

*Conservation Assessment
for
Deerberry (Vaccinium Stamineum)*



Photo: Hill 34822

USDA Forest Service, Eastern Region

December 31, 2002

Steven R. Hill, Ph.D.
Illinois Natural History Survey
Center for Biodiversity
607 East Peabody Drive
Champaign, Illinois 61820

SHAWNEE AND HOOSIER NATIONAL FORESTS



This document is undergoing peer review, comments welcome

This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation Assessment for the Eastern Region of the Forest Service. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject taxon, please contact the Eastern Region of the Forest Service - Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.

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ACKNOWLEDGMENTS

I would like to thank the staff of the United States Forest Service, Shawnee and Hoosier National Forests, for the opportunity to compile these conservation assessments and for their invaluable assistance with data and field opportunities. Mark Basinger, Stan McTaggart, Steve Olson, Beth Shimp, and Steve Widowski were particularly helpful in facilitating both the cost share agreement and fieldwork.

I would also like to thank the staff of the Illinois Natural History Survey, Champaign, for their assistance with logistics necessary to complete these reports. Vickie Bohlen, Jason Carl Butler, Kay Moran, and Angela Young were especially helpful. I would also like to thank John Taft for help in initiating these studies.

A special thanks to Ariane Hoard, my student at the University of Illinois during the summer of 2002, for her help in searching for information on the Internet and literature in support of these assessments, and to my assistant Sherry Weaver for her continuing assistance in processing the plant specimen vouchers.

EXECUTIVE SUMMARY

This Conservation Assessment is a review of the distribution, habitat, ecology, and population

biology of the deerberry, *Vaccinium stamineum* L., throughout the United States and Canada, and in the U.S.D.A. Forest Service lands, Eastern Region (Region 9), in particular. This document also serves to update knowledge about the status, potential threats, and conservation efforts regarding the deerberry to date. Deerberry is a shrub that is widespread throughout much of the eastern United States, reaching its northern limits in Vermont and southern Ontario, Canada. It grows mainly in dry open rocky forests, thickets, and clearings in acidic, often nutrient poor soils. Like many other blueberries, it is known to spread vegetatively through rhizomes making it difficult to determine how many individuals make up a population. Globally, its ranking is G5 (demonstrably secure globally, though it may be quite rare in parts of its range, especially at its periphery). Previous to its recent rediscovery, deerberry was considered to have been extirpated in Illinois by 1994 according to the Illinois Endangered Species Protection Board (IESPB) and it is not currently listed as threatened or endangered in the state. Previous to 1994 it had been listed as endangered in Illinois, and its rediscovery makes it likely to be listed again as endangered. Deerberry is included on the Regional Forester Sensitive Species list (RFSS) for the Shawnee National Forest but not the Hoosier National Forest. Its status is secure in the 29 states in the United States (including the District of Columbia [DC]) where it has been known to occur except in Kansas, Illinois, and Vermont (where it is listed as endangered), and it is listed as threatened in Ontario, Canada. Although it is common in most of its range it faces several risks that could result in its extirpation at the extreme edges of its range (as in Illinois) if it is not properly managed.

In addition to species listed as endangered or threatened under the Endangered Species Act (ESA), or species of Concern by U.S. Fish and Wildlife Service, the Forest Service lists species that are Sensitive within each region (RFSS). The National Forest Management Act and U.S. Forest Service policy require that National Forest System land be managed to maintain viable populations of all native plant and animal species. A viable population is one that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its range within a given planning area.

The objectives of this document are to:

- Provide an overview of the current scientific knowledge on the species.
- Provide a summary of the distribution and status on the species range-wide and within the Eastern Region of the Forest Service, in particular.
- Provide the available background information needed to prepare a subsequent Conservation Approach.

NOMENCLATURE AND TAXONOMY

Scientific Name: *Vaccinium stamineum* L.
Common Names: Deerberry, Tall deerberry, Squaw huckleberry, Buckberry, Highbush huckleberry, Southern gooseberry
Synonymy: *Vaccinium neglectum* (Small) Fern
[based on: *Polycodium neglectum* Small]
Vaccinium stamineum L. var. *melanocarpum* C. Mohr

Vaccinium stamineum L. var. *neglectum* (Small) Deam
[for a more complete synonymy for the species, see Appendix 1]

Class: Magnoliopsida (Flowering Plants - Dicotyledons)
Family: Ericaceae (the Heath family)
Plants Code: VAST (USDA NRCS plant database, W-10)
http://plants.usda.gov/cgi_bin/topics.cgi

There are approximately 33 - 41 other species of blueberry (*Vaccinium*) in North America north of Mexico depending upon differing interpretations. This species is the only member of *Vaccinium* section *Polycodium*, and it has no close relatives. The flower suggests a relationship to the cranberries, but the overall habit does not (Baker 1970, Clemants, pers. comm.).

DESCRIPTION OF SPECIES

Vaccinium stamineum is a deciduous openly branched shrub that can vary from 0.3 - 3.0 m in height but is commonly 0.5-1.5 m tall. Typically, it has multiple trunks that are twisted and contorted and cloaked in thin reddish-brown furrowed bark that shreds and peels. The ultimate twigs are very narrow, often about 1 mm in diameter, and hairless or with short hairs. Winter buds are terminal or axillary, ovoid, 0.5-1.5 mm long, pointed, with 4-6 overlapping bud scales that are light yellow or reddish orange. The leaves of the plant are yellowish-green, alternate, thin and papery, sometimes hairy and/or white-waxy (especially beneath), elliptic with a cuneate base and acute apex, and generally 3-7 cm long and 1.5-2.5 cm wide. The margins are entire and the petioles measure 1-3 mm. The flowers have 5 petals (fused) and 5 sepals, they are widely bell-shaped, white, and they are pendulous in racemes or panicles on specialized axillary branches with large leafy bracts. The flowers are especially unusual in that they are open before maturity with their parts extending outward while still green. The corolla eventually grows to 4-6 mm in length and becomes conspicuous. The yellowish stamens are long-exserted and each anther extends into two long tubes. The style is longer than the stamens, and the ovary position is inferior. The spherical fruits (berries) are marble or grape-like, usually firm, hairless, green or yellowish to purple-tinted, usually pale white-waxy when young, tart or bitter, and generally 1 cm in diameter (adapted from W-11, Ford 1995, Gleason & Cronquist 1991, Mohlenbrock 1986, and Radford *et al.* 1968). For a more detailed species description see Appendix 2.

HABITAT AND ECOLOGY

Vaccinium stamineum is normally found in dry areas (rocky forests, thickets, grassy fields, maple or oak forests) and, locally in some regions, in wet areas (bogs and borders of shrub swamps) in uplands (Wherry 1920). The species grows in dry, and occasionally moist, upland acidic organic and mineral soils with a pH of 3.4-5.9 and with low levels of exchangeable cations such as calcium and magnesium (Ford 1995) and, therefore, generally not over limestones. It grows well on well-drained, sandy soils as well and sometimes forms colonies by underground runners. The rock substrate is generally sandstone, chert (silica), or gneissic granite and most frequently with a south-facing exposure. Deerberry is usually found in partial shade in openings or open forests. Established deerberry can tolerate drought and do well on as little as 30 inches of rain per year (W-3).

At the edge of its range in Ontario, Canada, *Vaccinium stamineum* occurs most frequently in dry, rocky woods with a canopy closure of approximately 40%. It is not usually found in more open sites or in areas with deep shade. Granite-gneiss is a frequent substrate. Soils where populations grow are usually sandy with a low organic content. The plants are found on both steep slopes and on flat ground with all sites being well-drained. The plant is also often associated with burned sites in this area, where it is associated with other fire-tolerant species such as pitch-pine and lowbush blueberry (Ford 1995).

Deam (1932, 1940) described the associates of the plant in several locations in southern Indiana where he found it in 16 counties. He reported the plants mainly on forested slopes of the unglaciated region of the state where it was generally associated with black and chestnut oaks and, sometimes, Virginia pine. He also reported observing the plant in the “flats” of Switzerland County, where it was associated with white oaks, and in a low woods in an old lake bed in Crawford County, where it was associated with pin oak, sweet gum, and red maple.

In Illinois, likewise in an unglaciated region, one population is known to exist on a dry ridge in Hardin County in the Kaskaskia Experimental Forest section of the Shawnee National Forest in a Dry-mesic, Upland Forest Natural Community (as defined by White & Madany 1978). This population was observed in the field during the course of this report. Associated species at this site included the trees blackjack oak, post oak, Shumard oak, white oak, sassafras, hickory, beech, and flowering dogwood, the shrubs winged sumac, red cedar, farkleberry, and early lowbush blueberry (*Vaccinium pallidum* Ait.), the vines catbrier, dewberry, Virginia creeper, poison ivy, and ash grape, the herbs false yellow snapdragon, Solomon’s seal, bedstraw, palmate-leaved violet, tickseed, mountain dittany, and bluets, and the grasses and sedges poverty grass and *Carex* spp. (see also W-4). This site lies within the Shawnee Hill Natural Division of Illinois, Greater Shawnee Hills Section (Schwegman *et al.* 1973).

DISTRIBUTION AND ABUNDANCE

The range of *Vaccinium stamineum* extends from central Florida to east Texas, and north to Missouri, Indiana, Massachusetts and Vermont, and, in Canada, to southern Ontario; reports of the species in northeastern Mexico have not been confirmed. In the United States, specifically, the deerberry is known to occur in AL, AR, CT, DE, FL, GA, IL, IN, KS, KY, LA, MA, MD, MO, MS, NC, NJ, NY, OH, OK, PA, RI, SC, TN, TX, VA, VT, WV, and the District of Columbia. It should be pointed out that reports of the species in Maine have not been confirmed, and it is not listed for the state in Magee and Ahles (1999) or Haines and Vining (1998). Additional details on the distribution of deerberry can be found in Brown and Brown (1984), Chester *et al.* (1997), Jones and Coile (1988), Kartesz and Meacham (1999), Steyermark (1981), Strausbaugh and Core (1973), and Uttall (1986, 1987).

The record of the occurrence of *Vaccinium stamineum* in Canada in southern Ontario (the Thousand Islands) was first published by John Macoun (1884) who also noted its presence in the Niagara River region. Vander Kloet (1972) reported the rediscovery of this shrub on Wellesley Island. Its presence at the west end of Grenadier Island has since been noted. Here, in addition to the clones between the dock and the pavilion, there is also an extensive stand in the deciduous woods south of the golf course. The deerberry is still known in Canada only from the Thousand Islands and Niagara River regions (Cody 1975; Ford 1984, 1993, 1995).

At the western edge of its range in eastern Kansas, *Vaccinium stamineum* is only known from Cherokee County (McGregor, Barkley *et al.* 1986). In Oklahoma it has been found only in seven eastern counties in the Ouachita Mountains and Ozark Plateau, and it is considered to be uncommon (W-6).

In Texas at its southwestern range limit, *Vaccinium stamineum* is rather common in open forests in the “Big Thicket” area of the southeastern part of the state and is rarely found on forested bluffs in northeastern Texas (Correll & Johnston 1970).

At its northeastern limit of range *Vaccinium stamineum* is listed as endangered in Vermont, and no recent voucher specimens have been seen. However, according to Vermont Natural Heritage records, the species occurs only in Pownal, Vermont, where it was last visited in 1996 by botanist Bob Popp who recorded 300 ramets (D. Barrington, pers. comm.). It was said to occur in Maine by Gleason and Cronquist (1991) but no specimens or individuals have been located, and because it has never been found in neighboring New Hampshire its presence in Maine is unlikely. While uncommon in Massachusetts, it is present and it becomes more frequent towards the south.

In the southeastern United States, *Vaccinium stamineum* is common and widespread, occurring in essentially every county in the Carolinas, for example, and it is a characteristic shrub in the dry forests of the region (e.g. Radford *et al.* 1968, Godfrey 1988). In Florida it extends south into the central peninsula and is considered common (Wunderlin 1998).

Within the U.S. Forest Service Eastern Region (Region 9) *Vaccinium stamineum* has been confirmed to be present in the Allegheny National Forest (PA), Hoosier National Forest (IN), Mark Twain National Forest (MO), Monongahela National Forest (WV), Shawnee National Forest (IL), and the Wayne National Forest (OH). *Vaccinium stamineum* is not included on the Regional Forester Sensitive Species list for the Hoosier National Forest in Indiana because of its greater frequency there (Deam 1932, 1940).

In Illinois, *Vaccinium stamineum* has been collected at two localities. The first locality, a dry sandstone bluff top in the Shawnee National Forest in Pope County, was discovered in 1962 but recent attempts to relocate the plant at this site have not been successful (Herkert 1991, 1994; Shimp pers. comm.). However, a new site for *Vaccinium stamineum* was discovered in 1998 in Hardin County by Shawnee National Forest biologist Ray Smith, and that colony appears to be secure at present.

PROTECTION STATUS

The Nature Conservancy currently lists *Vaccinium stamineum* as a G5 plant, indicating that the species is globally secure and common overall. In the United States the species is given the National Heritage rank of N5 with a similar meaning. In Canada, the species is ranked N1 and Threatened. The state rankings vary considerably.

In addition, *Vaccinium stamineum* is listed on the U.S. Forest Service’s Regional Forester Sensitive Species list for Shawnee National Forest, but it is not listed on Indiana’s Threatened

and Endangered Species list. Official protection for the species outside of Forest Service lands depends upon state and local laws because it is also not listed as Federally threatened or endangered.

Table 1 lists the official state rank assigned by each state’s Natural Heritage program according to the Nature Conservancy at their Internet site (W-5). Appendix 3 explains the meanings of the acronyms used (W-1). A summary of the current official protection status for the deerberry follows:

<u>U.S. Fish and Wildlife Service:</u>	Not listed (None)
<u>U.S. Forest Service:</u>	Region 9, Sensitive (Illinois only, Shawnee National Forest)
<u>Global Heritage Status Rank:</u>	G5
<u>U.S. National Heritage Status Rank:</u>	N5
<u>Canada National Heritage Status Rank:</u>	N1

Table 1: S-ranks for *Vaccinium stamineum* [element PDERI180Z0]

<u>State</u>	<u>Heritage S-rank</u>	<u>State</u>	<u>Heritage S-rank</u>
Alabama	SR	Mississippi	SR
Arkansas	SR	Missouri	S5
Connecticut	SR	New Jersey	S5
Delaware	SR	New York	SR
District of Columbia	S?	North Carolina	S5
Florida	SR	Ohio	SR
Georgia	SR	Oklahoma	SR
Illinois	SX	Pennsylvania	S?
Indiana	SR	Rhode Island	SR
Kansas	S1	South Carolina	SR
Kentucky	S?	Tennessee	SR
Louisiana	SR	Texas	SR
Maine	SR	Vermont	S1
Maryland	SR	Virginia	SR
Massachusetts	SR	West Virginia	S5
Canada-Ontario	S1		

LIFE HISTORY

Vaccinium stamineum is a perennial shrub but its average life-span is not known. It appears to establish successfully from seeds scattered in the vicinity of the parent plants or by animals that forage on the fruits. Once established, a single plant can spread by means of underground woody rhizomes sending new stems (ramets) above ground at an increasing distance from the original

plant. Therefore, a thicket of deerberry shrubs may actually be composed of a single plant, and this is difficult to determine by other than genetic means. Some research has been conducted on this problem in South Carolina (Kreher *et al.* 2000). In this study, the genetic diversity within 25 patches of the species ranging from a few stems to aggregates of many stems in sites with a diameter of 30 m was analyzed. Results suggested that 50 % of the patches had at least two genetically distinct individuals (genets) and 25 % had more than 2 genets, but their most variable patches contained only 3 genets. This suggests that a large thicket of deerberry may have only one to a very few actual individual plants that have spread by means of vegetative growth. In addition, it helps to explain the fire resistance of the plant because so much of it is underground, and also why a patch can become a dense thicket after a fire from multiple stem sprouts from the rhizome. Theoretically, an individual could survive for centuries through vegetative reproduction in a suitable habitat. More study is needed to determine the extent of the genetic diversity for the species (Kreher *et al.* 2000).

Further details on life history, and particularly on phenology, follow in the next section.

POPULATION BIOLOGY AND VIABILITY

Vaccinium stamineum is known to flower primarily from May to June within its range, but this can vary from late April and sporadically on through August. Mature fruits can be found from late June until early October, also depending on location, year, and local conditions. Personal observations of the species in the Blue Ridge of South Carolina (Hill, unpub. data) have indicated first flowering on 29 April, a peak on 11-18 May, with the last flowers observed on 4 June. This appears to be the species average. In Illinois and similar latitudes, this is generally shifted 1-2 weeks later, and at the southernmost species limits 1-2 weeks earlier. The flowers are primarily visited by the bees *Melitta americana* (Sm.) and *Xylocopa virginica* (L.), and numerous other flower visitors have been reported (Baker 1970, Cane *et al.* 1985, Ford 1995). *Vaccinium stamineum* is known to be one of the hosts for the attractive Red-spotted Purple butterfly, *Limenitis arthemis* (Drury) according to Scott (1986).

The fruits normally ripen in the fall, from late August to early October. Edibility to humans appears to vary widely depending on ripeness, the person reporting, or the individual plant involved. They have been described as “sweet-spicy tasting, a little reminiscent of lady's perfume”, “sour” or “bitter” (W-3). There appears to be some confusion in the literature over whether or not *Vaccinium stamineum* is always meant by the common name deerberry, and so this must be carefully considered (*e.g.*, Hedrick 1972). Personal experience and most reports in the literature describe the fruit as being very bitter and unpalatable (see Ballington *et al.* 1984, 1988). Deer, as suggested by the common name, browse the fruits eagerly along with the sour/bitter wild crabapples (*Malus* spp.) with which they often grow (Hill, pers. obs.).

The berries are much larger, on average, than those of other species of wild *Vaccinium* and are too large for most small birds to eat whole as they do most of the other blueberries. Instead, the fruits may be broken open and eaten, or they are eaten whole by larger animals, whereupon they scatter the seeds through feces. Also unlike the other blueberries, the fruits fall (abscise) when ripe, making them more accessible to ground-dwelling animals. The fruits are an important wildlife food in eastern North America. According to some sources, many kinds of songbirds eat the berries and white-tailed deer, in particular, eat the leaves, twigs and berries (hence the

common name). The berries are also relished by ruffed grouse, bobwhite quail, wild turkeys, foxes, raccoons, black bears, chipmunks and squirrels (W-3). Another source has stated that the fruits are eaten by 14 bird species and several species of mammals (W-6). Germination of the seeds takes 6-8 weeks and may require stratification and cool moist conditions (Baker 1970).

The populations appear to set many fruits that are readily eaten and, presumably, dispersed by wildlife, and the shrub is resistant to and even benefits from limited forest fires. Therefore, the majority of the populations in the country appear to be quite viable. The species is a successful one at this time overall.

In Illinois, the species viability is certainly more questionable. Only one population is known at this time, and this inhabits a dry ridge in Hardin County within the Kaskaskia Experimental Forest unit of the Shawnee National Forest (Illinois Department of Natural Resources 2002). This population was observed in the field during the course of this report by myself with Steve Olson (formerly U.S.D.A., Shawnee National Forest) and Ariane Hoard (student, University of Illinois) during July 2002 (W-8). The population was found to be 16.6 m (48 ft) long by 13.7 m (45 ft) wide, with approximately 400 stems (ramets). Associated species at this site were listed above (see Habitat and Ecology). The genetic variability within the population is not known. The population is only the second ever found in Illinois, the first having been found in Pope County in Hayes Creek Canyon on the edge of a sandstone ledge, but it has not been seen there since the 1980's according to Illinois Natural Heritage records. On that basis the species was considered extirpated (Herkert 1994, IESPB 1999). In 1977, only two shrubs were present, and none were seen in 1990 (Mohlenbrock, in litt.). In contrast, the new population discovered by Ray Smith (U.S.D.A., Shawnee National Forest biologist) on 12 May 1998 appears to be very healthy. See Appendix 4 for details on its discovery (W-9).

Suitable habitat for the species occurs only in extreme southern Illinois in the area of the Shawnee Hills where there appears to be additional suitable habitat for the plant where it may grow. Additional searches are suggested. With proper habitat (canopy) management, the population should persist.

POTENTIAL THREATS

In the United States, overall, this species is secure and not currently threatened. Its habitat is common and deerberry can stand some types of disturbance. The only threats to the species are at the very edges of its range where ecological conditions are marginal for its persistence. Botanists generally believe that most native plants have reached the limit to which they can travel under present conditions of climate (that is, temperature and rainfall), substrate, dispersal mechanism, and other pertinent factors. In other words, species are in balance with their environment as long as the environment is stable.

In many biological simulations, ecological extremes are more important than the means in controlling plant distribution (Webb *et al.* 1975). An obvious example is that of frost tolerance (temperature extremes). A plant species completely intolerant of freezing can persist in a site indefinitely until the first time extreme temperatures cause it to freeze. One such freeze in a century may be enough to eliminate a species entirely from a wide area of its range, and changes in climate historically have caused the greatest changes in plant distributions. In Florida, for

example, the royal palm (*Roystonea elata* (Bartr.) F. Harper) once grew as far north as Lake and Volusia Counties in the northern half of Florida, according to William Bartram who investigated the area in the 1760's (Bartram 1791, 1958 edition, p. 90, 94, 115-116, 141) during which period citrus and indigo could be easily grown well into the Carolinas. Certain severe freezes in subsequent years may have brought about a local extinction of the palm. In his 1958 edition of Bartram's book, Francis Harper wrote: "In 1835, for example, a severe northwest wind blew for 10 days, and the thermometer dropped to 7 degrees; the St. John's River was partly frozen, and 'all' fruit was killed to the ground". He reasoned that the trees "have not been reported so far north in Florida by subsequent observers, and it is presumed that they did not survive the 'freeze' of 1835". Other severe freezes were also documented in 1894-1895 and this palm and many of its associates may have been eliminated at either time from all but extreme south Florida, where it is rare today (Glassman 2000). Clearly, temperature extremes can be a primary factor determining the distributions of such plants.

In the case of *Vaccinium stamineum*, current distribution appears to be dependent primarily on soil pH (hence substrate and bedrock type) and degree of canopy closure rather than temperature extremes. While most populations are in dry, well-drained sites, a few have been described as being in wetter sites, so soil moisture may not be the primary controlling factor, either. However, throughout its range, the species grows only in acidic soils and open habitats, with a canopy closure of 40 % or less, though some degree of shading appears to be necessary. Therefore, under natural conditions a threat to the species in an existing colony on suitable substrate would be from the closing of the canopy through increased vegetation growth. In order to manage for the species, then, infrequent fires or selective thinning of the forest stand within which it grows would be indicated. It has been shown to thrive in areas with such occasional fires (*e.g.*, Kreher *et al.* 2000).

Habitat fragmentation can have profound effects on the success and persistence of local populations. Any activities that result in barriers to dispersal, such as developments, clearcuts, road/utility line corridors, and mined areas limit the possibility of population expansion and genetic exchange in many species. Deleterious effects of fragmentation could possibly go unnoticed for a long period of time, making the short term effects on species viability less apparent, particularly in such a long-lived species as *Vaccinium stamineum*. Over time, as populations become increasingly more isolated, the effects of fragmentation can potentially be observed at the molecular level by reduced genetic frequencies caused by random drift (Barrett & Kohn 1991). When one is considering populations that are already isolated, as in the case of the Illinois population, random genetic drift may have already occurred and may have caused negative effects to the species.

Complete clearing or cutting of a forest stand would appear to eliminate *Vaccinium stamineum*, and therefore such practices could not be enacted where a colony occurs without adverse effects. Most deerberry stations in Canada occur next to well-used trails and there is evidence that trail use is having a negative impact on some of the populations (Ford 1995). This does not appear to be the case in Illinois because of restricted access to the site, and it has not been reported as a problem at sites elsewhere in the U.S.

An additional potential threat appears to be, both directly and indirectly, from the blueberry maggot, the larva of the fly *Rhagoletis mendax* Curran. In some areas it is the most important

preharvest pest of commercial blueberries. It is native to eastern North America, but since the 1960's it has spread into Canada and southward through most of mid-Atlantic states onto commercial blueberry plantings (Berlocher 1995, Milholland & Meyer 1984). Blueberry maggot was found to be common in the southeastern U.S. by Payne and Berlocher (1995), where an important host is deerberry, *Vaccinium stamineum* L., as well as highbush blueberry, *Vaccinium corymbosum* L. (endangered in Illinois), lowbush blueberry, and huckleberry, *Gaylussacia baccata*. The blueberry maggot is generally the most serious pest of blueberry production in the eastern United States, and there is zero tolerance for blueberry maggots in berries sold for processing; one maggot detected by inspectors can result in the refusal of an entire shipment. Berries become soft, mushy and unmarketable from maggots feeding within the berries. Fruit containing maggots may be seized and condemned by the FDA (W-2). Federal inspectors monitor interstate blueberry shipments, and processors and other buyers perform tests to detect contaminated berries. In Canada, the Federal Plant Protection Act and Regulations place movement restrictions on blueberry fruit, plants, soil and containers from areas known to be infested with blueberry maggot. Specific laws have also been enacted in some Canadian provinces regarding this problem (Appendix 5). Therefore, small populations of *Vaccinium stamineum* could be harmed not only by infestations with this native North American pest, but by those who might wish to eliminate the plant as a threat to commercial blueberry production. This sort of effort has not yet been documented nor is it mandated by statute.

At the current time, it does not appear that the populations of *Vaccinium stamineum* in the Hoosier or Shawnee National Forests are threatened with elimination from habitat loss. However, in the absence of future management of the forest for this species, it could decrease or be eliminated. There appears to be no immediate threat to the species from the blueberry maggot in Illinois or Indiana.

RESEARCH AND MONITORING

Vaccinium stamineum is being monitored by botanists working on behalf of the state Natural Heritage programs and other organizations in the areas where it is listed as endangered or threatened (W-5). However, a continuing problem is that there is neither sufficient funding nor are there enough botanists available to survey the immense area that needs to be covered in the monitoring of the large numbers of sensitive plants, including this one. There is a considerable area of suitable habitat in extreme southern Illinois where *Vaccinium stamineum* could exist, and continued searches for the species could be conducted.

In addition to the basic effort of locating additional populations of the species, it would be useful to conduct a genetic investigation of the diversity within the known population to determine if it is composed of one or more individuals. This could be expanded to compare it with the nearest populations in adjoining states to determine its origin or degree of genetic distance from them. Surveys and monitoring can continue to increase the data on number of ramets (stems arising from the ground) within the population, area covered by the colony, and success in fruit and seed maturation. Data proving the establishment of new individuals from local seed would be very significant in demonstrating the viability of the species locally. The techniques for this and other aspects of monitoring and studying rare plant species are explained well in Philippi *et al.* (2001) and Imm *et al.* (2001).

Among the results of recent research is the fact that *Vaccinium stamineum* has been shown to be

resistant to fire, and to actually benefit from fire management (Ford 1995, Kreher *et al.* 2000, Collins *et al.* 2001). This research along with the genetic studies should assist considerably in the understanding of this species.

Botanical surveys conducted by scientists from the Illinois Natural History Survey have shown repeatedly that with sufficient time and funding, and an experienced eye, many plants thought to be extirpated or else threatened or endangered can be found at additional locations (Hill 2002). These sorts of investigations have been important in that they have led not only to the de-listing of species once thought to be rare, but they have also resulted in the discovery of species previously unknown in the state. The U.S. Forest Service and other related agencies have done a fine job in the effort to preserve rare species with the resources that they have available. In the case of *Vaccinium stamineum*, as pointed out above, it was a sharp-eyed U.S. Forest Service biologist who re-discovered the plant in Illinois after it had been judged to be extirpated by the Illinois Endangered Species Protection Board (W-9).

RESTORATION

There are no known restoration efforts being conducted on *Vaccinium stamineum* anywhere in its range. Research has been conducted on the effects of fire on its growth as well as on genetic variation within patches, as pointed out above. The available research findings in this area suggest that fire management would result in an increased size and success of the local deerberry population, but not necessarily an increase in the establishment of new individuals (because of a lack of available data for the latter).

Nursery grown plants are occasionally available, and a brief Internet search found deerberry for sale by Hickory Hill Native Nursery, Inc., Brooksville, FL, and Wilcox Nursery, Largo, FL, for example. Restorations of any native plant species are recommended using only nursery propagated material grown from native, local populations to avoid interbreeding with genotypes not adapted to the local conditions and to avoid compromising the local gene pool. If this rule is not followed, the result is generally the loss of plants because they are not competitive under local conditions or the result could be the success of a plant or plants that can not be considered truly native (considered by some to be a plant community reconstruction rather than a restoration). The planting of deerberry in Illinois from Florida sources would not be encouraged in a restoration effort. Local plants should, instead, be propagated for planting in such an effort.

SUMMARY

Documented as native only in North America north of Mexico, *Vaccinium stamineum*, deerberry, is a nationally secure species in the United States of America but it is threatened in Canada. It is secure within 26 of the 29 U.S. states (including DC) where it has been documented, but it is not fully secure in Illinois, Kansas, and Vermont. Its distribution within and at the margins of its range is limited primarily by its preferences for acidic soil (generally well-drained) and open forest habitat (45 % canopy cover or less). It does not appear to have reproductive or dispersal problems. Deerberry is fire resistant and it can be long-lived, increasing through either sexual or vegetative reproduction. Deerberry was listed as Endangered in Illinois previous to 1994, and is listed currently as a Regional Forester Sensitive Species in the Shawnee National Forest. While

considered by the Illinois Endangered Species Protection Board in 1994 to have been extirpated in Illinois where it once grew in Pope County, within the Shawnee National Forest, another population was found subsequently in Hardin County, also on National Forest land, and the state status should be re-evaluated. Continued monitoring is needed in Illinois and searches should be conducted for additional populations in far southern parts of the state on suitable habitat. Management through infrequent scheduled burns or thinning of the canopy may be needed for it to persist at its present location, which is currently secure.

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- W-2. Department of Entomology, North Carolina State University
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- W-3. Floridata.com L.C.
http://www.floridata.com/ref/v/vacc_sta.cfm
- W-4. Illinois Plant Information Network (ILPIN)
<http://www.fs.fed.us/ne/delaware/ilpin/286.co>

- W-5. NatureServe (The Nature Conservancy)
<http://www.natureserve.org/>
- W-6. Oklahoma Biological Survey
<http://www.biosurvey.ou.edu/shrub/vacc-sta.htm>
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CONTACTS

Shawnee National Forest; 50 Highway 145 South, Harrisburg, IL 62946 (618) 253-7114

Elizabeth L. Shimp (618) 253-7114; e-mail: eshimp@fs.fed.us
Steve Widowski (618) 658-2111; e-mail: swidowski@fs.fed.us

Hoosier National Forest; 811 Constitution Avenue, Bedford, IN 47421 (812) 275-5987

Steven D. Olson (719) 553-1400; e-mail: solson01@fs.fed.us
currently: Pike-San Isabel National Forests,
Cimarron-Comanche National Grasslands,
Kachina Drive, Pueblo, CO 81008

Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65102-0180

Tim E. Smith (573) 751-4115 ext. 3200; e-mail: smith2@mdc.st
Dr. George A. Yatskievych (314) 577-9522; e-mail: george.yatskievych@mobot.org

Biological Consultant

John E. Schwegman (618) 543-9429; e-mail: botany@midwest.net

Brooklyn Botanic Garden

Dr. Steven Clemants (718) 941-4044; e-mail: steveclemants@bbg.org

Illinois Natural History Survey; 607 E. Peabody Drive, Champaign, IL 61820

Dr. Steven R. Hill (217) 244-8452; e-mail: srhill@mail.inhs.uiuc.edu

Dr. L. Richard Phillippe (217) 244-2181; e-mail: rickp@mail.inhs.uiuc.edu

Dr. John B. Taft (217) 244-5046; e-mail: taft@mail.inhs.uiuc.edu

Illinois Endangered Species Board

Dr. John E. Ebinger (217) 345-3815; e-mail: cfjee@eiu.edu

University of Vermont

Dr. David S. Barrington (802) 656-0431; email: dbarrington@zoo.uvm.edu

APPENDICES

Synonymy of *Vaccinium stamineum* L.

Modified from: *Vaccinium stamineum*, Technical page, by Steven Clemants, Brooklyn Botanic Garden, 1998, used with permission:

<http://www.bbg.org/sci/nymf/encyclopedia/eri/vac0110b.htm> [W-11]

**Vaccinium stamineum* L., Sp. Pl. 1: 350. 1753. **Pirococcus stamineus* (L.) Nutt., Trans. Amer. Phil. Soc., n.s. 8: 262. 1843. **Polycodium stamineum* (L.) Greene, Pittonia 3: 324. 1898. TYPE: North America. *P. Kalm. s.n.* (Lectotype: LINN 497.2), selected by (Van der Kloet, 1989).

**Vaccinium album* Pursh, Fl. Amer. Sept. 1: 285. 1814, nom. illeg. (Art. 53.1). TYPE: Type not designated, several elements cited. Pursh also wrote "I am not certain whether this is the *V. album* of Linnaeus or not. As I never could find any certainty about the authentic species. I venture to adopt this species for it."

**Vaccinium elevatum* Banks & Sol. ex Wikstr., Kongl. Vetensk. Acad. Handl. 43: 281. 1823.

**Pirococcus elevatus* (Banks & Sol. ex Wikstr.) Nutt., Trans. Amer. Phil. Soc., n.s. 8: 262. 1843. TYPE: Unknown.

**Pirococcus floridanus* Nutt., Trans. Amer. Phil. Soc., n.s. 8: 262. 1843. **Polycodium floridanum* (Nutt.) Greene, Pittonia 3: 325. 1898. **Vaccinium floridanum* Sleumer, Bot. Jahrb. Syst. 71: 425. TYPE: Type not designated, apparently two elements. [flowers small, leaves glaucous, bracts broadly ovate]

**Vaccinium kunthianum* Klotzch, Linnaea 24: 56. 1851. **Polycodium kunthianum* (Klotzch) C. B. Rob., Bull. Torrey Bot. Club 39: 559. 1912. TYPE: Location and collector unknown (Holotype: B). [calyx pubescent, fruit dark red or black, pubescence not velvety]

**Vaccinium caesium* Greene, Pittonia 3: 249. 1897. **Polycodium floridanum* var. *caesium*

(Greene) Ashe, J. Elisha Mitchell Sci. Soc. 46: 203. 1931. **Vaccinium floridanum* var. *caesium* (Greene) Sleumer, Bot. Jahrb. Syst. 71: 425. **Vaccinium stamineum* var. *caesium* (Greene) G. H. Ward, Castanea 39: 200. 1974. TYPE: United States. Florida: Lake Co.; vic. of Eustis, 12-31 March 1894, *G. V. Nash* 573 (Holotype: NDG; Isotype: US!). [large floral bracts]

**Vaccinium stamineum* var. *melanocarpum* C. Mohr, Bull. Torrey Bot. Club 24: 25. 1897.

**Vaccinium melanocarpum* (C. Mohr) C. Mohr ex Kearney, Bull. Torrey Bot. Club 24: 570. 1897. **Polycodium melanocarpum* (C. Mohr) Small, Fl. S.E. U.S. 894, 1336. 1903. TYPE: Type not cited. United States. Alabama: St. Clair Co.; near Asheville, 10 July 1880, *C. Mohr s.n.* (Holotype: UNA; Isotype: US!), note on US sheet "Mohr seems to have regarded this as the type of his species G.B.R." On the other hand, Ashe (Ashe 1931), states that type specimen is from United States. Alabama: St. Clair Co.; Springville, Jun 1880, *C. Mohr s.n.* (see also under *Vaccinium melanocarpum* var. *sericeum*). [calyx glabrous, leaves glabrous, fruit black]

**Vaccinium oblongum* Greene, Pittonia 3: 250. 1897. **Polycodium oblongum* (Greene) Greene, Pittonia 3: 324. 1898. TYPE: United States. Tennessee: near Dover, May 1863, *Green s.n.* (Holotype: NDG).

**Vaccinium revolutum* Greene, Pittonia 3: 324. 1898. **Polycodium floridanum* var. *revolutum* (Greene) Ashe, J. Elisha Mitchell Sci. Soc. 46: 203. 1931. **Vaccinium floridanum* var. *revolutum* (Greene) Sleumer, Bot. Jahrb. Syst. 71: 425. TYPE: United States. Florida: Lake Co.; vic. of Eustis, 1-15 May 1894, *G. V. Nash* 53 (Holotype: NDG; Isotype: US!).

**Vaccinium melanocarpum* var. *candicans* C. Mohr, Pl. Life Alabama 658. 1901. **Polycodium candicans* (C. Mohr) Small, Fl. S.E. U.S. 894, 1336. 1903. **Vaccinium candicans* (C. Mohr) Sleumer, Bot. Jahrb. Syst. 71: 426. TYPE: United States. Alabama: Lee Co.; Auburn, Aug. 1897, *Baker & Earle s.n.* (Syntypes: UNA and Herb. Geol. Surv.). [calyx glabrous, leaves pale velvety beneath]

**Vaccinium melanocarpum* var. *sericeum* C. Mohr, Pl. Life Alabama 658. 1901. **Vaccinium sericeum* (C. Mohr) Palmer, J. Arnold Arb. 13: 429. 1932. **Polycodium sericeum* (C. Mohr) C. B. Rob., Bull. Torrey Bot. Club 39: 559. 1912. **Vaccinium stamineum* var. *sericeum* (C. Mohr) G. H. Ward, Castanea 39: 201. 1974. TYPE: United States. Alabama: St. Clair Co.; near Springville, 28 May 1892, *Mohr s.n.?* (Syntypes: UNA and Herb. Geol. Surv.), Ashe (Ashe 1931) states type is Alabama, Clay Co., Ashland in Mohr herb. (UNA), and that this may be Asheville (St. Clair Co.) as one sheet has Ashland crossed out and Asheville written above by Mohr. [calyx and hypanthium densely hirsute]

**Polycodium neglectum* Small, Fl. S.E. U.S. 893, 1336. 1903. **Vaccinium stamineum* var. *neglectum* (Small) Deam, Shrubs Indiana, ed. 2, 288. 1932. TYPE: United States. Georgia: Crawford Co.; *Wilson* 159 (Holotype: NY). [leaves and branches glabrous]

**Polycodium langloisii* Greene, Leafl. Bot. Observ. 2: 226. 1912. **Vaccinium langloisii* (Greene) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: United States. Louisiana: Covington, 16 Apr 1894, *Langlois s.n.* (Holotype: NDG), according to Ashe (1931). [calyx pubescent, fruit red to black, pedicels not bracteate, plants 5-8 dm tall]

**Polycodium oliganthum* Greene, Leafl. Bot. Observ. 2: 226. 1912. TYPE: United States.

Florida: Lemon City, 23 May 1901, *S. M. Tracy* 7264 (Holotype: NDG; Isotype: US!).

**Polycodium interius* Ashe, Charleston Mus. Quart. 1: 32. 1925. **Vaccinium stamineum* var. *interius* (Ashe) Palmer & Steyermark, Ann. Missouri Bot. Gard. 22: 614. 1935. **Vaccinium interius* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: Type not designated, two elements. [leaves glabrous, yellowish green on both sides, fruit dark red]

**Polycodium quercinum* Ashe, Bull. Torrey Bot. Club 54: 580. 1927. **Vaccinium quercinum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 425. 1941. TYPE: Type not designated, two elements. [flowers small, leaves obtuse to rounded, pubescent on both surfaces]

**Polycodium depressum* Small, Torrey, 28: 5. 1928. **Vaccinium depressum* (Small) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: United States. Alabama: Baldwin Co.; Silverhill, 3 May 1926, Small et al., s.n. (Holotype: NY). [calyx pubescent, fruit red to dark purple, plant to 3 dm tall]

**Polycodium ashei* Harb., Amer. Midl. Naturalist 22: 180-181. 1930, *nom. illeg.* (Art. 53.1). **Vaccinium harbisonii* Sleumer, Bot. Jahrb. Syst. 71: 425. 1941. TYPE: Type not designated, two elements. [flowers small, leaves, inflorescence and twigs glabrous]

**Polycodium arcuatum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 207. 1931. **Vaccinium arcuatum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: United States. Mississippi: Hancock, McNeill, 8 May 1930, *W. W. Ashe* s.n. (Holotype: NCU). [calyx pubescent, fruit red to dark purple, pubescence not velvety, plant 10 dm tall]

**Polycodium arenicola* Ashe, J. Elisha Mitchell Sci. Soc. 46: 212-213. 1931. TYPE: Type not designated, two elements. [calyx glabrous, leaves pubescent, pale and whitened beneath, finely reticulated]

**Polycodium bellum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 209. 1931. **Vaccinium bellum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: United States. Mississippi: Adams Co.; Aug. 1929, *W. W. Ashe* s.n. (Holotype: NCU). [calyx glabrous, leaves sparingly pubescent and bright green beneath]

**Polycodium concoloratum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 204. 1931. **Vaccinium concoloratum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: United States. Florida: Seminole Co.; near Sanford, *W. W. Ashe* s.n. (Holotype: NCU). [flowers small, leaves acute or obtuse, green or yellowish beneath]

**Polycodium depressum* var. *minus* Ashe, J. Elisha Mitchell Sci. Soc. 46: 206. 1931. **Vaccinium depressum* var. *minus* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: Type not designated, two elements. [calyx pubescent, fruit red to dark purple, pubescence not velvety, plant dwarf]

**Polycodium floridanum* var. *molle* Ashe, J. Elisha Mitchell Sci. Soc. 46: 203. 1931. **Vaccinium floridanum* var. *molle* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 425. 1941. TYPE: United States. Georgia: Randolph Co.; 28 Apr. 1930, *W. W. Ashe* s.n. (Holotype: NCU). [calyx pubescent]

- **Polycodium glandulosum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 201. 1931. **Vaccinium glandulosum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 425. 1941. **Vaccinium stamineum* var. *glandulosum* (Ashe) G. H. Ward, Castanea 39: 201. 1974. TYPE: Type not designated, two elements. [stalked glands]
- **Polycodium interius* var. *commune* Ashe, J. Elisha Mitchell Sci. Soc. 46: 210. 1931.
 **Vaccinium interius* var. *commune* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: Type not designated, two elements. [leaves more or less pubescent beneath, especially in the veins]
- **Polycodium interius* var. *subglandulosum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 210. 1931.
 **Vaccinium interius* var. *subglandulosum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: United States. Arkansas: Garland Co.; Hot Springs Mtn., 1 Aug 1928, W. W. Ashe s.n. (Holotype: NCU). [inflorescence glandular pubescent, otherwise often glabrous; fruit occasionally glandular]
- **Polycodium lautum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 205. 1931. **Vaccinium lautum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 425. 1941. TYPE: United States. Florida: Washington Co.; E of Holmes Valley, 6 Jun 1929, W. W. Ashe s.n. (Holotype: NCU). [fruit 8-10 mm diam., calyx glabrous, leaves green beneath]
- **Polycodium multiflorum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 204. 1931, *nom. illeg.* (ICBN, Art. 53.1). **Vaccinium semipersistens* Sleumer, Bot. Jahrb. Syst. 71: 425. 1941. **Vaccinium stamineum* var. *multiflorum* (Ashe) G. H. Ward, Castanea 39: 201. 1974. TYPE: Type not designated, two elements. [hypanthium and fruit sparingly pubescent]
- **Polycodium multiflorum* var. *uniquum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 205. 1931.
 **Vaccinium semipersistens* var. *uniquum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 425. 1941. TYPE: Type not cited. [elongated calyx lobes glabrous]
- **Polycodium neglectum* var. *harbisonii* Ashe, J. Elisha Mitchell Sci. Soc. 46: 211. 1931.
 **Vaccinium neglectum* var. *harbisonii* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: United States. North Carolina: Macon Co.; Satula Mtn., T. G. Harbison & W. W. Ashe s.n. (Holotype: NCU?). [larger, occasionally 12-15 dm tall, consistently densely glaucous]
- **Polycodium parvum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 211. 1931. **Vaccinium parvum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: Type not designated, two elements. [calyx glabrous, leaves less than 6 cm, glabrous, pale or glaucous beneath]
- **Polycodium sericeum* var. *eburneum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 206. 1931.
 **Vaccinium sericeum* var. *eburneum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: Type not cited. [ample leaves glaucous as well as pubescent beneath]
- **Polycodium sericeum* var. *elongatum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 206. 1931.
 **Vaccinium sericeum* var. *elongatum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 425. 1941. TYPE: United States. Alabama: Coosa Co.; July 1926, W. W. Ashe s.n. (Holotype: NCU). [small, lanceolate leaves]

**Polycodium stamineum* var. *affine* Ashe, J. Elisha Mitchell Sci. Soc. 46: 212. 1931. **Vaccinium stamineum* var. *affine* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: Type not cited. [leaves white glaucous and soft pubescent beneath; fruit green or yellow]

**Polycodium stamineum* var. *austro-montanum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 212. 1931. **Vaccinium stamineum* var. *austro-montanum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: Type not designated, two elements. [leaves oblong or ovate-oblong, 6-12 cm; calyx usually pubescent, etc.]

**Polycodium stamineum* var. *virginianum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 212. 1931. **Vaccinium stamineum* var. *virginianum* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 426. 1941. TYPE: United States. Virginia: Shenandoah Co.; Massanutten Mtn., Sep 1913, *W. W. Ashe s.n.* (Holotype: NCU). [fruit red to russet, subglobose, obovate, or sometimes ovate, etc.]

**Polycodium sericeum* var. *elongatum* f. *chrysocarpum* Ashe, J. Elisha Mitchell Sci. Soc. 46: 206. 1931 **Vaccinium sericeum* f. *chrysocarpon* (Ashe) Sleumer, Bot. Jahrb. Syst. 71: 425. 1941. TYPE: Type not cited. [bright orange fruit]

**Polycodium macilentum* Small, Man. S.E. Fl. 1012, 1506. 1933. **Vaccinium macilentum* (Small) Sleumer, Bot. Jahrb. Syst. 71: 427. 1941. TYPE: United States. Alabama: Vaughs Mill, Earle 1632 (Holotype: NY).

**Polycodium leptosepalum* Small, Man. S.E. Fl. 1012, 1506. 1933. **Vaccinium leptosepalum* (Small) Sleumer, Bot. Jahrb. Syst. 71: 427. 1941. TYPE: United States. Mississippi: French Camp, Idam Clute 59 (Holotype: NY).

APPENDIX 2

Detailed description of *Vaccinium stamineum*

Modified from: *Vaccinium stamineum*, Technical page, by Steven Clemants, Brooklyn Botanic Garden, 1998, used with permission :

<http://www.bbg.org/sci/nymf/encyclopedia/eri/vac0110b.htm> [W-11]

HABIT perennial, deciduous, sometimes low-growing (chamaephyte), shrubs, autotrophic, monoclinal, with fibrous roots, 0.3-1.3 m tall, not modified.

STEMS erect, round, not winged, "regular". Prickles absent. Bark striate or furrowed, exfoliating, gray. Branches ascending, orange, round, not winged, 1.1-1.5 mm in diam. Twigs light orange-yellow or yellowish orange or greenish yellow, not odoriferous, round, 0.5-0.8 mm in diam., smooth, hairs short and unbranched or glabrous, spreading, unicellular, uniseriate, white, moderately dense or dense, throughout, not glabrescent, without glands. Pith present, white, round, continuous, nodal diaphragm absent. Thorns absent. Aerial roots absent. Sap translucent. Resin absent.

BUDS terminal and axillary buds monomorphic. Terminal bud present, ovoid, 0.8-1.5 mm long, pointed. Axillary buds present, 1, ovoid, 0.5-1.3 mm long, pointed. Bud scales 4-6, light yellow

or reddish orange, imbricate, ovate, chartaceous, cuspidate, glabrous, without glands. Leaf scars crescent, 0.2-0.3 mm high, 0.6-0.8 mm wide. Vascular bundle scars 1, elliptic, 0.1-0.2 mm tall.

LEAVES alternate, 1 per node, spaced \pm evenly along stem, divergent from stem, simple. Stipules present. Leaves petiolate or leaves sessile, petiole "typical", 0-0.3 cm long, hairs short and unbranched, erect, unicellular, uniseriate, moderately dense or dense, throughout, not glabrescent, without glands. Leaf: abaxial surface light yellowish green, adaxial surface yellowish green, blades narrowly elliptic or elliptic, plane, symmetric, 2.5-6.5 cm long, 1.4-2.7 cm wide, chartaceous, base cuneate, margin entire, apex acute or acuminate, abaxial surface hairs long and unbranched or glabrous, erect, multicellular, uniseriate, white, sparse to dense, along midveins or throughout, not glabrescent, without glands, adaxial surface hairs long and unbranched or glabrous, erect, multicellular, uniseriate, white, sparse, along midveins, not glabrescent, without glands. Brochidodromous venation, veins 5. Leaf lobes absent. Spines absent. Tendrils absent.

INFLORESCENCES monomorphic, regular or, if dimorphic, female inflorescence simple, raceme, axillary. Peduncle absent. Rachis present, 2.6-3.5 cm long. Bracts sessile, blades: abaxial surface light yellowish green, adaxial surface yellowish green, narrowly elliptic or elliptic, plane, 5.1-9.8 mm long, 2.5-3.2 mm wide, base acute, apex obtuse or emarginate, abaxial surface hairs long and unbranched or glabrous, abaxial hairs erect, multicellular, uniseriate, white, moderately dense, throughout, not glabrescent, without glands, adaxial surface hairs long and unbranched or glabrous, erect, multicellular, uniseriate, white, sparse, throughout, not glabrescent, without glands. Pedicel 8-17 mm long, hairs short and unbranched, hairs spreading, unicellular, uniseriate, white, sparse to moderately dense, throughout, not glabrescent, without glands. Bracteoles 0. Cupules absent.

FLOWERS formed on short shoots, monomorphic, with sepals and petals readily distinguishable from one another, bisexual. Perfect or female flowers white, 5-merous, 6-9 mm long, 6-10 mm wide, 3-9 flowers per inflorescence, perianth of two whorls. Calyx present, actinomorphic, campanulate, of fused sepals, persistent, abaxial and adaxial surfaces the same color, yellowish green, 1.8-3.2 mm long, 2.3-3.8 mm wide, tube 1.3 mm long, calyx limb 0.4-1.3 mm long, 2.3-3.8 mm wide. Sepals or sepal lobes 5, shallowly deltate or shallowly triangular, 0.4-1.3 mm long, 1.2-1.6 mm wide, base truncate, margin ciliate, apex acute, abaxial surface glabrous, without glands, adaxial surface glabrous, without glands. Epicalyx absent. Corolla present, actinomorphic, campanulate, of fused petals, deciduous, abaxial and adaxial surfaces the same color, white, 6-9 mm long, 6-10 mm wide, corolla limb 1.7-3 mm long, 6-10 mm wide. Petals or petal lobes 5, ovate, 2-3 mm long, 2.8-3.6 mm wide, base truncate, margin entire, apex obtuse, abaxial surface glabrous, without glands, adaxial surface glabrous, without glands. Gynoecium syncarpous. Carpels 5. Stigmas 1, truncate. Styles not persistent, 1, 6.3-7 mm long. Ovary inferior, 0.7-1.5 mm long, 1.3-2.8 mm wide, nectariferous disk present. Locules 5. Placentation axile. Androecium obdiplostemonous. Stamens 10, 4.5-5.3 mm long. Anthers linear, opening by pores, opening 1/4 of entire anther, bithecal, orange or light yellow, glabrous, spurred. Filaments free, straight, orange or light yellow, hairs short and unbranched, erect, unicellular, uniseriate. Staminodes absent.

FRUITS bacca (berry), blue, globose, 6-15 mm long, 6-15 mm wide, glabrous, without glands.

SEEDS 5 to many, yellowish orange or orange-yellow, ovoid, 1.1-1.6 mm long, 0.9-1.2 mm wide, wingless, not tailed, reticulate-foveate.

APPENDIX 3

Natural Diversity Database Element Ranking System

modified from: <http://www.cnpsci.org/html/PlantInfo/Definitions2.htm> [W-1]

Global Ranking (G)

G1

Critically imperiled world-wide. Less than 6 viable elements occurrences (populations for species) OR less than 1,000 individuals OR less than 809.4 hectares (ha) (2,000 acres [ac]) known on the planet.

G2

Imperiled world-wide. 6 to 20 element occurrences OR 809.4 to 4,047 ha (2,000 to 10,000 ac) known on the planet.

G3

Vulnerable world-wide. 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac) known on the planet.

G4

Apparently secure world-wide. This rank is clearly more secure than **G3** but factors exist to cause some concern (i.e. there is some threat, or somewhat narrow habitat).

G5

Secure globally. Numerous populations exist and there is no danger overall to the security of the element.

GH

All sites are historic. The element has not been seen for at least 20 years, but suitable habitat still exists.

GX

All sites are extirpated. This element is extinct in the wild.

GXC

Extinct in the wild. Exists only in cultivation.

G1Q

Classification uncertain. The element is very rare, but there is a taxonomic question associated with it.

National Heritage Ranking (N)

The rank of an element (species) can be assigned at the national level. The **N-rank** uses the

same suffixes (clarifiers) as the global ranking system above.

Subspecies Level Ranking (T)

Subspecies receive a **T-rank** attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies or variety.

For example: *Chorizanthe robusta* var. *hartwegii*. This plant is ranked **G2T1**. The G-rank refers to the whole species range (i.e., *Chorizanthe robusta*, whereas the T-rank refers only to the global condition of var. *hartwegii*. Otherwise, the variations in the clarifiers that can be used match those of the G-rank.

State Ranking (S)

S1

Critically imperiled. Less than 6 element occurrences OR less than 1,000 individuals OR less than 809.4 ha (2,000 ac). **S1.1** = very threatened; **S1.2** = threatened; **S1.3** = no current threats known.

S2

Imperiled. 6 to 20 element occurrences OR 3,000 individuals OR 809.4 to 4,047 ha (2,000 to 10,000 ac). **S2.1** = very threatened; **S2.2** = threatened; **S2.3** = no current threats known.

S3

Vulnerable. 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac). **S3.1** = very threatened; **S3.2** = threatened; **S3.3** = no current threats known.

S4

Apparently Secure. This rank is clearly lower than S3 but factors exist to cause some concern (i.e., there is some threat, or somewhat narrow habitat).

S5

Secure. Demonstrably secure to ineradicable in the state.

SH

All state sites are historic; the element has not been seen for at least 20 years, but suitable habitat still exists. Possibly extirpated.

SR

Reported to occur in the state. Otherwise not ranked.

SX

All state sites are extirpated; this element is extinct in the wild.

Notes: 1. Other considerations used when ranking a species or natural community include the

pattern of distribution of the element on the landscape, fragmentation of the population/stands, and historical extent as compared to its modern range. It is important to take a bird's eye or aerial view when ranking sensitive elements rather than simply counting element occurrences.

2. Uncertainty about the rank of an element is expressed in two major ways: by expressing the rank as a range of values (e.g., **S2S3** means the rank is somewhere between S2 and S3), and by adding a ? to the rank (e.g. S2?). This represents more certainty than S2S3, but less than S2.

APPENDIX 4

The Rediscovery of *Vaccinium stamineum* in Illinois (1998)

From Southern Illinois Outdoors: A weekly online product of American Publishing Company
<http://www.sioutdoors.com/stories/briefs062098.html> (W-9)

Endangered species disappears, reappears

VIENNA (ANS) June 20, 1998 -- When the bald eagle was removed from the federal endangered species list a few years ago, there were celebrations among nature-lovers who rejoiced over one of the major wildlife comebacks in recent history. When Illinois removed a plant called deerberry from its endangered species list several years ago, nobody but a handful of botanists seemed to notice.

The reason: The shrub-like plant, which resembles a blueberry bush, was determined to be vanished from the state for good.

"Plants that have not been found in the last 30 years are considered extirpated and are taken off the list," explains Sue Lauzon, executive director of the Illinois Endangered Species Protection Board. Deerberry, or *Vaccinium stamineum*, was only known to exist in one spot in Pope County. But by 1990, the plant was considered vanished from Illinois.

On May 12 this year, Shawnee National Forest biologist Ray Smith made a discovery.

While searching for a different species, Smith found a small population of deerberry in Hardin County. "We don't know that it still exists in Pope County," Smith says. "But it exists in Hardin. The entire population is about the size of this room."

APPENDIX 5

British Columbia, Canada: Regulation regarding the blueberry maggot

source: http://www.qp.gov.bc.ca/statreg/reg/P/PlantProtection/280_90.htm#section%202 [W-7]

B.C. Reg. 280/90

O.C.1268/90

Deposited August 27, 1990
Plant Protection Act

BLUEBERRY MAGGOT CONTROL REGULATION

Interpretation

- 1 In this regulation: "blueberry maggot" means *Rhagoletis mendax* Curran; "infested area" means any place listed in the Schedule or any other place where blueberry maggot is known to be established; "inspector" means an inspector appointed under the authority of the Ministry of Agriculture and Food Act.

Quarantine area established

- 2 To prevent the spread within the Province of blueberry maggot, the Province is declared to be a quarantine area.

Movement of fresh blueberries into the quarantine area

- 3 No person shall move fresh blueberries into the quarantine area from an infested area unless
- (a) the blueberries have been fumigated with methyl bromide at atmospheric pressure in accordance with one of the following: (i) 32 g/m³ for 2 hours at 27.7° C or above; (ii) 32 g/m³ for 2 1/2 hours at 22.2° C to 27.2° C; (iii) 32 g/m³ for 3 hours at 16.6° C to 21.6° C; (iv) 32 g/m³ for 3 1/2 hours at 10° C to 16.1° C
 - (b) the residues of methyl bromide on the blueberries do not exceed the maximum residue limit established under the Food and Drugs Act (Canada), and
 - (c) the blueberries are accompanied by (i) proof satisfactory to an inspector of compliance with the requirements in paragraph (a) and (b), and (ii) a certificate stating the name and address of the grower.

Sale of blueberries

- 4 No person shall sell or offer for sale within the quarantine area any fresh blueberries that have been moved into the quarantine area from an infested area, except if that person possesses, for those blueberries, a copy of both the proof and the certificate referred to in section 3 (c).

Offence

- 5 A person who contravenes section 3 or 4 commits an offence and is liable to a fine not exceeding \$2 000.

Schedule (Section 1) Infested Areas:

Nova Scotia, New Jersey, New Brunswick, New York, Prince Edward Island, North Carolina, Connecticut, Ohio, Delaware, Pennsylvania, District of Columbia, Rhode Island, Florida, South Carolina, Georgia, Tennessee, Maine, Vermont, Maryland, Virginia, Massachusetts, West Virginia, Michigan, Wisconsin, New Hampshire.

[Provisions of the Plant Protection Act, R.S.B.C. 1996, c. 365, relevant to the enactment of this regulation: sect. 8]

APPENDIX 6

Representative specimens of *Vaccinium stamineum* examined

Herbaria:

CLEMS = Clemson University Herbarium, Clemson, SC. GA = University of Georgia Herbarium, Athens. GH = Gray Herbarium of Harvard University, Cambridge, MA. ILL = University of Illinois Herbarium, Champaign. ILLS = Illinois Natural History Survey Herbarium, Champaign. MARY = University of Maryland Herbarium, College Park. MO = Missouri Botanical Garden Herbarium, St. Louis. NY = New York Botanical Garden Herbarium, Bronx. VT = University of Vermont Herbarium, Burlington. WIS = University of Wisconsin Herbarium, Madison.

ARKANSAS: LOGAN CO.: Mount Magazine, 20 May 1989, *Ulaszek 1363* (ILLS).

ILLINOIS: HARDIN CO.: Kaskaskia Experimental Forest, within Shawnee National Forest, 10 Jul 2002, *Hill, Olson, & Hoard 34822* (ILLS).

INDIANA: CRAWFORD CO.: Hoosier National Forest, 5.25 mi. S of English SE/4, MW/4, Sec. 13, T3S, R1W, 30 Jun 1990, *Ulaszek 1498* (ILLS).

KENTUCKY: LAUREL CO.: Laurel River KOA Campground, W of Corbin, 10 May 1976, *Evers & Evers 115471* (ILLS).

LOUISIANA: NATCHITOCHE PARISH: Kisatchie National Forest, Longleaf Vista Trail, LA119 S to trail, Derry, 18 Apr 1998, *Hill & Thomas 29957* (ILLS).

MARYLAND: ANNE ARUNDEL CO., Eagle Hill, Leatherleaf Lane, 28 Jun 1981, *Hill 10444* (GA, GH, ILL, MARY, MO, NY, VT); FREDERICK CO.: in Gambrill State Park, N of Frederick, 11 Jun 1972, *Windler & Stastny 3895* (ILLS); GARRETT CO., Swanton, foot of Backbone Mtn., 20 Sep 1980, *Hill 9561* (GH, MARY, MO, NY, TAES, VT); PRINCE GEORGES CO., W side Greenbelt Park along Kenilworth Avenue, Greenbelt, 15 May 1981, *Hill 10008* (BH, GH, MARY, MO, NY, VT, WIS); National Colonial Farm, Accokeek, 11 May 1985, *Hill 16270* (CLEMS); SAINT MARY'S CO., Leachburg, Spring Ridge Middle School, 12 Jun 1983, *Hill 12732* (MARY, NY, VT).

MISSOURI: SHANNON CO.: Clow State Forest; just S of Co. Road A, 1 mi. E of Route 19, 23 May 1988, *Taft & Solecki 2357, 2356* (ILLS); SAINT GENEVIEVE CO.: Pickel Springs, 15 May 1955, *Neill 6703* (ILLS); Pickel Springs, 15 May 1960, *Neill 15116* (ILLS); Pickel Springs, 13 May 1961, *Neill 15582* (ILLS); Pickel Springs, 15 May 1955, *Neill 6702* (ILLS).

NORTH CAROLINA: HAYWOOD CO.: Great Smoky Mountains National Park. Big Creek Watershed. Cave Creek Gap 7.5 minute quadrangle, 2 May 2000, *Busemeyer, Phillippe, &*

Larimore 126 (ILLS); JACKSON CO., Cullowhee, SE end of Berry Ridge, 28 Jul 2001, *Hill 34102* (ILLS, MO, NY, VT).

PENNSYLVANIA: CENTRE CO., E of Moshanna River, Snow Shoe, 14 June 2002, *Hill 34752* (ILLS, VT);

SOUTH CAROLINA: BERKELEY CO., Francis Marion National Forest, Witherbee, 14 May 1987, *Hill 17989* (CLEMS, NY, VT); LEXINGTON CO., Bluefield Road, Red Bank, 21 Sep 1987, *Hill 18844* (CLEMS, NY, VT); OCONEE CO., Mountain Rest, ridge west of West Village Creek, 8 May 1988, *Hill 19243* (CLEMS, NY, VT).

TENNESSEE: BLOUNT CO.: Woodland margin to US 129 around 3 mi. below intersection with the Foothills Parkway along Little Tennessee River, 15 May 1993, *Basinger & Basinger 5097* (ILLS); COCKE CO.: Great Smoky Mountains National Park. Cosby Watershed. Hartford 7.5 minute quad., top of Sutton Ridge, 1 May 1999, *Phillippe 30300* (ILLS); HICKMAN CO.: Middle Tennessee State Univ. Wildlife Management Area, Whitfield 7.5 minute quad., W/NW of Centerville, 22 Apr 1998, *Phillippe 29587* (ILLS); STEWART CO.: TVA - Land Between the Lakes Recreation Area, Blue Spring Road, 14 Apr 1995, *Ulaszek 2358* (ILLS).

TEXAS: HARDIN CO., 3 mi N of Kountze, E side Village Creek, 4 Apr 1979, *Hill 8283* (MARY, NY, TAES, VT)

VIRGINIA: GILES CO.: along U.S. 460 between Newport & the county line, 22 Jun 1978, *Evers & Evers 115876* (ILLS).

WEST VIRGINIA: KANAWHA CO.: Reamer, 1.5 mi. S of Clendenin, Route 119, N of Charleston, 17 May 1983, *Easterly s.n.* (ILLS).