

Furbish's lousewort (*Pedicularis furbishiae*)

**FIVE-YEAR REVIEW:
Summary and Evaluation**

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5-YEAR REVIEW

Species reviewed: Furbish's lousewort (*Pedicularis furbishiae*)

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**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW**

January 2007

Species reviewed: *Pedicularis furbishiae*, Furbish lousewort (now referred to as Furbish's lousewort)

1.0 GENERAL INFORMATION

1.1 Reviewers

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1.2 Methodology Used to Complete the Review: This 5-year review was initiated in conjunction with a status review for a 90-day finding on a petition to delist the Furbish's lousewort (70 FR 46467-46470). The review, conducted by Mark McCollough, USFWS Maine Field Office, consisted of an evaluation of the recovery objectives and criteria in the Revised Furbish Lousewort Recovery Plan (1991), review of recent survey and research findings provided by the Maine Natural Areas Program and Dr. Sue Gawler, and an analysis of the five ESA listing factors. To facilitate the five-factor analysis, a threats assessment was completed with the assistance of Don Cameron and Mark Ward, ecologists with the Maine Natural Areas Program (Appendix A).

1.3 Background

1.3.1 FR Notice announcing initiation of this review: August 10, 2005 (70 FR 46467-46470): 90-Day Finding on a Petition To Delist *Pedicularis furbishiae* (Furbish lousewort) and Initiation of a 5-Year Status Review

1.3.2 Listing history:

Original listing

FR Notice: 43 FR 17910-17916, Final Determination the Eleven Plant Taxa are Endangered and Two Plant Taxa are Threatened Species
Date listed: April 26, 1978
Entity listed: Species, *Pedicularis furbishiae*, Furbish lousewort
Classification: Endangered

Revised listing

In 1988 the Service had informal discussions about reclassification of the lousewort from an endangered to a threatened species. These discussions induced concern about the lack of complete survey data, especially because of the dynamic nature of the habitat and populations. Concern was also expressed about lack of understanding of population dynamics and viability. Recognizing that the recovery objectives in the 1983 recovery plan were no longer relevant, the Service recommended revision of the recovery plan in lieu of proceeding with a downlisting proposal.

- 1.3.3 Associated rulemakings/actions:** A petition to delist *Pedicularis furbishiae*, dated February 3, 1997, was submitted by Rob Gordon on behalf of the National Wilderness Institute. The petition requested that the Service remove the Furbish's lousewort from the List of Endangered and Threatened Wildlife and Plants on the basis of data error. The Service found that the petition did not provide substantial information and was not warranted (70 FR 46467-46470). The Service also used the petition finding as a means of notifying the public of its intent to initiate a 5-year status review for the species in FY2006.

Critical habitat has not been designated for this species.

- 1.3.4 Review history:** The Furbish's lousewort was included in a cursory 5-year review conducted for all species listed before 1991 (56 FR 56882, November 6, 1991). No formal 5-year reviews have been conducted for the lousewort since then; however, the 1982 recovery plan and 1991 revised recovery plan for this species have included assessments of its status.
- 1.3.5 Species' Recovery Priority Number at start of 5-year review:** 14 (TESS database). Ranked as a species with low threats and high recovery potential.

1.3.6 Recovery plan:

Name of plan: Revised Furbish lousewort (*Pedicularis furbishiae*)
Recovery Plan
Date issued: July 2, 1991
Date(s) of previous plan/revision(s): November 1982

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) Policy

2.1.1 **Is the species under review a vertebrate?** No, the species is a plant; therefore, the DPS policy is not applicable.

2.2 Recovery Criteria

2.2.1 **Does the species have a final, approved recovery plan containing objective, measurable recovery criteria?** It does to some degree. A recovery plan was approved 1983 and revised in 1991. Criteria for reclassifying the Furbish's lousewort from endangered to threatened (i.e., downlisting) are included in the 1991 plan; however, delisting criteria were not provided due to lack of information on long-term population dynamics and viability. In conjunction with the specified criteria, the plan recommends that the population be distributed throughout various river segments to maintain its historic distribution and prevent concentration of plants in a small number of river segments. Table 5 (p. 34) in the recovery plan provides targets for the distribution of populations and protected habitat by river section.

2.2.2 Adequacy of recovery criteria:

2.2.2.1 **Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?** No. Given that the revised plan is 15 years old, recent population data are not incorporated into the recovery criteria. The plan lacks recent published and unpublished scientific information on the Furbish's lousewort and its habitat.

2.2.2.2 **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?** No. Although the habitat protection criterion is applicable to listing factor A (the present or threatened destruction, modification, or curtailment of habitat or range), the recovery criteria do not address factors B-E (overutilization, disease or predation, inadequacy of existing regulatory mechanisms, or other natural or manmade factors affecting the species' continued existence). Further, although the plan generally describes threats to the species and its habitat (pp.27-29), the threats are not categorized under the five ESA listing factors.

2.2.3 Discussion of how each criterion has or has not been met, citing information:

Recovery Criterion 1: A geometric mean of 7,000 flowering stems has been maintained for a period of 6 years.

Total numbers of flowering stems, spanning 25 years of bi-annual counts (Maine Natural Areas Program, unpubl. data 2005) are provided in Table 1 on the following page.

Table 1. Flowering stem counts, 1980-2005

Year	Total number of flowering stems
1980	5,032
1984	4,878
1989	6,889
1991	3,065
1993	2,042
1995	2,460
1997	4,619
1999	4,627
2001	4,293
2003	5,627
2005	2,398

In addition to meeting the total population objective, the plan recommends that the population be distributed among 4 major segments of the St. John River, each containing 10-16 metapopulations. A map delineating the four river segments can be found in Figure 3 (page 7) of the 1991 recovery plan. River segment 1 is upriver of the Dickey Checkpoint (Allagash Plantation), segment 2 is from Dickey Checkpoint to the St. Francis Checkpoint (St. Francis), segment 3 is from the St. Francis Checkpoint to Fort Kent, and segment 4 is from Fort Kent to Hamlin on the Maine-New Brunswick border.

The distribution targets for the four river segments are as follows: 2,100 stems in segments 1, 2, and 3, and 700 stems in segment 4. In Table 2 below, flowering stem counts have been converted to geometric means relative to recovery population objective for each river segment.

Table 2. Population objectives by river segment and geometric means for 7 periods, 1980-2005

River segment	Population objective	1980-1989 geometric mean	1991-1995 geometric mean	1993-1997 geometric mean	1995-1999 geometric mean	1997-2001 geometric mean	1999-2003 geometric mean	2001-2005 geometric mean
1 (upriver)	+ 2100 stems	1177	1476	1552	1602	1600	1491	1367
2	+ 2100 stems	2511	484	592	1059	1697	2300	1402
3	+ 2100 stems	1618	464	651	949	1006	954	799
4 (downriver)	+ 700 stems	37	13	18	29	37	43	46
TOTAL	7000 stems	5343	2437	2813	3639	4340	4788	3614

The figures in Tables 1 and 2 indicate that Recovery Criterion 1, including both its abundance and distribution components, has been partially but not fully met. It should be noted that the 1991 downlisting criteria were coincidentally developed after the 1989 survey of 6,889 flowering stems, the largest population on record. This led to the conclusion that a population of 7,000 flowering stems was an achievable objective. That same year, however, one of the most formidable ice-scouring events in decades reshaped large portions of the river bank communities, and the Furbish's lousewort population was reduced by more than 50%. After 10 years, populations recovered but did not return to 1989 levels. An extensive ice-scouring event occurred again in the winter of 2004 and resulted in a population decline. These dynamics appear to preclude attainment of the downlisting population objective in the recovery plan.

Recovery Criterion 2: Fifty percent of the species' essential habitat is permanently protected. (Essential habitat consists of existing lousewort-occupied areas, and, given favorable conditions, potential habitat. Permanently protected means the habitat has been protected by acquisition, conservation easement, or deeded restrictions.)

The plan also recommends that habitat be protected in all four river segments commensurate to the amount needed to attain plant distribution objectives. The status of protecting Furbish's lousewort river habitat is summarized in the Table 3 below.

Table 3. Furbish's lousewort habitat protection

River segment	Miles of active habitat	Miles of potential habitat	Total miles of habitat	Miles of protected habitat	Habitat protection goal
1	11.18	2.96	14.14	4.8	7 mi.
2	5.05	0.46	5.52	0	2-4 mi.
3	2.26	0.25	2.52	0	≥2 mi.
4	<0.25	Not mapped	<1.00	0	Not specified

The first permanent protection of lousewort habitat was secured in the year 2000 when the Maine Chapter of The Nature Conservancy purchased 8 miles of river frontage from the Pingree heirs. In 2001, The Nature Conservancy acquired additional conservation easements on 5.2 miles of the river. Within these areas, there are 4.8 miles of active and potential lousewort habitat. Other corporate lands upriver of Allagash are protected under the St. John River Resource Protection Plan; however, this does not constitute permanent protection. One important stretch of lousewort habitat, the Maine Bureau of Parks and Lands' Allagash Lot (hundreds of feet of riverfront), is under restricted management directed at maintaining habitat quality.

These acquisitions and easements protect many high-quality lousewort populations and areas of potential habitat, encompassing approximately 4.8 of 18.85 miles (25%) of active and potential habitat. Nonetheless, habitat protection has occurred only in river

segment 1; thus, the quantity and distribution of protected lousewort habitat falls short of the downlisting objective.

2.3 Updated Information and Current Species Status

2.3.1 Biology and habitat:

2.3.1.1 New information on the species' biology and life history: Rangewide population trends have been tracked since 1980, and population viability has been modeled (Menges and Gawler 1986, Menges 1988, Menges 1990). Populations are monitored by counting flowering stems in much the same way as they have been since the early 1980s. Recent *de novo* surveys have found a few new, small populations farther upstream on the St. John River.

2.3.1.2 Abundance, population trends, demographic features and/or trends: After 25 years of monitoring the population and habitat conditions, it is apparent that abundance levels are tied to disturbance patterns within a narrow ice-scour zone. Periodic ice-scour events greatly reduce or eliminate populations but are essential to the species' survival in that they reduce competition from shrubby plants and create conditions suitable for seed germination and growth of lousewort seedlings. Immediately after ice scouring, populations decline substantially or disappear entirely, but population depression is usually temporary. If no severe ice scouring occurs in subsequent years, within 5 to 8 years reproducing populations begin to reestablish from seed sources present in the soil, from seeds of plants higher on the banks that escape scouring, or from seed drifting in the water. Within 10 to 12 years, shrubby vegetation and rank grasses usually begin to dominate the riverbank community and diminish habitat quality for the lousewort. Clearly, ice and flood events are important to the plant's survival and ecology

Although ice scour events occur annually along the St. John River, their extent and location are variable. Severe events occurred in 1984, 1991, and 2004 and were of sufficient extent and magnitude to cause substantial lousewort population declines; however, these events also created widespread conditions for future population growth. From a long-term perspective, lousewort abundance fluctuates in different reaches of the river depending on the periodicity and severity of ice-scour events. Ice scour does not affect all riverbank areas equally, and it is believed that the river reaches supporting the lousewort are among those most prone to regular ice scouring.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation: Modern genetic analyses have not been done for the Furbish's lousewort. In electrophoretic studies (Gawler et al. 1986, Waller et al. 1988), little if any genetic variation was detected, suggesting this endemic species has gone through a relatively recent population/genetic bottleneck, likely at the time the population was founded. Menges (1990) cautioned that the lack of genetic variation in the

lousewort could inhibit its ability to adapt to changes in the environment. The plant's flowers are pollinated by bumblebees, which are abundant along the river; thus, pollination does not seem to be limiting.

2.3.1.4 Taxonomic classification or changes in nomenclature: There have been no changes to the taxonomy and nomenclature of the Furbish's lousewort.

2.3.1.5 Spatial distribution, trends in spatial distribution, and/or historic range: The Furbish's lousewort is endemic to the St. John River valley, where it occurs along the St. John River, primarily on the south bank, within approximately 23 miles of the 165-mile stretch between the Big Black River and the Maine border with New Brunswick. The plant's distribution is well-documented in the 1991 recovery plan. Since that time a few new, small lousewort populations have been found, most notably upriver of the confluence of the Big Black and St. John Rivers; however, these new discoveries do not significantly influence the conclusions reached in the 1991 recovery plan, nor will they greatly influence population goals needed for recovery. Searches outside the river valley have not yielded discovery of any additional populations.

2.3.1.6 Habitat or ecosystem conditions: As explained in the 1991 recovery plan revision, lousewort habitat is confined to a narrow band (often less than 2m) of eroding riverbank below the forest edge and above the river bed. Louseworts grow almost exclusively on the north- or west-facing bank, indicating the importance of afternoon shade; in addition, shading, which depresses competing vegetation, is needed for seedling survival. Consequently, the riverbank shading provided by a forested riparian buffer is important to maintain the microclimate preferred by the lousewort and to provide a refugium for individual plants that escape catastrophic ice-scour.

The substrate on which Furbish's lousewort occurs consists of glacial lacustrine or till deposits as well as on post-glacial overbank or vertical accretion deposits (Gawler et al. 1987). Overall, louseworts tend to be found on steeper slopes, in wetter soils, in areas where the last catastrophic disturbance was 3-10 years ago, and/or in areas of high species richness (Gawler 1988). Louseworts are generally absent from areas of dense vegetation and from very open habitats. Entire populations may be eliminated by an ice-scour event. Ice-scour and slumping also can be destructive to individual plants; nevertheless, these events are essential for maintaining the mid-successional habitat the species requires.

From 1980 until the present time, each river reach supporting the species has been visited every other year; these visits have provided a long-term perspective of habitat changes and trends. In addition, Geographic Information System (GIS) analysis and overlaying of habitat maps with land ownership maps has enabled assessment of land use changes affecting the species' habitat.

Traditional land uses along the river comprised forestry (upper reaches) and agriculture (lower reaches). Since the late 1990s, however, conversion of farms for development has resulted in notable land use changes along the river. Riverfront property values are increasing, especially in the lower reaches of the river between Allagash and Fort Kent, as popularity of the area increases for residential and summer homes.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

A 5-factor threats analysis was completed with the assistance of ecologists affiliated with the Maine Natural Areas Program. The threats matrix, adapted from the threat assessment approach developed by The Nature Conservancy, is included in Appendix A.

2.3.2.1 Factor A. Present or threatened destruction, modification, or curtailment of the species' habitat or range:

In the final listing rule, the Dickey-Lincoln School hydropower project was identified as the overriding threat to the species. This proposed dam, which would have eliminated about 40% of the known population (43 FR 17910), was de-authorized by Congress on November 17, 1986 (U. S. Fish and Wildlife Service 1991) and no longer constitutes a foreseeable threat. With respect to other dams, increasing the capacity of the Grand Falls Dam in New Brunswick could flood a few populations on the Maine-New Brunswick border; however, the Furbish's lousewort is federally listed as endangered in Canada and changes to the operation of Grand Falls Dam are unlikely.

The conversion of farms for residential development, which alters the riparian forest or riverbank vegetation, is an increasing conservation concern. Habitat alteration poses a potentially substantial threat to the Furbish lousewort in river segments 2, 3, and 4 between Allagash and Fort Kent; overall, development has the potential to affect about 2/3 of the geographic range and population of the lousewort, as can be seen by the difference in lousewort population trends between the upstream and downstream portions of its range. The geometric mean of flowering lousewort populations in river segment 1 (upriver, undeveloped) increased by 16% from 1177 flowering stems (1980-89) to 1,377 stems (2001-2005) in contrast to a 54% decline of flowering stems (4,166 to 2,247) in river segments 2-4 (downstream, partially developed and agriculture) during the same time period. Further, individual lousewort populations in segments 2, 3, and 4 all have a downward trend in populations during the time period from 1989-2004/05 (Gawler 2005). Habitat degradation from development is one of the hypotheses explaining this decline, along with ice-scouring events affecting downriver segments more severely, and/or other stochastic events associated with small, fluctuating populations in a dynamic environment.

In the past, land use for most of river segments 2-4 comprises forestry or farming, and riverfront camps were uncommon. Today, with the decline of agriculture and increasing interest in riverfront homes, farms and woodlots are being sold to developers promoting subdivisions with river views. There is also a brisk market in summer homes located along the river. Causes of habitat degradation associated with shorefront development include dumping of refuse, slash, and fill; motorized vehicles; vegetation clearing; ATV use along the river bank; personal boat access; and impermeable surfaces that focus runoff.

Although threats from development are unquantified, data in field reports (e.g., Gawler 2004, 2005) provide examples of how new development has degraded or eliminated lousewort habitat from some stretches of the river. The degree to which development affects lousewort is contingent on alterations to the riparian forest and riverbank. The level of threat posed by development could be measured by examining a series of aerial photos, documenting habitat changes from lousewort field survey notes, and accessing real estate records; in addition, future threat could be quantified from a build-out analysis.

Many of the lousewort populations in river segment 1 have either been protected through fee title acquisition or easement or are on private forest industry lands with adequate riparian protections in place to protect the riverbank community. Despite habitat-related recovery targets and the protection strategies developed by Gawler (2004), however, no progress has been made in protecting habitat in river segments 2, 3 and 4. The Maine Natural Areas and St. John Valley Land Trust recently interviewed all landowners with lousewort on their lands in river segments 2-4, and several landowners expressed interest in selling or donating conservation easements or fee title to their lands. The interview results also document some landowners who intend to subdivide or sell their land for development. Funds are currently available through the Landowner Incentive Program and Recovery Land Acquisition Grants to encourage conservation of lousewort habitat. In addition, habitat mapping and protection priority strategies have been developed by Gawler (2004), based on an assessment of habitat quality and population fluctuations. This should enable more focused conservation efforts for Furbish's lousewort in the future.

2.3.2.2 Overutilization for commercial, recreational, scientific or educational purposes: Neither botanical collection nor vandalism is believed to affect this species.

2.3.2.3 Disease or predation: Competition from invasive species is a threat to the unique riverbank ecosystem in the lower river segments. Phragmites, Japanese knotweed, non-native grasses, and purple loosestrife have all been documented in lousewort habitat. These invasive plant species are linked to human activities such as riverbank clearing, trails, and mowing, and spread of invasive species is one consequence of shorefront development. The extent to which

invasive species are detrimental to individual populations of Furbish's lousewort has not been studied.

No diseases have been noted in Furbish's lousewort. Some evidence of deer and other mammalian herbivory has been observed; however, this is not believed to be a significant concern, because the area within range of the lousewort has very low deer densities.

2.3.2.4 Inadequacy of existing regulatory mechanisms: Residential development activities along the St. John River rarely require federal permits, nor do they use federal funding, and, in general, the Service rarely reviews federally funded or authorized projects along the St. John River.

Municipal Shoreland Zoning exists in the organized towns comprising river segments 2-4, but these ordinances provide only partial protection of lousewort habitat. "Clearcut" openings are prohibited in the first 100 feet from the high water line, but the zoning allows removal of up to 40% of the volume of trees. The shoreland zone extends to 250 feet from high water but is less restrictive higher up, allowing clearings of up to 25% of lot areas and 40% removal of forest cover. Shoreland zoning also allows pathways to the river and does not restrict ATV use or other manipulations of shoreline vegetation. Removing 40% of the forest cover from the riverbank can reduce shading that is critical for lousewort survival. Potential improvements to these ordinances could include ensuring that organized towns on the lower St. John River include Furbish's lousewort in their town comprehensive planning and development of more restrictive shoreland zoning provisions.

The upper reaches of the river are under the jurisdiction of Maine's Land Use Regulation Commission, which applies more restrictive shoreland protection through the St. John River Resource Protection Plan. In this plan, shoreline standards require no development, non-intensive recreational use, and more restrictive forest practices in the shoreland zone. Botanists surveying lousewort in the upper reaches of the St. John River have not reported that forest management in riparian zone is a cause of concern for the lousewort.

The Furbish's lousewort is state-listed as endangered, but neither plants nor their habitat have specific protections under the Maine Endangered Species Act. The Maine Natural Areas Program screens state-permitted projects and makes recommendations to avoid habitat loss.

2.3.2.5 Other natural or manmade factors affecting its continued existence: Other human-induced influences on the environment could affect the natural flood regime and possibly change the intensity and frequency of ice-scour events. The St. John River has little storage capacity in the upper watershed, and the river is known for its flashy nature. Forest management in the watershed could increase siltation and run-off (Menges and Gawler 1986).

Climate change is expected to affect the ice regime of northern rivers, including the St. John, by increasing the frequency of severe ice-scour events and patterns of spring ice breakup (Beltaos 1997, Beltaos and Prowse 2001). Beltaos (1999) did a hydroclimatic analysis for the upper St. John River using long-term climate and flow records and documented that a small rise in winter air temperatures over the past 80 years has already resulted in a substantial increase in the number of mild winter days and the amount of winter rainfall – previously rare occurrences in this region. These two factors have augmented river flows, causing increased breakup of ice cover and flow peaks in late winter and the frequency of spring ice jams and flooding. Beltaos (1999) documented a trend toward increasing winter flows in archived data (Fort Kent, U. S. Geologic Survey) going back to the 1920s. Climate change is anticipated to result in more frequent mid-winter ice jams on the upper St. John River, increasing the likelihood of flood damage and environmental changes (Beltaos et al. 2003).

The increased frequency of ice jam events is a particular concern. The frequency of flooding events on the St. John River has increased since the 1940s (Menges and Gawler 1986). Lousewort biology suggests that a disturbance interval of less than 6 to 10 years would interfere with maturation and seed production (Menges 1990). Historic (Kindervater and Walker 2000), and recent reviews (from 1976 on) (Beltaos et al. 2003) of ice-jam dynamics of the upper Saint John River document that although severe ice jams occurred less than 12 times since the early 1900s, most of those events occurred in the last 40 years. This corroborates the pattern of increased flood frequency reported by Menges and Gawler (1986). Botanists monitoring lousewort have reported major population-reducing ice jams in 1984, 1991, and 2004.

2.4 Synthesis

Furbish's lousewort lives in a dynamic environment where ice-scour events occur annually. Ice scouring temporarily reduces or eliminates individual populations but benefits the species as a whole by reversing successional changes that would cause long-term population losses. Ice-scoured riverbanks have conditions favorable for germination and maturation, and optimal habitat seems to be confined to those reaches of the river most prone to disturbance. Looking back over the past 25 years, Furbish's lousewort populations have fluctuated two- to three-fold in response to periodic ice-scouring events, and even during population low points, the species has never approached a level that indicates a potential for extinction. Based on averages derived from a 1983-1987 demographic study, there are 1.6 flowering stems per reproductive plant and 3.2 vegetative plants for every reproductive plant. It is estimated that when habitat conditions are ideal and ice scouring has not occurred for a period of 5 to 8 years, the population reaches 11,000-14,000 plants (5,500-7,000 flowering stems, e.g., in 1989 and 2003). Within 2 to 4 years after a severe ice scouring event (e.g., 1984, 1991, 2004), populations decline to about 4,000 plants (2,000 flowering stems). These population estimates do not include seedlings. Even during the population lows, the plant's distribution has remained relatively stable, and few

localized long-term extirpations have been documented. The plant seems well-adapted, and even dependent, on the dynamic nature of the habitat.

Being an endemic species, the lousewort could be threatened by being restricted to an environment prone to periodic catastrophes. However, given that within this environment the lousewort has a broad distribution of about 50 metapopulations spanning 165 river miles, it is extremely improbable that a single catastrophic event could extirpate the species. The species has persisted despite major stochastic ice and flood events spanning thousands of years following the last glaciation.

Menges (1990) did a population viability analysis for the lousewort. Based upon individual metapopulation extinction rates of 2-12% per year, models predicted almost certain extinction of the species over moderate periods of time. This was ameliorated, however, by incorporating an average founding rate of 3% per year for new metapopulations, which helped to balance losses. Modeling results thus indicated that either too-frequent catastrophic disturbance or too-infrequent disturbance could threaten the species. Menges (1990) believed that increases in the frequency of catastrophic flood or ice-scour events since the 1940s (Menges and Gawler 1986) could be detrimental to the lousewort. Since 1980, three major ice-scouring events have been recorded (1984, 1991 and 2004), and forest practices in the upper watershed may be responsible for increased flooding frequency (Menges 1990). It should be noted, however, that climate change is now playing a role in increasing flooding and ice-jam frequency on the St. John River and should be considered a potential threat. The population response to several ice scour events has been well documented. These data could be used in a new population viability model to assess the implications of increased ice scour frequency on the lousewort. Population viability modeling could also be a valuable tool in developing new population recovery objectives.

Even with large fluctuations in total population size, localized extinctions, and recolonizations, Furbish's lousewort continues to fluctuate between 2,000 to 7,000 flowering stems. Given this, the downlisting criterion of a 6-year geometric mean of 7,000 flowering stems seems unnecessarily high. Even after catastrophic events, the number of mature plants has not fallen to dangerously low levels that would cause concerns about extinction. After each severe-ice scour event, populations have rebounded. No significant problems have been detected with disease, predation, or reproduction and germination. The species is widely distributed in many metapopulations. It is unlikely that a single catastrophic event would affect the entire population. Within the confines of current natural phenomena and barring substantial increases in the frequency of ice scour events, the lousewort population does not appear to be immediately threatened with extinction. The greatest threats to the future of the species include residential development in river segments 2, 3, and 4 and climate change affecting the disturbance regime of the St. John River.

3.0 RESULTS

3.1 Recommended Classification: Reclassification to Threatened.

Rationale: Although the species has not met the downlisting criteria in the 1991 recovery plan, downlisting to Threatened is warranted based on the following considerations:

- The Dickey-Lincoln School hydropower project is no longer a threat.
- The species' does not appear to be threatened by genetic, disease, or predation.
- Population assessment for the last 25 years gives us a new perspective on natural population fluctuations in response to severe ice-scour and flooding events. The population seems to rebound from catastrophic events and does not seem to be threatened with extinction, i.e., population counts have stayed between 2,000-7,000 flowering stems despite documented several cycles of decline and recovery in response to ice-scour events.
- In hindsight, the downlisting goal of maintaining a geometric mean of 7,000 flowering stems was biologically unrealistic given the extent and stochastic nature of the species' habitat.
- It is unlikely a single catastrophic event could endanger the population. The population is widely distributed in about 50 metapopulations over 165 river miles.
- With regard to possible delisting, new threats have been identified since the 1991 recovery plan. Delisting should not be considered until more information becomes available on the severity of these threats to the species, particularly in regard to residential development and climate change. Shorefront development will likely have an effect on habitat quality in the lower portions of the river, while climate change is increasing the frequency of severe ice jams and flooding events.

3.2 Recovery Priority Number: 14C

Rationale: The lousewort remains subject to an unquantified degree of threat stemming from shoreline development and use as well as the long-term effects of climate change on the ice-scour and flood regime of the St. John River. The primary threat leading to the listing of the species, the Dickey-Lincoln Dam, has been fully abated. The species' recovery potential is high, requiring that habitat impacts be further assessed and, as needed, that habitat be adequately protected from adverse land uses. Shoreline development poses a current conflict with species conservation. These considerations lead to a priority of 14C, based on the criteria in 48 FR 43098.

3.3 Listing/Reclassification Priority Number: 6

Rationale: A change from Endangered to Threatened status will not result in a significant change in management options or regulatory requirements for Furbish's lousewort. Although a delisting petition was received for this species in 1997, it was found to be not warranted. The plant has not been petitioned since then. These considerations lead to a reclassification priority of 6, based on the criteria in 48 FR 43098.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The lousewort is a species that could be considered for delisting in the near future if it can be shown that habitat will be conserved in the downstream segments over the foreseeable future. To move in this direction, the Service needs specific information on:

- The degree of threat from residential development in river segments 2, 3, and 4. How much development has occurred in the last 10 years? Where is development located in relation to potential lousewort habitat? What is the potential for future development? How much habitat has been lost or degraded? Does all development lead to degradation of lousewort habitat?
- The degree of threat from climate change and severe ice jams and flooding. Is the frequency of severe ice scouring and flooding events sufficient to be limiting the population? Which metapopulations are most prone to severe ice scouring?
- Population viability in the context of a dynamic environment. Population viability models should be revised to incorporate the last 16 years data, which documented population response to two major ice scour events. The models could also better assess long-term population recovery goals for the species.

If information is received that the degree of threat validates the plant's continued listing as Threatened, then the recovery plan should be revised. The 1991 recovery plan revision lacks delisting objectives and criteria. New recovery criteria should be developed based on current information on population viability and responses to habitat perturbations. The plan should also be improved by developing recovery criteria that explicitly address the five listing factors. In particular, criteria related to improving municipal shoreland zoning, addressing habitat restoration caused by catastrophic ice scour events, and controlling invasive species should be added.

Finally, efforts to protect lousewort habitat in the lower river reaches should be emphasized. The recovery plan's 50% habitat protection goal for the four river segments is achievable. The Maine Natural Areas Program recently documented that many lousewort landowners are interested in selling or donating conservation easements or fee title. Grant programs like the Landowner Incentive Program and Private Stewardship Grant Program are ideal for these conservation programs. State and private funds should also be tapped when possible. More support is needed to help the St. John River Land Trust become a strong and active local presence in protecting riverfront habitat; if possible, additional conservation partners should be enlisted to help in conserving lousewort habitat. Lousewort habitat protection and some level of shoreline development can co-exist with careful planning and incentives. At this time, there seems to be no need for active reintroduction, habitat restoration, or propagation programs.

As long as the Furbish's lousewort remains listed, we will encourage conservation partners to help in documenting threats to the species and addressing habitat conservation in the downriver segments of the river.

5.0 REFERENCES

- Beltaos, S. 1997. Effects of climate on river ice jams. *In* Proceedings of the 9th Workshop on River Ice, 24-26 September 1997, Fredericton, New Brunswick. Committee on River Ice Processes and the Environment, Hydrology Section, Canadian Geophysical Union, Sidney, British Columbia, pp. 225-244.

- Beltaois, S. 1999. Climatic effects on the changing ice-breakup regime of the St. John River. *In* River Ice Management with a changing climate: dealing with extreme events, Proceedings of the 10th Workshop on River Ice Processes and the Environment, Hydrology Section, Canadian Geophysical Union, Sidney, British Columbia, Canada pp. 251-264.
- Beltaois, S. and Prowse, T. 2001. Climate impacts on extreme ice jam events in Canadian Rivers. *Hydrological Sciences Journal* 46(1):157-182.
- Beltaois, S., S. Ismail, and B. C. Burrell. 2003. Midwinter breakup and jamming on the upper Saint John River: a case study. *Canadian Journal of Civil Engineering* 30(1):77-88.
- Gawler, S. C., Eric S. Menges, and D. M. Waller. 1986. Population biology of Furbish's lousewort 1985 results. Holcomb Research Institute, Butler University, Indianapolis, Indiana. HRI Rept. No. 82. 53pp.
- Gawler, S. C., D. M. Waller, and E. S. Menges. 1987. Environmental factors affecting establishment and growth of *Pedicularis furbishiae*, a rare endemic of the St. John River Valley, Maine. *Bulletin of the Torrey Botanical Club* 114(3):280-292.
- Gawler, S. C. 1987. Monitoring of in Maine: past approaches and future recommendations. Maine State Planning Office Report, Augusta, ME. 9pp.
- Gawler, S. C. and L. L. Gregory. 1999. Population sizes of *Pedicularis furbishiae*, Furbish's Lousewort, along the St. John River, Maine: 1999 census results. E-2-14 Section 6 report to the U. S. Fish and Wildlife Service. Maine Natural Areas Program, Augusta, ME.
- Gawler, S. C. 2000. USFWS Section 6 *Pedicularis furbishiae* conservation tasks. E-2-15 Section 6 report to the U. S. Fish and Wildlife Service. Maine Natural Areas Program, Augusta, ME.
- Gawler, S. C. and D. S. Cameron. 2001. Population sizes of *Pedicularis furbishiae*, Furbish's Lousewort, along the St. John River, Maine: 2001 census results. E-2-15 Section 6 report to the U. S. Fish and Wildlife Service. Maine Natural Areas Program, Augusta, ME.
- Gawler, S. C. and D. S. Cameron. 2003. Field summary of Part 1 of Furbish's Lousewort (*Pedicularis furbishiae*) census along the St. John River, Maine. E-2-16 Section 6 report to the U. S. Fish and Wildlife Service. Maine Natural Areas Program, Augusta, ME.
- Gawler, S. C. 2004. Population sizes of *Pedicularis furbishiae*, Furbish's Lousewort, along the St. John River, Maine: 2002-2003 census results. E-2-17 Section 6 report to the U. S. Fish and Wildlife Service. Maine Natural Areas Program, Augusta, ME.
- Gawler, S. C. 2005. Population sizes of *Pedicularis furbishiae*, Furbish's Lousewort, along the St. John River, Maine: 2004-2005 census results. E-2-19 Section 6 report to the U. S. Fish and Wildlife Service. Maine Natural Areas Program, Augusta, ME.

- Gregory, L. L. and S. C. Gawler. 1998. Population sizes of *Pedicularis furbishiae*, Furbish's Lousewort, along the St. John River, Maine: 1995 census results. Section 6 report to the U. S. Fish and Wildlife Service. Maine Natural Areas Program, Augusta, ME.
- Gregory, L. L. and S. C. Gawler. 1996. Population sizes of *Pedicularis furbishiae*, Furbish's Lousewort, along the St. John River, Maine: 1993 census results. Section 6 report to the U. S. Fish and Wildlife Service. Maine Natural Areas Program, Augusta, ME.
- Gregory, L. L. and S. C. Gawler. 1992. Population sizes of *Pedicularis furbishiae*, Furbish's Lousewort, along the St. John River, Maine: 1991 census results. Section 6 report to the U. S. Fish and Wildlife Service. Maine Natural Areas Program, Augusta, ME.
- Gregory, L. L. and S. C. Gawler. 1990. Population sizes of *Pedicularis furbishiae*, Furbish's Lousewort, along the St. John River, Maine: 1989 census results. Section 6 report to the U. S. Fish and Wildlife Service. Maine Natural Areas Program, Augusta, ME.
- Gregory, L. L. and S. C. Gawler. 1990. Population sizes of Furbish's lousewort, *Pedicularis furbishiae*, 1980-1989. A report to the U. S. Fish and Wildlife Service from the Maine Critical Areas Program, Augusta. 24pp.
- Kindervater, A. and B. Walker. 2000. Flooding in New Brunswick, a historical perspective. Environment Canada and the New Brunswick Department of the Environment and Local Government, Fredericton, New Brunswick, Canada.
- Maine Natural Areas Program. 1998. Habitat maps for Furbish's Lousewort, *Pedicularis furbishiae*. E-2-13 Section 6 report to the U. S. Fish and Wildlife Service. Maine Natural Areas Program, Augusta, ME.
- Menges, E. S., D. M. Waller, and S. C. Gawler. 1986. Seed set and seed predation in *Pedicularis furbishiae*, a rare endemic of the St. John River, Maine. *American Journal of Botany* 73(8):1168-1177.
- Menges, E. S. 1988. Conservation biology of Furbish's lousewort. Final Report to Region 5, U. S. Fish and Wildlife Service. HRI Report No. 126. Holcomb Research Institute, Butler University, Indianapolis, Indiana. 61pp.
- Menges, E. S. and S. C. Gawler. 1986. Four-year changes in the population size of the endemic Furbish's lousewort: implications for endangerment and management. *Natural Areas Journal* 6(1):6-17.
- Menges, E. S. 1990. Population viability analysis for an endangered plant. *Conservation Biology* 4:52-62.

U.S. FISH AND WILDLIFE SERVICE

5-Year Review of Furbish's lousewort (*Pedicularis furbishiae*)

Current classification: Endangered

Recommended classification resulting from the 5-Year Review: Threatened

Recommended Recovery Priority Number: 14C

Appropriate Reclassification Priority Number: 6

Review conducted by: Mark McCollough, Maine Field Office

FIELD OFFICE APPROVAL:

Approve Mark McCollough Date 2/22/07
Acting Field Supervisor, Maine Field Office, Fish and Wildlife Service

REGIONAL OFFICE APPROVAL:

Approve [Signature] Date 4/9/07
Regional Director, Region 5, Fish and Wildlife Service

Listing factor (ESA)	Threat	Sources of threat	Severity (intensity of effect where activity occurs) 0=unknown 1= low 2=moderate 3=high	Geographic scope (extent of threat across species' range) 0=unknown 1=localized 2=significant portion of range 3=range-wide	Immediacy (how soon the threat could cause extinction) 0=unknown 1=distant future or not at all 2=foreseeable future 3=near future	Likelihood (how likely it is that the threat will cause extinction in the future) 0=unknown 1=not likely 2=somewhat likely 3=very likely	Possibility of abatement without ESA 1=highly probable 2=to some degree 3=not possible	Management potential 1=high 2=moderate 3=low
Present or threatened destruction, modification, or curtailment of species' habitat or range	Alteration of water levels	New dams	3 (if new dam is built)	2	3	1	1	1
	Alteration of water levels	modifications of existing dams (Grand Falls, NB)	2 (may flood a few ME populations)	1 (currently there are small populations at Hamlin, ME)	0	0	1 (lousewort also federally listed in Canada)	1
	Habitat disturbance	Dumping refuse, slash, or fill	2	1	1	1	2	1
	Habitat disturbance	Motorized vehicles in habitat (ATVs)	3	1 (could increase in downriver segments)	1	1	3	2
	Erosion and bank destabilization	Clearing of trees and shrubs along riverbank	3	1	1	1	2	2
	Erosion and bank destabilization	Recreational use (trails, ATVs)	2	1	1	1	2	2

	Decreased shade and moisture along riverbank	Clearing of trees and shrubs for houses, views, ag fields	3	1	1	1	2	2	2	2
	Impermeable surfaces immediately adjacent to the river (driveways, yards)	Focused stormwater runoff	2	1	1	3	2	2	3	
Overutilization for commercial, recreational, scientific, or educational purposes	Removal of plants	Botanical collection	1	1	1	1	2	2	1	
	Removal of plants	vandalism	1	1	1	1	2	2	3	
Disease or predation	Changes in habitat composition	Competition from invasive species	3	2	0	2	2	2	2	2 (phragmites, knotweed, loosestrife)
		Human activities (clearing, trails, mowing)	2	1	1	2	2	2	2	
Inadequacy of existing regulatory mechanisms	Inadequate municipal shoreland regulations	Poor or inconsistent conservation practices in the shoreland zone	2	1	1	2	2	2	1	1 (if properly implemented Shoreland Zoning could protect habitat)
		forest management	0	0	1	3	2	2	1	
Other natural or manmade factors affecting species' continued existence	Changes to natural flood regime and changes to intensity and frequency of ice scour events		0	3	0	1	2	2	1	

