

# Recovery Strategy for the Baikal Sedge (*Carex sabulosa*) in Canada

## Baikal Sedge



2012

**Recommended citation:**

Baikal Sedge Recovery Team. 2012. Recovery Strategy for the Baikal Sedge (*Carex sabulosa*) in Canada [FINAL]. *Species at Risk Act* Recovery Strategy Series. Parks Canada Agency, Ottawa, vi + 22pp.

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**Cover illustration:** Jennifer Line

Également disponible en français sous le titre  
« Programme de rétablissement du carex des sables (*Carex sabulosa*) au Canada »

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ISBN 978-1-100-14578-5

Catalogue no. En3-4/69-2012E-PDF

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## PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years.

The Minister responsible for the Parks Canada Agency and the Minister of the Environment are the competent ministers for the recovery of the Baikal Sedge and have prepared this strategy, as per section 37 of SARA. It has been prepared in cooperation with the Yukon Government, affected First Nation governments, local Renewable Resources Councils and local community organizations as per section 39(1) of SARA.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by the Parks Canada Agency, Environment Canada or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Baikal Sedge and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by the Parks Canada Agency, Environment Canada and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.


## RECOMMENDATION AND APPROVAL STATEMENT

*The Parks Canada Agency led the development of this federal recovery strategy, working together with the other competent minister(s) for this species under the Species at Risk Act. The Chief Executive Officer, upon recommendation of the relevant Park Superintendent(s) and Field Unit Superintendent(s), hereby approves this document indicating that Species at Risk Act requirements related to recovery strategy development (sections 37-42) have been fulfilled in accordance with the Act.*


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*All competent ministers have approved posting of this recovery strategy on the Species at Risk Public Registry.*

## ACKNOWLEDGMENTS

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The authors would like to acknowledge the contributions of the following people who assisted with information, reviews and other help in preparing the recovery strategy:

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## EXECUTIVE SUMMARY

Baikal Sedge (*Carex sabulosa*) is a perennial plant that usually grows in active, shifting dune environments. The species is currently listed as Threatened under the federal *Species at Risk Act*. Inventory work since the COSEWIC assessment in 2005 has shown that there are nearly three times as many populations in Canada as originally thought.

Recovery is considered technically and biologically feasible. Baikal Sedge is naturally rare in Canada and occurs in isolated populations within a restricted geographic area. The main threats to Baikal Sedge are 1) the potential for invasion by exotic species that exclude native vegetation, 2) recreational use impacts, 3) community development, and 4) natural successional change. Baikal Sedge occurs in specific dune environments and may primarily reproduce through clones, which makes the plant vulnerable to disease and other impacts. Four of the 14 known populations of Baikal Sedge are found within protected areas. Two populations are found in areas of active use within Yukon communities (Carcross and Whitehorse) and may be impacted by a variety of human disturbances.

The population objective for Baikal Sedge is to maintain at least 11 of the known populations in Yukon. Species found at 10 or fewer locations may be assessed as Threatened under criterion B (small distribution range & decline or fluctuation) of COSEWIC's 2010 assessment criteria, and our goal is eventual down-listing of the species. To prevent declines in the total number of mature individuals and the current area of occupancy, the populations to be maintained must include those with plants in a vigorous state of health in dunes with sufficient natural processes (ie/wind) required to maintain suitable habitat over the long term. The distribution objective is to prevent a decline in the extent of occurrence, by maintaining populations across the currently known range of the species in Yukon. Each dune ecosystem will be managed collaboratively to the extent possible to ensure the long-term persistence of healthy populations throughout the range.

Critical habitat is "the habitat necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species." (*Species at Risk Act*, s 2). A partial identification of critical habitat supporting the survival and recovery of Baikal Sedge is included in this recovery strategy. The identification is based on the best currently available information and includes the largest Baikal Sedge population in Yukon (representing 75% of the total Canadian population) and another cluster of small populations that count as a single population in this strategy. Further work is required to identify additional habitat to support the recovery of this species and achieve the population and distribution objectives.

One or more action plan(s) will be posted on the SARA Public Registry by April 2017.

## RECOVERY FEASIBILITY SUMMARY

Recovery of Baikal Sedge is considered biologically and technically feasible based on the following criteria:

**Table 1: Technical and Biological Feasibility of Baikal Sedge Recovery\***

Criteria	Feasibility
1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.	Yes. We do not currently know the rate of sexual reproduction within Baikal Sedge populations in Yukon, however the species is believed to reproduce primarily asexually through rhizomes and has successfully maintained itself up to this point.
2. Sufficient suitable habitat is available to support the species, or additional suitable habitat could be made available through habitat management and restoration.	Yes. At this time there is sufficient habitat, however one of the threats to Baikal Sedge in Yukon is changes to habitat as a result of natural succession and the encroachment of other species. Habitat management might be an option should it become necessary in future.
3. The primary threat to the species or its habitat (including threats outside of Canada) can be avoided or mitigated.	Yes. Threats can be mitigated through the actions outlined in Table 4, however some threats will need to be better understood to determine whether and how they can be avoided or mitigated.
4. Recovery techniques exist to achieve the population and distribution objectives, or can be expected to be developed within a reasonable timeframe.	Yes, however some recovery techniques will need to be better understood to determine whether or not they will be effective.

\*Criteria from Environment Canada (2009).

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## 1. COSEWIC SPECIES ASSESSMENT INFORMATION

**Date of Assessment:** May 2005

**Common Name (population):** Baikal Sedge

**Scientific Name:** *Carex sabulosa*

**COSEWIC Status:** Threatened

**Reason for Designation:** A geographically restricted species of three sand dune areas that serve as habitat for five populations. These consist of several million shoots produced mainly through asexual reproduction. The species has been impacted by declines in population numbers, size, area, quality of its habitat and on-going impacts from recreational use of all-terrain vehicles at Carcross and Bennett Lake. Such activity and much increased tourist visitations at the Carcross dune system may result in increased impacts on the habitat with the development of a major resort facility at this location. If the Alsek River is dammed again by the advance of the Lowell Glacier, as had occurred in recent past, the large population at the confluence of the Dezadeash and Kaskawulsh Rivers could be at risk.

**Canadian Occurrence:** Yukon Territory

**COSEWIC Status History:** Designated Threatened in 2005. Assessment based on a new status report.

## 2. SPECIES STATUS INFORMATION

In North America, Baikal Sedge populations have been identified in four separate large valleys in southwest Yukon and in one area in central Alaska. There are other populations more than 3000 km away in central Asia (COSEWIC 2005).

Baikal Sedge has a naturally restricted extent of occurrence and area of occupancy in Canada. At the time of initial assessment by COSEWIC, there were only 5 known populations. Baikal Sedge was assessed as threatened because of 1) a very small extent of occurrence (ca. 200 km<sup>2</sup>) and area of occupancy (<1 km<sup>2</sup>), combined with declines in area of occupancy, quality of habitat, and number of mature plants resulting especially from recreational use of the sand dune habitat, 2) the presence of only 5 populations and on-going and imminent threat from recreational activities, particularly at the Carcross dunes (affecting two of the original 5 populations), and 3) the possibility that the Lowell Glacier could advance and dam the Alsek River, thereby affecting the Alsek sedge population (representing 75% of the plants in Canada).

In the years since the initial COSEWIC assessment in 2005, 10 additional Baikal Sedge populations have been discovered. As well, the two Carcross populations and the two Takhini populations described in the COSEWIC report were re-evaluated and are now considered to be single populations (using NatureServe criteria). A total of 14 populations have now been reported in Canada. Population trend and area of occupancy were listed as declining (1-2% and 2-3% respectively) in the COSEWIC status report, however these metrics should be re-evaluated in light of the discovery of several new populations. In addition, the Lowell Glacier has receded

substantially in recent years, significantly decreasing the risk of the glacier advancing enough to dam the Alsek River. Because of 1) the increased number of populations now known to occur in Yukon (only three of which are currently threatened by recreational use or development), 2) the increased population trend and area of occupancy due to the discovery of new populations, and 3) the decreased risk of glacial advance, Baikal Sedge no longer meets the COSEWIC criteria for Threatened status.

### 3. SPECIES INFORMATION

#### 3.1 Species Description

Baikal Sedge, (*Carex sabulosa*), is a perennial plant that grows in northern dune environments. The plant has a long, thin triangular stem that can be between 15 and 35 centimeters long. Small clusters of cream-coloured flowers grow on three to five spikes that emerge from the top few centimetres of the stem. The top or terminal spike is club-shaped and has female flowers positioned above the male flowers while the remaining lateral spikes have only female flowers (Ball & Reznicek 2003). As the flowers mature and go to seed, the stems get weighed down by the drooping fruiting heads and take on a characteristic “arched” appearance. The seeds are enclosed in a cream-coloured balloon-like structure called a perigynium.



**Baikal Sedge** (*Carex sabulosa*)

Photo: J. Line

The leaves of the sedge are thin and look almost like grass. Dried leaves become curly and may persist for several growing seasons. Baikal Sedge has long rhizomes, a horizontal root system that sends out shoots to create more plants. As a result, one plant can populate a large area.

Baikal Sedge can be found growing alongside another, more common sedge, *Carex maritima*. They can be difficult to distinguish from one another so care must be taken in identifying Baikal Sedge. For a more detailed taxonomic description, see "Flora of N. America".

#### 3.2 Population and Distribution

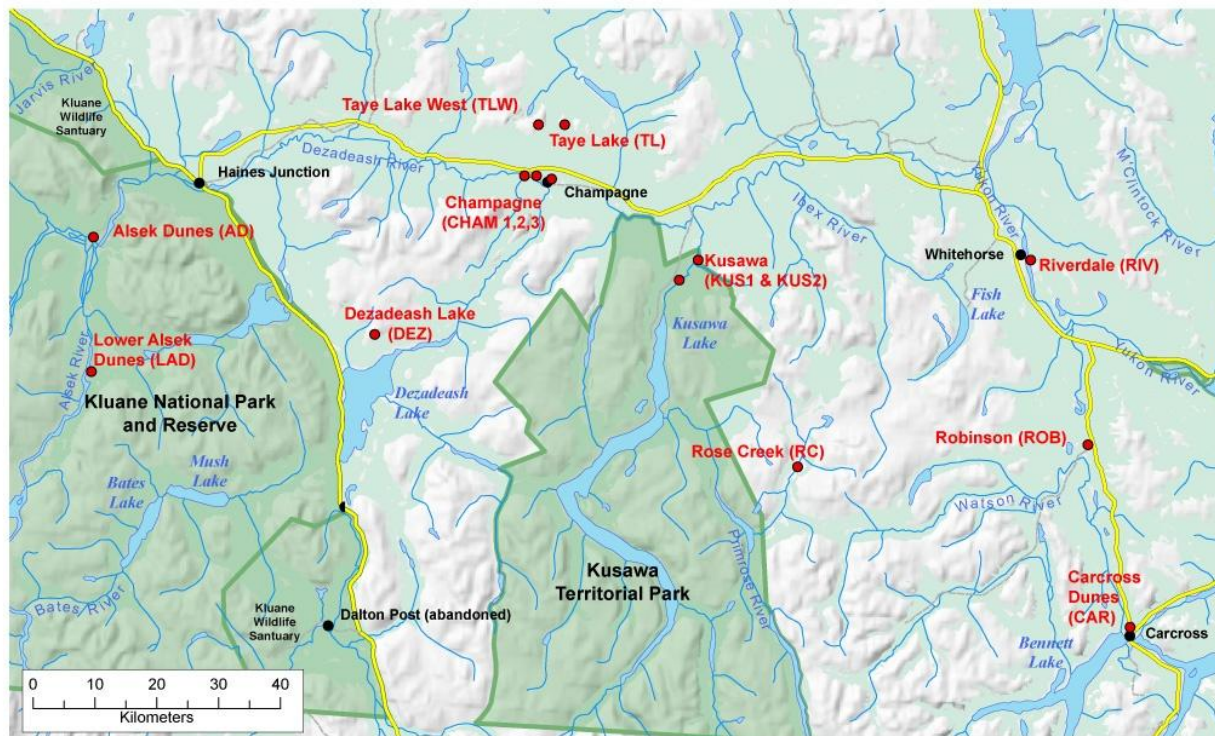
Baikal Sedge is distributed across Russia, Kazakhstan, and Mongolia, but is only found at a few sites in North America (COSEWIC 2005). These include one population found in central Alaska and 14 in Yukon. Baikal Sedge was likely more common in Yukon and Alaska at the end of the last ice age when open sand dune habitat was more plentiful. Glacial lakes, glacial rivers and strong winds moved sand deposits across the landscape. Populations of this plant were probably

equally dynamic, with seed and plant fragments being dispersed over long distances by these same mechanisms.

In Yukon, Baikal Sedge has been identified at 14 separate sites (Figure 1 and Table 2). These include two within Kluane National Park and Reserve: one at Alsek Dunes at the confluence of the Kaskawalsh, Dezadeash and Alsek Rivers (identified in the COSEWIC status report); and a smaller dune system about 18 kilometers south on the Alsek River (Line and Freese, 2006). Another two sites are located within Kusawa Territorial Park along the Takhini River. The Carcross Dunes near the community of Carcross and two sandy areas near Robinson are each home to Baikal Sedge populations. The Carcross population is split by a highway and was listed as two separate populations in the COSEWIC status report, however it is now considered to be a single population using the NatureServe criteria. Recent inventory work in the area revealed that the Robinson population was significantly larger than originally thought. In addition, populations have been identified at the following locations: Dezadeash Lake, Champagne (three separate populations), Taye Lakes (two populations), Rose Creek and Riverdale (Whitehorse) (Line 2010).

Two sites where Baikal Sedge had been collected in the past were also surveyed during the 2009-2010 inventory work to determine if the populations may have persisted undetected in recent years. These were Christmas Bay on Kluane Lake, originally located by V.C. Brink in 1974, and an unidentified location near Kusawa Lake originally located by C.A. Kennedy in 1985. Neither the Kusawa nor the Christmas Bay populations could be re-located during surveys, although at least one local resident thought they had recently seen the plant at Christmas Bay.

There are other small dune systems in southern and western Yukon, and inventory work is ongoing to find additional populations in the region. Traditional knowledge studies have been carried out by Yukon First Nations and several other potential sites have been identified for further surveys in 2011.



**Figure 1: Locations of Baikal Sedge in Yukon**

**Table 2: Baikal Sedge Populations in Yukon**

Location	Estimated Number of Ramets	Approximate Area of Extent
Carcross Dunes	200,000	210 hectares
Robinson Complex	19,000	2 hectares
Takhini Dunes 1 (Kusawa)	535,000	40 hectares
Takhini Dunes 2 (Kusawa)	200	0.5 hectares
Alsek Dunes	2.5 – 3 million	320 hectares
Lower Alsek Dunes	2,800	50 hectares
Dezadeash Lake	28,000	5 hectares
Rose Creek	30,000	2 hectares
Champagne 1	12,000	0.3 hectares
Champagne 2	13,000	0.5 hectares
Champagne 3	To be determined	To be determined
Taye Lake Complex	27,000	70 hectares

Taye Lake west	55,000	10 hectares
Whitehorse-Riverdale	To be determined	To be determined

*Sources: COSEWIC status report (2005), Line and Freese (2006), Line (2010), Line (2011)*

### 3.3 Needs of the Baikal Sedge

Baikal Sedge is predominantly found in areas where there are active, shifting sand dunes. The sand is loose and deep, usually 0.5 to 4 meters (COSEWIC 2005). The Yukon populations are found in areas close to the coastal mountains and glaciers where strong cold winds consistently blow. These environments are remnants of ice age landscapes when large glaciers and lakes covered much of the region. The winds and cool microclimates are important for the persistence of these dune environments.

Blowing sand is a common element of Baikal Sedge habitat, and the plant has the ability to send out new clones if older ones get buried. It is possible that patches of ramets shift location within the dune over time, which may mean that the plant requires a large area in order to maintain its population. In Yukon, the largest population by far (75% of the estimated total current population in Yukon) is found at Alsek Dunes, near the confluence of the Alsek and Kaskawulsh Rivers in Kluane National Park and Reserve. This area was flooded by glacial Lake Alsek, which was created when the Lowell Glacier dammed the Alsek River. When the glacier retreated 150 years ago, the lake completely drained and only the river now remains. The Alsek river valley therefore contains relatively young populations of Baikal Sedge. Approximately 3 million Baikal Sedge plants are now growing at this site (Line and Freese 2006).

It appears that Yukon's Baikal Sedge populations are maintained predominantly by asexual reproduction (rhizomes or horizontal root systems produce clones) (Line and Freese 2006). Clones from one plant can cover a large area, which means there may not be many individual plants. Initial results from a population genetics study indicate that there is limited genetic variation, which points to cloning, but that there is some genetic variation within the population (Jeff Saarela pers. com). However, additional work must be done in order to verify these findings. It is also unclear whether sexual reproduction takes place (i.e. viable seed is produced) with any frequency. If sexual reproduction is low, the Yukon populations may have low genetic diversity, making them more vulnerable to environmental change (Line and Freese 2006). In addition, the compaction of sand, through development or recreational activities, could limit the sedge's ability to reproduce by reducing the area where rhizomes could take hold.

Baikal Sedge plays an important role in stabilizing sand dunes. These plants are usually some of the first to colonize loose sandy areas and, through their root systems, create an environment that allows for the establishment of other plants. The sedge may also be important to the overall dune ecosystem. At this time, it is unknown if it is significant in the life cycle of other dune insects, plants or soil microorganisms.

Research on eolian deposits in the territory suggests sand dunes were common in Yukon and other northern landscapes during the last ice age (Stephen Wolfe, pers. com.). Most of these dunes have since been covered by Boreal forest through natural succession. As Baikal Sedge roots stabilize the loose open sand, Boreal plants are able to establish and eventually out-

compete the specialized sedge. This natural process may affect the long-term viability of some Baikal Sedge populations. Recent inventory work has focused on the remaining open eolian deposits, resulting in the discovery of several new sedge populations. As more of these dune environments disappear through natural succession, there are fewer sites where Baikal Sedge can flourish.

## 4. THREATS

### 4.1 Threat Assessment

**Table 3. Threat Assessment Table**

Threat	Level of Concern <sup>1</sup>	Extent	Occurrence	Frequency	Severity <sup>2</sup>	Causal Certainty <sup>3</sup>
<b>Habitat Loss</b>						
<b>Invasive Species</b>	High*	Widespread, particular concern near communities and roads	Anticipated	Unknown	High*	High
<b>Recreational Use (vehicles)</b>	Medium	Limited to certain sites	Documented	Recurrent	Medium-High (at one site)	Medium-High
<b>Community Development</b>	Medium	Limited to certain sites	Anticipated	Unknown	Medium	Medium
<b>Natural Change</b>	Low	Widespread	Anticipated	Unknown	Medium-Low	Medium-Low
<b>Reproduction</b>						
<b>Fungus</b>	Low	Widespread	Documented	Unknown	Low	Medium

\* The threat of invasive species is listed as ‘High’ to highlight the need for vigilance due to the potential for significant impacts to populations should invasive species be permitted to take hold. Continued monitoring and early action can keep this threat from ever truly becoming a concern.

<sup>1</sup> *Level of Concern: signifies that managing the threat is of (high, medium or low) concern for the recovery of the species, consistent with the population and distribution objectives. This criterion considers the assessment of all the information in the table).*

<sup>2</sup> *Severity: reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).*

<sup>3</sup> *Causal certainty: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability e.g. expert opinion; Low: the threat is assumed or plausible).*

## 4.2 Description of Threats

### Invasive Species

The establishment of invasive plant species in Yukon sand habitats is perhaps the greatest potential threat to Canada's Baikal Sedge populations. At this time, invasive dune stabilizers such as *Leymus angustus* (Altai Wild Rye) are beginning to encroach upon Baikal Sedge habitat in the Carcross Dunes area. *Melilotus officinalis* (sweet clover) is also beginning to invade the Dezadeash River corridor and it could move toward the populations found along the Alsek River. Both of these invasive species could out-compete Baikal Sedge since they also thrive in loose sand. Based on our knowledge of the behavior of these invasive species in other jurisdictions, the effects of their establishment at the Baikal Sedge sites could be significant in a very short time period. This type of threat requires a rapid, proactive control program to prevent it from occurring.

### Recreational Use

Recreational use is not a threat for Baikal Sedge populations in Kluane National Park and Reserve. The dunes located in Taye Lakes, Dezadeash, Rose Creek and on the northeast side of the Takhini River are also fairly inaccessible and are not visited by humans very often. The Champagne sites are within reach of the highway and the community of Champagne, but currently do not experience much human use. Recreational use may pose a problem for the 4 populations that are easily accessed: the southwest side of the Takhini River, the Carcross Dunes, Whitehorse-Riverdale and Robinson. Use of motorized recreational vehicles in the dunes can compact the sand and directly kill ramets. This is of particular concern in the Carcross Dunes, where recreational vehicle use is prevalent. The Takhini River sites will soon be part of the new Kusawa Territorial Park, which may have specific management approaches laid out in the park's management plan, and municipal regulations prohibit vehicle use at the Riverdale site.

Since 2007, a local tour company has been offering summer ATV excursions through the 'Carcross Desert' near the Klondike Highway. Most of these are packaged tours for Holland America cruise ship passengers, and it appears the tours generally follow the same route each time. In addition to this commercial venture, individual citizens also use the Carcross Dunes on a regular basis for ATV recreation in summer. The Whitehorse-Riverdale Dunes are a heavily used recreational area for biking, tobogganing, snowmobiles and ATVs, although municipal regulations prohibit vehicle use. The level of impact of recreational activities, especially vehicle use, on the Carcross and Whitehorse-Riverdale Dunes is unknown. Efforts must be made to determine what the impacts are to sedge populations of varying levels of recreational activity.

Snowmobiles are also used extensively in the Carcross Dunes. It is estimated that up to 30 snow machines can be using the dunes during a given winter weekend (Barrett pers. com.). While the snow machines are using the dunes primarily when they are covered with snow, they may have a compacting effect. Erosion of sand along the crest of dunes has been observed in Carcross. Again, the impacts of these activities on the sedge are unclear, and more monitoring would be required to develop a clearer understanding of the effects of snow machines.



## **Community Development**

Four of the 14 Baikal Sedge populations in Yukon are located in either national or territorial parks, so development in these areas is strictly controlled. There are a variety of landowners at the other sites, including private, First Nation, municipal and the crown. Two of the 14 populations occur right in town sites – Carcross and Whitehorse-Riverdale.

Community and economic development initiatives are important to the people of Carcross. Over the years, a few initiatives have been proposed that could impact the dunes and, subsequently, the sedge. As part of their Land Claims agreement, the Carcross Tagish First Nation owns as settlement land a waterfront portion of the Carcross Dunes; the First Nation may use this parcel for residential development. This land parcel is within Baikal Sedge habitat, and if development occurred at the site, it would destroy plants in the immediate vicinity and could impact habitat downwind of the site. As well, a hotel complex was proposed for the northwest corner of the Carcross dunes, but the project has not come to fruition. This development could also have impacts on the Baikal Sedge populations at this site.

One initiative that has occurred is the expansion of railway service between Carcross and the port of Skagway. This has meant larger numbers of tourists visiting the area during the summer months. The White Pass & Yukon Route Railway Company owns a significant portion of the Carcross dunes and it is not known whether the company plans to use these lands for future tourism opportunities. The Yukon Government Historic Sites Unit (Cultural Services Branch) has recently contacted the Carcross community to discuss future options for developing tourism, which may include ecotourism.

The Yukon government is working with Carcross Tagish First Nation and the community of Carcross to develop a local area plan and to update the existing zoning regulations for the area. New zoning regulations will implement the results of the local area planning process and could include recovery strategies (such as the Baikal Sedge recovery strategy)..

The Whitehorse-Riverdale Baikal Sedge site is a recent discovery and we have yet to evaluate the full range of land uses at this site. This population is very small and requires a population and area of occupancy assessment.

## **Changes to the Dune Ecosystem**

One of the longer-term threats to Baikal Sedge in Yukon is habitat loss due to natural succession - encroachment by and competition from other plant species. This could be the result of a variety of factors, including the sedges themselves creating a stable environment for other species to take hold in the absence of sufficient natural disturbance. Vegetation encroachment is less likely to take place in areas where natural disturbance cycles provide a source of loose sand for early successional species like Baikal Sedge. The speed with which this process is taking place at the Baikal sedge dune sites in Yukon is unclear and requires further study.



Climate change is another threat that might affect some of the dune-forming influences such as wind speed, rainfall and temperature at a local scale. Climate change and subsequent glacial melt may pose a particular concern for the large populations located along the Alsek River. At this time, the full extent of climate change and its effects on Baikal Sedge habitat are unknown. Continued monitoring of sites and climate patterns will help provide a better understanding of these changes.

### **Smut Fungus**

*Planetella lironis* is a smut fungus that infects the seeds of the sedge. The fungus has been documented in most Baikal Sedge populations. It is unclear how the fungus affects the overall survival of the plant. This species of smut fungus is very host-specific, suggesting a long-term evolutionary relationship. There are likely mechanisms in place such that the fungus parasitizes but doesn't kill its host outright. Further research is needed to determine what affects the fungus has on seed production and viability. The overall severity of the threat is probably low.

## **5. POPULATION AND DISTRIBUTION OBJECTIVES**

Baikal Sedge is naturally rare in Canada, occurring as isolated populations within a restricted geographic area. Inventory work since the COSEWIC assessment in 2005 has shown that there are nearly three times as many populations in Canada as originally thought. For this and other reasons described in this strategy, the species no longer meets COSEWIC's published criteria for an assessment of Threatened.

The population objective for Baikal Sedge is to maintain at least 11 of the known populations in Yukon. Species found at 10 or fewer locations may be assessed as Threatened under criterion B (small distribution range & decline or fluctuation) of COSEWIC's 2010 assessment criteria ([http://www.cosewic.gc.ca/pdf/assessment\\_process\\_e.pdf](http://www.cosewic.gc.ca/pdf/assessment_process_e.pdf)), and our goal is eventual down-listing of the species. To prevent declines in the total number of mature individuals and the current area of occupancy, the populations to be maintained should include those with plants in a vigorous state of health in dunes with sufficient natural processes (ie/ wind) required to maintain suitable habitat over the long term. The distribution objective is to prevent a decline in the extent of occurrence, by maintaining populations across the currently known range of the species in Yukon. Each dune ecosystem will be managed collaboratively to the extent possible to ensure the long-term persistence of healthy populations throughout the range.

The key threats to Baikal Sedge in Yukon are 1) the potential for invasion by exotic species that exclude native vegetation, 2) recreational use with motorized vehicles (ie/ ATVs etc), 3) development and 4) natural succession. Three of the 14 known populations are subject to significant recreational use by motor vehicles (Carcross, Whithorse-Riverdale and Kusawa West), however one (the Kusawa West population) will shortly be designated as a Territorial Park. Five other populations are within relatively close proximity to human habitation and could become subject to threats from motor vehicle use or development in the future. Several other populations are either protected or found in remote areas away from most of the threats. Natural succession is the only threat not caused by human uses.

## 6. BROAD STRATEGIES AND GENERAL APPROACHES TO MEET OBJECTIVES

- Complete inventory of the few remaining candidate dune systems and determine if new populations exist.
- Map Baikal Sedge distribution in Yukon and determine areas of occupancy at each location.
- Minimize or mitigate the threat of invasive species (including *Leymus angustus*, *Melilotus officinalis* (a.k.a. *Melilotus alba*)) before they take hold at any of the dune sites.
- Ensure that Baikal Sedge considerations are included in all relevant land and species management planning processes within the species' range in Yukon.
- Implement stewardship and public education/communications about Baikal Sedge to increase public support and stewardship activities for Baikal Sedge and sand dune ecosystems.
- Fill critical knowledge gaps regarding threats to Baikal Sedge, especially the impacts of recreational use as well as the long-term impacts of natural processes on the viability of sedge populations in Yukon.

### 6.1 Actions Already Completed or Currently Underway

The recovery team for Baikal Sedge includes federal, territorial and First Nation governments, conservation organizations and community groups. Over the past few years, as awareness of the sedge has increased, a series of actions have been taken by the different groups to learn more about the sedge and to raise awareness about its importance.

In 2006, Parks Canada in partnership with the Yukon government conducted an inventory of Baikal Sedge sites found within Kluane National Park and Reserve. This survey led to the discovery of a second small site within the park, 18 km south of the already identified Alsek dunes. Samples of smut fungus were gathered as part of this inventory and sent to Agriculture and Agri-Food Canada for analysis.

Further research was conducted by the Yukon government in 2007, including inventory at four known Baikal Sedge sites. Parks Canada, the Yukon government and the Canadian Museum of Nature also began a population genetics study that includes information from the initial six sites. The purpose of this study is to determine the levels of genetic diversity at each site and also to compare diversity among the sites. It is hoped that this study will shed some light on the amount of cloning within each population. Understanding how important asexual reproduction is to Baikal Sedge populations may also assist in estimating numbers of individuals within each population.

Also in 2007, the Yukon government, in partnership with the Carcross-Tagish First Nation and the Yukon Conservation Society, received funding from the federal Habitat Stewardship Program to begin community outreach and data collection for recovery planning. Interpretive

hikes, which targeted locals and special interest groups, were held throughout the summer. Five local youth were trained to use GPS and conducted plant surveys of the sedge in the Carcross Dunes. This was primarily an educational exercise and did not establish defensible information on critical habitat for Baikal Sedge, but provided insight into the overall distribution of the sedge in the Carcross Dunes.

In 2008 and 2009, the population genetics study continued with the Canadian Museum of Nature. Parks Canada and the Yukon government also began work with the University of Alaska to gain a better understanding of Baikal Sedge seed viability. Further work on the smut fungus was carried out by Agriculture and Agri-Food Canada. Some initial work on invasive species removal was carried out in the Carcross Dunes area. Analyses of these data are ongoing.

Several First Nations in southern Yukon received funding from the Aboriginal Funds for Species at Risk in 2009 and 2010 to collect traditional knowledge on Baikal Sedge and sand dune ecosystems, to perform some inventory work, and to report back to the communities. This work was carried out successfully for the most part, and in addition to adding new sites to the known distribution, resulted in increased awareness of the sedge in many communities throughout the species' range.

Several additional new Baikal Sedge populations were discovered during Environment Canada surveys for the Dune Tachinid Fly (*Germaria angustata* (Zett.)) in 2009.

## 6.2 Strategic Direction for Recovery

**Table 4. Recovery Planning Table**

<b>Threat or Limitation</b>	<b>Priority</b>	<b>Broad Strategy to Recovery</b>	<b>General Description of Research and Management Approaches</b>
Incomplete knowledge of species distribution and number of populations	Urgent	Inventory and Mapping	<ul style="list-style-type: none"> <li>• Survey and map area of occupancy at all remaining locations</li> <li>• Survey final few candidates with potential Aboriginal traditional, scientific or local ecological knowledge about Baikal Sedge at other sites</li> <li>• Examine possibilities of Baikal Sedge occurring in dunes in BC, NWT, Alaska</li> <li>• </li> </ul>
Habitat loss through invasive plant mono-culture	Urgent	Invasive alien plant species removal	<ul style="list-style-type: none"> <li>• Inventory invasive plants at all sites</li> <li>• Plan and implement removal of invasive species at Baikal Sedge sites</li> <li>• Plan for continued monitoring to ensure invasive species never take hold</li> </ul>
Lack of habitat management for Baikal Sedge	Urgent	Habitat Management	<ul style="list-style-type: none"> <li>• Ensure the inclusion of Baikal Sedge management in relevant planning initiatives (e.g. Local Area Plans, Park Management Plans).</li> </ul>
Lack of public knowledge of the impact of recreational activities on Baikal Sedge	Urgent	Public education and communication	<ul style="list-style-type: none"> <li>• Develop communication strategies</li> <li>• Produce and distribute educational materials</li> <li>• Promote best practices for recreational use at 4 sites where it is a threat.</li> </ul>
Incomplete knowledge of threats	Necessary	Research	<ul style="list-style-type: none"> <li>• Document impacts of recreational use and determine the relative importance of different levels of disturbance to individuals, to their habitat and to natural processes on survival</li> </ul>
	Useful	Research	<ul style="list-style-type: none"> <li>• Monitor rates of in-filling of dune habitats.</li> <li>• Determine how best to address issues of natural succession</li> </ul>

## 7. CRITICAL HABITAT

Critical habitat is "the habitat necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species." (*Species at Risk Act*, s 2). A partial identification of critical habitat supporting the survival and recovery of Baikal Sedge is included in this recovery strategy. The identification is based on the best currently available information and includes the largest Baikal Sedge population in Yukon (representing 75% of the total Canadian population) and another cluster of populations that count as a single population in this strategy. The size, density and health of the Alsek Dune sedge population made it a priority for critical habitat identification. Further work is required to identify additional habitat to support the recovery of this species and achieve the population and distribution objectives. To meet the population and distribution objectives for Baikal Sedge and to identify which populations should be included as critical habitat, it is necessary to determine which of the known locations are of adequate density and health class to remain viable over the long term (based on population size, plant health status, and ecosystem process). In the interim, each dune ecosystem will be managed collaboratively to the extent possible to ensure the long-term persistence of healthy populations throughout the range. Any remaining critical habitat will be identified to the extent possible as per the schedule of studies outlined in section 7.2 below.

### 7.1 Critical Habitat Identification

#### Alsek Dune

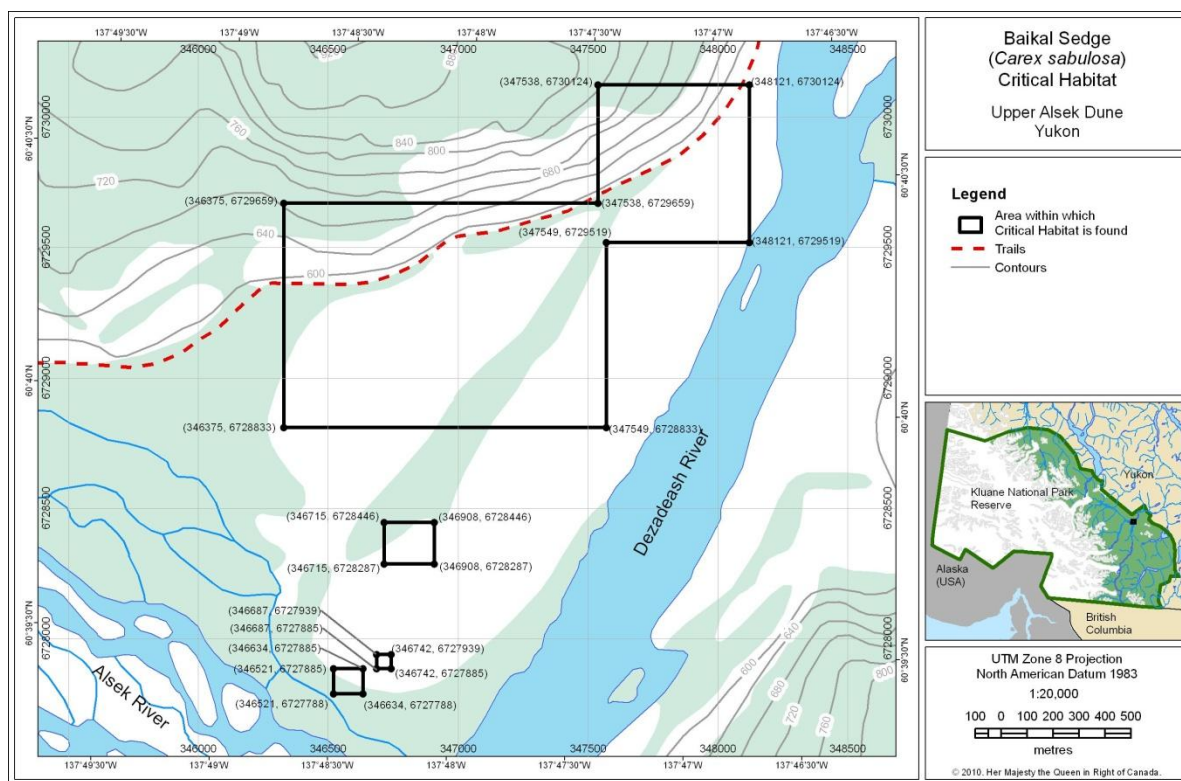
The Alsek Dune population of Baikal Sedge is located at the confluence of the Kaskawalsh, Dezadeash and Alsek Rivers in Kluane National Park and Reserve and in the traditional territory of Champagne & Aishihik First Nations (Figure 1). The Alsek Dune population is the largest by far in Canada, representing approximately 75% of the total population and 45% of the total area of Baikal Sedge in Canada.

The critical habitat for the Alsek Dune population (Figure 2) is identified as: 1) all open sand habitat supporting Baikal Sedge densities of more than 100 ramets (stems) per 10 m<sup>2</sup> (Figure 3) in any state of health, and 2) all open sand habitat supporting any Baikal Sedge at all ( $\geq 1$  ramet per 10 m<sup>2</sup>) in a moderate or better state of health (Figure 4). To assess sedge plant health, 10 m<sup>2</sup> plots were qualitatively ranked based on the following parameters: amount of new growth from the current season (i.e. size and number of new green blades per ramet); proportion of ramets with flowering/fruiting heads; size and robustness of the ramets. Small plants showing little to minimal new growth and zero to only a few flowering heads were considered to be in a minimal to poor state of health.

Open sand areas with fewer than 100 ramets per 10 m<sup>2</sup> that are in minimal to very poor health are not identified as critical habitat. Areas where Baikal Sedge is found in low densities and poor or minimal health status are often areas where there is less open sand due to the influx of other successional plant species that eventually out-compete Baikal Sedge for habitat. A certain

amount of disturbance in such areas may benefit a large Baikal Sedge population such as that at the Alsek Dune.

First Nation activities related to access and harvesting rights (including off-trail ATV use for transportation) are unaffected in the low-density areas where there is less open sand and the plants are in poor health, as these areas are not considered to be critical to meeting the populations and distribution objectives and are not identified as critical habitat for Baikal Sedge. Specifically, along the southern margin of the Alsek Dune, up to 30 m from the tree line at the edge of the dune (Figure 2), Baikal Sedge densities are low (0-99 ramets per 10 m<sup>2</sup>) and the plants are in poor health (Figures 3 & 4), likely due to the natural process of dune stabilization and competitive exclusion (succession) by other plant species. These areas are therefore outside the area of habitat identified as critical. As such, disturbance associated with ATV travel through this habitat would not seem to pose a threat to Baikal Sedge, and the availability of a travel corridor should accommodate the access rights of members of Champagne and Aishihik First Nations.



**Figure 2: Critical Habitat of Baikal Sedge on the Alsek Dune**

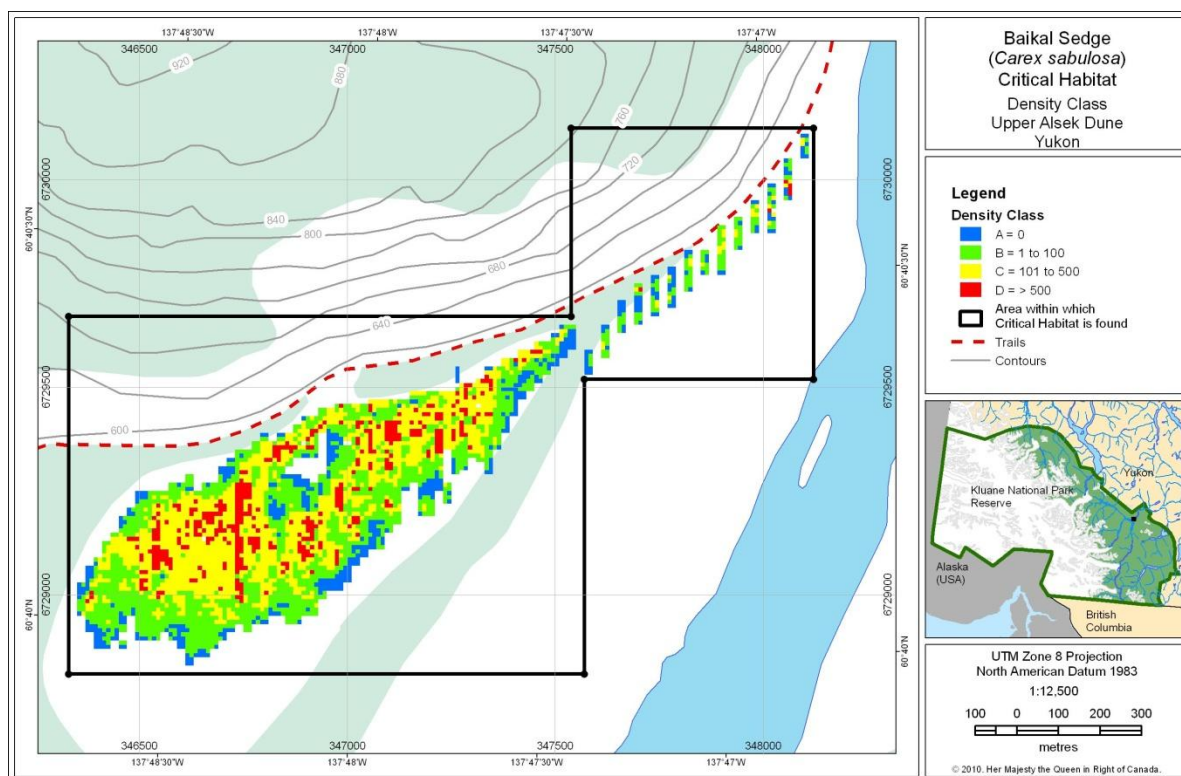


Figure 3: Densities of Baikal Sedge on the Alsek Dune

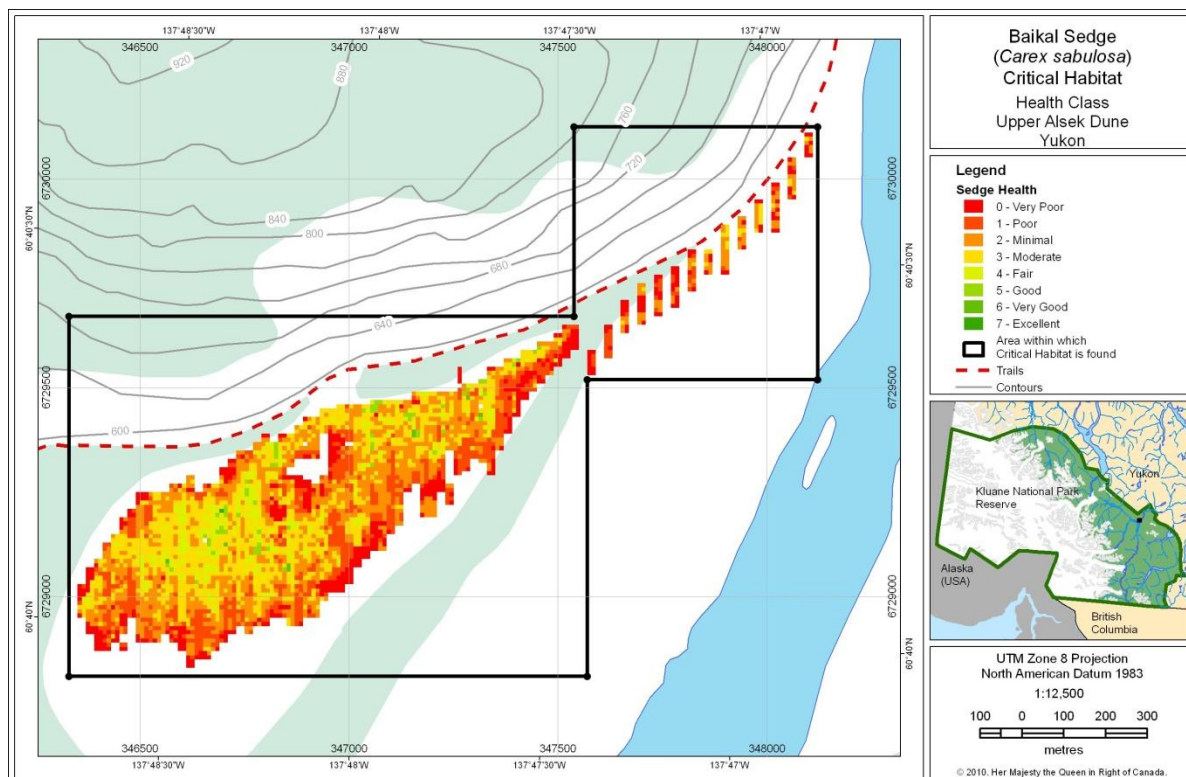


Figure 4: Health status of Baikal Sedge on the Alsek Dune



## Lower Alsek Dune

The Lower Alsek Dune population of Baikal Sedge is located along the Alsek River on Champagne & Aishihik First Nations territory in Kluane National Park and Reserve (Figure 1). This population is made up of 6 very small patches of sedge, so in order to maintain a sufficient numbers of individuals for the Lower Alsek population to remain viable over the long term, the critical habitat is identified as all open sand habitat supporting Baikal Sedge in any state of health (Figure 5, bounding box coordinates Table 5). The reason we are not using the same criteria for identifying critical habitat in the Lower Alsek that we did for the Upper Alsek is that each of the 6 Lower Alsek patches are less than 1 hectare in size with a combined total population of 2,800 ramets, compared to the 2.5 to 3.0 million ramets in the Upper Alsek population.

**Table 5. UTM Coordinates of Critical Habitat Bounding Boxes (Fig 5), Lower Alsek Dune**

ID	Box Corner	X Coord	Y Coord		ID	Box Corner	X Coord	Y Coord
LA1	Upper Left	346420	6709330		LA4	Upper Left	346320	6708250
	Upper Right	346510	6709330			Upper Right	346380	6708250
	Lower Right	346510	6709230			Lower Right	346380	6708160
	Lower Left	346420	6709230			Lower Left	346320	6708160
LA2	Upper Left	346350	6708660		LA5	Upper Left	346150	6707440
	Upper Right	346430	6708660			Upper Right	346210	6707440
	Lower Right	346430	6708570			Lower Right	346210	6707330
	Lower Left	346350	6708570			Lower Left	346150	6707330
LA3	Upper Left	346290	6708430		LA6	Upper Left	346100	6706840
	Upper Right	346390	6708430			Upper Right	346170	6706840
	Lower Right	346390	6708310			Lower Right	346170	6706790
	Lower Left	346290	6708310			Lower Left	346100	6706790



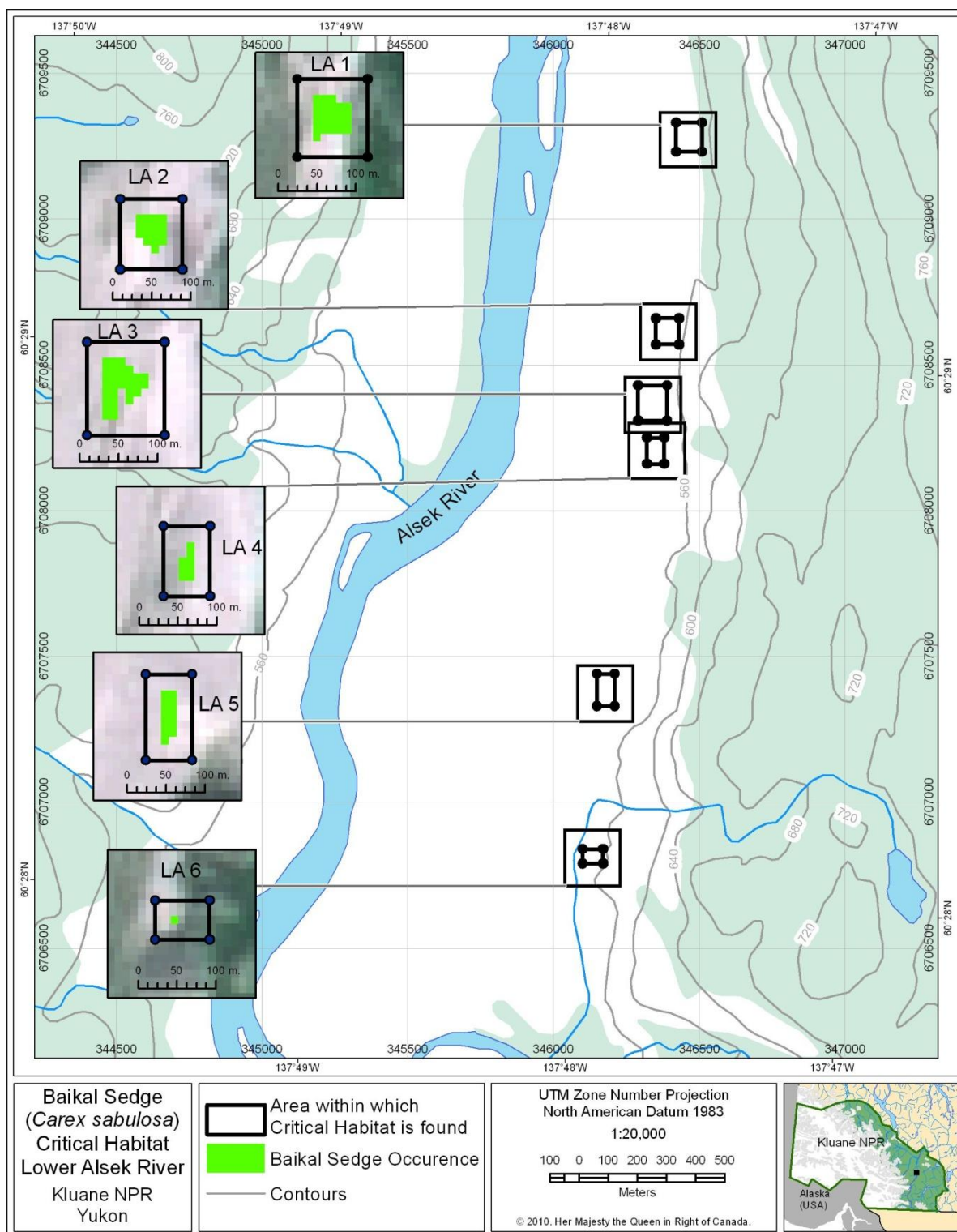


Figure 5: Critical Habitat of Baikal Sedge on the Lower Alsek Dune

## Biophysical Attributes

Within the identified boundaries, the biophysical attributes of critical habitat include the following:

- Semi-stabilized dunes to active, shifting sand dunes with sparse vegetation.
- Areas where sand is loose and deep, usually 0.5 to 4 metres.
- Areas where strong cold winds consistently blow - winds and cool microclimates are important for the persistence of the dune environments.

## 7.2 Schedule of Studies to Identify Critical Habitat

**Table 6. Schedule of Studies to Identify Critical Habitat**

Description of Activity	Rationale	Timeline
Identify remaining areas of suitable habitat, based on traditional knowledge, geospatial data and expert opinion, and survey this habitat for new occurrences.	The 11 populations of Baikal Sedge to be maintained must include those with plants in the highest health categories from among the known populations, so we must finish our population inventory work in order to ensure we include those populations in vigorous health.	2011
Map Baikal Sedge areas of occupancy at each location, as per the Recovery Objectives.	Establish the locations and extent of known populations of Baikal Sedge in Yukon	2011 and 2012
Collect information on habitat characteristics and ecosystem processes necessary to maintain Baikal Sedge populations at each known location, using standardized methods suitable for the species.	To identify key factors explaining the occurrence and abundance of Baikal Sedge and thresholds for ecosystem processes needed to maintain sand dunes over the long term. Analysis will assist in determining locations and conditions for the identification of critical habitat and focusing on populations with the best long-term viability.	2013
Document impacts of recreational use on Baikal Sedge and determine the relative importance of different levels of disturbance to individuals, to their habitat and to natural ecosystem processes, as per the Recovery Objectives.	A better understanding is required to determine how much and what kind of disturbance the plants can withstand and how quickly they re-establish in areas that have been disturbed in order to characterize activities that may destroy critical habitat.	2013
Monitor rates of infilling of habitat (based on photo-interpretation, other data sources) to better understand the significance of vegetation succession to the long-term viability of each known population.	Determine how to address issues of natural succession and the impact of this process on critical habitat identification.	2014

### 7.3 Activities Likely to Result in the Destruction of Critical Habitat

Destruction of critical habitat would result if any part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from single or multiple activities at one point in time or from the cumulative effects of one or more activities over time. Examples of activities that may result in the destruction of critical habitat of the Baikal Sedge include but are not limited to, the following:

**Table 7. Examples of Activities Likely to Result in the Destruction of Critical Habitat**

<b>Example of Activity Likely to Destroy Critical Habitat</b>	<b>Potential Effect on Critical Habitat</b>
Introduction of alien invasive or native invasive species in or within seeding distance (or other reproductive means, such as reproduction via cloning) of the critical habitat, via human transportation of seeds or plants (accidental or on purpose) or natural succession.	Competition crowding out Baikal Sedge and/or affecting ecosystem processes (diminishing wind effects, etc) leading to degradation of habitat
Repetitive recreational use of motorized vehicles such that Baikal Sedge ramets are destroyed or affected to the point of dying off.	Direct mortality of ramets; soil compaction that results in the destruction of rhizomes; facilitation of the introduction and spread of alien invasive species or other competitive species
Road development, trail development, structure building.	Habitat destruction; facilitation of the introduction and spread of alien invasive species or other competitive species; changes in wind and temperature regimes (microclimate) could lead to dune stabilization and plant succession that would ultimately exclude Baikal Sedge.

Threshold tolerance levels and cumulative effects for the above activities likely to destroy critical habitat have not been determined and require further assessment.

## 8. MEASURING PROGRESS

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives. Specific progress towards implementing the recovery strategy will be measured against indicators outlined in subsequent action plans. Table 8 summarizes the population and distribution targets for Baikal Sedge, based on the population and distribution objectives outlined in Section 5 above and the criteria that COSEWIC used to assess the species as Threatened. Table 8 also shows the current (2011) Baikal Sedge values for each COSEWIC criterion and the threshold values that result in a status assessment of “Threatened”.

**Table 8. Baikal Sedge Population and Distribution Targets**

COSEWIC Criteria		Value for Threatened	Value for Baikal Sedge (2011)	Target
B1	Extent of occurrence estimated to be	Less than 20,000 km <sup>2</sup>	Less than 20,000 km <sup>2</sup> (8168 km <sup>2</sup> )	Stable across at least 11 populations
B2	Index of area of occupancy estimated to be	Less than 2,000 km <sup>2</sup>	Less than 2,000 km <sup>2</sup> (120 km <sup>2</sup> )	Stable across at least 11 populations
a (i)	Fragmentation	Severe	Severe (but may be naturally fragmented)	No decline
a (ii)	Number of locations less or equal to	10	14	Maintain at least 11
b (i)	Extent of occurrence	Continuing decline	Stable (apparent increases are the result of new inventory)	Stable
b (ii)	Index of area of occupancy	Continuing decline	Stable (apparent increases are the result of new inventory)	Stable
b (iii)	Area, extent and/or quality of habitat	Continuing decline	Unknown	No target
b (iv)	Number of locations or populations	Continuing decline	Stable (apparent increases are the result of new inventory)	Maintain at least 11
b (v)	Number of mature individuals	Continuing decline	Unknown	No target
D2 (i)	Index of area of occupancy	Less than 20 km <sup>2</sup>	Unknown	No target
D2 (ii)	Number of locations	Less than 5	14	Maintain at least 11

**Objective: Maintain at least 11 of the known populations of Baikal Sedge in Yukon**

Every five years, success of recovery strategy implementation will be measured against the following performance indicators:

- Continued persistence of at least 11 of the extant populations of Baikal Sedge;
- Sufficient number of individuals in at least 11 Baikal Sedge populations maintained such that the populations will remain viable over the long term.

- Populations with plants in above average health categories (vigorous plants, presence of sufficient natural processes (ie/wind) required to maintain the dune habitat over the long term) are included among the 11 populations to be maintained over the long term.

## 9. STATEMENT ON ACTION PLANS

A proposed action plan for Baikal Sedge will be posted on the Species at Risk Act Public Registry by April 2017.

## 10. REFERENCES

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## APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

This recovery strategy will clearly benefit the environment by promoting the recovery of the Baikal Sedge. Activities to meet recovery objectives are unlikely to result in any important negative environmental effects, as they are mostly limited to inventory, habitat mapping and protection, increasing public awareness and engaging landowners. Activities may also inadvertently benefit non-target species. The greatest potential for environmental effects comes from invasive species removal activities, which if done carefully and following current protocols, is likely to result in a net benefit to both the Baikal Sedge and the ecosystem in which it lives.

Some recovery strategy activities (e.g., surveys involving the manipulation of animals) may require project-level environmental assessment as required under the Canadian Environmental Assessment Act (CEAA). Any activities found to require project-level environmental assessments will be assessed at that time pursuant to the provisions of the Act. The SEA process has concluded that this recovery strategy will have several positive effects on the environment. No significant negative effects are expected.