

**Recovery Implementation Strategy for  
the Furbish's Lousewort  
(*Pedicularis furbishiae*)  
Version 1.0**



Painting by

Kate Furbish Lousewort

*From*

*Plants and flowers of Maine:  
Kate Furbish's Watercolors,  
courtesy of Rowman & Littlefield*

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Northeast Region (Region 5)  
Maine Field Office, East Orland, Maine**

This Recovery Implementation Strategy (RIS) supplements the Furbish's lousewort revised recovery plan (Recovery Plan, U.S. Fish and Wildlife Service [USFWS] 2018a) and describes in greater detail how the site-specific, prioritized actions outlined in the revised recovery plan will be implemented, and estimates the time and costs to complete recovery. The RIS may be revised at any time during the recovery process, whenever experience and information gained call for a change in tactics, therefore maximizing flexibility of recovery implementation. As used here, "actions" are broad measures that clearly describe what needs to be done to accomplish the goal of long-term viability. "Activities" are the detailed, on-the-ground tactical steps needed to implement the higher-level recovery actions. Prioritized recovery actions from the Recovery Plan and their associated activities are listed below (table 1). Priority 1 actions are defined as those that must be taken to prevent extinction or to prevent the subspecies from declining irreversibly in the foreseeable future. Priority 2 actions are those that must be taken to prevent a significant decline in population size or habitat quality or some other significant negative impact. Priority 3 actions are all other measures that are necessary to provide for full recovery of the subspecies. We have assigned a priority to each action but not to each activity. Not all activities under an action are necessarily the same priority as the overall action; an action is assigned the priority of its highest priority activity. The assignment of priorities does not imply that some actions and activities are of low importance, but instead implies that lower priority items may be deferred while higher priority items are being implemented. Please refer to table 2 for a clear association among recovery actions, activities, and the threats they address.

Responsible organizations and costs for the Canadian portion of the range of the Furbish's lousewort are not included, since these are covered under the Canadian Furbish's Lousewort Recovery Plan (Environment Canada 2010). Canadian agencies and organizations are included in the following tables when their partnership and expertise are needed to accomplish some recovery activities or when the USFWS is needed to assist with Canadian recovery efforts. For example, the USFWS will assist with collecting seeds in Maine for restoring subpopulations in Canada. The Canadians will share technology about captive propagation of Furbish's lousewort. Only USFWS costs for these partnership efforts are reflected in this RIS.

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Acronyms used in Table 1 for partners in Furbish's lousewort recovery.

ACOE U.S. Army Corps of Engineers  
CFS Canadian Forest Service  
CONTR Miscellaneous contractors  
CWS Canadian Wildlife Service  
EC Environment Canada  
ERDNB Energy and Resource Development New Brunswick  
FN First Nations (Kingsclear and Tobique, New Brunswick; Aroostook Band of Mic Mac  
Indians, Houlton Band of Maliseet Indians, Maine)  
KMF Keeping Maine's Forest  
LUPC Maine Land Use Planning Commission  
MANWR Moosehorn-Aroostook National Wildlife Refuge  
MCFWRU Maine Cooperative Fish and Wildlife Research Unit  
MCFRU Maine Cooperative Forestry Research Unit  
ME Maine  
METNC Maine Chapter of The Nature Conservancy  
MNAP Maine Natural Areas Program  
MPME Municipal Planning Maine  
NB New Brunswick  
NBP New Brunswick Power  
NAFO National Alliance of Forest Owners  
NTC Nature Trust Canada  
NRCS Natural Resource Conservation Service  
SJRLT St. John River Land Trust  
UC University of Chicago  
UM University of Maine Orono  
UNB University of New Brunswick  
UMFK University of Maine Fort Kent  
USFWS U.S. Fish and Wildlife Service (Ecological Services)

Table 1. Recovery Actions, Activities, and Implementation Schedule.

Priority	Activity #	Recovery Action Description	Site-specific Information	Responsible Party(ies)	Action duration	Cost Estimates (\$1000s)					
						Total	2019-2028	2029-2038	2039-2048	2049-2058	2059-2068
<b>1</b>		<b>Action 1. Monitor the Furbish’s lousewort population and demographics and the status of the bumble bee pollinator to document trends.</b>									
	1.1	Continue biennial survey of flowering stems.	ME entire range	USFWS, MNAP	annual	1,000	200 20/yr.	200	200	200	200
	1.2	Monitor the annual location and severity of ice scour and flooding.	ME, NB	USFWS, CWS, UM, UNB, UMFK ERDNB	Initial devp., then annual	50	10 1/yr.	10	10	10	10
	1.3	Monitor climate change variables that are most likely to affect the Furbish’s lousewort. Monitor mid-winter temperatures and their effects on ice scour frequency and severity. Monitor summer temperature, drought, and soil moisture.	ME, NB	USFWS, EC	annual	50	10 1/yr.	10	10	10	10
	1.4	Monitor the condition of the riparian buffer adjacent to Furbish’s lousewort subpopulations and habitat.	ME entire range	USFWS, MNAP, UM, UMFK	Once/ 10 yrs.	50	10 5/every 5 yr.	10	10	10	10
	1.5	Monitor presence of invasive plant species.	ME entire range	USFWS, MNAP, UM, UMFK	Once/ 10 yrs.	50	10 1/yr.	10	10	10	10
	1.6	Periodically monitor the population of the half-black bumble bee in the St. John River Valley.	ME, NB	USFWS, ERDNB, UMFK	once/ 5 yrs.	50	10 5/every 5 yrs.	10	10	10	10
		<b>TOTAL</b>				1,250	250	250	250	250	250

Priority	Activity #	Recovery Action Description	Site-specific Information	Responsible Party(ies)	Action duration	Cost Estimates (\$1000s)					
						Total	2019-2028	2029-2038	2039-2048	2049-2058	2059-2068
<b>1</b>		<b>Action 2. Improve the health and viability of extant subpopulations and restore extirpated subpopulations throughout the historic range.</b>									
	2.1	Evaluate <b>extant sites</b> (n=9) in Maine and map suitable habitat and current plant distribution. Develop population objectives for each site based on habitat suitability and stressors. Develop a plan and priorities for increasing or maintaining viable, healthy subpopulations at each site.	ME entire range	MNAP USFWS	5 yrs.	37.5	37.5 7.5/yr				
	2.2	Evaluate <b>extirpated sites</b> (n=6) in downriver areas in Maine, evaluated and map suitable habitat, and review historic plant distribution. Develop population objectives and a plan for restoring viable, healthy subpopulations at each site based on habitat suitability and stressors.	downriver	MNAP USFWS	5 yrs.	37.5	37.5 7.5/yr				
	2.3	Identify and engage partners that could assist with habitat restoration. Improve habitat. If warranted, control competing vegetation, including invasive species, to ease competition. Restore forested riparian buffers.	ME entire range	MNAP USFWS CONTR	annual	750	150 15/yr	150	150	150	150
	2.4	Augment extant subpopulations and restore extirpated subpopulations with seed and/or propagated individuals.	ME, NB	MNAP, USFWS, UMFK, KMF	annual 2022 to 2035	350	175 25/yr	175 25/yr.			
	2.5	Establish and maintain a small captive population at the University of Maine at Fort Kent for experimental and restoration purposes. Refine and test captive propagation methods initiated in Canada. Provide seeds to Canada for seed storage, captive propagation, and restoring small subpopulations.	ME, NB	MNAPU SFWS CWS ERDNB UNB UMFK	5 yrs.	125	125 25/yr. for 5 yrs.				

	2.6	Promote conservation and management of native bees, butterflies, and other pollinators, especially the half-black bumble bee in the St. John River valley.	ME, NB	USFWS, MNAP, MANWR, NRCS, SJRLT, KMF, NAFO	annual	200	40 4/yr.	40	40	40	40
		<b>TOTAL</b>				1,500	565	365	190	190	190

Activity #	Recovery Action Description	Site-specific Information	Responsible Party(ies)	Action duration	Cost Estimates (\$1000s)						
					Total	2019-2028	2029-2038	2039-2048	2049-2058	2059-2068	
<b>1</b>	<b>Action 3. Achieve long-term habitat protection for each subpopulation.</b>										
3.1	Promote awareness and conservation of Furbish's lousewort on private lands, municipalities, land trusts, the Land Use Planning Commission, and other conservation-minded groups and individuals.	ME entire range	USFWS, MNAP	annual	150	30 3/yr.	30	30	30	30	30
3.2	By 2025 develop long-term (50-year) habitat management plans with landowner for each of the 9 extant and 6 extirpated subpopulations in Maine or any new subpopulation(s) created by activities 2.1 to 2.9.	ME entire range	USFWS, MNAP	5 yrs.	75	75 15/yr.					
3.3	Protect habitat by implementing memoranda of agreements, municipal and forestry zoning, and permanent conservation (fee title, conservation easements) as specified in the site-specific management plan.	ME entire range	USFWS, MNAP, MANWR, SJRLT, LUPC, METNC, KMF, NAFO, MPME, FN	annual	TBD <sup>1</sup>	TBD	TBD	TBD	TBD	TBD	TBD
3.4	Conduct environmental permit review for projects on the St. John River at the state and federal level. Identify and implement mitigation opportunities for projects that may degrade habitat.	ME entire range	USFWS, MNAP, LUPC	5 projects per decade	150	30 3/yr.	30	30	30	30	30
	<b>TOTAL</b>				375	135	60	60	60	60	60

<sup>1</sup> To be determined. Costs to protect habitat will not be known until management plans are completed for each subpopulation (activities 2.1 and 2.2). Long-term, voluntary management agreements will require funding but are the least expensive. Working with organized towns and the Land Use Planning Commission to improve shoreland zoning will require funding for meetings with agencies and landowners. Fee title and conservation easements will be the most expensive, but land values are lower in northern Maine and will be less expense/acre than for many other areas of the state.

Priority	Activity #	Recovery Action Description	Site-specific Information	Responsible Party(ies)	Action duration	Cost Estimates (\$1000s)					
						Total	2019-2028	2029-2038	2039-2048	2049-2058	2059-2068
<b>1</b>		<b>Action 4. Conduct scientific investigations to improve understanding of stressors, viability, propagation, restoration, and genetic needs and support adaptive management approaches to recovery.</b>									
	4.1	In support of Action 1, investigate demographics (e.g., pollination, seed production and survival, germination, recruitment, growth, survival) at selected extant subpopulations to ascertain population status and trends, inform management decisions, and identify stressors that may be influencing population growth.	ME selected subpops.	USFWS, MNAP, UM, UMFK, MCFWR	3-yr. study every 20 yrs.	450	150		150		150
	4.2	In support of Activities 1.3 and 1.4, document the climate envelope (upper tolerances of summer temperature and moisture) of the Furbish lousewort to inform recovery strategies when considering projections of future climate change.	Captive and wild popns.	USFWS, MNAP, UM, UMFK	2-3 yrs.	75	75				
	4.3	In support of Activity 1.3, develop a method to annually document the location and severity of ice scour through remote sensing coupled with ground-based observations to better document the extent and severity of ice scour and flooding.	ME, NB	USFWS, MNAP, EC, CWS, ERDNB	2 yrs.	125	125				
	4.4	In support of Activities 1.3 and 1.4, document and project the effects of climate change on ice scour and the Furbish's lousewort. Develop spatially explicit river ice and population models to better understand the effects on subpopulations. Assess future threat scenarios and identify the best management alternatives.	ME	USFWS, MNAP, MCFWR, UNB, ACOE, EC	2 yrs.	175	175				
	4.5	In support of Activity 1.8, develop a statistically robust, long-term program to monitor the half-black bumble bee ( <i>Bombus vagans</i> ) population throughout the range of the Furbish's lousewort.	ME, NB	USFWS, MCFWR	2 yrs.	125	125				
	4.6	In support of Action 2, conduct investigations to document the genetic diversity and genetic structure within the population. Determine whether there is inbreeding depression or loss of allelic diversity.	ME, NB	USFWS, MNAP, ERDNB,	3-yr. study every	375	125		125		125

		Recommend the most effective strategies to maintain genetic diversity and health of the metapopulation.		UMFK, UC	20 yrs.						
4.7		In support of Activities 2.1 to 2.4, investigate restoration methods including seeding and planting propagated plants. Conduct pilot reintroductions to determine the most effective ways to enhance and restore subpopulations.	ME entire range	MNAP USFWS UMFK	3-yr. study every 20 yrs.	250	250 25/yr				
4.8		In support of Activity 2.3, develop and conduct studies to evaluate pilot projects to improve, restore, and create habitat. Develop best management practices on how to restore eroded habitats and restore riparian forest. Develop best management practices on how to manage competing vegetation.	Selected sites in ME	MNAP, USFWS, UMFK, NAFO, KMF	3yr. initial study, then annual	225	125	25 2.5/yr.	25	25	25
4.9		In support of Activities 2.4 and 2.5 and Action 7, conduct research to develop methods to propagate the Furbish's lousewort. Evaluate growth, survival, and seed production of seeded and captive-propagated plants. Refine seed collection and seeding techniques and horticultural techniques for captive propagation and transplanting Furbish's lousewort.	ME entire range	USFWS, MNAP, UMFK	3 yr. initial study, then annual	225	125	25 2.5/yr.	25	25	25
4.10		In support of Action 7, conduct research to develop methods for long-term seed storage. Evaluate seed viability, growth, and survival of plants from seed that has undergone varying times of seed storage. Collect seed for storage.	ME, NB	USFWS, MNAP, ERDNB, CWS, EC, CFS	2 yr. initial study, then annual	65	25	10 1/yr.	10	10	10
		<b>TOTAL</b>				2,090	1,300	60	335	60	335

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						Total	2019-2028	2029-2038	2039-2048	2049-2058	2059-2068
<b>3</b>		<b>Action 5. Periodically review progress toward achieving recovery criteria and employ strategic habitat conservation and adaptive management to address threats.</b>									
	5.1	Use information collected from Activity 1.2 (biennial survey) to determine whether recovery Criterion 1 is met. Evaluate whether the metapopulation is stable or increasing by developing a simple linear regression of biennial survey counts for the next 30 years.	ME, NB	USFWS, MNAP, ERDNB, CWS	annual	50	10 1/yr.	10	10	10	10
	5.2	Collaborate with Canadian partners to share recovery progress and science. Monitor progress toward achieving 1,100 total plants in New Brunswick.	ME, NB	USFWS, MNAP, ERDNB, CWS	annual	50	10 1/yr.	10	10	10	10
	5.3	By 2020 develop a Strategic Habitat Conservation/Adaptive Management framework to document how results from monitoring (Recovery Action 1) and scientific investigation (Recovery Action 4) will be used to inform recovery strategies, priorities, and activities.	ME	USFWS, MNAP	once	25	25				
		<b>TOTAL</b>				175	55	30	30	30	30

Priority	Activity #	Recovery Action Description	Site-specific Information	Responsible Party(ies)	Action duration	Cost Estimates (\$1000s)					
						Total	2019-2028	2029-2038	2039-2048	2049-2058	2059-2068
<b>1</b>		<b>Contingency Action 6. Establish new subpopulations in unoccupied areas having suitable habitat.</b>									
	6.1	Identify locations to expand the range of the Furbish's lousewort and establish new populations (e.g., upriver of Blue Brook, between Allagash and Fort Kent, Fort Kent to Van Buren).	Upriver of Blue Brk; gaps in downriver range	MNAP USFWS, UMFK, CONTR	Annual	400	0	250 25/yr. for 10 yrs.	50 5/yr.	50	50
	6.2	Incremental costs needed to monitor, study, manage, and protect new populations (Activities 1.1, 1.6, 3.1, 3.2, 3.3, and 4.8 apply to any new subpopulations that may be created under this contingency action)	New subpopulations	USFWS, MNAP, UMFK, UMCFR	annual	200	0	50 10/yr.	50	50	50
		<b>TOTAL</b>				600	0	300	100	100	100

Priority	Activity #	Recovery Action Description	Site-specific Information	Responsible Party(ies)	Action duration	Cost Estimates (\$1000s)					
						Total	2019-2028	2029-2038	2039-2048	2049-2058	2059-2068
<b>1</b>		<b>Contingency Action 7. Store seeds and establish captive populations in Maine and Canada.</b>									
	7.1	Initiate a long-term seed storage program to maintain current genetic diversity and seeds for future reintroductions. Collect seeds from as many sources and individuals as possible from each of the extant subpopulations in the United States and Canada, following Center for Plant Conservation guidelines to limit effects to extant populations. Maintain separate samples collected from each individual, label the collection date, and geographic coordinates. Allocate seed samples from each subpopulation for long-term storage in a seed bank so that subpopulations may be restored following catastrophic losses. Evaluate long-term seed storage techniques and performance of stored seed (Activity 5.4).	ME entire range	USFWS, MNAP, UMFK, CFWR, CFS	annual	Costs in activity 4.11					
	7.2	Expand the captive population at UMaine Fort Kent (Activity 2.5) and establish at least two captive propagation locations in Maine to produce seed and raise plants to enhance and restore subpopulations. Translocate seed and plants from captive propagation sites into the wild. Work with Canadian partners to establish captive populations where climate may be more suitable. (Supported by Activity 4.9)	ME, NB	MNAPU SFWS CWS ERDNB UNB UMFK	annual	1,000	0	250 25/yr.	250	250	250
		<b>TOTAL</b>				1,000	0	250	250	250	250

Priority	Activity #	Recovery Action Description	Site-specific Information	Responsible Party(ies)	Action duration	Cost Estimates (\$1000s)					
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<b>1</b>		<b>Contingency Action 8. Enhance seed production.</b>									
	8.1	If warranted, hand-pollinate Furbish's lousewort to enhance germination and seed production.	ME, NB	USFWS, MNAP, ERDNB, UMFK, UM	annual	600	0	150 15/yr.	150	150	150
	8.2	If warranted, protect flowering plants from herbivory or seed parasites (e.g., plume moth).	ME selected sites	USFWS, MNAP, UMFK, SJRLT, NAFO, KMF	annual	800	0	200 20/yr.	200	200	200
		<b>TOTAL</b>				1,400	0	350	350	350	350

Priority	Activity #	Recovery Action Description	Site-specific Information	Responsible Party(ies)	Action duration	Cost Estimates (\$1000s)					
						Total	2019-2028	2029-2038	2039-2048	2049-2058	2059-2068
<b>1</b>		<b>Contingency Action 9. Work with Canadian partners to implement strategies to prevent extinction.</b>									
	9.1	Investigate strategies to prevent extinction of the Furbish's lousewort. Evaluate rivers in Canada that may have ice regime and habitat suitable to Furbish's lousewort in a warmer climate. Translocate wild plants. Establish captive propagation sites in cooler summer climates in Canada. Establish populations in new habitats with suitable disturbance regime.	ME, Canada	USFWS, MNAP, ERDNC, CWS	annual, if needed	TBD	0	TBD <sup>2</sup>	TBD	TBD	TBD
		<b>TOTAL</b>				TBD	0	TBD	TBD	TBD	TBD

<sup>2</sup> To be determined. Costs associated with assisted migration could be substantial. Costs will be greater if it is difficult to find rivers having the right environmental conditions and disturbance regime to meet the Furbish's lousewort's needs. Costs will be greater if candidate river systems are in remote parts of Canada.

Table 2. Stressors affecting the survival of the Furbish’s lousewort (USFWS 2018) and associated recovery criteria, actions, and activities.

ESA Listing Factors	Threats Description	Recovery		
		Criteria	Actions	Activities
Factor A The present or threatened destruction, modification, or curtailment of its habitat or range.	Development	2	1, 2, 3, 4, 5, 6, 7	1.1, 1.4, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3, 3.4, 4.1, 4.7, 4.8, 4.9, 5.3, 6.1, 6.2, 7.2
	Possible invasive species		1, 2, 3	1.1, 1.5, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4
Factor C Disease or predation	Possible herbivory, seed predation, disease or other unidentified stressors		1, 2, 3, 4, 5, 8	1.1, 2.1, 2.2, 3.1, 4.1, 4.9, 5.1, 5.2, 5.3, 8.1, 8.2
Factor E Other natural or manmade factors affecting its continued existence	Climate change	1	1, 2, 3, 4, 5, 6, 7, 9	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 4.7, 4.8, 4.9, 4.10, 5.1, 5.2, 5.3, 6.1, 6.2, 7.1, 7.2, 9.1
	Low genetic diversity, low adaptive capacity		1, 2, 4, 5, 7, 8, 9	1.1, 2.4, 2.5, 4.1, 4.6, 4.10, 5.2, 5.3, 7.1, 7.2, 9.1
	Population fragmentation and isolation in downriver areas	2	1, 2, 3, 4, 5, 6, 7	1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3, 3.4, 4.1, 4.3, 4.4, 4.7, 4.8, 4.9, 5.1, 5.2, 5.3, 6.1, 6.2, 7.2
	Possible decline of bumble bee pollinator		1, 2, 3, 4, 5, 7, 8	1.1, 1.6, 2.1, 2.2, 2.3, 2.6, 3.1, 3.2, 3.4, 4.1, 4.4, 4.6, 4.8, 4.9, 5.1, 5.2, 5.3, 7.2, 8.1, 9.1