Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Bent Spike-rush (*Eleocharis geniculata*), Southern Mountain population, in Canada

Bent Spike-rush

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For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

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[1] www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[2] 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 after the publication of the final document on the SAR Public Registry.

The Minister of Environment and Climate Change is the competent minister under SARA for the Bent Spike-rush, Southern Mountain population, and has prepared this recovery strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Province of British Columbia, 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 Environment and Climate Change Canada or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Bent Spike-rush, Southern Mountain population, 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 Environment and Climate Change 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.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected.

In the case of critical habitat identified for terrestrial species including migratory birds, SARA requires that critical habitat identified in a federally protected area[3] be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against

[2] www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2

[3] These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994,* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies.

If the critical habitat for a migratory bird is not within a federal protected area and is not on federal land, within the exclusive economic zone or on the continental shelf of Canada, the prohibition against destruction can only apply to those portions of the critical habitat that are habitat to which the *Migratory Birds Convention Act, 1994* applies as per SARA ss. 58(5.1) and ss. 58(5.2).

For any part of critical habitat located on non-federal lands, if the competent minister forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, or the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to prohibit destruction of critical habitat. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

Acknowledgments

This document borrows significantly from the COSEWIC assessment and status report on the Bent Spike-rush *Eleocharis geniculata*, Great Lakes Plains population and Southern Mountain population, in Canada (COSEWIC 2009) and the Recovery Strategy for the Bent Spike-rush (*Eleocharis geniculata*), Great Lakes Plains population, in Canada (Environment Canada 2016). All those involved in the development of these documents are gratefully acknowledged. This recovery strategy was prepared by Matt Huntley, Eric Gross, Darcy Henderson, Kella Sadler, and Sarah Cheng (Environment and Climate Change Canada, Canadian Wildlife Service – Pacific Region (ECCC CWS-Pacific Region)). Leah Westereng, Brenda Costanzo, and Grant Furness (B.C. Ministry of Environment), Paul Grant (B.C. Forests, Lands and Natural Resource Operations) and Kim Borg (ECCC CWS-National Capital Region) provided helpful editorial advice and comment.

Executive Summary

Bent Spike-rush (*Eleocharis geniculata)* is a small (2-20 cm) tufted annual plant from the sedge family. It is made up of numerous slender stalks, each topped by a spikelet of small flowers which gives the species its common name. The plant produces small dry black fruitlets. Bent Spike-rush has two populations in Canada, the Southern Mountain and Great Lakes populations, which were both designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Endangered in April 2009 based on a new status report. Both populations of Bent Spike-rush were listed as Endangered under Schedule 1 of the federal *Species at Risk Act* (SARA) in 2011. In British Columbia (B.C.), the Southern Mountain population[4] is red-listed. The Great Lakes population of the species is listed as Endangered under Ontario's *Endangered Species Act, 2007*, and is addressed in another recovery strategy[5].

In Canada, the Southern Mountain population is only found in one location, on the east shore of Osoyoos Lake in B.C. It is found at the edges of seasonally flooded ponds in areas of open sandy or muddy soils that are free from competition from taller and more aggressive plants. In B.C., the Bent Spike-rush, Southern Mountain population occurs within an area of approximately 1200 m^2 with an estimated population of greater than 10,000 mature individuals.

There are unknowns regarding the feasibility of recovery of the Bent Spike-rush, Southern Mountain population, but recovery may be biologically and technically feasible should these unknowns be addressed. The range of Bent Spike-rush is restricted to specific and geographically limited habitat. In B.C., primary threats to the species include future residential development, invasive plants, especially grasses, and recreational disturbance.

The population and distribution objective for Bent Spike-rush, Southern Mountain population, is to maintain its distribution, and to maintain or (where feasible and appropriate) increase the abundance of the existing population within its current distribution as well as any new populations that may be identified in the future.

The broad strategies to be taken to address the threats to the survival and recovery of the species are presented in section 6.2, Strategic Direction for Recovery.

[4] It is important to note that the taxonomy of the Southern Mountain population is currently unresolved. As of 2017 the province of British Columbia does not consider this population to be Bent Spike-rush (*Eleocharis geniculata*) but rather a new species of *Eleocharis* (as yet undetermined). However, until the species is reassessed by COSEWIC and any associated listing (re)assignments are reviewed and accepted by the Minister of Environment and Climate Change and the Governor in Council, the species' legal name under SARA remains Bent Spike-rush, Southern Mountain population.

[5] Recovery Strategy for the Bent Spike-rush (*Eleocharis geniculata*), Great Lakes Plains population, in Canada

Critical habitat is not identified for Bent Spike-rush, Southern Mountain population in Canada at this time, but a schedule of studies has been included. The identification of critical habitat will be updated when the information becomes available, either in a revised recovery strategy or action plan(s).

One or more action plans will be posted on the Species at Risk Public Registry within five years of the final posting of the recovery strategy.

Recovery Feasibility Summary

Based on the following four criteria that Environment and Climate Change Canada uses to establish recovery feasibility, there are unknowns regarding the feasibility of recovery of the Bent Spike-rush, Southern Mountain population. In keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of SARA, as would be done when recovery is determined to be technically and biologically feasible. This recovery strategy addresses the unknowns surrounding the feasibility of recovery.

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. The Bent Spike-rush, Southern Mountain population is estimated to be greater than 10,000 individuals. While population size may fluctuate due to the dynamic nature of its habitat, the population persists and is maintained over the long term by its seedbank, which can remain dormant for many years (COSEWIC 2009). The available data are insufficient to determine naturally sustainable ranges in population size, and/or related trends.

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.

Yes. There is one known location for this population in Canada and sufficient suitable habitat is currently available to support it. Other suitable habitats of open sandy soil alongside seasonally wet, sheltered ponds are limited in area but available in close proximity (COSEWIC 2009). Bent Spike-rush has not been detected in those nearby habitats after several surveys, and it is unknown if other limiting factors or threats prevent colonization and detection. Recent successful attempts to restore a disturbance regime on similar sandy beach habitats in the Okanagan Valley for the recovery of Short-rayed Alkali Aster (*Symphyotrichum frondosum*) (Henderson and Patterson 2016) suggest restoration efforts may have similar positive effects for Bent Spike-rush.

3. The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.

Unknown. As an annual plant with only one known occurrence, the risk of a stochastic event causing extirpation is high. The principal threats to Bent Spike-rush, Southern Mountain population are residential and commercial developments, invasive alien species, and recreational disturbance. Stewardship and cooperation with landowners and land managers can prevent or mitigate some major threats through recovery methods including habitat protection, inventory and monitoring, invasive species management, and habitat restoration/rehabilitation.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

Yes. Standard propagation techniques exist for raising vascular plants from seed and raising stock for reintroduction, and habitat restoration techniques also are available. Little is known about the species' reproductive biology, including factors affecting seed dormancy and germination, seed dispersal, fruiting success, and seed bank characteristics.

The reason for the limited distribution of the Bent Spike-rush in British Columbia at present is unknown. Because the Bent Spike-rush, Southern Mountain population has only been recorded at one location to date, it is possible that the species has always been rare in the province, in which case the species always may be vulnerable to human-caused and natural stressors, despite maintaining the currently existing population, by virtue of its limited distribution.

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1. COSEWIC* Species Assessment Information

Date of Assessment: April 2009

Common Name (population): Bent Spike-rush - Southern Mountain Population

Scientific Name: *Eleocharis geniculata*

COSEWIC Status: Endangered

Reason for Designation: Only a single population of this annual species of the sedge family is known from a seasonally flooded wetland complex within a sandy spit at Osoyoos Lake, B.C. Approximately 10,000 small plants are restricted to an area of about 1200 square metres where they are at risk from stochastic events and the potential impacts from the spread of exotic grasses.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Endangered in April 2009. Assessment based on a new status report.

* COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

2. Species Status Information

The Canadian range of Bent Spike-rush (*Eleocharis geniculata*) is represented by two disjunct populations: the Southern Mountain population, which is restricted to south-central British Columbia (B.C.), and the Great Lakes Plains population, which is restricted to southern Ontario. All references to “Bent Spike-rush” in this document imply the “Bent Spike-rush, Southern Mountain population”, i.e., wherever population name is not specifically stated.

It is important to note that the taxonomy of the Southern Mountain population is currently unresolved. As of 2017 the province of British Columbia does not consider this population to be Bent Spike-rush (*Eleocharis geniculata*) but rather a new species of *Eleocharis* (as yet undetermined). However, until the species is reassessed by COSEWIC and any associated listing (re)assignments are reviewed and accepted by the Minister of Environment and Climate Change and the Governor in Council, the species’ legal name under SARA remains Bent Spike-rush, Southern Mountain population.

Legal Status: SARA Schedule 1 (Endangered) (2011).

Table 1. Conservation Status of Bent Spike-rush (NatureServe 2015, B.C. Conservation Data Centre 2015).

Global (G) Rank*	National (N) Rank*	Sub-national (S) Rank*	COSEWIC Designation	B.C. List**	B.C. Conservation Framework***
G5	Canada (N1N2); United States (NNR)	Canada: British Columbia (S1), Ontario (S1); United States: Alabama (SNR), Arizona (SNR), California (SNR), Florida (SNR), Georgia (SNR), Hawaii (SNA), Illinois (S1), Indiana (S2), Kansas (S1), Louisiana (S1?), Michigan (SNR), Mississippi (S3S4), Nebraska (S1), New Jersey (SNR), North Carolina (SNR), Ohio (S1), Oklahoma (SNR), Pennsylvania (SNR), South Carolina (SNR), Texas (SNR)	Endangered (2009)	Red	Highest priority: 1 under goal 3

*Rank 1- critically imperiled; 2- imperiled; 3- vulnerable to extirpation or extinction; 4- apparently secure; 5- secure; H- possibly extirpated; NR – status not ranked.
** Red - extirpated, endangered, or threatened in B.C.; Blue - special concern in B.C.; Yellow - not at risk in B.C.
*** Six-level scale: Priority 1 (highest priority) through to Priority 6 (lowest priority); The three goals of the B.C. Conservation Framework are: 1. Contribute to global efforts for species and ecosystem conservation; 2. Prevent species and ecosystems from becoming at risk; 3. Maintain the diversity of native species and ecosystems.

Less than 1 % of the global range of the Bent Spike-rush occurs in Canada where the species is at the northern extent of its North American distribution (COSEWIC 2009).

3. Species Information

3.1 Species Description

Bent Spike-rush is a small (2-20 cm) tufted annual sedge composed of numerous slender stalks. Stalks usually are topped by a single spikelet composed of bisexual flowers that produce small dry black fruitlets. Not all fruit germinate the subsequent year, and Bent Spike-rush depends on a seedbank for the long-term persistence of a population because seeds can remain dormant for many years or decades (COSEWIC 2009). The black fruitlets separate this species from most other tufted Canadian species of *Eleocharis*.

3.2 Species Population and Distribution

The Bent Spike-rush has a pantropical distribution, including the West Indies, Bermuda, North, Central, and South America, Africa, Asia, Pacific Islands (including Hawaii), and Australia. It is fairly widespread in the southern United States but uncommon to rare further north. In Canada, it has been reported from one location in British Columbia and

two locations along the shores of Lake Erie in Ontario. The closest occurrences of Bent Spike-rush to the B.C. population are in southern California and Nevada (COSEWIC 2009) which makes genetic exchange and natural dispersal from these populations extremely unlikely. The Canadian range accounts for less than one percent of the species range in North America (~7.7 km²) which includes the Great Lakes Plains population in Ontario (~6.7 km²).

In British Columbia, Bent Spike-rush, Southern Mountain population has been recorded only from one site on the east side of Osoyoos Lake. This population was first noted in 1939 with additional observations recorded in 1980, 1991, 1993, 2000, 2005, 2006, 2007, 2010, and, most recently, 2014 (COSEWIC 2009; UBC Herbarium 2017).

Population estimates have not been recorded consistently, and, as a result, there is no long-term trend analysis available (although COSEWIC (2009) found no significant change between 2005 and 2007). In 2007, the total estimated area of habitat at this site occupied 1200 m² with a population of approximately 10,000 mature individuals (COSEWIC 2009). In 2014, “not many scattered plants” were noted during a survey (UBC Herbarium 2017). However, annual species often may have wide fluctuations in numbers from year to year (COSEWIC 2009). The Index of Area of Occupancy, based on a 2x2 km grid, is 4 km^2 in B.C.

3.3 Needs of the Bent Spike-rush, Southern Mountain population

Bent Spike-rush is a very small annual plant that is only capable of reproducing by seed. A soil seedbank must exist where it occurs, but the longevity of that seed, whether it becomes dormant or is non-dormant, and conditions necessary to stimulate germination are unknown. Generally, annual vascular plants are most common in environments subject to chronic disturbance such as shorelines subject to wave action or fluctuating water levels, early stages of vegetative succession following a disturbance that increases resource availability, or a region with unpredictable pulses of resources like rainfall in a desert (Baskin and Baskin 1988).

In Canada, Bent Spike-rush is found at the edges of seasonally flooded ponds in areas of open sandy or muddy soils that are free from competition from taller and more aggressive plants (COSEWIC 2009). In the wetland classification system developed for B.C. (MacKenzie and Moran 2004), the marsh wetland class (Wm) is divided into 9 plant associations. The Bent Spike-rush, Southern Mountain population occurs in a marsh habitat intermediate between “Wm04 Common Spike-rush” and “Wm06 Great Bulrush”[6] which is typically dominated by perennial Common Spike-rush (*Eleocharis palustris*) or Sharp Bulrush (*Schoenoplectus pungens*) (MacKenzie and Moran 2004). In such habitats, a sandy or gravelly lakeshore with or without a thin organic soil layer is

[6] The wetland classification system uses a two-letter Class and two-number Association code. E.g., Wm04 refers to Wetland-Marsh-Site Association #04. Refer to Mackenzie and Moran (2004) for addition details.

present, and flooding in winter and spring is followed by water tables dropping to just below the surface for summer and fall.

Bent Spike-rush is restricted to specific and geographically limited habitat. Other shoreline habitats of open sandy soil alongside seasonally wet, sheltered ponds are limited but available nearby (COSEWIC 2009). However, Bent Spike-rush has not been detected after several surveys and it is unknown if timing or other factors have limited detection or colonization of other sites.

Osoyoos Lake is one of the warmest lakes in Canada, and Osoyoos experiences the hottest summer temperatures and one of the longest frost-free seasons in Canada (Environment and Climate Change Canada 2016). Habitats on the shoreline of Lake Erie in Ontario where the Great Lakes Plains population of Bent-spike rush occurs are similar. As such, a long and warm growing season with high soil moisture content must be necessary for Bent Spike-rush to germinate, complete development, and produce viable seed for subsequent generations.

4. Threats

4.1 Threat Assessment

There is only one known occurrence of Bent Spike-rush, Southern Mountain population in Canada, on the shores of Osoyoos Lake. The following threat assessment is based on the International Union for Conservation of Nature–Conservation Measures Partnership (IUCN-CMP) unified threats classification system. It is consistent with methods used by the B.C. Conservation Data Centre and the B.C. Conservation Framework. For a detailed description of the threat classification system, see the Conservation Measures Partnership website[7] (CMP 2010). For purposes of threats assessment, only present and future threats are considered. Threats may be observed, inferred, or projected to occur in the near term. Threats are characterized in terms of scope, severity, and timing. Threat "impact" is calculated from scope and severity. For information on how the values are assigned, see Master et al. (2012). Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational). Limiting factors are not considered during this assessment process. Historical threats, indirect or cumulative effects of the threats, or any other relevant information that would help understand the nature of the threats are presented in the Description of Threats section.

[7] www.conservationmeasures.org/initiatives/threats-actions-taxonomies/threats-taxonomy

Table 2. Threat calculator assessment for Bent Spike-rush, Southern Mountain population, in Canada.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]	Detailed threats
1	Residential & commercial development					
1.1	Housing & urban areas	Very High	Pervasive	Extreme	Moderate	Possible in the next 10 years for development to begin.
6	Human intrusions & disturbance					
6.1	Recreational activities	High	Large	Serious	Moderate	On-going and increasing in proportion to regional population growth.
7	Natural system modifications					
7.2	Dams & water management/use	Negligible	Pervasive	Negligible	High	On-going, severity has been negligible so far.
8	Invasive & other problematic species & genes					
8.1	Invasive non-native/alien species	High	Pervasive	Serious	High	On-going, severity could increase greatly if weed control efforts ever stop.

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

4.2 Description of Threats

A description of known threats to Bent Spike-rush, Southern Mountain population, in British Columbia is provided below. The calculated overall threat impact[8] to Bent Spike-rush, Southern Mountain population, is Very High. Currently the primary threats are housing and urban development (#1.1), recreational development (#6.1) and invasive species (#8.1). All other threats are of negligible impact.

The COSEWIC (2009) status report reviewed additional potential threats (i.e., livestock grazing, and pollution via agricultural runoff) which now are not considered threats based on existing fencing that prevents access by livestock, and distance from potential pollution sources.

IUCN Threat 1: Residential & Commercial Development

1.1 Housing & urban areas (Very High Threat Impact)

Although there are no known development plans for the area containing the population, this is a possibility in the future. A housing development has been constructed ~200 m north of the site. Throughout the Okanagan Valley, nearly all other sandy alluvial deposits or exposed sand bar habitats have been developed. Historically the development may have been for agricultural production. However, residential development on shorelines now threatens riparian habitats. Often all natural vegetation is cleared, wet areas are filled in, and cover is replaced by buildings, pavement, and landscaping with non-native vegetation down to the high water mark. Such development is effectively irreversible and would eliminate habitat necessary to support a population. Human population growth continues in the Okanagan and pressure for developing lakefront property is common. The future risk is very high, given patterns of development observed elsewhere in the valley.

IUCN Threat 6: Human Intrusion & Disturbance

6.1 Recreation activities (High Threat Impact)

The shoreline near the population is frequently used by boaters and swimmers who access the site by boat. There is a current and increasing future risk to plants being trampled by heavy foot traffic and disturbed by excavations for fire pits, latrines, and sandcastles during the summer when plants are most sensitive during germination and development. Should residential development occur upslope in the near future, recreational activity along the beach will greatly increase and further add to this

[8] The overall threat impact was calculated following Master et al. (2012) using the number of Level 1 Threats assigned to this species where timing = High or Moderate. It included 1 Very High, 2 High, 0 Medium, and 0 Low Threats (**Error! Reference source not found.**2). The overall threat impact considers the cumulative impacts of multiple threats.

disturbance. The current and future risk is high, given limited access by boat at this time, but future potential exists for increased access and impact.

IUCN Threat 7: Natural System Modifications

7.2 Dams & water management/use (Negligible Threat Impact)

The artificial management of the water levels of Osoyoos Lake by the Zosel Dam in Oroville by the United States under the International Joint Commission has been suggested as being a possible threat to this species. Lake levels have been managed for nearly thirty years and Bent Spike-rush remains at the site although there is no data on population changes over this period (the distribution of this species before the dam was built is unknown, but it may have been more widespread). However, it may take more time in order for the influence of the dam on lake levels and on the habitat to affect this species. For example, at least since 2005 when first observed, the shorelines along many portions of the shore of Osoyoos Lake, including the population site, have slowly been eroded away by wave action. Although wave action has always been present, wave action would have affected a much broader elevational range of shore before the dam was built, and the shore would not have had the cut banks that appear today. (COSEWIC 2009)

The occupied habitat is in a lagoon away from the active shoreline. Therefore, water management may eventually threaten the population of Bent Spike-rush by reducing the extent of habitat affected by seasonal flooding and summer draw-down, and the stability of water levels can permit perennial vegetation (native and non-native) to succeed on these sites and out-compete the at-risk plant. Given the lack of response by Bent Spike-rush to water management at this time, the threat is negligible.

IUCN Threat 8: Invasive & Other Problematic Species & Genes

8.1 Invasive non-native/alien species (High Threat Impact)

Invasive species may pose a continuing threat; in particular, Reed Canary Grass (*Phalaris arundinacea*), Creeping Bentgrass (*Agrostis stolonifera*), and Perennial Sow-thistle (*Sonchus arvensis*) are common and continue to dominate riparian habitats in the south Okanagan Valley. Although efforts of weed removal during Habitat Stewardship Program-funded (HSP) work have focused on the areas where rare species have been found, risk to the population will continue if control of the invasive grass is not maintained. The introduced form of Common Reed (*Phragmites australis*) in the region may pose a future threat (COSEWIC 2009). In all cases the aggressive competition for resources could limit germination and persistence of Bent Spike-rush. This is a current and increasing future threat to the species, and is a high level threat.

5. Population and Distribution Objectives

The population and distribution objective for Bent Spike-rush, Southern Mountain population, is to maintain its distribution, and to maintain or (where feasible and appropriate) increase the abundance of the existing population within its current distribution as well as any new populations that may be identified in the future.

Rationale:

COSEWIC designated Bent Spike-rush, Southern Mountain population, as Endangered based on a single population in a very limited area (1200 m^2) at risk from stochastic events and impacts from the spread of alien grasses (COSEWIC 2009). Additional threats include increasing future residential development and recreational disturbance. Although threat mitigation may address many of the threats to the species, considering the species' historical distribution, and the limited amount of suitable habitat remaining, it is likely that the species will remain at risk in Canada. Current recovery efforts focus on maintaining the one known extant population in B.C. If additional naturally-occurring populations are discovered or re-discovered, these should also be maintained.

The trend in population size (including direction and rate of change) for the population is unknown. Population estimates have not been recorded consistently, and, as a result, there is no long-term trend analysis available. COSEWIC (2009) found no significant change between 2005 and 2007 estimates of ~10,000 individuals covering 1200 m^2 area; however, in 2014 "not many scattered plants" were observed. It is important to note for future monitoring and/or trend estimation purposes, that the population size of this annual species may fluctuate normally between survey years. Where the best available information and/or long-term monitoring indicates overall population decline, attempts to increase abundance (e.g., through seeding or change in land use management) should be considered.

6. Broad Strategies and General Approaches to Meet Objectives

6.1 Actions Already Completed or Currently Underway

The British Columbia population is protected within a fenced area. Responsible land managers have supported HSP-funded conservation efforts at this site (2004-2007). Most of this work was focused on invasive plant removal, especially at the sites where rare plant species have been found. Signage that denotes the rarity of the species in this area is located along the shore of the protected area (COSEWIC 2009).

6.2 Strategic Direction for Recovery

Table 3. Recovery Planning Table for Bent Spike-rush, Southern Mountain population.

Threat or Limitation	Priority[a]	Broad Strategy to Recovery	General Description of Research and Management Approaches
Knowledge gap	Essential	Research	• Conduct taxonomic review of Bent Spike-rush, Southern Mountain population, collections at the one known site (east side of Osoyoos Lake) to confirm the species' correct identification.
Knowledge gap	Essential	Survey	• Conduct targeted surveys in areas of suitable habitat within the proximity of the Bent Spike-rush, Southern Mountain population, in the South Okanagan to detect new populations.
IUCN 8.1 Invasive alien species	Essential	Habitat Protection and Stewardship	• Continue beneficial alien invasive plant management. • Work with respective land managers to develop and implement best management practices for alien invasive plant management.
IUCN 1.1 Housing and 6.1 Recreation	Necessary	Habitat Protection and Stewardship	• Develop a land use plan for avoiding environmentally sensitive areas and eliminating the threat of future residential development or reducing the threat of recreational disturbance. • Consult with respective land managers on how best to provide this support.
IUCN 7.2 Dams and water management	Beneficial	Monitoring & Research	• Evaluate the effect of water level management on the population and distribution of Bent Spike-rush and other species at risk using similar habitats in the Okanagan Valley. • Consult members of the Okanagan Basin Water Board for advice about how this evaluation can complement existing initiatives.

[a] "Priority" reflects the degree to which the broad strategy contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species.

7. Critical Habitat

7.1 Identification of the Species' Critical Habitat

Section 41 (1)(c) of SARA requires that recovery strategies include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. A primary consideration in the identification of critical habitat is the amount, quality, and locations of habitat needed to achieve the population and distribution objectives.

Critical habitat for the Bent Spike-rush, Southern Mountain population, is not identified at this time. A schedule of studies has been included that describes the activities required to complete the identification of critical habitat in support of the population and distribution objectives. The identification of critical habitat will be updated when the information becomes available, either in a revised recovery strategy or action plan(s).

7.2 Schedule of Studies to Identify Critical Habitat

The following schedule of studies (Table 4) outlines the activities required to complete the identification of critical habitat for the Bent Spike-rush, Southern Mountain population, in Canada.

Table 4. Schedule of Studies to Identify Critical Habitat for the Bent Spike-rush, Southern Mountain population.

Description of Activity	Rationale	Timeline
Work with applicable organizations to identify critical habitat for the Bent Spike-rush, Southern Mountain population, at Osoyoos Lake.	This activity is required such that sufficient critical habitat is identified to meet the population and distribution objectives.	2019-2024

8. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives.

- The abundance of Bent Spike-rush populations (as measured by number of plants) is maintained or increased at all known extant sites in British Columbia;
- The distribution of Bent Spike-rush populations (as measured by occupied area of occurrence) is maintained at all known extant sites in British Columbia.

Measurements are to allow for annual effects, and related variation in annual monitoring results, i.e., trends in repeated annual estimates are to be evaluated over the course of a longer time period, for example, over a five year interval (2019-2024).

9. Statement on Action Plans

One or more action plan(s) for Bent Spike-rush, Southern Mountain population, will be posted on the Species at Risk Public Registry by 2024.

10. 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*[9]. 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 and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[10] goals and targets.

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.

The Bent Spike-rush, Southern Mountain population, occurs in the southern interior of B.C. in similar habitat as other shoreline plants in the area that are characterized as species at risk. For example, the SARA Schedule 1 plant species Toothcup (*Rotala ramosior*), Scarlet Ammannia (*Ammannia robusta*), Short-rayed Alkali Aster (*Symphyotrichum frondosum*), and Small-flowered Lipocarpha (*Lipocarpha micrantha*) also occur around Osoyoos Lake in the Okanagan Valley. Provincially (B.C.) rare plants, Awned Cyperus (*Cyperus squarrosus*), Thyme-leaved Spurge (*Chamaesyce serpyllifolia* ssp. *serpyllifolia*), and Beaked Spike-rush (*Eleocharis rostellata*), are known to co-occur in these areas as well. Recovery planning activities for Bent Spike-rush will be implemented with consideration for all co-occurring species, with focus on species at risk, such that inadvertent negative impacts to these individuals and their habitats are minimized or avoided.

[9] www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html
[10] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1

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