

# *Arceuthobium pusillum*

Dwarf Mistletoe

Viscaceae



*Arceuthobium pusillum* by Joseph OBrien, USDA Forest Service, Bugwood.org

## ***Arceuthobium pusillum* Rare Plant Profile**

New Jersey Department of Environmental Protection  
State Parks, Forests & Historic Sites  
State Forest Fire Service & Forestry  
Office of Natural Lands Management  
New Jersey Natural Heritage Program

501 E. State St.  
PO Box 420  
Trenton, NJ 08625-0420

Prepared by:  
Jill S. Dodds  
jsdodds@biostarassociates.com

March, 2022

For:  
New Jersey Department of Environmental Protection  
Office of Natural Lands Management  
New Jersey Natural Heritage Program  
natlands@dep.nj.gov

This report should be cited as follows: Dodds, Jill S. 2022. *Arceuthobium pusillum* Rare Plant Profile. New Jersey Department of Environmental Protection, State Parks, Forests & Historic Sites, State Forest Fire Service & Forestry, Office of Natural Lands Management, New Jersey Natural Heritage Program, Trenton, NJ. 15 pp.

## Life History

*Arceuthobium pusillum* (Dwarf Mistletoe) is a perennial parasitic plant that grows on conifers. While the plants are tiny and could easily be overlooked, they frequently cause the host trees to form conspicuous masses of deformed branches known as witches' brooms that call attention to their presence. Host responses to different species of *Arceuthobium* range from local swelling to broom formation, and broom types may vary from round to flattened and from open to dense. *A. pusillum* infections typically result in dense, globose brooms (Tinnin et al. 1982).

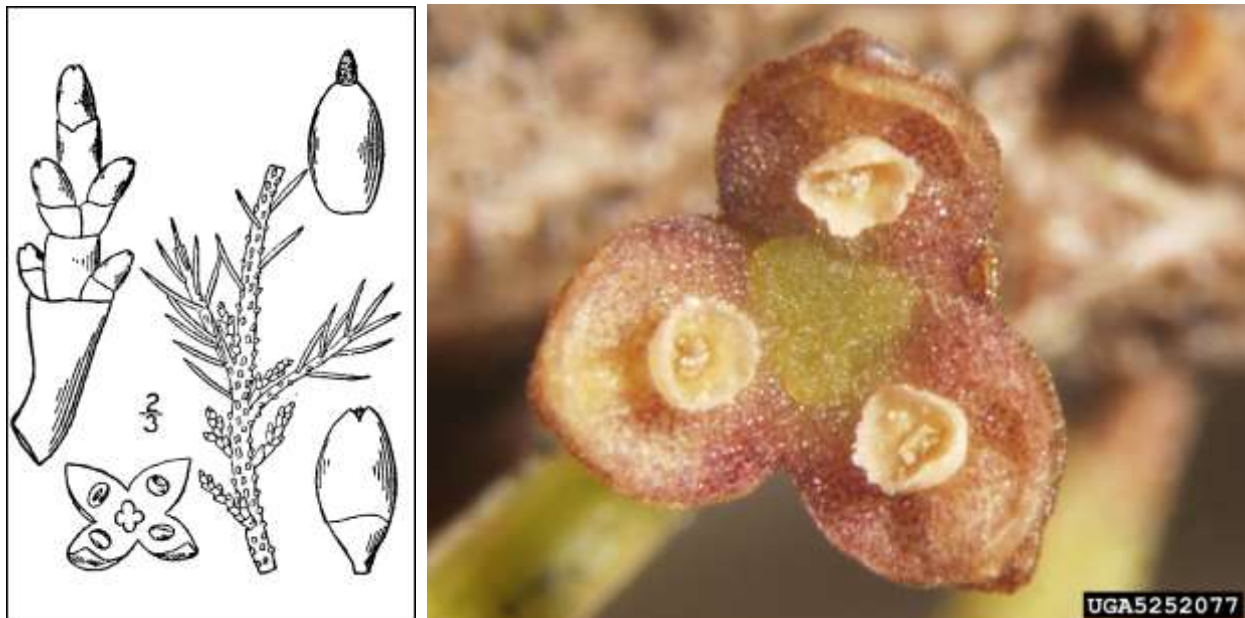
Thoreau was unaware of the little plants that initiated the broom-like masses he described in 1858, as *A. pusillum* was still unknown to science (Eaton 1935). The diminutive mistletoe was independently discovered at two sites in New York during 1871 and a description was published the following year, resulting in a wave of enthusiasm that led to documentation of the species in a number of additional states during the decades that followed (von Schrenk 1900). The altered appearance of infected trees often aided botanists in locating *Arceuthobium pusillum* (Jack 1900, Fernald 1900). Herman von Schrenk (1900) reported that the brooms gradually appropriated the trees' resources, draining their vitality and leaving them stunted or dead in striking contrast to healthy neighboring conifers. Parasitism by *A. pusillum* initially causes its host to produce fewer, smaller, yellower needles and as an infection proceeds it decreases the tree's growth and reproduction, increases susceptibility to other damaging agents, and eventually results in crown dieback and death (Geils and Hawksworth 2002, Baker et al. 2006). The associated reduction in timber quality and quantity has inspired a great deal of the research conducted on *Arceuthobium*.



Witches' broom formed by *Arceuthobium pusillum*, by Steven Katovich, Bugwood.org.



When an *A. pusillum* seed germinates on a young twig it produces a radicle that penetrates into the host plant's cortex and development proceeds inside of the branch for four years before the first shoots appear (Hawksworth and Wiens 1996). Dwarf Mistletoe shoots seldom exceed a centimeter in length (Reznicek et al. 2011), and its stems may be green, orange, red, maroon, or brown (Nickrent 2020). The stems are simple or few-branched, the leaves are opposite, rounded, and scale-like, and the flowers are generated at the tips or axils. Flowers do not appear until the fifth year (Baker et al. 2006)—they develop during the autumn and overwinter as mature buds (Hawksworth and Wiens 1996). *Arceuthobium pusillum* plants are dioecious, producing either male (staminate) or female (pistillate) flowers, and those with pistillate flowers usually have longer shoots. The pistillate flowers have a minute perianth comprised of 2 small lobes, while the earlier-blooming staminate flowers usually have 3–4 reddish lobes (occasionally 2 or 5) and a sessile anther associated with each lobe. The anthers are able to open or close in response to changes in environmental conditions (Hawksworth and Wiens 1996). Flowers of *A. pusillum* bloom between March and May(–June), and the fruits mature during September and October (See Britton and Brown 1913, Fernald 1950, Gleason and Cronquist 1991, Nickrent 2020).



Left: Illustration by Britton and Brown 1913, courtesy USDA NRCS 2022a. Right: Male flower by Joseph O'Brien, USDA Forest Service, Bugwood.org.

### **Pollinator Dynamics**

*Arceuthobium* flowers have characteristics of both wind and insect-pollinated plants, and the strategies vary between species. While the minute mistletoe flowers produce tiny amounts of nectar (staminate flowers) or stigmatic exudate (pistillate flowers), the extent of its value as an attractant for pollinators has not been determined. Nevertheless, over 200 species of generalist insect pollinators have been documented for the genus (Hawksworth and Wiens 1996).

After studying fertilization in *Arceuthobium pusillum*, Baker et al. (1985) concluded that the Dwarf Mistletoe was able to utilize both mechanisms but insect pollination was of greater

importance. Nets that excluded most insects while allowing the passage of wind-blown pollen significantly reduced fruit production, and pollen traps utilized to measure wind dispersal collected relatively small amounts. Examination of insects trapped in the vicinity of pistillate flowers found the most abundant pollen on the bodies of flies (Syrphidae, Tachinidae), beetles (Lampyridae), and wasps (Aphidiidae, Ichneumonidae, Tenthredinidae, Vespidae). Some less frequent pollinators were also identified, resulting in a list of 59 species from 36 families in 6 orders (see Baker et al. 1985). Unlike many species of *Arceuthobium* which require an extensive period (up to two years) to produce fruit after pollination, *A. pusillum* fruits mature just five months after the flowers are fertilized (Hawksworth and Wiens 1996).

### **Seed Dispersal**

The fruit of *Arceuthobium pusillum* is a tiny, oval, bicolored berry containing a single seed (Nickrent 2020). As the fruits ripen, their stems bend down toward the outer branches of the host plant (von Schrenk 1900). The initial dispersal is explosive: A substantial increase in temperature is followed by rapid contraction of the fruit, causing forceful expulsion of the seed at about 13.7 meters/second (Reznicek et al. 2011, Stevens 2017). Expelled seeds may travel for 12 meters or more (Reznicek et al. 2011). A sticky coating on the seeds allows them to adhere to surfaces where they land, including twigs of the host plant or other nearby plants where they may germinate if the site is suitable (Jack 1900). Most *Arceuthobium* seeds land on needles of the host tree within 2–4 meters and, when suitably moistened, they can slide down an upright needle to its basal twig (Hawksworth and Wiens 1996). The sticky outer layer can also adhere to the feet of arboreal birds or squirrels, facilitating transport to a new location, and once the coating has dried it holds the seed in place where it overwinters until germinating in the spring (Baker et al. 2006).

In order to develop, an *Arceuthobium* seed must end up on a twig that is less than five years old because the bark of young twigs is more easily penetrated by the mistletoe's emerging radicle. Typically more than half of dispersed seeds do not reach favorable germination sites (Hawksworth and Wiens 1996), and many of those that do are subsequently dislodged by precipitation or destroyed by fungi and insects (Baker et al. 2006).

### **Habitat**

At the community scale, the habitat of *Arceuthobium pusillum* occurrences is tied to the location of its host plants. Dwarf Mistletoe is most often found growing on Black Spruce (*Picea mariana*), which is generally identified as its principal host (Nickrent 2020). Once discovered, *A. pusillum* was soon also reported as occasionally occurring on other spruces (*Picea glauca*, *P. rubens*) and on Tamarack (*Larix laricina*) by New England botanists (Jones 1900, Eggleston 1900, Rand 1907). Additional species noted as rare hosts include *Abies balsamea*, *Pinus banksiana*, *P. resinosa*, and *P. strobus* (Hawksworth and Wiens 1996).

Throughout its range, *Arceuthobium pusillum* most frequently occurs in spruce bogs (Coddington and Field 1978, Hawksworth and Wiens 1996, Rhoads and Block 2007, Reznicek et al. 2011).

Stand characteristics of Black Spruce bogs were examined in terms of tree density, age, size, percentage living, and species richness but no clear pattern was found that would predict the presence/absence of Dwarf Mistletoe (Gray et al. 2021). *A. pusillum* has also been found in thickets, at forest borders, and on dunes when growing on *Picea glauca* in the Great Lakes region (Reznicek et al. 2011). The spruce forests hosting *A. pusillum* may be found at elevations of 0–800 meters, and are often situated near the coast, inland bogs, rivers, or lakes (Nickrent 2020).

When an *Arceuthobium* seed germinates on a conifer twig and broom development commences, a microhabitat is generated in which the parasite may continue to thrive for some time. A host tree will preferentially shuttle water and nutrients to a broom, and those then serve as supplies for the mistletoe. The proliferation of twigs creates more space for the *Arceuthobium* to grow, and on occasion the resources are further exploited by the initiation of secondary infections on twigs within the broom (Tinnin et al. 1982). A witches' broom will often be the last living part of a declining tree, increasing the mistletoe's opportunities for reproduction and establishment on a new host (Baker et al. 2006).

### **Wetland Indicator Status**

*Arceuthobium pusillum* is not included on the National Wetlands Plant List (NWPL). Any species not on the NWPL is normally considered to be Upland (UPL) in all regions where it occurs (U. S. Army Corps of Engineers 2020). However, *A. pusillum* is a parasite that grows on other plants rather than on a typical substrate. Its primary host, *Picea mariana*, is listed as a facultative wetland species, as is *Larix laricina*. Other secondary hosts are considered to be facultative (*Abies balsamea*) or facultative upland species (*Picea glauca*, *P. rubens*, and all three *Pinus spp.*). Based on the preferences and relative importance of its host species, *A. pusillum* is most likely to be found in wetlands, but may also occur in nonwetlands.

### **USDA Plants Code (USDA, NRCS 2022b)**

ARPU3

### **Coefficient of Conservatism (Walz et al. 2018)**

CoC = 10. Criteria for a value of 9 to 10: Native with a narrow range of ecological tolerances, high fidelity to particular habitat conditions, and sensitive to anthropogenic disturbance (Faber-Langendoen 2018).

### **Distribution and Range**

The global range of *Arceuthobium pusillum* is restricted to North America (POWO 2022). The map in Figure 1 depicts the extent of the species throughout the United States and Canada.

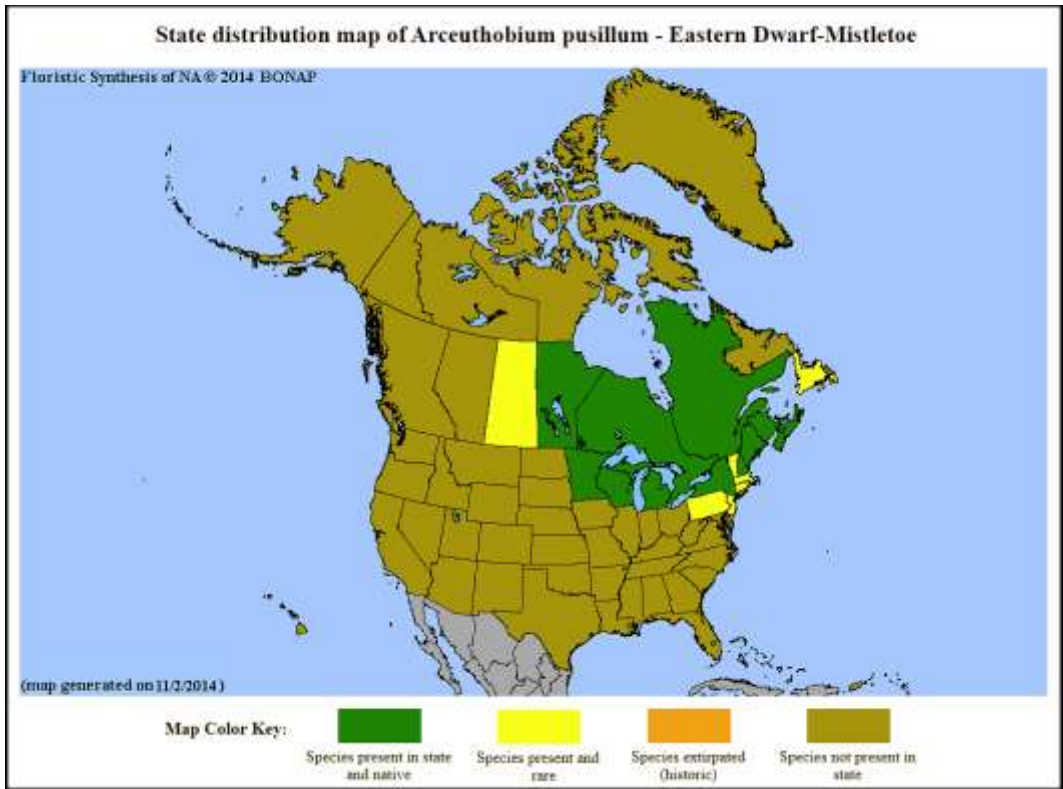


Figure 1. Distribution of *A. pusillum* in North America, adapted from BONAP (Kartesz 2015).

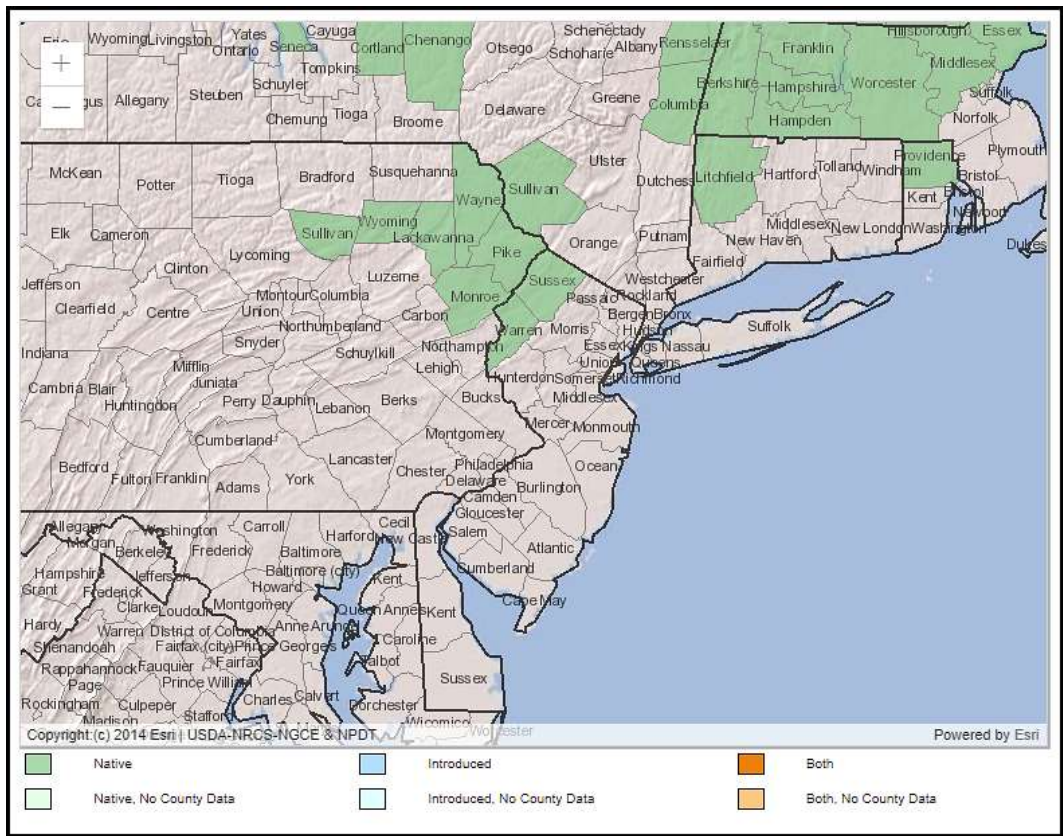


Figure 2. County records of *A. pusillum* in New Jersey and vicinity (USDA NRCS 2022b).



The USDA PLANTS Database (2022b) shows records of *Arceuthobium pusillum* in two New Jersey counties: Sussex and Warren (Figure 2, above). The data include historic observations and may not reflect the current distribution of the species. A specimen in the collection of Delaware State University's Claude E. Phillips Herbarium reportedly originated in Morris County but additional information was not available (Mid-Atlantic Herbaria 2022).

### Conservation Status

*Arceuthobium pusillum* is considered globally secure. The G5 rank means the species has a very low risk of extinction or collapse due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats (NatureServe 2022). The map in Figure 3 (below) illustrates the conservation status of *A. pusillum* throughout its range. In the core portions of its range, the species is secure, apparently secure, or unranked. *A. pusillum* is critically imperiled (very high risk of extinction) in one province and three states, imperiled (high risk of extinction) in two states, and vulnerable (moderate risk of extinction) in one province and two states.

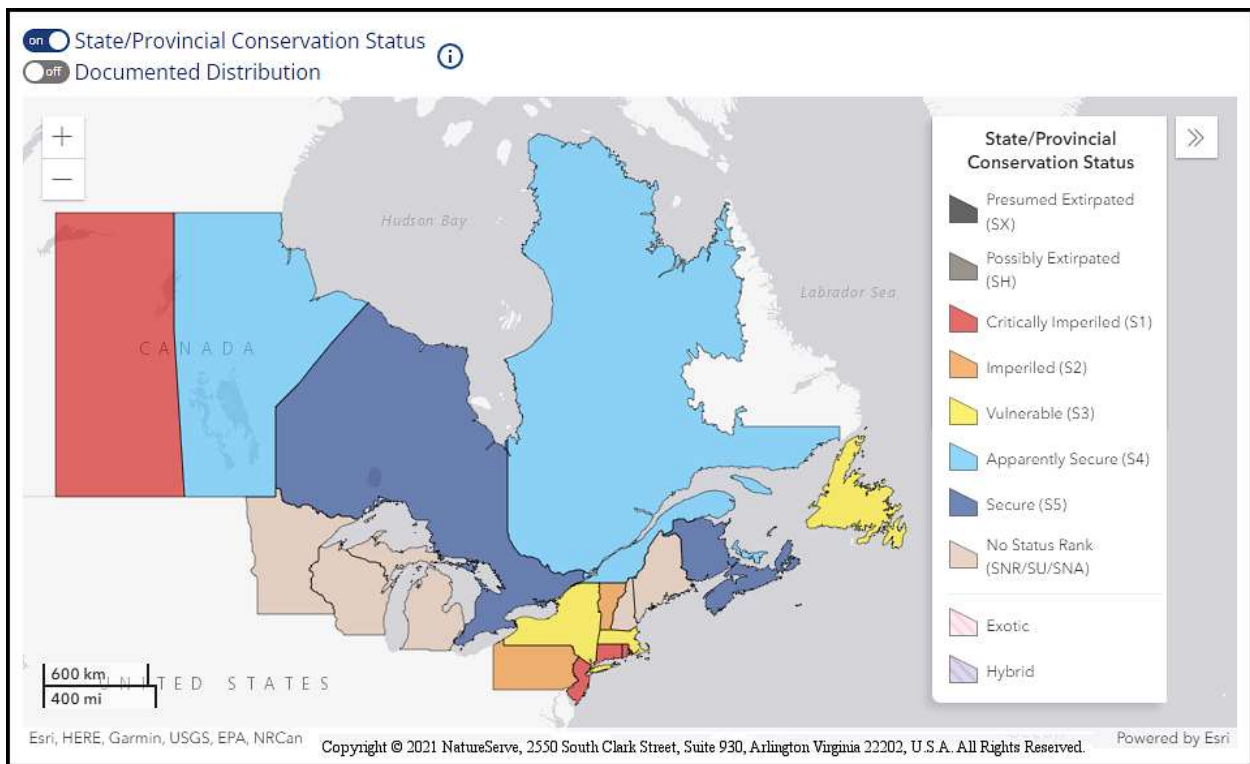


Figure 3. Conservation status of *A. pusillum* in North America (NatureServe 2022).

New Jersey is one of the states where *Arceuthobium pusillum* is critically imperiled (NJNHP 2022). The S1 rank signifies five or fewer occurrences in the state. A species with an S1 rank is typically either restricted to specialized habitats, geographically limited to a small area of the state, or significantly reduced in number from its previous status. *A. pusillum* is also listed as an endangered species (E) in New Jersey, meaning that without intervention it has a high likelihood



of extinction in the state. Although the presence of endangered flora may restrict development in certain communities, being listed does not currently provide broad statewide protection for the plants. Additional regional status codes assigned to the mistletoe signify that the species is eligible for protection under the jurisdictions of the Highlands Preservation Area (HL) and the New Jersey Pinelands (LP) (NJNHP 2010).

Griscom (1931) published the first record of *Arceuthobium pusillum* in New Jersey, reporting the species from two Sussex County sites where he had collected plant specimens with Mackenzie a decade earlier. Fables (1956) recounted records of Dwarf Mistletoe from one site in Warren County and three in Sussex. The mistletoe apparently persisted in both counties through the early 1970s (Fairbrothers and Hough 1973), but by 1998 it was only known to be extant in Sussex County (Breden et al. 2006). *A. pusillum* is presently considered extant at three sites in New Jersey. One has an estimated viability rank of 'Good' and the other two are ranked as 'Fair' (NJNHP 2022).

### **Threats**

*Arceuthobium pusillum* is dependent on the presence of its hosts, the most important of which is presently *Picea mariana*. Consequently deforestation, alterations to hydrology, or other actions that would contribute to a decline in Black Spruce are also considered threats to Dwarf Mistletoe (MANHESP 2019, PANHP 2019). During the early 1900s, for example, elimination of all but a single spruce tree eradicated the *A. pusillum* population once known from Thoreau's bog (Eaton 1935). Fortunately, *Picea mariana* is currently unranked or ranked as secure/apparently secure throughout nearly all of its range (NatureServe 2022).

The mere presence of a suitable host does not guarantee success for *Arceuthobium pusillum*. Eaton (1931) observed that branches of an infected tree were interlocked with those of a healthy tree but no sign of the mistletoe could be found on the latter. A number of factors can come into play to constrain the proliferation of *Arceuthobium* species including limited dispersal, low establishment rates, or a variety of host resistance mechanisms, and *Arceuthobium* population size may be kept in check by fire when a large proportion of dead trees is present in a stand (Tinnin 1981). Parasitic mistletoes also have some parasites of their own, including the fungus *Wallrothiella arceuthobii* which destroys the immature fruits of *Arceuthobium pusillum* (Weir 1915). Because *Arceuthobium* species cause symptoms that eventually result in the death of the hosts upon which they depend, natural dynamics that limit their unbridled spread do not represent a threat to the mistletoes but rather serve as an important means of maintaining a balance in the host/parasite relationship (Geils and Hawksworth 2002).

Threats to either *Arceuthobium pusillum* or its host could result from disruption of the processes that maintain a balance between host and parasite. One potential source of disruption is a rapid shift in climactic conditions. An assortment of regional repercussions from climate change could affect parasites and their hosts in different ways, interfering with established patterns and relationships (Way 2011). Hawksworth and Wiens (1996) identified a number of Dwarf Mistletoe features that make it well-suited to winter extremes including reduced shoots, spring flowering, rapid fruit maturation, and broom type. *A. pusillum* plants at the southern end of the

species range where it is already less abundant may have difficulty adapting to rising temperatures, although no research concerning the potential effects of climate change on the Dwarf Mistletoe was found. There have, however, been a number of studies on how Black Spruce might respond to shifting climactic conditions. Because *Picea mariana* is susceptible to heat stress and drought stress, particularly during the establishment phase, results consistently suggest that the species may expand northward but is likely to experience regeneration failure in the southern part of its range (Lamhamedi and Bernier 1994, Dufour-Tremblay et al. 2012, Sniderhan et al. 2020). Figure 4 compares the current ranges of *Arceuthobium pusillum* and its primary host, and it is evident that depletion of *Picea mariana* along its southern boundary is likely to result in simultaneous losses of Dwarf Mistletoe.



Figure 4. Native range comparison for *Arceuthobium pusillum* (left) and *Picea mariana* (right) adapted from BONAP (Kartesz 2015).

### **Management Summary and Recommendations**

When the term 'management' has been applied to *Arceuthobium pusillum* the emphasis has often been on reduction or eradication of the species in order to preserve the economic value of its host trees (Hawksworth and Wiens 1996, Baker et al. 2006). Tinnin (1981) pointed out that such efforts are unnecessary and may have unintended impacts, and that if left alone the proliferation of *Arceuthobium spp.* was likely to be held in check by natural counterbalances. Geils and Hawksworth (2002) noted that mistletoes add value to their communities by shaping forest structure, acting as natural disturbance agents, and providing food and shelter for wildlife.

There is little to recommend in terms of active management for the benefit of *Arceuthobium pusillum*. In areas where the species is particularly vulnerable, efforts should focus on conservation of its host trees and the associated habitat which might include land acquisition or the establishment of buffers to protect wetlands. Dwarf Mistletoe's response to a warming climate should be monitored in order to learn whether the species will shift its range, adapt to a new host, or simply decline in response to the anticipated changes in distribution of Black

Spruce. Deliberate introduction of the parasitic species to a host or region where it does not already occur is inadvisable, as such actions are likely to have unintended consequences.

### **Synonyms and Taxonomic Notes**

The accepted botanical name of the species is *Arceuthobium pusillum* Peck. Orthographic variants, synonyms, and common names are listed below (ITIS 2021, POWO 2022).

Traditional taxonomy places *Arceuthobium* in the Viscaceae (Kartesz 2015, Nickrent 2020). It previously sat within a subfamily (Viscoideae) of the Loranthaceae (Zomlefer 1994) and recent molecular-based classification systems have again reduced the former family to a group (Visceae), this time placing it in the Santalaceae (Stevens 2017).

#### **Botanical Synonyms**

*Arceuthobium abigenium* (Alph.Wood) Alph.Wood  
*Arceuthobium minutum* Engelm.  
*Arceuthobium oxycedri* var. *abigenium* Alph.Wood  
*Razoumofskya pusilla* (Peck) Kuntze  
*Razoumofskya minuta* (Engelm.) Kuntze

#### **Common Names**

Dwarf Mistletoe  
Eastern Dwarf-mistletoe

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Bugwood.org. Forestry Images. <https://www.forestryimages.org/plants.cfm> Courtesy of Bugwood Image Database System. Cover image 5027087 and image 5252077 by Joseph O'Brien, USDA Forest Service; image 1457005 by Steven Katovich. Licensed by <https://creativecommons.org/licenses/by/3.0/us/>

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