

Furbish's Lousewort *Pedicularis furbishiae* in New Brunswick: Status Report



Prepared for:

Committee on the Status
of Species at Risk
in New Brunswick
(NB COSSAR)

Natural Resources and
Energy Development

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This document, “Furbish’s Lousewort *Pedicularis furbishiae* in New Brunswick: Status Report”, has been drafted by Sean Blaney of the Atlantic Canada Conservation Data Centre for the New Brunswick Department of Natural Resources and Energy Development for use by the Committee on the Status of Species at Risk in New Brunswick (NB COSSAR). It is intended to be a supplemental report to the national Committee on the Status of Endangered Wildlife in Canada (COSEWIC) documents “COSEWIC assessment and status report on the Furbish’s Lousewort *Pedicularis furbishiae* in Canada” (COSEWIC 2000) and “COSEWIC status appraisal summary on Furbish’s Lousewort *Pedicularis furbishiae* in Canada” (COSEWIC 2011). It is not to be considered a stand-alone report.

The national COSEWIC (2011) status appraisal summary for Furbish’s Lousewort can be accessed on the federal Species at Risk public registry:

<https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html>

Earlier COSEWIC reports may be made available by contacting the COSEWIC Secretariat:
E-mail: ec.cosepac-cosewic.ec@canada.ca www.cosewic.ca

A more recent summary of the species’ ecology and status in the United States (USFWS 2018) is available at: <https://ecos.fws.gov/ServCat/DownloadFile/166496>

Photo Credit: Martin Williams, Canadian Forest Service

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Refer also to NB COSSAR status assessment document:

Furbish’s Lousewort (*Pedicularis furbishiae*): Status, Criteria, Status History, and Reason for Designation. Committee on the Status of Species at Risk (COSSAR) in New Brunswick (January 2023)

EXECUTIVE SUMMARY:

Furbish's Lousewort is a remarkable, globally rare perennial herb not closely related to any other lousewort in eastern North America. It is found only on the Saint John River in Maine and New Brunswick and is known in Canada from only five New Brunswick subpopulations occurring over 35 km of river shore between Grand Falls and the Aroostook River.

The provincial population has declined by 73% since 2002 and three of the five subpopulations are nearing extirpation. The main cause of recent decline is loss of plants and changes in habitat caused by severe flooding and ice scouring. These processes are necessary for creating and maintaining Furbish's Lousewort habitat, but their frequency and severity have increased and will likely continue to increase with a changing climate.

TECHNICAL SUMMARY FOR NEW BRUNSWICK

Furbish's Lousewort

Pedicularis furbishiae

pédiculaire de Furbish

Range of occurrence in New Brunswick: Upper Saint John River between Grand Falls and Aroostook River

Demographic Information

1.	Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines [2011] is being used)	Estimated at 8-10 years • USFWS (2018) gives 3-5 years to maturity and anticipated maximum age of ~10-15
2.	Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes, observed decline
3.	Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations, whichever is longer up to a maximum of 100 years].	73% decline in approximately 2 generations. Future declines are unclear, but recent decline has not necessarily ceased
4.	[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations, whichever is longer up to a maximum of 100 years].	73% decline within fewer than 3 generations going back to 2002. Future declines are unclear, but recent decline has not necessarily ceased
5.	[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations, whichever is longer up to a maximum of 100 years].	Unknown
6.	[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any period [10 years, or 3 generations, whichever is longer up to a maximum of 100 years], including both the past and the future.	73% within fewer than 3 generations going back to 2002. Future declines are unclear, but recent decline has not necessarily ceased
7.	Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. No b. Yes, in part c. No
8.	Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

9.	Estimated extent of occurrence (EOO)	48.5 km ²
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10.	Index of area of occupancy (IAO) (Always report 2x2 grid value).	24 km ² 6 occupied 2 x 2 km grid cells
11.	Is the population “severely fragmented” i.e., is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	a. Possibly b. Possibly
12.	Number of “locations” (use plausible range to reflect uncertainty if appropriate) <i>Aroostook subpopulation was down to zero in 2022 and is no longer considered a location</i>	2 to 4, depending on whether Medford, Stirrett and Big Flat are grouped as a single location based on threat of flood / ice scour effects.
13.	Is there an [observed, inferred, or projected] continuing decline in extent of occurrence? <i>Aroostook subpopulation was down to zero in 2022 and is likely no longer a viable subpopulation</i>	Yes. Projected decline based on likely loss of Aroostook, Stirrett and Big Flat subpopulations.
14.	Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy? <i>Aroostook subpopulation was down to zero in 2022 and is likely no longer a viable subpopulation</i>	Yes. Projected decline based on likely loss of Aroostook, Big Flat and Stirrett subpopulations.
15.	Is there an [observed, inferred, or projected] continuing decline in number of subpopulations? <i>Aroostook subpopulation was down to zero in 2022 and is likely no longer a viable subpopulation</i>	Yes. Projected decline based on likely loss of Aroostook, Big Flat and Stirrett subpopulations.
16.	Is there an [observed , inferred, or projected] continuing decline in number of “locations”?	Yes. Aroostook subpopulation is down to zero in 2022 and is no longer considered a location. Big Flat (2 plants) and Stirrett (2 plants) subpopulations are projected to be lost soon.
17.	Is there an [observed , inferred, or projected] continuing decline in [area, extent and/or quality] of habitat?	Yes. Habitat appears to have become unsuitable or less suitable at Aroostook, Stirrett, Big Flat and Medford due to succession and/or excessive erosion. Invasive exotic plants are likely to continue to increase.
18.	Are there extreme fluctuations in number of subpopulations?	No
19.	Are there extreme fluctuations in number of “locations”?	No
20.	Are there extreme fluctuations in extent of occurrence?	No
21.	Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each subpopulation)

22.	Subpopulations (give plausible ranges)	N Mature Individuals
	Grand Falls	183 (2022)
	Medford	59 (2022)
	Stirrett Preserve	2 (2021)
	Big Flat	2 (2022)
	Aroostook	0 (2022, 1 seen in 2021)
	Total	246

Quantitative Analysis

23.	Is the probability of extinction in the wild at least [20% within 20 years or 5 generations whichever is longer up to a maximum of 100 years, or 10% within 100 years]?	Not available
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Threats (direct, from highest impact to least, as per IUCN Threats Calculator)

Was a threats calculator completed for this species? No. A detailed threat assessment was included in the 2006 NB Recovery Strategy.

Threats that may be applicable in New Brunswick:

- i. Climate change causing increased frequency and intensity of flooding and ice scouring
- ii. Competition from native woody plants, herbivory and seed predation
- iii. Competition from exotic plant species
- iv. Shoreline and bank alteration associated with development of recreational or residential properties
- v. Roads

What additional limiting factors are relevant?

Habitat specificity (seepy rivershore banks with limited competition but less than annual severe scouring), possibly limited dispersal or establishment capability.

Potentially reduced genetic fitness due to extremely low population sizes.

24.

Rescue Effect (immigration from outside New Brunswick)

25.	Status of outside population(s) most likely to provide immigrants to New Brunswick.	Outside NB, only known on Saint John River in Maine (S1S2), where populations are considerably larger but are mostly 60+ km upriver and also limited and declining, especially in downstream sites closer to NB population.
26.	Is immigration known or possible?	Immigration from Maine is possible via seed transport in downstream flow, but this has not been documented.
27.	Would immigrants be adapted to survive in New Brunswick?	Yes
28.	Is there sufficient habitat for immigrants in New Brunswick?	Possibly, but widespread substantial loss of plants in NB suggests problems with habitat quality
29.	Are conditions deteriorating in New Brunswick?+	Yes, based on declines in extent of habitat and population
30.	Are conditions for the source (i.e., outside) population deteriorating?+	Yes, based on substantial population declines and modelling of climate and mid-winter ice scour events.
31.	Is the New Brunswick population considered to be a sink?+	No
32.	Is rescue from outside populations likely?	Some immigration may be possible. Likelihood of rescue is unknown, but probably unlikely.

+ See COSEWIC 2019b [Table 3](#) (Guidelines for modifying status assessment based on rescue effect)

Data Sensitive Species

33.	Is this a data sensitive species?	No
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Status History

34.	COSEWIC: Designated Endangered in Canada in April 1980. Status re-examined and confirmed Endangered in April 1998, May 2000, and May 2011. NB Endangered Species Committee: assessed as Endangered in October 1991. NB COSSAR: Has not been assessed.
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PREFACE:

Furbish's Lousewort was listed as Endangered on the New Brunswick *Endangered Species Act* in 1982. The New Brunswick Endangered Species Committee assessed it as Endangered in 1991 based on 3 occurrences and 450 plants (NB ESC 1991). It remained Endangered under the NB *Endangered Species Act* in 1996 and was carried over onto the new NB *Species at Risk Act* in 2013 as Endangered with protections.

The "Recovery Strategy for Furbish's Lousewort (*Pedicularis furbishiae*) in New Brunswick" was prepared by the Furbish's Lousewort Recovery Team and published in 2006. The federal Minister of the Environment adopted the provincial strategy, with additions designed to meet the requirements of federal legislation (Environment Canada 2010).

Since the original assessment and listing, much survey work and population monitoring has been undertaken which has documented two new sites, demonstrated absence elsewhere in areas between known sites, and has identified threats more clearly. Conservation of the species via ex situ means has also been undertaken more extensively in recent years (CFS 2021; Gyllström 2021).

STATUS of the FURBISH'S LOUSEWORT *Pedicularis furbishiae* in NEW BRUNSWICK

WILDLIFE SPECIES DESCRIPTION: see COSEWIC (2000, 2011), USFWS (2018).

Eligibility for assessment in New Brunswick: Furbish's Lousewort is a native species in New Brunswick. It is endemic to the Saint John River in New Brunswick and Maine and has been known in New Brunswick since the first collection at Grand Falls by J. Moser in 1878.

DISTRIBUTION:

New Brunswick Range: In New Brunswick, Furbish's Lousewort is known from five subpopulations (collections of occurrences within 1 km of one another and separated from other such collections of occurrences by at least 1 km) along a 35 km stretch of the Saint John River from Grand Falls to just north of the mouth of the Aroostook River (Figure 1). All occurrences are in the Centreville-Grand Falls Ecodistrict of the Saint John Valley Ecoregion. An 1882 specimen collected by G.U. Hay from "Andover" at the Fowler Herbarium, Queen's University, suggests Furbish's Lousewort once extended at least another 5 km to 7 km further downstream prior to loss of shoreline habitat to the Beechwood Dam headpond.

Using the Atlantic Canada Conservation Data Centre (AC CDC) database of rare species locations (AC CDC 2021), the minimum convex polygon that represents Extent of Occurrence (EOO) for Furbish's Lousewort in New Brunswick is 48.5 km².

The Index of Area of Occupancy (IAO), defined as the total area of 2 x 2 km grid cells that intersect all known Furbish's Lousewort occurrences in New Brunswick, is 24 km².

Search effort: Based on its occurrence along the Saint John River in Maine upstream from New Brunswick, Furbish's Lousewort's potential range in New Brunswick extends 114 km upstream to St. Francois where the river enters Canada. The downstream limit of potential occurrence is the northern end of the Beechwood Dam headpond at Perth-Andover, below which natural shoreline communities have been inundated. This entire zone of potential occurrence has been well searched for Furbish's Lousewort. Early targeted searching that located the Grand Falls, Stirrett and Aroostook sites included Stirrett (1980), Brown (1982), Day (1983) and Drummond (1987). Major fieldwork projects took place in 2001-2002, when AC CDC and Nature Trust of New Brunswick staff covered the 157 km distance from St. Francois to Perth-Andover on foot and by canoe (Simpson and Blaney 2003) and Nature Trust of New Brunswick contractors Gart

Bishop and Bruce Bagnell conducted floristic assessments of Furbish's Lousewort habitat (Bagnell 2003; Bishop 2002; Bagnell and Bishop 2014) and potential habitat. This work discovered the Medford and Big Flat subpopulations. Intermittent site monitoring, mostly by NB DNRED staff and contractors, has continued since 2002 (Table 1). Since 2018, work has intensified to include comprehensive annual monitoring, mostly by Canadian Forest Service led by Martin Williams, because of concern over population declines. In 2018 and 2019 AC CDC also conducted extensive work in areas not known to be occupied by Furbish's Lousewort to confirm that new colonization events were not compensating for observed population declines in known sites. Shorelines were carefully searched on foot 1 km upstream and downstream of the known limits of subpopulations, and 36 randomly selected 1 km shoreline segments between St. Francois and Perth-Andover were surveyed on foot. No new occurrences were found.

Other calcareous rivers in northern New Brunswick have habitats similar to those occupied by Furbish's Lousewort on the Saint John River. These habitats have also been relatively well-surveyed by AC CDC and other botanists because of their high diversity of rare plants. The Restigouche River has been intensively surveyed for almost all its length, as has the Aroostook River in the short portion downstream from the Tinker Dam to its mouth. Much of the Green River was covered in 2016, and the undammed sections of the lower Tobique have also been visited by botanists in scattered locations.

Search effort for Furbish's Lousewort has been sufficient to confirm that it is very rare in New Brunswick and that there are likely no large populations remaining to be discovered.

HABITAT:

Habitat Requirements: For detailed description of Furbish's Lousewort habitat in New Brunswick, see Bagnell (2003) and Bishop (2002), or refer to NB Recovery Strategy (Appendix C); in Maine see Macior (1978; 1980), Gawler et al. (1987), and the many other references in USFWS (2018). For habitat notes from herbarium records, refer to Appendix A (this document).

Furbish's Lousewort has been considered a "fugitive" species (sensu Grime 1979; COSEWIC 2000) in that it occupies disturbance-created habitats that regularly become unsuitable over time because of succession and erosion. Furbish's Lousewort occurs mostly within a narrow band of ice-scoured riverbank below the forest edge and well above the average summertime water's edge (Gawler et al. 1987). The banks are usually moderately sloped, groundwater seepage is usually present and soils are sandy or gravelly, calcareous lacustrine or glacial till deposits that are low in nitrogen and high in calcium (Macior 1978; Gawler et al. 1987). Furbish's Lousewort is shade tolerant but is a poor competitor and it usually occurs where shrub cover is not very dense. Herbaceous cover tends to be extensive and diverse but is not

dominated by taller and densely growing species. Mature trees (often Eastern White Cedar, *Thuja occidentalis*) on the riverbank above the zone occupied by Furbish's Lousewort frequently provide partial shade. Afternoon shade and cool, moist microclimates are mentioned as important factors for the species in Maine, where few occurrences tend to be in south-facing locations unless they are heavily shaded by cedar trees (McCollough 2007).

The Aroostook subpopulation, reduced to zero plants in 2022, was atypical in being well above the typical flood zone on an old railway embankment below what is now the NB Trail. Railroad track maintenance continually reduced shrub and sapling cover in the same manner that ice scour would along the river, but after that ceased, numbers declined substantially.

Furbish's Lousewort is a hemi-parasite, meaning that seedlings require the development of a parasitic root attachment to other perennial species. The attachment appears to be lost as the plant matures but there is some uncertainty on this point. Furbish's Lousewort is probably a host generalist, but several nitrogen-fixing species have been used successfully as hosts in cultivation: clovers (*Trifolium* species, all of which are European in New Brunswick), Canada Tick-trefoil (*Desmodium canadense*) and Speckled Alder (*Alnus incana* ssp. *rugosa*) (Macior 1980; Fournier, unpublished; CFS 2021).

Habitat Trends: Substantial loss of habitat through flooding likely occurred with the development of hydroelectric dams at Grand Falls (1920) and Beechwood (1955), and additional habitat losses have likely occurred from other human infrastructure given that the Saint John River is heavily settled throughout Furbish's Lousewort range in New Brunswick. An analysis of habitat alteration along the upper Saint John River in New Brunswick is given in NTN (2005).

The consistent declines observed across almost all occurrences of Furbish's Lousewort in Maine and New Brunswick over the past ten years suggest a widespread recent problem or problems with habitat. Observations suggest that the main driver of population loss is flooding and ice scour events that are eroding habitat and removing plants at rates greater than habitat is regenerating and greater than plants can recolonize. There is evidence that flooding and ice scouring have been more severe in recent years than in historic times before climate change impacts (see *Threats – Climate Change and Severe Weather*) and that less favourable current flooding and ice scour regimes have reduced habitat quality and possibly habitat extent.

Non-native plant species may also be causing ongoing reduction in habitat quality. A great diversity of exotic plant species co-occur with Furbish's Lousewort on the shores of the Saint John River. Although never directly studied, competition from exotic plants is mentioned as a

potential threat in COSEWIC (2011) and USFWS (2018). Exotic species co-occurring with Furbish's Lousewort are discussed further under *Threats*.

As noted under *Threats – Climate Change and Severe Weather*, warming summer temperatures may be making habitat less suitable and could ultimately exceed the species' climate envelope.

There is limited evidence of recent direct human destruction or alteration of Furbish's Lousewort habitat in New Brunswick and it is not considered to be a significant factor in recent habitat trends.

BIOLOGY: see COSEWIC (2000, 2011) and USFWS (2018).

POPULATION SIZES AND TRENDS:

Abundance: The 2022 count for New Brunswick subpopulations was 244 individuals, as noted in Table 1.

Trends: We have good recent population data for the New Brunswick's Furbish's Lousewort (Table 1), enabling strong understanding of population trends. The total New Brunswick population has declined dramatically since the early 2000s, with most of that decline occurring after 2008. The maximum New Brunswick population of 915 plants was recorded in 2002. Comprehensive population counts since that time showed a decline to 2008 (29% decline from 2002) and an even steeper decline to 2014 (83% decline from 2002), followed by a fairly stable population of approximately 200 individuals between 2018 and 2022, which represents a decline of between 77% and 73% relative to the 2002 population. Every subpopulation has declined substantially. Relative to the highest totals recorded at each site, Big Flat, Aroostook and Stirrett have lost 98% to 100% of their plants, while Medford and Grand Falls have lost 80% and 39%, respectively, of their plants.

Table 1. Counts of total number of individuals (flowering and non-flowering) at all New Brunswick subpopulations of Furbish’s Lousewort since 2000 (after which data collection became more consistent and all recent subpopulations had been discovered). Data from NB DNRED (Sabine pers. comm. 2021, 2022), Canadian Forest Service (Williams pers. comm. 2021) and AC CDC (2021). Yellow shaded cells for the Big Flat and Aroostook subpopulations include information related to transplanted individuals as explained in the footnotes. For counts from years before 2000, see Appendix B (this document) or refer to NB Recovery Strategy (Appendix B, Table A).

YEAR	Grand Falls	Medford	Stirrett & vicinity	Big Flat ¹	Aroostook ²	NB TOTAL
Site max (yr)	298 (2001)	294 (2008)	225 (1984)	131 (2004)	388 (2006)	
2000		no count	62	no count	84	unknown
2001	298	no count	147	no count	314	unknown
2002	243	187	137	124	224	915
2003	264	171	104	no count	204	unknown
2004	no count	no count	no count	131	no count	unknown
2006	no count	no count	46	no count	388	unknown
2007	no count	no count	43	no count	241	unknown
2008	68	294	41	48	198	649
2014	62	36	4	35	20	157
2018	71	64	5	64	2	206
2019	116	43	2	24 [-5]	0 [+5]	190
2020	no count	78	2	14 [-7]	0 [+2]	unknown
2021	152	61	2	3	0 [+1]	219
2022	183	59	no count	2	0	244 - 246

¹The counts at Big Flat for 2019 and 2020 include the initial totals (24, 14) and indicate that five and seven plants were removed for transplanted because of concern about loss to erosion. The five plants removed in 2019 were translocated to Aroostook. The seven plants removed in 2020 were translocated to the Grand Falls garden site (Gyllstrom2021).

²Counts at Aroostook for 2019 to 2021 include totals for naturally established plants (0) plus remaining transplanted individuals originating from Big Flat, all of which were lost as of 2022.

Rescue Effect: As a localized endemic, the only source of rescue from outside New Brunswick for Furbish’s Lousewort is the population upstream in Maine. The nearest Maine subpopulation (at Hamlin, Maine) is essentially contiguous with the Grand Falls subpopulation across the international border less than 1 km upstream from the limits of the subpopulation on the Canadian side. This subpopulation has been stable since its discovery in 2004 [counts of flowering stems: ~75 (2004); 310 (2008); 247 (2011); 390 (2013); 259 (2015); 239 (2017); 333 (2019); 284 (2021) (Maine Natural Areas Program 2022)]. It may be important in maintaining numbers at Grand Falls. The great majority of the Maine population is 70 – 100+ km further upstream beyond Fort Kent (Figure 1). The average and maximum distances that seeds could disperse downriver is unknown, but the tiny seeds have

a loose reticulate seed coat that allows them to float for several days (Menges 1990), during which they could easily cover 100+ km if unimpeded by obstacles. Furbish's Lousewort plants grow in sites that are flooded at least annually, meaning that many or most seeds would have potential to disperse via river flow. Rescue effect cannot, however, be considered a strong mitigating factor against extirpation risk in Canada. The relatively small population in Maine is declining, with the greatest declines occurring in downstream areas closest to the Canadian range (USFWS 2018). Extensive observation in New Brunswick suggests habitat conditions are declining and has provided no evidence of regular colonization of new locations. Chances of long-distance transport to and establishment at the small areas of suitable habitat in Canada are not known and may not be large. Therefore, rescue from the Maine population is considered unlikely.

THREATS AND LIMITING FACTORS: (see also COSEWIC 2011; NB DNR 2006)

11. Climate change & severe weather

11.4: Storms & flooding

Periodic flooding is a natural and expected occurrence on the Saint John River and is critical for maintaining habitat in an early-intermediate stage of succession ideal for Furbish's Lousewort. Over the last 20 years, however, the numbers of plants lost to flood-related erosion and bank slumping has far exceeded the numbers of new plants recruited into the population. There is evidence from modeling studies and from actual observation that numbers and severity of Saint John River flood and ice jam events has increased in the last 80 years and can be expected to increase further with a greater frequency of mid-winter thaws and rainfalls (Beltaos 1999; Beltaos and Prowse 2001; Tang and Beltaos 2008; Beltaos and Prowse 2009; all as cited in McCollough 2007 and USFWS 2018; Monk 2020). Recorded and projected climate changes are described in detail in USFWS (2018) and Monk (2020), but the observed and projected increase in major ice jams is an important point relative to Furbish's Lousewort habitat because the major ice jams have a greater potential to make large changes to shoreline habitats than warm-season flooding.

Consistent with the large to extreme declines in New Brunswick subpopulations, some downstream occurrences of Furbish's Lousewort in Maine (those closer to the New Brunswick subpopulations) have been noted as losing resiliency to natural disturbance, experiencing local extirpations, and becoming "incapable of supporting the species in the near term" as a result of flood events and resulting erosion (USFWS 2018).

11.3: Temperature Extremes

The closest relatives of Furbish's Lousewort are western louseworts occurring in cool, moist, alpine areas (Tkach et al. 2014) and the habitats in which the species occurs along the Saint John River are consistently cooler and moister than the surrounding average. USFWS (2018) suggests that Furbish's lousewort requires a cool, moist, subboreal climate. Ideal and maximum summer temperatures for the species are not well understood, but there is clearly a possibility that Furbish's Lousewort may be affected negatively by increased summer temperatures in future which could be 1 to 3.5 degrees warmer by 2050 and 3 to 6 degrees warmer by 2080 (Dietz and Arnold 2021).

8. Invasive & other problematic species & genes

8.1: Invasive non-native/alien species

A great diversity of exotic plant species co-occur with Furbish's Lousewort on the shores of the Saint John River. Although never directly studied, competition from exotic plants is mentioned as a potential threat in COSEWIC (2011), McCullough (2007) and USFWS (2018). Exotic species that were noted in AC CDC 2018-2019 field surveys as being common along Saint John River shorelines in Victoria County and that may be of concern because of potential to occur densely on seepy banks include Colt's-foot (*Tussilago farfara*), Reed Canary Grass (*Phalaris arundinacea*), Smooth Brome (*Bromus inermis*), White Sweet Clover (*Melilotus albus*), Red Clover (*Trifolium pratense*), Purple Vetch (*Vicia cracca*), Wild Madder (*Galium mollugo*), Field Sow-thistle (*Sonchus arvensis*), Common St. John's-wort (*Hypericum perforatum*), Ox-eye Daisy (*Leucanthemum vulgare*) and Purple Loosestrife (*Lythrum salicaria*) (AC CDC 2021).

Photographs in CFS (2021) show a sweet-pea species (*Lathyrus sylvestris* or *L. latifolius*) climbing on a Furbish's Lousewort plant, and another lousewort that is surrounded by what may be Crown Vetch (*Securigera varia*). Both sweet-peas and Crown Vetch are widely used in bank stabilization along roadsides and can be quite invasive on riverbanks, as in the case of Crown Vetch at the Mactaquac Dam further downstream on the Saint John River (Blaney, pers. obs. 2000).

Although not yet noted as directly competing with Furbish's Lousewort, Colt's-foot may be an important invasive species because it is abundant along the river and is especially associated with the seepy riverbanks favoured by Furbish's Lousewort (Blaney, Chapman and Mazerolle, pers. obs. 2001-2019). It forms dense rhizomatous patches that likely have potential to outcompete young lousewort plants and Colt's-foot may be more resistant to flood impacts than lousewort because of its sturdy, interconnected rhizomes, that may enable patches to persist in or rapidly colonize areas that are ice-scoured.

8.2: Problematic native species

Shading of Furbish's Lousewort habitat associated with natural succession to dense tall herbs, shrubs and saplings, and deposition of Red Oak (*Quercus rubra*) leaves, have been important factors in the decline of the Aroostook subpopulation occurring on the embankment of a former railroad bed that is now the NB Trail. Cessation of CN Rail vegetation management with the closure of the railroad in 1995 was noted as having had a negative impact on the Furbish's Lousewort subpopulation in COSEWIC (2000). Efforts to manage vegetation at that site for the benefit of Furbish's Lousewort go back to at least the 1990s (COSEWIC 2000), but do not appear to have been consistently applied over the past 20 years. Succession can also reduce suitability of occupied riverbank habitats over time if flood and ice scour fail to remove or prune back competing woody species. Increased cover from Speckled Alder (*Alnus incana* ssp. *rugosa*) is noted as a concern at the Stirrett and Medford subpopulations (Wallace, pers. comm. 2022).

Herbivory has been noted by Snowshoe Hare (*Lepus americanus*), White-tailed Deer (*Odocoileus virginianus*), and perhaps rodents, as well as seed parasitism by the plume moth (*Amblyptilia pica*), as summarized in USFWS (2018). It is difficult to determine the long-term effects of these natural factors to the Furbish's Lousewort population; however, given the very small population size, any amount likely affects the potential for recovery.

4. Transportation & service corridors

4.1: Roads & railroads

Road construction and maintenance is not known to be currently affecting Furbish's Lousewort directly in New Brunswick. Road construction adjacent to upper riverbanks occupied by Furbish's Lousewort has been noted as a factor that appears to be preventing landward migration of suitable shaded bank habitat as slumping and erosion takes place. Over time, erosion eats into river banks and causes tree fall further upslope and away from the river. In areas where roads are just a few metres back from the upper riverbank, the remnant band of trees may ultimately be lost entirely, leaving an open slope that would tend to be less suitable habitat for Furbish's Lousewort. This is noted as a factor at the Stirrett (Wallace, pers. comm.) and Big Flat (Toner, pers. comm.) subpopulations.

6. Human intrusions & disturbance

6.1: Recreational activities

There has been no evidence of consistent issues with recreational activities damaging Furbish's Lousewort plants or habitat at rivershore occurrences in New Brunswick. Damage has been

noted at the Aroostook subpopulation from all-terrain vehicles (CFS 2021) and from trail development as the site became the NB Trail after railway decommissioning (COSEWIC 2000). Neither situation was suggested as a primary driver of the decline in the subpopulation, which was attributed primarily to competition from shrubs and saplings, and accumulation of leaf litter.

1. Residential and Commercial Development

1.3: Tourism & recreation areas

Furbish's Lousewort habitat cannot support permanent structures because of flood impacts and there are few examples of human infrastructure in the immediate vicinity of New Brunswick subpopulations. A cabin has been constructed well up the bank at the Medford subpopulation, and similar construction of recreational or permanent dwellings could occur at other private land sites. The most likely impacts on lousewort would be via construction of stairways and paths down the banks to the river, and removal of shading trees to enhance river views. At present this is best considered a potential future threat.

7. Natural system modifications

7.3: Other ecosystem modifications: Loss of pollinators

Macior (1978) found that the Half-black Bumblebee (*Bombus vagans*) was the primary or perhaps the only effective pollinator of Furbish's Lousewort at a site in Maine. Other bumblebee species had tongues shorter than was required to obtain nectar via the floral tube and did not visit Furbish's Lousewort (*B. fervidus*, *B. ternarius*) and/or cut through the corolla to obtain nectar without pollination (*Bombus terricola*). USFWS (2018) suggested pollinator loss as a potential threat. Half-black Bumblebee is not among the bumblebees experiencing the greatest declines in the past 10-20 years (Colla et al. 2012) and is currently ranked S5 (Demonstrably Secure) in New Brunswick (AC CDC 2022). It is also unclear whether the Macior (1978) observations from a single site and single season apply broadly to all Furbish's Lousewort. The extent to which pollination limitation affects Furbish's Lousewort is thus unclear.

Limiting Factors: Furbish's Lousewort is associated with small patches of specialized habitats having a particular disturbance history, pH, moisture, shading and slope. Habitat specificity likely plays a large role in the rarity of Furbish's Lousewort.

There is also a time factor associated with successful establishment, considering the species' biology in combination with river dynamics. From the NB Recovery Strategy (2006): *“The interaction of disturbance events and other environmental factors suggests a limited window for establishment of Furbish’s lousewort (Gawler et al. 1987). The presence of even a small number of residual plants may enhance the probability of re-establishment of a subpopulation. Regeneration is favoured on a moss substrate, which generally requires three years post-disturbance to form. Given that plants in the wild do not produce seed until their third summer (Gawler et al. 1987), a minimum of six years would be required for establishment and reproduction following disturbance. An interval of ten years between disturbances is likely a more accurate estimate of the time required for a sub-population to achieve significant reproduction and to contribute to the overall survival of the species (Menges 1990).”* The more frequent and severe storms and weather occurring in recent years associated with climate change likely further reduces the chances of successful establishment.

Genetic fitness may be limited at sites with very small subpopulation sizes. Other intrinsic characteristics may limit the species' ability to disperse and establish in new areas. Alternatively, the species may have never had a large population and the resulting small pool of seeds produced annually is simply insufficient to effectively disperse to patchy suitable habitat on the Saint John River and to suitable habitat on other regional river systems.

Number of Locations: As noted under threats, loss of plants and habitat to flood-related erosion and ice scour events are considered here to be the primary threat to Furbish’s Lousewort by which locations are defined at all subpopulations, except for the near-extirpated Aroostook railway subpopulation that occurs above the annual flood line. Flood and ice scour events can act at the scale of a whole subpopulation, and they can be strongly correlated across subpopulations such that a year with heavy ice jamming and flooding might see major scouring at multiple subpopulations. The Grand Falls subpopulation is above the Grand Falls Dam, which reduces water level fluctuations and it would likely be best considered a separate location, but one might consider the subpopulations downstream from the Grand Falls Dam (Stirrett, Medford and Big Flat) to be a single location given that they could all be affected by the same flood event. The Aroostook subpopulation, down to zero plants in 2022, does not appear to represent a viable population and is not considered a location here. The number of locations is thus between two and four depending how the Stirrett, Medford and Big Flat sites are counted.

PROTECTION, STATUS AND RANKS:

Protection: Furbish's Lousewort receives the general prohibitions against harm afforded an Endangered Species under Canada's *Species at Risk Act* and New Brunswick's *Species at Risk Act*.

Legal listings:

- Canada's *Species at Risk Act*, Schedule 1: Endangered (June 6, 2003)
- New Brunswick *Species at Risk Act*, Endangered (2013), originally listed under New Brunswick *Endangered Species Act* in 1982 and again in 1996
- United States Endangered Species Act: Endangered (April 26, 1978; proposed Threatened 2021)

Non-legal Status / Ranks:

- Global Status: G1G2 (Critically Imperiled Globally. Last Reviewed March 10, 2020)
- COSEWIC: Endangered (Designated Endangered in April 1980. Status re-examined and confirmed Endangered in April 1998, May 2000, and May 2011.)
- Canada: N1 (= Critically Imperiled. Last reviewed 2015)
- New Brunswick S1 (= Critically Imperiled. Last reviewed 2020)
- United States: N1S2 (= Critically Imperiled to Imperiled)
- State ranks: S1S2 in Maine (=Critically Imperiled to Imperiled)
- All except COSEWIC status above are from NatureServe (2021).

Habitat Protection and Ownership:

In New Brunswick, the boundary of public land ownership along larger non-tidal watercourses is generally defined by the average or mean high water mark. Because Furbish's Lousewort is found below the average high water mark, some or most occurrences may be on Crown land, even in areas of privately owned water frontage. Riverfront landowners, however, are often not aware of or respectful of this ownership distinction and may alter shore frontage within the Crown land zone. The discussion below treats ownership of the adjacent shoreline as if it extends all the way to the low-water river shore.

The extant plants at the Stirrett subpopulation are within the Nature Trust of New Brunswick's Stirrett Nature Preserve, which protects the plants from development-related impacts but has not protected them from loss due to the impacts of succession and erosion. In past years this subpopulation also extended onto private land. The Grand Falls subpopulation and some plants at the Big Flat subpopulation are on land owned by the Crown corporation NB Power; the

Aroostook site is owned by NB DNRED. All other plants are on private land. Landowners have been contacted to make them aware of Furbish's Lousewort and their responsibilities given that the Furbish's Lousewort habitat on their land is designated as Survival Habitat under the NB *Species at Risk Act* and Critical Habitat under the federal *Species at Risk Act*. Furbish's Lousewort habitat is also subject to regulation under the NB *Clean Water Act*, Watercourse and Wetland Alteration Regulation (90-80), which requires that a permit be obtained for any activity within 30m of the shoreline.

BIOGRAPHICAL SUMMARY OF REPORT WRITER(S):

Sean Blaney is the Executive Director and Senior Scientist of the Atlantic Canada Conservation Data Centre, where he is responsible for maintaining status ranks and a rare species occurrence database for vascular plants in each of the three Maritime provinces. Since beginning with the AC CDC in 1999, he has discovered over 23,000 rare plant occurrences during extensive fieldwork across the Maritimes. Sean is a member of the COSEWIC Vascular Plant Species Specialist Subcommittee, the New Brunswick Committee on the Status of Species at Risk, the Nova Scotia Atlantic Coastal Plain Flora Recovery Team, and has authored or co-authored 23 COSEWIC and provincial status reports. Prior to employment with ACCDC, Sean received a B.Sc. in Biology (Botany Minor) from the University of Guelph and an M.Sc. in Plant Ecology from the University of Toronto and worked on biological inventory projects in Ontario as well as spending eight summers as a naturalist in Algonquin Park, where he co-authored the second edition of the park's plant checklist.

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Martin Williams of Canadian Forest Service and David Mazerolle of Kouchibouguac National Park (formerly of AC CDC) provided details on recent subpopulation counts. Mary Sabine and Maureen Toner of NB DNRED provided various references and background information.

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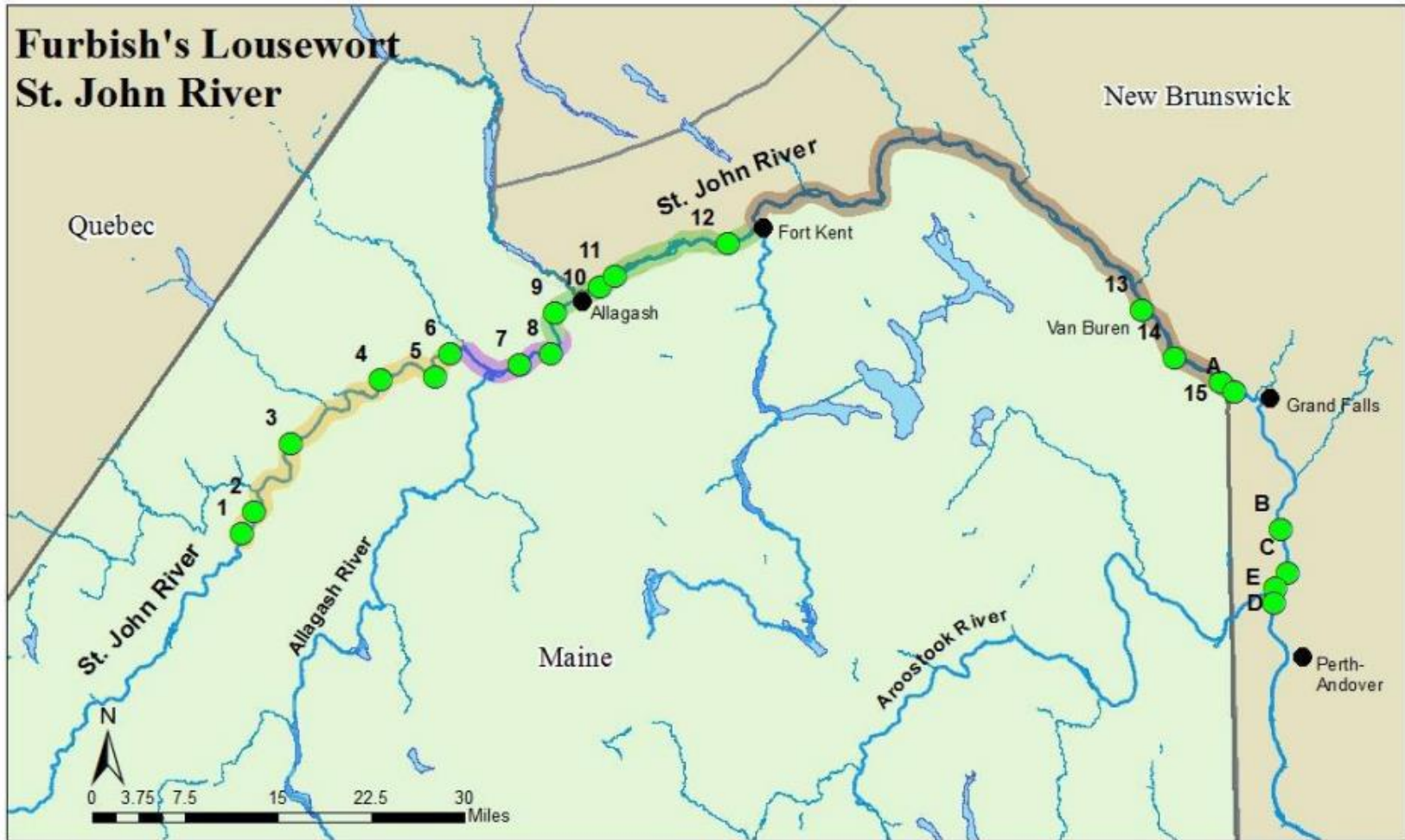
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377

378 **Figure 1.** Global distribution of Furbish’s Lousewort (*Pedicularis furbishiae*) in New Brunswick, Canada and Maine, United

379 States. Map from USFWS (2019).

380 Appendix A: Habitat notes and other details from herbarium records of 67 specimens of
 381 Furbish's Lousewort (*Pedicularis furbishiae*) collected between 1879-1977, held in 19
 382 herbaria/collections in North America and Europe, as compiled in Stirrett (1977)¹.
 383

Date	Collector	Location	Habitat notes	Specimen # in Stirrett 1977	Name of Herbarium / Institution ²
1878	J. Moser	Grand Falls, NB		38	QU
<i>(Note from Stirrett 1977- "Originally identified as <u>Ped. canadensis</u> verified as <u>Ped. Furbishiae</u> by B. Boivin. 1964.)</i>					
July 18, 1879	George U. Hay	Grand Falls, NB	"copses and banks"	33	NBM [# 2644]
Summer 1880	Kate Furbish	Van Buren, ME	"on St. John River where water trickled down its sides"		
<i>(Note from Stirrett 1977 – "At Van Buren, she [Kate Furbish] did find the plant which two years later was named after her. She recognized the plant as new to her because she wrote, 'Pedicularis N. Sp.? on St. John River where water trickled down its sides.'" [Furbish 1881 in Stirrett 1977])</i>					
Aug. 1882	J. E. Wetmore	Upper St. John River	"Banks of stream"	32	NBM [# 2643] <i>(Note from Stirrett 1977- "probably Andover")</i>
Aug 8, 1884	J. Vroom	Aroostook River, NB	"on the Aroostook River banks in New Brunswick"	10	BM-NH [#1709] <i>(Note from Stirrett 1977: 3 specimens collected by Vroom in 1884)</i>
Aug. 20, 1884	J. Vroom	Aroostook, NB	"wet banks"	28	NMC-NS [# 97558]
July 20, 1892	George A. Inch	Opposite Little River, Victoria Co, NB	"river bank"	34	NBM [# 2645]
July 26, 1893	M.L. Fernald	Van Buren, ME	"banks of St. John River"	14, 20	HU-GH, HU-NEBCH
Aug 17, 1893	M.L. Fernald	St. Francis, Aroostook Co, ME	"moist gravelly thickets"; "moist gravelly thickets along the St. John River"; "moist gravelly banks"	1, 6, 18, 30, 41, 59	ANS, AS-KBI, HU-GH, NMC-NS [# 188487], SMNH, UNH [#561]
July 23, 1900	Emile F. Williams	Fort Kent, ME	"winding ledges" of St. John River	46	UM
Aug 13, 1901	B.L. Robinson and M.L. Fernald	Van Buren, ME	Type station; "wooded alluvial banks of the St. John River"; "Banks of St. John River"	3, 7, 11, 12, 15, 21, 29, 42, 60	ANS, AS-KBI, BM-NH, CMNH, HU-GH, HU-NEBCH, NMC-NS [# 188486], SMNH, UNH

					(Note from Stirrett 1977: 20 specimens collected that day)
Aug 14, 1901	J.R. Churchill	Mouth of Aroostook River, NB	"woods"	13, 49	HU-GH, UM
July 9, 1904	Dana W. Fellows Meeting of Josselyn Botanical Society	Fort Kent, ME Frenchville, ME	"Hillside below town"; "Hillside thicket"	56, 57	UNH (Note in Stirrett 1977: 5 specimens collected at Fort Kent and Frenchville during the time of this meeting, July 6-10, 1904)
Aug. 17, 1907	Dana W. Fellows	Fort Kent, ME	"bank of St. John River"	62	UNH [#4439]
Aug. 11, 1908	Collector Unknown	Fort Kent, ME (2 miles above)	"upper border of gravel shore St. John River"	63	UNH
July 26, 1917	H. St. John and G.E. Nichols	Township XV, Range 13, Aroostook Co, ME	"Edges of woods along St. John River"	31	NMC-NS [# 188488]
July 7, 1943	Geo M. Stirrett	Grand Falls, NB	"shore of St. John River below Grand Falls. A station of 5 plants."	37	PRI
Aug. 19, 1977	Harold Hinds and Geo. M. Stirrett	Grand Falls, NB	"Moist gravelly area, west bank St. John River."	52	UNB

384

385 1: Stirrett, Geo. M. 1977. Report on the Investigations of the Flora of Northern Maine and Northern New
386 Brunswick with particular reference to *Pedicularis furbishiae* and other rare plants. 61 pp. Contract
387 number DACW 33-77-M-0885 with the Army Corps of Engineers.

388

389 2. Herbarium / Institution abbreviations:

- 390 ▪ ANS = Academy of Natural Sciences, Philadelphia, PA.
- 391 ▪ AS-KBI = Academy of Science, U.S.S.R., V.L. Komarov Botanical Institute, Leningrad, U.S.S.R.
- 392 ▪ BM-NH = British Museum (Natural History) London, England
- 393 ▪ CMNH = Carnegie Museum of Natural History, Pittsburg, PA.
- 394 ▪ HU-GH = Harvard University, Gray Herbarium, Cambridge, MA.
- 395 ▪ HU-NEBCH = Harvard University, New England Botanical Club Herbarium, Cambridge, MA.
- 396 ▪ NMC-NS = National Museum of Canada, Natural Sciences, Ottawa, ON.
- 397 ▪ NBM = New Brunswick Museum, Saint John, NB

- 398 ▪ PRI = Plant Research Institute, Canada Agriculture, Ottawa, ON.
- 399 ▪ QU = Queen’s University, Fowler Herbarium, Kingston, ON.
- 400 ▪ SMNH = Swedish Museum of Natural History, Stockholm, Sweden.
- 401 ▪ UM = University of Maine, Dept. of Botany
- 402 ▪ UNB = University of New Brunswick Herbarium, Fredericton, NB.
- 403 ▪ UNH = University of New Hampshire, Herbarium, Portland Society of Natural History, Durham,
- 404 NH.
- 405

406 Appendix B: Counts of Furbish's Lousewort (*Pedicularis furbishiae*) at each site known in New Brunswick between 1977-2014,
 407 along with field notes and/or New Brunswick Department of Natural Resources and Energy Development (DNRED) comments (in
 408 italics) providing details and important context on search effort and survey methods.

Site	Year	Total	In Flower	Field Lead	Field Notes and <i>DNRED Comments</i>
Above Grand Falls	1979	254+	154+	G. Stirrett	Information from Stirrett 1980 where he states, "The following is taken mostly from Stirrett (1977D. App. 1), but updated by person investigations during the summers of 1978 and 1970."
	1981	102		Robin T. Day	Robin T. Day. 1983. Can. Field Naturalist Note: Search assumed to be less extensive, as Day says "In 1977, Stirrett and Tribe made a more extensive survey of this site along 1.2 miles of the riverbank and they found 'about 254+ plants': 154 flowering plants and 100 young non-flowering plants. (Stirrett 1977, 1980). There has been little disturbance to these populations since 1977, and therefore 254+ plants is probably the best estimate of current numbers."
	1982	117		D. Brown	<i>Note: little information on methods</i>
	1983	125			In Drummond 1987. <i>Note: I have not found the original source of these data, but the report includes data from 1981-1984, plus 1987 - it may be that NBDNR conducted counts in 1982, 1983, 1984 and clearly in 1987.</i>
					No 1984 data for this site in Drummond 1987
	1987	120	41		Drummond 1987. Noted that some plants may have been missed - high water levels prevented search of some areas of shoreline. Also, some plants that were counted may have been in the US, as the border was not marked. Drummond believed that these factors would have been insignificant to the overall count.
	1998	75	N/A	A. MacDougall	MacDougall 1998 Site visit June 15. Thorough search from old TCH bridge to US border (~2.5k). No GPS data.
	1999	171		Sullivan & Toner	Sullivan & Toner 1999 June 11. Total = 171. Found rods for MacDougall's stations 3-8, time did not allow for searching for stations 1 & 2 (where MacDougall had found a total of 3 plants in 1998), as the starting point was too far from bridge. Station adjacent to boat launch did not seem to correspond to any of MacDougall's stations. <i>Note: Search may have been more intensive than MacDougall's, with mature plants found at a station that did not seem to be included in 1998 data.</i>

Site	Year	Total	In Flower	Field Lead	Field Notes and <i>DNRED</i> Comments
	2001	298	115	Hoyt & Newell	Aug. 8, 2001. Total count = 298; 115 plants were in flower. Thorough search (6.5 hrs) - Grand Falls bridge to the US border.
	2002	243	105	Bishop	Bishop, Gart. July 31 - Aug 1, 2002. for NTN. Thorough search. Total count =243 plants; 105 in flower
	2003	264		Bishop	B&B Botanical 2003. thorough search and assessment of associated bryophyte species.
	2008	68		R. Fournier	Data reported to NBDNR 2008. Surveys conducted June 2,3 and 9 - team of one.
	2014	62		Bishop (& Bagnell)	July 21-24. Thorough searches, with 100 m upstream and downstream from the last plant. Report for ECCC re critical habitat delineation.
Stirrett Preserve	1977	70+	44		Note: August 20, 1977 from Stirrett 1977 in Stirrett 1980
	1979	115+	69+		Census on June 26, 1979. From Stirrett (1980); "They are scattered in 10 stations along 0.8 miles of river bank. Count taken in 1979." <i>Note: the property was purchased for conservation in 1989; the George Stirrett Preserve was established in 1992. The preserve (< 1 km) does not appear to include the full length of shoreline described by Stirrett (1980) for the early counts (0.8 miles). The mouth of the Little River is a common feature for pre and post - Preserve counts. However, the 2001 and 2002 surveys extended further downstream, adding another 11 plants (all in flower in 2001, 9 in flower in 2002)) to the Preserve count. These additional plants were not found in 2004. It was also extended a short distance upstream to include the area that was likely part of the original surveys. The 3 plants (in flower) found at this site in 2001 may have been the progeny of the (14?) translocated to the site by Fred Tribe, who grew them from seed. Note - Little River to end of Preserve is 0.6km</i>
	1981	212		Robin Day	"Prolonged searching during my 1981 census led to the discovery of 212 plants along 1.5 km of riverbank south of the Little River delta." (Day 1983) <i>Note: Robin T. Day. 1983. Can. Field Naturalist</i>
	1982	213		D. Brown	Site referred to as Little River
	1983	175			In Drummond 1987. <i>Note: I have not found the original source of these data, but the report includes data from 1981-1984, plus 1987 - it may be that NBDNR conducted counts in 1982, 1983, 1984 and clearly in 1987.</i>
	1984	225			August 20, 1977 from Stirrett 1977 in Stirrett 1980

Site	Year	Total	In Flower	Field Lead	Field Notes and <i>DNRED</i> Comments
	1987	165	28		Notes in Drummond: he considered this a decline, citing the severity of the previous winter as the most plausible explanation. "Trees high up on the shore have ice-scarred trunks. Much of the soil along the shore no longer exists." Then "Several hundred meters downstream from the mouth of the Little River, a different sort of problem faces the louseworts. Dense vegetation consisting mainly of Speckled Alder (<i>Alnus incana</i> (L) Moench. ssp. <i>rugosa</i> (Du Roi) Clausen) provides heavy competition for any lousewort attempting to grow here. It also makes searching for them impossible. However, the odds that a lousewort would be found growing here are slim so the count should not be affected by this inability to search. The louseworts tended to be congregated in areas which did not receive the full brunt of the spring run-off. Several were found near the base of trees that were toppled over. The tree trunks acted as icebreakers, preventing erosion and shielding the louseworts. In areas where they were found, they were often packed together very densely. For example, in one 7 m ² area of river bank, 50 plants were found."
	1991	313+	112	Patricia O'Brien	Patricia O'Brien. Steward for NTN B at Stirrett Preserve. Data shared with NBDNR.
	1996	136	90	Patricia O'Brien	Patricia O'Brien. Steward for NTN B at Stirrett Preserve. Data shared with NBDNR.
	1998	50		NBDNRE	
	1999	65		Patricia O'Brien	NBDNRE database
	2000	62		NBDNRE	NBDNRE database
	2001	133		Hoyt and Newell	very thorough search. <i>Note: Preserve only</i>
	2001b	11	11	Hoyt and Newell	<i>Note: ~150 m downstream of Stirrett Preserve</i>
	2001c	3		Hoyt and Newell	<i>Note: just upstream of preserve - perhaps progeny of translocation plants from seed by Fred Tribe</i>
	2002	126	66	Bishop	Bishop 2002
	2002b	11	9	Bishop	Bishop 2002. <i>Note: ~150 m downstream of Stirrett Preserve</i>
	2003	104			B&B Botanical 2003

Site	Year	Total	In Flower	Field Lead	Field Notes and DNRED Comments
	2006	46	36	NBDNR& NTNB	NBDNR database
	2007	43		NBDNR& NTNB & NBPower	
	2008	41		R. Fournier	Data shared with NBDNR 2008. Surveys conducted June 2,3 and 9 - team of one.
	2014	4			B&B Botanical 2014. Searched 3 km river section from Little River downstream.
Aroostook	1978	33+			<i>Note: Stirrett 1978 in Stirrett 1980</i>
	1981	80		R. Day	<i>Note: Robin T. Day. 1983. Can. Field Naturalist</i>
	1982	125		D. Brown	Referred to as Railway Site. Brown notes "The embankment has been kept clear of large bushes and trees by the railway company's cutting and spraying.....In recent years, the railway company has agreed not to disturb the site, and the population of these plants has increased. (However, it will be interesting to note over the next few years if the lack of disturbance, with a subsequent increase in competition, will affect the louseworts.)" <i>Note: this site is away from the river.</i>
	1983	231			In Drummond 1987. <i>Note: I have not found the original source of these data, but the report includes data from 1981-1984, plus 1987 - it may be that NBDNR conducted these counts, as there is a reference to Brown for 1984. in 1982, 1983, 1984 and clearly in 1987.</i>
	1984	234			Brown 1984 is referenced in Drummond 1987
	1987	171	50		Drummond 1987. Two hypotheses presented for the decline: competition (vegetation now 0.5m high) and human error (due to dense vegetation).
	1991	50+	12	Patricia O'Brien	Steward for Stirrett Preserve - data shared with NBDNR
	1999	42	42	Patricia O'Brien	Steward for Stirrett Preserve - data shared with NBDNR
	2000	84			DNRE database
	2001	314	163		Hoyt and Newell, 2001
	2002	224	97	Bishop	Bishop 2002
2003	204			B&B Botanical 2003	

Site	Year	Total	In Flower	Field Lead	Field Notes and DNRED Comments
	2006	388		NTNB + NBDNR	mid-June
	2007	241		NTNB + NBDNR + NBPower	Aug
	2008	198		R. Fournier	Data shared with NBDNR 2008. Surveys conducted June 2, 3 and 9 - team of one.
	2014	20		Bishop	B&B Botanical 2014
Medford discovered in 2002	2002	187	61		
	2003	171			B&B Botanical 2003
	2008	204		R. Fournier	Data shared with NBDNR 2008
	2014	36		Bishop	B&B Botanical 2014
Big Flat discovered in 2002	2002	124	99	Bishop	Bishop 2002
	2003	131		Bishop and Bagnell	B&B Botanical 2003
	2008	48		R. Fournier	Data shared with NBDNR 2008. Surveys conducted June 2, 3 and 9 - team of one.
	2014	35		Bishop	B&B Botanical 2014

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