

## Recovery Strategy for the Grand Coulee owl-clover (*Orthocarpus barbatus*) in British Columbia



Prepared by the Southern Interior Rare Plants Recovery Team



Ministry of  
Environment

November 2007

## **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 our 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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barbatus*) in British Columbia**

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## Disclaimer

This recovery strategy has been prepared by the Southern Interior Rare Plants 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 Grand Coulee owl-clover 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 the Grand Coulee owl-clover.

## **RECOVERY TEAM MEMBERS**

### **Southern Interior Rare Plants Recovery Team:**

Harold Baumbrough, Biologist, Naramata, BC

Brenda Costanzo, Plants at Risk Biologist, B.C. Ministry of Environment, Victoria, BC

Orville Dyer (co-chair), Wildlife Biologist, B.C. Ministry of Environment, Penticton, BC

Matt Fairbarns, Botanist, Victoria, BC

Pam Krannitz, Canadian Wildlife Service, Vancouver, BC

Ted Lea (co-chair), Vegetation Ecologist, B.C. Ministry of Environment, Victoria, BC

Alex McLean, B.C. Ministry of Forests and Range

Terry McIntosh, Biospherics Environmental Inc., Botanist

Bryn White, Okanagan College

## **AUTHOR**

Matthew D. Fairbarns

## **RESPONSIBLE JURISDICTIONS**

The British Columbia Ministry of Environment is responsible for producing a recovery strategy for the Grand Coulee owl-clover under the *Accord for the Protection of Species at Risk in Canada*. Environment Canada's Canadian Wildlife Service participated in the preparation of this recovery strategy.

## **ACKNOWLEDGEMENTS**

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## EXECUTIVE SUMMARY

Grand Coulee owl-clover (*Orthocarpus barbatus*) was assessed as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2005, and listed on Schedule 1 of the federal *Species at Risk Act* in 2006. The designation of Endangered was assigned because the few small populations in Canada are subject to extreme fluctuations in numbers of mature plants and are at continued risk from introduced weeds, overgrazing, and housing developments.

Grand Coulee owl-clover is a small annual plant with a global range restricted to intermountain grassland and shrub-steppe areas from the southern Okanagan and Similkameen valleys in south-central British Columbia south to south-central Washington. The species is listed as globally vulnerable.

There are only five extant populations known from Canada containing between 6,000 and 13,000 reproductive individuals, although the species may once have been more abundant. The five populations occupy a total area of approximately 3 ha. Two populations occur wholly on private land. Two populations occur partially on private land and partially on Crown land. One population occurs wholly on Crown land. Two of the Crown land sites are currently being considered for sale to private interests and a mitigation strategy is being developed.

The Canadian extent of occurrence only covers about 86 km<sup>2</sup> near Osoyoos, BC. Within its range, the species is restricted to grassland and shrub-steppe communities but further research and inventory are required before its critical habitat can be defined and mapped. Grand Coulee owl-clover faces threats from residential and recreational development, invasive plant species, agricultural land development, grazing, demographic collapse associated with small population sizes, and dispersed recreation activities. Significant knowledge gaps relating to population dynamics, seasonal development, interactions with invasive plant species, and responses to grazing complicate recovery planning.

Recovery is determined to be feasible for this species. The recovery goal is to maintain extant populations of Grand Coulee owl-clover within its range in Canada. This goal is supported by the following objectives:

1. to protect the five known populations of Grand Coulee owl-clover by 2012;
2. to develop, by 2008, and implement a research program to determine the feasibility/necessity of population reintroductions by addressing knowledge gaps relating to population size, distribution, annual variation, detailed habitat requirements, seed bank persistence, and population viability requirements; and
3. to quantify and mitigate potential threats from habitat loss, invasive plants, livestock grazing, and recreation between 2008 and 2012.

The main approaches to achieve these objectives include protection of habitat and individuals, stewardship, research, mapping & inventory, population restoration, and public education & outreach. A recovery action plan is expected to be complete by October 2012.

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## BACKGROUND

### Species Assessment Information from COSEWIC

**Date of Assessment:** May 2005

**Common Name (population):** Grand Coulee owl-clover

**Scientific Name:** *Orthocarpus barbatus*

**COSEWIC Status:** Endangered

**Reason for Designation:** A semiparasitic annual restricted to a small area east of the Cascade Mountains. The few small populations are subject to extreme fluctuations in numbers of mature plants and are at continued risk from introduced weeds, overgrazing, and housing developments. One population in South Okanagan Grasslands Protected Area is protected from development.

**Canadian Occurrence:** British Columbia

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

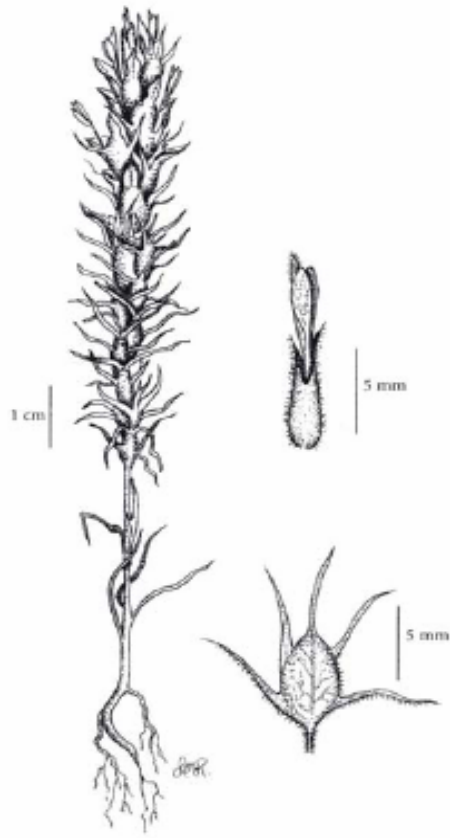
### Description of the Species

This section is adapted from the species description in the status report published by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2005) except where otherwise stated.

Grand Coulee owl-clover is a yellowish annual herb (Figure 1; Pojar 2000) arising from an erect stem 8–25 cm tall.

The stem is slender and simple or with erect branches arising from its upper portion (Pojar 2000). The plant has a mixture of long and short hairs and is tinged yellowish-green. The leaves are arranged alternately on the stem, lack stalks, are linear to narrowly lanceolate, have spreading hairs, and are 2–4 cm long. The leaves are entire or deeply cleft into 3–5 long, narrow lobes (rounded segments).

The flowers are grouped in a dense, prominently bracted terminal spike. The bracts are green or yellowish-green and cleft into 3–5 narrow lobes. The actual flower consists of a calyx (the outer ring of reduced, petal-like structures), the petals themselves, and the stamens and pistil enclosed within the petals. The calyx is fused to form a tube-like structure. The petals, which extend beyond the bracts, are yellow and 10–12 mm long. They are fused into a two-lipped, tube-shaped structure. The upper beak-like lip is much longer than the small, lower lip. The fruits (capsules) are elliptical and contain several seeds with tight-fitting, netted coats.



**Figure 1.** Illustration of *Orthocarpus barbatus*. Plant habit (left), flower (top right) and characteristic bract subtending the flowers. (Line drawing by Lora May Richards in Pojar 2000; by permission.)

## Populations and Distribution

Grand Coulee owl-clover is restricted to intermountain areas from the southern Okanagan and Similkameen valleys in south-central British Columbia south to Grant County in south-central Washington (Figure 2).



**Figure 2.** Distribution of Grand Coulee owl-clover in North America (from COSEWIC 2005).

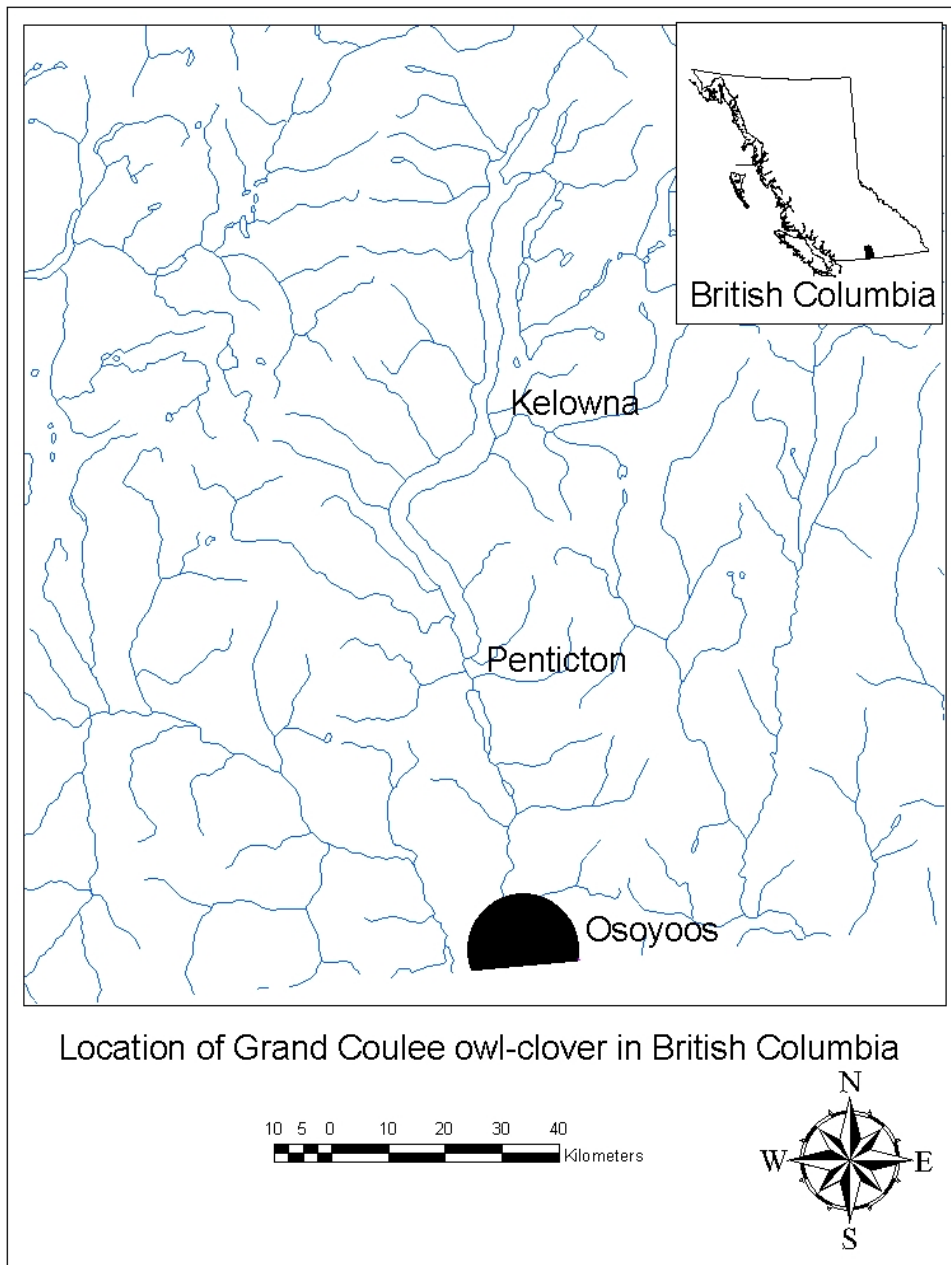
Conservation ranks are provided in Table 1. Grand Coulee owl-clover is ranked by NatureServe (2006) as globally imperiled to uncommon with a rounded global rank of G3 (vulnerable) because there is insufficient information on the species' abundance, although there is abundant suitable habitat in its range.

**Table 1.** Conservation ranks for Grand Coulee owl-clover

<b>Location</b>	<b>Rank</b>	<b>Rank description</b>
British Columbia	S1	Critically imperiled
Washington	SNR	Not ranked
Global	G2G4	Imperiled, vulnerable or uncommon

Source: B.C. Conservation Data Centre 2005, Washington Natural Heritage Program 2005, NatureServe 2006.

In Canada, populations of Grand Coulee owl-clover occur along the U.S. border near Osoyoos, BC (Figure 3; Table 2).



**Figure 3.** Distribution of Grand Coulee owl-clover in Canada.

Based on the most recent field visits, the extent of occurrence in Canada is about 86 km<sup>2</sup> (a new calculation based on the area of a polygon including the five known populations), the area of occupancy is approximately 3 ha, and the Canadian population totals approximately 6,000–13,000 plants. The Canadian extent of occurrence represents less than 1% of the global value. Very limited historical information or trends are available, as the species was only discovered in Canada in the mid-1990s, and the area was not previously visited by botanists. As is typical for many annual plant species, including other grassland *Orthocarpus* spp., population abundance and distribution fluctuate dramatically from year to year, making it difficult to determine trends.

Sufficient information is not available to determine the global area of occupancy or global population size. Extrapolating from the extent of occurrence data, and assuming that the density and size of populations are greatest in the core of the species range, one may reasonably infer that the Canadian area of occupancy and population size represent less than 1% of the corresponding global values. On the other hand, the global rank (G2G4) suggests that the species may be relatively uncommon, even within its core range. In this case, the Canadian area of occupancy and population size values may represent as much as 10% of the global values.

**Table 2.** Summary of populations of Grand Coulee owl-clover in Canada

Population locality	Status and description	Land tenure
East of Osoyoos	One subpopulation of 367 plants occupying ~1800 m <sup>2</sup> (2002)	Private
Mt. Kruger above racetrack	Five subpopulations between 153 and 4058 plants occupying ~282 m <sup>2</sup> (2003 to 2007)	Partially private and partially Crown (Crown is under review for potential sale)
Kilpoola	Three subpopulations of 5500 to 8500 plants occupying ~29 465 m <sup>2</sup>	Partially private and partially crown protected area
Mt. Kruger above golf course	Two subpopulations of 190 plants occupying an area of ~25 m <sup>2</sup> (2007)	Crown under review for potential sale
Mt. Kobau	>200 plants (area unknown)	Private

## Needs of the Grand Coulee Owl-clover

### Habitat and biological needs

Grand Coulee owl-clover is restricted to the Southern Okanagan Basin Ecosection (B.C. Ministry of Environment 2005), in the very dry hot Okanagan variants of the Bunchgrass and Ponderosa Pine biogeoclimatic zones (B.C. Ministry of Forests 2003). The growing seasons are extremely dry and hot. Within this area, it occurs in big sagebrush (*Artemisia tridentata*) and antelope-brush (*Purshia tridentata*) communities between 350 and 920 m above sea level. The antelope-brush community types where it occurs on the east flanks of Mount Kruger have been heavily modified by fire, which has only left sparse antelope-brush (T. Lea, pers. comm., 2006). In British Columbia, Grand Coulee owl-clover often occurs on sandy or gravelly sites. It appears to prefer south-facing, gentle to moderate slopes (M. Fairbarns, pers. obs., 2006) but has been found on gentle east slopes and on steeper (to 35%) south slopes (M. Fairbarns, pers. obs., 2006; F. Lomer, pers. comm. 1996). The soil depth and parent material at occupied sites have not been described but it appears that the soils tend to be medium to deep and moderately to well drained. Common species in the vicinity may include big sagebrush (*Artemisia tridentata*) and three-tip sagebrush (*Artemisia tripartita*); native grasses such as needle-and-thread (*Stipa comata*), Sandberg's bluegrass (*Poa secunda* ssp. *secunda*), and bluebunch wheatgrass (*Pseudorogneria spicata*); introduced grasses including cheatgrass (*Bromus tectorum*), Kentucky bluegrass (*Poa*

*pratensis*), bulbous bluegrass (*Poa bulbosa*), and six-weeks fescue (*Vulpia octoflora*); and various forbs including pasture sage (*Artemisia frigida*), woolly plantain (*Plantago patagonica*), long-leaved phlox (*Phlox longifolia*), and thread-leaved fleabane (*Erigeron filifolius* var. *filifolius*). Grand Coulee owl-clover is most successful on microsites with exposed mineral soil and little vegetation competition. The influences of fire and fire suppression, and grazing at various levels of intensity and timing, have not been examined.

Grand Coulee owl-clover does not reproduce from cuttings or pieces of the plants thus dispersal of the species depends on seeds. The key demographic attributes of Canadian plants are not known. It is an annual species so populations are replenished either by recruitment from a local seed bank and/or by dispersal from other populations. Long-distance dispersal between populations is probably rare so banked seeds are essential to the persistence of populations. Canadian plants produce large amounts of seed but there is no information regarding seed viability or the species' ability to bank seeds over long periods. The species' pollination ecology has not been studied; similar species of *Orthocarpus* are often pollinated by bees.

### Ecological role

Grand Coulee owl-clover is a facultative root parasite. Root parasites form connections with the root systems of other plants and extract water and nutrients (but not sugars or other organic compounds) from their host. In the case of Grand Coulee owl-clover, this parasitic nature is facultative, meaning that the plant is capable of growing without a host although this may be quite rare in nature. Closely related species may parasitize a wide variety of hosts so host-availability is unlikely to influence recovery potential.

### Limiting factors

Although not noted in the COSEWIC status report, some populations are too distant to exchange pollen with any other known populations. However, given the relatively large size of the outlying populations, there may be little risk of inbreeding depression despite their isolation. On the other hand, they may suffer from founder effects.

### Threats

The following section is adapted from the species description provided in the status report written by COSEWIC (2005) except where otherwise stated.

### Threat classification

**Table 3.** Threat classification table

1 Residential and recreational development		Threat attributes	
Threat category	Habitat loss or degradation	Extent	Localized
General	Housing or recreational	Occurrence	Historic, current, anticipated

<b>threat</b>	development	<b>Frequency</b>	Continuous
<b>Specific threat</b>	Habitat conversion, fragmentation, and isolation	<b>Causal certainty</b>	High
		<b>Severity</b>	Potentially high but varies among sites
<b>Stress</b>	Reduced population size, reduced population viability or local extinctions	<b>Level of concern</b>	High
<b>2 Agricultural development</b>		<b>Threat attributes</b>	
<b>Threat category</b>	Habitat loss or degradation	<b>Extent</b>	Localized
<b>General threat</b>	Crop production.	<b>Occurrence</b>	Historic, current, anticipated
		<b>Frequency</b>	Continuous
<b>Specific threat</b>	Habitat conversion and tilling	<b>Causal certainty</b>	High
		<b>Severity</b>	Potentially high but varies among sites
<b>Stress</b>	Reduced population size, reduced population viability, or local extinctions	<b>Level of concern</b>	High
<b>3 Grazing</b>		<b>Threat attributes</b>	
<b>Threat category</b>	Habitat loss or degradation	<b>Extent</b>	Widespread
<b>General threat</b>	Overgrazing	<b>Occurrence</b>	Historic, current, anticipated
		<b>Frequency</b>	Seasonal
<b>Specific threat</b>	Alteration of habitat characteristics due to soil compaction or disturbance and stem breakage due to trampling	<b>Causal certainty</b>	Low but not well understood
		<b>Severity</b>	Low but requires research
<b>Stress</b>	Reduced population size or reduced population viability	<b>Level of concern</b>	Low but requires research
<b>4 Dispersed recreational activities</b>		<b>Threat attributes</b>	
<b>Threat category</b>	Habitat loss or degradation	<b>Extent</b>	Localized
<b>General threat</b>	Recreational activities (ATVs)	<b>Occurrence</b>	Current, anticipated
		<b>Frequency</b>	Seasonal
<b>Specific threat</b>	Alteration of habitat characteristics or temporary habitat conversion	<b>Causal certainty</b>	Low but not well understood
		<b>Severity</b>	Low but requires research
<b>Stress</b>	Reduced population size or viability and direct mortality	<b>Level of concern</b>	Low but requires research
<b>5 Invasive plants</b>		<b>Threat attributes</b>	
<b>Threat category</b>	Exotic species	<b>Extent</b>	Widespread



<b>General threat</b>	Cheatgrass ( <i>Bromus tectorum</i> ).	<b>Occurrence</b>	Current, anticipated
		<b>Frequency</b>	Seasonal
<b>Specific threat</b>	Alteration of habitat characteristics or resource competition	<b>Causal certainty</b>	Low but not well understood
		<b>Severity</b>	Low but requires research
<b>Stress</b>	Reduced population size or reduced population viability	<b>Level of concern</b>	Low but requires research
<b>6</b>	<b>Demographic collapse</b>	<b>Threat Attributes</b>	
<b>Threat category</b>	Changes in ecological dynamics or natural processes	<b>Extent</b>	Localized
<b>General threat</b>	Demographic collapse	<b>Occurrence</b>	Unknown but potentially anticipated
		<b>Frequency</b>	Unknown
<b>Specific threat</b>	Stochastic population fluctuation and collapse	<b>Causal certainty</b>	Unknown
		<b>Severity</b>	Unknown
<b>Stress</b>	Local extinctions	<b>Level of concern</b>	Unknown

## Description of the threats

**Habitat loss or degradation:** Land conversion, particularly for residential and recreational development, poses the greatest current threat to Grand Coulee owl-clover. The human population of the south Okanagan valley region is growing very rapidly and development around Osoyoos, particularly along the east slopes of Mount Kruger, is rapidly occurring on potential habitat for Grand Coulee owl-clover. One of the populations on the east slopes of Mount Kruger is on private land, which is likely to be developed for residential use. The other population on the east slopes of Mount Kruger is on provincial Crown land close to a parcel of private land and may be prone to damage if housing is built on the private land. Both of these populations occur within a kilometer of recreational developments (a golf course and a racetrack) as well as recent housing developments.

Large areas of the lower slopes and valley bottoms of the Okanagan valley are suited to agricultural land development including the conversion of “native pasture” to vineyards and orchards. Agricultural land conversion has already eliminated a considerable amount of habitat suitable for Grand Coulee owl-clover and there is a high potential for further habitat loss.

Crown lands are still used for livestock grazing, as are most of the private land sites. At one time, decreasing range condition due to heavy livestock use probably posed the greatest threat to Grand Coulee owl-clover in Canada.

The Crown range land on Mount Kruger is in poor range condition and stocking rates have been reduced accordingly. This has decreased the potential for further direct impact on Grand Coulee owl-clover but there are still sufficient livestock on the sites to pose a significant risk of habitat degradation through trampling and soil compaction,

and to facilitate invasion by weedy plants.

Heavy grazing may have offsetting benefit, by reducing the cover of other plants and increasing the amount of bare mineral soil, which provides a superior germination site (M. Fairbarns, pers. obs., 2006).

The COSEWIC status report does not directly address the threat posed by dispersed recreational activities. The east slopes of Mount Kruger receive heavy motorized recreation use, especially from four-wheel drive vehicles and motorbikes (M. Fairbarns, pers. obs., 2006). This informal use tends to concentrate on grassland areas and avoid rock outcrops, so it presents a serious potential threat to habitat suitable for Grand Coulee owl-clover. Inventory in 2007 identified ATV use nearby most sites but no direct use within sites (Young and Klym 2007). A historic dirt road bisects the Kipoola locality, the largest population, but does not appear to be causing impacts currently.

**Exotic species:** Invasions of alien herbaceous plant species pose the second greatest threat to Grand Coulee owl-clover. Grasslands throughout the south Okanagan valley have been heavily impacted by a number of invasive plants. New invasive alien species arrive in the area regularly and some quickly become serious grassland weeds. Surveys in 2007 (Young and Klym 2007) suggest cheatgrass (*Bromus tectorum*) is the main invasive species that is currently within the perimeter of owl-clover sites.

**Changes in Ecological Dynamics or Natural Processes:** The COSEWIC status report does not directly address the threat of demographic collapse (populations may become too small to sustain themselves) but does draw attention to the small population size, extreme population fluctuations, and small area of extent. These factors may dispose some populations to stochastic events and demographic collapse. It is not clear that the seedbank contains sufficient seeds to perpetuate the population, especially considering that similar species of owl-clover do not appear to bank abundant seed for more than 2 years (Fairbarns 2005).

## **Actions Already Completed or Underway**

The South Okanagan–Similkameen Conservation Program (SOSCP) is a partnership of non-governmental, government, and First Nations organizations that work together to conserve the biodiversity of a region, which includes the Canadian extent of occurrence of Grand Coulee owl-clover. SOSCP promotes stewardship through landowner contact, applies First Nations knowledge and ecological heritage, offers educational programs, assists in securing sites for conservation, and undertakes research and habitat restoration. One population is protected within the South Okanagan Grasslands Protected Area and is identified within the protected area's Annual Management Plan. Inventory and monitoring projects were conducted in 2004, 2006, and 2007. A mitigation plan is being developed for potential Crown land sale on the west bench of Osoyoos where owl-clover sites occur.

## **Knowledge Gaps**

More survey work should be conducted in other parts of the Southern Okanagan Basin and possibly within the Okanagan Range and Southern Okanagan Highland Ecosections to determine the presence of unreported populations.

The key demographic attributes should be described for populations in Canada to determine what stages present the most serious bottlenecks to population growth and to identify the underlying factors. This information will provide a scientific basis for developing well-targeted management actions, which are likely to foster efficient, effective, and economical recovery.

The seasonal development of Grand Coulee owl-clover should be studied. Knowledge of germination dates, important growth periods, flowering times, and seed dispersal periods will provide a scientific basis for timing management activities and avoiding grazing impacts.

Seed viability, germination requirements, and seedbank longevity should be determined. This information will assist in the development of effective techniques for seed collection and storage, propagation, and population establishment/augmentation. The breeding system should be investigated. If the results indicate that Grand Coulee owl-clover is an outbreeder, its major pollinator guilds should be identified.

The identity and abundance of weedy species should be described in occupied and potential habitat. This information will help to develop of a weed management plan to aid in recovery.

Habitat condition and (where it occurs) current grazing practices should be determined at all five populations. This information is necessary to assess the risk presented by grazing and modify range management practices if warranted.

## **RECOVERY**

### **Recovery Feasibility**

Recovery is biologically and technically feasible for Grand Coulee owl-clover (Table 4).

**Table 4.** Technical and biological feasibility of recovery criteria from Environment Canada *et al.* (2005)

<b>Criteria</b>	<b>Feasibility</b>
1. Are individuals capable of reproduction currently available to improve the population growth rate or population abundance?	Yes. It reproduces sexually and produces abundant seed.
2. Is sufficient suitable habitat available to support the species or could it be made available through habitat management or restoration?	Yes. While Grand Coulee owl-clover requires specialized habitat conditions, many areas of unoccupied habitat appear capable of sustaining populations in their current condition or after invasive species populations have been reduced.
3. Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?	Yes. Threats can be mitigated through the actions outlined in Table 5.
4. Do the necessary recovery techniques exist and are they demonstrated to be effective?	Yes. Over the short term, recovery techniques consist primarily of threat mitigation techniques.

## Recovery Goal

To maintain extant populations of Grand Coulee owl-clover within its range in Canada.

## Rationale for the Recovery Goal

No information is available on the historic population size or distribution for this species since it was first reported in Canada in the 1990s. As a result, it is not possible to set a population restoration target. The current population size and distribution are not well known due to limited inventory. A substantial amount of unsurveyed potential habitat has been identified and additional populations may exist. Grand Coulee owl-clover grows from seeds; annually, its seed bank persistence is unknown, although similar species do not persist for more than 2 years. Large annual fluctuations in population size are documented and local population extirpations may be expected, especially at sites with low numbers. Viable population size is not known. These knowledge gaps and biological limiting factors make it difficult to set a credible population target that is focused on numbers or maintaining specific populations. Maintaining a viable population in the long term will ensure persistence of the species in Canada and may require protecting more than one population to ensure that impacts from stochastic events are mitigated. The requirements for maintaining a viable population will be addressed through a research program. The short-term objectives will also address other knowledge gaps, threats, and interim habitat protection needs.

## Recovery Objectives

1. To protect<sup>1</sup> the five known populations of Grand Coulee owl-clover by 2012.
2. To develop, by 2008, and implement a research program to determine the feasibility/necessity of population reintroduction by addressing knowledge gaps

<sup>1</sup> Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations, and protected areas.

relating to population size, distribution, annual variation, detailed habitat requirements, seed bank persistence, and population viability requirements.

3. To quantify and mitigate potential threats from habitat loss, invasive plants, livestock grazing, and recreation between 2008 and 2012.

A portion of the species' habitat needs to be protected in the short-term to ensure that the species persists in Canada while knowledge gaps are being addressed. The short-term target is believed to be necessary to maintain the species in the short-term and is achievable by 2012, based on recovery team consensus in absence of suitable scientific information. Protected habitat is habitat that has been occupied by Grand Coulee owl-clover, is secure from habitat loss, is monitored regularly, and is managed to minimize impacts from known threats.

### **Approaches Recommended to Meet Recovery Objectives**

Sound stewardship practices are essential. It will be necessary to work with landowners and land managers to develop mechanisms to protect and manage areas of important habitat for this species to ensure its survival and recovery. See Table 5 for details of approaches.

## Recovery planning table

Broad strategies for the recovery of Grand Coulee owl-clover are presented in Table 5.

**Table 5.** Broad recovery approaches for Grand Coulee owl-clover

<b>Priority</b>	<b>Broad approach/strategy</b>	<b>Threat</b>	<b>General description</b>
Objective 1	Habitat and species protection	<ul style="list-style-type: none"> <li>Residential and recreational development</li> <li>Agricultural development</li> </ul>	<ul style="list-style-type: none"> <li>Develop priorities for acquisition or protection (e.g., covenants and other stewardship agreements) of sites in conjunction with the South Okanagan-Similkameen Conservation Program (SOSCP).</li> <li>Establish protection for the 5 known populations.</li> </ul>
Objective 1	Habitat stewardship	<ul style="list-style-type: none"> <li>Invasive plants</li> <li>Grazing</li> <li>Dispersed recreation activities</li> </ul>	<ul style="list-style-type: none"> <li>Prepare Best Management Practices to support landowners in habitat stewardship activities.</li> <li>Consider designation as an Identified Wildlife Management Species and prepare an Identified Wildlife Management Account for occurrences on Crown land subject to grazing.</li> <li>Identify which private and public landowners have populations of Grand Coulee owl-clover on their lands.</li> <li>Contact landowners through the landowner contact program of SOSCP.</li> <li>Engage the cooperation of all involved landowners and land managers in habitat stewardship.</li> </ul>
Objectives 1, 2	Research	<ul style="list-style-type: none"> <li>Demographic collapse</li> <li>Invasive plants</li> <li>Grazing</li> </ul>	<ul style="list-style-type: none"> <li>Inventory habitat attributes for Grand Coulee owl-clover and identify important habitat attributes.</li> <li>Determine whether bottlenecks are affecting pollination/reproduction, dispersal, seed production, recruitment, and recruit survival.</li> <li>Determine minimum viable population size.</li> <li>Determine appropriate restoration and adaptive management techniques for existing populations of Grand Coulee owl-clover and their habitat.</li> <li>Develop techniques and priorities to establish new populations.</li> </ul>

<b>Priority</b>	<b>Broad approach/strategy</b>	<b>Threat</b>	<b>General description</b>
Objectives 1, 2, 3	Mapping and inventory	<ul style="list-style-type: none"> <li>• Demographic collapse</li> <li>• Grazing</li> <li>• Invasive plants</li> </ul>	<ul style="list-style-type: none"> <li>• Identify and delineate critical habitat for the species.</li> <li>• Identify and prioritize areas for inventory.</li> <li>• Conduct inventory surveys to determine whether any populations are undocumented (i.e., to determine necessity of re-introductions).</li> <li>• Assess low elevation grasslands throughout the extent of occurrence to prioritize for establishment of new populations.</li> <li>• Monitor extant populations.</li> </ul>
Objectives 1, 2	Population restoration	<ul style="list-style-type: none"> <li>• Demographic collapse</li> </ul>	<ul style="list-style-type: none"> <li>• Increase the area of occupancy and abundance of existing populations above minimum viable population size if necessary.</li> <li>• Develop and implement a population restoration plan for locations with existing populations (including a monitoring component) if necessary.</li> <li>• Conduct trials for Grand Coulee owl-clover population establishment and augmentation.</li> <li>• If required, develop and implement a translocation plan to establish new populations of Grand Coulee owl-clover.</li> </ul>
Objectives 1, 2	Public education and outreach	<ul style="list-style-type: none"> <li>• Residential and recreational development</li> <li>• Invasive plants</li> <li>• Agricultural land development</li> <li>• Grazing</li> <li>• Dispersed recreation activities</li> </ul>	<ul style="list-style-type: none"> <li>• Increase public awareness of the existence and conservation value of Grand Coulee owl-clover and associated species at risk.</li> <li>• Develop priorities, in conjunction with SOSCP, to deliver public education and outreach concerning species at risk, and their habitats and management to key audiences.</li> </ul>

## Performance Measures

The relationships between the three objectives and six main approaches are indicated in Table 5. The effectiveness of the six approaches will be evaluated according to the following criteria:

1. Habitat and Species Protection
  - Establishment of agreements to protect known populations.
2. Stewardship
  - Completion of Best Management Practices for Grand Coulee owl-clover.
  - Develop stewardship agreements with landowners.
  - Establishment of contacts with federal, provincial, and/or municipal authorities responsible for lands where establishment of populations of Grand Coulee owl-clover are proposed if necessary.
3. Research
  - Establishment of a scientific study of population processes.
  - Development of successful techniques for establishment of experimental populations.
  - Completion of a pilot project for testing restoration and adaptive management techniques to increase size and area occupied by extant populations.
4. Mapping and Inventory
  - Completion of detailed habitat and population inventories for extant populations.
  - Completion of critical habitat identification and consultation with landowners.
  - Annual monitoring of extant populations.
5. Population Restoration
  - Restoration plan has been developed.
  - Population augmentation trials completed.
  - If required, translocation plan developed.
6. Public Education and Outreach
  - Production and distribution of outreach materials to key audiences.

## Critical Habitat

### Identification of the species' critical habitat

No critical habitat, as defined under the federal *Species at Risk Act* [S.2], is proposed for identification at this time. It is expected that critical habitat for Grand Coulee owl-clover will be identified following completion of outstanding work required to quantify specific habitat and area requirements, as outlined in the schedule of studies below. In addition, there is a need for consultation and development of stewardship options with affected landowners.



## Recommended schedule of studies to identify critical habitat

**Table 6.** Schedule of studies

Description of activity	Outcome/rationale	Timeline
Document microhabitat conditions where populations now occur (critical abiotic and biotic features of habitat including: soil texture, soil depth, slope, aspect, hydrologic regime for the entire growing period, species composition, etc.). Particular attention should be paid to locations in Canada with robust populations.	Identification of important habitat attributes	Suggested completion date: 2012
Identify high quality unoccupied sites and conduct surveys to determine whether they possess the key attributes that prevail where the species occurs. Survey efforts should focus on low elevation (< 900 m) grasslands from the mouth of the Ashnola River to the southeast flanks of Anarchist Mountain and up the Okanagan valley as far as Okanagan Falls. Surveys should be conducted between mid-June and mid-July to simultaneously survey for unreported populations of Grand Coulee owl-clover.	Identification of occupied and potentially occupied habitat	Suggested completion date: 2012
Map candidate critical habitat and consult with landowners. Identify critical habitat.	Critical habitat is identified	Suggested completion date: 2012

## Existing and Recommended Approaches to Habitat Protection

Two populations occur completely on private land. One population occurs partly on private land and partly on Crown land. The two remaining populations occur completely on Crown land; one of these is within the South Okanagan Grasslands Protected Area.

The habitat on private land could be protected through stewardship mechanisms that prevent development for recreational, residential, or high-intensity agricultural use. Mechanisms could include establishment of conservation covenants, eco-gifting of the small areas where Grand Coulee owl-clover occurs, or sale of the properties for conservation by willing landowners.

The habitat could be protected from grazing damage by implementing stewardship initiatives such as establishment of best management practices and voluntary protection of important areas of habitat on private land. Any stewardship program could consider establishment of grazing exclosures to exclude livestock from high quality habitat, or by excluding grazing during the growing and seed dispersal period for Grand Coulee owl-clover (probably April–August). Exclosures should be designed to minimize impacts on grazing practices outside the exclosure. Exclosures may be less effective than timed grazing because they tend to favour an increase in biomass and litter, which appear to

reduce habitat quality for Grand Coulee owl-clover. Best Management Practices could be incorporated into range use plans and annual management plans for parks.

The abundance and species composition of invasive weeds should be monitored and weeds should be controlled when necessary to protect habitat.

The potential for ATV damage could be reduced through best management practices and education.

## **Effects on Other Species**

A number of other rare species, such as the Western Rattlesnake (*Crotalus oreganus*), Gopher Snake (*Pituophis catenifer deserticola*), and Badger (*Taxidea taxus*) have been reported in the vicinity of one or more populations of Grand Coulee owl-clover.

It is not possible to discuss all possible interactions associated with recovery; however, actions to assist in the recovery of Grand Coulee owl-clover will likely benefit other species at risk. For example:

- Increased public education and awareness may limit harmful recreational activities in locations with species at risk.
- Management of invasive species may restore habitat for other plant species at risk.

However, actions to assist in the recovery of Grand Coulee owl-clover may negatively affect other plants at risk. For example:

- If not planned and implemented carefully, large-scale management actions, such as invasive species removal or the use of herbicides, may have negatively affect other plants at risk (e.g., through trampling, increased herbivory, and inadvertent dispersal of alien species during disposal).

All on-site activities (surveys, research, and management) to aid recovery pose a threat from trampling to co-occurring rare species that occur in or sites with Grand Coulee owl-clover, unless care is taken to avoid damage.

## **Socioeconomic Considerations**

Recovery actions could potentially affect the following socio-economic sectors: recreation, private land development, and ranching. These effects are expected to be low in most cases.

## **Recommended Approach for Recovery Implementation**

An ecosystems approach should be taken to maintain this and other species at risk found in similar habitats. Any actions that are suggested will also include the involvement of the South Okanagan-Similkameen Conservation Project (SOSCP).

For successful implementation in protecting species at risk, there will be a strong need to engage in stewardship on various land tenures. Stewardship involves the voluntary cooperation of landowners to protect species at risk and the ecosystems they rely on. The preamble to the federal *Species at Risk Act* (SARA) recognizes 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.” The Bilateral Agreement on Species at Risk between British Columbia and Canada acknowledges 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.”

**Stewardship approach for private lands:** It is possible that additional populations of this species may occur on private lands. As with other species at risk found on private property, stewardship efforts will be the key. To successfully protect many species at risk in British Columbia, there will have to be voluntary initiatives by landowners to help maintain areas of natural ecosystems that support these species. This stewardship approach will cover many different kinds of activities, such as: following guidelines or best management practices to support species at risk; voluntarily protecting important areas of habitat on private property; conservation covenants on property titles; ecogifting part or all of their property to protect certain ecosystems or species at risk; or selling their property for conservation. For example, both government and non-governmental organizations have had good success in conserving lands in the province.

## **Statement on Action Plans**

A recovery action plan for Grand Coulee owl-clover should be completed by October 2012.

## REFERENCES

- British Columbia Conservation Data Centre. 2005. B.C. Species and Ecosystems Explorer. B.C. Min. Sustainable Resour. Manage., Victoria, BC. <<http://srmapps.gov.bc.ca/apps/eswp/>> Accessed [August 3, 2005]
- British Columbia Ministry of Environment. 2005. Ecosection map, Thompson and Okanagan Regions. <[http://wlapwww.gov.bc.ca/sir/fwh/wld/map\\_page/images/ecosctns.gif](http://wlapwww.gov.bc.ca/sir/fwh/wld/map_page/images/ecosctns.gif)> Accessed [February 2006]
- British Columbia Ministry of Forests. 2003. Biogeoclimatic ecosystem classification subzone/variant map for Penticton Forest District, Kamloops Forest Region. Victoria, BC. 1:250,000. <[http://www.for.gov.bc.ca/hre/becweb/papermap/Field/DPE\\_Penticton\\_Field.pdf](http://www.for.gov.bc.ca/hre/becweb/papermap/Field/DPE_Penticton_Field.pdf)> Accessed [February 2006]
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2005. COSEWIC assessment and status report on the Grand Coulee Owl-clover (*Orthocarpus barbatus*) in Canada. Ottawa, ON. vi + 17 p. <[http://www.sararegistry.gc.ca/virtual\\_sara/files/cosewic/sr%5Fgrand%5Fcoulee%5Fowlclover%5Fe%2Epdf](http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr%5Fgrand%5Fcoulee%5Fowlclover%5Fe%2Epdf)> Accessed [January 2006]
- Environment Canada, Parks Canada Agency, and Fisheries and Oceans Canada. 2005. Species at Risk Act Policy: Recovery – draft policy on the feasibility of recovery. April 15, 2005. Ottawa, ON.
- Fairbarns, M.D. 2005. Demographic and phenological patterns of *Orthocarpus bracteosus* (Rosy Owl-clover). Research report to Interdepartmental Recovery Fund. 23 p.
- National Recovery Working Group. 2005. Recovery handbook (ROMAN). 2005–2006 Edition, October 2005. Recovery of Nationally Endangered Wildlife, Ottawa, ON. 71 p. + appendices.
- NatureServe. 2006. NatureServe Explorer: an online encyclopedia of life. Version 6.1. Arlington, VA. <<http://www.natureserve.org/explorer>> Accessed [June 25, 2007]
- Pojar, J. 2000. Scrophulariaceae. Pages 114–218 in G.W. Douglas, D. Meidinger, and J. Pojar (eds.). Illustrated flora of British Columbia. Vol. 5. Dicotyledons (Salicaceae through Zygophyllaceae) and Pteridophytes. B.C. Min. Environ., Lands and Parks, and Min. For., Victoria, BC. 389 p.
- Washington Natural Heritage Program. 2005. List of vascular plants tracked by the Washington Natural Heritage Program - July 2005. <<http://www.dnr.wa.gov/nhp/refdesk/lists/plantrnk.html>> Accessed [December 2005]
- Young, V. and C. Klym. 2007. Grand Coulee owl-clover inventory and monitoring, 2007. Penticton, BC. Min. Environ. Working Report.

## Personal Communications

- Lea, T. 2006. E-mail correspondence to M. Fairbarns. March 2, 2006. Species at Risk Biologist. B.C. Min. Environ., Ecosystems Branch, Victoria, BC.

Lomer, F. 2006. E-mail correspondence to M. Fairbarns. January 2006. Botanist. Vancouver, BC.

McLean, A. 2006. E-mail correspondence to M. Fairbarns. January 2006. District Range Management Specialist. B.C. Min. For., Penticton, BC.

Penny, J. 2005. E-mail correspondence to M. Fairbarns. December 2005. Senior Botanist. B.C. Conservation Data Centre, Victoria, BC.