Ilex montana

Large-leaf Holly

Aquifoliaceae

Ilex montana by Tara Rose Littlefield, 2021

***Ilex montana* 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

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Life History

Ilex montana (Large-leaf Holly) is a woody plant in the Aquifoliaceae that can grow as a several-stemmed shrub or as a small tree under 12 meters in height. The branching pattern is alternate and the leaf petioles have a distinctly U-shaped channel on the upper side. The deciduous leaves are thin, smooth, egg-shaped, sharply toothed, and pointed at the tips. Flowers and clusters of leaves often develop on short lateral branch spurs which, when present, can readily distinguish *I. montana* from other *Ilex* species that occur in New Jersey. *Ilex* species are generally dioecious, having primarily male (staminate) or female (pistillate) flowers on any given plant. Male and female flowers often have rudimentary organs of the opposite sex, but occasionally a few functionally bisexual flowers may also be mixed in. Both pistillate and staminate flowers have 4–5 (sometimes more) small, white or greenish-white petals. *In Ilex montana*, both the sepals and the tips of the corolla lobes are ciliate (See Small 1903, Britton and Brown 1913, Ammons and Core 1945, Fernald 1950, Symonds 1963, Gleason and Cronquist 1991, Rhoads and Block 2007, Weakley et al. 2022).

Left: Britton and Brown 1913, courtesy USDA NRCS 2022a. Right: W. D. Brush, USDA Forest Service.

Ilex montana blooms between April and June, producing mature fruit in August and September (Hough 1983, Rhoads and Block 2007, Weakley et al. 2022). The staminate flowers grow in small clusters (fascicles) but the pistillate flowers are often solitary or in pairs. In addition to

having more flowers per fascicle, male plants produce about twice as many fascicles as female plants (Cavigelli et al. 1986). Because the species is dioecious only the female plants develop fruit but male plants must be present in the vicinity for fertilization to occur. Cavigelli et al. (1986) found a slight spatial segregation between male and female *I. montana* plants and suggested that some microenvironmental variation might influence the distribution of the sexes within a population. In the fall the female plants are more conspicuous due to the bright red fruits, which are about 9–12 mm in diameter (Small 1903, Weakley et al. 2022).


Left: Courtesy Thomas L. Muller, Lady Bird Johnson Wildflower Center. Right: Tara Rose Littlefield, 2021.

Ilex montana has been identified as a species with potential value as a natural source of industrial raw materials. Carr and Bagby (1987) reported a high yield of polyphenols and natural oils from Large-leaf Holly plants, noting that the shrubs could be encouraged to produce a denser growth of branches and foliage in response to pruning. Plant-based oils and polyphenols may be used to develop an assortment of products including papermaking fibers, animal feeds, fermentation substrates, soil amendments, and fuels (Buchanan et al. 1980).

Pollinator Dynamics

Most species in the Aquifoliaceae are insect-pollinated (Zomlefer 1994) and bees are the primary pollinators of *Ilex* species (Brizicky 1964). The insects are attracted to nectar, which is produced by small glands on the lower part of the petals (Brizicky 1964). Cavigelli et al. (1986) observed that the flowers of *I. montana* had a "pleasant fragrance." Many generalist bees will visit holly flowers (Stubbs et al. 1992) but there are also a few bees that specialize on *Ilex*. *Colletes banksi* is the *Ilex* specialist most likely to be encountered in the northeast, while *Colletes brimleyi* and *Perdita floridensis* have a more southern distribution. All three *Ilex* specialists are relatively rare (Fowler 2016, Fowler and Droege 2020). Since *Ilex montana* plants are essentially unisexual self-fertilization cannot take place (Ainsworth 2000), and the species does not grow clonally

(Cavigelli et al. 1986). Consequently, reproduction in *I. montana* is completely dependent on its insect pollinators.

Seed Dispersal

The fruits of *Ilex montana* are drupes, each of which typically contains 4–5 nutlets that are strongly ribbed on the back (Small 1903, Weakley et al. 2022). Birds are the primary means of seed distribution in *Ilex* (Brizicky 1964), although mammals such as black bears, raccoons, coyotes, and foxes have also been cited as agents of dispersal for holly plants (Willson 1993). Stiles (1980) characterized the drupes of *I. montana* as "fall low-quality fruits." Fruits in that category are likely to be overlooked early in the season by migrating birds that favor fruits with a higher nutritional content, thus remaining on the plants into the winter months when they are more likely to be dispersed by resident species. Although the strategy results in a more local dispersal pattern, it may also favor the deposition of propagules in suitable locations. Reilly et al. (2006) noted that the establishment of *I. montana* in a recently-created forest gap had probably been facilitated by birds.

Ilex montana seeds that land in a suitable location may take two or three years to establish (Deno 1993). When *Ilex* fruits are ripe the nutlet embryos are not fully mature and their hard seed coats delay germination, allowing time for further development (Bonner 1949). Lumb (2008) germinated *I. montana* seeds in a greenhouse after providing a period of warm stratification followed by a period of cold stratification, although Deno (1993) found that the species germinated best in outdoor treatments. In nature, *Ilex* seeds can be expected to germinate 16 months to three years after dispersal (Bonner 1949). While mycorrhizae have been documented in a few *Ilex* species (Wang and Qiu 2006) no reports of fungal associations were found for *I. montana*.

Habitat

At higher elevations, *Ilex montana* is likely to be found in rich soils on moist wooded slopes, ridges, ravines, or mountainsides (Fairbrothers and Hough 1973, Hough 1983, Rhoads and Block 2007) . However, the species is also known to occur at lower, wetter sites such as headwaters wetlands or the edges of bogs (Rhoads and Block 2000, Weakley et al. 2022). Lumb (2008) collected *I. montana* seeds along the shoreline of a glacial lake, Coddington and Field (1978) cited a lowland occurrence in a limestone valley, and Weakley and Schafale (1994) noted that Large-leaf Holly was commonly encountered in a swamp-forest-bog complex located in a poorly drained bottomland. New Jersey populations occur in both dry (ravine slope) and wet (perimeter of shrub swamp) habitats (NJNHP 2022).

Community types where *Ilex montana* has been reported include dry oak-heath forest and evergreen forests dominated by Eastern Hemlock (*Tsuga canadensis*) or Red Spruce (*Picea rubens*). At those sites, Great Laurel (*Rhododendron maximum*) and Mountain Laurel (*Kalmia latifolia*) are typical associates in the shrub layer (Pauley 1989, Block and Rhoads 2013, NJNHP 2022).

Although it is often associated with well-established forests, *Ilex montana* can benefit from canopy gaps. Woods (1951) observed that *I. montana* grew best in open sites with well-drained soil, noting that he had seen it occur in greatest abundance at the site of an old burn. Cavigelli et al. (1986) found that the species could become quite dense in gaps, reporting that with more light the plants grew taller and flowered in greater profusion. At one North Carolina site, *Ilex montana* established a new population following a fire and became one of the dominant woody species in the post-burn community (Reilly et al. 2006).

Wetland Indicator Status

The U. S. Army Corps of Engineers divided the country into a number of regions for use with the National Wetlands Plant List and portions of New Jersey fall into three different regions (Figure 1). *Ilex montana* has more than one wetland indicator status within the state. In the Atlantic and Gulf Coastal Plain region, *I. montana* is a facultative species, meaning that it occurs in both wetlands and nonwetlands, but in other parts of the state it is a facultative upland species, meaning that it usually occurs in nonwetlands but may occur in wetlands (U. S. Army Corps of Engineers 2020).

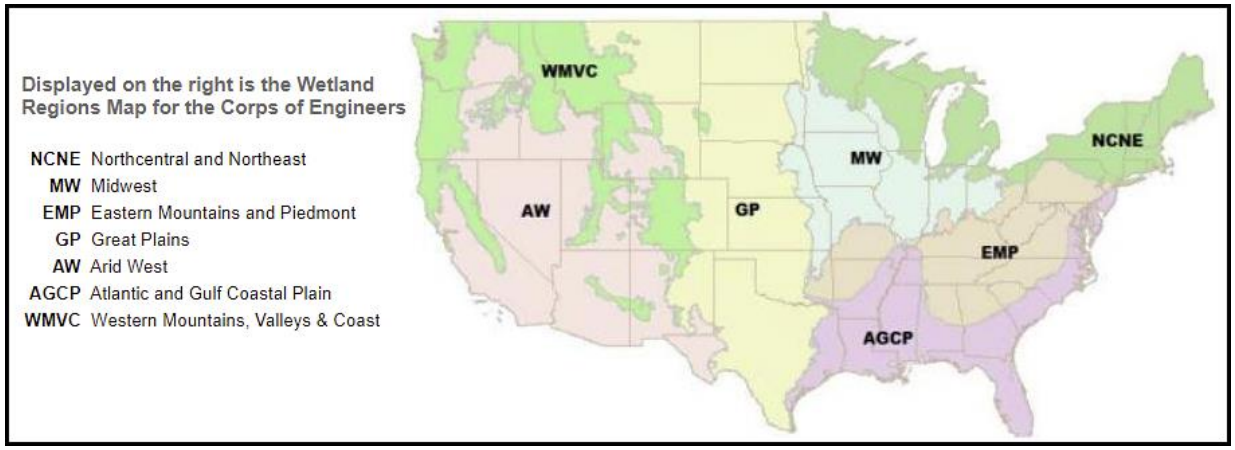

Figure 1. Mainland U. S. wetland regions, adapted from U. S. Army Corps of Engineers (2020).

USDA Plants Code (USDA, NRCS 2022b)

ILMO

Coefficient of Conservatism (Walz et al. 2018)

CoC = 9. 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 *Ilex montana* is restricted to the eastern United States (POWO 2022) where it is generally associated with the Appalachian mountains (Weakley et al. 2022). The map in Figure 2 depicts the extent of Large-leaf Holly in North America.

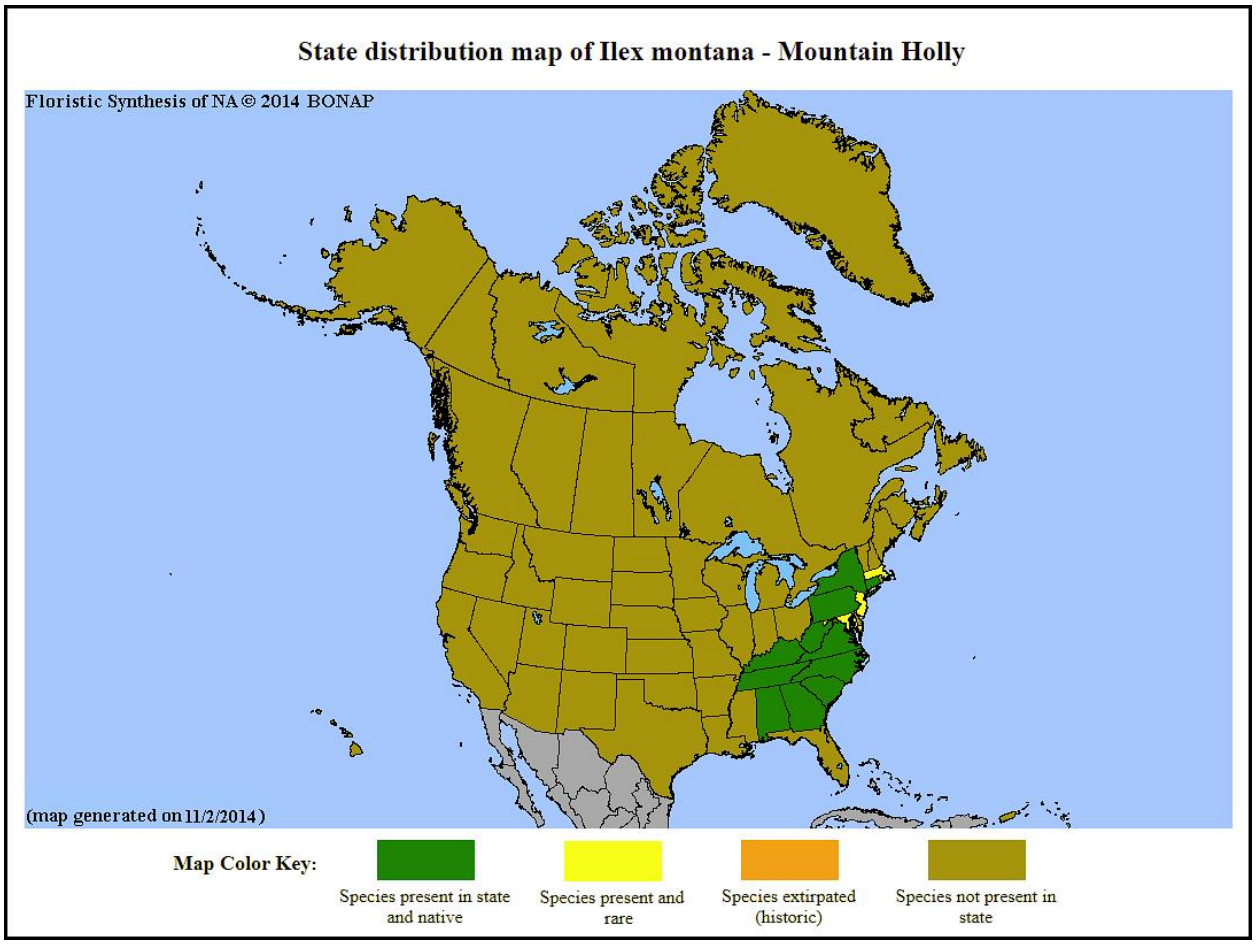

Figure 2. Distribution of I. montana in North America, adapted from BONAP (Kartesz 2015).

The USDA PLANTS Database (2022b) shows records of *Ilex montana* in four New Jersey counties: Morris, Passaic, Sussex, and Warren (Figure 3 below). The data include historic observations and do not reflect the current distribution of the species.

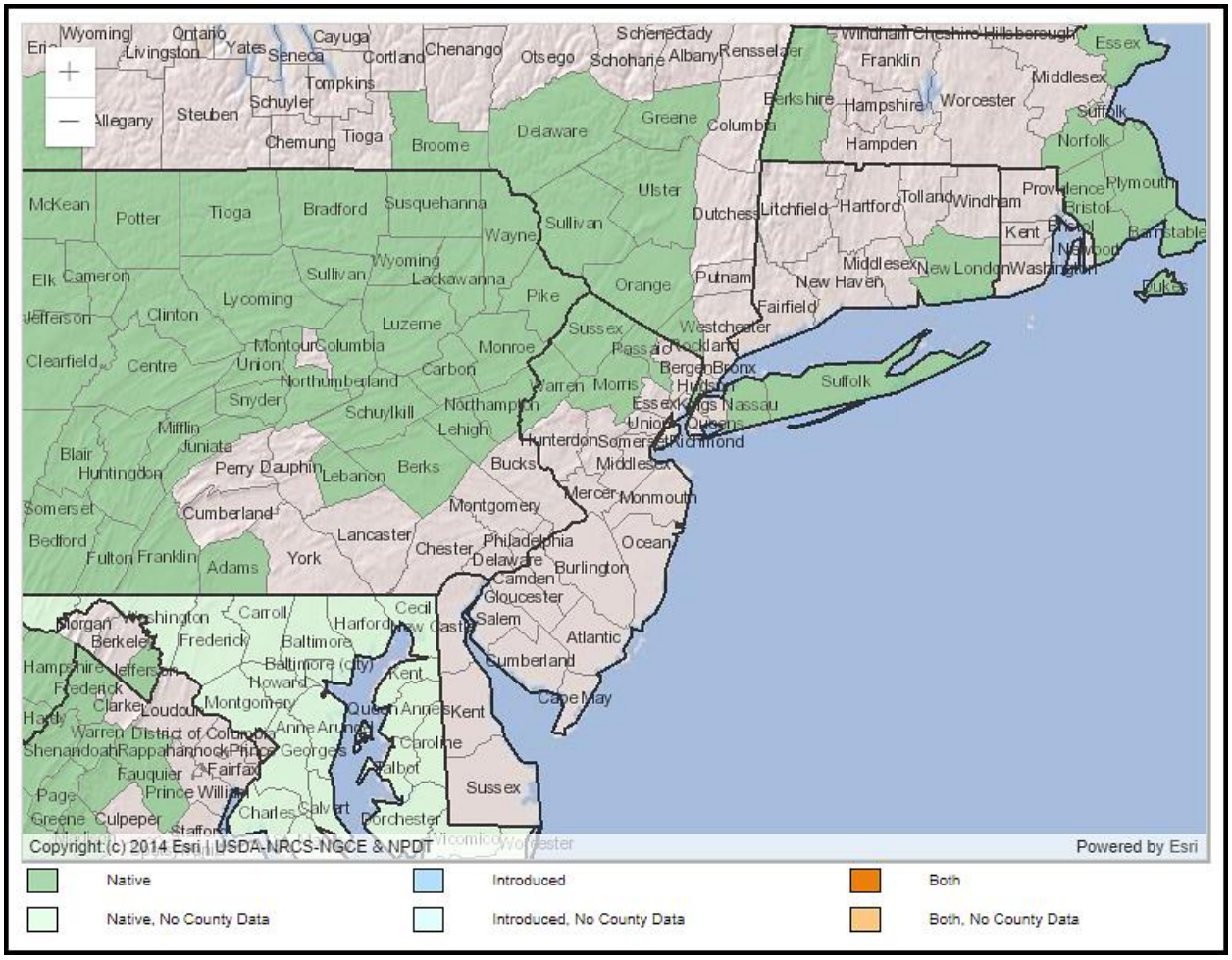

Figure 3. County records of I. montana in New Jersey and vicinity (USDA NRCS 2022b).

Conservation Status

Ilex montana 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 below (Figure 4) illustrates the conservation status of *I. montana* throughout its range. The species is critically imperiled (very high risk of extinction) in Massachusetts and New Jersey and vulnerable (moderate risk of extinction) in Mississippi. In the core of its range, Big-leaf Holly is secure, apparently secure, or unranked.

In New Jersey, the critically imperiled (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. *Ilex montana* 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 plants. Additional regional status codes

assigned to *I. montana* 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).

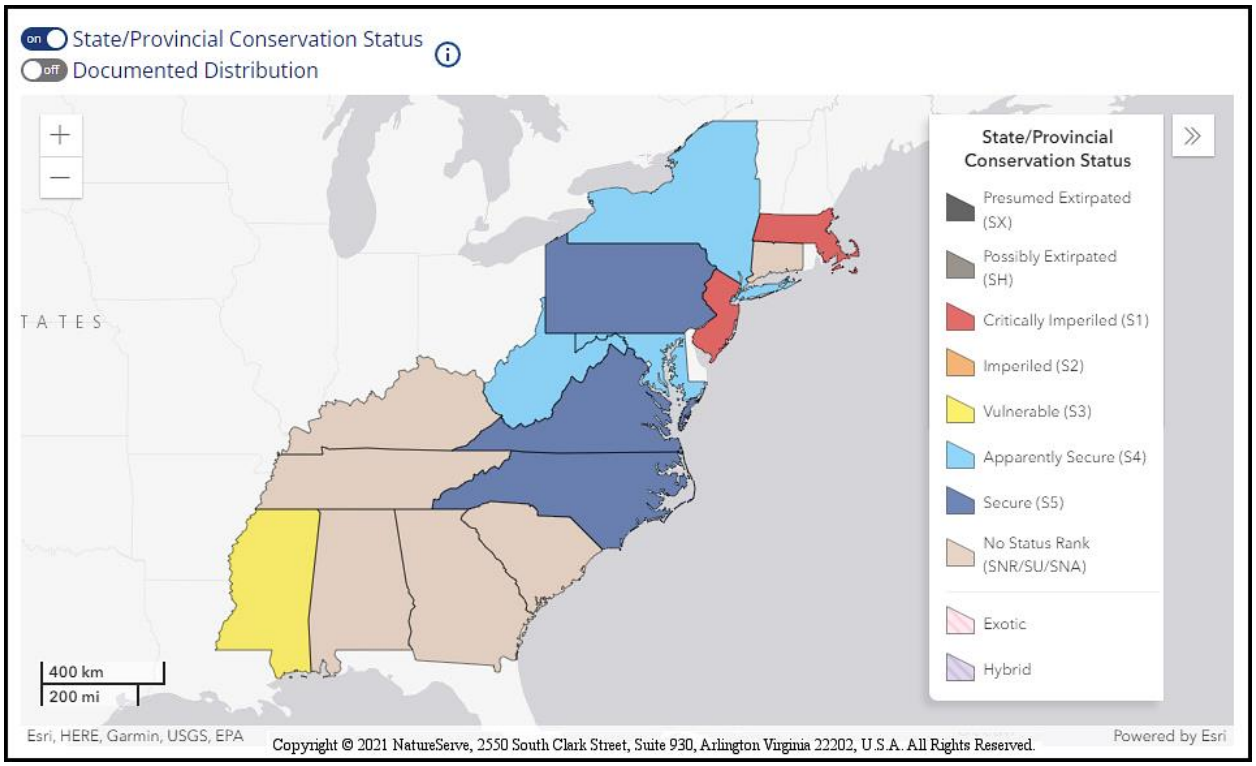

Figure 4. Conservation status of I. montana in North America (NatureServe 2022).

It appears that *Ilex montana* was first collected in New Jersey near the beginning of the twentieth century. Taylor (1915) reported scattered occurrences in the northwestern part of the state, and Fairbrothers and Hough (1973) noted that only a few occurrences were known from New Jersey's mountainous regions. Two populations were documented by Vincent Abraitys between 1967 and 1973 (Snyder 1984), one of which is now ranked as historical (NJNHP 2022). At the end of the 1900s three counties (Morris, Passaic, and Warren) each had a single population (Breden et al. 2006), and those are the only occurrences still considered extant in the state although their ongoing presence has not been confirmed during the present century (NJNHP 2022).

Threats

Herbivory by White-tailed Deer (*Odocoileus virginianus*) is a significant threat to *Ilex montana*. Cavigelli et al. (1986) observed high mortality in young *I. montana* plants due to browsing, noting that most plants in the Virginia population they studied were 3–4 years old and only a few survived long enough to reproduce. Similar concerns were raised following botanical studies in Pennsylvania forests where deer browsing was severe. At one site, a lack of woody species regeneration was reported and the *I. montana* population had been reduced to "a few well-chewed shrubs" (Rhoads and Block 2000). At another site, all of the Large-leaf Holly plants present had "a distinct browse line" (Block and Rhoads 2013). Overpopulation of White-tailed

Deer is also a substantial problem in New Jersey. Studies have shown that ecosystem damage can occur at population densities above 10 deer per square mile, but in some rural and suburban parts of the state 2010 population densities were considerably higher (estimates up to 114/mi^2) and the number of deer has risen since then (NJDSR 2019).

At one of the sites surveyed by Block and Rhoads (2013), Japanese Barberry (*Berberis thunbergii*) was listed as a species that co-occurred with *Ilex montana*. *B. thunbergii* is one of the most problematic invasive species in New Jersey forests, where it can form dense monocultures and alter the soil chemistry in ways that are detrimental to native species (Snyder and Kaufman 2004, Kaufman and Kaufman 2007). The barberry may inhibit regeneration of *Ilex montana* at sites where the invasive plant proliferates.

Pollinator loss could be an emerging threat to *Ilex montana*. A review of available data suggests that a global decline in bee diversity is taking place (Zatara and Aizen 2021). Because *I. montana* must rely on insects in order to reproduce, a decrease in the number of available pollinators could reduce fruit production and limit the renewal of extant populations and the colonization of new sites.

One of New Jersey's *Ilex montana* populations could not be relocated during the last monitoring event, and habitat changes observed at the site included a major loss of trees and a rock slide (NJNHP 2022). While the absence of the Large-leaf Holly was not directly attributed to either of those factors, both are representative of patterns that are becoming more frequent throughout the state. Widespread loss of canopy trees is occurring in Northern New Jersey as a result of the spread of pests and diseases like the Emerald Ash Borer and Beech Leaf Disease (NJFS 2022). Although a healthy population of *I. montana* might benefit from the creation of a canopy gap, relatively minor losses such as those resulting from treefalls can be catastrophic when only a few individuals are present—as was the case with the aforementioned occurrence. Rock slides are another phenomenon taking place more often in the region as a result of changing climactic conditions. More intense storm events in the northeast are causing an increase in erosion (Hill et al. 2020), which sometimes results in mud or rock slides in areas with steeply sloping terrain. Other regional climate change effects that could impact the communities where *I. montana* occurs include rising temperatures and lengthier droughts. Large-leaf Holly reportedly has limited tolerance to changes in microclimate (Coder 2021), so some adverse effects from global shifts in climactic conditions may be expected.

Management Summary and Recommendations

New Jersey is situated on the periphery of *Ilex montana*'s Appalachian range, and range-edge populations are often small and particularly vulnerable to extirpation (Bahn et al. 2006). The state's remaining occurrences of *Ilex montana* contain relatively few individuals (NHNHP 2022) and updated evaluations are needed to assess population viability and identify threats. Although the extant colonies are located in high-quality habitat that is subject to little human disturbance the plants are still vulnerable to deer. Any impacts of herbivory should be noted during monitoring visits in order to determine whether site-specific plans are required to protect the surviving *I. montana* plants.

Although pollination is fairly well understood at the genus level, species-specific research on *Ilex montana*'s pollinator relationships is warranted. While most species of *Ilex* are dioecious, some are also able to reproduce vegetatively (for examples see Torimaru and Tomaru 2012, Buckley and Avila-Sakar 2013, Vega et al. 2022). Since that is not the case for *I. montana* (Cavigelli et al. 1986), the long-term survival of the species could depend on pollinator abundance and availability. Land managers could also benefit from additional knowledge regarding Large-leaf Holly's ability to compete with non-native vegetation and the species' range of tolerance for changes in habitat characteristics or climactic conditions.

Synonyms

The accepted botanical name of the species is *Ilex montana* Torr. & Gray ex Gray. Orthographic variants, synonyms, and common names are listed below (ITIS 2021, POWO 2022, USDA NRCS 2022b).

Botanical Synonyms	Common Names
Ilex ambigua var. *montana* (Torr. & A. Gray) H. E. Ahles	Large-leaf Holly
Ilex ambigua f. *montana* (Torr. & A. Gray) A. E. Murray	Mountain Holly
Ilex ambigua ssp. *montana* (Torr. & A. Gray) A. E. Murray	Big-leaved Holly
Ilex ambigua var. *monticola* (A. Gray) Wunderlin & Poppleton	Mountain Winterberry
Ilex amelanchier var. *monticola* (A. Gray) Alph. Wood	Sand Holly
Ilex montana f. *rotundifolia* F. W. Woods	
Ilex monticola A. Gray	
Ilex monticola var. *mollis* Britton	

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Well drained slopes, ridges, and streamsides throughout eastern Tennessee

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