.W. 1996. Plants of Pictured Rocks National Lakeshore. PocketFlora Press, Calumet, Michigan. 103 pp.

Chapman, W.K. 1997. Orchids of the Northeast, A Field Guide. Syracuse University Press, Syracuse, New York. 200 pp.

Coleman, R.A. 1990. *Malaxis monophyllos* var. *brachypoda* rediscovered in California. American Orchid Society Bulletin 59:41-45.

Conrad, N. Personal Communication. New York Natural Heritage Program.

Correll, D.S. 1978. Native Orchids of North America North of Mexico. Stanford University Press, Stanford, CA. 399 pp.

de Repentigny, L. 1978. Extension d'aire: *Malaxis monophyllos* var. *brachypoda* (Gray) F. Morris. Naturaliste Can. 105:117-118.

Devliegher, W. and W. Verstraete. 1997. The effect of *Lumbricus terrestris* on soil in relation to plant growth: Effects of nutrient enrichment processes (NEP) and gut-associated processes (GAP). Soil Biol. Biochem. 29: ¾: 341-346.

Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. Measuring and Monitoring Plant Populations. U.S. Department of the Interior. Denver, CO. 477 pp.

Fahselt, D. 1988. The dangers of transplantation as a conservation technique. Natural Areas Journal 8:238-243.

Fernald, M.L. 1926. Two summers botanizing in Newfoundland. Rhodora 28:161-178 (in part).

Fernald, M.L. 1950. Gray's Manual of Botany: A Handbook of the Flowering Plants and Ferns of the Central and Northeastern United States and Adjacent Canada, 8th ed. American Book Company, New York. 1632 pp.

Fuller, A. M. 1933. Studies on the Flora of Wisconsin. Part 1: The Orchids; Orchidaceae. Bulletin of the Public Museum of the City of Milwaukee. Vol. 14, No. 1, Pp. 1-284, Plates 1-54, Text Figs. 1,2, Maps 1-24. Feb. 23, 1933. Milwaukee, Wis. USA. Published by the Order of the Board of Trustees.

Gleason, H.A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. The New York Botanical Garden, the Bronx, New York.

Gould, J. Personal Communication. Alberta Natural Heritage Information Centre.

Gray, Asa. 1835. (Asa Gray, *Elements of botany*. New York, 1836. 1253.a.26).

Grund, S. 2001. Personal communication. Pennsylvania Natural Diversity Inventory – West.

Hale, Cindy. 2003. Personal communication.

Hale, C.M., L.E. Frelich, and P.B. Reich. 2000. Impacts of invading European earthworms on understory plant communities in previously worm-free hardwood forests of Minnesota. Oral Presentation at The Ecological Society of America 85th Annual Meeting. August 6 – 10, 2000. Snowbird, Utah.

Harms, V.L. 1984. Adder's-mouth orchids in Saskatchewan. Blue Jay 42:14-20.

Hiawatha National Forest TES Plant Atlas.

Hickman, J.C. (ed.). 1993. The Jepson Manual: Higher Plants of California. University of California Press, Berkeley. 1400 pp.

Homoya, M.A. 1993. Orchids of Indiana. Indiana Academy of Science. 276 pp.

Illustrated Flora of British Columbia. Volume 7. Monocotyledons (Orchidaceae through Zosteraceae). Edited by Douglas, G.W., D. Meidinger, and J. Pojar. Copyright 2001 Province of British Columbia. British Columbia, Ministry of Environment, Lands, and Parks. Ministry of Sustainable Resource Management. Ministry of Forests.

IUCN/SSC Orchid Specialist Group. 1996. Orchids--Status Survey and Conservation Action Plan. IUCN, Gland, Switzerland and Cambridge, UK. 153 pp.

Jennings, W.F. 1989. Final report Colorado Natural History Small Grants Program prepared for the Nature Conservancy. Species studied: *Eustoma grandiflorum, Spiranthes diluvialis, Malaxis brachypoda, Hypoxis hirsuta, Physaria bellii, Aletes humilis.*

Johnson, K. 1981. Rare plant alert: Littlest orchids. Bulletin (Manitoba Naturalists Soc.) 4:1.

Johnsson, R.G. 1963. The orchids of Isle Royale National Park. Isle Royale Natural History Association. Houghton, Michigan. 29 pp.

Klock, G.O., R.G. Cline, and D.N. Swanston. 1984. Geology and Soil. In: Wenger, K.F. 1984. Forestry Handbook, Second Edition. John Wiley and Sons, Inc. New York.

Kott, L. and E. Kott. 1974. A record of the orchid *Malaxis monophyllos* (L.) Sw. from northeastern British Columbia. The Canadian Field Naturalist 88:89.

Labrecque, J. Personal communication. Botanist at Minister of Environment, Quebec, CA.

Larocque, Mark. Wisconsin State Herbarium. University of Wisconsin, Madison. (http://wiscinfo.doit.wisc.edu/herbarium/photographers.html)

Lawrence, B., M. C. Fisk, T. J. Fahey, and E. R. Suarez. 2003. Influence of nonnative earthworms on mychorrhizal colonization of sugar maple (*Acer saccharum*). New Phytologist. 157: 145-153.

Low Impact Forestry (http://www.lowimpactforestry.com/environment/speciesatrisk.htm) 2001.

Luer, C.A. 1975. The Native Orchids of the United States and Canada excluding Florida. The New York Botanical Garden. Bronx, New York. 361 pp.

Maher, R.V., D.J. White, G.W. Argus, and P.A. Keddy. 1978. The Rare Vascular Plants of Nova Scotia. Syllogeus #18, National Museums of Canada, National Museum of Natural Sciences, Ottawa. 37 pp.

Maine Department of Conservation, Natural Areas Division. No date. Rare plant fact sheet (for *Malaxis brachypoda*).

Marie-Victorin, F. 1947. Flore Laurentienne. Les Fréres des Écoles Chrétiennes, Montreal. 916 pp.

Massachusetts Natural Heritage Program. No date. Fact sheet for *Malaxis brachypoda*.

McClain, Bill. Personal communication. Illinois Natural Heritage Division.

Minnesota County Biological Survey. 1998. Rare plant information sheet cited in USFS (2001b).

Morris, F. and E.A. Eames. 1929. Our Wild Orchids: Trails and Portraits. Charles Scribner's Sons, New York. 464 pp.

Moss, E.H. 1932. The vegetation of Alberta: IV. The poplar association and related vegetation of central Alberta. Journal of Ecology 20:380-415.

NatureServe: An online encyclopedia of life [web application]. 2000. Version 1.1. Arlington, Virginia, USA: Association for Biodiversity Information. Available at (http://www.natureserve.org/) (Accessed: January 3, 2001).

Nordman, C. Personal communication. Div. of Natural Heritage. *Malaxis brachypoda* is listed as SRF (State Report False) In: Kartesz (1999), (CD-ROM).

Orchids of Wisconsin, Web 2001. Wisconsin State Herbarium, Department of Botany: University of Wisconsin – Madison, 430 Lincoln Drive Madison, WI 53706-1381 U.S.A. Orchids of Wisconsin – *Malaxis monophyllos* var. *brachypoda.* (http://www.botany.wisc.edu/Orchids/monophyllos.html)

Rasmussen, H.N. 1995. Terrestrial Orchids: From Seed to Mycotrophic Plant. Cambridge University Press, Cambridge cited in Zettler (1997).

Reddoch, J.M. and A.H. Reddoch. 1997. The orchids in the Ottawa District: Floristics, phytogeography, population studies, and historical review. The Canadian Field-Naturalist 111:1-184.

Reeves, L.M. and T. Reeves. 1984. Life history and reproduction of *Malaxis paludosa* in Minnesota. American Orchid Society Bulletin 53:1280-1291.

Reeves, T. and L. Reeves. 1985. Rediscovery of *Malaxis paludosa* (L.) Sw. (Orchidaceae) in Minnesota. Rhodora 87:133-136.

Rousseau, C. 1974. Géographie floristique du Québec-Labrador. Presses Univ. Laval.

Scoggan, H.J. 1978. The Flora of Canada. Part 2. Pteridophyta, Gymnospermae, Monocotyledoneae. National Museum of Natural Sciences publications in Botany #7:93-545. National Museums of Canada. Ottawa.

Schultz, J. Personal communication. Forest Plant Ecologist, Hiawatha National Forest, Michigan, USA.

Sheviak, C.J. 1974. An Introduction to the Ecology of the Illinois Orchidaceae. Illinois State Museum Scientific Papers XIV, Springfield, Illinois. 89 pp.

Shubat, D. and Walton, G. 1997. Rare Plants of Minnesota's Arrowhead. Published by Olga Lakela Herbarium, University of Minnesota, Duluth. 112 pp.

Sytsma, K.J. Wisconsin State Herbarium. University of Wisconsin, Madison. (http://wiscinfo.doit.wisc.edu/herbarium/photographers.html)

Smith, W.R. 1993. Orchids of Minnesota. University of Minnesota Press, Minneapolis, Minnesota. 172 pp.

Szczawinski, A.F. 1959. The Orchids of British Columbia. British Columbia Provincial Museum Handbook No. 16. 124 pp.

Tapia, S. Region 2, Rocky Mountain. Personal communication. Cited Ryke *et al*. 1994; updated 1999.

USDA NCRS Plant Database. 2001. (http://plants.usda.gov)

USDA, Region 2, TES Plant Management Strategy, 1999.

U.S. Fish and Wildlife Service. 1988. National list of vascular plant species that occur in wetlands. US Fish and Wildlife Biological Report 88 (24) cited in (http://plants.usda.gov/plants/wetinfo.html) (Accessed 2 January 2001).

USDA Forest Service Manual. (2670.5.22).

U.S. Forest Service (USFS). 1999. Forest Six-factor Evaluation Worksheet for Chequamegon-Nicolet National Forest, Chippewa National Forest, and Huron-Manistee.

U.S. Forest Service (USFS). 1999. DRAFT literature review: *Malaxis brachypoda*--white adder's mouth. U.S. Forest Service (Region 9) and the Chippewa, Superior, and Chequamegon-Nicolet National Forests. Prepared by Steve Chadde.

U.S. Forest Service, (USFS). 2000. Regional Forester Sensitive Species (RFSS) plant list. U.S. Forest Service, Eastern Region (R9). 29 February 2000.

U.S. Forest Service (USFS). 2000. Questions for population viability assessment (PVA) panel (*Malaxis brachypoda*). US Forest Service, Region 9. Unpublished.

U.S. Forest Service (USFS). 2001a. DRAFT conservation assessment: *Botrychium oneidense* (Gilbert) House (Blunt-lobed grapefern). U.S. Forest Service.

U.S. Forest Service (USFS). 2001b. Chippewa National Forest (Minnesota) information sheet, available from Ian Shackleford, Chippewa National Forest.

Voss, E.G. 1972. Michigan Flora Part I Gymnosperms and Monocots. Cranbrook Inst. Sci. Bull. 55 & Univ. Michigan Herb. 488 pp.

Wallace, J.E. 1951. The Orchids of Maine. University of Maine Studies #65. University Press, Orono, Maine. 80 pp.

Westbrooks, R.G. 1998. Invasive Plants, changing the Landscape of America: Fact Book. Federal Interagency Committee for the Management of Noxious and Exotic Weeds. Washington, D.C. 109 pp.

Whiting, R.E. and P.M. Catling. 1986. Orchids of Ontario. The CanaColl Foundation, Ottawa. 169 pp.

Wisconsin State Herbarium, Department of Botany: University of Wisconsin – Madison, 430 Lincoln Drive Madison, WI 53706-1381 U.S.A.

Orchids of Wisconsin – *Malaxis monophyllos* var. *brachypoda.*
(http://www.botany.wisc.edu/Orchids/monophyllos.html)
(http://www.botany.wisc.edu/wisflora/scripts/detail.asp?SpCode=MALMONvBRA)
(http://www.botany.wisc.edu/wisflora/photographers.html)
(http://www.botany.wisc.edu/wisflora/dots/MALMONvBRA.gif)

Zettler, L.W. 1997. Orchid-fungal symbiosis and its value in conservation. McIlvainea 13:40-45.

LITERATURE CITED IN ANOTHER CITATION (Original not examined)

Alban, D.H. and E.C. Berry. 1994. Effects of earthworm invasion on morphology, carbon, and nitrogen of a forest soil. Applied Soil Ecology 1:243-249 cited in USFS (2001a).

Bennett, B. (Yukon Renewable Resources, pers. comm.) cited Bill Cody (Flora of the Yukon)

Darwin, C. 1862. The various contrivances by which British and foreign orchids are fertilised by insects. (1979 reprint, re-titled Fertilization of orchids by insects). Coleman. Stanfordville, New York cited in Reeves and Reeves (1984).

Gaddy, L.L. 1983. Studies on the biology of the small whorled pogonia (*Isotria medeoloides*) in South Carolina. Nat. Areas Journal 3:14-37 cited in Zettler (1997).

Gill, D.E. 1996. The natural population ecology of temperate terrestrials; Pink Lady's-Slippers, *Cypripedium acaule*. In: Proceedings of the North American Native Terrestrial Orchid Propagation and Production Conference. C. Allen [ed.]. Pp. 91-106. National Arboretum, Washington, D.C., USA cited in Zettler (1997).

Hagerup, O. 1941. Bestøvningen hos *Liparis* og *Malaxis*. Bot. Tidsk. I 45:396-402 cited in Catling and Catling (1991).

Judziewicz, E.J. 1983. Field survey report on the endangered, threatened, and rare vascular plants of the Nicolet National Forest, Wisconsin. Bureau of Endangered Resources, Wisconsin Department of Natural Resources, Madison, WI cited in USFS (1999).

Luer, C.A. 1975. The Native Orchids of the United States and Canada excluding Florida. The New York Botanical Garden. Bronx, New York. 361 pp cited in Reeves and Reeves (1984)

Minnesota County Biological Survey. 1998. Rare plant information sheet cited in USFS (2001b).

Peattie, D.C. 1930. Flora of the Indiana Dunes. Field Museum of Natural History, Chicago, Illinois. 432 pp cited in Homoya (1993).

Pepoon, H.S. 1927. An annotated flora of the Chicago area. Chicago Academy of Sciences

Bulletin. 554 pp cited in Homoya (1993).

Peterson, A.E. and R.M. Dixon. 1971. Water movement in large soil pores: validity and utility of the channel concept. College of Agr. and Life Sci., Univ. of Wisconsin Res. Rep. 75 cited in USFS (2001a).

Porsild, A.E. and H.A. Crum. 1961. The vascular flora of Liard Hotsprings, B.C. with notes on some bryophytes. National Museum of Canada. Bulletin 171 (1959). Pp. 137-197 cited in Kott and Kott (1974).

Rasmussen, H.N. 1995. Terrestrial Orchids: From Seed to Mycotrophic Plant. Cambridge University Press, Cambridge cited in Zettler (1997).

Ryke, N., D. Winters, L. McMartin, and S. Vest. 1994 (updated 1999). Threatened, endangered, and sensitive species of the Pike and San Isabel National Forests and Comanche and Cimarron National Grasslands cited in email from Steve Tapia, Region 2.

Summerhayes, V.S. 1951. Wild Orchids of Britain. Collins, London. 366 pp. cited in Case (1987).

Wisconsin Natural Heritage Program EO data. September 24, 1999 cited in USFS 1999.

OTHER REFERENCE INFORMATION

Casson, J., I. Shackleford, L. Parker, and J. Schultz. 2000. Conservation strategy for the goblin fern, *Botrychium mormo* (W.H. Wagner). USDA Forest Service--Eastern Region, 27 October 2000 draft cited in USFS (2001a).

Clements, M.A. 1988. Orchid mycorrhizal associations. Lindleyana 3:73-86.

Hartmann, T. 1991. Alkaloids, Chpt. 3. In Rosenthal, G.A. and M.R. Berenbaum (eds.). Herbivores: Their Interactions with Secondary Plant Metabolites. Academic Press, Inc., New York. 468 pp.

Lesica, P. and K. Ahlenslager. 1996. Demography and life history of three sympatric species of *Botrychium* subg. *Botrychium* in Waterton Lakes National Park, Alberta. Can. J. Bot. 74:538-543.

Lüning, B. 1985. Alkaloids of the Orchidaceae, Chpt 7. In The Orchids: Scientific Studies. Withner, C.L. (ed.). Robert E. Krieger Publishing Company, Malabar, Florida. 604 pp.

Magee, D.W. and H.E. Ahles. 1999. Flora of the Northeast: A Manual of the Vascular Flora of New England and Adjacent New York. University of Amherst Press, Amherst, Massachusetts. 1213 pp.

Taylor, R.L. 1967. The foliar embryos of *Malaxis paludosa*. Canadian Journal of Botany 45:1553-1556.

TABLES

Table 1. Range wide distribution of *Malaxis brachypoda*.

NOTE: Element occurrence record (EOR) information was obtained from heritage programs in the U.S. and Canada, unless another source was cited. Heritage programs in each state and most provinces with possible EORs were sent emails requesting occurrence and other information about this orchid species. "No response" indicates that no response was received from that program. Each occurrence may represent from one to a hundred or so individuals.

State/Province | Number of occurrences, governmental units and source (if not heritage program)

Alaska No response.
At least **1** occurrence [Source: Checklist for Fort Richardson Army Base, near Anchorage (1995), represented by collection at the Museum Herbarium, Univ. AK, Fairbanks. (Accessed: 13 February 2001). Authorization is needed to view site (2003). (www.uaa.alaska.edu/enri/)].

California **2** occurrences [3 occurrences in 2 counties; (1 possibly extirpated in 1 county, remaining 2 occurrences in second county)].

Colorado Response, but no EOR information was sent.
2 occurrences; [4 occurrences, (2 probably extirpated, 2 others in two counties)]. Source: (Jennings 1989).

Connecticut **6** occurrences in 1 county; [2 historical (before 1940), and 4 (after 1987)].

Illinois **0** occurrences; (1 extirpated, see discussion for Illinois in the section on Distribution, Status, and Abundance).

Indiana **0** occurrences; (see discussion for Indiana in the section on Distribution, Status, and Abundance)

Maine **20** occurrences; [21 occurrences in 10* counties, 16 historical (before 1978), 4 recent (1978 to 2001), and 1 extirpated].
*In 8 counties according to Magee and Ahles (1999).

Massachusetts 13 occurrences; [7 historical (reported prior to 1978), and 6 recent (verified since 1978)]. In 3 counties (Magee and Ahles 1999).

Table 1. Range wide distribution of *Malaxis brachypoda*. (Continued)

Michigan At least **28** occurrences [in 27 counties and Isle Royale (Voss 1972)].
12 occurrences in Hiawatha National Forest (in 3 counties). (Source: Index for Plant Atlas, Hiawatha National Forest).

Minnesota No response.
41 known sites within the Laurentian Mixed Forest Province in MN. (Source: MN Natural Heritage Program, 2000, cited in USFS 2001b).
23 occurrences in Chippewa National Forest. [Source: Occurrence records for Chippewa National Forest (Ian Shackleford)].
0 (1 historic)--not known from Superior NF (USFS 1999 cited MN Natural Heritage Program's EORs); USFS 2001b; one historic site from 1956 (Ed Lindquist, Superior NF, pers. comm.).
In 8 counties (1950 - 1992) and in 3 counties (before 1950); [Sources: (Smith 1993); species status sheet, MN County Biological Survey, (1998) cited in USFS 2001b; occurrence records for Chippewa National Forest (Ian Shackleford)].

New Hampshire 3 occurrences in 3 counties; [2 historical (before 1950), and 1 recent (in 1983)].

New Jersey No response.
At least **1** occurrence; [in 1 county (Correll 1978)].

New York ~**70** occurrences; (most are historic records before 1950) scattered statewide in 32 counties [source: Chuck Sheviak, Curator of Botany, New York State Museum, pers. comm., 2001].

Pennsylvania No response from Eastern PA program.
15 occurrences; [1 extant, 11 historic (western PA), 3 historic (eastern PA)].

Tennessee **0** occurrences; (see discussion for Tennessee in the section on Distribution, Status, and Abundance).

Texas **0** occurrences; (see discussion for Texas in the section on Distribution, Status, and Abundance).

Vermont No response.
At least **7** occurrences; [in 7 counties (Magee and Ahles 1999)].

Wisconsin **49** occurrences in 16 counties.

Alberta **17** occurrences.

Table 1. Range wide distribution of *Malaxis brachypoda*. (Continued)

BritishColumbia At least **16** occurrences.

New Brunswick ~**7** occurrences. [Source accessed: 14 February 2001. (http://www.lowimpactforestry.com/environment/speciesatrisk.htm)}

Manitoba No response.
3 occurrences (Johnson 1981).

Ontario No response (not tracked in Ontario).
1 occurrence in Moskoka District. [Source accessed: 13 February 2001, (www.library.utoronto.ca/muskoka_flora/species/sp0020.htm)].
At least **1** occurrence in Baxter Conservation Area (South of Ottawa). [Source accessed: 14 February 2001, (www.icons.net/~wendt/species.htm)].
~**58** colonies; [since 117 colonies of *Malaxis brachypoda* in the Ottawa District, western Ontario/eastern Quebec (Reddoch and Reddoch 1997), perhaps about half are in Ontario].

Quebec At least 50 occurrences.
~**58** colonies; [since 117 colonies of *Malaxis brachypoda* in the Ottawa District, western Ontario/eastern Quebec (Reddoch and Reddoch 1997), perhaps about half are in Quebec].

Saskatchewan ~**7** occurrences.

EORs in U.S.	**257**
EORs in Canada	**166**
TOTAL OCCURRENCES in the U.S. and CANADA	**at least 423**

Table 2. Number of Element Occurrence Records (EORs) in U.S. National Forests.

State/National Forest (NF)	Number of Element occurrence records (source)
California	
San Bernardino NF, (San Gorgonio Wilderness)	**1** (Roxanne Bittman, California Natural Diversity Database, pers. comm., 2001).
Colorado	
Pike NF	**1** (Steve Tapia, Region 2, pers. comm., 2001).

Michigan	
Hiawatha NF,	**12** (Index for plant atlas, Hiawatha NF).
Huron-Manistee NF	**1** (Alex Cleveland pers. comm., 2001).
Minnesota	
Chippewa NF	**23** (Ian Shackleford, Chippewa NF, pers. comm.).
Superior NF	**0** (1 historic)--not known from Superior NF (USFS 1999 cited MN Natural Heritage Program's EORs; USFS 2001b; one historic site from 1956 (Ed Lindquist, Superior NF, pers. comm., 2001).
Wisconsin	
Chequamegon-Nicolet NF	**3** on the Chequamegon NF; **17** on the Nicolet NF (USFS 1999 cited MN Natural Heritage Program's EORs, 24 September 1999).

Total State EORs	**257**
Total National Forest EORs	**41**
% of U.S. EORs occurring in National Forests	**13.5% (likely less than this %)**

Table 3. Sites* of *Malaxis brachypoda* [information from element occurrence records (EORs) and other sources]

State/Province	Total EORs**	Public protected sites: (USFS)	Public protected sites: (State)	Public unprotected site: (Other USFS)	Public unprotected site: (State)	Public unprotected site: (Other)	Private Protected	Private Not Protected	Unknown Protection
Alaska	1					1			
California	2	1							1
Colorado	2			1		1			
Connecticut	6						1	1	4 (2 hist.)
Maine	20								20 (16 hist.)
Massachusetts	13								13 (7 hist.)
Michigan	27			13					14
Minnesota	41			15	5	1		2	18
New Hampshire	3							1	2 historic
New York	~70								~70 mostly historical?
Pennsylvania	15							1	14 historic
Wisconsin	49			22	3	1		4	23
Alberta	17		~9			~3	~0	~5	
British Columbia	16		1			4			11

Manitoba	3									3
New Brunswick	~7									~7
Ontario	58								1	57
Quebec	58									58
Saskatchewan	~7									7
Totals* **	~415	1	0	~10	50	8	11	1	15	~323
		Total public protected sites = ~11			Total public unprotected sites = 69			1	15	~323

Total protected sites within range: ~12 Total unprotected (or unknown): ~407

Protected means an area "maintained in its natural state with an active management which allows for mimicking of natural processes or allows natural disturbances to proceed without interference" (The Nature Conservancy definition).

* A site can be anywhere from one to 50 (100) individuals.
** Occurrences that were extirpated/probably extirpated were not included in the total EORs column; historic occurrences (i.e., records before 1978) were included.
*** Totals may not add up due to discrepancies in reporting format.

APPENDICES

APPENDIX A: Heritage Status Rank Definitions. Global (G), National (N), and Subnational (S); [subnational (or subnation) refers to state or provincial level; e.g., Michigan, Ontario)] (NatureServe 2001).

Rank	Definition
G4Q	Apparently Secure — Uncommon but not rare (although it may be rare in parts of its range, particularly on the periphery), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern. Typically more than 100 occurrences and more than 10,000 individuals. Questionable taxonomy.
N3	See S3 below.
N4	See S4 below.
S1	Critically imperiled--Critically imperiled in the subnation because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the subnation. Typically 5 or fewer occurrences or very few remaining individuals (<1,000).
S1.1	A subnational rank that is subdivided to permit a state to further prioritize its vulnerable elements.
S1S2 or S2S3	A numeric range rank is used to indicate the range of uncertainty about the exact status of the element.
S2	Imperiled--Imperiled in the subnation because of rarity or because of some factor(s) making it very vulnerable to extirpation from the subnation. Typically 6 to 20 occurrences or very few remaining individuals (1,000 to 3,000).
S3 or N3	Vulnerable--Vulnerable in the nation or subnation either because rare and uncommon found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21 to 200 occurrences or between 3,000 and 10,000 individuals.
S4 or N4	Apparently Secure--Uncommon but not rare, and usually widespread in the nation. Possible cause of long-term concern. Usually more than 100 occurrences and more than 10,000 individuals.
S?	Unranked--Subnation rank not yet assessed.
SU	Unrankable--Currently unrankable due to lack of information or due to substantially

conflicting information about status or trends.

SR Reported-- Element reported in the subnation but without a basis for either accepting or rejecting the report, or the report not yet reviewed locally. Some of these are very recent discoveries for which the program hasn't yet received first-hand information; others are old obscure reports.

APPENDIX B: Element occurrence records (EOR) and other reports for *Malaxis brachypoda* in the United States and Canada. CONFIDENTIAL.

UNITED STATES

CALIFORNIA

Location: California, San Bernardino County
EO number: 1
Date last observed: 5 August 1989
Ownership: Unknown
Abundance: 1989 (1 plant); previously not seen since 1947)
Habitat: On silty humps on bank of lilies in marshy area near stream with grasses, *Gentiana*, *Trifolium*, and corn lilies.
Plant in 1989 was in moderate to heavy shade. Elevation 8400'
Comments: Impacts from hikers and foraging animals on a nearby trail threaten the plant.
Information source: California Natural Diversity Database

Location: California, Riverside County
EO number: 2
Date last observed: 5 September 1922; possibly extirpated
Ownership: Unknown
Abundance: Plant has not been rediscovered in spite of recent (1980, 1981) searches.
Habitat: Rare in wet meadow, growing in small elevations. Elevation 8000'
Comments: Meadows heavily grazed and trampled
Information source: California Natural Diversity Database

Location: California, San Bernardino County
EO number: 3
Date last observed: 13 August 1989
Ownership: USFS, San Bernardino National Forest, San Gorgonio Wilderness
Abundance: 1989 (25 plants)
Habitat: In wet meadow area in short grasses and ridges among *Veratrum californicum* (corn lilies). Elevation 7800'
Comments: Foraging animals and occasional hikers in meadow could threaten plants here.
Information source: California Natural Diversity Database

COLORADO

Location: Colorado, Boulder County
EO number: 002
Date last observed: 1981
Ownership: Boulder Mountain Park
Abundance: 7 plants in 1989
Habitat: Along stream from springs, in moss. Elevation 7200'
Comments: Although trail is close by, it is unlikely that significant disturbance would occur from hikers who generally stay on the trail.
Information source: Jennings (1989)

Location: Colorado, Jefferson County
EO number: 003
Date last observed: 1989
Ownership: USFS (or private inholding in Pike NF??)
Abundance: 6 plants
Habitat: Streamside, under small spruce tree and associated with aspen, birch, *Goodyera repens;* in less than 10 square feet area; 8030 - 8080' elevation.
Comments: Logging is occurring on the hillside about 100' from the population; the marshy nature of the creekside habitat will probably save it from logging. Population should be monitored and larger populations or better sites sought in the vicinity.
Information source: Jennings (1989) (www.ndis.nrel.colorado.edu/ndis/rareplants/pike.html). Accessed 14 February 2001

Location: Colorado, Boulder County
EO number: 004
Date last observed: 1971 (not relocated since; extirpated?)
Ownership: Boulder Mountain Park
Abundance: 5 plants in 1970
Habitat: Series of pools and falls with mossy stream banks with *Listera convallarioides*. Elevation 7500'
Information source: Jennings (1989)

CONNECTICUT

Location: Connecticut, Litchfield County
EO number: 001
Date last observed: 1996
Ownership: Private, in part
Abundance: 1996 (1plant); 1990 (6 plants; 1 with fruit from last year); 1988 (2 plants); 1984 (15 in fruit/flower); and earlier
Habitat: Peaty mucky substrate; in headwater springs. Elevation 710'
Comments: Water level has been significantly lowered by artificial drainage for agricultural

reclamation by downstream landowner
Information source: Connecticut Natural Diversity Database

Location: Connecticut, Litchfield County
EO number: 002
Date last observed: 7 August 1992
Ownership: The Nature Conservancy
Abundance: 1993 (not found); 1992 (observed); 1986 (2 plants, 1 in fruit); and earlier
Habitat: Brook, cold mucky inlet. Elevation 700'
Information source: Connecticut Natural Diversity Database

Location: Connecticut, Litchfield County
EO number: 003
Date last observed: 11 June 1988
Ownership: Unknown
Abundance: 1996 (not found); 1988 (2 plants)
Habitat: Calcareous seepage swamp, in a wet hollow amid *Thuja*. Elevation 650'
Comments: Unlike most CT and MA populations
Information source: Connecticut Natural Diversity Database

Location: Connecticut, Litchfield County
EO number: 004
Date last observed: 28 June 1995
Ownership: Unknown
Abundance: 1995 (87 plants); 1989 (not found); 1987 (21 plants)
Habitat: A small seepage swamp with seasonal flow. Elevation 760'
Information source: Connecticut Natural Diversity Database

Location: Connecticut, Litchfield County
EO number: 005
Date last observed: 21 June 1939
Ownership: Unknown
Abundance: Mostly very open seepy slope in hemlock grove; very local.
Information source: Connecticut Natural Diversity Database

Location: Connecticut, Litchfield County
EO number: 006
Date last observed: September 1909
Ownership: Unknown
Abundance: Wet cold woods, in leaf mould
Information source: Connecticut Natural Diversity Database

MAINE

Location: Maine, Aroostook County
EO number: 001
Date last observed: Summer 1984, extirpated
Ownership: Unknown
Abundance: 1990 (extirpated); 1984 (3 plants); 1983 (18+stems); 1980 (8 flowering stems)
Habitat: Quaking *Thuja* bog, with pond in center; plants in 1980 at pond edge
Comments: Area logged severely after registry
Information source: Maine Natural Areas Program

Location: Maine, Aroostook County
EO number: 002
Date last observed: 2 July 1985
Ownership: Unknown
Abundance: 1997 (not found); 1985 (3 flowering and 2 vegetative plants)
Habitat: North calcareous bog underlain by limey bedrock and marl deposits; open; with scattered clumps of white cedar and larch in *Sphagnum*
Comments: Small population, but in good habitat, protected area; CD population quality rank
Information source: Maine Natural Areas Program

Location: Maine, Aroostook County
EO number: 003
Date last observed: 7 September 1896 (historic)
Ownership: Unknown
Habitat: Cedar swamp
Information source: Maine Natural Areas Program

Location: Maine, Aroostook County
EO number: 004
Date last observed: 19 July 1902 (historic)
Ownership: Unknown
Habitat: Cedar swamp
Information source: Maine Natural Areas Program

Location: Maine, Aroostook County
EO number: 005
Date last observed: 8 July 1904 (historic)
Ownership: Unknown
Habitat: Arbor vitae swamps, lowest wet spots
Information source: Maine Natural Areas Program

Location: Maine, Aroostook County
EO number: 006

Date last observed: 11 July 1902 (historic)
Ownership: Unknown
Habitat: Arbor vitae swamp
Information source: Maine Natural Areas Program

Location: Maine, Aroostook County
EO number: 007
Date last observed: 8 September 1896 (historic)
Ownership: Unknown
Habitat: Cedar swamp
Information source: Maine Natural Areas Program

Location: Maine, Aroostook County
EO number: 008
Date last observed: 12 August 1944
Ownership: Unknown
Habitat: Boggy woods
Information source: Maine Natural Areas Program

Location: Maine, Piscataquis County
EO number: 009
Date last observed: September 1871 (historic)
Ownership: Unknown
Abundance: 1986 (not found); 1871; 1870
Information source: Maine Natural Areas Program

Location: Maine, Somerset County
EO number: 010
Date last observed: 18 August 1915 (historic)
Ownership: Unknown
Habitat: Wet woods
Information source: Maine Natural Areas Program

Location: Maine, Franklin County
EO number: 011
Date last observed: 10 August 1893 (historic)
Ownership: Unknown
Information source: Maine Natural Areas Program

Location: Maine, Oxford County
EO number: 012
Date last observed: June 1874 (historic)
Ownership: Unknown
Habitat: Cedar swamp

Information source: Maine Natural Areas Program

Location: Maine, Oxford County
EO number: 013
Date last observed: 1895 (historic)
Ownership: Unknown
Comments: Specimen exhibited at Boston Horticultural Hall
Information source: Maine Natural Areas Program

Location: Maine, Oxford County
EO number: 014
Date last observed: 20 August 1923 (historic)
Ownership: Unknown
Abundance: 1923 (plentiful)
Habitat: Arbor vitae swamp, on wet mossy elevations
Information source: Maine Natural Areas Program

Location: Maine, Kennebec County
EO number: 015
Date last observed: June 1878 (historic)
Ownership: Unknown
Habitat: Swamp
Information source: Maine Natural Areas Program

Location: Maine, Kennebec County
EO number: 016
Date last observed: 6 July 1916 (historic)
Ownership: Unknown
Habitat: Swamp in woods
Information source: Maine Natural Areas Program

Location: Maine, Androscoggin County
EO number: 017
Date last observed: 9 July 1916 (historic)
Ownership: Unknown
Information source: Maine Natural Areas Program

Location: Maine, York County
EO number: 018
Date last observed: 29 July 1931 (historic)
Ownership: Unknown
Information source: Maine Natural Areas Program

Location: Maine, Washington County

EO number: 019
Date last observed: 9 July 1989
Ownership: Unknown
Abundance: 1991 (not seen, very dry); 1989 (11-50 plants, some in flower); 1981 (one flowering plant)
Habitat: Low, moist depression on coastal island, with conspicuous patch of *Iris versicolor*
Comments: Population quality rank of A
Information source: Maine Natural Areas Program

Location: Maine, Washington County
EO number: 020
Date last observed: Summer 1989 (extant)
Ownership: Unknown
Abundance: 1989 (single plant)
Habitat: Seepy slope with calciphiles such as *Adiantum pedatum* and *Cystopteris bulbifera*
Information source: Maine Natural Areas Program

Location: Maine, Penobscot County
EO number: 021 (extant)
Date last observed: 16 August 1988 (extant)
Ownership: Unknown
Habitat: Associated with cedars
Information source: Maine Natural Areas Program

MASSACHUSETTS

Location: Massachusetts
Ownership: Unknown
Abundance: 6 occurrences (1978 to present); 7 historical occurrences (before 1978)
Habitat: Shady, wet areas such as swamps and bogs, usually growing in *Sphagnum* moss, with little else. It also favors coniferous, forested fens and peatland communities dominated by coniferous trees and influenced by highly calcareous water.
Information source: Massachusetts Natural Heritage Program fact sheet

MICHIGAN (not tracked in Michigan)

Location: Michigan, Hiawatha National Forest
Ownership: USFS, Hiawatha National Forest
St. Ignace District, Mackinac County: 6 occurrences, one of which in dense closed canopy white cedar swamp with open understory, wet spots and dense Sphagnum mosses (M. Jaunzems specimen, 6 July 1999)
Munising District, Alger County: 2 occurrences
Rapid River/Manistique District (Delta County): 4 occurrences

Location: Michigan, Alcona County, Near Huron-Manistee Forest
Habitat: Shoreline
Information source: University of MI herbarium specimen; information provided by Dr. Ed Voss (3 January 2000)

Location: Michigan, Manistee County
Specifics: Malthy Swamp, T24N R4E Sec 29,32
Ownership: Huron-Manistee National Forest
Habitat: Cedar swamps – presumed historic record
Information source: University of MI herbarium specimen; information provided by Dr. Ed Voss (3 January 2000)

Location: Michigan, Ogemaw County
Habitat: Under cedar
Information source: University of MI herbarium specimen, July 1972; information provided by Dr. Ed Voss (3 January 2000)

Location: Michigan, Oscoda County
Near Huron-Manistee Forest (1966)
Habitat: Cedar swamp
Comment: With *Habenaria obtusa*
Information source: University of MI herbarium specimen; information provided by Dr. Ed Voss (3 January 2000)

Location: Michigan, Otsego County (1966)
Habitat: Old tote road along river
Comment: Common
Information source: University of MI herbarium specimen (2002); Fred Case collector

Location: Michigan, Montmorency County (1962)
Habitat: Along creek
Information source: University of MI herbarium specimen (2002); Fred Case collector

Location: Michigan, Kalamazoo County (1933)
Habitat: Wooded bog
Information source: University of MI herbarium specimen (2002); Hanes

Location: Michigan, Emmet County (1964)
Habitat: Ridge trail at Wilderness State Park
Information source: University of MI herbarium specimen (2002)

Location: Michigan, Cheboygan County (1924)
Habitat: Bog near Burt Lake
Information source: University of MI herbarium specimen (2002)

Location: Michigan, Charlevoix County (1958)
Habitat: Mixed woods
Comment: Beaver Island
Information source: University of MI herbarium specimen (2002); Voss specimen

Location: Michigan, Keweenaw County (1930)
Comment: Isle Royale
Information source: University of MI herbarium specimen (2002)

Location: Michigan, Mackinac County, Summerby Swamp
Information source: Fred Case (pers. comm.)

Location: Michigan, Chippewa County, north of Trout Lake
Habitat: In somewhat battered cedar swamps along highway
Information source: Fred Case (pers. comm.)

Location: Michigan, Alger County, near Shingleton
Habitat: Cedar swamps
Information source: Fred Case (pers. comm.)

Location: Michigan, Alger County, near Sable Falls
Habitat: Steep mossy banks in ravine
Information source: R. McVaugh (Univ. of MI)

Location: Michigan, Alger County, Grand Sable Dunes, near Grand Sable Lake
Ownership: Pictured Rocks National Lakeshore
Abundance: >60 plants in 2 ft. square area; other plants occurred as scattered individuals
Habitat: Wooded dunes just above lake; in very dark thickets of *Abies balsamea* high in the dunes in a cool, but not especially moist location.
Comments: A few dozen feet from a *Calypso bulbosa* site studied by Jan Schultz (Hiawatha National Forest)
Information source: Fred Case (pers. comm.)

Location: Michigan, Alger County
Habitat: Steep north-facing sandy bank; in open sunlight
Comments: With *Malaxis unifolia*
Information source: Fred Case (pers. comm.)

Location: Michigan, Mackinac**,** Hiawatha National Forest
Date last observed: 10 September 2001
Ownership: USDA, Forest Service
Abundance: Scattered individuals in twos or threes
Location: Michigan, Alger County, Grand Sable Dunes, near Grand Sable Lake

Ownership: Pictured Rocks National Lakeshore
Abundance: >60 plants in 2 ft. square area; other plants occurred as scattered individuals
Habitat: Cedar swamp; mostly in darkest part of swamp with open understoy; on hummocks (on high and low positions, but not right at bottom of hummocks); some plants adjacent to very narrow deer trail. Tree species include*Thuja occidentalis, Abies balsamea, Larix laricina*, and *Picea mariana*. Understory species include *Rhamnus alnifolia, Lonicera villosa, Rubus pubescens*, and *Vaccinium angustifolium.* Herbaceous species include *Carex eburnea, Sphagnum spp., Linnaea borealis, Hylocomium splendens, Carex leptalea, Carex pedunculata, Coptis trifolia, Smilacina trifolia,, Equisetum scirpoidea, Polygala paucifolia, Mitella nuda, Cornus canadensis*
Comments: Old logging trail to east of area surveyed; ditch also old
Information source: Michigan Natural Features Inventory special plant form (Mark Jaunzems)

MINNESOTA

US Forest Service EOR:

Location: Minnesota, Beltrami County, and Chippewa National Forest
FS#: 1001
Date last observed: 1993 July
Ownership: USDA, Forest Service
Habitat: Mixed conifer swamp, phase white cedar
Information source: Chippewa National Forest (record provided by Ian Shackleford)

Location: Minnesota, Itasca County, and Chippewa National Forest
FS #: 1002
Date last observed: 18 May 1994
Ownership: State
Habitat: In transition between hardwood and lowland conifer
Information source: Ian Shackleford

FS#: 1003 ???

Location: Minnesota, Itasca County, and Chippewa National Forest
FS#: 1004
Date last observed: 16 June 1998
Ownership: USDA, Forest Service
Abundance: 3 plants
Habitat: Lowland hardwoods with aspen, black ash canopy
Information source: Ian Shackleford

Location: Minnesota, Itasca County, and Chippewa National Forest
FS#: 1005
Date last observed: 27 June 1998

Ownership: USDA, Forest Service
Abundance: 3 plants
Habitat: Cedar on edge of stand with *Rubus*, sedges, maple seedlings, ash seedlings; balsam/white cedar canopy; moist wood; not boggy with peaty soil.
Information source: Ian Shackleford

Location: Minnesota, Itasca County, and Chippewa National Forest
FS#: 1006
Date last observed: 10 July 1999
Ownership: USDA, Forest Service
Abundance: 5 plants
Habitat: Growing at the edge of a lowland conifer/lowland hardwood site that is an inclusion in a larger upland hardwood site
Information source: Ian Shackleford

Location: Minnesota, Itasca County, and Chippewa National Forest
FS#: 1007
Date last observed: 9 July 1999
Ownership: USDA, Forest Service
Abundance: 2 plants
Habitat: Growing on the sides of a hummock site within a lowland conifer forest type
Information source: Ian Shackleford

Location: Minnesota, Cass County, and Chippewa National Forest
FS#: 2001
Date last observed: 6 September 1993
Ownership: Private
Abundance: 1 plant
Habitat: In cedar swamp

Location: Minnesota, Cass County, and Chippewa National Forest
FS#: 2002
Date last observed: 7 July 1999
Ownership: USDA, Forest Service
Abundance: 4 plants
Habitat: Balsam-fir-birch-aspen; plants found in large cedar inclusions; growing on *Sphagnum*
Information source: Ian Shackleford

Location: Minnesota, Itasca County, and Chippewa National Forest
FS#: 3001
Date last observed: 16 July 1997
Ownership: USDA, Forest Service
Abundance: 5 plants
Habitat: Mixed conifer swamp

Information source: Ian Shackleford

Location: Minnesota, Itasca County, and Chippewa National Forest
FS#: 3002
Date last observed: 2 July 1998
Ownership: USDA, Forest Service
Abundance: 6 plants
Habitat: Mixed ash, balsam, aspen at edge of ash cedar wetland
Information source: Ian Shackleford

Location: Minnesota, Itasca County, and Chippewa National Forest
FS#: 4001
Date last observed: 19 June 1994
Ownership: State
Habitat: Cedar swamp
Information source: Ian Shackleford

Location: Minnesota, Itasca County, and Chippewa National Forest
FS#: 4002
Date last observed: 19 June 1994
Ownership: USDA, Forest Service
Habitat: Cedar swamp
Information source: Ian Shackleford

Location: Minnesota, Itasca County, and Chippewa National Forest
FS#: 4003
Date last observed: 20 May 1994
Ownership: USDA, Forest Service
Habitat: Along the edge of pools in northern hardwood stand
Information source: Ian Shackleford

Location: Minnesota, Cass County, and Chippewa National Forest
FS#: 5001
Date last observed: 16 July 1992
Ownership: USDA, Forest Service
Abundance: 20 plants
Habitat: South bank of river at bottom of slope
Information source: Ian Shackleford

Location: Minnesota, Cass County, and Chippewa National Forest
FS#: 5002
Date last observed: 24 July 1992
Ownership: Private
Habitat: Plants occur in and around pools in a lowland conifer swamp; observed in four of many

pools in the swamp
Information source: Ian Shackleford

Location: Minnesota, Cass County, and Chippewa National Forest
FS#: 5003
Date last observed: 26 June 1992
Ownership: County
Habitat: In a lowland conifer swamp along edge of pools under ash; swamp is just a pocket surrounded by high ground
Information source: Ian Shackleford

Location: Minnesota, Cass County, and Chippewa National Forest
FS#: 5004
Date last observed: 25 August 1993
Ownership: State
Habitat: In cedar swamp
Information source: Ian Shackleford

Location: Minnesota, Cass County, and Chippewa National Forest
FS#: 5005
Date last observed: 5 September 2000
Ownership: USDA, Forest Service
Abundance: 8 plants
Habitat: Closed canopy white cedar swamp, growing on *Sphagnum*
Information source: Ian Shackleford

Location: Minnesota, Cass County, and Chippewa National Forest
FS#: 5006
Date last observed: 7 September 2000
Ownership: State
Abundance: 2 plants
Habitat: Growing on mossy log. Under balsam fir and paper birch, edge of white cedar swamp.
Information source: Ian Shackleford

Location: Minnesota, Cass County, and Chippewa National Forest
FS#: 5007
Date last observed: 5 September 2000
Ownership: USDA, Forest Service
Abundance: 2 plants
Habitat: Growing on *Sphagnum*, black ash canopy, open, with balsam fir and northern white cedar
Information source: Ian Shackleford

Location: Minnesota, Cass County, and Chippewa National Forest

FS#: 5008
Date last observed: 30 August 2000
Ownership: USDA, Forest Service
Abundance: 2 plants
Habitat: Growing on moss, in northern white cedar swamp, with black ash, balsam fir
Information source: Ian Shackleford

Location: Cass County, and Chippewa National Forest
FS#: 5009
Date last observed: 5 September 2000
Ownership: USDA, Forest Service
Abundance: 7 plants
Habitat: Black ash with small balsam fir, alder
Information source: Ian Shackleford

Location: Minnesota, Cass County, and Chippewa National Forest
FS#: 5010
Date last observed: 29 August 2000
Ownership: USDA, Forest Service
Abundance: 1 plant
Habitat: Edge of cedar-shrub swamp with black ash, some blowdown. Another population ~150' west.
Information source: Ian Shackleford

Location: Minnesota, Cass County, and Chippewa National Forest
FS#: 5011
Date last observed: 30 July 2001
Ownership: USDA, Forest Service
Abundance: 12 plants
Habitat: Overstory dominated by small green ash and balsam fir. Other canopy species include *Betula papyrifera, Aspen* spp., and *Thuja occidentalis*. Microtopography on floor created by *Sphagnum* hummocks. Associated species include *Rubus pubescens, Maianthemum canadense, Cornus canadensis, Mitella nuda*, and *Aralia nudicaulis*.
Information source: Chippewa National Forest TES database (December 2001)

MN DNR EOR: (As of May 10, 2002)

Location: Minnesota, St. Louis County
MN DNR #: 1
Date Last Observed: July 1956
Ownership: Owner unknown
Site: Not named
Legal: T050N R20W 19
Managed Area(s): Not managed or no record

Source: LAKELA, O. (20635)
In deep sphagnum (rare). Prairie Lake Rd., Hwy 51. 1 Dup.

Location: Minnesota, St. Louis County
MN DNR #: 2
Date Last Observed: July 1956
Ownership: Owner unknown
Site: Indian Hill 14
Legal: T068N R21W 14
Managed Area(s): Not managed or no record
Source: Lakela, O. (20540)
Arbor vitae swamp, W side of Hwy 53 S of Ash R. Trail Jct. 1 dup.

Location: Minnesota, Crow Wing County
MN DNR #: 3
Date Last Observed: August 1891
Ownership: Owner unknown
Site: Site not named or no record
Legal:
Managed Area(s): Not managed or no record
Source: Sandberg, J.H.
Rich woods. Not mapped. 1 dup.

Location: Minnesota, Pine County
MN DNR #: 4
Date Last Observed: August 1945
Ownership: Owner unknown
Site: Site not named or no record
Legal:
Managed Area(s): Not managed or no record
Source: Moore, J.W. and Huff, N.L. (18139)
In balsam-spruce swamp, 5 Mi NE of Headwaters St. Croix SP

Location: Minnesota, Itasca County
MN DNR #: 5
Date Last Observed: July 1977
Ownership: Owner unknown
Site: Wabu Woods
Legal: T057N R26W 22
Managed Area(s): Not managed or no record
Source: Wheeler and Glaser (2240)
SESE Sec 22 T57N R26W CA 11.5 mi WNW of Grand Rapids. Growing in a Speckled alder thicket- Black ash swamp. In wet soil and with almost full shade

Location: Minnesota, Clearwater County
MN DNR #: 6
Date Last Observed: July 1971
Ownership: MN DNR Wildlife (Scientific and Natural Areas)
Site: Iron Springs Bog
Legal: T144N R36W 28
Managed Area(s): Iron Springs Bog SNA. Mississippi Headwaters State Park
Source: Ownbey, G.B. (4507)
1.3 mi due W of L Itasca post office, E side of Sucker Crk, SE Sec 28 T144N R36W. Among sphagnum and other mosses under Black spruce, bog. Substrate was on dryish side for bog and Malaxis restricted to a narrow transitional zone.

Location: Minnesota, Hubbard County
MN DNR #: 7
Date Last Observed: August 1935
Ownership: MN DNR Parks and Recreation
Site: Itasca State Park
Legal: T143N R35W 30
Managed Area(s): Itasca State Park
Source: Grant, M.L. (6595)
Spruce bog SE of Mary L NWNE 30 T143 R35. (Also Itasca SP).

Location: Minnesota, Clearwater County
MN DNR #: 8
Date Last Observed: 10 July 1984
Ownership: MN DNR Parks and Recreation
Site: Itasca Wilderness Sanctuary (2000 acres)
Legal: T143N R36W 15
Managed Area(s): Itasca Wilderness Sanctuary SNA. Itasca State Park
Source: Smith, W.R. (9540)
One plant seen in sphagnum hummock in spruce-tamarack swamp. With *Liparis loeselii, Listera cordata, Malaxis unifolia*. SW 1/4 SW 1/4 Sec 15, T143N R36W.

Location: Minnesota, Lake of the Woods County
MN DNR #: 9
Date Last Observed: July 1979
Ownership: MN DNR Forestry (State Forest and Con-Con Land)
Site: Hamilton Farm 17
Legal: T158N R32W 17
Managed Area(s): Beltrami Island State Forest
Source: Boe, J. (738)
Lake of the Woods Co Sec 17 T158N R32W. In hardwood stand (Fraxinus, Ulmus, Quercus) along Bankton Trail. With *Botrychium virginianum, Carex intumescens, C. tenera, Lonicera hirsute, Galium triflorum*. Taken from rare plant site form.

Location: Minnesota, Cass County
MN DNR #: 10
Date Last Observed: 16 July 1992
Ownership: U.S. Forest Service (National Forest)
Site: Shingobee River
Legal: T141N R31W 17
Managed Area(s): Chippewa National Forest
Source: Myhre, K. (KMM2751)
Located on the south bank of the Shingobee River at the bottom of a very steep decline to an iron-spring bog dominated by *Thuja occidentalis*. Plants occur in and around the first pools encountered at the base of the slope. 20 plants observed in the vicinity of 5 pools, and 1 plant observed deeper in the swamp. Assoc. species incl*: Botrychium virginianum, Moneses uniflora, Saxifraga pennsylvanica, Goodyera repens var. ophioides*, and *Platanthera obtusata*.

Location: Minnesota, Cass County
MN DNR #: 11
Date Last Observed: 24 July 1992
Ownership: Private
Site: Rogers Point
Legal: T141N R29W 06
Managed Area(s): Leech Lake Reservation. Chippewa National Forest
Source: Myhre, K. (KMM2822)
Located in the Cedar Springs Lodge Wildlife Refuge. Plants occur in and around pools in a swamp forest dominated by *Thuja occidentalis*. Assoc. species include: *Platanthera orbiculata, P. obtusata, P. hyperborea, Corallorhiza trifida, Goodyera repens var. ophioides, Halenia deflexa, Botrychium virginianum*, and *Cypripedium calceolus var. parviflorum*. Tremendous variation in the size of flowering plants which were observed in only four of the many pools in this bog.

Location: Minnesota, Cass County
MN DNR #: 12
Date Last Observed: 26 June 1992
Ownership: Private
Site: Rogers 31
Legal: T142N R27W 31
Managed Area(s): Chippewa National Forest. Leech Lake Reservation
Source: Myhre, K. (KMM2425)
Infrequent in a swamp forest dominated by *Fraxinus nigra, Abies balsamea*, and *Thuja occidentalis*. Plants growing in needle duff under balsams and along edge of the pools under ash. This swamp is in a pocket surrounded by high ground on all sides. Very Moist. Plants in mid-bloom. Assoc. spp include: *Platanthera obtusata, P. hyperborea, Cypripedium calceolus var. parviflorum, Goodyera repens var. ophioides, Cypripedium reginae*, and *Corallorhiza trifida*.

Location: Minnesota, Pine County
MN DNR #: 13
Date Last Observed: 21 July 1993
Ownership: MN DNR Parks and Recreation
Site: St. Croix State Park
Legal: T040N R19W 15
Managed Area(s): St. Croix StatePark
Source: Myhre, K. and Aaseng, N. (KMM4213)
Located 3.5 miles north of head of the Rapids Landing in St. Croix State Park. Plants occur in a swamp forest dominated in a small area by *Thuja occidentalis* near the base of a gentle slope. Associated species include: *Athyrium angustum, Impatiens carpensis, Onoclea sensibilis, Goodyera repens*, and *Cypripedium calceolus var. parviflorum*. Large specimens relatively visible due to seedpods; fresh flower still connected to pod.

Location: Minnesota, Pine County
MN DNR #: 14
Date Last Observed: 21 July 1993
Ownership: MN DNR Parks and Recreation
Site: St. Croix State Park
Legal: T040N R19W 11
Managed Area(s): St. Croix State Park
Source: Myhre, K. (KMM4220)
Located 4 miles north of head of Rapids Landing in St. Croix State Park. Plants occur in swamp forest *with Abies balsamea, Fraxinus nigra, Acer rubra*, and *Betula alleghaniensis*. Associated species include: *Osmunda cinnamomea, O. regalis, Mitella nuda, Clintonia borealis*, and *Cypripedium regina*. Drier area swamp as it approaches the upland.

Location: Minnesota, Pine County
MN DNR #: 15
Date Last Observed: 31 August 1993
Ownership: Owner unknown
Site: Nickerson 30
Legal: T045N R16W 30
Managed Area(s): Nemadji State Forest
Source: Aaseng, N. (9383106)
Approx. 7 mi ESE of Duquette, Nemadji State Forest; north end of large Black ash swamp. With red maple and yellow birch. 5-10 plants growing in moss covered hollows near edge of pools. Assoc. species include *Gymnocarpium dryopteris, Coptis groenlandica, Clintonia borealis*, and *Taxus canadensis*. PH = 5.7 – 5.8.

Location: Minnesota, Pine County
MN DNR #: 16
Date Last Observed: 04 August 1993

Ownership: Owner unknown
Site: Ludwig Unit
Legal: T044N R16W 05
Managed Area(s): Nemadji State Forest
Source: Aaseng, N. (9380401)
Approx. 9.5 mi southeast of Kerrick, in Ludwig mgt area, Nemadji State Forest. Eight plants growing in Balsam fir (11 cm DBH) and Black ash (13 cm DBH) swamp. With ash sapling understory. Old stumps in area. Assoc. species incl *Mitella nuda, Coptis groenlandica, Dryopteris cristata, Carex leptalea*, and *Rhus radicans*. Additional individuals found during search to the east.

Location: Minnesota, Cass County
MN DNR #: 17
Date Last Observed: 25 August 1993
Ownership: U.S. Forest Service (National Forest)
Site: Boy Lake 23
Legal: T142N R28W 27
Managed Area(s): Chippewa National Forest. Leech Lake Reservation
Source: Boe, J. (93082501)
In cedar swamp west of Releve 93-45. Assoc. species: *Platanthera orbiculata, Lycopodium lucidulum*.

Location: Minnesota, Cass County
MN DNR #: 18
Date Last Observed: 06 August 1993
Ownership: U.S. Forest Service (National Forest)
Site: West Sucker Creek
Legal: T144N R30W 02
Managed Area(s): Bowstring State Forest. Chippewa National Forest. Leech Lake Reservation
Source: Boe, J. (93080601)
In Releve 93-36. In cedar swamp with Balsam fir. Assoc. species: *Coptis groenlandica, Aster puniceus, Smilacina trifolia, Aster borealis, Lonicera villosa*, and *Lysimachia thyrsiflora*. 1 plant in Releve, on sphagnum at base cedar. DNR Releve #4441.

Location: Minnesota, Roseau County
MN DNR #: 19
Date Last Observed: 21 August 1990
Ownership: MN DNR Forestry (State Forest and Con-Con Land)
Site: Gun Club
Legal: T164N R40W 25
Managed Area(s): Lost River State Park
Source: Aaseng, N. (9082131)
Approx. 500 m south of Gun Club parking lot along Canadian border. In White cedar- Black spruce swamp with scattered Balsam fir. Single plant found growing on moss hummock with

Ledum groenlandicum, Linnaea borealis, Mitella nuda, Platanthera obtusata, Cornus canadense, and *Equisetum scirpoides*.

Location: Minnesota, Itasca County
MN DNR #: 20
Date Last Observed: 19 June 1994
Ownership: MN DNR Forestry (State Forest and Con-Con Land)
Site: North Lake Jessie 13
Legal: T149N R25W 13
Managed Area(s): Big Fork State Forest. Chippewa National Forest
Source: Myhre, K. (KMM5040)
Located one mile north of Gunderson Lake. Plants occur in a lowland forest dominated by *Thuja occidentalis*. Infrequently observed at this site but much potential habitat. This year's bulb swelling and splitting leaf sheath; last year's bulb still present below (June 19).

Location: Minnesota, Itasca County
MN DNR #: 21
Date Last Observed: 19 June 1994
Ownership: U.S. Forest Service (National Forest)
Site: West Stokes 14
Legal: T060N R27W 14
Managed Area(s): Chippewa National Forest
Source: Myhre, K.M. (KMM5035)
Located one mile northwest of Bello Lake. Plants occur in a swamp forest dominated by *Thuja occidentalis*. Last year's bulb shrinking; flower stalk extending, approaching bloom (June 19). Rare at this site.

Location: Minnesota, Itasca County
MN DNR #: 22
Date Last Observed: 20 May 1994
Ownership: U.S. Forest Service (National Forest)
Site: North Star Cedar
Legal: T058N R26W 04
Managed Area(s): Bowstring State Forest. Chippewa National Forest
Source: Myhre, K. M. (KMM 4783)
Located along the east shore of the southeast bay of North Star Lake. Plants occur along the edge of the pools in a swamp forest dominated by *Thuja occidentalis*. 31 capsules on last year's flower spike; new leaf emerging from side of bulb; several very tough, fiberous sheaths surrounding bulb and new leaf.

Location: Minnesota, Itasca County
MN DNR #: 23
Date Last Observed: 18 May 1994
Ownership: MN DNR Forestry (Lands outside State Forest and Con-Con Land)

Site: Kinghurst 4
Legal: T149N R27W 04
Managed Area(s): Chippewa National Forest
Source: Myhre, K.M. (KMM4762)
Located 3 miles northwest of the town of Dora Lake. Plants occur along the edge of a seepage area at the base of a steep slope. The area is a transition from a Sugar maple forest to a cedar-spruce-balsam lowland. New leaf is emerging from side of bulb; last year's flower spike has approximately 20 seed capsules.

Location: Minnesota, Pine County
MN DNR #: 24
Date Last Observed: 22 July 1994
Ownership: Owner unknown
Site: Rock Lake
Legal: T041N R17W 11
Managed Area(s): Not managed or no record
Source: Aaseng, N. (94722)
Approx. 1.2 mi west of Rock Lake, in 14 acre White cedar swamp surrounded by a Black ash swamp. Three individuals growing in area under dense cedar canopy. Vegetation dominated by moss and *Carex leptalea*. Assoc. spp: *Mitella nuda, Pyrola asarifolia, Rubus pubescens*, and *Arisaema triphyllum*. CSA stand #73. Releve 4715.

Location: Minnesota, Pine County
MN DNR #: 25
Date Last Observed: 01 September 1994
Ownership: Owner unknown
Site: Crystal Creek
Legal: T041N R16W 09
Managed Area(s): St. Croix State Forest
Source: Aaseng, N. (9490108)
Approx. 2.5 mi N of Danbury and 1.4 mi W of St. Croix River. In mixed hardwood swamp approx. 190 m west of St. Croix Forest Road. Single plant growing under Black ash and Balsam fir with scattered Yellow birch. Vegetation dominated *by Osmunda cinnamomea, Asarum canadense*. Assoc. spp: *Carex leptalea, Mitella nuda, Rubus pubescens*, and *Cornus canadense*.

Location: Minnesota, Aitkin County
MN DNR #: 26
Date Last Observed: 11 August 1991
Ownership: Owner unknown
Site: White Elk Brook 9
Legal: T050N R26W 09
Managed Area(s): Hill River State Forest
Source: Myhre, K.M. (KMM1149)

3 miles south of Swatara on County Rd 29, 1 mi east on a logging road. Infrequent. Swamp dominated by *Thuja occidentalis*. In peat soil. Associated with *Botrychium virginianum, Halenia deflexa, Scutellaria galericulata*.

Location: Minnesota, Aitkin County
MN DNR #: 27
Date Last Observed: 02 July 1991
Ownership: Private
Site: Wealthwood 8
Legal: T045N R26W 08
Managed Area(s): Wealthwood State Forest
Source: Myhre, K.M. (KMM1083)
2.5 mi north Mille Lacs Lake on TWP Rd 51, east side of the Rd. Private land. 12 plants – possibly more. Swamp forest with *Thuja occidentalis* and *Fraxinus nigra*. In peat soil. Assoc. with *Mitchella repens, Asarum canadense, Abies balsamea*.

Location: Minnesota, Aitkin County
MN DNR #: 28
Date Last Observed: 11 June 1991
Ownership: Owner unknown
Site: Taylor Lake 23
Legal: T052N R25W 23
Managed Area(s): Hill River State Forest
Source: Smith, W.R. and Myhre, K.M. (WRS18754)
36+ plants located in a cedar swamp 0.5 miles NW of Washburn Lake. Assoc. spp.: *Corallorhiza trifida, Cypripedium calceolus parviflorum, Platanthera obtusata* and *Goodyera repens ophioides*.

Location: Minnesota, Aitkin County
MN DNR #: 29
Date Last Observed: 20 June 1991
Ownership: Owner unknown
Site: Taylor Lake 23
Legal: T052N R25W 23
Managed Area(s): Hill River State Forest
Source: Engels, A. and Myhre, K.M. (Sight record)
Located in cedar swamp 0.5 mi west of Washburn Lake. Assoc. spp.: *Malaxis uniflora, Listera cordata*, and *Platanthera obtusata*.

Location: Minnesota, Beltrami County
MN DNR #: 30
Date Last Observed: July 1993
Ownership: U.S. Forest Service (National Forest)
Site: Taylor 23

Legal: T148N R31W 23
Managed Area(s): Chippewa National Forest (Blackduck State Forest)
Source: Estes, C. (Sight record)
Comp 77, Stand 21 of the Blackduck District. Chippewa NF TES #1001.

Location: Minnesota, Aitkin County
MN DNR #" 31
Date Last Observed: 24 June 1997
Ownership: Owner unknown
Site: Hay Lake Hardwoods
Legal: T052N R23W 36
Managed Area(s): Savanna State Forest
Source: Butler, C. and Anderson, B. (97001)
About 6 miles SE of the Town of Jacobson, on a forested ridge south of Hay Lake Campground. On W side of Hay Lake snowmobile trail. At the edge of an ash swamp at the base of a maple-basswood ridge. Some White cedar mixed with the ash at the edge and continuing up into higher ground. Plants occur around the edges of pools among the ash and cedars. About 20 plants seen. Assoc. spp.: *Aralia nud, Platanthera hyper, Goodyera rep, Mitella nuda*, and *Clintonia bor*.

Location: Minnesota, Aitkin County
MN DNR #: 32
Date Last Observed: 23 July 1997
Ownership: Owner unknown
Site: Turner 16
Legal: T050N R23W 16
Managed Area(s): Savanna State Forest
Source: Engels, A. and Dahle, R. (97015)
About ½ mile north od Aitkin Lake. About a block north of the Twin Lakes Forest Road. At the edge of an ash swamp at the base of an east facing hardwood covered slope. About ten plants seen. Associated with *Caltha palustris*.

Location: Minnesota, Itasca County
MN DNR #: 33
Date Last Observed: 18 July 1997
Ownership: U.S. Forest Service (National Forest)
Site: Bowstring Lake 30
Legal: T147N R26W 30
Managed Area(s): Bowstring State Forest. Leech Lake Reservation. Chippewa National Forest.
Source: Suddendorf, T. (TS97002)
5 plants located approx. 1 mi east of Cut Foot Sioux Campground along CO RD 35 of Turtle Mound parking area. Found in pool of water/sphagnum bog dom by *Thuja occidentalis*. Assoc. spp.: *Picea mariana, Abies balsamea, Cornus canadensis, Mitella nuda, Clintonia borealis, Coptis groenlandica, Gymnocarpium dryopteris, Platanthera obtusata, Ledum*

groenlandicum, and *Circaea lutetiana*.

Location: Minnesota, Aitkin County
MN DNR #: 34
Date Last Observation: 07 August 1997
Ownership: MN DNR Wildlife (Wildlife Management Area)
Site: Moose-Willow WMA
Legal: T051N R25W 15
Managed Area(s): Moose-Willow WMA. Hill River State Forest
Source: Gerdes, L. and Boe, J. (2289)
Moose-Willow WMA, approximately 6 miles SE of Hill City and east of the Moose River Pool. Black ash swamp with *Abies balsamea* and a few *Populus tremuloides*. Assoc. spp. include *Trientalis borealis, Rubus pubescens, Coptis trifolia*. 3 plants observed at lower edges of hummocks.

Location: Minnesota, Beltrami County
MN DNR #: 35
Date Last Observed: 13 July 1997
Ownership: MN DNR Parks and Recreation
Site: Lake Bemidji State Park
Legal: T147N R33W 24
Managed Area(s): Lake Bemidji State Park
Source: Mortensen, S. and C. (Photo record)
1 plant observed during plant search for orchids. *Malaxix paludosa, M. unifolia* and at least 9 other orchid species observed. Photo taken.

Location: Minnesota, Itasca County
MN DNR #: 36
Date Last Observed: 16 June 1998
Ownership: U.S. Forest Service (National Forest)
Site: Bigosh 24
Legal: T147N R28W 24
Managed Area(s): Chippewa National Forest. Bowstring State Forest. Leech Lake Reservation
Source: Moen, D. (photo record)
Plants observed with *Asarum, Anemone, Rubus, Viola* under canopy of aspen and Black ash. Photo taken. CNF TES #1004.

Location: Minnesota, Itasca County
MN DNR #: 37
Date Last Observed: 02 July 1998
Ownership: U.S. Forest Service (National Forest)
Site: Sand Lake 28
Legal: T148N R26W 28
Managed Area(s): Chippewa National Forest. Leech Lake Reservation

Source: Suddendorf, T. (TS98002)
Located along Forest Trail 2529 leading to Birds Eye Lake. Near Sand Lake, 1.5 miles west of CO RD 130. Plants found growing adjacent to ash/cedar wetland in aspen stand. 6+ plants found. With *Equisetum scirpoides, Mitella nuda, Rubus pubescens*, and *Platanthera hyperborea*, growing on south side of trail. CNF TES #3002.

Location: Minnesota, Itasca County
MN DNR #: 38
Date Last Observed: 27 June 1998
Ownership: U.S. Forest Service (National Forest)
Site: Good Hope 34
Legal: T148N R28W 34
Managed Area(s): Bowstring State Forest. Leech Lake Reservation. Chippewa Natioanl Forest
Source: Moen, D. (DM98003)
Plants located under canopy of White cedar and balsam. Local ground cover is *Rubus, Equisetum, Aralia nudicaulis, Mitella, Acer rubrum* and *Fraxinus nigra* seedlings. Compartment 257, Stand 14. CNF TES #1005.

Location: Minnesota, Crow Wing County
MN DNR #: 39
Date Last Observed: 18 June 1998
Ownership: Owner unknown
Site: Fairfield 14
Legal: T137N R26W 14
Managed Area(s): Not managed or no record
Source: Zager, S.C. (980618-1)
Rare in mixed hardwood canopy. Ten plants observed on hummocks beneath Balsam fir and White spruce canopy. Canopy 20-25 m tall; 100% cover densely shading substrate. Subcanopy sparse with Black ash. Shrub layer 50-75% including *Acer spicatum*. Associates: *Gymnocarpium dryopteris, Thalictrum dioicum, Rubus pubescens*.

Location: Minnesota, Itasca County
MN DNR #: 40
Date Last Observed: 10 July 1999
Ownership: U.S. Forest Service (National Forest)
Site: Kinghurst 3
Legal: T149N R27W 03
Managed Area(s): Big Fork State Forest. Chippewa National Forest
Source: Vandewater, G. (Photo record)
5 plants observed on moss-covered hummocks at edge of a lowland conifer/lowland hardwood site that is an inclusion of a larger upland hardwood site. Assoc. spp.: *Mitella nuda, Carex disperma, C. intumescens, C. retrorsa, Cornus Canadensis, Athyrium filix-femina, Glyceria striata, Thelypteris striata*. CNF TES #1006.

Location: Minnesota, Itasca County
MN DNR #: 41
Date Last Observed: 09 July 1999
Ownership: U.S. Forest Service (National Forest)
Site: WIRT 4
Legal: T149N R26W 04
Managed Area(s): Chippewa National Forest
Source: Vandewater, G. (Photo record)
Two plants growing on the sides of hummock site within a lowland conifer forest type. Assoc. plants include *Thuja occidentalis, Fraxinus nigra, Gymnocarpium dryopteris, Thelypteris phegopteris, Caltha palustris, Mitella nuda, Platanthera hyperborea, Corallorhiza trifida*. CNF TES #1007.

Location: Minnesota, Cass County
MN DNR #: 42
Date Last Observed: 07 July 1999
Ownership: U.S. Forest Service (National Forest)
Site: Diamond 27
Legal: T144N R29W 27
Managed Area(s): Leech Lake Reservation. Bowstring State Forest. Chippewa National Forest
Source: Mulligan, M. (99MM003)
Four plants located in lowland cedar micro-site, surrounded by upland Balsam fir with some birch and aspen. Plants beginning to senesce when speciman was collected. Stand #CL 143/2. Photos also taken at site. CNF TES #2002.

Location: Minnesota, Aitkin County
MN DNR #: 43
Date Last Observed: 25 June 1999
Ownership: MN DNR Forestry (State Forest and Con-Con Land)
Site: Verdon 7
Legal: T051N R24W 07
Managed Area(s): Savanna State Forest
Source: Carlson, B.W. (00788)
9 miles ENE of Haypoint, 1/8 mile west of Washburn Lake rd. 5 plants growing on the moss-covered edges of mucky, weft-covered low spots of the microtopography in a large White cedar swamp. Assoc.: *Fraxinus nigr, Rubus pube, Acer spic, Coptis groe, Maianthemum cana, Carex lept*. Peat greater than 1 meter deep. DNR Releve #8034.

Location: Minnesota, Cass County
MN DNR #: 44
Date Last Observed: 05 September 2000
Ownership: U.S. Forest Service (National Forest)
Site: Rogers 30
Legal: T142N R27W 30

Managed Area(s): Chippewa National Forest. Leech Lake Reservation
Source: Berger, R. (RB00005)
2 individuals located in northern White cedar swamp edge near hardwoods, near blowdown. Compartment 163, Stand 15. CNF TES #5007.

Location: Minnesota, Cass County
MN DNR #: 45
Date Last Observed: 07 September 2000
Ownership: U.S. Forest Service (National Forest)
Site: Rogers 31
Legal: T142N R27W 31
Managed Area(s): Chippewa National Forest. Leech Lake Reservation
Source: Berger, R. (10)
Two plants on rotten mossy log. Tree spp: Small Balsam fir, Paper birch, White cedar nearby. West of closed canopy White cedar forest. Approx. 0.5 mi west of Lomis Lake. In swampy area. Assoc. spp: *Trientalis borealis, Fragaria virginiana, Carex spp, Linnaea borealis, Mitella nuda, Maianthemum canadense, Aster macrophyllus, Cornus canadensis*. Browsed *Taxus canadensis* 6 ft south, 4 ft west. Compartment 163. CNF TES #MABR 5006.

Location: Minnesota, Cass County
MN DNR #: 46
Date Last Observed: 05 September 2000
Ownership: U.S. Forest Service (National Forest)
Site: Rogers 14
Legal: T142N R27W 14
Managed Area(s): Chippewa National Forest
Source: Berger, R. and Eiring, K. (RB0011)
8 plants in 3 patches in swampy area. Patch 1: Closed canopy White cedar forest with Balsam fir and Black ash understory. Patch 2:and 3: East edge of cedar forest. Trees medium sized Black ash, White cedar, Paper birch, and Balsam fir. Transition to shrub swamp. Herbs: *Viola spp., Asarum can, Trientalis bor, Phryma lepto, Circaea alp, Parthenocissus ins, Mitella nuda, Sanguinaria can, Equisetum spp., Aralia nud, Acer spic, Fragaria virg, Gymnocarpium dryop*, etc. CNF #5005.

Location: Minnesota, Cass County
MN DNR #: 47
Date Last Observed: 30 August 2000
Ownership: State of Minnesota (Other)
Site: Rogers 31
Legal: T142N R27W 31
Managed Area(s): Chippewa National Forest. Leech Lake Reservation
Source: Berger, R. (8)
White cedar swamp. Small cedar, Black ash, Balsam fir nearby. Blow-down areas around. On island of hummock growing on moss, 0.3 mi west of Rabbit Lake. Assoc. spp.*: Rubus*

pubescens, Viola spp., Bidens spp., Mitella nuda, Parthenocissus inserta, Equisetum spp., Caltha palustris. On Compartment map 163. CNF TES #5008.

MN OTHER EOR

Location: Minnesota, northeast and southeast off Bemidji
Abundance: Occasional
Habitat: Cedar swamps; in both highly disturbed and previously lumbered and in undisturbed mature *Thuja-Abies-Larix* swamps
Comments: *Malaxis paludosa, Goodyera repens,* and *Amerorchis rotundifolia*
Information source: Fred Case (pers. comm.)

Location: Minnesota, St. Louis County, and Superior National Forest
Date last observed: 1956 (extirpated?)
Ownership: Unknown
Habitat: Arbor-vitae swamp
Comments: Plans to improve a nearby highway
Information source: Ed Lindquist, Superior National Forest (pers. comm.)

NEW HAMPSHIRE

Location: New Hampshire, Grafton County
Date last observed: 24 June 1880 (historical)
Ownership: Unknown
Habitat: Wet bogs
Information source: New Hampshire Natural Heritage Inventory

Location: New Hampshire, Carroll County
Date last observed: 31 August 1983
Ownership: Private?
Abundance: 1983 (2 plants, 1 was vegetative, 1 had flowering spike with single mature capsule)
Habitat: On edge of a rock (in moss); rock was immediately adjacent to a vernal stream channel. General area shaded, moist mid-slope in transitional hardwood/softwood woods with *Goodyera pubescens, Hamamelis virginiana, Polystichum acrostichoides, Aster divaricatus,* and *Acer saccharum*
Information source: New Hampshire Natural Heritage Inventory

Location: New Hampshire, Coos County
Date last observed: 1907 (historical)
Ownership: Unknown
Habitat: General area was mud, dense cedar bog
Information source: New Hampshire Natural Heritage Inventory

NEW YORK (not tracked in New York)

Location: New York
Abundance: Considered common in New York[1]; present in more than 30 counties[2]
Information source:
[1] Nick Conrad, NY Natural Heritage Program, pers. comm.
[2] Old herbarium file entry (Charles Sheviak, New York State Museum)

PENNSYLVANIA

Location: Pennsylvania, Warren County
Date last observed: 1999 or 2000
Ownership: Private
Abundance: About 30 plants
Habitat: Coniferous/deciduous swamp in a sphagnous depression
Comments: Population is not currently protected, but may be in the not-to-distant future; informal monitoring being done on population
Information source: Steve Grund, Pennsylvania Natural Diversity Inventory--West (pers. comm.)

Location: Pennsylvania. 11 historic records in western Pennsylvania and three historic in the eastern Pennsylvania
Ownership: Unknown
Information source: Steve Grund, Pennsylvania Natural Diversity Inventory--West (pers. comm.)

WISCONSIN

Location: Wisconsin, Brown County
EO number: 001
Date last observed: 16 August 1879
Habitat: Amidst cedar swamp
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Burnett County
EO number: 002
Date last observed: 3 July 1930
Habitat: Low woods, *Betula lutea* and *Abies balsamea*
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Door County
EO number: 003
Date last observed: 24 July 1974
Habitat: Wet, shaded shale with *Alnus rugosa*
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Door County
EO number: 004
Date last observed: 25 June 1973
Habitat: Cutover white cedar swamp succeeding to *Alnus rugosa*, *Cornus stolonifera*, and *Rhamnus alnifolia*
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Door County
EO number: 005
Date last observed: 20 August 1916
Abundance: One colony
Habitat: Wet mossy woods
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Door County
EO number: 006
Date last observed: 29 August 1929
Abundance: Rare
Habitat: Wet woods
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Door County
EO number: 007
Date last observed: 17 July 1986
Abundance: 8 plants seen, 65% in leaf and 35% in flower; seed production evident; establishment appears poor.
Habitat: Near the edge of tamarack bog, in saturated, flat area with filtered light
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Iron County
EO number: 008
Date last observed: 2 August 1917
Abundance: 1917 (species collected; "occasional"); 1996-1995 (species not relocated)
Habitat: Shady woods (1917)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Iron County
EO number: 009
Date last observed: 21 July 1896
Abundance: 1896 (species collected); 1996-1995 (species not relocated)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Manitowoc County
EO number: 010

Date last observed:
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Marinette County
EO number: 011
Date last observed: 23 August 1974
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Marinette County
EO number: 012
Date last observed: 16 August 1959
Habitat: Wet woods, *Larix-Picea-Thuja-Populus*
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Marinette County
EO number: 013
Date last observed: 5 July 1964
Habitat: Dense wet *Picea mariana-Thuja occidentalis* bog with *Sphagnum* understory
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Milwaukee County
EO number: 014
Date last observed: July 1884
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Ozaukee County
EO number: 015
Date last observed: 21 June 1938
Habitat: Common in dark damp places
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Sheboygan County
EO number: 016
Date last observed: 1 August 1915
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Waushara County
EO number: 017
Date last observed: 12 July 1918
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Wood County
EO number: 018
Date last observed: July 1883

Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 019
Date last observed: 29 May 1982
Abundance: Scattered plants; alkaline, second-growth wooded swamp dominated by white cedar
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 020
Date last observed: 1 July 1982
Abundance: Scattered plants
Habitat: Pole-sized white cedar-balsam fir-black ash swamp
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Ozaukee County
EO number: 021
Date last observed: 27 June 1991
Abundance: 1988? (rare); 1990 (species observed); 1991 (species observed)
Habitat: 1990-1988: black spruce bog; in dense shade under spruce and tamarack, among mosses, but not *Sphagnum* in wet trails.
Comments: 1990-1988? (Buckthorn pulled by hand)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Florence County
EO number: 022
Date last observed: 23 July 1992
Abundance: 1992 (over 50 flowering plants over entire site; no more than 2 plants seen together; individuals of this species are likely scattered throughout much of the site.)
Habitat: (1992) moderately stocked black spruce, tamarack, and cedar swamp in saturated peatlands (somewhat drier near drainages and ponds). Slope is 2%. High species diversity in herbaceous community. Canopy cover is approx. 50% and up. Spring pond, pools and small streams present. Associated species: *Sphagnum* spp., *Dryopteris cristata*, *Carex* spp., *Caltha palustris*, *Rubus Amerorchis rotundifolia*, *Valeriana sitchensis*, *Arethusa bulbosa*, *Cypripedium reginae*.
Comments: 1992 (site is disturbed only by recent survey activity along the boundary of two sections; site should be periodically surveyed for beaver activity)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Marinette County
EO number: 023
Date last observed:
Abundance: A number of individuals
Habitat: Cedar swamp

Information source: Wisconsin Natural Heritage Inventory element occurrence records *pubescens*, *Geum* spp., *Betula pumila*, *Pyrola secunda*, *Malaxis unifolia*, *Platanthera hyperborea*, *Platanthera obtusata*, *Platanthera dilatata*, *Cornus canadensis*, *Galium* spp., *Menyanthes trifoliata*, *Saxifraga pennsylvanica*, *Moneses unifolia*, *Gaultheria hispidula*, *Gaultheria procumbens*, *Rhamnus alnifolia*, *Listera cordata, Polemonium occidentale*,

Location: Wisconsin, Door County
EO number: 024
Date last observed: 1983
Abundance: 1983 ("rare")
Habitat: On mossy hummocks and logs in shade swales, a community most closely approximating Curtis' northern wet-mesic forest and dominated by white cedar, with lesser amounts of black ash, balsam fir, and white and black spruce.

Location: Wisconsin, Door County
EO number: 025
Date last observed: 23 June 2000
Abundance: 2000 (1 flowering clump)
Habitat: (2000) second-growth boreal forest dominated by 3-12" Abies. Clump is in old trail with *Cornus canadensis, Linnaea, Aster lateriflorus, Mitella nuda, Viola* sp. Non-*Sphagnum* mosses on level moist loamy soil in partial shade.
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Taylor County
EO number: 026
Date last observed: 9 September 1993
Ownership: USDA, Forest Service, Chequamegon-Nicolet National Forest
Abundance: 1993 (5 plants, all in fruit, found in brief search; could be fairly common in parts of this swamp)
Habitat: In mixed black ash/fir/cedar swamp; *Malaxis brachypoda* was in area not dominated by northern white cedar. It was found in moist areas between the highest areas and the very wet "wells." Most were at the base of black ash trees, one at base of balsam fir. Plants could hardly be called "rooted," essentially a bulb set into the moss and underlying organic matter. Associated species: *Rubus pubescens*, poison ivy, *Symplocarpus, Osmunda regalis, O. cinnamomea*, red maple seedlings, *Circaea alpina*, *Cornus canadensis, Coptis, Laportea, Pilea* sp., *Trientalis, Onoclea, Parthenocissus* sp., *Aralia nudicaulis* (on elevated areas), *Viola* sp., *Galium* sp., *Lycopus* sp., *Polygonum arifolium*, mosses. In basically level, shaded, with areas of standing water.
Comments: Site is not managed for timber. Adjacent uplands on private land, including some steep slopes, were recently logged, but probably don't pose a threat. Gravel mining in adjacent esker, or anything that would alter the existing hydrology, could threaten.
Information sources: Wisconsin rare plant reporting form and Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 027
Date last observed: 25 August 1993
Abundance: 1993 (single flowering/fruiting plants observed twice)
Habitat: (1993) moist white cedar swamp. Moss covered flat to slightly depressed peat soils. Densely shaded to slightly open understory. Sparse shrub canopy when present. Associates include *Rubus pubescens, Pyrola secunda, Cypripedium reginae, Platanthera clavellata, Rumex* spp., *Caltha palustris, Cypripedium acaule, Smilacina trifolia, Osmunda regalis, Drosera rotundifolia, Rhamnus alnifolia, Vaccinium oxycoccos, Botrychium virginianum.*
Comments: 1993 (no immediate threats observed)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Marinette County
EO number: 028
Date last observed: 10 July 1993
Abundance: 1993 (two flowering stems observed)
Habitat: (1993) mixed conifer swamp of tamarack with black spruce and cedar, moss covered hummocks, with very wet veins between. Associates include *Valeriana sitchensis, Rhamnus alnifolia, Smilacina trifolia, Mitella nuda, Caltha palustris, Rubus pubescens, Galium* sp., *Vaccinium oxycoccos,* and *Saxifraga pensylvanica*. Low lying, moss covered saturated and peat soils with 50% cover of conifer overstory. Part of a large forested wetland, of moderate floristic diversity.
Comments: 1993 (no present threats; activity associated with lake, E.G. maintenance, reconstruction, improvements could have adverse impacts through direct destruction of altering of hydrology)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Taylor County
EO number: 029
Date last observed: 18 July 1994
Abundance: 1994 (one 5" tall plant observed in a 75' radius search; plant was healthy looking
Habitat: (1994) cedar-ash swamp; plant growing on a non-*Sphagnum* moss in a mixed white cedar-black ash swamp. Other associates include *Onoclea, Rubus pubescens*, and red maple seedlings.
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Marinette County
EO number: 030
Date last observed: 15 June 1991
Abundance: 1991 (11 plants in flower observed, 2-5 plants with leaves and no spikes. 80% in flower over 5-10 sq. yards habitat; normal vigor)
Habitat: (1991) cedar swamp; filtered light
Comments: 1991 (logging may be a threat)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Forest County
EO number: 031
Date last observed: 27 June 1995
Abundance: 1995 (3 stems observed, two in flower/bud, one sterile)
Habitat: (1995) patch of mature, mossy cedar swamp within a mixed aspen-ash-elm-spruce-fir-cedar swamp. Associates include *Botrychium virginianum, Clintonia, Coptis, Mitella nuda, Caltha palustris, Goodyera,* and mosses. Adjacent to a *Chrysosplenium*-alder spring pond. *Thuja* 8-14" DBH and *Abies* 1" DBH.
Information source: Wisconsin Natural Heritage Inventory element occurrence records

EO number: 032 ??

Location: Wisconsin, Taylor County
EO number: 033
Date last observed: 7 July 1995
Abundance: 1995 (three flowering individuals were observed within a 1 m radius, 100% in flower/bud. A larger area was searched, but no others were found
Habitat: (1995) plants on wet, non-sphagnaceous mosses in a white cedar-black ash-hemlock-balsam fir swamp of ca 6 acres in size. Associates include *Coptis, Onoclea, Trientalis, Cornus canadensis, Rubus pubescens, Mitella nuda*, *Pyrola secunda,* and *Moneses*
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 034
Date last observed: 15 August 1996
Abundance: 1996 (3 plants observed, 100% in fruit)
Habitat: (1996) cedar-black ash swamp with *Thuja occidentalis, Fraxinus nigra, Abies balsamea, Sphagnum, Alnus rugosa, Acer spicatum, Coptis groenlandica, Mitella nuda*, and *Rubus pubescens*. EO found in hollows of *Sphagnum* mat, sheltered by fallen timber, in the ash-cedar portion of swamp, not in pure ash or cedar.
Comments: 1996 (deer browsing may be a threat, nearby *Cypripedium calceolus* were eaten. Logging may be a threat)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Florence County
EO number: 035
Date last observed: 12 August 1996
Abundance: 1996 (ca 12 stems observed in one location)
Habitat: (1996) northern wet-mesic forest/strip-cut mixed conifer swamp. Uncut strips are mixed cedar, black spruce, tamarack, with alder in openings. Cut strips are dense alder and bog birch.
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County

EO number: 036
Date last observed: 1 October 1996
Abundance: 1996 (2 fruiting stems observed)
Habitat: (1996) black ash/white cedar swamp with lesser quantities of red maple, yellow birch, and hemlock. Shady, wet, open understory. Associates include *Rubus pubescens, Cornus canadensis, Gymnocarpium dryopteris, Coptis trifolia, Goodyera repens*, and red maple seedlings.
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 037
Date last observed: 1 July 1997
Abundance: 1997 (July; one flowering plant observed on the side of a cedar hummock, rooted in *Sphagnum*, under a canopy of cedar.)
Habitat: (1997) northern wet-mesic forest cedar swamp with *Thuja occidentalis, Sphagnum spp., Rubus pubescens, Abies balsamea, Gaultheria hispidula, Coptis trifolia, Maianthemum canadense*, and *Gymnocarpium dryopteris*.
Comments: 1997 (no disturbance or threats observed)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 038
Date last observed: 10 July 1997
Abundance: 1997 [July; one flowering plant observed growing on the side of a hummock, rooted in peaty soil (not *Sphagnum*) under a mostly black ash canopy].
Habitat: (1997) July; northern wet-mesic forest black ash swamp. Associates include *Thuja occidentalis, Ulmus americana, Rubus pubescens, Tsuga canadensis, Aralia nudicaulis, Picea mariana*, and *Acer rubrum*.
Comments: 1997 (no disturbance or threats observed)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 039
Date last observed: 1 July 1997
Abundance: 1997 (44 stems observed in 5 discrete sphagnumous "wet depressions"; 61% in flower/bud; 39% mature non-flowering plants
Habitat: (1997) northern wet-mesic forest; relatively dry white cedar swamp. Other tree species include balsam fir, paper birch, black spruce, and black ash. Associates include *Maianthemum canadense, Coptis trifolia, Trientalis borealis*, and *Aralia nudicaulis*.
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 040
Date last observed: 16 July 1997

Abundance: 1997 (July; 14 stems located during a quick search, more are very likely present. 80% in fruit, 20% mature non-flowering plants)
Habitat: (1997) northern hardwood swamp in wet, mucky depressions along drainage-way of a very small creek under balsam, black ash, cedar, and yellow birch. Associates included *Rubus pubescens, Viola* sp., *Mitella nuda, Coptis trifolia*, and liverworts.
Comments: No threats noted
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Door County
EO number: 041
Date last observed: 19 August 1998
Abundance: 1998 (July; 3 individual plants, 100% in flower/bud)
Habitat: *Thuja occidentalis, Fraxinus nigra* lowland forest with a heavy understory of *Thuja, Alnus incana, Cornus stolonifera*. Saturated muck soils bordering small shallow pond. Light overstory over 5 m combined with heavy understory creates low light at ground level. Moss covered downed logs and root hummocks abundant.
Comments: No human disturbance
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Door County
EO number: 042
Date last observed: 9 July 1998
Abundance: A single fruiting plant seen in shade in mossy hummocky swamp
Habitat: northern wet-mesic forest (6-9" dhh white cedar swamp) with *Lycopus uniflorus, Maianthemum canadense, Fraxinus nigra* seedlings, *Trientalis borealis, Osmunda regalis*, and *Carex disperma*
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 043
Date last observed: 3 September 1998
Abundance: 1998 (16 stems. 90% in fruit, 10% seedlings)
Habitat: (1998) northern wet-mesic forest, mixed conifer swamp with white cedar, balsam fir, black ash and black spruce. Plants in *Sphagnum* in a wet depression
Comments: No threats noted
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 044
Date last observed: 30 June 1998
Abundance: 1998 (25 stems widely scattered in large area of suitable habitat. 90% in flower/bud. 10% mature non-flowering. More individuals are certainly present.)
Habitat: (1998) second growth mixed Northern white cedar swamp with black ash and balsam fir. Growing in the wettest areas on the sides of hummocks at the edge of very wet depressions.

Comments: No threats noted
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 045
Date last observed: 13 July 1998
Abundance: 1998 (six stems in flower/bud)
Habitat: (1998) cedar swamp with *Cornus alternifolia, Dryopteris cristata, Mitella nuda, Caltha palustris, Onoclea sensibilis.* Nearly full shade. Cold wet organic soil. Black muck pool between bases of cedar trees
Comments: 1998 (deer traffic and new canopy openings from spruce budworm)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Florence County
EO number: 046
Date last observed: 26 August 1997
Abundance: 1997 (5 fruiting stems)
Habitat: (1997) cedar swamp with *Sphagnum, Picea mariana*, tamarack, etc. Small swamp of ten acres at best. Cool and dark, fairly well drained with creek running through middle.)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 047
Date last observed: 17 July 1997
Abundance: 1997 (2 stems with flowers and fruit)
Habitat: (1997) cedar swamp with *Sphagnum, Streptopus roseus, Coptis groenlandica, Mitella nuda, Picea mariana*; in partial shade, wet organic soil, glacial till parent material
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Door County
EO number: 048
Date last observed: 29 June 1999
Abundance: 20 plants in level, moist to wet shaded soil
Habitat: Older growth white cedar swamp, some balsam fir, black ash, glossy buckthorn, tag alder, white birch with *Listera cordata, Mitella nuda, Trientalis, Rubus pubescens, Cornus canadensis, Aralia nudicaulis, Carex leptalea, C. trisperma, C. interior, C. pedunculata, Dryopteris cristata, Linnaea, Coptis, Lycopodium lucidulum, Gaultheria hispidula.*
Comments: Spread of invasive species, especially glossy buckthorn is greatest imminent threat. Logging, disruption of hydrology and residential development are other potential threats.
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Oconto County
EO number: 049
Date last observed: 11 July 1996

Habitat: (1996) rich white cedar swamp
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Waupaca County
EO number: 050
Date last observed: 17 July 2000
Abundance: 2000 (only a couple of stems noted; probably more unseen)
Habitat: (2000) very nice, unlogged, wet springy white cedar, black spruce, tamarack swamp with *Sphagnum, Coptis trifolia, Smilacina trifolia, Carex interior, C. trisperma, C. leptalea, Mitella nuda*)
Information source: Wisconsin Natural Heritage Inventory element occurrence records

Location: Wisconsin, Washburn County, near Spooner
Habitat: Cedar swamp
Comments: Many orchid species present
Information source: Fred Case (pers. comm.)

Location: Wisconsin, Door County
Habitat: Interdunal swamps in cedar cover
Information source: Fred Case (pers. comm.)

CANADA

BRITISH COLUMBIA

Location: British Columbia
Date last observed: 10 August 1975
Information source: British Columbia Data Centre's element occurrence records

Location: British Columbia
Date last observed: 8 July 1971
Ownership: British Columbia parks
Habitat: *Picea mariana/Sphagnum* bog bordering swamp
Comments: Protected site
Information source: British Columbia Data Centre's element occurrence records

Location: British Columbia
Date last observed: 18 July 1950
Information source: British Columbia Data Centre's element occurrence records

Location: British Columbia

Date last observed: 26 June 1952
Habitat: On wet ledges
Information source: British Columbia Data Centre's element occurrence records

Location: British Columbia
Date last observed: 17 July 1954
Habitat: Very rare on moist, lush, steep rock slope
Information source: British Columbia Data Centre's element occurrence records

Location: British Columbia
Date last observed: 16 June 1981
Habitat: Bog-forest transition, infrequent
Information source: British Columbia Data Centre's element occurrence records

Location: British Columbia
Date last observed: 18 July 1997
Abundance: 2 plants
Habitat: In a *Carex rostrata* fen approximately 2 ha. in size. No standing water, slope 0%, aspect south 20 deg west. With *Carex kelloggii, Juncus ensifolius, Torreychloa pauciflora, Myosotis laxa, Hypericum scouleri*.
Information source: British Columbia Data Centre's element occurrence records

Location: British Columbia
Date last observed: 18 July 1997
Abundance: 2 plants
Habitat: In stepped *Sphagnum* meadow with pools and slow-moving stream. With *Ledum groenlandicum, Carex interior, Carex viridula*. Aspect S 20 deg W.
Information source: British Columbia Data Centre's element occurrence records

Location: British Columbia
Date last observed: 18 July 1997
Abundance: 3 plants flowering and several non-flowering
Habitat: On mossy stream banks in Douglas-fir/white pine/western hemlock forest. With *Tofieldia glutinosa, Juncus effusus* and *Lycopus uniflorus.*
Information source: British Columbia Data Centre's element occurrence records

Location: British Columbia
Date last observed: 21 August 1997
Abundance: 1997-08-21 (3 plants)
Habitat: In disturbed drainage channel. A *Typha* fen with flowing water. Dominants: *Typha latifolia, Ledum groenlandicum*. Associates: *Hypericum scouleri*, *Senecio pauperculus, Mimulus moschatus.* Slope 5%, aspect S35E.
Information source: British Columbia Data Centre's element occurrence records

Location: British Columbia
Date last observed: 18 July 1997
Abundance: 1997-07-18 [7 plants (2 flowering, 5 immature)]
Habitat: In boggy depression, *Typha-Carex* fen. Also with *Senecio indecorus, Listera convallarioides, Drosera rotundifolia, Ophioglossum pusillum*. Slope 0%, aspect 200 deg south. Surrounding upland forest dry *Pinus contorta-Pseudotsuga* on basalt ridges.
Information source: British Columbia Data Centre's element occurrence records

Location: British Columbia
Date last observed: 19 July 1997
Abundance: 1997-07-18 (5 plants)
Habitat: In open marshy meadow in slowly flowing stream. Dominants: *Petasites frigidus* var. *palmatus, Ribes lacustre, Carex pachystachya*. Associates: *Holcus lanatus, Juncus effusus, Botrychium virginianum, Ophioglossum pusillum, Senecio pauperculus, S. indecorus*. Level site. Surrounding upland forest dry *Pinus contorta-Pseudotsuga* on basalt ridges.
Information source: British Columbia Data Centre's element occurrence records

Location: British Columbia
Date last observed: 25 June 1980
Habitat: In *T. heterophylla, T. plicata* forest; *V. ovalifolium, L. americanum, C. alpina*, *E. sylvaticum, M. punctatum, S. capillaceum*; silt clay fluvial; rego gley, subhy
Information source: British Columbia Data Centre (not yet entered in their database)

Location: British Columbia
Date last observed: June 1970
Habitat: Fresh water bog but with *Triglochin maritima*
Information source: British Columbia Data Centre (not yet entered in their database)

Location: British Columbia
Date last observed: 15 June 1970
Habitat: Fresh water bay
Information source: British Columbia Data Centre (not yet entered in their database)

Location: British Columbia
Date last observed: 20 August 1971
Habitat: Open fen
Information source: British Columbia Data Centre (not yet entered in their database)

APPENDIX C: ACKNOWLEDGMENTS

We wish to acknowledge and thank the various natural heritage programs in the United States and Canada and others for providing information about occurrences of *Malaxis brachypoda*, which has been very helpful in preparing this conservation assessment. Below is a list of database

managers or other contacts at various natural heritage programs or their equivalents in the United States and Canada. U.S. Forest Service personnel and other contacts are listed as well. For each State/province of heritage program or equivalent, the information listed consists of contact name, email and/or phone number, and affiliation of non-heritage program contacts. Requests made for information from mid 2000 to early 2001.

Alaska: Rob _____ (anrl@uaa.alaska.edu), (no response)

California: Roxanne Bittman (RBittman@dfg.ca.gov)

Colorado: 1) Jill Handwerk (jhand@lamar.colostate.edu). Forwarded request to Beth Vandusen, environmental review coordinator, (no response)

2) Denny Bohon (dbohon@fs.fed.us), South Platte Ranger District (no response)

3) A. Petterson (apetterson@fs.fed.us), Arapahoe/Roosevelt NF, (no response)

4) Steve Tapia (stapia@fs.fed.us), Rocky Mountain Region (R2), USFS, Pike and San Isabel NF

Connecticut: Nancy Murray (nancy.murray@po.state.ct.us)

Illinois: Bill McClain (BMCCLAIN@dnrmail.state.il.us)

Indiana: Ronald Hellmich, 317-232-4052

Maine: Emily Pinkham (Emily.Pinkham@state.me.us)

Massachusetts: Paul Somers (paul.somers@state.ma.us)

Michigan: 1) Mike Penskar (penskarm@state.mi.us)

2) Sue Trull (strull@fs.fed.us), Ottawa NF

3) Jan Schultz (jschultz@fs.fed.us), Hiawatha National Forest

4) Alix Cleveland (acleveland@fs.fed.us), Huron-Manistee NF, (no response)

Minnesota: 1) Welby Smith (welby.smith@dnr.state.mn.us), (no response)

2) Mary Shedd (mshedd@fs.fed.us), Superior NF

3) Ed Lindquist (elindquist@fs.fed.us), Superior NF

	4) Ian Shackleford (ishackleford@fs.fed.us), was on Chippewa NF, now on Ottawa NF
	5) Timothy Reeves (reeves@sjc.cc.nm.us), studied *Malaxis* spp.
New Hampshire:	Sara Cairns (SARAC@dred.state.nh.us)
New Jersey:	David Snyder (dsnyder@dep.state.nj.us), (no response)
New York:	1) Nick Conrad (nbconrad@gw.dec.state.ny.us)
	2) Charles Sheviak (csheviak@MAIL.NYSED.GOV)
Pennsylvania:	1) J. Farber (jfarber@dcnr.state.pa.us), Eastern Pennsylvania, (no response)
	2) Steve Grund (SGrund@paconserve.org), Western Pennsylvania
	3) John Kunsman (JKunsman@dcnr.state.pa.us)
Tennessee:	Carl Nordman (cnordman@mail.state.tn.us)
Texas:	Bill Carr (bcarr@flash.net)
Vermont:	Everett Marshall (everettm@fwd.anr.state.vt.us)
Wisconsin:	1) Kristin Westad (WestaK@mail01.dnr.state.wi.us)
	2) Merel Black (mblack@facstaff.wisc.edu), Herbarium, University of WI
	3) Marjy Brzeskiewicz (mbrzeskiewicz@fs.fed.us), Chequamegon-Nicolet NF
Alberta:	1) John Rintoul (John.Rintoul@gov.ab.ca)
	2) Joyce Gould (Joyce.Gould@gov.ab.ca)
Atlantic Canada:	Sean Blaney (sblaney@mta.ca)
British Columbia:	Marta Donovan, 250-356-0928
Manitoba:	Jason Greenall (jgreenall@nr.gov.mb.ca), (no response)
Ontario:	Michael Oldham (michael.oldham@mnr.gov.on.ca), (no response)

Quebec:	Jacques Labrecque (jacques.labrecque@menv.gouv.qc.ca)
Saskatchewan:	Sheila Lamont (Sheila.Lamont.erm@govmail.gov.sk.ca)
Yukon:	1) Bruce Bennett (Bruce.Bennett@gov.yk.ca)
	2) Catherine Kennedy (Catherine.Kennedy@gov.yk.ca)