



## CANADIAN FOREST SERVICE

# Furbish's lousewort:

## Using science to protect and restore an endangered plant in Canada

IMPACT NOTE NO. 66

Furbish's lousewort (*Pedicularis furbishiae*) is a rare perennial plant that is found only in the province of New Brunswick and the state of Maine. In Canada, the plant was designated endangered by the Committee on the Status of Endangered Wildlife in Canada in 1980 and listed as such in New Brunswick since 1982.

Furbish's lousewort is protected under Schedule 1 of the federal *Species at Risk Act* and the *New Brunswick Species at Risk Act*. Canadian Forest Service (CFS) researchers at Natural Resources Canada (NRCan), in collaboration with many other Canadian and United States partners, are contributing to its recovery strategy. They are researching genomics and species restoration to help the long-term protection and restoration of the species.

### Life cycle

The plant starts out as a basal rosette of fern-like leaves (Figure 1A). Like most *Pedicularis* species, it is a hemiparasite that attaches to a host to obtain part of its nutrition.

After about three years, mature plants produce one or more flowering stems (Figure 1B). By mid to late summer, the flowers are pollinated by the half-black bumblebee (*Bombus vagans*) (Figure 1C), which is the only species known to pollinate Furbish's lousewort.

Egg-shaped seed capsules mature in late September and release seed soon thereafter (Figure 1D). With no known dispersal vectors, most seed will end up colonizing around the parent plant. Some migration is possible by water in hope of finding other suitable habitat where a new colony can begin.

Furbish's lousewort is found in the traditional territory of the Wolastoqey Nations, including one site less than 1 kilometre from the Tobique First Nation (Negotkuk). The plant is endemic to the riverbanks of the Saint John River, in both New Brunswick and Maine (Figure 2), which makes it the *Pedicularis* species with the most restricted distribution in the world.

The plant exists in a harsh environment, growing along riverbanks that are subject to natural disturbances such as flooding and ice scouring. Furbish's lousewort actually relies on these disturbances to remove competing vegetation and create new seedbeds for the establishment of new plants.

This situation is a double-edged sword because the disturbances necessary for the establishment of new sites also cause the destruction of existing habitat. For this reason, Furbish's lousewort is often referred to as a fugitive species because it disappears and reappears in different areas over time as habitat is created and destroyed.

**Figure 1.** A) A mature Furbish's lousewort plant emerging in the spring, B) Multiple inflorescences at the tip of a 50 to 80 cm high stalk appearing in midsummer to late summer, C) A half-black bumblebee (*Bombus vagans*) pollinating a Furbish's lousewort inflorescence, D) Furbish's lousewort seed isolated from capsules

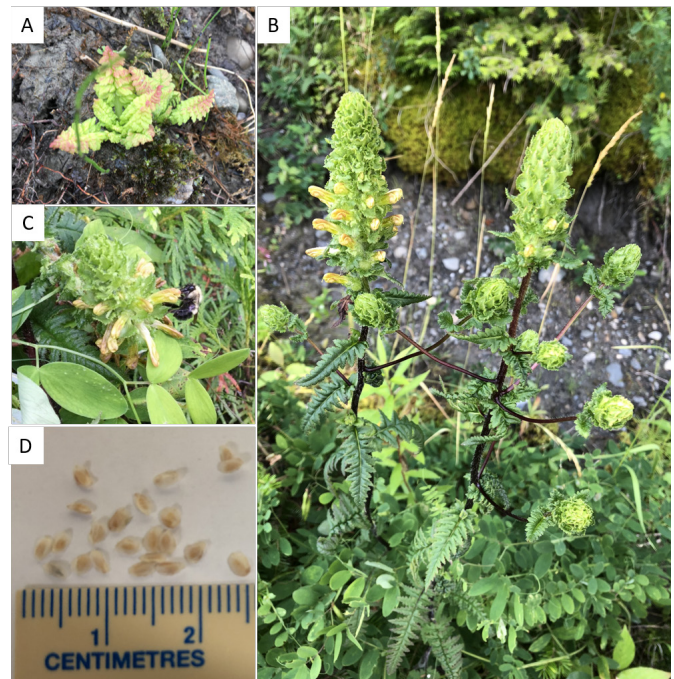
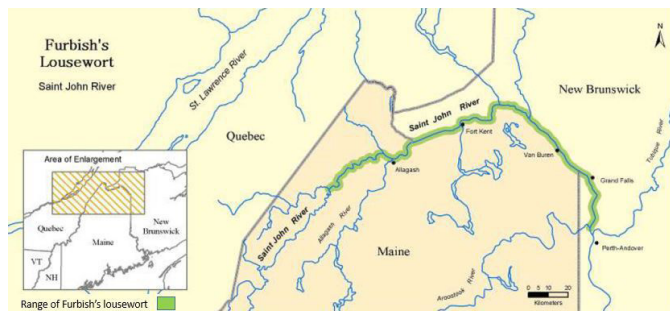


Figure 2. Global range of Furbish's lousewort



Resource: Adapted [reprinted] Furbish's Lousewort Recovery Team. 2006. *Recovery strategy for Furbish's lousewort (Pedicularis furbishiae) in New Brunswick*. New Brunswick Department of Natural Resources

## Population decline

Very little is known about the Furbish's lousewort, which was discovered in the late 1800s by American botanist Kate Furbish. In 1975, the Smithsonian Institute listed the species as rare and probably extinct. However, in 1976, the species was "re-discovered" during an environmental assessment for the Dickey-Lincoln dam project in Maine. The plant was also re-discovered in New Brunswick in 1977 by George M. Stirrett as part of a survey associated with an environmental assessment of the same Dickey-Lincoln dam project.

The data on populations of Furbish's lousewort in New Brunswick and Maine prior to 1977 is limited. However, it is believed that this plant was once more common and that populations were affected by natural causes and/or anthropogenic factors.

Shorelines are changed by ice scouring or flooding, and severe weather events associated with climate change are likely to increase both, resulting in more habitat loss.

The human factors that disturb sites include the construction of dams, the creation of large reservoirs, tree clearing for road

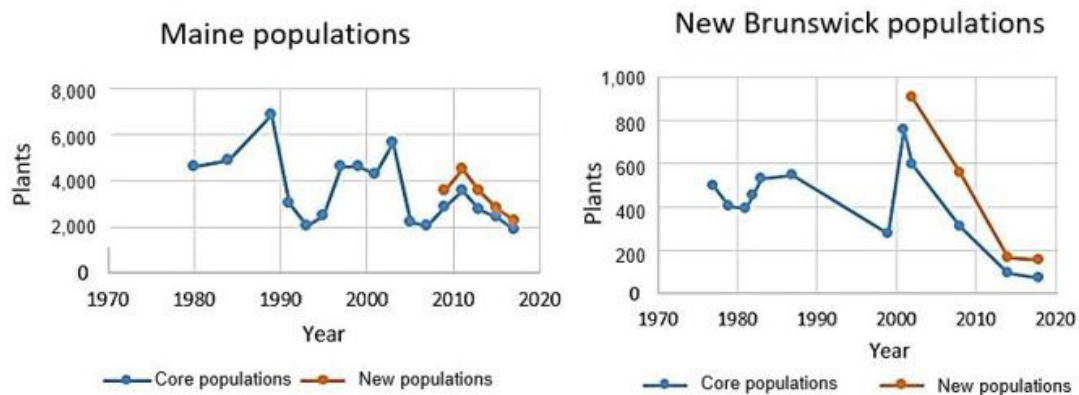
building, and more localized threats such as gravel pits and dumping.

It is believed that these factors have all contributed to the loss of suitable habitat and to population decline over the years.

Presently, there are only 20 known sites: 15 are in Maine and 3 of the 5 in New Brunswick are at imminent risk of being lost. The subpopulations in Maine, especially those in the upper part of its range along the Saint John River, are more stable than populations located further downriver in New Brunswick and in Maine.

Although fluctuations in subpopulations have occurred over the past 40 years, the trend has been a gradual decrease in numbers (Figure 3). In 1989, surveys in Maine recorded 6,836 mature plants. In 2017, that number was down to 2,240, with about one third of the core sites no longer having any plants. The trend for the populations in New Brunswick is similar, with 904 plants surveyed in 2002 and only 187 plants surveyed during the last count in 2019.

Figure 3. Populations of Furbish's lousewort



Resource: Adapted [Reprinted] from the U.S. Fish and Wildlife Service. 2018. *Species Status Assessment Report for (Pedicularis furbishiae) Furbish's Lousewort*. Version 1.1. Ecological services Maine Field Office. East Orland, Maine.

## Science for recovery and protection

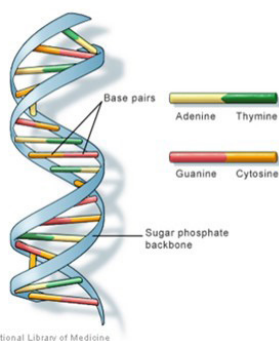
In 2006, the Furbish's Lousewort Recovery Team (see References) prepared a recovery strategy for the plant in New Brunswick, and Environment Canada subsequently adopted the strategy. The recovery strategy is contained in six broad themes:

- Population and site management stewardship
- Protection of a species and its habitat
- Monitoring to track changes in populations
- Scientific research to fill knowledge gaps
- Establishment of new sites
- Stewardship and education for the general public

The CFS is contributing to recovery efforts focusing on species protection and scientific research through three main objectives: genomics, ex situ cryopreservation, and field bank establishment (Figure 4). These objectives will help support other themes that are directly involved in natural population recovery by enhancing the number of plants at existing sites or by establishing new ones.

Figure 4: The main research project objectives

### Genomics



### Genomics

Although it is recognized that biodiversity at the ecosystem and species level is important, diversity at the genetic level is often overlooked but critical for the long-term adaptation and resilience of the species.

In this project, range-wide genomics work will help assess diversity within and between the subpopulations found in New Brunswick and Maine.

This work consists of collecting leaf samples from populations throughout the species range, isolating the DNA and using next generation sequencing technology to find these genetic differences. The data will be used to guide the ex situ cryopreservation program and support decision-making for species recovery. Genome sequencing and annotation of one Furbish's lousewort plant from the Grand Falls, New Brunswick, subpopulation is also

### Ex situ cryostorage program



underway, in collaboration with the Field Museum (Chicago, Illinois) and Canada 150 Sequencing Initiative from Canada's Genomic Enterprise.

### Ex situ cryostorage program

Seed preservation is an easy and inexpensive method to store species genetic diversity. The ex situ conservation program will include the collection, testing and cryopreservation of seed lots from across the range of Furbish's lousewort.

Storage at a very low temperature (-196°C) in liquid nitrogen can ensure long-term seed viability. The storage is especially important for seed from endangered species because the seed cannot be tested extensively because of its limited quantities.

Research on developing methods to efficiently cryostore and regenerate plants by using in vitro germination is key for the production of the plants that will

### Field bank establishment



be used to populate the field banks.

Presently, 28 seed lots from New Brunswick and 34 seed lots from Maine are stored at NRCan's [National Tree Seed Centre](#), which is the only national seed bank preserving the genetic diversity of Canada's forests.

### Field bank establishment

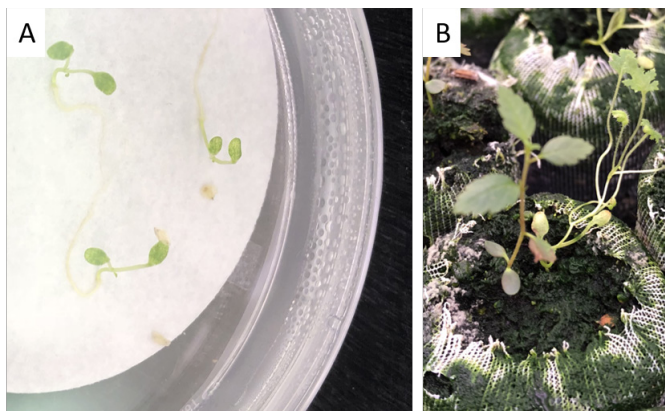
Field banks are areas planted with the objective of enhancing seed and plant production (Figure 5). A field bank for Furbish's lousewort was established in fall 2020 in Grand Falls, New Brunswick, and another is planned in 2021 at the Acadia Research Forest, in Noonan, New Brunswick.

The field banks will use seed from the National Tree Seed Centre and will provide a back up representing a selection of the diversity across the range. The field banks will ensure that the plants are grown in a location where ice scouring, flooding and habitat loss are not threats.

Bringing plants from different subpopulations within the field bank will allow us to maximize the remaining genetic diversity of the seed sources. Once the field bank plants mature and produce seed, the seed will be used as part of future recovery strategies to enhance plant numbers on existing sites or to colonize new sites.

Through these research objectives, CFS science will contribute to the recovery strategy of this rare endangered plant in hope of fully restoring this species.

**Figure 5. A) Furbish's lousewort germinants after 21 days. Each germinant contains two first leaves (cotyledons), which will provide photosynthetic capabilities until the first true leaves emerge. B) Furbish's lousewort seedling with its speckled alder host (front)**



## Partnering for recovery

The survival of Furbish's lousewort can be achieved only through a strong commitment from stakeholders and collaborators. The New Brunswick Department of Natural Resources and Energy Development led the recovery planning process and continues as a principle collaborator on recent recovery efforts.

Many other key collaborators including the University of New Brunswick, the Nature Trust of New Brunswick, Tobique First Nation (Negotkuk), Atlantic Canada Conservation Data Centre, Environment and Climate Change Canada-Canadian Wildlife Service are involved in monitoring the species and discussions for species restoration.

In addition to Canadian collaborators, the U.S. Fish and Wildlife Service and the Field Museum (Chicago, Illinois) are also collaborating in this effort. J.D. Irving, Limited and NRCan are providing sites for the establishment of field banks. Funding for the CFS project activities is supported by NRCan-CFS, Environment and Climate Change Canada, the Critical Habitat Interdepartmental Program, and the Canada 150 Sequencing Initiative.

## References

- Furbish's Lousewort Recovery Team. 2006. *Recovery Strategy for Furbish's Lousewort (Pedicularis furbishiae) in New Brunswick*. New Brunswick Department of Natural Resources. Fredericton, New Brunswick.
- U.S. Fish and Wildlife Service. 2018. *Species Status Assessment Report for (Pedicularis furbishiae) Furbish's Lousewort*. Version 1.1. Ecological services Maine Field Office. East Orland, Maine. 59 pages plus 3 appendices.

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