

**ANALYZING VEGETATIVE COVER OF THE
BOIS BRULE RIVER WATERSHED RE-VISITED
IN NORTHWESTERN WISCONSIN, PART II:
VEGETATION AND LAND COVER CHANGES (1852 TO 2017)***

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ABSTRACT

The vascular plants of the Bois Brule River watershed are listed, and over 160 years of change in plant communities observed is described. The watershed covers approximately 51,300 ha in northwestern Wisconsin, primarily in Douglas County with a short arm extending eastward into Bayfield County. The Bois Brule River travels southwest to the northeast 71 km from its headwaters and drains into Lake Superior. The diverse landscape supports boreal forest, northern mesic forest, northern wet-mesic forest, pine barrens, and other forested and non-forested communities. Five generalized changes in the watershed were noted: (i) the pine barrens community declined by more than 95%, (ii) the northern wet-mesic forest (dominated by *Thuja occidentalis*) immediately surrounding the river has been reduced to a narrow band, (iii) the large complex of conifer wetlands is greatly reduced, (iv) northern hardwood swamp (dominated by *Fraxinus nigra*, *Alnus incana* thickets, and the boreal forest in the lower reaches of the forest have been reduced and converted largely to timber production, and (v) old growth forest has been reduced to less than 1% of its pre-EuroAmerican settlement extent. A total of 839 vascular plant species have been documented in the watershed, 747 of them during our survey. Additionally, we documented 233 species new to the watershed, of which 53 are new county records and 13 are listed as endangered, threatened, or special concern in Wisconsin. This study has shown that the Bois Brule River watershed harbors a diverse assemblage of plants and is worth further conservation action. It is recommended that additional survey work continue in the future to inform and guide land managers.

KEYWORDS: Flora of Wisconsin, land cover change, pre-settlement conditions, Brule River Survey.

* Data sets used in this article are available upon request from the Lake Superior Research Institute at the University of Wisconsin–Superior, Superior, Wisconsin.

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INTRODUCTION

This is the second of two articles (the first of which is Hlina et al. 2020) reporting on a three-year project to re-survey and analyze vegetative and land use changes in the exceptional Bois Brule River watershed in northwestern Wisconsin over the last 160 years. The watershed of the Bois Brule River (hereafter referred to as the Brule River) exhibits an exceptionally diverse array of habitat types and outstanding water resources that support fish and wildlife species and numerous rare flora and fauna. The watershed is on the southwest side of Lake Superior, in northwestern Wisconsin. The watershed crosses through three ecoregions: Lake Superior clay plains, covering the northern third, the Bayfield sand plains from the southwest to the northeast and the Milles Lacs uplands to the west. The consistent flow of cold waters of the Brule River moving through hundreds of feet of outwash sandy plains to arise on the valley floor is a product of the cedar swamps in the headwaters and groundwater-connected springs. The vegetative cover of the Brule River watershed is exceptional, with large tracts of lowland forest at the region of the headwaters and old growth pine forest extending to Winneboujou, an unincorporated community located where County Highway B crosses the Brule River. The narrowing lower reaches of the watershed consist of boreal forest heavily influenced by Lake Superior.

For more than a century, the Brule River has been recognized as one of the premier trout streams of the Upper Midwest, with presidents of the United States and influential families fishing its waters and occupying its shores. By the late 1930s, managers, residents, and visitors noticed a significant decline in the fisheries, even after in-stream improvements and heavy stocking programs. These early observations led to the first comprehensive study of the Brule River watershed in northwest Wisconsin. As Schneberger and Hasler (1944) noted:

The need for an intensive study on this stream became evident when it was realized that during a five-year period extending from 1937 to 1941, a total of \$34,247.67 was expended for the planting of fish and that stocking was not bringing about the desired results of maintaining or improving fishing.

The Brule River was studied from 1942–1945 and 1954 using a watershed approach. The Brule River Survey started in 1942 as a collaborative study conducted by the Wisconsin Conservation Commission, the University of Wisconsin-Madison, University of Wisconsin-Superior (then the Superior State Teacher's College), and private citizens (Schneberger and Hasler 1942). The survey examined the physical, biological, and chemical characteristics of the Brule River watershed and resulted in a series of eleven papers: Bean and Thomson (1944), Churchill (1945), Evans (1945), Fassett (1944), Fischthal (1945), O'Donnell (1944), O'Donnell (1945), O'Donnell and Churchill (1954), Schneberger and Hasler (1942), Thomson (1944), Thomson (1945).

The survey's objective was to pinpoint environmental disturbances that may be impacting fish populations. Botanists Norman Fassett and John Thomson conducted vegetative studies and floristic inventories of the Brule River valley and its forests, pine barrens, and wetland communities to document change and

provide baseline vegetative data. This work provided a critical view of the vegetation in the watershed in the early 1940s.

These earlier studies lend themselves to follow-up research to document vegetative changes, which we have now undertaken some seventy years later, the results of which are reported in this article. The objectives of this study were 1) to undertake a comprehensive floristic inventory of the forests of the Brule River watershed, focusing on complete species identification and voucher specimens, 2) to make qualitative summaries of floristic changes between our time and that of Fassett and Thomson, and 3) to characterize large-scale land cover changes in the watershed over three time periods: 1852–1856, 1932–1943, and 2014–2017.

METHODS AND MATERIALS

Study Site

The Brule River watershed is in northwestern Wisconsin, primarily in Douglas County with a short arm extending eastward into Bayfield County. The watershed consists of more than 51,300 ha of forests, barrens, lakes, spring ponds, and the Brule River itself, which traverses 71 km, including 32 km as a steep river gorge draining into Lake Superior. The river channel is remarkable in that it flows northeastward in the ancient channel of the much larger Glacial Lake Duluth outlet that in glacial times (approximately 9,500–10,000 years ago) flowed southwesterly in what is now the St. Croix River (Clayton 1984; LaBerge 1994). The headwaters of both rivers are in the Divide Swamp, which is part of the Brule Glacial Spillway State Natural Area. The Brule River State Forest follows the river gorge and consists of 19,020 ha of forest lands managed by the State of Wisconsin for harvest, management and protection. There are four state natural areas in the state forest: Brule Glacial Spillway 1,070 ha, Mott's Ravine 265 ha, Brule River Boreal Forest 263 ha and Brule Rush Lake 9 ha and 21 additional primary sites that offer further conservation potential within its boundaries (O'Connor 2016).

Between 2003 and 2016, more than 1,214 ha within the Brule River State Forest were removed from their earlier status as areas of priority conservation and restoration activities (O'Connor 2016). Simultaneously, the state of Wisconsin has recently increased timber production lands from 27% to 58% within the Brule River State Forest with most of the increase taken from the natural land's designation (Wisconsin Department of Natural Resources 2017). These policy shifts have a high potential to reverse natural succession away from multi-age and old growth forest communities with high diversity towards an earlier successional sere, thereby creating a greater likelihood of a simplified forest, which already occurs on 35% of the watershed.

Climate

The general climate of the watershed is continental. Based on weather data from Gordon, Wisconsin (located at the southern end of the watershed), the mean annual precipitation is 81 cm. On average, July is the wettest month with a mean of 11.4 cm of precipitation. The mean annual temperature is 5.0°C; July is the warmest month with a mean of 19.9°C, and January is the coldest with a mean of -12.3°C. The length of the frost-free growing season has ranged from 45 days to 145 days with an average of 118 days per year (Midwestern Regional Climate Center 2017a).

In contrast, the area of the watershed to the north is influenced by Lake Superior. The large body of water provides an oceanic-like microclimate that moderates the climate, making winters warmer and summers cooler in the areas near the lake. According to weather data from Superior, Wisconsin (located to the west of the watershed and on Lake Superior), the mean annual precipitation is 78 cm. On average, September is the wettest month with a mean of 10.4 cm of precipitation. The mean annual temperature is 5.2°C; July is the warmest month with a mean of 19.1°C and January is the coldest with a mean of -10.1°C. The length of the frost-free growing season has ranged from 64 days to 189 days with an average of 148 days per year based on data collected from 1981 to 2010 (Midwestern Regional Climate Center 2017b).

The forests on the Brule River watershed exhibit responses to three microclimates that dictate forest composition. In the lower reaches of the river where forest is restricted to a narrow steep val-

ley and is influenced by the cooler temperatures of Lake Superior, boreal forest is found. Old growth coniferous bogs and swamps persist in the headwaters, where seepage springs deliver cool enriched mineral waters to a dense quagmire of *Thuja occidentalis*, *Picea mariana*, *Larix laricina*, and *Alnus incana*. Due to the foresight of early scientists and land managers, large tracts of this forest have been protected (Thomson 1945). The landscape rising above the middle reaches of the river exhibits yet a third microclimate, consisting of nutrient-poor, outwash glacial sand plains from the last glacial period (Sweet 1880; Clayton 1984; LaBerge 1994). In these pine barrens, drought resistant, fire-dependent species continue to shift through a mosaic of dwarf pine trees, scrub oaks, and open prairie. Today, most of this land consists of pine plantations (*Pinus banksiana* and *P. resinosa*) and is managed by private companies or state and county forest agencies.

Geology

The landscape of the watershed has been shaped by Precambrian lava flows, faulting, sedimentation, long epochs of erosion, and, finally, Pleistocene glaciation. Late in the Precambrian period, about 1.1 billion years ago, tectonic forces began rifting the North American craton (Laurentia), near present-day Lake Superior. The rifting extended 2,200 km southwest to present-day Kansas and 800 km southeast through present-day Michigan (Dott and Attig 2004). From these fissures, lava was released and spread across the region for millions of years. At the close of the Precambrian a shallow sea flooded the area laying down layers of sedimentary rocks. Over time these sediment deposits buried the underlying Keweenaw basalt. The sheer weight of the lava flows, and sediments formed the Lake Superior syncline, a down-warping of the earth's surface (LaBerge 1994). Faulting would occur numerous times along the syncline. The Douglas Fault would later up-thrust the underlying basalt and distort the Keweenaw sandstones, creating the steep river valley in the lower reaches of the watershed (Bean and Thomson 1944, LaBerge 1994).

While these Precambrian events provide the underlying structure for the Brule River valley, a recent period of glaciation called the Wisconsinan, shaped the landscape with deposition of outwash sands and glacial till. Clayton (1984) describes numerous epochs of the ice sheets advancing and retreating. The last phase of the Wisconsinan glacial period occurred 25,000 years ago with the advancement of the Superior lobe. It scraped its way down the length of the valley that was to become the Lake Superior basin. Around twelve thousand years ago, Glacial Lake Duluth began to form, roughly 180 m higher than present-day Lake Superior. Over the next one thousand years, the Superior Lobe started melting for the final time. The initial meltwater formed a channel flowing from the southwest to the northeast. A spillway would eventually form to the south called the Brule/St. Croix spillway (Dott and Attig 2004). This new spillway would drain Glacial Lake Duluth to the south. Eventually (approx. 9,500 years ago), the continual erosive force of meltwater carved a deep channel that resulted in the stream flow reversing and now flowing northeast back to Glacial Lake Duluth. When the glaciers fully receded, a divide formed out of which the Brule and St. Croix rivers flow in opposite directions today (Bean and Thomson 1944).

Based on this geology and subsequent deposit of sediments, the Brule River watershed can be split into three main sections starting at the southwest and moving northeast.

1) At the headwaters of the watershed, the gradient is very gentle and flat. The river meanders slowly and arises out of a complex of conifer swamps dominated by *Thuja occidentalis*, *Larix laricina* and *Picea mariana*. Surrounding this boggy lowland, at least 30.5 m of outwash sands were deposited by streams draining the melting waters (Clayton 1984). Springs in the headwaters region are direct indications of the groundwater flow resulting from these outwash plains.

2) In the middle section of the river, the sandy outwash is reduced and replaced with glacial till and occasional sandstone outcrops (Bean and Thomson 1944). The sandstone exposures provide many of the rapids and falls seen in this section of the river. Many of the lakes present today (e.g., Lake Nebagamom and Lake Minnesuing) were likely depressions on the landscape prior to glaciation and that filled once the melting ice retreated (Clayton 1984). Additionally, this area of the valley readily stores water in hundreds of small wetlands.

3) Finally, in its lower reaches, the river flows through lacustrine deposits of red clay accumulated in Glacial Lake Duluth (9,500 years ago) (Clayton 1984). As the ice melted and retreated, clay deposits mixed with iron oxide were exposed, giving the soils their characteristic red brick color. Clay soils are characterized by the small grain size, a high water-holding capacity, and an elevated cation-exchange with nutrients in the soil (U.S. Environmental Protection Agency 1980). These heavy soils are impermeable, poorly drained, high in nutrients, and remain cool and moist throughout the grow-

TABLE 1. Number of floristic inventory survey sites in each forest community type. Thomson sites are the sites selected in the forest community types surveyed by Thomson (1945). New sites are the additional sites first surveyed in the present study.

Forest Community Type	Thomson Sites	New Sites	Total
Boreal Forest	6	4	10
Northern Dry Forest	–	5	5
Northern Dry-Mesic Forest	–	6	6
Northern Hardwood Swamp	6	1	7
Northern Mesic Forest	2	7	9
Northern Wet Forest	–	6	6
Northern Wet-Mesic Forest	3	9	12
Pine Barrens	4	2	6

ing season, which influences the species composition of the boreal forests they support (Epstein 2017).

Land Cover Analysis

To characterize the early vegetation of the Brule region, we used ArcGIS to digitize maps published by Fassett (1944) and Thomson (1945) that correspond to the time periods 1852–1856 and 1932–1943. We established a boundary of the current Brule River watershed based on recent elevation data using an automated watershed creation tool in ArcGIS. We cross-walked current land cover type information from Wiscland 2.0 data at a 600 dpi resolution (Wisconsin Department of Natural Resources 2016a) into the cover type categories used by Fassett (1944) and summarized the areas in each land cover type for all time periods as a way of inferring qualitative changes in the region. Strict area-based comparisons with early maps are subject to a moderate level of inaccuracy due to comparatively coarse tools used prior to the development of GIS; however, Thomson (1945) stated that the rates of error were below 7% for the early maps.

Floristic Inventories

Floristic inventories were conducted between May and September in 2015, 2016, and 2017 to document the flora of 61 sites, across eight terrestrial forest community types in the Brule River watershed: boreal forest, northern dry forest, northern dry-mesic forest, northern mesic forest, northern hardwood swamp, northern wet-mesic forest, northern wet forest and pine barrens (Table 1, Figure 1). These forest community types are described and classified in a Wisconsin Department of Natural Resources publication on Wisconsin's natural communities (Epstein 2017). In 2015–2017, 21 sites were chosen and surveyed in forested community types originally surveyed by Thomson (1945). Although Thomson (1945) did not disclose his site locations, we used geographical and locational information indicated on his more than 500 herbarium voucher specimens, which are in the Donald W. Davidson Herbarium at the University of Wisconsin-Superior (SUWS) and the Wisconsin State Herbarium at the University of Wisconsin-Madison (WIS). Sites were further refined by inspecting forest stand compartment maps from the Wisconsin Department of Natural Resources, followed by an on-site visit to confirm representative types.

Thomson's community species lists were created by assigning his herbarium specimens to specific forest community types. Additional species noted by Thomson (1944, 1945) but not represented by specimens were added to these community lists. Thomson combined northern wet-mesic and northern wet forest as conifer bog forest. We used his label information and our professional judgment to separate these communities into the northern wet and northern wet-mesic forest classification of today.

Forty additional sites were added to the study to provide a greater geographic representation of the eight forest types in the watershed. These sites were selected by viewing digital land cover maps to identify potential sites, followed by on-site visits to confirm representative habitats.

All sites were a minimum of five acres in size. Sites were selected if the following characteristics were evident: (i) boreal forest, a strong conifer component was present in the understory and the forest was approaching a mid-late successional sere; (ii) northern dry forest dominated by *Pinus banksiana* and *P. resinosa*, while devoid of *P. strobus*; (iii) northern dry-mesic forest, a component of

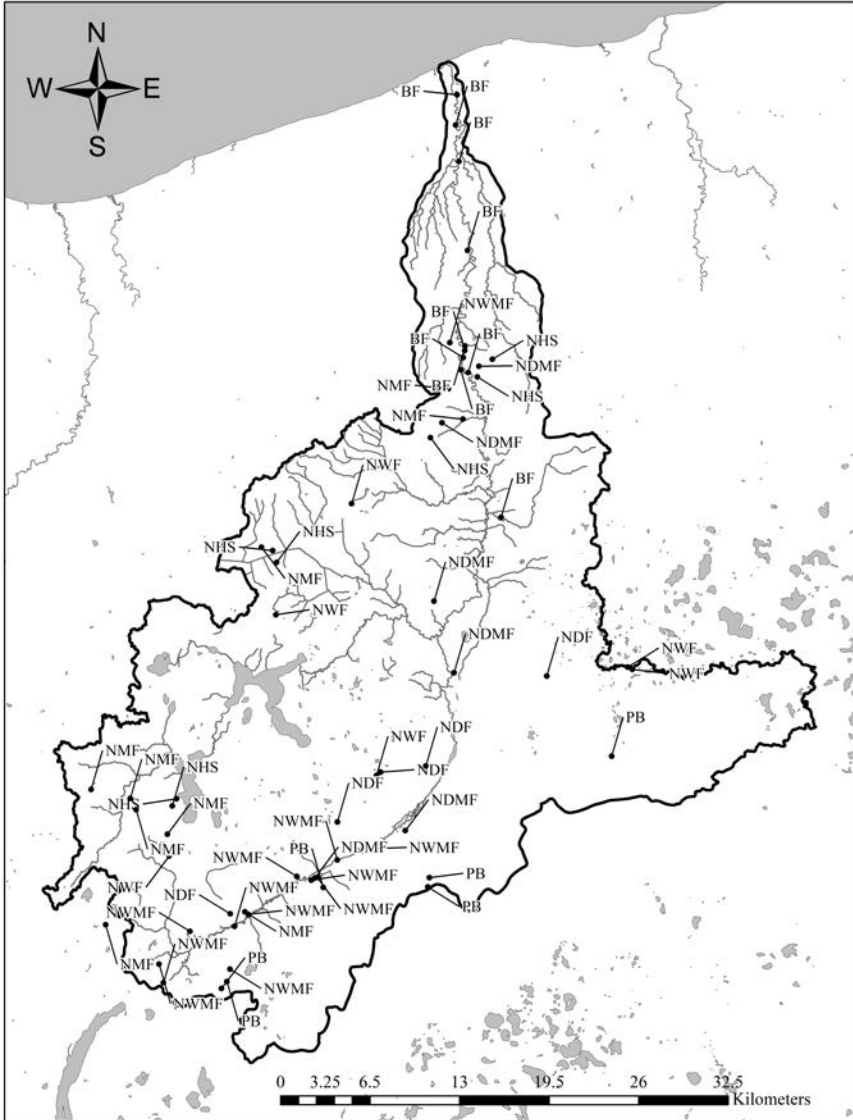


FIGURE 1. Brule river watershed. Survey sites are indicated by black dots, and the forest community type of each is indicated by the following codes: BF=boreal forest, NDF=northern dry forest, NDMF=northern dry-mesic forest, NHS=northern hardwood forest, NMF=northern mesic forest, NWF=northern wet forest, NWMF=northern wet-mesic forest, PB=pine barrens.



FIGURE 2. Northern wet-forest communities dominated by *Picea mariana* was one of the eight forest community types surveyed. Photo by Reed J. Schwarting.

Pinus strobus was found in the canopy, along with *Pinus resinosa* and/or *Pinus banksiana* as associates; (iv) northern hardwood swamps dominated by *Fraxinus nigra*; (v) northern mesic forest dominated by *Acer saccharum* or *Tsuga canadensis* with or without *Betula alleghaniensis*, *Fraxinus americana* or *Tilia americana*; (vi) northern wet forest dominated by *Picea mariana* or *Larix laricina*, with a canopy at least 6 m in height (Figure 2); (vii) northern wet-mesic forest dominated by *Thuja occidentalis*; and (viii) pine barrens consisted of mosaics of prairie-like openings, scrub oaks, and small stands of pines.

At each site, a floristic inventory was completed by a team of professional botanists from Illinois and Wisconsin. The team meandered through each site compiling a species list and collecting voucher specimens until no new species were observed (Figure 3). At the end of each survey, all observed species were assigned an abundance designation in one of four categories: abundant (A) = locally dominant species and those species that were widely distributed and often found growing in large quantities, common (C) = widely distributed and often found but not in abundant quantities, occasional (O) = not widespread but found in small numbers, rare (R) = rare to the site, only a small population or very few individuals found. These codes were applied to each site within a forest community type and then combined to create a complete species list for each community type. The abundance codes were applied subjectively by the team, but a conscientious effort was made for consistency. These descriptors are subjective estimates and should not be confused with quantitative cover values.

Voucher specimens were added to the archival Thomson collection housed at SUWS and the general herbarium collection at WIS (Figure 4). Duplicates were prepared and given to the Illinois Natural History Survey Herbarium (ILLS). Nomenclature primarily follows Voss and Reznicek (2012), which includes most Wisconsin species. Judziewicz et al. (2014) was used for all the grass species and for those species not included, the Flora of North America (Flora of North America Editorial Committee 1993+) was consulted.

Additional surveys were conducted at known and potential localities for rare and notable plants



FIGURE 3. Field team of Paul Marcum, Loy R. Phillippe, and Mary Ann Feist collecting voucher specimens to add to the Thomson archival collection. Photo by Derek S. Anderson.



FIGURE 4. *Heuchera richardsonii*. A July 1943 Brule River Survey collection by Dr. John Thomson found in the pine barrens community at the abandoned Volker farm field. It was preserved specimens like these that narrowed our designated sites for repeat surveys. Digital image from University of Wisconsin-Superior, Superior.

of the watershed. Rare plants included any plant species listed on the Wisconsin Natural Heritage Working List (Wisconsin Department of Natural Resources 2016d). Notable species are uncommon species found for the first time in the watershed and may also be new to Douglas County. Rare and notable plant populations were identified and documented by recording latitude and longitude, population size, phenology, and site characteristics and by taking photographs.

Analysis

We calculated various statistics to characterize the flora within each forest community type and made comparisons with similar calculations that we applied to Thomson's data and voucher specimens for each forest community type (Thomson 1944, Thomson 1945). Such comparisons were made for all community types except northern dry forest and northern dry-mesic forest, which had few representative sites remaining in the watershed. We calculated average species richness per site and total species richness across all sites within each community as a basic measure of floristic diversity.

A floristic quality assessment (FQA) was used to provide an ecological condition assessment based on all species in the forest. This assessment was originally developed in the late 1970's in the Chicago region to identify protection-worthy lands with a simple, repeatable, quantitative method (Swink and Wilhelm 1979). They assigned a Coefficient of Conservatism (C), a number from 0 to 10 for each species representing the Illinois flora. In the early 2000's, Wisconsin's expert botanists convened and did the same for Wisconsin's vascular plants (Bernthal 2003). This list is now maintained by the Wisconsin Department of Natural Resources (Wisconsin Department of Natural Resources 2016c).

The FQA relies on two measurements, the Mean C and the Floristic Quality Index (FQI). The FQI is sensitive to the total hectares surveyed as species richness increases as the sample area increases (Matthews 2005). We were unable to determine Thomson's sample areas in 1944–45 and chose the Mean C as a reliable metric in comparing the two time periods at the forest community scale. Species that are relatively tolerant of anthropogenic disturbance have low C-values, whereas species that are less tolerant of anthropogenic disturbance have high C-values (Spyreas 2019). We calculated a Mean Coefficient of Conservatism (C) for each forest type community. *Mean C* is the

arithmetic average of the C values across the total number of plant species observed (n) by the cumulative surveys by forest type. We calculated versions of C for all species (C_t) and for native species only (C_n). Since non-native species have a Coefficient of Conservatism of zero, C_t will always be less than C_n .

$$\bar{C} = (C_1 + C_2 + C_3 + \dots + C_n) \div n$$

Further, we determined the percentage of non-native species, as well as the presence and abundance of prevalent ground layer species. In each forest community type, we classified prevalent ground layer species as those found in 80% or more of the surveyed sites with an abundance code of (A) or (C) in at least 50% of them. Most prevalent ground layer species are those with an abundance code of (A) or (C) and occur in 80% or more of the surveyed sites.

We used Sørensen Similarity Coefficients (Sørensen 1948) to identify sites that were compositionally dissimilar from others in their corresponding forest community type. The calculated coefficient ranges from 0 to 1, where a higher value indicates a higher percentage of shared species between the two sites. We calculated the coefficient for all pairs of sites within each forest community type. We removed sites in each community type where the coefficient was less than 0.4 from further comparisons. This process resulted in the removal of three sites that were likely misclassified, one each from the northern wet-mesic forest, northern hardwood swamp, and pine barrens communities.

RESULTS

Vegetation Cover Map Analysis (1852–2017)

As with all regions throughout the Midwest, land cover changes over the past 160 years have been substantial in the Brule River watershed. Today public lands encompass 60% (30,729 ha) of the watershed and include: Brule River State Forest, Douglas County Forestry and Parks and Bayfield County Forestry. The remaining 40% (20,570 ha) of the land in the watershed is controlled by private land holdings including timber management, logging companies and shoreline and streambank landowners. Based on comparisons of land cover maps across time periods (Table 2, Figure 5), we noted five general trends:

1. There was a shift from open pine barrens and dry forest to managed pine plantation in the southeastern extent of the watershed. These pine barrens declined from over 16,187 ha in 1852–1856 and 12,140 ha in 1932–43 to approximately 908 ha today.

2. Old-growth (northern dry-mesic forest) had been reduced by 75% of its pre-EuroAmerican settlement coverage by the 1940s. As a result of private and public protection of these old growth forests in land trusts and managed natural lands there has been a slight rebound with 2.6% (1,325 ha) of land represented in the watershed.

3. The early surveys depict a narrow strip of northern wet-mesic forest surrounding the Brule River from the headwaters area extending northeast up to Big Lake (Thomson 1945). Thomson (1945) noticed on-going harvesting in this forest in the 1940s that resulted in a substantial narrowing of this band. In 1945, the Brule River State Forest expanded its boundaries to include these headwater

TABLE 2. Land cover area of historical community types and their current equivalents in three different time periods, illustrating vegetation changes in the Brule River watershed. The cover area for 1852–1856 and 1932–1943 were mapped originally in Fassett (1944) and are digitized for our comparisons here. The areas in the column headed 2014–2016 (Fassett) were determined using Wiscland 2.0 and cross-walked to Fassett's cover types. The areas in the column headed 2014–2016 (Current) refer to Epstein's (2017) natural communities' classification in discussing the eight forested communities in the watershed.

Historical Mapped Community Classification	Land Cover in hectares				Current Community Classification
	1852–1856	1932–1943	2014–2016 (Fassett)	2014–2016 (Current)	
Aspen	7609	15168	13529	13302	Northern hardwood aspen
				226	Northern hardwood oak-maple
Bog conifer	6702	3571	3401	971	Northern wet-mesic forest
				1936	Northern wet forest
				495	Muskeg
Lowland hardwood	230	4988	5420	5420	Northern hardwood swamp
Maple-yellow birch	924	192	750	750	Northern mesic forest
Pine forest	3649	881	17293	2649	Northern dry-mesic forest
				14644	Northern dry forest – pine plantation
Pine-hardwood	6717	2096	4480	4480	Northern mixed/conifer hardwood
Pine barren	16882	12285	908	908	Pine barren
Spruce-fir forest	3413	432	1877	1877	Boreal forest
Cleared	0	4010	2165	427	Developed
				1725	Agriculture
Willow, alders, etc.	0	59	574	273	Alder thicket
				44.5	Northern wet meadow
Marsh	85			13	Shrub carr
				244	Open bog
Open water	1490	1482	915	915	Open water
Maple coppice	45	642	0		
Small fir & aspen	0	1248	0		
Totals	47054	47768	51312	51300	

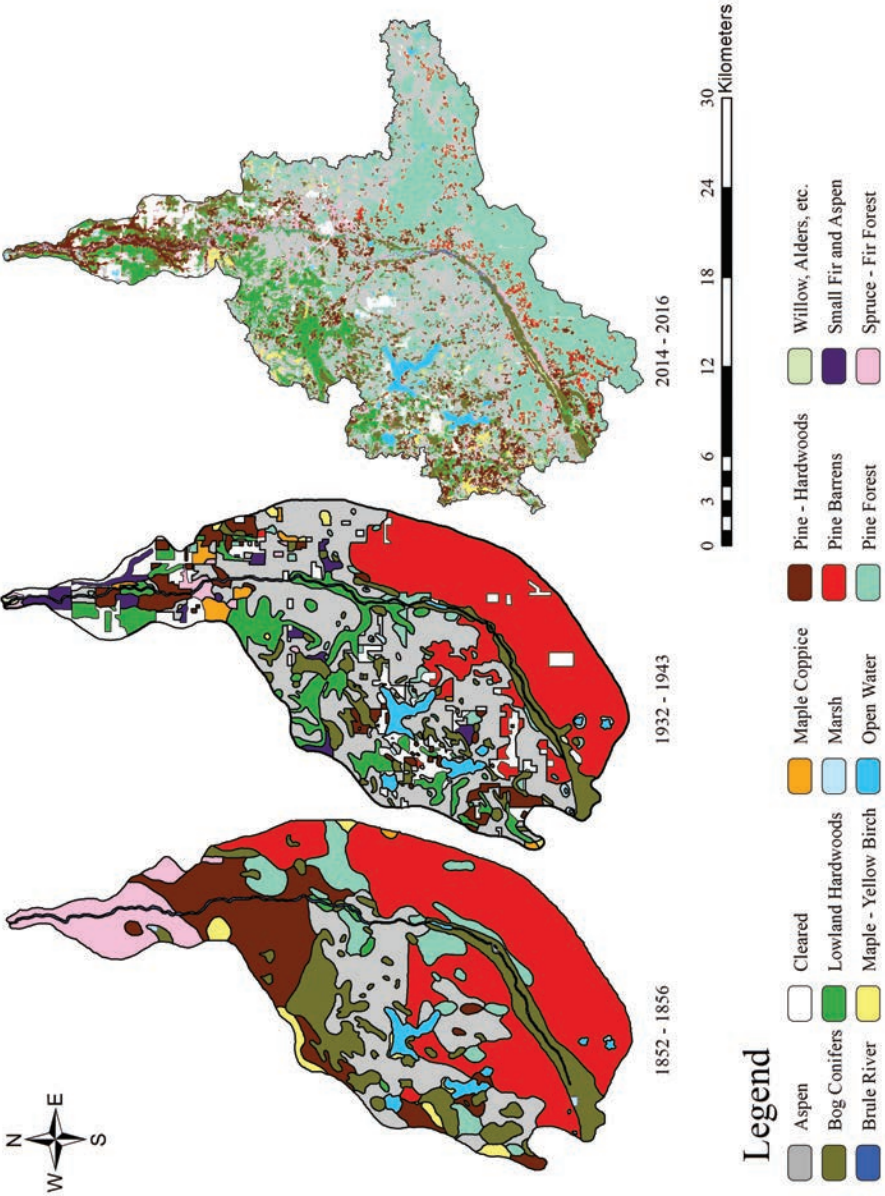


FIGURE 5. Land cover changes in the Brule River watershed from 1852 to 2016.

forests, offering protection and management (Wisconsin Department of Natural Resources 2017).

4. A large conifer bog complex north of Lake Nebagamon was depicted on the 1852–1856 map. By the 1940s, there was a substantial decline from *Thuja occidentalis* to a lower quality forest of northern hardwood swamps dominated by *Fraxinus nigra* and *Alnus incana*. Remnants of the original forest are present, but in even smaller parcels.

5. Boreal forest extending from the mouth of the river towards the southwest has been greatly diminished, though recovery is occurring, and some stands are approaching old growth. Substantial forest lands were initially cleared for farming, while thousands of hectares have been placed into managed timber production consisting primarily of *Populus* spp., *Quercus* spp. and *Acer* spp.

Forest Inventory Summaries

During his surveys in 1944 and 1945, Thomson collected 523 specimens representing 376 species. In this study, surveying in similar forest community types but with greater sampling effort, we collected over 2,200 specimens representing 747 species (16.6% of them non-native). A review of Thomson's collections and other herbarium records revealed documented records of 92 species not found during our surveys. These are listed in Table 3. This brings the total of species documented for the watershed to 839. From our surveys, we recorded 53 new records for Douglas County (17% of them non-native species) (Table 4, Figure 6). Further, we collected 233 species (5% of them non-native) from the Brule River watershed for the first time. Three concurrent studies on the watershed were further referenced (Hlina et al. 2018a; Hlina et al. 2018b; Schwarting et al. 2018) in creating the comprehensive species list of the Brule River watershed in Appendix 1. An additional 18 species (Table 5) were seen and recorded in these studies but we failed to collect, and no historical herbarium records were found; therefore, these species are not included in the comprehensive species list (Appendix 1). Thomson vouchered enough species from the boreal forest, northern wet-mesic forest, pine barrens, northern hardwood swamps, northern mesic forest, and northern wet forest communities for us to compare his collection data with our observed and vouchered specimens.

Boreal forest averaged 132 species per site, with a range of 93–182 species. Dominant tree species include *Populus tremuloides*, *Abies balsamea*, *Picea glauca*, and *Pinus strobus*. Community richness was 66 families, 192 genera, 362 species of which 14.9% are non-native. The five most dominant families were Cyperaceae (11%), Asteraceae (10%), Rosaceae (8%), Poaceae (8%) and Ranunculaceae (5%). Twelve prevalent ground layer species were recorded (Appendix 2), with four species being most prevalent: *Eurybia macrophylla*, *Maianthemum canadense*, *Pteridium aquilinum*, and *Aralia nudicaulis*. Thomson's community richness consisted of 38 families, 79 genera, and 105 species, 5% of which are non-native (Thomson 1945). Seventy-nine percent of prevalent species were also surveyed by Thomson. The value for C_n was 5.3, as compared to 4.9 for Thomson's survey, while C_t was 4.5, as compared to 4.7 (Figure 7).

TABLE 3. Plant taxa previously documented from the Brule River Watershed but not encountered during the 2015–2016 survey. Non-native species are indicated with an asterisk (*). *Tephrosieris palustris* is listed in Wisconsin as Special Concern and was last seen in the watershed by L.S. Cheney in 1897.

Family	Species
	PTERIDOPHYTES
Cystopteridaceae	<i>Cystopteris tenuis</i>
Equisetaceae	<i>Equisetum</i> × <i>ferrissii</i>
Lycopodiaceae	<i>Dendrolycopodium obscurum</i>
Lycopodiaceae	<i>Huperzia selago</i>
Lycopodiaceae	<i>Lycopodiella inundata</i>
Ophioglossaceae	<i>Botrychium lanceolatum</i>
Ophioglossaceae	<i>Sceptridium multifidum</i>
	DICOTS
Amaranthaceae	* <i>Froelichia gracilis</i>
Anacardiaceae	<i>Rhus</i> × <i>pulvinata</i>
Apiaceae	* <i>Pastinaca sativa</i>
Apiaceae	<i>Sanicula odorata</i>
Araliaceae	<i>Aralia hispida</i>
Asteraceae	* <i>Achillea ptarmica</i>
Asteraceae	<i>Ambrosia psilostachya</i>
Asteraceae	* <i>Artemisia pontica</i>
Asteraceae	* <i>Artemisia vulgaris</i>
Asteraceae	* <i>Centaurea jacea</i>
Asteraceae	<i>Cirsium discolor</i>
Asteraceae	* <i>Crepis tectorum</i>
Asteraceae	* <i>Grindelia squarrosa</i>
Asteraceae	<i>Liatris ligulistylis</i>
Asteraceae	<i>Rudbeckia laciniata</i>
Asteraceae	<i>Symphyotrichum boreale</i>
Asteraceae	<i>Symphyotrichum pilosum</i>
Asteraceae	<i>Tephrosieris palustris</i>
Betulaceae	<i>Alnus viridis</i>
Boraginaceae	<i>Lithospermum carolinense</i>
Boraginaceae	* <i>Lithospermum officinale</i>
Brassicaceae	* <i>Erysimum cheiranthoides</i>
Brassicaceae	<i>Rorippa palustris</i>
Brassicaceae	* <i>Sisymbrium altissimum</i>
Brassicaceae	* <i>Thlaspi arvense</i>
Caprifoliaceae	<i>Symphoricarpos occidentalis</i>
Caryophyllaceae	* <i>Silene dichotoma</i>
Caryophyllaceae	* <i>Stellaria borealis</i>
Caryophyllaceae	* <i>Stellaria graminea</i>
Fabaceae	<i>Lespedeza capitata</i>
Fabaceae	* <i>Robina pseudoacacia</i>
Fabaceae	* <i>Trifolium campestre</i>
Fabaceae	* <i>Trifolium pratense</i>
Fabaceae	* <i>Vicia villosa</i>
Gentianaceae	<i>Gentiana rubricaulis</i>
Lamiaceae	* <i>Ajuga genevensis</i>
Lindleriaceae	<i>Lindernia dubia</i>
Molluginaceae	* <i>Mollugo verticillata</i>
Onagraceae	<i>Oenothera perennis</i>
Penthoraceae	<i>Penthorum sedoides</i>
Plantaginaceae	* <i>Linaria vulgaris</i>

(Continued on next page)

TABLE 3. (Continued)

Family	Species
Plantaginaceae	<i>Nuttallanthus canadensis</i>
Plantaginaceae	<i>Veronica peregrina</i>
Plantaginaceae	* <i>Veronica serpyllifolia</i>
Polygalaceae	<i>Polygala sanguinea</i>
Polygonaceae	<i>Polygonum achoreum</i>
Polygonaceae	* <i>Polygonum aviculare</i>
Portulacaceae	* <i>Portulaca oleracea</i>
Ranunculaceae	<i>Clematis occidentalis</i>
Rhamnaceae	<i>Ceanothus americanus</i>
Rosaceae	<i>Agrimonia striata</i>
Rosaceae	<i>Aronia</i> × <i>prunifolia</i>
Rosaceae	<i>Crataegus succulenta</i> var. <i>macracantha</i>
Rosaceae	* <i>Filipendula rubra</i>
Salicaceae	* <i>Salix alba</i>
Urticaceae	<i>Urtica dioica</i>
MONOCOTS	
Alismataceae	<i>Alisma triviale</i>
Alismataceae	<i>Sagittaria cuneata</i>
Convallariaceae	<i>Maianthemum stellatum</i>
Cyperaceae	<i>Carex arcta</i>
Cyperaceae	<i>Carex cryptolepis</i>
Cyperaceae	<i>Carex houghtoniana</i>
Cyperaceae	<i>Carex lurida</i>
Cyperaceae	<i>Carex pellita</i>
Cyperaceae	<i>Cyperus lupulina</i>
Cyperaceae	<i>Eleocharis obtusa</i>
Cyperaceae	<i>Schoenoplectus pungens</i>
Cyperaceae	<i>Scirpus microcarpus</i>
Eriocaulaceae	<i>Eriocaulon aquaticum</i>
Hydrocharitaceae	<i>Elodea nuttallii</i>
Juncaceae	<i>Juncus balticus</i>
Juncaceae	<i>Juncus interior</i>
Juncaceae	<i>Juncus vaseyi</i>
Orchidaceae	<i>Calopogon tuberosus</i>
Orchidaceae	<i>Goodyera pubescens</i>
Orchidaceae	<i>Malaxis unifolia</i>
Orchidaceae	<i>Plantathera clavellata</i>
Poaceae	<i>Agrostis hyemalis</i>
Poaceae	<i>Alopecurus aequalis</i>
Poaceae	<i>Ammophila breviligulata</i>
Poaceae	<i>Dichanthelium columbianum</i>
Poaceae	* <i>Echinochloa crusgalli</i>
Poaceae	<i>Eragrostis hypnoides</i>
Poaceae	* <i>Poa annua</i>
Potamogetonaceae	<i>Stuckenia filiformis</i>

TABLE 4. New vascular plant records for Douglas County. Non-native species are indicated by an asterisk (*). The Douglas County collection of *Lactuca hirsuta* is the second known collection from the state of Wisconsin.

Family	Taxon
Asteraceae	<i>Bidens discoidea</i>
Asteraceae	<i>Helianthus hirsutus</i>
Asteraceae	* <i>Hieracium lachenalia</i>
Asteraceae	<i>Lactuca hirsuta</i>
Asteraceae	<i>Krigia biflora</i>
Asteraceae	<i>Pseudognaphalium obtusifolium</i>
Asteraceae	<i>Symphotrichum urophyllum</i>
Boraginaceae	* <i>Myosotis arvensis</i>
Brassicaceae	<i>Cardamine pratensis</i> var. <i>palustris</i>
Caprifoliaceae	<i>Triosteum aurantiacum</i>
Caryophyllaceae	* <i>Arenaria serpyllifolia</i>
Caryophyllaceae	* <i>Dianthus barbatus</i>
Caryophyllaceae	* <i>Gypsophila muralis</i>
Caryophyllaceae	<i>Moehringia lateriflora</i>
Caryophyllaceae	* <i>Spergularia rubra</i>
Cyperaceae	<i>Carex alopecoidea</i>
Cyperaceae	<i>Carex backii</i>
Cyperaceae	<i>Carex bromoides</i> var. <i>bromoides</i>
Cyperaceae	<i>Carex echinodes</i>
Cyperaceae	<i>Carex hirtifolia</i>
Cyperaceae	<i>Carex muehlenbergii</i>
Cyperaceae	<i>Carex normalis</i>
Cyperaceae	<i>Carex ormostachya</i>
Cyperaceae	<i>Carex radiata</i>
Cyperaceae	<i>Carex rosea</i>
Cyperaceae	<i>Carex sprengelii</i>
Cyperaceae	<i>Carex tribuloides</i>
Cyperaceae	<i>Carex</i> × <i>knieskernii</i>
Droseraceae	<i>Drosera intermedia</i>
Ericaceae	<i>Pyrola americana</i>
Fabaceae	<i>Hylodesmum glutinosum</i>
Fabaceae	* <i>Vicia cracca</i>
Gentianaceae	<i>Gentiana alba</i>
Grossulariaceae	<i>Ribes lacustre</i>
Hemerocallidaceae	* <i>Hemerocallis fulva</i>
Juncaceae	<i>Juncus brachycephalus</i>
Lamiaceae	<i>Clinopodium vulgare</i>
Lythraceae	<i>Decodon verticillatus</i>
Onagraceae	<i>Oenothera clelandii</i>
Orobanchaceae	<i>Conopholis americana</i>
Plantaginaceae	<i>Plantago rugelii</i>
Plantaginaceae	* <i>Veronica longifolia</i>
Poaceae	<i>Bromus latiglumis</i>
Poaceae	<i>Bromus pubescens</i>
Poaceae	<i>Cinna arundinacea</i>
Poaceae	<i>Dichanthelium linearifolium</i>
Poaceae	<i>Dichanthelium oligosanthes</i>
Poaceae	<i>Elymus wiegandii</i>
Poaceae	<i>Torreyochloa pallida</i>
Potamogetonaceae	<i>Potamogeton nodosus</i>
Potamogetonaceae	<i>Potamogeton oakesianus</i>
Rosaceae	<i>Crataegus submollis</i>
Smilacaceae	<i>Smilax illinoensis</i>



FIGURE 6. *Conopholis americana*, one of 53 new county records for Douglas County in northwestern Wisconsin. Photo by Derek S. Anderson.

TABLE 5. Species seen during this study but not vouchered and for which no herbarium records from the Brule River watershed are known. An asterisk (*) indicates a non-native species.

Family	Species
Apiaceae	<i>Osmorhiza longistylis</i>
Asteraceae	<i>Erigeron philadelphicus</i>
Asteraceae	<i>Helianthus pauciflorus</i>
Asteraceae	<i>Heliopsis helianthoides</i>
Brassicaceae	<i>Boechera grahamii</i>
Brassicaceae	<i>Cardamine diphylla</i>
Cyperaceae	<i>Carex blanda</i>
Cyperaceae	<i>Carex laxiflora</i>
Cyperaceae	<i>Cyperus schweinitzii</i>
Fabaceae	<i>Dalea purpurea</i>
Lamiaceae	* <i>Nepeta cataria</i>
Orchidaceae	<i>Spiranthes cernua</i>
Poaceae	<i>Elymus villosus</i>
Ranunculaceae	<i>Anemone acutiloba</i>
Rosaceae	* <i>Pyrus communis</i>
Salicaceae	<i>Salix nigra</i>
Smilacaceae	<i>Smilax ecirrhata</i>
Vitaceae	<i>Vitis riparia</i>

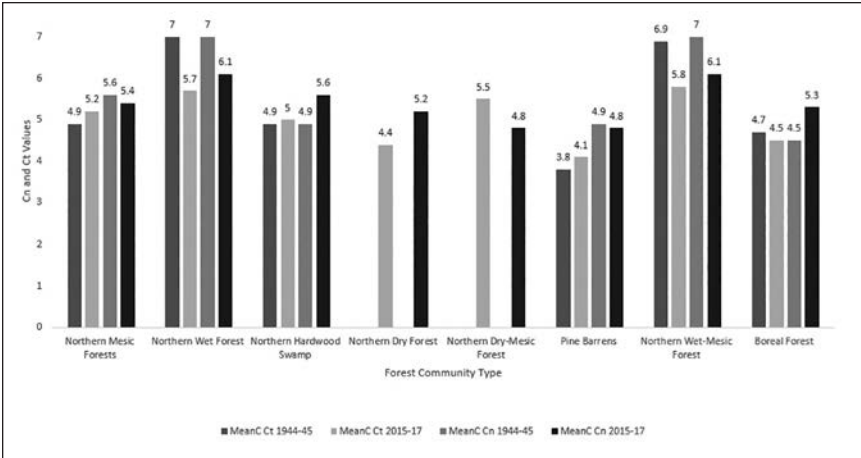


FIGURE 7. *Ct* and *Cn* values compared with the Thomson data of 1944–45. There was no comparison data for the northern dry and northern dry-mesic forests communities, as these were not forest types that Thomson recognized.

Northern wet-mesic forest averaged 98 species per site, with a range of 67–125 species. Dominant tree species include *Thuja occidentalis* and *Abies balsamea*. Community richness consisted of 64 families, 163 genera and 299 species, of which 4.3% are non-native. The five dominant families were Cyperaceae (12.3%), Asteraceae (8%), Rosaceae (7%), Ericaceae (6%) and Poaceae (5%). Eleven prevalent ground layer species were recorded (Appendix 2), with five species being most prevalent: *Rubus pubescens*, *Coptis trifolia*, *Maianthemum canadense*, *Trientalis borealis*, and *Cornus canadensis*. Thomson’s community richness consisted of 40 families, 71 genera, and 83 species, of which 3% were non-native (Thomson 1945). Eighty percent of prevalent species we recorded were also surveyed by Thomson. The value for *Cn* was 6.1, as compared to 6.9 for Thomson’s survey, while *Ct* was 5.7, as compared with 6.7 (Figure 7).

Pine barrens averaged 87 species per site, with a range of 62–111 species. Dominant tree species included *Pinus resinosa* and *Pinus banksiana*. Community richness consisted of 54 families, 137 genera, and 207 species, of which 16.4% are non-native. The four dominant families were Asteraceae (20%), Poaceae (13.8%), Rosaceae (10.5%), and Cyperaceae (5.7%). Sixteen prevalent ground layer species were recorded (Appendix 2), with eleven species being most prevalent: *Comptonia peregrina*, *Corylus americana*, *Prunus pumila*, *Rubus flagellaris*, *Carex pensylvanica*, *Vaccinium angustifolium*, *Quercus macrocarpa*, *Quercus ellipsoidalis*, *Andropogon gerardii*, *Danthonia spicata*, and *Monarda fistulosa*. Thomson’s community richness consisted of 39 families, 94 genera, and 127 species, of which 17% were non-native (Thomson 1945). Sixty-three percent of prevalent species recorded, were also surveyed by Thom-

son. *Cn* was 4.8, compared to 4.9 from Thomson's survey. *Ct* was 4.1, compared to 4.0 (Figure 7).

Northern hardwood swamp averaged 93 species per site, with a range of 71–130 species. Dominant tree species included *Fraxinus nigra* and *Thuja occidentalis*. Community richness consisted of 66 families, 170 genera, and 307 species, of which 10.7% are non-native. The four dominant families were Cyperaceae (13%), Asteraceae (9%), Poaceae (8%), and Rosaceae (7%). Ten prevalent ground layer species were recorded (Appendix 2), with four species being most prevalent: *Carex stipata*, *Rubus pubescens*, *Carex intumescens*, and *Onoclea sensibilis*. Thomson's community richness consisted of 33 families, 47 genera, and 52 species with no non-native species (Thomson 1945). Twenty-five percent of our prevalent species were also surveyed by Thomson. *Cn* was 5.6 compared to 4.9 in Thomson's. *Ct* was 5.0 compared to 4.9 (Figure 7).

Northern wet forest averaged 36 species per site, with a range of 23–71 species. Dominant tree species included *Picea mariana* and *Larix laricina*. Community richness consisted of 44 families, 93 genera, and 156 species, of which 6.4% were non-native. The five dominant families were Cyperaceae (18%), Rosaceae (11%), Ericaceae (7%), Asteraceae (6%), and Poaceae (6%). Four prevalent ground layer species were recorded (Appendix 2), with two species being the most prevalent: *Rhododendron groenlandicum* and *Maianthemum trifolium*. Thomson's community richness consisted of 16 families, 25 genera, and 34 species with no non-native species (Thomson 1945). One hundred percent of our prevalent species were also surveyed by Thomson. *Cn* was 6.1, compared to 7.0 in Thomson's survey. *Ct* was 5.7, compared to 7.0 (Figure 7).

Northern mesic forest averaged 85 species per site, with a range of 42–144 species. Dominant tree species included *Acer saccharum*, *Tilia americana*, and *Acer rubrum*. Community richness consisted of 59 families, 147 genera, and 242 species, of which 10% were non-native. The five dominant families were Cyperaceae (11%), Poaceae (9%), Asteraceae (8%), Rosaceae (7%), and Ranunculaceae (6%). Six prevalent ground layer species were recorded (Appendix 2), with three species being most prevalent: *Acer saccharum*, *Maianthemum canadense*, and *Clintonia borealis*. Thomson's community richness consisted of 31 families, 45 genera, and 59 species, of which 3% were non-native (Thomson 1945). Eighty-three percent of our prevalent species were also surveyed by Thomson. *Cn* was 5.6 for both time periods. *Ct* was 4.9, compared to 5.5 in Thomson's survey (Figure 7).

Although we could not do comparisons for the remaining forest types, we provide summary data from our surveys for two additional forest types. Northern dry forest averaged 75 species per site, with a range of 45–111 species. Dominant tree species included *Pinus resinosa* and *P. banksiana*. Community richness consisted of 51 families, 134 genera, and 209 species, of which 15.8% were non-native. The five dominant families were Asteraceae (11%), Poaceae (11%), Rosaceae (11%), Cyperaceae (6%), and Ericaceae (6%). Seven prevalent ground layer species were recorded (Appendix 2), with three species being most prevalent: *Maianthemum canadense*, *Pteridium aquilinum*, and *Oryzopsis asperifolia*. *Cn* for all northern dry forest species was 5.2, while *Ct* was 4.4 (Figure 7).

Northern dry-mesic forest averaged 94 species per site, with a range of 39–128 species. Dominant tree species included *Pinus resinosa*, *P. banksiana*, *P. strobus*, and *Betula papyrifera*. Community richness consisted of 65 families, 163 genera, and 263 species, of which 12.9% were non-native. The five dominant families were Asteraceae (10%), Rosaceae (9%), Poaceae (8%), Cyperaceae (6%), and Ericaceae (5%). Seven prevalent ground layer species were recorded (Appendix 2), with four species being most prevalent: *Maianthemum canadense*, *Pteridium aquilinum*, *Aralia nudicaulis*, and *Eurybia macrophylla*. *Cn* was 5.5, while *Ct* was 4.8 (Figure 7).

The following species were documented by Thomson (1945), but not found by our 2015–2017 surveys: *Agrimonia striata*, *Alnus viridis*, *Botrychium lanceolatum*, *B. matricariifolium*, *Botrypus virginianus*, *Calopogon tuberosus*, *Carex retrorsa*, *Celastrus scandens*, *Clematis occidentalis*, *Geum fragarioides*, *Grindelia squarrosa*, *Liatris ligulistylis*, *Nuttallanthus canadensis*, *Osmorhiza longistylis*, *Rudbeckia laciniata*, *Symphoricarpos occidentalis*, *Symphyotrichum boreale*.

Among various plant growth forms, graminoid species displayed substantial proportional compositional increases between the two time periods (1945, 2017) in the boreal forest, northern hardwood swamp and northern wet-mesic forest, while there was only a slight increase of graminoids in the northern mesic forest. There was no change in plant growth forms for the pine barrens and northern wet forest (Table 6).

Appendix 3 summarizes these details for all forest types surveyed.

Rare and Notable Species

Between 2015 and 2017, we found thirteen species listed as rare in Wisconsin (Wisconsin Department of Natural Resources 2016c): *Asclepias ovalifolia* (Figure 8), *Callitriche hermaphroditica*, *Calypso bulbosa*, *Carex backii*, *Coptidium lapponicum*, *Cypripedium parviflorum* var. *makasin*, *Eriophorum chamissonis* (Figure 9), *Geum macrophyllum* var. *macrophyllum*, *Petasites frigidus* var. *sagittatus*, *Pyrola minor*, *Ribes oxycanthoides*, *Rhynchospora fusca*, and *Vaccinium vitis-idaea*. Six rare species were found in the northern wet-mesic forest, four in the boreal forest, one in the pine barrens, one in the northern hardwood swamp and one in the northern wet forest. These areas may be the last refuge in the Brule River watershed, if not in the State of Wisconsin, for the species *Coptidium lapponicum* and *Calypso bulbosa* and many other rare plant assemblages. An additional ten notable species with low occurrences were added to the list (Table 7).

DISCUSSION

We could not determine the exact methods that Thomson (1944, 1945) used to survey the flora of each of these communities. Upon close examination of his herbarium specimens and his papers (Thomson, 1944; Thomson 1945), it

TABLE 6. Number of species of five growth forms represented in species lists for 1944–1945 and 2015–2016 in each of the eight forest community types. Data for 1944–1945 are omitted for northern dry forests and northern dry-mesic forests due to lack of historical data.

Growth Form	1944–1945		2015–2016	
	Number of Species	Percentage (%)	Number of Species	Percentage (%)
Boreal forest				
Tree	16	15	25	7
Shrub	21	21	62	17
Forb	57	54	198	55
Graminoid	8	8	70	19
Vine	3	3	7	2
Totals	105	100	362	100
Northern wet-mesic forest				
Tree	6	7	19	6
Shrub	14	17	57	19
Forb	55	67	162	54
Graminoid	8	9	57	19
Vine	0	0	4	2
Totals	83	100	299	100
Pine barrens				
Tree	7	6	13	6
Shrub	19	15	28	14
Forb	81	64	121	58
Graminoid	18	14	43	21
Vine	1	1	2	1
Totals	126	100	207	100
Northern hardwood swamp				
Tree	8	15	20	7
Shrub	7	13	51	16
Forb	33	64	167	54
Graminoid	2	4	64	21
Vine	2	4	5	2
Totals	52	100		100
Northern mesic forests				
Tree	8	13	18	7
Shrub	8	14	44	18
Forb	34	58	126	53
Graminoid	8	14	51	21
Vine	1	1	1	1
Totals	59	100	242	100

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TABLE 6. (Continued)

Growth Form	1944–1945		2015–2016	
	Number of Species	Percentage (%)	Number of Species	Percentage (%)
Northern wet forest				
Tree	7	21	13	8
Shrub	9	26	38	24
Forb	10	29	65	42
Graminoid	8	24	40	26
Vine	0	0	0	0
Totals	34	100	156	100
Northern dry forest				
Tree			15	7
Shrub			43	21
Forb			105	50
Graminoid			46	22
Vine			0	0
Totals			209	100
Northern dry-mesic forest				
Tree			24	9
Shrub			51	19
Forb			143	54
Graminoid			41	16
Vine			4	2
Totals			263	100

appears that Thomson may have had some bias towards collecting along roadways and in abandoned fields. Furthermore, Thomson collected on his own on 53 field days spanning a three-year period, whereas our research teams consisted of groups of surveyors and professional botanists surveying the equivalent of 180 field days spanning a three-year period. The level of effort far exceeded Thomson's and has likely contributed to the discrepancy between the measurements of species richness, species composition, and species abundance for the two time periods.

When examining changes in the function, structure, and growth of the groundcover stratum, a clear pattern emerges. First, the graminoids have become more dominant throughout several forest types (Table 6). Recent authors (Rooney and Waller 2003; Rooney 2009; Burton et al. 2014) suggest that graminoids are better able to recover from browsing pressure than most forbs, which leads to their increased dominance in today's forests because of an increase in herbivory by white-tailed deer. A second trend observed was an increase in the total number of tree species in most forest types (Table 6), while species percentages as a portion of forest composition remained the same across all community types. A likely explanation is the exhaustive nature of our studies



FIGURE 8. *Asclepias ovalifolia* in a population of more than 200 individuals located in a recently harvested pine plantation in the pine barrens community type. Photo by Derek S. Anderson.



FIGURE 9. *Eriophorum chamissonis* in a population of hundreds found in one small bog near the shores of Lake Nebagamon in the western portion of the watershed. Photo by Reed J. Schwarting.

TABLE 7. Rare, threatened, endangered species in the watershed. Also included in the list are notable species which are uncommon species found for the first time in the watershed and may also be a new Douglas County record. In the State Status column, SC = Special Concern, THR = Threatened, END = Endangered, N = Notable.

	Number of Occurrences	Year Last Observed	State Status	Comments
<i>Asclepias ovalifolia</i>	1	2015	THR	100 plants
<i>Callitriche hermaphroditica</i>	4	2016	SC	cold spring waters
<i>Calypso bulbosa</i> var. <i>bulbosa</i>	2	2016	THR	125 plants in 1996; two plants in 2016
<i>Carex assiniboiensis</i>	1	2016	N	boreal tributary ravine
<i>Carex backii</i>	2	2015	SC	bedrock glade
<i>Carex vaginata</i>	Several	2016	N	scattered
<i>Carex</i> × <i>knieskernii</i>	1	2016	N	several plants
<i>Coptidium lapponicus</i>	3	2015	END	>250 plants
<i>Cypripedium parviflorum</i> var. <i>makasin</i>	3	2016	SC	numerous
<i>Cypripedium parviflorum</i> var. <i>pubescens</i>	1	2016	N	numerous
<i>Cypripedium reginae</i>	2	2016	N	two locations
<i>Dryopteris fragrans</i>	1	2015	N	rock outcropping
<i>Eriophorum chamissonis</i>	1	2017	SC	hundreds of plants in one bog
<i>Epilobium palustre</i>	1	2017	SC	one plant
<i>Gentiana alba</i>	1	2017	N	several plants on riverbank
<i>Geum macrophyllum</i> var. <i>macrophyllum</i>	1	2016	SC	one plant
<i>Huperzia selago</i>	1	1996	SC	
<i>Lactuca hirsuta</i>	1	2015	N	a few dozen
<i>Platanthera huronensis</i>	1	2015	N	
<i>Pyrola minor</i>	1	2015	END	unknown
<i>Petasites frigidus</i> var. <i>sagittatus</i>	3	2015	THR	several populations
<i>Rhynchospora fusca</i>	1	2016	SC	hundreds of plants
<i>Ribes oxycanthoides</i>	1	2017	THR	several plants
<i>Taxus canadensis</i>	3	2015	N	several plants
<i>Tephrosia palustris</i>	1	1897	SC	
<i>Vaccinium vitis-idaea</i>	1	2015	END	70–100 plants

and the large percentage of trees that were found at the seedling stage; these seedlings may have been discounted or overlooked by Thomson.

We observed 124 non-native species throughout all the forest communities we surveyed. Of these, *Rhamnus cathartica* poses the greatest threat to the lower reaches of the boreal forest, growing in thickets that replace native understory shrubs and forbs. *Iris pseudacorus* is found from the southern edge of Big Lake to the mouth of the river. There is an active invasive plant management program on Lake Minnesuing, and to a lesser extent on Lake Nebagamon, for controlling these populations, while the Brule River community is just becoming aware of the threat. *Myosotis scorpioides* and *Nasturtium officinale* are naturalized from near the headwaters to the mouth of the river and have likely replaced some native aquatic plant populations (e.g., *Ranunculus aquatilis*, *Callitriche palustris*, and *Callitriche hermaphroditica*). *Bromus inermis*, *Phalaris arundinacea*, and *Centaurea stoebe* are found growing along disturbed road, trails, ditches, parking

areas, and other disturbed areas, but the populations are well managed. Two emerging invasive plant threats to the watershed include the recent appearance of small populations of *Sorbus sorbifolia* and *Valeriana officinalis* that were found embedded in both the boreal forest and the northern wet-mesic forest. Lastly, a private landowner informed us of a large population of *Berberis thunbergii* planted decades earlier within the watershed, but our survey teams did not observe this species, and as a result it is not included on our list in Appendix 1.

Boreal Forest

By the time of the Thomson survey, the boreal forest was greatly diminished due to cutover with early successional species such as *Abies balsamea* and large stands of *Populus* spp. present. Boreal forest occupied approximately 6.9% of the watershed (Fassett 1944). Dominant species were *Betula papyrifera*, *Populus grandidentata*, *Populus tremuloides*, and *Prunus pensylvanica*. Ground cover species of importance were *Eurybia macrophylla*, *Diervilla lonicera* and *Pteridium aquilinum* (Thomson 1945).

The present-day boreal forest covers 3.6% (1,877 ha) of the watershed and is found north of the Copper Range. It is characterized as gradually sloping to the northeast within a gentle terrain, bisected by numerous steep ravines. A contiguous second- and third-growth aspen forest continues to dominate the forest today with some *Abies balsamea* and *Picea glauca* in the understory (Wisconsin Department of Natural Resources 2016b). Other areas have lost timber due to an alteration of the hydrology caused by heavy equipment resulting in swamping that favors thickets of *Alnus incana* and *Salix* spp.

Boreal forest *Ct* values indicate a slight decrease in floristic quality. Thomson did not discover as many non-native plants in these early successional forests (only 5%) as we did in today's boreal forest (14.9%). Thomson classified the boreal forest as "The Aspen Association," since the boreal forest composition was greatly compromised from early logging activities and was dominated by hardwoods in the 1940s (Fassett 1944, Thomson 1945). Family dominance has changed from Rosaceae, Asteraceae, Ranunculaceae, and Salicaceae in the 1940s to Cyperaceae, Asteraceae, Rosaceae, Poaceae, and Ranunculaceae today. The graminoids represent almost 20% of the boreal forest flora today, in contrast to only 7% in the 1940s. Many earlier inventories often overlooked graminoid species and that may explain the changes we observed. Another observation is that insect pollination dependent families (e.g., Rosaceae and Ranunculaceae) have declined, while wind-pollinated families (e.g., Cyperaceae and Poaceae) have substantially increased. These findings are consistent with the trends found during a project that re-surveyed the 1959 baseline data collected by John T. Curtis for selected northern forests in Wisconsin (Rooney et al. 2004).

The best examples of remnant boreal forest stands are along steep ravines near the mouth of the river and extending inland for several miles. The cooler climate and red clay soils dictate which tree species can be sustained in this part of the watershed. In these areas we see the returning prominence of *Pinus strobus*, *Abies balsamea*, and *Picea glauca*, while *Betula papyrifera* has decreased in abundance (Hlina et al. 2018a). In the deep creek ravines along tributaries, dom-

inant trees include *Thuja occidentalis*, *Abies balsamea*, *Picea glauca*, and *Populus tremuloides*. The boreal forest on the Brule River is slowly recovering, and opportunities for restoration are high. In the Biotic Inventory of the Brule River State Forest O'Conner (2016) states:

The Brule River State Forest offers the single best opportunity for clay plain boreal forest restoration on state-owned land on the entire Superior Coastal Plan Ecological Landscape and possibly North America.

Such restoration will ensure the continued biodiversity, complexity, and health of this rare plant community in Wisconsin for future generations.

Northern Wet-Mesic Forest

As noted earlier, Thomson (1945) lumped northern wet forest and northern wet-mesic forest into one plant community type, which he called conifer bog. The dominant species he noted were *Abies balsamea*, *Larix laricina*, *Picea mariana*, *Thuja occidentalis*, and *Sphagnum* spp. He noted two shrubs, *Chamaedaphne calyculata* and *Rhododendron groenlandicum*, as significant components of the understory. The coverage of this forest was 6.8% during his survey (Fassett 1944).

In the present day, northern wet-mesic forest encompasses 967 ha, approximately 2% of the watershed in the headwater region of the Brule River and is dominated by old-growth even-aged stands of *Thuja occidentalis*. From 1942 to 1945, Thomson observed that area residents and farmers were harvesting the cedar in this area for fence posts and other uses, exposing the sphagnum hummocks and pools to wind and sun resulting in severe desiccation and recommended that all cutting cease (Thomson 1945). Thomson recognized the importance of this area and the direct influence it had on sustaining water quality, water flow, and stable temperatures needed to support brown, brook, and rainbow trout populations in the river. This forest is now approaching 200 years of age and exhibits little apparent regeneration in the last 70–80 years. Beals et al. (1960) and others (Alverson et al. 1988; Van Deelen 1999; Rooney et al. 2002; Forester et al. 2008) have documented the impact of deer populations on the ability of *Thuja occidentalis* to regenerate. Due to the lack of regeneration, the *Thuja occidentalis* swamps, which are the largest in the state, are vulnerable to disappearance in the next 50–75 years (Bushman 2006; Scheller and Mladenoff 2005, 2008). Based on our survey data and observations, this forest is most likely to be replaced by *Abies balsamea* and *Acer rubrum* trees with large patches of *Alnus incana* thickets.

Northern wet-mesic forest *Ct* values depict a decrease in floristic quality from 6.9 to 5.8 and in *Cn* values from 7 to 6.1. Non-native species slightly increased temporally, from 3% to 4.3%, but this alone does not explain the discrepancy in floristic quality between the two time periods. As was standard in the 1940s, and as noted earlier, Thomson classified both the northern wet forest (*Picea mariana* and *Larix laricina* dominant) and northern wet-mesic forest (*Thuja occidentalis* dominant) as one community type called conifer bog, though the former has a greater percentage of conservation species. In *Vegetation of Wisconsin*, Curtis

(1959) compares these two-forest community types and finds only a 50% similarity between them, and therefore separated them into northern wet forest and northern wet-mesic forest. This difference perhaps explains the wide differences in C values. Family dominance has also changed from Cyperaceae, Orchidaceae, Caprifoliaceae, Rosaceae, and Ericaceae to Cyperaceae, Asteraceae, Rosaceae, Poaceae, and Ericaceae. Graminoid dominance has increased from 11% to 17%. Surprisingly *Maianthemum canadense*, *Aralia nudicaulis*, and *Acer spicatum*, which are highly prevalent today, were not recorded in the 1940s. It is possible that these species were simply overlooked. Another substantial decline was found in Orchidaceae, dropping from 6.0% to 2.9%. Three orchid species that were present in the 1940s but are absent today are *Calopogon tuberosus*, *Goodyera pubescens*, and *Spiranthes cernua*. *Calypso bulbosa*, a state threatened orchid, is probably near extinction in the Brule River watershed (E. J. Judziewicz, personal communication 2016). Judziewicz studied the same cedar swamps in the mid- to late 1990s and found hundreds of individuals of *Calypso bulbosa* (Epstein et. al. 1999). During the field seasons of 2015 and 2016 only four plants were found, two of which were sterile and two in flower. Moreover, Rooney and Waller (2003) and Rawinski (2008) described the effects of high deer densities on the understory flora of forested ecosystems, which may explain some of this decline, as well as a drop in the C_t values of northern wet-mesic forest.

Pine Barrens

Pine barrens were frequently burned and were mostly treeless at the time of the Brule River surveys of the 1940s; the last big fire occurred in 1936 (Fassett 1944). Thomson (1945) and Fassett (1944) documented a much more intact pine barrens than we find today, noting many characteristics such as shrubby jack pine, scattered red pine savannas, and vast open barrens. They reported the pine barrens covered 25.7% of the total watershed in 1938; today pine barrens cover approximately 1.8% (908 ha). Lost to history is the full extent of the flora of the pine barrens as it existed in 1854. The land that was historically pine barrens is now managed as pine plantation monocultures predominantly by private timber companies, the Brule River State Forest, and Douglas and Bayfield counties. The C -values show little difference between the 1940s and now and may indicate that the pine barrens remain a community in recovery.

Thomson's (1945) description of the *Pinus banksiana* community distinguished between two paths of succession, both essentially leading to a *Pinus banksiana*, *P. resinosa*, *Quercus* spp. community based upon the intensity and intervening time between fires. He noted the dominant woody plants in scattered stands as *Pinus banksiana* and *Quercus ellipsoidalis*. Ground cover species of importance were *Corylus americana*, *Danthonia spicata*, *Comptonia peregrina*, *Pteridium aquilinum*, *Quercus macrocarpa*, *Salix humilis*, and *Vaccinium angustifolium*. (Thomson 1945). Many associate species are prairie species adapted to drier conditions, low soil fertility, and fire.

Pine barrens C_t and C_n values show little change between the two time periods. These values are low relative to other forest types and may indicate an overabundance of species tolerant of anthropogenic disturbances with low C values

in Asteraceae and Poaceae. These species accounted for more than 30% of the flora. Pine barrens of today are embedded in large acreages of pine plantation, resulting in the highest percentage of non-native species (16.4%) of all the communities surveyed. Family dominance has remained the same (Asteraceae, Poaceae, and Rosaceae). *Hieracium aurantiacum* (orange hawkweed) is the only non-native species that ranked high enough to make the prevalent ground layer species list for any community in the Brule River watershed. Another interesting observation is the successful spread of *Carex pensylvanica*, a native sedge that was not recorded by Thomson, though its presence in other adjacent forested communities may explain its presence in the pine barrens.

Due to the smaller open areas and savanna-like conditions, the globally rare pine barrens are home to a wide variety of wind-dispersed non-native plants (e.g., *Agrostis gigantea*, *Centaurea stoebe*, and *Cirsium arvense*). Fire suppression activities have altered the pine barrens landscape by eliminating large patches (950–1500 ac) of open habitat (Radeloff et al. 2000; Grossman and Mladenoff 2007; Scheller and Mladenoff 2008). It is doubtful that the historical shifting mosaic of oak and pine savanna surrounded by large open patches will be achieved without further use of fire and other management tools by land managers. Open barrens in the watershed occur only in small parcels today, and not as the vast terrain of yesteryear, that numerous wildlife species such as sharp-tailed grouse, bobolink, and savannah sparrow require (Radeloff et al. 1999). The best remaining examples of pine barrens in the Brule River watershed are found at Mott's Ravine State Natural Area and in patches between forests of recent harvests. It was at Mott's Ravine that *Lactuca hirsuta* was found, only the second collection of this species for Wisconsin. The 2003 Brule River State Master Plan includes plans to modestly increase the acreage of pine barrens found at Mott's Ravine (Van Horn et al. 2003).

Northern Dry Forest

Northern dry forest prior to extensive landscape disturbance was comprised of large stands of *Pinus resinosa* interspersed within pine barrens. The forest covered approximately 12% of the watershed. It was quickly harvested during the lumbering activities in the late 19th century and converted to jack and red pine plantations by the late 1930s. The five stands we surveyed were either *Pinus resinosa* plantations greater than 100 years old or small pockets of older *P. resinosa* and *P. banksiana* intermixed with scrub oak (*Quercus macrocarpa* and *Q. ellipsoidalis*). In the barrens area of the watershed, these forest plantations are heavily represented and occupy 28.5% (14,614 ha) of the watershed. Thomson treated this forest as a successional stage within the pine barrens complex and hence one-to-one comparison was not possible with our data. This forest, as expected, had one of the lowest diversities of all the communities and a higher level of non-native species compared to the other communities. The understory of the northern dry forest is dominated by *Acer rubrum* and *Abies balsamea* saplings and hazelnut (*Corylus* spp.), with pine regeneration not apparent. The Brule River State Forest has identified three primary sites for northern dry forest needing protection (Wisconsin Department of Natural Resources 2017). These sites

are exceptionally small and subject to catastrophic damage from extreme weather events. Opportunities for management, including the use of fire to increase open conditions for pine seedlings, are suggested in the 2016 Biotic Inventory of the Brule River State Forest (O'Connor 2016).

Northern Dry-Mesic Forest

At time of settlement these valuable northern dry-mesic forests encompassed 7.8% of the watershed and by the 1940's had declined to 1.8% of the area. Today, this forest type has slightly rebounded and occupies approximately 2.6% (1,325 ha) of the watershed, with most old growth northern dry-mesic forest in land trust stewardship. Due to generations of human activity with the creation of trails, roads, homes, outbuildings, and earlier landscape plantings, a suite of non-native species was found. Except for *Berberis thunbergii*, none of these species have compromised the ecological integrity of this old growth forest. *Berberis thunbergii*, which was planted in the area as an ornamental, has increased its spread in recent years into the surrounding forest. Species richness remains high (263 species), but much of the gain compared with Thomson's survey has come from non-native species (12.9% of the current total). *Acer rubrum* and *Abies balsamea* seedlings are dominant in the understory and are poised to become the replacement forest in the absence of *Pinus strobus* and *P. resinosa* regeneration. Though floristic richness remains high, 40% of species in this forest were found only once during the surveys of this forest type and at a relatively low abundance.

Northern Hardwood Swamp

Fassett (1944) and Thomson (1945) defined northern hardwood swamp as a lowland hardwood association, a minor component of the watershed, occupying only 6.7% of the total watershed area. Thomson (1945) noted that the dominant tree species are *Acer rubrum*, *Fraxinus nigra*, and *Ulmus americana*. Associated woody species included: *Abies balsamea*, *Alnus incana*, *Betula papyrifera*, and *Populus balsamifera*. Ground cover species were numerous and many of the species commonly associated with wet habitats, such as *Carex tuckermanii*, *Carex crinita*, *Scutellaria lateriflora*, *Galium trifidum*, and *Micranthes pennsylvanica* were observed. Surprisingly, only 25% of prevalent ground layer species were common to both surveys. The discrepancy might be explained through the diversity of plant associations we observed in the thirteen northern hardwood swamp sites surveyed by our team.

Today, a large area of high-quality northern hardwood swamp exists in the watershed covering 10% (5,420 ha) of the watershed. The present-day northern hardwood swamp community has 307 species, of which 10.7% are non-native, which is in the lower range among the communities surveyed. This community harbored the greatest number of *Carex* species (32), as well as large numbers of shade tolerant specialists. By far the greatest threat to these lowland swamps is the invasion of the emerald ash borer that causes high mortality in all species of *Fraxinus*. Our survey did not find any evidence of the beetles. Likewise, no signs

of the beetle have ever been found in the Brule River State Forest (D. Schulz, personal communication 2017).

Based on our survey results, it is likely that these lowlands, if compromised by the beetle, may be replaced by *Acer rubrum*, *Abies balsamea*, and the shrub *Alnus incana*, as these species are the most well-represented woody species in understory layers. This could have a profound effect on the structure, function, and ecological integrity of this forest.

If *Fraxinus nigra* suffers increased mortality from an emerald ash borer invasion, it is likely that severe hydrological changes will occur in this wetland forest. Slesak et al. (2014) showed that in an infected ash forest, flood conditions lasted six to eight weeks longer, which would have serious consequences to the establishment of other tree species and the groundcover vegetation that grows based on hydrological regimes (saturation, very wet, wet, and moderately wet). In the Brule River region, these new conditions may favor weedy aquatic and wet meadow graminoid species, such as *Phalaris arundinacea*, *Typha* spp., and *Phragmites australis* that are able to easily colonize from adjacent landscapes. Some long-term projects evaluating the success of anticipated replacement species (e.g., *Quercus bicolor*, *Celtis occidentalis*) have been conducted or are underway in similar regional forests (Looney et al. 2015, Rooney et al. 2015). These two species remain south of the tension zone in Wisconsin and still have no presence in the Brule watershed.

Northern Mesic Forest

Fassett's (1944) land cover analysis depicted this forest type as having little importance in the watershed, with less than 1.7% of the land cover. Northern mesic forest stands were predominately located on the north side of Lake Minnesuing and to the east of the Brule River near and on the Copper Range and are known locally as Sugar Camp Hill. Dominant tree species included *Acer rubrum*, *Acer saccharum*, *Betula alleghaniensis*, *Betula papyrifera*, *Ostrya virginiana*, *Pinus strobus*, and *Tilia americana* (Thomson 1945). The associated ground cover species consisted of species associated with maple–basswood forest, such as *Dryopteris carthusiana*, *Actaea pachypoda*, *Botrypus virginianus*, *Sanicula marilandica*, and *Lysimachia ciliata*.

Thomson (1945) noted that the large sugar bush trees (*Acer* spp.) were gone, as was the sugar camp of earlier days. The topsoil was lost, first by logging and then with subsequent fires resulting in erosion. Most of the landscape of the 1940s was covered with a coppice scrubby growth of *Acer* spp., and Thomson predicted it would be many years before this forest recovered (Thomson 1945). Surprisingly, Thomson did not include *Tsuga canadensis* in his description of this forest. However, on May 9, 1944, Thomson did collect a voucher specimen on the bank of a stream crossing the Copper Range (Appendix 1). Later, Davidson et al. (1973) documented a range extension for *Tsuga canadensis* at one of the stands at the westernmost boundary of the watershed near Lake Minnesuing. Today, *Tsuga canadensis* is known to extend further west into St. Louis County in Minnesota and several others.

Today, northern mesic forest, typically dominated by *Acer saccharum*, *Betula*

allegghaniensis, and *Tilia americana*, comprises 1.5% of the watershed, covering 750 ha. As in yesteryear, this mesic forest is located along the Copper Range and on the southwestern side of Lake Minnesuing. Sugar Camp Hill on top of the Copper Range was last logged in 1933 and has slowly been regenerating a maple–basswood forest. Today, these stands have moved to a later successional stage and are slated to be harvested in the next decade. In the Lake Minnesuing area, some mesic forest stands have a component of *Tsuga canadensis*. These are privately and publicly owned, and most are of poor quality. A few are represented by multi-age stands with relatively high species diversity. A patch of *Adiantum pedatum* was found in a deep gully in such a stand and represents only the third known occurrence of this species in the watershed.

Northern Wet Forest

Thomson (1945) lumped this forest community type together with northern wet-mesic forest community type into what he called conifer bog. This is described in more detail above under northern wet-mesic forest.

Today, northern wet forest encompasses 3.8% (1,896 ha) of the watershed and consists of weakly minerotrophic, conifer-dominated, acid peatlands located north and south of the Lake Nebagamon region where the water table is near the surface or where drainage is somewhat impeded. A large forested complex consisting of a mix of *Fraxinus americana*, *Thuja occidentalis*, *Larix laricina*, and *Picea mariana* intergrade into a mosaic in this region, with species individually responding to gradients of pH, water depth, the presence of *Sphagnum* spp., and available nutrients. This forest is uncommon in the watershed, except in the headwaters region and is distinct with a specialized associations of plant species. However, even this forest has increased from zero non-native species to 6.4% between the two studies. An area deserving further protection occurs along the east side of Degerman Road, north of Lake Nebagamon. In this region we observed a northern wet forest dominated by a canopy of *Picea mariana* with ample regeneration of 3.6–4.6 m tall *Thuja occidentalis* and uncommon forbs underneath; this is the only area in the watershed known to have significant *Thuja occidentalis* regeneration.

CONCLUSION

Overall, our study has shown that the Brule River watershed is of exceptional quality, but also an area at high risk. Many challenges exist for sustaining, maintaining, and restoring its natural forest communities. The boreal forest remains susceptible to severe erosion of clay banks as rain events and snow melts intensify under changing climate scenarios. The northern wet-mesic swamps are even-aged and apparently not regenerating naturally. Northern hardwood swamps are likely to decline substantially in the watershed over the next 50 years from emerald ash borer infestations. Old growth northern dry-mesic forest will not likely regenerate in the absence of fires and are a declining presence in the watershed

forests. The pine barrens mosaic remains diminished and the area continues to be dominated by *Pinus resinosa* and *P. banksiana* plantations with only small opportunities to expand.

The purpose of this study was to document the existing flora, make comparisons with earlier surveys, and make qualitative and quantitative data available for future researchers. We highly recommend that a similar survey be made one or two decades after this study to document changes and inform land managers and decision-makers with new information for making the difficult decisions they will face in the future.

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APPENDIX 1. Vascular plant taxa documented for the Brule River Watershed. Nomenclature follows Voss and Reznicek (2012) for species known to occur in Michigan. Nomenclature for other species follows the published volumes of the Flora of North America (Flora of North America Editorial Committee 1993+) and Judziewicz et al. (2014) was used for grasses. The list is organized by major plant groups, then alphabetically by family and species within each major group. Non-native species are indicated by an asterisk (*) in front of the name.

For taxa collected during the current project, the collection number is prefaced by the initial of the last name of the primary collector: A = Anderson; F = Feist; H = Hlina; M = Marcum; P = Philippe; S = Schwarting. Earlier collections are indicated by an italicized collection number and by the full name of the collector with the exception of Thomson, whose collections are denoted with a *T*. Links to the voucher specimens can be found at Consortium of Midwest Herbaria (2020).

The Habitat column indicates the most common communities in which a particular species was observed, using the following abbreviations: BF = Boreal Forest; WC = White Cedar; PB = Pine Barrens; NDF = Northern Dry Forest; NDMF = Northern Dry-Mesic Forest; NHS = Northern Hardwood Swamp; NMF = Northern Mesic Forest; BSS = Black Spruce/Tamarack Forest; AP = Aquatic Plants (Brule River, Lake Minnesuing, Lake Nebagamon); MB = Mud Bank Plants; W-NF = Wetlands - Non-forested; LSS = Lake Superior Shoreline; D = Disturbed Site.

The Status column indicates whether a taxon is on Wisconsin's rare species list (END = Endangered; THR = Threatened; SC = Special Concern), is a new record for the Brule River watershed (indicated by WS), or is a new county record (indicated by CR).

Taxon	Habitat	Status
PTERIDOPHYTES		
ATHYRIACEAE (LADY FERN FAMILY)		
<i>Athyrium filix-femina</i> (L.) Roth (common lady fern); F6037, F6074, F6411, F6489, M6844, M6882, F6489, T5159, T5525	BF, NDMF	
CYSTOPTERIDACEAE (Brittle Fern Family)		
<i>Dryopteris fragilis</i> (L.) Bernh. (brittle bladder fern); M7134, M7135, F5654	BG	WS
<i>Cystopteris tenuis</i> (Michx.) Desv. (MacKay's brittle fern); <i>Sommerville 95</i>	NMF	
<i>Gymnocarpium dryopteris</i> (L.) Newm. (common oak fern); F6008, F6093, M6863, T5503	BF, NMF	
DENNSTAEDTIACEAE (Braeken Fern Family)		
<i>Pteridium aquilinum</i> (L.) Kuhn (braeken fern); F6409, S109, T5088, T5100	PB, NDMF	
DRYOPTERIDACEAE (Wood Fern Family)		
<i>Dryopteris carthusiana</i> (Vill.) H. P. Fuchs (spinulose wood fern); F6002, F6005, F6092, F6360, M6974, M7056, M7138, M6845, M6862, <i>Is.n.</i>	BF, NMF	
<i>Dryopteris cristata</i> (L.) A. Gray (crested shield fern); F6360, M6838, M6860, T5507	WC, NHS	
<i>Dryopteris fragrans</i> (L.) Schott (fragrant fern); F5658	BG	
<i>Dryopteris intermedia</i> (Willd.) A. Gray (evergreen wood fern); F6336, F5624, P43857	BF, NDM	

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
EQUISETACEAE (Horsetail Family)		
<i>Equisetum arvense</i> L. (common horsetail); H3568	BF, NMF	
<i>Equisetum fluviatile</i> L. (river horsetail); F6579, H3635, H3789, M7295	BSS, AP	
<i>Equisetum hyemale</i> L. (scouring rush); H3985, H3565	NHS, NMF	
<i>Equisetum laevigatum</i> A. Braun (smooth horsetail); H3706	NMF	WS
<i>Equisetum scirpoides</i> Michx. (dwarf scouring rush); F5618, F5644, F6139, M6721	WC	
<i>Equisetum sylvaticum</i> L. (woodland horsetail); F5634, M6720, P43787	BF, NMF	
<i>Equisetum</i> × <i>ferrissii</i> Clute (woodland horsetail); T5549	NDF	
ISOETACEAE (Quillwort Family)		
<i>Isoetes echinospora</i> Durieu (spiny spored quillwort); S233	AP	
LYCOPODIACEAE (Club-Moss Family)		
<i>Dendrolycopodium dendroideum</i> (Michx.) A. Haines (tree club moss); A2630, F6101, F6331, M6649, P43848, P44191	BF, NDMF	WS
<i>Dendrolycopodium hickeyi</i> (W.H. Wagner, Beitel & R.C. Moran) A. Haines (Hickey's tree club moss); H3874, H3979, M6849	WC, NDMF	
<i>Dendrolycopodium obscurum</i> (L.) A. Haines (ground pine); <i>Conklin 404</i> , <i>Salomaki 9736</i>	WC	WS
<i>Diphasiastrum complanatum</i> (L.) Holub (northern ground-cedar); M6766	NDF, NDMF	
<i>Diphasiastrum digitatum</i> (Dill. ex A. Braun) Holub (trailing ground-pine); A2628, H3513, M7248, S113, S287	NDMF	
<i>Diphasiastrum tristachyum</i> (Dill.) Holub (northern ground-pine); M7211	PB	
<i>Huperzia lucidula</i> (Michx.) R. Trevis. (shining club moss); H3656, F5610, <i>Is.n.</i>	WC, NHS	
<i>Huperzia selago</i> (L.) Bernhardt (fir club moss); <i>Clark 1065</i>	WC	
<i>Lycopodiella inundata</i> (L.) Holub (bog club moss); T5360	W-NF	
<i>Lycopodium clavatum</i> L. (running ground pine); F6332, H3518, M6650, M7212, P43866	NDF, NDMF	
<i>Spinulum annotinum</i> (L.) A. Haines (stiff clubmoss); F5615, F6100, F6328, M6651, M7114, M6866, P44105, T5341, T5495	WC, NDMF	
ONOCLEACEAE (Sensitive Fern Family)		
<i>Matteuccia struthiopteris</i> (L.) Todaro (ostrich fern); P43774, F6513, F6570, <i>Is.n.</i>	NHS, NMF	
<i>Onoclea sensibilis</i> L. (sensitive fern); F6118, F6375, F6496, M6969, P43775, P44156, <i>Is.n.</i>	BF, NHS	
OPHIOGLOSSACEAE (Adder's-Tongue Family)		
<i>Botrychium lanceolatum</i> (S.G. Gmel.) Angstr. (lace-leaved moonwort); T5577	NMF	
<i>Botrypus virginianus</i> (L.) Michx. (rattlesnake fern); S127, T5391, T5559	WC	
<i>Sceptridium multifidum</i> (S. G. Gmel.) M. Nishida (leathery grape fern); T5400	PB	

OSMUNDACEAE (Royal Fern Family)			
<i>Osmunda claytoniana</i> L. (interrupted fern); S120			BF, NMF
<i>Osmunda regalis</i> L. (royal fern); S191			WC, NHS
<i>Osmundastrum cinnamomeum</i> (L.) C. Presl (cinnamon fern); F6319, S110			WC, BSS
POLYPODIACEAE (Polypody Fern Family)			
<i>Polypodium virginianum</i> L. (common polypody fern); F5645.1, M7119, T5311			BG
PTERIDACEAE (Maidenhair Fern Family)			
<i>Adiantum pedatum</i> L. (maidenhair fern); S142			NMF
SELAGINELLACEAE (Spikemoss Family)			
<i>Selaginella rupestris</i> (L.) Spring (rock spikemoss); F5651, T5142, T5200			PB
THELYPTERIDACEAE (Marsh Fern Family)			
<i>Phegopteris connectilis</i> (L.) Slosson (northern beech fern); F6011, F6073 H3607, M6874, T5504			BF, NMF
<i>Thelypteris palustris</i> Schott (marsh fern); S186, T5528			WC, NHS
WOODSIACEAE (Woodisia Family)			
<i>Woodisia ilvensis</i> (L.) R. Br. (rusty cliff fern); F5646, F5650.1, T5335			BG
GYMNOSPERMS			
CUPRESSACEAE (Cypress Family)			
<i>Thuja occidentalis</i> L. (white cedar); M7288, P44145, T5.n.			WC, BF
PINACEAE (Pine Family)			
<i>Abies balsamea</i> (L.) Mill. (balsam fir); S34, S45, H4288, T499, T5500			BF, WC, NDFM
<i>Larix laricina</i> (Du Roi) K. Koch (tamarack); M7030, M7163, M7306, F6428, F6376, P44097, T s.n.			BSS, WC
* <i>Picea abies</i> (L.) H. Karst (Norway spruce); S86			BF
<i>Picea glauca</i> (Moench) Voss (white spruce); S38, S46			BF, NDMF
<i>Picea mariana</i> (Mill.) Britton, Sterns & Poggenb. (black spruce); F6404, M7262, M7309, T5497			BSS, WC
<i>Pinus banksiana</i> Lamb. (jack pine); M6691, M6810, P44006, T5223, T5698			PB, NDMF
<i>Pinus resinosa</i> Aiton (red pine); F5652			PB, NDMF
<i>Pinus strobus</i> L. (white pine); P43779			NDFM, WC
* <i>Pinus sylvestris</i> L. (Scotch pine); S289			BF
<i>Tsuga canadensis</i> (L.) Carrière (eastern hemlock); F6098, S119, T5501			NMF

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Taxon	Habitat	Status
APPENDIX 1. (Continued)		
TAXACEAE (Yew Family)		
<i>Taxus canadensis</i> Marshall (American yew); H3418, P43784, <i>Ts.n.</i>	BF, WC	
DICOTS		
ADOXACEAE (Moschatel Family)		
<i>Sambucus canadensis</i> L. (American elderberry); H2397		
<i>Sambucus racemosa</i> L. (red-berried elder); F5625, F6060, S69	WC, BSS	WS
<i>Viburnum lentago</i> L. (nanny berry); F6571, H3951, P43884, S133, <i>T5518</i>	BF, NMF	
<i>Viburnum rafinesquianum</i> Schult. (arrow-wood); P43783, P44212, F6348, F6600	BF, WC	
<i>Viburnum trilobum</i> Marshall (American high-bush cranberry); H3954, P44153, F6595, <i>T5477</i>	BF, NHS	WS
	BF, WC	
AMARANTHACEAE (Amaranth Family)		
<i>Chenopodium album</i> L. (lamb's quarters); S278	PB	
<i>Chenopodium simplex</i> (Torr.) Raf. (maple leaf goosefoot); F6125	BF	WS
* <i>Froelichia gracilis</i> (Hook.) Moq. (cottonweed); <i>Judziewicz 12125, Sumlan 737</i>	PB	
ANACARDIACEAE (Cashew Family)		
<i>Rhus typhina</i> L. (staghorn sumac); H4108, <i>T5257</i>	BF, NDF	
<i>Rhus x pulvinata</i> Greene (hybrid sumac); <i>T5500</i>	NMF	
<i>Toxicodendron rydbergii</i> (Rydb.) Greene (western poison-ivy); S129	NDF, NDMF	WS
APIACEAE (Parsley Family)		
<i>Angelica atropurpurea</i> L. (purple-stemmed angelica); S265	W-NF	
<i>Cicuta bulbifera</i> L. (bulblet water hemlock); H3910, M7242, M7281, F6523, <i>T5091</i>	W-NF, NHS	
<i>Cicuta maculata</i> L. (water hemlock); F6089, M6864, P44146	BF, NHS	
<i>Heracleum maximum</i> Bartram (cow parsnip); H4072, M6730, <i>T5540</i>	W-NF	
<i>Osmorhiza claytonii</i> (Michx.) C. B. Clarke (hairy sweet cicely); F6335, S128, <i>T5538</i>	NMF	
* <i>Pastinaca sativa</i> L. (wild parsnip); <i>T5255</i>	D	
<i>Sanicula marilandica</i> L. (black snakeroot); F6079, M6765, M6808, M7003, <i>T5482</i>	BF, NMF	
<i>Sanicula odorata</i> (Raf.) Pryer & Philippe (clustered black snakeroot); <i>Christensen s.n.</i>	BF	
<i>Sium suave</i> Walter (water parsnip); H3624, P44070, <i>T5320</i>	W-NF, NHS	
<i>Zizia aurea</i> (L.) W. D. J. Koch (common golden alexanders); P43867	BF	WS

APOCYNACEAE (Dogbane & Milkweed Family)			
<i>Apocynum androsaemifolium</i> L. (spreading dogbane); H4046, S205			WS
<i>Apocynum cannabinum</i> L. var. <i>hypericifolium</i> A. Gray (clasping dogbane); S181			WS
<i>Asclepias exaltata</i> L. (poke milkweed); H3511, H3616, M7216			THR, WS
<i>Asclepias incarnata</i> L. (swamp milkweed); M7247, T5290, T5547			
<i>Asclepias ovalifolia</i> Decne (dwarf milkweed); H3386, H3387			
<i>Asclepias syriaca</i> L. (common milkweed); H4044, S254			
AQUIFOLIACEAE (Holly Family)			
<i>Ilex mucronata</i> (L.) M. Powell, V. Savolainen & S. Andrews (mountain holly); A2441, F6432, F6458, M6662, M6827, M7162, P44133, T5482		WC, BSS	
<i>Ilex verticillata</i> (L.) A. Gray (winterberry); F6061, F6146, F6432, M6823, M7181, M7289, P43868, P44160, P44185, P44208, T5099		BE, NMF, NHS	
ARALIACEAE (Ginseng Family)			
<i>Aralia hispida</i> Vent. (bristly sarsaparilla); T5256		NMF	
<i>Aralia nudicaulis</i> L. (wild sarsaparilla); F6308, F6407, P43746, T5479		BF, NDMF, NMF	
<i>Aralia racemosa</i> L. (American spikenard); F6407, M7126, P43860, T5099, T5545		BF, NDMF, NMF	
<i>Hydrocotyle americana</i> L. (marsh pennywort); H3556, M6842		WC	
<i>Panax trifolius</i> L. (dwarf ginseng); H3566, H3816, S194, T5418		NMF	WS
ARISTOLOCHACEAE (Birthwort Family)			
<i>Asarum canadense</i> L. (Canadian wild-ginger); F5631, H3562, H3857, S103		WC, NDMF	
ASTERACEAE (Sunflower Family)			
<i>Achillea millefolium</i> L. (common yarrow); H3487, S170		PB, NDF	
* <i>Achillea ptarmica</i> L. (sneezewort); H4061		D	
<i>Ambrosia artemisiifolia</i> L. (ragweed); H4061		PB, NCF	WS
<i>Ambrosia psilostachya</i> DC. (western ragweed); T s.n.		NDMF	
<i>Anaphalis howellii</i> Greene (pearly everlasting); H3962, M7231		PB, NDF	
<i>Antennaria margaritacea</i> (L.) Benth. (pearly everlasting); H3962, M7231		PB, NDF	
<i>Antennaria neglecta</i> Greene (cat's foot); H3582, S95		BF	
<i>Antennaria parlinii</i> Fernald (smooth pussy's toes); M6693, P43760, P44022, T5205, T5374		PB, NDMF	
* <i>Arctium minus</i> Bernh. (common burdock); S270		BF	WS
* <i>Artemisia pontica</i> L. (Roman wormwood); T5270		PB	
* <i>Artemisia vulgaris</i> L. (mugwort); T5116		NDMF	

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
<i>Bidens beckii</i> Spreng. (water beggar-ticks); F6515, T5367	AP	
<i>Bidens cernua</i> L. (nodding beggar's tick); F6553, M7278, T5359	W-NF	
<i>Bidens connata</i> Willd. (purple-stemmed tickseed); H3791	W-NF, NHS	CR
<i>Bidens discolor</i> (Torr. & A. Gray) Britton (swamp beggar's tick); H3938	W-C, NHS	
<i>Bidens frondosa</i> L. (common beggar's tick); F6138, F6555, M6848, M7240, P44139, T5.n.	W-NF, NHS	
<i>Bidens tripartita</i> L. (straw-stem beggar-ticks); H3534	W-NF	
<i>Bidens vulgata</i> Greene (tall beggar-ticks); H3484	W-NF, NHS	WS
* <i>Centaurea jacea</i> L. (brown knapweed); T5076	PB, NDF	
* <i>Centaurea stoebe</i> L. (spotted knapweed); H4088, T5190	PB, NDF	
* <i>Cirsium arvense</i> (L.) Scop. (Canada thistle); H3834, M7228	NDF, BF	
<i>Cirsium discolor</i> (Willd.) Spreng. (field thistle); Mitchell 87	PB	
<i>Cirsium muticum</i> Michx. (swamp thistle); F6494, H3585, H3690, T5.n.	NHS, BF	
* <i>Cirsium vulgare</i> (Savi) Ten. (bull thistle); S264	PB, NDMF	
<i>Conyza canadensis</i> (L.) Cronq. (horseweed); M6778, P43898, T5544	PB	
* <i>Crepis tectorum</i> L. (hawk's beard); T5268	PB	
<i>Doellingeria umbellata</i> (Mill.) Nees (flat-topped aster); F6080, M6832, M6885, P43869, P44136, P44178, T5139, T5566	BF, NMF	
<i>Erechtites hieracifolius</i> (L.) DC. (burnweed); H3987	PB	
<i>Erigeron annuus</i> (L.) Pers. (annual fleabane); S193, S207	BF	WS
<i>Erigeron glabellus</i> Nutt. (streamside fleabane); S283, T5548	PB	
<i>Erigeron strigosus</i> Willd. (daisy fleabane); M6746, M6790, T5182, T5387	PB, NDMF	
<i>Eupatorium perfoliatum</i> L. (boneset); P44213, S274	W-NDF	
<i>Eurybia macrophylla</i> (L.) Cass. (big-leaved aster); F6072, P44167, T5517	BF, NDF	
<i>Euthamia graminifolia</i> (L.) Nutt. (grass-leaved goldenrod); H3725, P43906, T5.n.	PB, NDMF	
<i>Eutrochium maculatum</i> (L.) E. E. Lamont (spotted Joe-pye-weed); M6858, P44158, T5298	W-NF	
* <i>Gnaphalium uliginosum</i> L. (cud weed); H3963, T5195	NDMF	
* <i>Grindelia squarrosa</i> (Pursh) Dunal (gunweed); T5434	NMF	
<i>Helianthus giganteus</i> L. (giant sunflower); P43881, M7263, F6598, T5449	BF, NDMF	
<i>Helianthus hirsutus</i> Raf. (hairy sunflower); H3486	BF	CR
<i>Helianthus occidentalis</i> Riddell (western sunflower); M6745, M6785, T5130	PB	
<i>Helianthus strumosus</i> L. (pale-leaved sunflower); H3738, M6792	PB	
* <i>Hieracium aurantiacum</i> L. (devil's paintbrush); F6361, M6788, M6999, P43897	PB, NDF, NDMF	WS
* <i>Hieracium caespitosum</i> Dumort. (yellow hawkweed); M6743, M7000, P44004	PB, NDF	

* <i>Hieracium lachenalii</i> Suter (common hawkweed); F6029, F6097, P43865	BF, NDMR	CR
* <i>Hieracium piloselloides</i> Vill. (glaucous king-devil); H4095, S135	NHS, NMF	WS
<i>Hieracium scabrum</i> Michx. (rough hawkweed); P43891, P43907, M7111, S29, T5483	BF, PB	
<i>Hieracium umbellatum</i> L. (Canada hawkweed); F6076, M6793	PB, NMF	WS
<i>Krigia biflora</i> (Walter) S. F. Blake (false-dandelion); H3842, P44013	PB	CR
<i>Lactuca biennis</i> (Moench) Fernald (tall blue lettuce); S177	PB, NHS	WS
<i>Lactuca canadensis</i> L. (Canada lettuce); P43854, T5186, T5187	PB, NMF	
<i>Lactuca hirsuta</i> Nutt. (hairy tall lettuce); M6749	PB	WS
* <i>Leucanthemum vulgare</i> Lam. (ox-eye daisy); S134, T5543	PB, NDF	
<i>Liatis aspera</i> Michx. (rough blazing star); M6781, M7226, P43904	PB	
<i>Liatis ligulistylis</i> (A. Nelson) K. Schum. (meadow blazing star); T5071	PB	
* <i>Matricaria discoidea</i> DC (pineapple weed); S2111	D	
<i>Packera aurea</i> (L.) Á. Löve & D. Löve (golden ragwort); M6970, M6977, M7043, T5559	NDF, NHS	
<i>Packera paupercula</i> (Michx.) Á. Löve & D. Löve (northern ragwort); F6353, P44018, P44050, S173, T5332, T5515	PB, NHS	
<i>Petasites frigidus</i> (L.) Fries (sweet colt's-foot); H3555	BF, NDMF	
<i>Petasites sagittatus</i> (Pursh) A. Gray (arrowhead sweet colt's foot); Photo	BF	THR
<i>Prenanthes alba</i> L. (white lettuce); F6086, P44169, S21, T5441	BF, NMF	
<i>Pseudognaphalium obtusifolium</i> (L.) Hilliard & B. L. Burt (cat's-foot; fragrant cudweed); F6087, M6794, P43919	PB, NDMF	CR
<i>Rudbeckia hirta</i> L. (black-eyed Susan); H4063, T5388	NDF	
<i>Rudbeckia laciniata</i> L. (cut-leaved coneflower); T5523, T5524	BF	
<i>Solidago canadensis</i> L. (Canada goldenrod); S280, T5516	BF, NMF	
<i>Solidago flexicaulis</i> L. (zig-zag goldenrod); F6123	BF, NMF	
<i>Solidago gigantea</i> Aiton (giant goldenrod); F6077, F6112, F6568, M7227, P43871, P44144, P44175, T53379	BF, NMF	
<i>Solidago hispida</i> Willd. (hairy goldenrod); P43910, T5125	BF, NMF	
<i>Solidago juncea</i> Aiton (early goldenrod); H3388, P43895, T5122	PB	
<i>Solidago nemoralis</i> Aiton (gray goldenrod); H3527, M6776, M7223, P43894, T5121, T5123	PB	
<i>Solidago ptarmicoides</i> (Torr. & A. Gray) B. Boivin (upland white goldenrod); H4094, T5133, T5380	PB	
<i>Solidago speciosa</i> Nutt. (showy goldenrod); M6796, M7224	PB	
<i>Solidago uliginosa</i> Nutt. (bog goldenrod); M6877, P44149, T5120, T5340	WC, NHS, BSS	
* <i>Sonchus arvensis</i> L. (field sow-thistle); F6126, F6584	BF	
* <i>Sonchus oleraceus</i> L. (common sow-thistle); H4117	D	WS
<i>Symphoricarum boreale</i> (Torr. & A. Gray) Á. Löve & D. Löve (northern bog aster); T5124, T5140	WC	

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
<i>Symphoricarichum ciliolatum</i> (Lindl.) A. Löve & D. Löve (northern heart-leaved aster); M7221, M7225, P43863, T5136	BF, PB, NDF	
<i>Symphoricarichum laeve</i> (L.) A. Löve & D. Löve (smooth aster); M6740, P43912, T5185, T5132	PB	
<i>Symphoricarichum lanceolatum</i> (Willd.) G. L. Nesom var. <i>lanceolatum</i> (panicled aster); F6111, F6585, M6789, S25, T5138, T53568	W-NF, NHS	
<i>Symphoricarichum lateriflorum</i> (L.) Á. Löve & D. Löve (calico aster); F6075, P43870, P44150, P44182, S22	BF, NMF	WS
<i>Symphoricarichum ontarionis</i> G. L. Nesom (Ontario aster); H4020	BF	
<i>Symphoricarichum oolentangiense</i> (Riddell) G. L. Nesom (sky blue aster); M6777, P43889, T53567	PB	
<i>Symphoricarichum pilosum</i> (Willd.) G. L. Nesom (frost aster); T5135	PB	
<i>Symphoricarichum puncticeum</i> (L.) Á. Löve & D. Löve (swamp aster); M6822, M6868, M7239, P44138, T5485, T5565	NHS, W-NF	
<i>Symphoricarichum urophyllum</i> (DC.) G. L. Nesom (arrow-leaved aster); H4170, H4615	PB	CR
* <i>Tanacetum vulgare</i> L. (common tansy); F6583, H4106	BF, NDF	WS
* <i>Taraxacum officinale</i> F. H. Wigg (common dandelion); F5636	BF, NMF	WS
<i>Tephroservis palustris</i> (L.) Rehb. (marsh groundsel); <i>Cheney 7419</i>	W-NF	
* <i>Tragopogon dubius</i> Scop. (lesser goat's beard); P44018, P44050, P44016, S277, T5252	PB	WS
BALSAMINACEAE (Touch-Me-Not Family)		
<i>Impatiens capensis</i> Meerb. (orange jewel-weed); F6506, F6574, M7315, <i>Ts.n.</i>	NHS, WC	
BERBERIDACEAE (Barberry Family)		
<i>Caulophyllum thalictroides</i> (L.) Michx. (blue cohosh); S72, T5568	BF	
BETULACEAE (Birch Family)		
<i>Alnus incana</i> (L.) Moench (speckled alder); F5642, F6071, F6511, F6533, M6836, M7253, P44098, P44211, T5052	BF, NHS, W-NF	
<i>Alnus viridis</i> (Chaix) DC. (green alder); <i>Ts.n.</i>	NDMF	
<i>Betula alleghaniensis</i> Britton (yellow birch); H3973, S122, T5492, T5540	NMF	
<i>Betula papyrifera</i> Marshall (paper birch); M6677	BF, NDF	
<i>Betula pumila</i> L. (bog birch); F6378, S87	BSS	
<i>Carpinus caroliniana</i> Walter (American hornbeam); H3439	NFM, NDMF	
<i>Corylus americana</i> Walter (American hazelnut); P43918, M7144, M7213, P44009, P44038, F6354, P44186, T5382, T5545	PB, NDMF	
<i>Corylus cornuta</i> Marshall (beaked hazelnut); F6410, F6342, M7172, P44187, <i>Ts.n.</i>	BF, NMF	
<i>Ostrya virginiana</i> (Mill.) K. Koch (ironwood); M7011, M7140, P44189, T5537	BF, NMF	

BORAGINACEAE (Borage Family)			
<i>Cynoglossum boreale</i> Fernald (northern wild comfrey); F6049, H4050			
<i>Lithospermum canescens</i> (Michx.) Lehm. (hoary puccoon); M6687, M6798, P44039, S96, T5227, T5371, T5383		BF, NDMF	
<i>Lithospermum carolinense</i> (J. F. Gmel.) MacMill. (hairy puccoon); T3377		PB, NDF	
<i>Lithospermum officinale</i> L. (gromwell); <i>Epstein s.n.</i>		PB	
* <i>Myosotis arvensis</i> (L.) Hill (field forget-me-not); P43762		BF	CR
* <i>Myosotis scorpioides</i> L. (forget-me-not); F6142, M6965, M7264, <i>Is. n.</i>		BF, AP, WC	
* <i>Myosotis sylvatica</i> Hoffm. (garden forget-me-not); H3817		BF, NMF	WS
BRASSICACEAE (Mustard Family)			
<i>Arabidopsis lyrata</i> (L.) O'Kane & Al-Shehbaz (sand cress); H3493, T5560		PB	WS
* <i>Barbarea vulgaris</i> W. T. Aiton (yellow rocket); S58, S101		BF, NHS	
* <i>Berteroa incana</i> (L.) DC. (hoary alyssum); S286, T5563		NDMF	
<i>Cardamine concatenata</i> (Michx.) O.Schwarz (toothwort); H3895, S73		BF	WS
<i>Cardamine pennsylvanica</i> Willd (Pensylvania bitter-cress); H3869, M6964		BF, NHS	WS
<i>Cardamine pratensis</i> L. var. <i>palustris</i> Wimm. & Grab (cuckoo flower); H3896		BF	CR
* <i>Erysimum cheiranthoides</i> L. (wormseed mustard); <i>Gerst s.n.</i>		D	
* <i>Lepidium densiflorum</i> Schrad. (small pepper grass); H3380, S281, T5201		D	
* <i>Nasturtium officinale</i> W. T. Aiton (water cress); H3658, M7271, T5272		D	AP, NHS, WC
<i>Rorippa palustris</i> (L.) Besser (yellow cress); T5179		D	
* <i>Sisymbrium altissimum</i> L. (tumble mustard); <i>Gerst s.n.</i>		D	
* <i>Thlaspi arvense</i> L. (penny-cress); <i>Gerst s.n.</i>		D	
<i>Turritis glabra</i> L. (tower mustard); H3376, H3672, M6820, S210		PB	
CABOMBACEAE (Water-shield Family)			
<i>Brasenia schreberi</i> J.F. Gmel. (water-shield); H3642		AP	WS
CAMPANULACEAE (Bell Flower Family)			
<i>Campanula aparinoides</i> Pursh (marsh bellflower); F6554, T5085		NHS, W-NF	
* <i>Campanula rapunculoides</i> L. (creeping bellflower); H3704, S275		NDF, NDMF	WS
<i>Campanula rotundifolia</i> L. (harebell); M6738, M7155, P44055, T5384		PB, NDF, NDMF	
<i>Lobelia inflata</i> L. (Indian tobacco); H3856, M7161		PB, NDF, NDMF	
<i>Lobelia spicata</i> Lam. (spiked lobelia); S290		D	WS
CANNABACEAE (Hemp Family)			
<i>Humulus lupulus</i> L. (common hops); H3861, F6578, T5355		BF	

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
CAPRIFOLIACEAE (Honeysuckle Family)		
<i>Lonicera canadensis</i> Marshall (American fly honeysuckle); F5616, P43759, P43773, M6663, M6963, F6309, M7053, T5390	BF, WC	
<i>Lonicera dioica</i> L. (mountain honeysuckle); H3825	NDF, NDMF	WS
<i>Lonicera hirsuta</i> Eaton (hairy honeysuckle); H3368, F6144, F6359, M6888	PB, NDF, NDMF	WS
* <i>Lonicera morrowii</i> A. Gray (Asian fly honeysuckle); H3968	BF, NHS	
<i>Lonicera oblongifolia</i> (Goldie) Hook. (swamp fly honeysuckle); S214, T5239	BF, WC, NDMF	WS
* <i>Lonicera tatarica</i> L. (Tartarian honeysuckle); F6059	BF, NHS	
<i>Lonicera villosa</i> (Michx.) Schultes (mountain fly honeysuckle); F6025, M6668, S31, S60, T5237	BF, NHS	WS
* <i>Lonicera</i> × <i>bella</i> Zabel (hybrid honeysuckle); S132	BF, NMF	
<i>Symphoricarpos albus</i> (L.) S. F. Blake (snowberry); H3865, M6819, M7217, T5181	PB, NDF, NDMF	
<i>Symphoricarpos occidentalis</i> Hook. (wolfberry); T5480	NDMF	CR
<i>Triosteum aurantiacum</i> E. P. Bicknell (early horse-gentian); H3521, P43873	BF	
CARYOPHYLLACEAE (Pink Family)		
* <i>Arenaria serpyllifolia</i> L. (thyme-leaved sandwort); S97	BF	CR
* <i>Cerastium fontanum</i> Baumg. (mouse-ear chickweed); H3897, S112, T5198, T5324	NDF, NDMF	
* <i>Dianthus barbatus</i> L. (sweet-William); H3666, H3667	NMF	CR
* <i>Gypsophila muralis</i> L. (cushion baby's breath); M6855	D	CR
<i>Moehringia lateriflora</i> (L.) Fenzl (wood sandwort); P43772	BF	CR
* <i>Sceleranthus annuus</i> L. (knawel); H3908, M6756, S76, T5094	PB, NDF	
<i>Silene antirrhina</i> L. (sleepy catchfly); M6758	PB	WS
* <i>Silene dichotoma</i> Ehrh. (forked catchfly); <i>Fassett 9226</i>	PB	
* <i>Silene latifolia</i> Poir. (white campion); S160, T5258	PB, NDF, NDMF	
* <i>Silene vulgaris</i> (Moench) Garcke (bladder campion); H3728, S201, T5392	PB, NDMF	
* <i>Spargularia rubra</i> (L.) J.Presl & C.Presl (red sand spurry); P44057, S152	NDF	CR
<i>Stellaria borealis</i> Bigelow (northern stitchwort); <i>Davis s.n., Koch 5800</i>	WC	
* <i>Stellaria graminea</i> L. (starwort); <i>Gerst s.n.</i>	D	
<i>Stellaria longifolia</i> Willd. (long-leaved chickweed); M6709, M7034, M6980, M7062, S176, T5260	WC, NHS	
CELASTRACEAE (Bittersweet Family)		
<i>Celastrus scandens</i> L. (American bittersweet); F6596, T5354	BF	

CERATOPHYLLACEAE (Hornwort Family)			
<i>Ceratophyllum demersum</i> L. (coon's tail); F6559, H3761, H3577, T5192, T5272	AP		
CISTACEAE (Rock-Rose Family)			
<i>Crocanthemum bicknellii</i> (Fernald) Janch. (Bicknell's rock-rose); H3934, M6732	PB		WS
<i>Crocanthemum canadense</i> (L.) Britton (common frostweed); P43902, P43902, T5393	PB		
<i>Lechea intermedia</i> Britton (intermediate pinweed); M6803, M6816, M7156, P43921	PB, NDF		WS
CONVOLVULACEAE (Morning Glory Family)			
<i>Calystegia spithamea</i> (L.) Pursh (low bindweed); M6751, P44011, S144, T5333, T5514	PB, NDF, NDNF		
CORNACEAE (Dogwood Family)			
<i>Cornus alternifolia</i> L. f. (pagoda dogwood); P44188, T5522	BF, WC, NMF		
<i>Cornus canadensis</i> L. (bunchberry); F6137, F6314, F6434, M6869, M7005, M7027, M7174, P43761, P44194,	BF, WC, NMF		
T5138			
<i>Cornus foemina</i> Mill. subsp. <i>racemosa</i> (Lam.) J. S. Wilson (gray dogwood); H4045, S208, T5253	BF, NDF		
<i>Cornus rugosa</i> Lam. (round-leaved dogwood); F6078, F6510, F6593, H3975, H3709, T5404	BF, NDMF		
<i>Cornus sericea</i> L. (red-osier dogwood); F6048, F6116, F6484, F6566, M6989, M7287, T5081, T5563	BF, NHS, BSS		
CUCURBITACEAE (Gourd Family)			
<i>Echinocystis lobata</i> (Michx.) Torr. & A. Gray (wild cucumber); H4053	BF, NHS		
DIERVILLACEAE (Bush-honeysuckle Family)			
<i>Diervilla lonicera</i> Mill. (bush honeysuckle); F6134, F6143, F6345, M7121, P43908, T5403	PB, NDF		
DROSERACEAE (Sundew Family)			
<i>Drosera intermedia</i> Hayne (spoon-leaved sundew); M7193, P44069, P44126	W-NF		CR
<i>Drosera rotundifolia</i> L. (round-leaved sundew); F6403, M6901, F6460, T5314, T5551	WC, BSS, W-NF		
ELAEAGNACEAE (Oleaster Family)			
<i>Shepherdia canadensis</i> (L.) Nutt. (soapberry); F6044, H3373, H3554, T5.n.	BF		
ERICACEAE (Heath Family)			
<i>Andromeda glaucophylla</i> Link (bog rosemary); A2609, F6437, F6442, P44094, P44122, T5550	BSS, W-NF		
<i>Arctostaphylos uva-ursi</i> (L.) Spreng. (bearberry); P44026, T5097	PB, NDF		
<i>Chamaedaphne calyculata</i> (L.) Moench (leatherleaf); F6374, F6433, F6449, M7022, M7182, M7251, P44080,	WC		
P44114			

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
<i>Chinaphila umbellata</i> (L.) W. P. C. Barton (pipsissewa); M6764, M7150, M7189, P44045, P44190	BF, NDF, NDMF	
<i>Epigaea repens</i> L. (trailing arbutus); H3510, P44041, S59, T5106, T5306	PB, NDF	
<i>Gaultheria hispida</i> (L.) Bigelow (creeping snowberry); F5633, F6013, F6422, M7025	WC, BSS	
<i>Gaultheria procumbens</i> L. (wintergreen); F6102, M6679, M7024, M7151, M7169, P44028, P44192	BF, WC, PB	
<i>Hypoxis montropa</i> Crantz. (pinesap); A2612, M7152	WC, NMF	
<i>Kalmia polifolia</i> Wangerh. (bog-laurel); M7021, M7185, M7255, F6377, P44090, P44121, T5313, T5549	WC, BSS, W-NF	
<i>Moneses uniflora</i> (L.) A. Gray (one-flowered pyrola); F5609, F6006, F6018, F6321, H3829, P43864, T5104, T5241	BF, WC, NDF	
<i>Monotropa uniflora</i> L. (Indian-pipe); F6007, F6416, M7130, P44172, P44193	WC, NDF, BSS	
<i>Orthilia secunda</i> (L.) House (one-sided pyrola); F5617, F6004, M6667, M6766, M6763, M6829.1, M6870, P44168, H3830, T5389	WC, NDMF	
<i>Pyrola americana</i> Sweet (American wintergreen); H3525, M6762, M7145, M7148, P43874, P44171	BF, NDMF	CR
<i>Pyrola asarifolia</i> Michx. (pink shinleaf); F6131, H3801, H3845, T5511, T5561	BF, NMF	
<i>Pyrola chlorantha</i> Sw. (green shinleaf); S32, S78, T5245	BF, WC	
<i>Pyrola elliptica</i> Nutt. (large-leaved shinleaf); F6032, F6090, F6127, M6834, M7128, P44042, P44164	BF, NDMF	
<i>Pyrola minor</i> L. (snowline wintergreen); M6829.2	WC	END, WS
<i>Rhododendron groenlandicum</i> (Oeder) Kron & Judd (labrador tea); F6390, M6894, M7017, M7165, F6367, M7256, F6429, P44071	BSS, NHS	
<i>Vaccinium angustifolium</i> Aiton (early low blueberry); F6402, F6421, M6660, M6680, M7020, P43767, P44002, P44127, T5183, T5184, T5336	BF, WC, NDMF	
<i>Vaccinium macrocarpon</i> Aiton (large cranberry); F6438, F6472, P44118, P44130	WC	WS
<i>Vaccinium myrtilloides</i> Michx. (velvet-leaf blueberry); F6431, M6661, M7019, P43788, P44008	BSS, WC	WS
<i>Vaccinium oxycoccos</i> L. (small cranberry); F6396, F6438, F6472, M7026, M7178, M7254, P44065, T5552	WC, BSS	
<i>Vaccinium vitis-idaea</i> L. (lingonberry); Photo	WC	END
EUPHORBIACEAE (Spurge Family)		
<i>Euphorbia glyptosperma</i> Engelm. (rib-seed sand mat); S260	PB	
<i>Euphorbia maculata</i> L. (spotted sand-mat); S259	PB	
FABACEAE (Pea and Bean Family)		
<i>Amphicarpaea bracteata</i> (L.) Fernald (American hog peanut); F6085, F6586, T5343	NDMF, NMF	
<i>Astragalus canadensis</i> L. (Canadian milkvetch); F6051	BF	WS
<i>Hyloidesmum glutinosum</i> (Willd.) H. Ohasi & R.R. Mill (pointed tick-trefoil); H3883	BF	CR
<i>Lathyrus japonicus</i> Willd. (beach pea); F6597	LSS	

<i>Lathyrus ochroleucus</i> Hook. (cream pea); F5666, F6364, P44029, T5325	BF, NDF, NMF
<i>Lathyrus venosus</i> Willd. (veiny pea); S255, T5509, T5518	BF
<i>Lespedeza capitata</i> Michx. (round headed bush clover); T5348	PB
* <i>Lotus corniculatus</i> L. (bird's foot trefoil); S150	BF, NDMF
* <i>Lupinus polyhyllus</i> Lindl. (garden lupine); S130	WS
* <i>Medicago lupulina</i> L. (black medic); H4065	WS
* <i>Melilotus albus</i> Medik. (white sweet-clover); S203	WS
* <i>Melilotus officinalis</i> (L.) Pall (yellow sweet-clover); S151	WS
* <i>Robinia pseudoacacia</i> L. (black locust); T5169	NDMF
* <i>Securigera varia</i> (L.) Lassen (crown-vetch); H4107	BF
* <i>Trifolium arvense</i> L. (rabbit-foot clover); S158, S268, S284	BF
* <i>Trifolium aureum</i> Pollich (hop clover); M7157, S197, T5386	BF, NDF
* <i>Trifolium campestre</i> Schreb. (low hop clover); <i>Gerst s.n.</i>	NDF
* <i>Trifolium hybridum</i> L. (alsike clover); S269, T5520	NDF
* <i>Trifolium pratense</i> L. (red clover); <i>Christensen s.n.</i>	NDF
* <i>Trifolium repens</i> L. (white clover); S192	D
<i>Vicia americana</i> Willd. (American vetch); M7002, M7157, S148, T5576	D
* <i>Vicia cracca</i> L. (cow vetch); M7153	CR
* <i>Vicia sativa</i> L. (common vetch); H4064	
* <i>Vicia villosa</i> Roth (hairy vetch); T5524	
FAGACEAE (Beech Family)	
<i>Quercus ellipsoidalis</i> E. J. Hill (northern pin oak); P43855, T5102, T5189	PB, NDMF
<i>Quercus macrocarpa</i> Michx. (bur oak); T5218, T5264, T5349, T5542, T5578	PB, NDMF
<i>Quercus rubra</i> L. (red oak); P44214, T5515	PB, NDMF
GENTIANACEAE (Gentian Family)	
<i>Gentiana alba</i> Nutt. (pale gentian); H4055	W-NF
<i>Gentiana andrewsii</i> Griseb. (bottle gentian); H1924	W-NF
<i>Gentiana rubricaulis</i> Schwein. (red-stemmed gentian); T5509	W-NF
<i>Halenia deflexa</i> (Sm.) Griseb. (spurred gentian); M6711, M6853, M6887, P44176	BF, NDMF
GERANIACEAE (Geranium Family)	
<i>Geranium bicknellii</i> Britton (Bicknell's geranium); H3796, M7133, T5161	PB, BG

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
GROSSULARIACEAE (Gooseberry Family)		
<i>Ribes americanum</i> Mill. (wild black current); F5635, S54, T5334, T5521	BF, NMF	
<i>Ribes cynosbati</i> L. (prickly wild gooseberry); F5648, H3710, M7129	BF, NMF	
<i>Ribes glandulosum</i> Grauer (skunk current); A2443, A2445, M6646, M6654.2, M6973, T5537, T5555	WC, NHS	
<i>Ribes hirtellum</i> Michx. (swamp gooseberry); F5665, F6483, M6655, M7060, S49, <i>Is.n.</i>	WC, NMF, BSS	
<i>Ribes hudsonianum</i> Richardson (northern black current); F5606, F6024, F6039, M6645	WC, NHS	
<i>Ribes lacustre</i> (Pers.) Poir. (bristly black current); M6729, P43782	BF, WC	CR
<i>Ribes oxycanthoides</i> L. (northern gooseberry); M6988, S51, S91	NHS	THR, WS
<i>Ribes triste</i> Pall. (swamp red current); F5619, F6054, F6502, M6647, M6654.1, M7061, T5537	BF, WC, NHS	
HALORAGACEAE (Water-milfoil Family)		
<i>Myriophyllum heterophyllum</i> Michx. (various leaved water-milfoil); H3578	AP	WS
<i>Myriophyllum sibiricum</i> Komarov (spiked water-milfoil); F6562, F6530, H3580, M7312, T5193, T5273	AP	
<i>Myriophyllum tenellum</i> Bigelow (slender water-milfoil); S234, T5541	AP	
<i>Myriophyllum verticillatum</i> L. (water-milfoil); F6562	AP	
HYPERICACEAE (St. John's Wort Family)		
<i>Hypericum ascyron</i> L. (giant St. John's-wort); F6514, S271, T5288	W-NF	
<i>Hypericum canadense</i> L. (Canadian St. John's-wort); H3699	W-NF	WS
* <i>Hypericum perforatum</i> L. (common St. John's-wort); H4105, M7160	PB, NDF	WS
<i>Triadenum fraseri</i> (Spach) Gleason (marsh St. John's-wort); F6461, F6541, M7244, M7308, P44084, P44200, T52899	W-NF	
LAMIACEAE (Mint Family)		
<i>Agastache foeniculum</i> (Pursh) Kuntze (blue giant hyssop); M6757, T5508	PB	
* <i>Ajuga reptans</i> L. (bugle); <i>Clark 1264</i>	BF	
<i>Climopodium vulgare</i> L. (wild basil); H3374, H3749	NMF	
<i>Dracocephalum parviflorum</i> Nutt. (American dragonhead); M6818	PB	
* <i>Galeopsis tetrahit</i> L. (hemp-nettle); M7230, <i>Is.n.</i>	PB, NDMF	CR
* <i>Glechoma hederacea</i> L. (creeping-Charlie); S106	BF, NDMF	WS
<i>Lycopus americanus</i> W. P. C. Barton (common water horehound); H3846, S285, T5482	NHS, W-NF	
<i>Lycopus uniflorus</i> Michx. (northern bugleweed); F6542, M6847, M6893, M7259, P44075, P44140, T5273, T5481	NHS, W-NF	
<i>Mentha canadensis</i> L. (wild mint); S272, T5480	BF, NHS, WC	

<i>Monarda fistulosa</i> L. (wild bergamot); H3721, M7222, T5077	
<i>Prunella vulgaris</i> L. (self-heal); S180, T5263	
<i>Scutellaria galericulata</i> L. (marsh skullcap); F6550, H3772, P44091, <i>Is.n.</i>	
<i>Scutellaria lateriflora</i> L. (mad-dog skullcap); F6507, F6550, M6861, M7276, P44101, P44162	
<i>Stachys arenicola</i> Britton (marsh hedge nettle); H3947	
<i>Stachys tenuifolia</i> Willd. (smooth hedge nettle); H4103, M6783	
LENTIBULARIACEAE (Bladderwort Family)	
<i>Utricularia intermedia</i> Hayne. (northern bladderwort); F6538, M7233, P44135	
<i>Utricularia minor</i> L. (lesser bladderwort); F6563, H3646, H3695, H3972	
<i>Utricularia vulgaris</i> L. subsp. <i>macrorrhiza</i> (J. Le Conte) R. T. Clausen (common bladderwort); F6531, H3620, P44216, S240	
LINDERNIACEAE (False Pimpernel Family)	
<i>Lindernia dubia</i> (L.) Pennell (false pimpernel); T5484	
LINNAEACEAE (Twinflower Family)	
<i>Limnaea borealis</i> L. (twinflower); F6304, M6760, M7008, P44032, T5248	
LYTHRACEAE (Loosestrife Family)	
<i>Decodon verticillatus</i> (L.) Elliott (swamp loosestrife); S243	
* <i>Lythrum salicaria</i> L. (purple loosestrife); F6477, H4115, S239	
MALVACEAE (Mallow Family)	
<i>Tilia americana</i> L. (basswood); Koch 12273	
MENYANTHACEAE (Buckbean Family)	
<i>Menyanthes trifoliata</i> L. (buckbean); P44089, S168, T5560	
MOLLUGINACEAE (Carpetweed Family)	
<i>Mollugo verticillata</i> L. (carpetweed); T5174, T5082	
MYRICACEAE (Bayberry Family)	
<i>Comptonia peregrina</i> (L.) J. M. Coult. (sweet fern); F6405, M6686, M6734, P43905, P44001, T5519	
<i>Myrica gale</i> L. (sweet gale); F6535, M7265	
MYRSINACEAE (Myrsine Family)	
<i>Lysimachia ciliata</i> L. (fringed loosestrife); F6151, S28	

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
<i>Lysimachia quadrifolia</i> L. (whorled loosestrife); A2483, M7149, P43851, P43900, T5513, T5541	PB, NDF	
<i>Lysimachia terrestris</i> (L.) Britton, Sterns & Poggenb. (swamp candles); A2608, F6456, M7180, P44072, P44123, P44197, T5561	NHS, W-NF	
<i>Lysimachia thysiflora</i> L. (tufted loosestrife); F6391, H3623, M7059, P44141, S171, T5302	WC, W-NF	
<i>Trientalis borealis</i> Raf. (star flower); P43752, P44034, T5316	WC, PB, NDMF	
NYPHAEACEAE (Water Lily Family)		
<i>Nuphar microphylla</i> (Pers.) Fernald (small yellow pond lily); S250	AP	
<i>Nuphar variegata</i> Durand (yellow pond lily); F6527, S249, T5486	AP	
<i>Nymphaea odorata</i> Aiton. (fragrant water-lily); H3655, P44199, S236	AP	WS
OLEACEAE (Olive Family)		
<i>Fraxinus americana</i> L. (white ash); S121	NMF	
<i>Fraxinus nigra</i> Marshall (black ash); M6967, M7054, M7236, T5546, T5557	NHS, WC	
<i>Fraxinus pennsylvanica</i> Marshall (green ash); F6582, S44, T5364	BF, NMF	
ONAGRACEAE (Evening-Primrose Family)		
<i>Chamerion angustifolium</i> (L.) Holub (fireweed); A2606, M6791, M7192	PB, NDF	WS
<i>Circaea alpina</i> L. (small enchanter's nightshade); M6843, M6889, M7052, P44106, S174, T5090, T5246	WC, NHS	
<i>Circaea canadensis</i> (L.) Hill (broad-leaf enchanter's-nightshade); H3708, H3877, M7139	NHS, NMF	WS
<i>Epilobium ciliatum</i> Raf. (willow herb); F6135, F6569, M7279, M7314, T5274	WC, NHS	
<i>Epilobium coloratum</i> Biehler (cinnamon willow herb); M6878, P44159	WC, NHS	
<i>Epilobium leptophyllum</i> Raf. (American marsh willow-herb); F6476, M6833, M6857, M7299	WC, W-NF	
<i>Epilobium palustre</i> L. (marsh willow-herb); M6896, S190	WC	WS
<i>Ludwigia palustris</i> (L.) Elliott (marsh purslane); H3588	W-NF	
<i>Oenothera biennis</i> L. (common evening primrose); H3726, H4100, P43899	PB, NDMF	
<i>Oenothera clelandii</i> W. Dietr., Raven & W.L. Wagner (evening primrose); M6744	PB	CR
<i>Oenothera perennis</i> L. (small evening primrose); <i>Goessl 7644</i>		WS
<i>Oenothera villosa</i> Thunb. (evening primrose); M6780	PB	
OROBANCHACEAE (Broom-rape Family)		
<i>Agalinis paupercula</i> (A. Gray) Britton (smooth false foxglove); H1918	W-NF	
<i>Conopholis americana</i> (L.) Wallr. (American cancer-root); A2604, M7100, M7110	NMF	CR
* <i>Euphrasia stricta</i> J. F. Lehm. (drug eye-bright); M6856, P44215	PB	WS

<i>Melampyrum lineare</i> Desr. (cow-wheat); A2488, F6412, M6733, M6761, M7142, M7190, P44023, T5562	PB, NDF	
<i>Pedicularis canadensis</i> L. (wood-betony); F6355, H3398, M6695, P44046, T5317	PB, NDF	
OXALIDACEAE (Wood-sorrel Family)		
<i>Oxalis acetosella</i> L. subsp. <i>montana</i> (Raf.) D. Löve (mountain wood-sorrel); M6890, P44111, S179	WC, NHS	WS
<i>Oxalis dillenii</i> Jacq. (southern yellow wood-sorrel); M6805	BF, WC	WS
<i>Oxalis stricta</i> L. (wood-sorrel); H4073, S198	PB, NDF	WS
PAPAVERACEAE (Poppy Family)		
<i>Capnoides sempervirens</i> (L.) Borkh. (pink corydalis); F5650, M7132, T5338, T5423	BG	
<i>Sanguinaria canadensis</i> L. (bloodroot); H3564	BF	
PENTHORACEAE (Stonecrop Family)		
<i>Penthorum sedoides</i> L. (ditch stonecrop); T5283	W-NF	
PHRYMACEAE (Lopseed Family)		
<i>Mimulus glaberratus</i> Kunth (James' monkey-flower); H4054, M7305, T5191	W-NF	
<i>Mimulus ringens</i> L. (monkey-flower); F6560, T5284	WC	
PLANTAGINACEAE (Plantain Family)		
<i>Callitriche hernaphroditica</i> L. (autumnal water starwort); H4016, M7291, T5278, T5357, T5510	AP	SC
<i>Callitriche palustris</i> L. (water starwort); F6015, M6903, M7270, T5280, T5281, T5378	AP	
<i>Chelone glabra</i> L. (turtle head); F6113, F6582, F6594, M6831, M6872, M7241, M7280, P44147	BF, W-NF	
<i>Hippuris vulgaris</i> L. (common mare's will); M7297	AP	WS
* <i>Linaria vulgaris</i> Mill (butter and eggs); T5565	D	
<i>Nuttallanthus canadensis</i> (L.) D. A. Sutton (blue toad-flax); <i>Judziwicz 11400</i>	PB, NDF	
* <i>Plantago major</i> L. (broad-leaved plantain); P43858	PB, NDF	WS
* <i>Plantago patagonica</i> Jacq. (woolly plantain); M6804	PB	WS
<i>Plantago rugelii</i> Decne. (American plantain); H3903, P44165	BF, NDF	CR
<i>Veronica beccabunga</i> L. var. <i>americana</i> Raf. (American brooklime); F6003, M6900, M7268	WC, NHS	
* <i>Veronica longifolia</i> L. (garden veronica); F6034	BF	CR
* <i>Veronica officinalis</i> L. (common speedwell); F6150, H3479, M7001, M7095	BF, NDMF	
<i>Veronica peregrina</i> L. (purslane speedwell); <i>Judziwicz 10701, Koch 12277</i>	D	
<i>Veronica scutellata</i> L. (marsh speedwell); P44096	W-NF	WS
<i>Veronica serpyllifolia</i> L. (thyme-leaved speedwell); <i>Gilbert, s.n.</i>	BF, NDMF	

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
POLYGALACEAE (Milkwort Family)		
<i>Polygala paucifolia</i> Willd. (fringed polygala); F5620, F6315, P43850	WC, NDMF	
<i>Polygala polygama</i> Walter (racemed milkwort); M6737, M6797, M6813, P44052, S216, T5394	PB, NDF	
<i>Polygala sanguinea</i> L. (field milkwort); <i>Garske 770</i>	D	
POLYGONACEAE (Buckwheat Family)		
<i>Fallopia climodis</i> (Michx.) Holub (fringed black bindweed); F6334, F6499, M7124, P43861	WC, NHS	WS
* <i>Fallopia convolvulus</i> (L.) A. Löve (black bindweed); M6814, P43911, S204	BF, PB	
<i>Fallopia scandens</i> (L.) Holub (false buckwheat); F6334, H4101	BF, NDMF	
<i>Persicaria amphibia</i> (L.) Delabare (water smartweed); P44210, S247, T5550	BSS	WS
* <i>Persicaria hydropiper</i> (L.) Delabare (marsh-pepper knotweed); M7286	W-NF	
<i>Persicaria lapathifolia</i> (L.) Delabare (noddng smartweed); F6537, T5178	W-NF	WS
* <i>Persicaria maculosa</i> Gray (curly-top knotweed); H3969, H4104	W-NF	WS
<i>Persicaria pensylvanica</i> (L.) M. Gómez (Pensylvania knotweed); H3529	WC	WS
<i>Persicaria punctata</i> (Elliott) Small (dotted smartweed); H3765	W-NF	WS
<i>Persicaria sagittata</i> (L.) H. Gross (arrow-leaved tear-thumb); M6865, P44157, T5286	WC, W-NF	
<i>Polygonella articulata</i> (L.) Meisn. (coastal joint weed); M6801, P43887	PB	WS
<i>Polygonum achoreum</i> S. F. Blake (leathery knotweed); T5171	PB	
* <i>Polygonum aviculare</i> L. (prostrate knotweed); T5101, T5198	NDF	
* <i>Rumex acetosella</i> L. (sheep sorrel); S89, S282, T5323	PB, NDF	
* <i>Rumex crispus</i> L. (curly dock); H4049, S154, T5233	BF, NHS	
* <i>Rumex obtusifolius</i> L. (bitter dock); H3745	BF	WS
<i>Rumex orbiculatus</i> A. Gray (great water dock); F6522, M7243, M7269, P44161, T5083	W-NF	
PORTULACACEAE (Purslane Family)		
* <i>Portulaca oleracea</i> L. (purslane); T5381	PB	
RANUNCULACEAE (Buttercup Family)		
<i>Actaea pachypoda</i> Elliott (doll's-eyes); H3608, H3715	NMF	WS
<i>Actaea rubra</i> (Aiton) Willd. (red baneberry); F6132, F6313, F6480, M6876, T5519, T5530, T5546	BF, WC, NDMF	
<i>Anemone americana</i> (DC.) H. Hara (round-leaved hepatica); F5612, S41, T5307	BF, NMF	
<i>Anemone canadensis</i> L. (Canada anemone); S94, S138, T5326	BF, NDMF	
<i>Anemone cylindrica</i> A. Gray (thimbleweed); F6047	PB	WS
<i>Anemone quinquefolia</i> L. (wood anemone); F5622, F6351, M6653, M6682, M7007, P43753, T5309,	BF, NDF, NMF	

<i>T5505, T5222</i>			
<i>Anemone virginiana</i> L. (thimbleweed); F6128, S23	BF		
<i>Aquilegia canadensis</i> L. (wild columbine); F6333, F5653, T5327	BF, NDF, NMF		
<i>Callitha palustris</i> L. (marsh marigold); F5638, F6322, M6652, M6962, M7042	WC, W-NF		
<i>Clematis occidentalis</i> (Homem.) DC. (purple clematis); <i>Sasse, s.n.</i>	WC		
<i>Clematis virginiana</i> L. (virgin's bower); F6572, H3939, H3980, H4056, T5326	BF, NHS		
<i>Coptidium lapponicum</i> (L.) Rydb. (Lapland buttercup); F6366	WC	END	
<i>Coptis trifolia</i> (L.) Salisb. (goldthread); F5607, M6644, P44112, T5092, T5093, T5232	BF, WC, NMF		
<i>Ranunculus abortivus</i> L. (kidney-leaved buttercup); M6986, T5422	BF, NDMF		
* <i>Ranunculus acris</i> L. (tall buttercup); F6082, M6961, S115	BF, NMF		
<i>Ranunculus hispidus</i> Michx. (bristly buttercup); H3594, H3716, H3820, M6971	BF, NHS, NMF	WS	
<i>Ranunculus longirostris</i> Godt. (aquatic buttercup); H3759, H3862, M7277, S221, T5166, T5279, T5295	AP		
<i>Ranunculus pensylvanicus</i> L. f. (bristly buttercup); H3984, M7311	BF, NHS, NMF	WS	
<i>Ranunculus recurvatus</i> Poir. (hooked buttercup); F6500, H3596, M6719, M7057	WC	WC	
<i>Ranunculus sceleratus</i> L. (celery-leaf buttercup); H3396	BF, WC, NHS		
<i>Thalictrum dasyacarpum</i> Fisch. & Avé-Lall. (purple meadow-rue); F6120, F6512, M6715, M6867, T5490, T5507			
<i>Thalictrum dioicum</i> L. (early meadow-rue); F5629, F6350, M6653, M6682, P43753	BF, WC, NHS	WS	
RHAMNACEAE (Buckthorn Family)			
<i>Ceanothus americanus</i> L. (New Jersey tea); <i>Clark 98</i>	NDF		
<i>Ceanothus herbaceus</i> Raf. (Jersey tea); P43911, P44054, T5331	PB		
<i>Rhamnus alnifolia</i> L'Her. (alder-leaved buckthorn); A2444, H3587, M6657, S188, T5240, T5529	BF, NHS		
* <i>Rhamnus cathartica</i> L. (common buckthorn); M7232, S167, S288	BF, NDMF, NHS, NMF		
ROSACEAE (Rose Family)			
<i>Agrimonia gryposepala</i> Wallr. (tall agrimony); F6045, F6081, F6497, P43872, S24	BF, NHS, NMF		
<i>Agrimonia striata</i> Michx. (roadside agrimony); T5269	WC		
<i>Amelanchier arborea</i> (F. Michx.) Fernald (common serviceberry); F6344, F6435, H3365, S62	BF, WC, NDMF	WS	
<i>Amelanchier bartramiana</i> (Tausch) M. Roem. (mountain Juneberry); H3599	BSS		
<i>Amelanchier interior</i> Nielsen (inland serviceberry); F6481, H3904, M6669	WC		
<i>Amelanchier laevis</i> Wiegand (smooth serviceberry); H3597	BF, WC, NDMF		
<i>Amelanchier sanguinea</i> (Pursh) DC. (round-leaved serviceberry); F5655, F6043, F6344, M6671, M7120, P43999, P44044, T5314	BF, WC, NDMF		
<i>Amelanchier spicata</i> (Lam.) K. Koch (shadbush serviceberry); M6697	PB		

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
<i>Aronia melanocarpa</i> (Michx.) Elliott (chokeberry); P44204	NDF, BSS	
<i>Aronia x prunifolia</i> (Marshall) Rehder (chokeberry); T5554	W-NF	
<i>Comarum palustre</i> L. (marsh cinquefoil); A2607, F6399, F6453, F6547, M7166, P44077, P44124	WC, NHS, BSS	
<i>Crataegus chrysoarpa</i> Ashe (hawthorn); A2545, P43748	BF	WS
<i>Crataegus punctata</i> Jacq. (dotted hawthorn); F6601	BF	CR
<i>Crataegus submollis</i> Sarg. (northern red haw); A2546, H4021	BF	
<i>Crataegus succulenta</i> subsp. <i>macracantha</i> (hawthorn); T5488	BF	
<i>Dryocallis arguta</i> (Pursh) Rydb. (prairie cinquefoil); M6752, P43920	PB	WS
* <i>Filipendula rubra</i> (Hill) B. L. Rob. (queen-of-the-prairie); <i>Clark 1344</i>	D	
<i>Fragaria vesca</i> L. (woodland strawberry); F6311, M7131, S156, T5277	BF, WC, NMF	
<i>Fragaria virginiana</i> Mill. (wild strawberry); F5643, M6685, M7013, P43749, T5221, T5401	BF, WC, NMF	
<i>Geum aleppicum</i> Jacq. (yellow avens); F6055, F6083, F6492, M7108, T52275, T5512	BF, NDF, NDMF	
<i>Geum canadense</i> Jacq. (white avens); F6487	BF, NHS	WS
<i>Geum fragaroides</i> (Michx.) Smedmark (barren strawberry); F6305, P43790, P44015, P44025, S43, T5531	PB, NDF	
<i>Geum laciniatum</i> Murray (rough avens); F6492, M6993	NHS	WS
<i>Geum macrophyllum</i> Willd. (large-leaved avens); (H3964, F6010)	WC, NDMF	SC, WS
<i>Geum rivale</i> L. (purple avens); M6726, M6859, M6898, M7044	BF, WC, NHS	
* <i>Potentilla argentea</i> L. (silvery cinquefoil); H3893, T5516	PB, NDF	
<i>Potentilla norvegica</i> L. (rough cinquefoil); S155, S266, T5188	PB, NDF	
* <i>Potentilla recta</i> L. (rough-fruited cinquefoil); S219	PB, NDF	WS
<i>Potentilla simplex</i> Michx. (common cinquefoil); F6356, P44014, P44051	BF, WC	WS
<i>Prunus americana</i> Marshall (American plum); S52	BF, NDMF	
<i>Prunus nigra</i> Aiton (Canada plum); H3482, H3806, H3833, S26, T5356, T5376	BF, WC, NMF	
<i>Prunus pensylvanica</i> L. f. (pin cherry); H3603, M6664, M7122, M7191, T5087, T5370	PB, NDF	
<i>Prunus pumila</i> L. (sand cherry); M6678, P44000, T52226, T5405	PB, NDF	
<i>Prunus serotina</i> Ehrh. (black cherry); S117, T5300	PB, NDF	
<i>Prunus virginiana</i> L. (chokecherry); F5637, F6340, F6482, F6599, M6659, M6698, P43785	BF, NHS, NMF	
<i>Rosa acicularis</i> Lindl. (bristly rose); F5656, F6019	BF, PB, NHS	WS
<i>Rosa blanda</i> Aiton (smooth rose); A2484, A2487, F6122, F6580, M6996, P44049, T5513	BF, WC, PB	
<i>Rosa carolina</i> L. (pasture rose); H3664, M6747, M6795	BF, PB, NDMF	
<i>Rubus allegheniensis</i> Porter (common blackberry); F6352, F6358, M7143, P44030, T5517	BF, PB, NDF	WS
<i>Rubus canadensis</i> L. (Canadian highbush blackberry); H3880, S93	NDF, NDMF	
<i>Rubus flagellaris</i> Willd. (short-stalk dewberry); H3384, H3385, M6767, P43903, P44003, P44036	PB, NDF	WS

<i>Rubus hispidus</i> L. (swamp dewberry); H3686	WC	WS
<i>Rubus parviflorus</i> Nutt. (thimbleberry); M7125	BF, WC, NDMF	WS
<i>Rubus pubescens</i> Raf. (dwarf raspberry); F5640, M6656, M6723, M6968, M7045, S61, T5320	BF, WC, NDMF	
<i>Rubus setosus</i> Bigelow (bristly blackberry); F6379, F6387, H4018, S195	PB, BSS	
<i>Rubus strigosus</i> Michx. (red raspberry); M6990	BF, PB, NMF	
<i>Sibbaldopsis tridentata</i> (Aiton) Rydb. (three-toothed cinquefoil); A2489, M6736, M6806, P44053, T5.n.	PB	
* <i>Sorbaria sorbifolia</i> (L.) A. Braun (false spiraea); S258	BF	
* <i>Sorbus americana</i> Marshall (American mountain ash); M6884	BF, NDMF, NHS, NMF	WS
* <i>Sorbus aucuparia</i> L. (European mountain ash); S145	NDMF	WS
<i>Spiraea alba</i> Du Roi (white meadowsweet); F6465, F6546, M7170, M7267, P44079, P44113	WC, NHS, BSS	WS
<i>Spiraea tomentosa</i> L. (steepleshub); H2179, H4113	BSS	WS
RUBIACEAE (Madder Family)		
<i>Galium aparine</i> L. (cleavers); H3898, T5338	BF	
<i>Galium asprellum</i> Michx. (rough bedstraw); F6107, F6485, F6565, T5271, T5448	BF, WC, NMDF	
<i>Galium boreale</i> L. (northern bedstraw); S218	BF, PB	
<i>Galium labradoricum</i> (Wiegand) Wiegand (northern bog bedstraw); F6536, F6543	WC	WS
<i>Galium tinctorium</i> L. (stiff bedstraw); F6469, S141, S163, T5084	BF, NHS	
<i>Galium trifidum</i> L. (small bedstraw); F6536, F6543, M6982, M7304	BF, WC, NHS	
<i>Galium triflorum</i> Michx. (fragrant bedstraw); F6022, F6038, F6362, M7012, P44184, T5247	BF, NMF, NHS	
<i>Houstonia longifolia</i> Gaertn. (long-leaved blueets); P43915, T5170	PB	
<i>Mitchella repens</i> L. (partridgeberry); F6136, P43757, T5421	BF, WC, NDMF	
SALICACEAE (Willow Family)		
<i>Populus balsamifera</i> L. (balsam poplar); S50, T5556	BF, NDF, NHS	
<i>Populus grandidentata</i> Michx. (big-tooth aspen); H3372, H3375, S104, T5523	BF, NDMF	
<i>Populus tremuloides</i> Michx. (quaking aspen); H4743	BF, NDMF, NHS	
* <i>Salix alba</i> L. (white willow); T5363	BF	
<i>Salix bebbiana</i> Sarg. (Bebb's willow); F6509, H3657, H3988	BF, NHS, NMF	
<i>Salix candida</i> Willd. (sage-leaved willow); H2703	W-NF	WS
<i>Salix discolor</i> Muhl. (pussy willow); F6020, M6665, S33, T5484	BF, WC, NHS	
<i>Salix eriocephala</i> Michx. (heart-leaved willow); S159, T5484	NDF, NDMF	
<i>Salix exigua</i> Nutt. (sandbar willow); F6587, S146	W-NF	
<i>Salix humilis</i> Marshall (prairie willow); M6699, P43747, S37, T5095, T5494, T5502, T5510, T5547	PB, NDMF	
<i>Salix lucida</i> Muhl. (shining willow); F6470, T5487	W-NF	

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
<i>Salix pedicellaris</i> Pursh (bog willow); H3610, P44082, F6397, F6454, F6475	BSS	
<i>Salix petiolaris</i> Sm. (slender willow); F6473, S40	BSS	
<i>Salix pyrifolia</i> Andersson (balsam willow); F6370, F6474, M6670, P44095 P44206	WC, BSS	WS
* <i>Salix</i> × <i>fragilis</i> L. (hybrid crack willow); S164	BF	
SANTALACEAE (Sandalwood Family)		
<i>Comandra umbellata</i> (L.) Nutt. (bastard toadflax); F6363, H3477, H4047, T5330	PB, NDF, NDMF	
SAPINDACEAE (Soapberry Family)		
<i>Acer negundo</i> L. (box elder); S126	BF, NHS	WS
<i>Acer rubrum</i> L. (red maple); P43750	BF, NDMF, NMF	WS
<i>Acer saccharum</i> Marshall (sugar maple); S92, S108	BF, NMF, NHS	WS
<i>Acer spicatum</i> Lam. (mountain maple); F5628, F5660, F6001, F6119, F6323, M6892, M7123, P43862	BF, NDF, NDMF	
SARRACENIACEAE (Pitcher-Plant Family)		
<i>Sarracenia purpurea</i> L. (pitcher plant); F6401, F6444, M7188, P44067, P44131, T5567	BSS	
SAXIFRAGACEAE (Saxifrage Family)		
<i>Chrysosplenium americanum</i> Hook. (golden saxifrage); H3936, M6846, T5108, T5124	BF, WC, NHS	
<i>Heuchera richardsonii</i> R. Br. (alum root); H3393, H3552, P43917, T5204, T5301	PB	
<i>Micranthes pensylvanica</i> (L.) Haw. (swamp saxifrage); F5654, M6972, M7047, T5026	BF, WC, NHS	
<i>Mitella diphylla</i> L. (bishop's cap); F5621, F5641	BF, WC	
<i>Mitella nuda</i> L. (naked miterwort); F5613, H3379, H3481, M6673, T5249, T5417	BF, WC, NHS	
SCROPHULARIACEAE (Figwort Family)		
<i>Scrophularia lanceolata</i> Pursh (early figwort); F6573, H4109, S136, S206, T3564	D	
* <i>Verbascum thapsus</i> L. (mullein); H4062, S276, T5.n.	PB	
SOLANACEAE (Nightshade Family)		
<i>Physalis virginiana</i> Mill. (Virginia ground cherry); H3888, M6750, S217, T5180, T5407	PB	
* <i>Solanum dulcamara</i> L. (bittersweet night-shade); F6130, F6567	BF, WC, NHS	
THYMELACEAE (Mezereum Family)		
<i>Dirca palustris</i> L. (leatherwood); A2601, H3589, M7098	BF, NDF, NMF	
ULMACEAE (Elm Family)		
<i>Ulmus americana</i> L. (American elm); H3978, T5533	BF, NDF, NHS	

URTIACEAE (Nettle Family)		
<i>Laportea canadensis</i> (L.) Wedd. (wood nettle); H3983, S165, T5554		
<i>Urtica dioica</i> L. (stinging nettle); T5574		BF, WC, NHS BF, NHS
VALERIANACEAE (Valerian Family)		
* <i>Valeriana officinalis</i> L. (garden valerian); F6109, F6575, P43877		BF, NDF, WC
VERBENACEAE (Vervain Family)		
<i>Verbena hastata</i> L. (blue vervain); H3744, S267, T5345		NHS, W-NF
VIOLACEAE (Violet Family)		
<i>Viola adunca</i> Sm. (hook-spur violet); M6681, M7141, M7229		PB, NDF, NDMF WS
<i>Viola blanda</i> Willd. (sweet white violet); H3583, H3899, Koch 7731		BF, WC
<i>Viola cucullata</i> Aiton (blue marsh violet); H3399, S100		BF, WC, NHS WS
<i>Viola labradorica</i> Schrank (dog violet); F5626, H3600, H3613, M7014, P43754, P44174, T5231		BF, PB, NDMF
<i>Viola macloskeyi</i> F. E. Lloyd (smooth white violet); F5627, H3583, H3899, M6666, S77, S99, T5398		BF, WC, NHS PB, NDF
<i>Viola pedata</i> L. (bird's-foot violet); M6689, S74, T5220		BF, NDF
<i>Viola pubescens</i> Aiton (yellow wood violet); F5630, P43776, T5536, T5308		BF, NMF, NDF WS
<i>Viola renifolia</i> A. Gray (kidney-leaved violet); H3498, H3900, S63		BF, WC, NDMF WS
<i>Viola sororia</i> Willd. (common blue violet); H4034, S71		BF, ND, NHS
VITACEAE (Grape Family)		
<i>Parthenocissus inserta</i> (A. Kern.) Fritsch (grape woodbine); P43885		BF WS
<i>Parthenocissus quinquefolia</i> (L.) Planch. (Virginia creeper); S182		BF, WC, NDMF
MONOCOTS		
ACORACEAE (Sweet Flag Family)		
<i>Acorus americanus</i> (Raf.) Raf. (sweet-flag); H2834, T5491		AP
* <i>Acorus calamus</i> L. (sweet-flag); H4150, S166		AP
ALISMACEAE (Water-Plantain Family)		
<i>Alisma triviale</i> Pursh (northern water plantain); T5351, T5483		AP
<i>Sagittaria cuneata</i> E. Sheld. (arum-leaved arrow-head); T5259, T5477		AP
<i>Sagittaria latifolia</i> Willd. (arrow-head); F6516, H3774, H3850, T5194, T5292		AP
<i>Sagittaria rigida</i> Pursh (stiff arrow-head); F6517, H3629, H3771, H3863, T5282, T5291, T5293, T5339		AP

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Taxon	Habitat	Status
APPENDIX 1. (Continued)		
Taxon		
ALLIACEAE (Onion Family)		
<i>Allium tricoccum</i> Aiton (wild leeks); H3711, M7107, S39, T5539	BF, NMF	
ARACEAE (Arum Family)		
<i>Arisaema triphyllum</i> (L.) Schott (jack-in-the-pulpit); F6338, M6852, T5425	BF, WC, NHS	WS
<i>Calla palustris</i> L. (wild calla); F6384, F5663, M6839, M7173, M7307, P44074, P44125, P44155, T5251, T5551	WC, NHS, BSS	WS
<i>Lemna minor</i> L. (common duckweed); F6540, M7237, M7266	AP	
<i>Lemna trisulca</i> L. (star duckweed); H3576, M7292	AP	
<i>Lemna turionifera</i> Landolt (red duckweed); H3955, T5163	AP	
<i>Spirodela polyrrhiza</i> (L.) Schleid. (greater duckweed); F6532, H3640, T5163	AP	
<i>Symplocarpus foetidus</i> (L.) W.P.C. Barton (skunk cabbage); S172, T5552	NHS	
CONVALLARIACEAE (Lily-of-the-valley Family)		
<i>Clintonia borealis</i> (Aiton) Raf. (blue-bead lily); F6346, F6414, M6824, M6854, M6895, M7117, M7175, P43765, P44179, T5426	BF, WC	
* <i>Convallaria majalis</i> L. (European lily-of-the-valley); S131	BE, NHS	
<i>Maianthemum canadense</i> Desf. (wild lily-of-the-valley); F6094, F6365, F6413, M6347, M7116, P43768, P44024, T5319, T5337	BF, NDF, NMF	
<i>Maianthemum racemosum</i> (L.) Link (false Solomon's-seal); F6365, H3545, P44183	BF, NDF, NMF	WS
<i>Maianthemum stellatum</i> (L.) Link (starry false Solomon's-seal); <i>Schlapper</i> ; 35/03	PB	
<i>Maianthemum trifolium</i> (L.) Sloboda (false may flower); F6393, F6420, M7023, P44088, T5321, T5553	BSS, WC	
<i>Polygonatum pubescens</i> (Willd.) Pursh (downy Solomon's-seal); F5659, F6349, M7118, P43858	BF, NDF, NDMF	WS
<i>Siretopus lanceolatus</i> (Aiton) Reveal (rose twisted stalk); F6339, H3475, M6850, P43778, S18, T5416	BF, NDF, NDMF	
<i>Uvularia grandiflora</i> Sm. (bellwort); F5645, F6056, F6113, S66	NDMF, NMF	
<i>Uvularia sessilifolia</i> L. (sessile bellwort); F6117, F6357, F6408, M6799, M7066, M7115, P43786, T5312	BF, NDF, NDMF	
CYPERACEAE (Sedge Family)		
<i>Bulbostylis capillaris</i> (L.) C. B. Clarke (dense tuft hair sedge); A2486	PB	
<i>Carex adusta</i> Boott (lesser brown sedge); M6759, P44027, P44037, T5405	NDF	
<i>Carex alopecoidea</i> Tuck. (foxtail sedge); H3811	NMF	CR
<i>Carex aquatilis</i> Wahlb. (water sedge); H3999	BF, WC	WS
<i>Carex arcta</i> Boott (northern cluster sedge); <i>Christensen s.n.</i>	NMF	
<i>Carex arctata</i> Boott (drooping woodland sedge); F5661, F6027, F6095, F6153, F6310, M7096, M7010, T5242	BF, NDF, NDMF	

<i>Carex assiniboensis</i> W.Boott (Assimiboine sedge); A3747, H3628, H3750	BF	WS
<i>Carex aurea</i> Nutt. (golden sedge); F6046	BF	
<i>Carex backii</i> W. Boott (Rocky Mountain sedge); A2603, F5649, H3419, M7127	BG	SC, CR
<i>Carex bebbii</i> (L. H. Bailey) Fernald (Bebb's sedge); H3907, M6704, T5173	WC	
<i>Carex bromoides</i> Willd. (brome-like sedge); H4007, H4010, M7039	BF, NHS, NMF	CR
<i>Carex brunnescens</i> (Pers.) Poir. (brownish sedge); F6041, M6705, M6957, M7046	WC, NHS, BSS	
<i>Carex canescens</i> L. (silvery sedge); M6987, M7031, M7038	BF, WC, NHS	WS
<i>Carex castanea</i> Wahltenb. (chestnut sedge); F6152, M6707, M7004, M7094, M7109, P43751, P43764	BC, BSS	
<i>Carex chondorrhiza</i> L. f. (cord-root sedge); F6425, H3783, M7257	BF, NDMF	WS
<i>Carex communis</i> L. H. Bailey (fibrous root sedge); F5662, F6325, H3605, H3606, P43766, S55, T5478	NHS	
<i>Carex comosa</i> Boott (bristly sedge); H3909, M7235, P44154	PB	WS
<i>Carex crawfordii</i> Fernald (Crawford's sedge); H3776, H4040, M6800	BF, WC, NHS	
<i>Carex eryneta</i> Lam. (fringed sedge); F6490, M6953, M7040, M7102, P44109, P44148, T5521	W-NF	
<i>Carex cryptolepis</i> Mack. (northeastern sedge); <i>Goessl 7675, Sulman 747</i>	NDMF, NMF	
<i>Carex debilis</i> Michx. (northern weak sedge); M7168	WC, NMF	
<i>Carex deflexa</i> Hornem. (northern sedge); F6327, F6330, F6343, M6658, M7063	BF, NDF, NMF	
<i>Carex deweyana</i> Schwein. (Dewey's sedge); F6033, M6716, M7064, P43758, S57	WC, BSS	WS
<i>Carex disperma</i> Dewey (soft leaf sedge); F5632, F6012, M6643, M6712	BF, WC, NHS	WS
<i>Carex eburnea</i> Boott (bristle-leaf sedge); H3966	BF	CR
<i>Carex echinata</i> Murray (star sedge); H3400, F6464	PB	
<i>Carex echinodes</i> (Fernald) P.Rothr., Reznicek, & Hipp. (marsh straw sedge); F6062	BF, NDMF, NMF	
<i>Carex foenea</i> Willd. (bronze-headed oval sedge); F6312, F6337, H3491	BF, NDMF, NMF	
<i>Carex gracillima</i> Schwein. (graceful sedge); F6040, F6063, F6310, M6713, M6958, M7006, M7050, M7113, P43763	WC	WS
<i>Carex granularis</i> Willd. (limestone meadow sedge); F6050	BF, WC, NHS	WS
<i>Carex gynandra</i> Schwein. (nodding sedge); F6053, F6070, M6717, M6727, M6880, M6899	BF	CR
<i>Carex hirtifolia</i> Mack. (hairy sedge); H3812	W-NF	
<i>Carex houghtoniana</i> Dewey (Houghton's sedge); <i>Davis s.n., Koch 5730</i>	WC, NHS, AP	
<i>Carex hystericina</i> Willd. (bottlebrush sedge); F6023, M6722, M6897, M7300, T5177	WC, NHS	
<i>Carex interior</i> L. H. Bailey (inland sedge); F6000, M6728, S118	BF, NDMF, NMF	
<i>Carex intumescens</i> Rudge (greater bladder sedge); A2602, F6148, F6307, F6508, M6706, M6960, M6995, M7006, M7041, M7092, M7176, P44103, T5250, T5539	NHS, W-NF	WS
<i>Carex lacustris</i> Willd. (lake sedge); F6371, F6549, S125	BSS, W-NF	
<i>Carex lasiocarpa</i> Ehrh. (woolly fruit sedge); F6381, F6451, F6471, P44129		

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
<i>Carex leptalea</i> Wahlenb. (bristly stalked sedge); F6009, M6873, M6956, M7048, P44102	WC, BSS	
<i>Carex leptoneuria</i> (Fernald) Fernald (nerveless woodland sedge); F6026, F6324, H3592, H3601, M7036, P44102	BF, WC, NHS	
<i>Carex limosa</i> L. (muck sedge); F6439, H3617, P44087	W-NF	WS
<i>Carex lurida</i> Wahlenb. (shallow sedge); A459	W-NF	
<i>Carex magellanica</i> Lam. (boreal bog sedge); F6028, F6398, F6427, F6468, M6826, M6904, M7028, M7179, M7261	BSS, WC, W-NF	
<i>Carex muehlenbergii</i> Schkuhr ex Willd. (Muhlenberg's sedge); M6753	PB	CR
<i>Carex normalis</i> Mack. (greater straw sedge); F6147	BF, NHS	CR
<i>Carex oligosperma</i> Michx. (few seed sedge); F6380, F6452, M7033, M7186, M7260, P44073, P44117	BSS, WC	
<i>Carex ornostachya</i> Wiegand (necklace spike sedge); F6324, P43777	BF, NDMF	CR
<i>Carex pauciflora</i> Lightf. (few flowered sedge); M7194, P44063	W-NF	
<i>Carex peckii</i> Howe (Peck's sedge); F5614, F6306, H3604, H3797	NMF, BF, NDMF	WS
<i>Carex pedunculata</i> Willd. (long-stalk sedge); F5608, M6648, P43756	BF, WC, NMF	WS
<i>Carex pellita</i> Willd. (broad-leaved wooly sedge); Koch 5718, <i>Freckmann 29090</i>	WC	
<i>Carex pensylvanica</i> Lam. (Pennsylvania sedge); M6684, P43780, P44031, S75	PB, NDMF, NMF	
<i>Carex projecta</i> Mack. (necklace sedge); F6486, F6503, M6710, M6714, M6978, M6985, M6994, M6998, M7099, M7105, M7158, P44142	BF, NHS, NMF	
<i>Carex pseudo-cyperus</i> L. (false bristly sedge); M7302	AP	
<i>Carex radiata</i> (Wahlenb.) Small (eastern star sedge); H3998, M6981, M6983	BF, NHS	CR
<i>Carex retrorsa</i> Schwein. (deflexed bottlebrush sedge); F6140, H3748, T5527	BF, WC, W-NF	
<i>Carex rosea</i> Willd. (rosy sedge); H3595	BF, NHS	CR
<i>Carex rostrata</i> Stokes (beaked sedge); H2775, S273	BSS, WC	WS
<i>Carex scabrata</i> Schwein. (eastern rough sedge); F6084, H4011	BF, NMF	
<i>Carex scoparia</i> Willd. (broom sedge); H2302	BF, NMF, NHS	
<i>Carex siccata</i> Dewey (dry-spiked sedge); H3809, P44017	PB	WS
<i>Carex sprengelii</i> Spreng. (long-beaked sedge; Sprengel's sedge); H3805, P43791	BF	CR
<i>Carex stipitata</i> Willd. (common fox sedge); F6495, M6955, M6725, P44107	BF, NDF, NMF	
<i>Carex stricta</i> Lam. (tussock sedge); M7032, T5261	BSS, WC, W-NF	
<i>Carex tenera</i> Dewey (quill sedge); F6145, P43998	BF, PB	
<i>Carex tenuiflora</i> Wahlenb. (sparse flower sedge); F6400	WC	
<i>Carex tonsa</i> (Fernald) E. P. Bicknell (shaved sedge); M6683, P44047, S56	PB, NDF	
<i>Carex tribuloides</i> Wahlenb. (blunt brome sedge); H4031	W-NF	CR
<i>Carex trisperma</i> Dewey (three seeded sedge); F6392, F6419, M7018, M7101, M7167, T5244	WC, BSS, NHS	

<i>Carex tuckermanii</i> Dewey (Tuckerman's sedge); M6954, M7103, M7238, T5520	NHS, NMF	WS
<i>Carex umbellata</i> Willd. (early oak sedge); F5647	BF	
<i>Carex utriculata</i> Boott (yellow lake sedge); F6372, F6424, F6452, F6525, M7183, P44085, P44115	NHS, BSS, W-NF	
<i>Carex vaginata</i> Tausch (sheathed sedge); H3403, F6017	WC	
<i>Carex vesicaria</i> L. (blister sedge); M6979, P44205	NHS	
<i>Carex viridula</i> Michx. (litttle green sedge); S80	WC	
<i>Carex vulpinoidea</i> Michx. (fox sedge); H3662	W-NF	CR
<i>Carex × knieskernii</i> Dewey (hybrid sedge); H3714, M7009	NMF	WS
<i>Cyperus houghtonii</i> Torr. (Houghton's nut sedge); M6817, P43893	PB	
<i>Cyperus lupulinus</i> (Spreng.) Mareks (slender sand sedge); <i>Epinstein s.n.</i>	PB	
<i>Dulichium arundinaceum</i> (L.) Britton (three-way sedge); H3632, P44195, S202, T5366, T5566	NHS, W-NF	
<i>Eleocharis acicularis</i> (L.) Roem. & Schult. (needle spike rush); S232	NHS, AP	
<i>Eleocharis erythropoda</i> Steud. (bald spike rush); H4024, T5176	AP, W-NF	
<i>Eleocharis intermedia</i> Schult. (intermediate spike rush); H3958, H4151, T5285	AP	
<i>Eleocharis obtusa</i> (Willd.) Schult. (blunt spike rush); <i>Svenson (1971-01-01)</i>	AP, W-NF	
<i>Eleocharis ovata</i> (Roth) Roem. & Schult. (oval spike rush); H3758	W-NF	
<i>Eleocharis palustris</i> (L.) Roem. & Schult. (spike rush); F6556, M7296, P44196	AP, W-NF	
<i>Eriophorum angustifolium</i> Honck. (narrow leaf cotton grass); F6406, H4002, S82, T5230	BSS, W-NF	
<i>Eriophorum chamissonis</i> C.A. Meyer (Chamisso's cotton grass); H2152, S81, S107	W-NF	
<i>Eriophorum gracile</i> W. D. J. Koch (slender leaf cotton grass); F6443, H3622, H3723	W-NF	
<i>Eriophorum tenellum</i> Nutt. (conifer cotton grass); A2610, F6446, M7258, P44068, P44092, P44119, P44201	W-NF	WS
<i>Eriophorum vaginatum</i> L. (tussock cotton grass); F6389, F6445, M7029, T5229, T5572	WC, BSS	
<i>Eriophorum virginicum</i> L. (tawny cotton grass); A2611, F6418, F6447, M7187, M7249, P44066, P44116	BSS, W-NF	
<i>Eriophorum viridicarinatum</i> (Engelm.) Fernald (green-keeled cotton grass); S187, T5238	W-NF	
<i>Rhynchospora alba</i> (L.) Vahl (white beak sedge); F6448, P44086	W-NF	WS
<i>Rhynchospora fusca</i> (L.) W. T. Aiton (brown beak sedge); A2614, F6463, H3697	W-NF	SC
<i>Schoenoplectus acutus</i> (Bigelow) A. Löve & D. Löve (hard-stem bulrush); H3891	AP	WS
<i>Schoenoplectus pungens</i> (Vahl) Palla (chair-maker's rush); <i>Salomaki 97/26</i>	AP	
<i>Schoenoplectus smithii</i> (A. Gray) Sojak var. <i>setosus</i> (Fernald) S.G. Smith (Smith's bulrush); A2633, P44202	AP	WS
<i>Schoenoplectus tubernaemontani</i> (C. C. Gmel.) Palla (soft stem bulrush); F6520, H3769, M7301, S242, T5358, T5479	AP	
<i>Scirpus atrocinctus</i> Fernald (black-girdled wool-grass); H3859, M7177	NHS, BSS	WS
<i>Scirpus atrovirens</i> Willd. (black bulrush); F6121, P44181	BF, NMF, NHS	WS
<i>Scirpus cyperinus</i> (L.) Kunth (wool-grass); F6440, M7284, P44099, P44132, P44163	BF, NHS, BSS	

(Continued on next page)

APPENDIX 1. (Continued)

Taxon	Habitat	Status
<i>Scirpus microcarpus</i> J. Presl & C. Presl (panicked bulrush); <i>Allen s.n.</i> , <i>Gerst s.n.</i> , <i>Koch 12276</i>	WC, W-NF	
<i>Trichophorum alpinum</i> (L.) Pers. (alpine bulrush); A2613, F6462	W-NF	
ERIOCAULACEAE (Pipewort Family)		
<i>Eriocaulon aquaticum</i> (Hill) Druce (pipewort); T5542	AP	CR
HEMEROCALLIDACEAE (Day-lily Family)		
<i>Hemerocallis fulva</i> (L.) L. (orange daylily); S263	BF	
HYDROCHARITACEAE (Frog's-bit Family)		
<i>Elodea canadensis</i> Michx. (common waterweed); F6526, F6552, H3928, M7272, T5165, T5275, T5294	AP	
<i>Elodea nuttallii</i> (Planch.) H. St. John (slender waterweed); <i>Ts.n.</i>	AP	
<i>Najas flexilis</i> (Willd.) Rostk. & Schmidt (slender naiad); H3633, S226	AP	
<i>Valisneria americana</i> Michx. (eel-grass); F6551, M7275, <i>Ts.n.</i>	AP	
IRIDACEAE (Iris Family)		
* <i>Iris pseudacorus</i> L. (yellow-flag); S143	AP, W-NF	
<i>Iris versicolor</i> L. (wild blue-flag); F6386, F6441, M6840, M6976, M7245, M7252, P44081, P44128, T5266, T5556	AP, W-NF	
<i>Sisyrinchium montanum</i> Greene (mountain blue-eyed grass); P44019, P44020, T5481	PB	
JUNCACEAE (Rush Family)		
<i>Juncus balticus</i> Willd. (arctic rush); <i>Lahit 80</i>	AP	
<i>Juncus brachycephalus</i> (Englem.) Buchenau (small headed rush); F6521	WC, BSS, W-NF	
<i>Juncus brevicaudatus</i> (Englem.) Fernald (narrow-panicle rush); F6467, H3700, P44203	WC, AP, W-NF	WS
<i>Juncus effusus</i> L. (soft-stem rush); F6478, H3974, M6991, M7294	NHS, BSS, WC	WS
<i>Juncus Greenei</i> Oakes & Tuck (Greene's rush); H2724, H3996	WC	WS
<i>Juncus interior</i> Wiegand (inland rush); <i>Fields 108</i>	D	
<i>Juncus nodosus</i> L. (joint rush); H3995, M7298	AP	
<i>Juncus tenuis</i> Willd. (path rush); S199, T5197	BF, NDF, NMF	
<i>Juncus vaseyi</i> Engelm. (Vasey's rush); <i>Judziwicz 11717</i>	W-NF	SC
<i>Luzula acuminata</i> Raf. (hairy wood rush); F5611, M6642, P43755	BF, NDMF, NMF	
<i>Luzula multiflora</i> (Ehrhart) Lej. (common wood rush); P43789, S42	BF, NDF	WS
LILIACEAE (Lily Family)		
<i>Erythronium americanum</i> Ker Gawl. (yellow trout lily); P43781, S47	BF	WS

<i>Lilium michiganense</i> Farw. (Michigan Lily); F6035	BF, NHS
<i>Lilium philadelphicum</i> L. (wood lily); M6735, T5369, T5379	PB
ORCHIDACEAE (Orchid Family)	
<i>Arethusa bulbosa</i> L. (dragon's mouth); S184	WC
<i>Calopogon tuberosus</i> (L.) Britton, Sterns & Poggendb. (grass pink); <i>Ts.n.</i>	W-NF
<i>Calypto bulbosa</i> (L.) Oakes (fairy slipper); Photo	WC
<i>Corallorhiza maculata</i> (Raf.) Raf. (spotted coral-root); F6415, <i>Ts.n.</i>	BF, NDMF
<i>Corallorhiza trifida</i> Châtel (early coral-root); M6675, M7058, P44108, S178	WC, NHS
<i>Cypripedium acaule</i> Aiton (moccasin flower); F6430, M6825, M7016, P44137, T5402	WC
<i>Cypripedium parviflorum</i> Salisb. var. <i>makasin</i> (Farw.) Sheviak (small yellow lady's slipper); F6369	WC
<i>Cypripedium parviflorum</i> Salisb. var. <i>pubescens</i> (Willd.) O. W. Knight (yellow lady's slipper); Photo	WC
<i>Cypripedium reginae</i> Walter (showy lady's slipper); P43876	BF
<i>Goodyera pubescens</i> (Willd.) R. Br. (downy rattlesnake plantain); <i>Gockman s.n.</i>	NDF
<i>Goodyera repens</i> (L.) R. Br. (creeping rattlesnake plantain); H3553, M6851, T5078	NDMF
<i>Goodyera tessellata</i> Lodd. (tesselated rattlesnake plantain); H3480, M7214	PB, NDMF
<i>Malaxis unifolia</i> Michx. (green adder's mouth); T5396, T5408	WC
<i>Neottia cordata</i> (L.) Rich. (heart-leaved twayblade); A2442, F5623, M6674	WC
<i>Platanthera aquilonis</i> Sheviak (northern green orchid); M6828, M6902	WC
<i>Platanthera clavellata</i> (Michx.) Luer (club-spur orchid); <i>Judziewicz 11977, Nekola s.n.</i>	WC
<i>Platanthera huronensis</i> (Nutt.) Lindl. (green bog orchid); P44110, P44143, S175, T5353	NHS
<i>Platanthera obtusata</i> (Pursh) Lindl. (blunt-leaved orchid); F6368, M6830, S212, T5105, T5385, T5558	WC
<i>Platanthera psychodes</i> (L.) Lindl. (purple fringed orchid); M7246, S262	W-NF
<i>Pogonia ophioglossoides</i> (L.) Ker Gawl. (rose pogonia); F6466	W-NF
<i>Spiranthes lacera</i> (Raf.) Raf. (northern slender lady's tresses); H4093	PB
POACEAE (Grass Family)	
* <i>Agrostis gigantea</i> Roth (red top); H3671, M7112, T5143, T5530	PB, NDMF, NMW
<i>Agrostis hyemalis</i> (Walter) Britton, Sterns & Poggendb. (tickle grass); T5410, T5411, T5679	PB, NDF
<i>Agrostis perennans</i> (Walter) Tuck. (autumn bent grass); F6141, M6837, M6881, P44162, T5480	BF, NDMF
<i>Agrostis scabra</i> Willd. (tough bent grass); A2485, F6544, M6754, M6784, M7159, M7303	PB
* <i>Agrostis stolonifera</i> Willd. (creeping bent grass); H2811	W-NF
<i>Alopecurus aequalis</i> Sobol. (short-awned foxtail); T5533	W-NF
* <i>Alopecurus pratensis</i> L. (meadow foxtail); M6997, S53	NHS
<i>Annophila breviflata</i> Fernald (beach grass); <i>Castle 92-18</i>	LSS

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
<i>Andropogon gerardii</i> Vitman (big bluestem); M6782, M7219, P43888, T5072	PB, NDF	
* <i>Anthoxanthum odoratum</i> L. (sweet vernal grass); H4290, <i>Clark 1260</i>	D	
<i>Aristida basivirens</i> Vasey (fork-tipped three-awn grass); M6802, P43890	PB	WS
<i>Brachelytrium aristosum</i> (Michx.) Branner & Coville (long-awned wood grass); F6501, M6703, M6883, M7037, M7093	BF, NDMF, NMF	
<i>Bromus ciliatus</i> L. (fringed brome); F6042, F6088, F6488, M6708, M6886, M7106, M7220, P44104, P44151, P44180	BF, NDMF, NMF	
* <i>Bromus inermis</i> Leyss. (smooth brome); S137, S279, T5217	D	
<i>Bromus kalmii</i> A. Gray (prairie brome); A2490, M6739, M6787, M7218, P44012	PB, NDF, NDMF	
<i>Bromus latiglumis</i> (Shear) Hitchc. (hairy wood brome); H3674	NDF	CR
<i>Bromus pubescens</i> Spreng. (Canadian brome); H3371, H3720	BF, LNHS, NMF	
<i>Calamagrostis canadensis</i> (Michx.) P. Beauv. (blue-joint grass); F6091, F6149, F6388, F6417, F6426, F6592, M6841, M6879, M6966, M7285, P44083	BF, W-NF, NHS	
<i>Cinna arundinacea</i> L. (common wood reed); F6491, H3611	NDMF, NHS	CR
<i>Cinna latifolia</i> (Goepf.) Griseb. (wood reed grass); F6103, M6821, M6871	BF, NMF, NHS	
* <i>Dactylis glomerata</i> L. (orchard grass); S116, T5267	NMF	
<i>Danthonia spicata</i> (L.) Roem. & Schult. (poverty oat grass); M6731, M6741, M6742, M6815, M7097, P44007, T5412, T5532, T5536	PB, NDF, NDMF	
<i>Dichanthelium acuminatum</i> (Sw.) Gould & C. A. Clark (hairy panic grass); H4005, M7146, P44040, P44170	PB, NDF, NDMF	
<i>Dichanthelium columbianum</i> (Scribn.) Freckmann (hemlock panic grass); T5409	PB	
<i>Dichanthelium depauperatum</i> (Muhl.) Gould (starved panic grass); M6755, P44021, P44056, T5216, T5529	PB, NDF	
<i>Dichanthelium linearifolium</i> (Scrib.) Gould (linear-leaved panic grass); H4028, M7147	PB	CR
<i>Dichanthelium meridionale</i> (Ashe) Freckmann (mat panic grass); H4006, M6748	PB	WS
<i>Dichanthelium oligosanthes</i> (Schult.) Gould (red dot panic grass); H3669	NMF	CR
<i>Dichanthelium xanthophysum</i> (A. Gray) Freckmann (slender rosette grass); A2605, M6807, M7154, P43852, P44166, T5553	PB, NDF, NDMF	
* <i>Digitaria ischaemum</i> (Schreb.) Muhl. (smooth crabgrass); P43892	PB	WS
* <i>Echinochloa crusgalli</i> (L.) P. Beauv. (barnyard grass); T5534	PB	
<i>Echinochloa muricata</i> (P. Beauv.) Fernald (barnyard grass); H3483, T5103, T5534	PB	
<i>Elymus canadensis</i> L. (Canada wild rye); S256	LSS	
<i>Elymus lysitrix</i> L. (bottlebrush grass); F6014, F6057, F6114, F6493, P43880, P44173, T5276	BF, NDF, NMF	

* <i>Elymus repens</i> (L.) Gould (quack grass); H3655, T5526			
<i>Elymus trachycaulus</i> (Link) Gould (slender wheat grass); F6058, H3735, M6811, M7136, S153, S257			
<i>Elymus virginicus</i> L. (Virginia wild rye); H3970, F6106, P43879			
<i>Elymus wiegandii</i> Fernald (Wiegand's wild rye); F6577, P43878			CR
<i>Eragrostis hypnoides</i> (Lam.) Britton, Sterns & Poggenb. (creeping love grass); T5344			
<i>Festuca saximontana</i> Rydb. (Rocky Mountain fescue); H4058, M6692			WS
<i>Festuca subverticillata</i> (Pers.) E.B.Alexeev (nodding fescue); M7137			WS
* <i>Festuca trachyphylla</i> (Haack) Krajina (hard fescue); H3680			WS
<i>Glyceria borealis</i> (Nash) Batch. (northern manna grass); F6385, F6533, H3793, M7283			
<i>Glyceria canadensis</i> (Michx.) Trin. (rattlesnake grass); F6457, M7164, M7234, M7250, P44076, P44134, P44209			NHS, BSS
<i>Glyceria grandis</i> S. Watson (reed manna grass); H3625, T5481			NHS, W-NF
<i>Glyceria striata</i> (Lam.) Hitchc. (fowl manna grass); F6021, F6504, F6518, M6959, M7055			BF, WC, W-NF
<i>Koeleria macrantha</i> (Ledeb.) Schult. (June grass); H4030, P44010, T5528			PB, NDF
<i>Leersia oryzoides</i> (L.) Sw. (rice cut grass); F6548, H3860, M7282, T5487			NHS, AP
<i>Milium effusum</i> L. (wood millet); F6031, F6099, M7051, F6505, T5534			BF, NMF
<i>Muhlenbergia glomerata</i> (Willd.) Trin. (marsh muhly); M7215, P43853, P43913			PB, NDMF
<i>Muhlenbergia mexicana</i> (L.) Trin. (leafy satin-grass); M6779, P43882, P44177			PB, NDF, NDMF
<i>Oryzopsis asperifolia</i> Michx. (rough-leaved rice grass); F6318, M6688, P43771, T5224, T5225			BF, NDMF, NMF
* <i>Phalaris arundinacea</i> L. (reed canary grass); F6564			W-NF, NHS, NMF
* <i>Phleum pratense</i> L. (Timothy); H4025, T5525			BF, NDF, PB
<i>Piptatherum pungens</i> (Spreng.) Dorn (mountain rice grass); H4036, M6694			PB
<i>Poa alsodes</i> A. Gray (woodland bluegrass); H4037, M7049			NHS
* <i>Poa annua</i> L. (annual bluegrass); <i>Gilbert s.n.</i>			BF, NDF
* <i>Poa compressa</i> L. (Canada bluegrass); H3681, S147			BF, PB, NDMF
* <i>Poa nemoralis</i> L. (wood bluegrass); F6036, F6052, F6329, P43849			BF, NDF, NDMF
<i>Poa palustris</i> L. (marsh bluegrass); F6030, F6498, P44048, S70, T5527, T5535			WC, NHS
* <i>Poa pratensis</i> L. (Kentucky bluegrass); F6316, F6341, H4027, M6690			BF, NHS, NMF
<i>Poa saltuensis</i> Fernald & Wiegand (old pasture bluegrass); F6326, F6329, H4013, M7015, M7065			WC, NMF
<i>Schizachne purpurascens</i> (Torr.) Swallen (false melic grass); F6317, H3405, M7067, P44005, T5506			BF, PB, NDMF
<i>Sorghastrum scoparium</i> (Michx.) Nash (little bluestem); M6786, P43896, T5073			PB
* <i>Setaria pumila</i> (Poir.) Roem. & Schult. (yellow foxtail); H3485			D
<i>Sorghastrum nutans</i> (L.) Nash (Indian grass); P43922			PB
<i>Spartina pectinata</i> Link (prairie cord grass); P43886			BF

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APPENDIX 1. (Continued)

Taxon	Habitat	Status
<i>Sphenopholis intermedia</i> (Rydb.) Rydb. (slender wedge grass); A2600, M6724	BF, NMF	WS
<i>Torreyochloa pallida</i> (Torrey) Church (pale false manna grass); P44078	W-NF	CR
<i>Zizania palustris</i> L. (northern wild rice); S253	AP	
PONTEDERIACEAE (Pickerel-weed Family)		
<i>Heteranthera dubia</i> (Jacq.) Macmill. (water star grass); H3643, M7313, M7318, S224	AP	WS
POTAMOGETONACEAE (Pondweed Family)		
<i>Potamogeton alpinus</i> Balb. (alpine pondweed); H3768, H3892, H3956, S231, T5088, T5262, T5280, T5347	AP	
<i>Potamogeton amplifolius</i> Tuck. (large-leaved pondweed); S220	AP	
<i>Potamogeton berchtholdii</i> Fieber (slender pondweed); H3923	AP	
<i>Potamogeton epiphydrus</i> Raf. (ribbon leaf pondweed); F6545, F6588, H3694, H3698, H3851	AP	
<i>Potamogeton foliosus</i> Raf. (leafy pondweed); H3693, H3637, M7293, S230, S246, T5297, T5486	AP	
<i>Potamogeton friesii</i> Rupr. (Fries's pondweed); F6519	AP	
<i>Potamogeton gramineus</i> L. (variable leaf pondweed); F6545, H3785, H3647, S227, T5346, T5234	AP	WS
<i>Potamogeton illinoensis</i> Morong (Illinois pondweed); H4066, M7274	AP	
<i>Potamogeton natans</i> L. (floating-leaf pondweed); F6524, H3634, H3696, M7310, T5279, T5361	AP	
<i>Potamogeton nodosus</i> Potr. (long-leaf pondweed); H3788	AP	CR
<i>Potamogeton oakesianus</i> J.W. Robbins (Oakes' pondweed); P44198, P44218	AP	CR
<i>Potamogeton obtusifolius</i> Mert. & W.D.J. Koch (blunt-leaf pondweed); M7273, Ts.n.	AP	
<i>Potamogeton praelongus</i> Wulfen (white-stemmed pondweed); H3636, H4294, T5164, T5270	AP	
<i>Potamogeton pusillus</i> L. (small pondweed); F6539, H4293, P44217, T5278	AP	WS
<i>Potamogeton richardsonii</i> (A. Benn.) Rydb. (Richardson's pondweed); F6558, F6589, F6016, M7290, T5167, T5168, T5276	AP	
<i>Potamogeton robbinsii</i> Oakes (Robbin's pondweed); H3574, H3787	AP	
<i>Potamogeton spirillus</i> Tuck. (spiral pondweed); S225, S228, S229, S235, S244	AP	
<i>Potamogeton strictifolius</i> A. Benn. (narrow-leaved pondweed); H3915, T5296	AP	
<i>Potamogeton zosteriformis</i> Fernald (flat-stemmed pondweed); H3762, H3914, F6529, T5274, T5299	AP	
<i>Stuckenia filiformis</i> (Pers.) Börner (narrow-leaved pondweed); <i>Alverson 1803a</i>	AP	
<i>Stuckenia pectinata</i> (L.) Börner (sago pondweed); H3767, H3960, F6590, F6591, T5271, T5172, T5175, T5277, T5283, T5311	AP	
SCHEUCHZERIAEAE (Pod-grass Family)		
<i>Scheuchzeria palustris</i> L. (pod-grass); F6436, M7184, P44074, P44120	WC, W-NF	WS

SMILACACEAE (Carrion Flower Family)			
<i>Smilax illinoensis</i> Mangaly (Illinois carrion-flower); P43775.2			CR
<i>Smilax lasoneura</i> L. (bristly greenbrier); H3840		BF BF	WS
TRILLIACEAE (Trillium Family)			
<i>Trillium cernuum</i> L. (nodding trillium); F5639, F6096, F6320, M6718, M6875, M6984, P43770, T5420, T5562		BF, ND MF, NMF	WS
<i>Trillium grandiflorum</i> (Michx.) Salisb. (big white trillium); S64		BF, WC	
TYPHACEAE (Cat-tail Family)			
<i>Sparganium americanum</i> Nutt. (American bur-reed); F6557		AP	
<i>Sparganium angustifolium</i> Michx. (narrow-leaved bur-reed); S238, <i>Ts.n.</i>		AP	
<i>Sparganium emersum</i> Rehm. (green-fruited bur-reed); S237, S251, T5490, T5512		AP	
<i>Sparganium eurycarpum</i> Engelm. (common bur-reed); H4152, T5493		AP	
<i>Sparganium fluctuans</i> (Morong) B. L. Rob. (floating bur-reed); H3644, H3786, H3930, S241, T5489		AP	
* <i>Typha angustifolia</i> L. (narrow-leaved cat-tail); F6528, H3775, M7316		AP	WS
<i>Typha latifolia</i> L. (common cat-tail); M7317, T5352		AP	
* <i>Typha</i> × <i>glauca</i> Godt. (hybrid cat-tail); H3920		AP	WS

APPENDIX 2. Prevalent ground layer species in each forest community type. Frequency of occurrence is the percentage of sites within the forest community type in which the species occurs. Frequency of common occurrence is the percentage of sites within the forest community type in which the species is widely distributed.

Species	Frequency of occurrence	Frequency of common occurrence
Boreal Forest		
<i>Eurybia macrophylla</i>	100	100
<i>Rubus parviflorus</i>	100	100
<i>Maianthemum canadense</i>	100	90
<i>Pteridium aquilinum</i>	100	80
<i>Aralia nudicaulis</i>	80	100
<i>Cornus canadensis</i>	100	50
<i>Carex gracillima</i>	100	50
<i>Athyrium filix-femina</i>	90	67
<i>Cornus sericea</i>	90	56
<i>Equisetum arvense</i>	90	56
<i>Anemone quinquefolia</i>	80	63
<i>Calamagrostis canadensis</i>	80	50
Northern Wet-Mesic Forest		
<i>Rubus pubescens</i>	100	100
<i>Coptis trifolia</i>	100	100
<i>Maianthemum canadense</i>	100	91
<i>Trientalis borealis</i>	100	82
<i>Cornus canadensis</i>	100	82
<i>Clintonia borealis</i>	100	64
<i>Gaultheria hispidula</i>	100	64
<i>Mitella nuda</i>	100	55
<i>Osmunda cinnamomea</i>	100	55
<i>Aralia nudicaulis</i>	91	50
<i>Orthilia secunda</i>	91	50
<i>Carex disperma</i>	82	56
Pine Barrens		
<i>Comptonia peregrina</i>	100	100
<i>Corylus americana</i>	100	100
<i>Prunus pumila</i>	100	100
<i>Rubus flagellaris</i>	100	100
<i>Carex pensylvanica</i>	100	100
<i>Vaccinium angustifolium</i>	100	100
<i>Quercus macrocarpa</i>	100	83
<i>Quercus ellipsoidalis</i>	100	83
<i>Andropogon gerardii</i>	83	100
<i>Danthonia spicata</i>	83	100
<i>Monarda fistulosa</i>	83	80
<i>Hieracium aurantiacum</i>	100	50
<i>Solidago nemoralis</i>	100	50
<i>Schizachyrium scoparium</i>	100	50
<i>Arctostaphylos uva-ursi</i>	83	60
<i>Bromus kalmii</i>	83	60

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APPENDIX 2. (Continued)

Species	Frequency of occurrence	Frequency of common occurrence
Northern Dry Forest		
<i>Maianthemum canadense</i>	100	100
<i>Pteridium aquilinum</i>	100	100
<i>Oryzopsis asperifolia</i>	80	80
<i>Carex pensylvanica</i>	100	60
<i>Eurybia macrophylla</i>	100	60
<i>Rubus allegheniensis</i>	100	60
<i>Uvularia sessilifolia</i>	100	60
Northern Dry Mesic Forest		
<i>Maianthemum canadense</i>	100	100
<i>Pteridium aquilinum</i>	100	100
<i>Aralia nudicaulis</i>	100	83
<i>Eurybia macrophylla</i>	100	83
<i>Oryzopsis asperifolia</i>	100	67
<i>Clintonia borealis</i>	100	50
<i>Lonicera canadensis</i>	100	50
Northern Hardwood Swamp		
<i>Carex stipata</i>	100	100
<i>Rubus pubescens</i>	100	86
<i>Glyceria striata</i>	86	86
<i>Carex intumescens</i>	100	71
<i>Carex gracillima</i>	100	57
<i>Onoclea sensibilis</i>	100	56
<i>Carex projecta</i>	86	71
Northern Mesic Forest		
<i>Acer saccharum</i> (seedlings)	100	89
<i>Maianthemum canadense</i>	100	89
<i>Clintonia borealis</i>	89	88
<i>Carex pensylvanica</i>	100	67
<i>Aralia nudicaulis</i>	100	56
<i>Quercus rubra</i> (seedlings)	89	78
Northern Wet Forest		
<i>Rhododendron groenlandicum</i>	100	100
<i>Maianthemum trifolium</i>	100	83
<i>Carex trisperma</i>	100	66
<i>Vaccinium angustifolium</i>	100	50

APPENDIX 3. Summary of data for the eight forest community types. Major tree dominants are derived from importance values in the *Forest stand changes in the Bois Brule River 1968 to 2016* (Hlina et. al. 2020). Leading families are the percentage of all species in the forest community type that are in that family.

Category	Data
Boreal Forest	
Major tree dominants	<i>Populus tremuloides</i> , <i>Abies balsamea</i> , <i>Picea glauca</i> , <i>Pinus strobus</i>
Most prevalent ground layer species	<i>Eurybia macrophylla</i> , <i>Maianthemum canadense</i> , <i>Pteridium aquilinum</i> , <i>Aralia nudicaulis</i>
Leading families	Cyperaceae (10.1%), Asteraceae (9.6%), Rosaceae (8.0%), Poaceae (7.4%) Ranunculaceae (5.3%)
Average species richness	132
Total species richness	362
<i>Ct</i>	4.5
<i>Cn</i>	5.3
Non-native species (%)	14.9%
Growth form counts	Trees (26), Shrubs (50), Forbs (208), Graminoids (64), Vines (6)
Northern Wet-Mesic Forest	
Major tree dominants	<i>Thuja occidentalis</i> , <i>Abies balsamea</i>
Most prevalent ground layer species	<i>Rubus pubescens</i> , <i>Coptis trifolia</i> , <i>Maianthemum canadense</i> , <i>Trientalis borealis</i> , <i>Cornus canadensis</i>
Leading families	Cyperaceae (10.8%), Asteraceae (9.9%), Rosaceae (7.9%), Poaceae (5.8%) and Ericaceae (5.3%)
Average species richness	98
Total species richness	299
<i>Ct</i>	5.8
<i>Cn</i>	6.1
Non-native species (%)	4.3%
Growth form counts	Trees (18), Shrubs (48), Forbs (142), Graminoids (51), Vines (1)
Pine Barren	
Major tree dominants	<i>Pinus banksiana</i> , <i>Pinus resinosa</i>
Most prevalent ground layer species	<i>Comptonia peregrina</i> , <i>Corylus americana</i> , <i>Prunus pumila</i> , <i>Rubus flagellaris</i> , <i>Carex pensylvanica</i> , <i>Vaccinium angustifolium</i> , <i>Quercus macrocarpa</i> , <i>Quercus ellipsoidal</i> , <i>Andropogon gerardii</i> , <i>Danthonia spicata</i> , <i>Monarda fistulosa</i>
Leading families	Asteraceae (17.8%), Poaceae (12.0%), Rosaceae (11.6%)
Average species richness	79
Total species richness	207
<i>Ct</i>	4.1
<i>Cn</i>	4.8
Non-native species (%)	16.4%
Growth form counts	Trees (12), Shrubs (27), Forbs (118), Graminoids (32), Vines (1)

APPENDIX 3. (Continued)

Category	Data
Northern Hardwood Swamp	
Major tree dominants	<i>Fraxinus nigra</i> , <i>Thuja occidentalis</i>
Most prevalent ground layer species	<i>Carex stipata</i> , <i>Alnus incana</i> , <i>Rubus pubescens</i> , <i>Glyceria striata</i>
Leading families	Cyperaceae (15.9%), Asteraceae (11.4%), Poaceae (10.6%) and Rosaceae (9.3%).
Average species richness	92
Total species richness	307
<i>Ct</i>	5.0
<i>Cn</i>	5.6
Non-native species (%)	10.7%
Growth form counts	Trees (19), Shrubs (43), Forbs (164), Graminoids (75), Vines (6)
Northern Dry Forest	
Major tree dominants	<i>Pinus resinosa</i>
Most prevalent ground layer species	<i>Maianthemum canadense</i> , <i>Pteridium aquilinum</i> , <i>Oryzopsis asperifolia</i>
Leading families	Asteraceae (11.7%), Rosaceae (11.2%), Poaceae (11.2%), Cyperaceae (6.6%) and Ericaceae (6.1%)
Average species richness	75
Total species richness	209
<i>Ct</i>	4.4
<i>Cn</i>	5.2
Non-native species (%)	15.8%
Growth form counts	Trees (14), Shrubs (42), Forbs (104), Graminoids (33), Vines (4)
Northern Dry Mesic Forest	
Major tree dominants	<i>Pinus resinosa</i> , <i>Abies balsamea</i> , <i>Pinus strobus</i>
Most prevalent ground layer species	<i>Maianthemum canadense</i> , <i>Pteridium aquilinum</i> , <i>Aralia nudicaulis</i> , <i>Eurybia macrophylla</i>
Leading families	Asteraceae (11.3%), Rosaceae (9.2%), Poaceae (8.3%), Cyperaceae (5.4%) and Ericaceae (5.4%)
Average species richness	94
Total species richness	263
<i>Ct</i>	5.5
<i>Cn</i>	4.8
Non-native species (%)	12.9%
Growth form counts	Trees (27), Shrubs (38), Forbs (133), Graminoids (35), Vines (7)

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APPENDIX 3. (Continued)

Category	Data
Northern Mesic Forest	
Major tree dominants	<i>Acer saccharum</i> , <i>Tilia americana</i> , <i>Acer rubrum</i>
Most prevalent ground layer species	<i>Acer saccharum</i> , <i>Maianthemum canadense</i> , <i>Clintonia borealis</i>
Leading families	Cyperaceae (10.7%), Poaceae (9.4%), Asteraceae (9.0%), Rosaceae (7.7%), Ranunculaceae (5.6%) and Liliaceae (3.4%)
Average species richness	85
Total species richness	242
<i>Ct</i>	5.2
<i>Cn</i>	5.4
Non-native species (%)	10%
Growth form count	Trees (20), Shrubs (37), Forbs (125), Graminoids (50), Vines (2)
Northern Wet Forest	
Major tree dominants	<i>Picea mariana</i> , <i>Larix laricina</i>
Most prevalent ground layer species	<i>Rhododendron groenlandicum</i> , <i>Maianthemum trifolium</i>
Leading families	Cyperaceae (19.0%), Ericaceae (13.1%), Asteraceae (6.4%), Rosaceae (6.0%), and Poaceae (4.8%)
Average species richness	36
Total species richness	156
<i>Ct</i>	5.7
<i>Cn</i>	6.1
Non-native species (%)	6.4%
Growth form count	Trees (10), Shrubs (22), Forbs (31), Graminoids (21), Vines (0)