Recovery Strategy for the short-rayed alkali aster (*Symphyotrichum frondosum*) in British Columbia

Prepared by the Short-rayed Alkali Aster Recovery Team

BRITISH COLUMBIA
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Ministry of Environment

August 2009

About the British Columbia Recovery Strategy Series

This series presents the recovery strategies that are prepared as advice to the province of British Columbia on the general strategic approach required to recover species at risk. The Province prepares recovery strategies to meet its commitments to recover species at risk under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada – British Columbia Agreement on Species at Risk*.

What is recovery?

Species at risk recovery is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a recovery strategy?

A recovery strategy represents the best available scientific knowledge on what is required to achieve recovery of a species or ecosystem. A recovery strategy outlines what is and what is not known about a species or ecosystem; it also identifies threats to the species or ecosystem, and what should be done to mitigate those threats. Recovery strategies set recovery goals and objectives, and recommend approaches to recover the species or ecosystem.

Recovery strategies are usually prepared by a recovery team with members from agencies responsible for the management of the species or ecosystem, experts from other agencies, universities, conservation groups, aboriginal groups, and stakeholder groups as appropriate.

What's next?

In most cases, one or more action plan(s) will be developed to define and guide implementation of the recovery strategy. Action plans include more detailed information about what needs to be done to meet the objectives of the recovery strategy. However, the recovery strategy provides valuable information on threats to the species and their recovery needs that may be used by individuals, communities, land users, and conservationists interested in species at risk recovery.

For more Information

To learn more about species at risk recovery in British Columbia, please visit the Ministry of Environment Recovery Planning webpage at:

<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>

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Recommended citation

Short-rayed Alkali Aster Recovery Team. 2009. Recovery strategy for the short-rayed alkali aster (*Symphyotrichum frondosum*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 16 pp.

Cover illustration/photograph

Brian Klinkenberg

Additional copies

Additional copies can be downloaded from the B.C. Ministry of Environment Recovery Planning webpage at:

<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>

Publication information

ISBN 978-0-7726-6194-4
Date: August 6, 2009
British Columbia. Ministry of Environment
Recovery strategy for the short-rayed alkali aster (*Symphyotrichum frondosum*) in British Columbia [electronic resource]

Disclaimer

This recovery strategy has been prepared by the Short-rayed Alkali Aster Recovery Team, as advice to the responsible jurisdictions and organizations that may be involved in recovering the species. The British Columbia Ministry of Environment has received this advice as part of fulfilling its commitments under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada - British Columbia Agreement on Species at Risk*.

This document identifies the recovery strategies that are deemed necessary, based on the best available scientific and traditional information, to recover short-rayed alkali aster populations in British Columbia. Recovery actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations. These goals, objectives, and recovery approaches may be modified in the future to accommodate new objectives and findings.

The responsible jurisdictions and all members of the recovery team have had an opportunity to review this document. However, this document does not necessarily represent the official positions of the agencies or the personal views of all individuals on the recovery team.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this strategy. The Ministry of Environment encourages all British Columbians to participate in the recovery of short-rayed alkali aster.

RECOVERY TEAM MEMBERS

Short-rayed Alkali Aster Recovery Team
Harold Baumbrough, Biologist Naramata, BC
Brenda Costanzo (co-chair), British Columbia Ministry of Environment, Victoria, BC
Orville Dyer (co-chair), British Columbia Ministry of Environment, Penticton, BC
Matt Fairbarns, Botanist, Victoria, BC
Terry McIntosh, Botanist, Vancouver, BC

Former recovery team members
Pam Krannitz (retired), formerly Environment Canada's Canadian Wildlife Service, Vancouver, BC
Ted Lea (retired), Vegetation Ecologist, Victoria, BC

Technical advisors
Ron Hall, Osoyoos Indian Band, Oliver, BC

AUTHOR

Brian Klinkenberg

RESPONSIBLE JURISDICTIONS

The British Columbia Ministry of Environment is responsible for producing a recovery strategy for short-rayed alkali aster under the *Accord for the Protection of Species at Risk in Canada*. Environment Canada's Canadian Wildlife Service, Pacific-Yukon Region participated in the preparation of this recovery strategy.

ACKNOWLEDGEMENTS

Thanks to the following individuals for contribution of key information on the populations of *Symphyotrichum frondosum* in B.C.: Harold Baumbrough, Eva Durance, Orville Dyer, Matt Fairbarns, and Frank Lomer.

EXECUTIVE SUMMARY

Short-rayed alkali aster is an annual late summer flowering species reported in British Columbia from lakeshores and pond margins in the Okanagan Valley. There it is found in eight extant populations on the shoreline of four lakes - Osoyoos, Vaseux, Skaha, and Max. Additionally, two ephemeral records for the species have been identified in the lower Fraser Valley, but as they are only single plants, further surveys are required to determine if populations will persist in the area. These occurrences are not considered in this recovery strategy.

Suitable habitat for short-rayed alkali aster includes the narrow shoreline of lakes and ponds on the moist sandy/muddy beaches. These areas are influenced by seasonal water variation and wave action, and in very proximal, drier, narrow upper beach areas that may periodically be subject to flooding. Short-rayed alkali aster is a seed banking species, and recruitment in some years is seed bank dependent. As a shoreline species, the plants and the seed bank are tied to lake dynamics, including wave action that removes organic build up and disperses seeds, high water levels that control encroachment by woody and other species, and summer draw down that allows germination from the seed bank.

At three of the five populations on Osoyoos Lake, and the populations at Vaseux Lake and Skaha Lake, this species is threatened by recreational beach use and development, and associated beach management activities.

The long-term recovery goal for short-rayed alkali aster is to maintain the existing populations within the known range of the species in Canada.

The recovery objectives are:

1. Protect populations and their habitat at the known occupied sites in the Okanagan Valley by 2013.
2. Address knowledge gaps relating to optimal habitat, effects of water levels on germination and survival, impacts from recreation and management activities and impacts from invasive plant species by 2013.
3. Determine population trends for all known populations (from 2009 through 2013).
4. Determine whether other viable populations exist in the Fraser River drainage and in the South Okanagan valley by 2013.

No critical habitat can be identified for short-rayed alkali aster in Canada at this time. It is expected that critical habitat will be proposed following the completion of outstanding work required to quantify specific habitat and area requirements for the species, further research on the biology of the species, and monitoring of the populations to determine population trends. Consultation with affected landowners and organizations will also be necessary.

A recovery action plan will be completed by 2013.

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Species Assessment Information from COSEWIC

Date of Assessment: April 2006
Common Name (population): short-rayed alkali aster
Scientific Name: *Symphyotrichum frondosum*
COSEWIC Status: Endangered
Reason for designation: An annual herb of lake shorelines present at only a few remaining sites in restricted habitats. The small populations are subject to disruption from such activities as trampling, beach management, spread of invasive plants and potential development of a major facility at one of the primary sites.
Canadian Occurrence: British Columbia
COSEWIC Status History: Designated Endangered in April 2006. Assessment based on a new status report.

Description of the Species

Short-rayed alkali aster (*Symphyotrichum frondosum*; previously known as *Aster frondosus*) is an annual, rarely perennial tap-rooted species of flowering plant in the *Asteraceae* family (Douglas et al. 1998). In British Columbia, it is small to medium sized (1-60 cm), with small daisy-like flowers that have narrow, pink to whitish ray petals and yellow disk flowers. Larger plants are strongly branched and produce multiple flowers. Leaves are alternate on the stem and usually oblanceolate in shape. The lower leaves are petioled (with a short stalk), becoming sessile (stalkless) towards the top of the plant. Seeds are achenes (dry single-seeded fruit that do not open when mature) with numerous short bristles at their apices.

Populations and Distribution

Short-rayed alkali aster is found only in North America, where it occurs from British Columbia (B.C.) south to Utah, Arizona, New Mexico, California, and Mexico (COSEWIC 2006; Figure 1). In B.C., there are currently eight extant populations in the southern Okanagan Valley (COSEWIC 2006; Figure 2; Table 1).

On Osoyoos Lake there are five populations distributed around the lake, on the northwest, northeast, east, southeast, and southwest shores (Table 1). One population (southeast shore) has three subpopulations: Cottonwood Park, and two others[1], however, the Cottonwood Park subpopulation was extirpated in 2002. Two of the five Osoyoos Lake populations were discovered after the publication of the status report (COSEWIC 2006), these being the southwest and the northwest shore populations identified in Table 1. The other three populations are: the

[1] Locations of these two subpopulations are not disclosed to protect the privacy of the landowners.

south end of Skaha Lake[2] (at Christie Memorial Provincial Park), the east shore of Vaseux Lake[2] (3 subpopulations), and the shoreline of Max Lake.

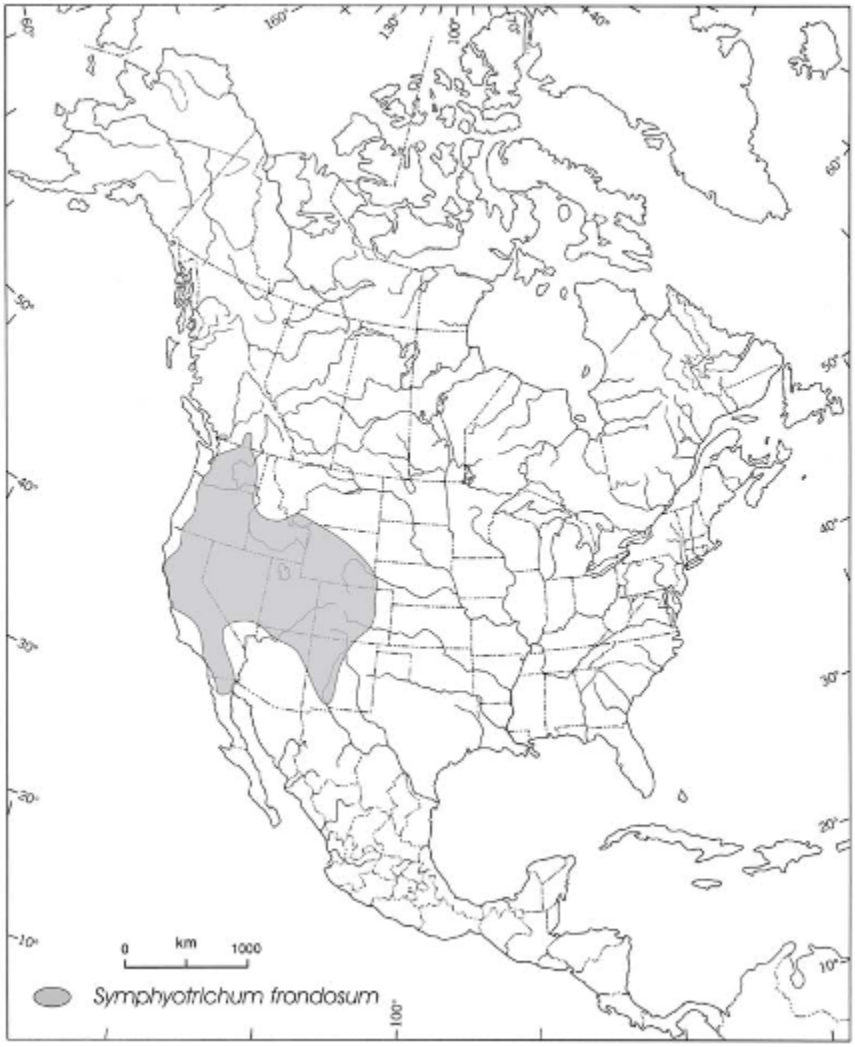

Figure 1. North American distribution of short-rayed alkali aster (from COSEWIC 2006).

[2] Note: Reference to Vaseux or Skaha populations in this document refers to populations surveyed within Vaseux Lake Provincial Park or Christie Memorial Provincial Park, respectively. The plants are also on adjacent private lands which were not surveyed as land owner permission was not requested to do so.

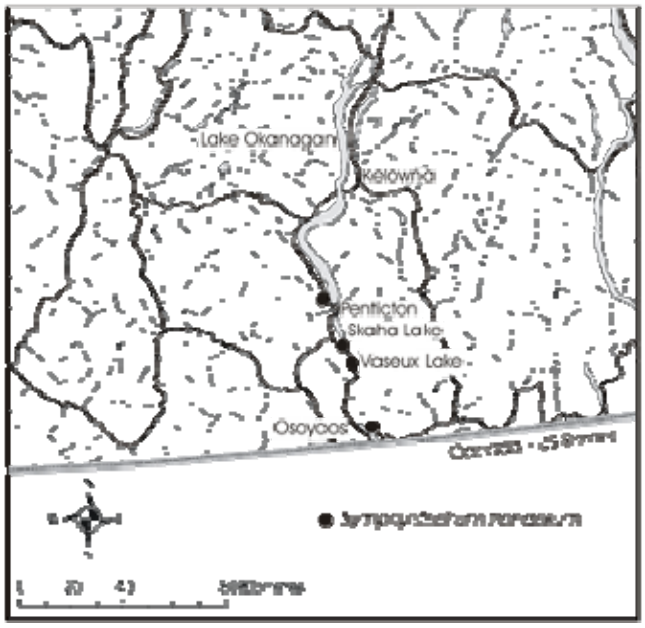

Figure 2. Distribution of short-rayed alkali aster in British Columbia and Canada[3] (COSEWIC 2006). Dots may represent multiple populations.

One new subpopulation was found at the Vaseux Lake population after publication of the 2006 COSEWIC status report (Dyer et al 2007). The new subpopulation (#3) was 370m north of the Vaseux Lake Provincial Park subpopulation #1 and contained thousands of individuals, including 305 flowering individuals. This subpopulation established naturally on recently created habitat made by a debris torrent that flowed into Vaseux Lake in 2004. The debris torrent area was surveyed between 2004 and 2007, but no plants were observed until 2007. Dyer et al (2007) also revisited subpopulation #2 within Vaseux Lake Provincial Park, which was 93 m north of subpopulation #1 at the Park campground, counting 15 plants in 2007. Frank Lomer previously observed 2 plants at subpopulation #2 in 2005 (CDC 2008).

There are two historic populations that could not be accurately reconciled (due to geographic imprecision of the original data) with the current B.C. Conservation Data Centre (B.C. CDC) data. These are the "Osoyoos Lake" and "Penticton" records from Eastham in 1939 and 1947 respectively (B.C. CDC 2008). The former has been incorporated into the Osoyoos lake northeast shore population by the B.C. CDC. There are no herbarium specimens for the latter, therefore it has not been incorporated into any existing population data and is not considered in this recovery strategy. However, it could be the Max Lake population.

As well, two additional records are reported for this species, one previously reported in the status report: Surrey, BC, in a dredging pile along the Fraser River, 1 plant (1994); New Westminster, BC, along the river edge, 1 plant (September 2006). These records may indicate that the species is present in the upper Fraser drainage (Lomer pers. comm. 2007), but they do not appear to be viable populations. As such, we are not considering them in this recovery strategy unless they are re-discovered as viable populations.

[3] Distribution excludes Fraser Valley collection sites.

Table 1. Extant populations of short-rayed alkali aster in British Columbia.

Location of population[4]	Subpopulation	Abundance data and last observation date	Tenure status[5]
Osoyoos Lake, northwest shore (EO9)	N/A	2007: one plant	Withheld
Osoyoos Lake, northeast shore (EO2)	N/A	1993: 50-70 plants	Withheld
Osoyoos Lake, east shore (EO6)	N/A	1999: 40+ plants over 200m^2	Withheld
Osoyoos Lake, southeast shore (EO3)	Subpopulation #1 Cottonwood Park	2000: one plant/2m 2002: extirpated	City of Osoyoos
	Subpopulation #2	1992: no data	Withheld
	Subpopulation #3	2002: 5 plants/m^2	Withheld
Osoyoos Lake, southwest shore (EO8)	N/A	2007: 10 plants	Withheld
Vaseux Lake (EO4)	Subpopulation #1	1999: 100 plants/20m^2 2002: 100 plants/20m^2 2003: 12 plants/4m^2 2005: 287 flowering plants 2006: 59 flowering plants 2007: 186 flowering 2008: 0 plants	Provincial Park
	Subpopulation #2 – (2005)	2005: 2 plants 2007: 15/20m^2	Provincial Park (93m north of subpopulation #1)
	Subpopulation #3 – (2007; debris torrent)	2007: thousands, (305 flowering plants) 2008: fewer than previous year	Provincial Park (370m north of subpopulation #1)
Skaha Lake (Christie Beach = Christie Memorial Provincial Park, EO5)	N/A	1999: 4900 plants/500m^2; 2002: 525 plants/500m^2; 2003: > 100 plants. 2005: 13 flowering 2006: 191 plants flowering 2007: 63 plants flowering	Provincial Park
Max Lake (Madeline Lake) West Bench campground, Penticton (EO7)	N/A	2003: 5 plants 2005: 0 2006: 0 2007: not checked 2008: 0	Private (The Land Conservancy and South Okanagan Regional District)

Less than one percent of the species' global distribution is found in Canada. The percentage of historical range lost is unknown, and the rate of change over the last ten years is also unknown. However, this is a species that can fluctuate in numbers from year to year (see abundance information in Table 1). The Canadian extent of occurrence of this species is 56 km^2, excluding

[4] EO numbers refer to Element Occurrences tracked by the BC Conservation Data Centre
[5] Tenure may be withheld to respect the privacy of the land owners.

the Fraser River records which are thought to be ephemeral (material potentially washed down the Fraser River). The combined area of occupancy in Canada is 900 m^2.

This species is globally ranked as G4 (apparently secure). In the United States short-rayed alkali aster is ranked as S2 (imperilled) in Wyoming, and not ranked (SNR) in Arizona, California, Colorado, Idaho, Maine, Nevada, New Mexico, Oregon, Utah, and Washington. In Montana it is ranked as SH (possibly extirpated) (NatureServe 2008). It is ranked as S1 (critically imperiled) in B.C. and is a priority 1 species under goal 3 of the B.C. Conservation Framework (see http://www.env.gov.bc.ca/conservationframework/ for details).

Needs of the Short-rayed Alkali Aster

Habitat and biological needs

In B.C., short-rayed alkali aster is found in the bunchgrass biogeoclimatic zone in the southern Okanagan Valley (COSEWIC 2006). Short-rayed alkali aster is a late emergent, wet shoreline species that is reported from lakeshore habitats on sandy beaches (Osoyoos Lake), and from the lightly sloping draw down zone of lakes and ponds (Vaseux Lake, Skaha Lake, Max Lake) (COSEWIC 2006).

In California, this species is known from granitic soils of meadow and mountain slopes, and around moist alkaline flats, marshes, ponds and ditches, and is often found in steppes (COSEWIC 2006, Flora North America 2007). In Oregon, this species is found in mud flats (Fertig 2000).

For species that are adapted to the shoreline environment, fluctuating water levels are important to population dynamics. Fluctuating water levels mean that shoreline plants are subject to wave energy that can reduce organic accumulations and competition from other plant species, as well as potentially enhance seed dispersal.

Germination has been observed in May or June when the water levels drop (Baumbrough pers. comm. 2007), although it is possible germination may occur earlier. Flowering is reported from late July to early October during the draw down period. As asters are commonly wind-dispersed, further dispersal is possible via wave action, lake currents, and waterfowl (COSEWIC. 2006).

Seed banks allow the vegetation to replace itself during low water periods (Keddy and Reznicek 1986), and high water levels are essential to the survival of shoreline species because they reduce invasions by other, often woody, species (Keddy and Reznicek 1982).

Ecological role

This is a rare species that occurs in B.C. at the northern limits of its range, representing a significant peripheral occurrence. Information on the ecological role of this species is unknown.

Limiting factors

Specific information on limiting factors for this species is not available. However, the ecology of shoreline species in general is well known (Keddy 2000) and this points to limiting factors relevant to short-rayed alkali aster:

- As a shoreline species, short-rayed alkali aster is influenced by wave exposure, water level fluctuations, and associated siltation which can bury the seeds too deep for emergence. However, annual shoreline species depend on fluctuating water levels to maintain periodic open sandy shorelines or flats with reduced competition. During low water periods, if climatic conditions are favourable, plants sprout abundantly from newly exposed seedbanks.
- As a species occurring at the northern limits of its range in B.C., short-rayed alkali aster may also be influenced by climatic fluctuations and may be temperature limited.

Threats

Threat classification

Table 2. Threat classification table for short-rayed alkali aster.

1 Recreational degradation (Vaseux Lake, Skaha Lake, Osoyoos Lake)		**Threat attributes**		
Threat category	Habitat loss or degradation	**Extent**	widespread (3 populations)	
			Local	**Range-wide**
General threat	Recreational activities	**Occurrence**	current	
		Frequency	seasonal	
Specific threat	Beach use – sunbathing, digging, boat launching and storage, trampling and compaction	**Causal certainty**	unknown	
		Severity	moderate	
Stress	Reduced numbers of plants	**Level of concern**	high	
2 Beach management (Skaha Lake, Osoyoos Lake)		**Threat attributes**		
Threat category	Habitat loss or degradation	**Extent**	widespread (2 of 4 populations)	
			Local	**Range-wide**
General threat	Habitat alteration	**Occurrence**	current	
		Frequency	seasonal	
Specific threat	Roto-tilling of the beach	**Causal certainty**	Unknown, but potentially moderate to high at Skaha Lake population. Low at Osoyoos Lake southeast shore subpopulation #3.	

		Severity	high	
Stress	Loss of seedlings, mature plants, and seeds	**Level of concern**	high	
3 Invasive plant species (Vaseux Lake, Max Lake, Osoyoos Lake, Skaha Lake)		**Threat attributes**		
Threat category	Exotic or invasive species	**Extent**	Widespread (4 populations)	
			Local	**Range-wide**
General threat	Alteration of habitat characteristics	**Occurrence**		current
		Frequency		recurrent
Specific threat	Resource competition leading to shading of seedlings	**Causal certainty**		medium
		Severity		high
Stress	Reduced growth	**Level of concern**	high	
4 Livestock (Osoyoos Lake)		**Threat attributes**		
Threat category	Habitat loss or degradation	**Extent**	localized	
			Local	**Range-wide**
General threat	Livestock use — shoreline impact	**Occurrence**	unknown	
		Frequency	occasional	
Specific threat	Alteration of habitat characteristics ; trampling of plants	**Causal certainty**	low	
		Severity	unknown	
Stress	Reduced numbers of plants.	**Level of concern**	low	
5 Shoreline development (Osoyoos Lake)		**Threat attributes**		
Threat category	Habitat loss or degradation	**Extent**	localized	
			Local	**Range-wide**
General threat	Shoreline development	**Occurrence**	One historical loss (Osoyoos lake southeast subpopulation #1); one potential	
		Frequency	unknown	
Specific threat	Habitat conversion, fragmentation	**Causal certainty**	high	
		Severity	unknown	
Stress	Reduced population size and viability, population extirpation	**Level of concern**	high	
6 Loss of natural lake dynamics: water level control (Skaha Lake, Vaseux Lake, Osoyoos Lake)		**Threat attributes**		

Threat category	Habitat loss or degradation	**Extent**	Widespread (3 populations)	
		localized	**Local**	**Range-wide**
General threat	Managed lake levels	**Occurrence**	current	
		Frequency	continuous/seasonal	
Specific threat	Alteration of natural water levels	**Causal certainty**	medium	
		Severity	high	
Stress	Reduced population size and viability.	**Level of concern**	high	

Description of the threats

1. Recreational degradation (Vaseux Lake, Skaha Lake, Osoyoos Lake)
Recreational activities may have a negative effect on three populations due to trampling and soil compaction by people. While this potential threat is seasonal in nature (e.g. bathers, boat launching, and storage), it may impact directly on populations.

2. Beach management (Skaha Lake, and Osoyoos Lake)
Beach management activities at two populations, in particular roto-tilling the beach at Skaha, can result in a threat to the populations (e.g., by spreading seeds of invasive plants such as sweet white clover [*Melilotus alba*]), but can also positively influence the populations by reducing competition from other plants. Roto-tilling may have serious adverse affects when carried out post-germination and pre-seed set, resulting in loss of seedlings, mature plants, and seeds.

3. Invasive plant species (Vaseux Lake, Skaha Lake, Max Lake, Osoyoos Lake)
In drought years in particular, conditions along lake and pond shorelines can favour dry ground, non-shoreline species, including invasive species. This may be exacerbated by lake level changes that result in reduced wave action and a subsequent reduction in organic matter removal from shoreline areas. Invasive species were noticeable at Vaseux Lake, and reported from Max Lake (Baumbrough pers. comm. 2007). In particular, white sweet clover (*Melilotus alba*) was abundant at Vaseux Lake in 2004, but not noticeable in the preceding two years. It dominated the site at the north edge, shading seedlings of short-rayed alkali aster. Invasives reported from Max Lake in 2005 included: purple loosestrife (*Lythrum salicaria*), houndstooth (*Cynoglossum officinale),* giant burdock (*Arctium lappa*), Canada thistle (*Cirsium arvense*), diffuse knapweed (*Centaurea diffusa*) and sulphur cinquefoil (*Potentilla recta*). As well, at Max Lake, encroachment by native common cattail (*Typha latifolia*) and bulrush (*Scirpus sp.*) into the area previously occupied by short-rayed alkali aster has occurred. This encroachment throughout Max Lake is likely contributing to altered lake level dynamics, and the site may no longer be suitable for the species.

4. Livestock (Osoyoos Lake)
Livestock are reported at subpopulation #3 on Osoyoos Lake south east shore population (COSEWIC 2006). Although fencing was erected to control this (Douglas 1999), livestock have occasionally entered the area. Livestock are not known to graze on this species, but trampling may occur.

5. Shoreline development (Osoyoos Lake)
As lakeshore habitat is attractive for urban or commercial development, it is a future risk for unprotected populations. Shoreline development along the shores of Osoyoos Lake, (e.g. the causeway at the south side in Osoyoos where plants had been reported), has likely caused the loss of subpopulations of this species, or at least a loss of potential habitat into which the species could expand (J. Penny pers. comm. 2007). Lomer (pers. comm. 2002) reported a subpopulation lost at Cottonwood Park, Osoyoos Lake due to the dumping of rock fill to create a breakwater. One of the newly discovered populations along the northwest shore of Osoyoos Lake is within a proposed development footprint (McIntosh, pers. comm. 2007).

6. Changes in ecological dynamics or natural processes: Loss of natural lake dynamics - water level control (Skaha Lake, Vaseux Lake, Osoyoos Lake)
A series of dams along the Okanagan Valley, including the Zosel Dam in Oroville, Washington, regulates water levels in Osoyoos and Vaseux Lakes. Although an impact on this species is suspected, the actual impact of these dams and associated water level regulation on the short-rayed alkali aster populations within the Okanagan Valley is unknown. These dams have been in place for decades (e.g. Zosel Dam on Lake Osoyoos since 1929, Vaseux Lake Dam since 1921), and Eastham (1947) describes the species as abundant at Osoyoos Lake. However, historical and pre-dam population counts are unknown and prevalence of populations in the region prior to their constructions is unknown. Eastham's assessment may reflect a period (or perhaps cycle) of species abundance. In assessing threat to this species, we have taken into account that shoreline species are adapted to fluctuating water levels, including regular flooding and summer draw down with associated siltation and wave action that reduces organic matter, and, ultimately, competition. Water level regulation affects these parameters. Water level alteration in the lakes could potentially reduce the narrow shoreline band within which this species could occupy, and then alter the persistence or emergence of seeds from the seed bank and any subsequent recruitment. Lake level management may influence wave action dynamics that are an integral part of shoreline plant ecology in lakes (Keddy 2000; Keddy and Reznicek 1986).

Actions Already Completed or Underway

- Invasive plant species removal has been on-going at Max Lake by local naturalists (Baumbrough pers. comm. 2007).
- Invasive plant species removal at Osoyoos Lake and control at Vaseux Lake.
- Inventory and monitoring has been ongoing since 2003 at several populations.
- A conservation covenant has been placed on the property at which the Max Lake population is located (co-held by TLC The Land Conservancy of B.C. and Regional District of the Okanagan-Similkameen).
- Fencing was installed to protect one of the Osoyoos Lake sub-populations from ATV damage and livestock trespass.
- The Skaha and Vaseux Lake populations are within provincial parks.

Knowledge Gaps

- Research on habitat and ecological requirements, species biology (including demography, genetics, and pollination mechanisms), as well as the impacts of invasive species and

nutrient loading[6], are required for this species to define optimal habitat characteristics. Assessment of undisturbed United States populations will also add to our understanding.
- Monitoring the annual or biannual variation in lake levels in Osoyoos Lake over the next ten years is required to aid in assessing the impact of managed water levels and effects of climate change on this species.
- The degree of impact for all identified threats must be clarified.
- As plants have been found in the lower Fraser Valley twice, field work is required further upstream from Surrey to Kamloops to determine if viable populations exist outside of the Okanagan Valley.

RECOVERY

Recovery Feasibility

1) Are individuals capable of reproduction currently available to improve the population growth rate or population abundance? Yes, the current populations of short-rayed alkali aster are capable of reproducing (members of the Asteraceae family reproduce readily from seed), as shown by a recently established subpopulation at Vaseux Lake.
2) Is sufficient suitable habitat available to support the species or could it be made available through habitat management or restoration? Yes, there is sufficient habitat for this species, again using the Vaseux Lake example in which a small beach was formed from a storm in 2004, creating new habitat for the species to colonize.
3) Can significant threats to the species or its habitat be avoided or mitigated through recovery actions? Yes, through effective management for this species, including the potential control of invasive species, some of the threats can be mitigated.
4) Do the necessary recovery techniques exist and are they demonstrated to be effective? Yes, recovery techniques already exist for recovery of this species.

Based on the above assessment, recovery for this species is biologically and technically feasible.

Recovery Goal

The long-term recovery goal for short-rayed alkali aster is to maintain the existing populations within the known range of the species in Canada.

Rationale for the Recovery Goal

Since this species is an annual (fluctuation in population numbers from year to year) and there are no population trend data available, it is not possible to set numerical recovery goals. As well, there is no historical evidence that this species was more abundant in the past. Mitigation of threats through restoration activities such as the removal of invasive plants or controlling water levels, are more likely to affect the recovery of the species than reintroduction.

[6] Nutrient loading was mentioned in the COSEWIC status report and needs to be investigated further.

Recovery Objectives

1. Protect populations and their habitat at the known occupied sites in the Okanagan Valley by 2013.
2. Address knowledge gaps relating to optimal habitat, effects of water levels on germination and survival, impacts from recreation and management activities and impacts from invasive plant species by 2013.
3. Determine population trends for all known populations (from 2009 through 2013).
4. Determine whether other populations exist in the Fraser River drainage and in the South Okanagan valley by 2013.

Approaches Recommended to Meet Recovery Objectives

A broad strategy to address threats will include habitat protection, habitat management, inventory and monitoring, research, and outreach. These tasks generally will be accomplished through voluntary stewardship and partnerships such as the South Okanagan-Similkameen Conservation Program (SOSCP). Habitat protection may take many forms including stewardship agreements and conservation covenants on private lands, land use designations on Crown lands, and protection in federal, provincial, and local government areas. A multi-species approach, including other COSEWIC listed or provincially red-listed beach dependant plant species, is recommended where ranges overlap.

Recovery planning table

Table 3. Recovery planning table for short-rayed alkali aster.

Priority	Obj.	Threat or concern addressed	Broad strategy to address threats	Recommended approaches to meet recovery objectives
Urgent	1	Habitat loss or degradation - mortality due to recreational degradation, beach management, shoreline development, invasive plant species, livestock	Public outreach – stewardship and communication with land owners and land managers, site management	• Encourage all landowners and land managers to steward and manage lands for persistence of the species including use of best management practices for mitigating threats • Work with landowners or managers to develop effective stewardship agreements at all occupied sites.
Urgent	2	Knowledge gaps	Scientific research	• Develop a prioritized research program to clarify knowledge gaps including optimal habitat, effects of water levels on germination and survival, effects from recreation and management activities, and from invasive plant species. The research program should include options for academic partnerships.
Necessary	1, 2	Changes in ecological	Manage water levels	• Work in cooperation with the U.S. International Joint Commission, and

		dynamics or natural processes		private landowners to manage water levels
Urgent	1, 3	Knowledge gaps	Population monitoring	• Determine population trends by monitoring known sites annually
Necessary	4	Knowledge gaps	Inventory	• Inventory potential habitats in the Upper Fraser Basin and South Okanagan valley.

Performance Measures

1. Population monitoring indicates that the trend in numbers of plants at the sites are stable or increasing by 2013 (Objective 1);
2. Agreements established with appropriate land managers and land owners, best management practices developed, and annual monitoring to determine the impacts of threats by 2013 (Objective 1 and 3);
3. Knowledge gaps have been addressed by scientific research by 2013 (Objective 2);
4. Impact of the threats to the populations has been investigated as well as a reduction of threats by 2013 (Objective 2);
5. Surveys of suitable habitat for new populations has been conducted in the Fraser River drainage and the South Okanagan by 2013 (Objective 4);

Critical Habitat

Identification of the species' critical habitat

No critical habitat as defined under the *Federal Species at Risk Act* can be identified for short-rayed alkali aster at this time. It is expected that critical habitat will be proposed following the completion of outstanding work required to quantify specific habitat and area requirements for the species, further research on the biology of the species, and monitoring of the populations to determine population trends. Consultation with affected landowners and organizations will also be necessary.

Recommended schedule of studies to identify critical habitat

Table 4. Schedule of studies.

Description of activity	Outcome/rationale	Timeline
Characterize habitats of existing populations. Assessment of undisturbed United States populations will be important.	Quantify habitat variables for a detailed understanding of growing conditions that will help define/delineate critical habitat.	2009-2013
Inventory for undocumented populations in the South Okanagan valley and the Upper Fraser Basin.	Identify additional important habitat and populations.	2009-2013

Research into seed bank ecology, including assessment of duration of viability, frequency of seed dormancy and areal coverage of the bank.	Knowledge about the areal coverage of the seed bank, depth of seed bank, and width of areas that might be defined as supporting the seed bank will guide definition of critical habitat. Understanding dormancy is important to understanding possible areas a species may actually be occupying, although plants are not visible.	2009-2013
Conduct research to clarify identified threats.	Knowledge of impacts that might affect critical habitat.	2009-2013

Existing and Recommended Approaches to Habitat Protection

Two populations are in provincial parks (Vaseux Lake and Skaha Lake). One population at Max Lake, on private land, is protected by a conservation covenant administered by The Land Conservancy and the Regional District of the Okanagan-Similkameen. Management practices are being examined to reduce potential impacts on the aster. Discussions with land owners and land managers regarding stewardship options are necessary at the remaining locations.

Effects on Other Species

Douglas (1999) reports the following species in association with short-rayed alkali aster at Osoyoos Lake sites: *Rotala ramosior*, (toothcup), *Ammannia robusta* (scarlet ammannia), *Eleocharis acicularis* (needle spike-rush), *Cyperus aristatus*, (*C. squarrosus*; awned cyperus), *Eleocharis geniculata* (capitate spike rush), and *Lipocarpha micrantha* (small-flowered lipocarpha). Toothcup, scarlet ammania, and small-flowered lipocarpha are listed on Schedule 1 of the federal *Species at Risk Act*. Specific interactions with these and other species are unknown, but it is expected that recovery actions for short-rayed alkali aster will benefit these other plant species at risk.

Socioeconomic Considerations

Recovery actions may impact the following socioeconomic sectors: recreation, livestock grazing, and development. The degree of impact is likely to be low because the total occupied area is less than 1 ha.

Recommended Approach for Recovery Implementation

For successful implementation in protecting species at risk there will be a strong need to engage in stewardship on a variety of land tenures. Stewardship involves the voluntary cooperation of landowners to protect species at risk and the ecosystems they rely on. It is recognized in the preamble to the federal *Species at Risk Act* (SARA) that "stewardship activities contributing to the conservation of wildlife species and their habitat should be supported" and that "all Canadians have a role to play in the conservation of wildlife in this country, including the prevention of wildlife species from becoming extirpated or extinct". It is recognized in the *Canada – British Columbia Agreement on Species at Risk* that: "stewardship by land and water owners and users is fundamental to preventing species from becoming at risk and in protecting

and recovering species that are at risk"; and that "cooperative, voluntary measures are the first approach to securing the protection and recovery of species at risk".

Recovery actions will be integrated with the South Okanagan-Similkameen Conservation Program (SOSCP). As well, if the lower mainland occurrences are deemed to be viable populations, recovery actions will be integrated with the South Coast Conservation Program (SCCP) using a multi-species approach.

Statement on Action Plans

A recovery action plan(s) will be completed by 2013.

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