PROPOSED

Species at Risk Act
Recovery Strategy Series
Adopted under Section 44 of SARA

Recovery Strategy for the Grand Coulee Owl-clover (*Orthocarpus barbatus*) in Canada

Grand Coulee Owl-clover

2012

Canada

Recommended citation:

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For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry (www.sararegistry.gc.ca).

Cover illustration: Terry McIntosh

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RECOVERY STRATEGY FOR THE GRAND COULEE OWL-CLOVER (*Orthocarpus barbatus*) IN CANADA

2012

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada.

In the spirit of cooperation of the Accord, the Government of British Columbia has given permission to the Government of Canada to adopt the "Recovery strategy for the Grand Coulee Owl-clover (*Orthocarpus barbatus*) in British Columbia" under Section 44 of the *Species at Risk Act.* Environment Canada has included an addition which completes the SARA requirements for this recovery strategy, and excludes the section on Socio-Economic Considerations. Socio-economic factors are not part of the consideration process for federal recovery strategies developed under SARA. These factors are kept isolated from this strategic phase of recovery planning.

2012

The federal Recovery Strategy for the Grand Coulee Owl-clover in Canada consists of:

PART 1: Federal Addition to the "Recovery strategy for the Grand Coulee owl-clover (*Orthocarpus barbatus*) in British Columbia", prepared by Environment Canada.

PART 2: "Recovery strategy for the Grand Coulee owl-clover (*Orthocarpus barbatus*) in British Columbia", prepared by the Southern Interior Rare Plants Recovery Team for the British Columbia Ministry of Environment.

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PART 1: Federal Addition to the “Recovery strategy for the Grand Coulee owl-clover (*Orthocarpus barbatus*) in British Columbia”, prepared by Environment Canada

PREFACE

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

SARA section 37 requires the competent Minister, which is the federal Minister of the Environment in this case, to prepare a recovery strategy for all listed extirpated, endangered or threatened species. SARA section 44 allows the Minister to adopt all or part of an existing plan for the species if it meets the requirements under SARA for content (sub-sections 41(1) or (2)).

The attached provincial recovery strategy (Part 2 of this document) was provided as science advice to the jurisdictions responsible for managing the species in British Columbia. Environment Canada has prepared this federal addition to meet the requirements 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 Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Grand Coulee Owl-clover 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 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.

SPECIES STATUS INFORMATION

Legal Designation: SARA Schedule 1 (Endangered) (2006)

Table 1. Conservation Status (from NatureServe 2011 and B.C. Conservation Framework 2011).

Global (G) Rank	National (N) Rank	Sub-national (S) Rank	COSEWIC Status	B.C. List	B.C. Conservation Framework
G2G3 (imperiled, or vulnerable to extirpation or extinction)	Canada (N2) United States (NNR)	Canada: BC (S2); United States: WA (SNR)	Endangered (2005)	Red	High priority: 2, 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

** 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

It is estimated that the percent of the global range of this species in Canada is less than 1%.

SPECIES AT RISK ACT REQUIREMENTS

The following sections address specific requirements of SARA that are either not addressed, or which need more detailed comment, in the "Recovery strategy for the Grand Coulee Owl-clover (*Orthocarpus barbatus*) in British Columbia" (Part 2 of this document, referred to henceforth as "the provincial recovery strategy").

1. Socio-economic Considerations

The "Recovery strategy for the Grand Coulee owl-clover (*Orthocarpus barbatus*) in British Columbia" contains a short statement on socio-economic considerations. As socio-economic factors are not a consideration in any aspect of the preparation of SARA recovery strategies, (see Section 41(1) of SARA), the Socio-economic Considerations section of the "Recovery strategy for the Grand Coulee owl-clover (*Orthocarpus barbatus*) in British Columbia" is not considered part of the federal Minister of Environment's recovery strategy for this species. Furthermore, socio-economic factors were excluded from the preparation of all other sections of this federal addition, including Population and Distribution Objectives and Critical Habitat.

2. Recovery Feasibility

This section replaces the "Recovery Feasibility" section in the provincial recovery strategy.

Recovery of the Grand Coulee Owl-clover (*Orthocarpus barbatus*) is considered technically and biologically feasible based on the following four criteria (Government of Canada 2009):

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, there are at least five extant populations in Canada. This species reproduces sexually and produces abundant seed. Field data that would permit determination of abundance trends are lacking.

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

   Yes, there is habitat to support the existing populations in British Columbia, and additional suitable habitat might also be made available through habitat management or restoration. 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. The primary threats to the species or its habitat (including threats outside of Canada) can be avoided or mitigated.

   Yes, threats can be mitigated through identified recovery planning approaches.

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

   Yes, general recovery techniques consist primarily of threat mitigation.

3. Population and Distribution Objectives

This section replaces the "Recovery Goal" section in the provincial recovery strategy.

Environment Canada has determined the Population and Distribution Objective for Grand Coulee Owl-clover to be:

To maintain the five extant populations of this species at their locations in Canada. To maintain or improve current population sizes at these locations, as well as any other extant populations that may be identified.

Rationale:

Historical abundance and distribution information for this species show five confirmed extant populations near Osoyoos, B.C. (2002, 2006, 2007, 2011[1] surveys). This species is at the northern extent of its range in Canada. There is no information to indicate that the species was previously more widespread, therefore an objective to actively increase the number of populations, which may allow for downlisting of the species, is not appropriate. However, if additional naturally occurring populations are discovered, they should also be maintained.

4. Critical Habitat

4.1 Identification of the Species' Critical Habitat

This section replaces the "Critical Habitat" section in the provincial recovery strategy.

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. The 2007 provincial recovery strategy for this species noted that critical habitat could not be identified at that time (nor is it required in the provincial process), but that it might be identified in a subsequent federal strategy or addition. This federal document does identify critical habitat to the extent possible for this species. More precise boundaries may be mapped, and additional critical habitat may be added in the future if ongoing research (e.g. through work by the province, stewardship and recovery groups, university projects, or related federal Interdepartmental Recovery Fund projects) supports the inclusion of areas beyond those currently identified. 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.

[1] Portions of two populations surveyed May-June, 2011: observers Kella Sadler (Environment Canada), Andrew Robinson (Environment Canada), Terry McIntosh (consultant), Orville Dyer (B.C. Ministry of Forests, Lands and Natural Resource Operations), Kirk Safford (B.C. Ministry of Environment), Mark Weston (B.C. Parks, B.C. Ministry of Environment), Sara Bunge (B.C. Parks, B.C. Ministry of Environment).

Ecological attributes of Grand Coulee Owl-clover habitat are outlined in the provincial recovery strategy (2007), and in McIntosh (2007):

1. Landscape attributes: Canadian distribution is restricted to the Southern Okanagan Basin Ecosection, in the very dry hot Okanagan variants of the Bunchgrass and Ponderosa Pine Biogeoclimatic Zones.
2. Habitat attributes: Within this distribution area, Grand Coulee Owl-clover occurs in Big Sagebrush (*Artemisia tridentata*) and Antelope-brush (*Purshia tridentata*) communities, between 350-920 m elevation. It appears to prefer south-facing, gentle to moderate slopes, but has been found on gentle east slopes and steeper (to 35%) south slopes.
3. Microhabitat attributes: Plants occur in small, flat to gently-sloping areas, or larger areas associated with fine, possibly wind-blown sediment (loess). Soils appear to be medium to deep and moderately- to well- drained.

Critical habitat for Grand Coulee Owl-clover is fully identified for the five known extant populations, occurring near Osoyoos, B.C. Grand Coulee Owl-clover is an annual species, with a climate-dependent life history. Plants are dependent on seed production, and on a seed bank (i.e., accumulation of seeds in the soil) in order to grow and maintain populations every year. Seed dispersal is estimated to be predominantly short-distance. Population numbers may fluctuate annually, depending on climatic conditions. Annual species may depend on low-intensity disturbance for long-term persistence, in perpetuating appropriate microhabitat for individual germination and growth (e.g., wind, surficial erosion, and frost heave may affect the habitats where they have been found); disturbance may also help to decrease competition from other plants. Sub-population[2] locations may vary between years, depending on local disturbance, and environmental conditions that contribute to successful germination. This factor highlights the importance of maintaining connectivity between existing sub-populations, to ensure successful annual establishment in suitable microhabitats, from a persistent seed bank (Bush and Lancaster, 2004).

Critical habitat is identified as the area occupied by individual plants or patches of plants, including the associated potential location error from GPS units, plus an additional 50 meters to encompass the immediately adjacent areas. Ecosystem processes (e.g. erosional patterns) that occur on the sagebrush-dominated slopes where Grand Coulee Owl-clover occurs are integral to the production and maintenance of suitable microhabitat conditions. Where slopes are apparent as a distinct ecological feature[3] at the landscape scale, the entire portion of the slope associated with the plant or patch of plants is also identified as critical habitat. Connectivity is maintained between sub-populations where they occur in close proximity, and where there is consistent intermediate habitat. The exact areas identified as critical habitat, and the methodology behind the identification, are described in Appendix 1.

[2] "Populations" are separated by >1 km; "sub-populations" represent records of individuals, or patches of individuals, that are within 1 km of each other.

[3] "Distinct" ecological, or landscape features are here referred to as those that are distinguishable at a landscape scale (through use of detailed ecosystem mapping or aerial photos), which, at that scale, appear as ecologically contiguous features with relatively distinct boundaries (e.g., cliffs, banks, or slopes, drainage basins, seepage plateaus, or distinct vegetation assemblages), and which comprise the context for a species occurrence.

4.2 Schedule of Studies to Identify Critical Habitat

This section replaces the "Recommended schedule of studies to identify critical habitat" section in the provincial document.

Critical habitat has been fully identified in this document, therefore no schedule of studies is required.

4.3 Examples of Activities Likely to Result in Destruction of Critical Habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time. Activities described in Table 2 include those likely to cause destruction of critical habitat for Grand Coulee Owl-clover; destructive activities are not limited to those listed.

Table 2. Examples of activities likely to result in destruction of critical habitat for Grand Coulee Owl-clover.

Activity	Description of how activity may result in destruction of critical habitat	Threat level
Conversion of natural landscape for human use and development	Results in direct loss of habitat through vegetation removal or replacement, debris deposition, or impact by machinery.	High
Livestock grazing	Results in trampling of habitat (i.e., alteration of local biophysical conditions), including disturbance or compaction of soil by animal hooves. Effect may be immediate or long-term, and cumulative.	Low / Unknown
Use of ATVs or other vehicles outside of existing trails	Results in disturbance of local biophysical conditions, including immediate or proximal substrate properties, to the extent that the habitat is no longer suitable for Grand Coulee Owl-clover.	Low / Unknown
Deliberate introduction of alien invasive plants	Direct effect is a reduction of space and soil available for Grand Coulee Owl-clover, and indirect effects, e.g., alteration of shade, water, and nutrients available to exclude niche range of Grand Coulee Owl-clover.	Unknown

Landscape development, i.e., conversion of the natural landscape for residential, recreational, industrial and/or agricultural purposes, has been identified as the major threat likely to result in destruction of critical habitat for Grand Coulee Owl-clover. The Okanagan valley is experiencing high rates of development. Development around Osoyoos, particularly along the east slopes of Mount Kruger, is rapidly occurring on potential habitat for Grand Coulee Owl-clover. A considerable amount of suitable habitat has already been lost to landscape conversion, e.g., for

housing, farmland, vineyards, and recreation (golf course, race track). Critical habitat may be damaged from excessive grazing, or by overuse by recreational users (ATVs, hiking). These threats were observed to be low in 2007, but they should be monitored. Crown lands are still used for livestock grazing, as are most of the private lands. Recreational activities are anticipated to increase as local development continues.

5. Statement on Action Plans

One or more action plans will be posted on the Species at Risk Public Registry by 2014.

6. Effects on the Environment and Other Species

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

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

Grand Coulee Owl-clover occurs in the South Okanagan Valley, where other rare species are found. Critical habitat identified for Grand Coulee Owl-clover is known to overlap with critical habitat identified for Branched Phacelia, for example. The recovery approaches proposed are not expected to negatively affect any other species. The recommended habitat protection will indirectly benefit other species at risk in the area; increased public education and awareness may limit harmful recreational activities at these locations, and management of invasive species may restore habitat for other plant species at risk. In acknowledgement of the high potential for shared habitat among local species at risk, large-scale management actions, such as invasive species removal or the use of herbicides, should be planned and implemented carefully. All on-site activities (surveys, research, and management), to aid recovery may pose a threat to co-occurring species (e.g., via trampling, increased herbivory, or inadvertent dispersal of alien species during disposal), unless care is taken to avoid damage.

7. References

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Appendix 1. Critical habitat identification and location

1. Decision tree for critical habitat identification

In Canada, there are five confirmed populations of Grand Coulee Owl-clover: (1) east Osoyoos (Figure A1); (2) South Okanagan Grasslands Protected Area – East Chopaka Unit (Figure A2, "Kilpoola"); (3) Osoyoos westbench - north (Figure A3, "Mt. Kruger above golf course"); (4) Osoyoos westbench - south (Figure A4, "Mt. Kruger above racetrack"); and, (5) Mount Kobau (Figure A5). A decision tree was developed to identify critical habitat for these populations, based on available knowledge.

The first decision is regarding the quality of available information on all records[4] of this species in Canada, with the choice of accepting or rejecting any given record for consideration as critical habitat based on three criteria, i.e., time since most recent observation, location uncertainty, and observation of current habitat suitability.

The second decision is based on how readily the habitat is able to be defined. For all accepted records a minimum "critical function zone" distance[5] is imposed. If critical habitat is readily identifiable based on available ecological information (ecosystem and/or aerial photo mapping, as well as expert advice from individuals who have specialized knowledge of the species and its locations), boundaries are extended on that basis to include areas of importance; i.e., priority landscape features that are plainly critical to the occurrence. "Distinct" ecological, or landscape features are here referred to as those that are distinguishable at a landscape scale (through use of detailed ecosystem mapping or aerial photos), which, at that scale, appear as ecologically contiguous features with relatively distinct boundaries (e.g., cliffs, banks, or slopes, drainage basins, seepage plateaus, or distinct vegetation assemblages), and which comprise the context for a species occurrence.

If the information described above is not available, i.e., (a) absence of high-resolution mapping, (b) lack of detailed ecosystem information, or (c) lack of expert advice, and/or (d) absence of any apparent landscape features of critical importance which would direct identification, then a formula for minimum habitat size (defaulting to minimum "critical function zone" distance) is proposed.

This approach (1) allows for an emphasis on ecological attributes which are of actual importance to the species, (2) permits the opportunity to use all available types of knowledge and information on a priority basis (i.e., within the context of a logical sequence of implementation), and (3) provides a method to identify critical habitat when detailed and/or specialized knowledge is lacking.

[4] "Records" are here referred to as the finest-scale of data available (i.e., point data representing individual plants, or polygons representing discrete patches of plants). The term "occurrence" is used synonymously in this text, to describe actual portions of a landscape that are occupied by individuals or patches of individuals, and which form the basis for critical habitat mapping.
[5] Minimum "critical function zone" distance is defined here as 50 m additional to the area of occupancy. Detailed rationale for use of this distance is included in section 2 of this Appendix.

Decision Tree:

1a. Occurrences have not been revisited for >25 years, **and** use imprecise and/or inaccurate geographic referencing systems (location uncertainty distance is greater than 100 m), **or** the habitat no longer exists at that location to support the species (no critical habitat will be defined until more is known about the population and location)

1b. Occurrences have been relocated and revisited in the past 25 years, **or** habitat has been revisited in the past 5 years to confirm it has the potential to support an occurrence, **or** geographic reference is accurate and precise (location uncertainty distance is less than 100 m) (go to 2)

2. Minimum critical habitat identified for ALL occurrences will include (*a*) specified area of occupancy, (*b*) all of the habitat within the GPS error distance (m) of the specified area of occupancy, and (*c*) an added minimum critical function zone distance of 50 m to ensure the inclusion of all necessary habitat associated with the occurrence (refer to rationale section following the decision tree), i.e., in all cases:

- *Minimum critical habitat (distance to boundary) = occurrence area + b + c*

2a. Where the species is a generalist associated with widespread habitats, **or** a specialist that occupies dynamic disturbance regimes difficult to delineate as patches in space, **or** occupies habitat that is otherwise poorly defined, **or** the best available information does not support more detailed interpretation and determination of critical habitat at a landscape scale, the minimal critical function zone distance (as defined above) is maintained around all occurrence areas.

2b. Where the species occupies readily identifiable habitat patches, such that any or all of the following methods of determination are available, and applicable, and support more detailed interpretation and determination of critical habitat:

- use of detailed ecosystem mapping
- use of aerial photos for identification of critical landscape features, and opportunities for connectivity, particularly wherever habitat quality and characteristics are continuous between patches
- use of any existing studies that can provide more detailed insight into critical habitat location and connectivity between occurrences
- consideration of any special circumstances or threats

In this case, this additional set of information may be used to extend critical habitat identification beyond the minimal critical habitat distance described above, i.e.:

- *Critical habitat (distance to boundary) = occurrence area + b + c + d*

Where *d* = extent of additional critical habitat identified; i.e., landscape feature, connectivity corridor, adjustment for special circumstances. In order to ensure that the identification of critical habitat is biologically defensible, extended and/or irregular critical habitat boundaries should be developed with, agreed upon, and confirmed by, species experts and/or relevant recovery teams.

2. Rationale for decision tree hierarchy

To identify habitat critical for the survival or recovery of a plant, it is necessary to consider factors that contribute to sustained reproductive success and colonization (i.e., dispersal of propagules, successful germination, and natural population fluctuation), as well as primary resources required for growth (i.e., space, water, sunlight, nutrients).

Population dynamics for plants in early successional environments may show greater fluctuation, both spatially and temporally, as compared to plants that comprise later-successional environments. This can be attributed to contrasting life history strategies typical of colonizing, versus competitive, and/or slow-growing species. Colonizing species can occupy patches opportunistically and perpetually within early-successional habitats (Hanski 1982), and are dependent on (a) local ecosystem dynamics, to perpetuate the creation of suitable habitat patches, and (b) connectivity between patches, for successful dispersal and colonization. Patch dynamics may be important within the context of later-successional environments as well, e.g. some species may persist as "satellite" species in old growth forest, colonizing new forest gaps. Plants with a more competitive live history approach (typically perennial, slower-growing) will have occurrences that are more spatially and temporally consistent, and which may therefore exhibit a more directly observable link between "threshold" breeches in required microhabitat properties, and population decline.

In most cases a detailed understanding of population dynamics will not be available for individual plant species at risk. The task, therefore, is to identify the properties that we know are of critical importance to its success, built on a prioritized model of (1) identifying basic biological requirements, (2) understanding ecological dynamics that relate to the context of the occurrence, (3) promoting connectivity between occurrences to foster reproductive success, and (4) accounting for special circumstances and threats.

The first priority in critical habitat identification should be to identify the primary resources required for the species growth. Each plant species has a different range of biological requirements, however. Where species occur, niche requirements have been met; therefore it follows that identifying an occurrence will involve identifying the unique combination of microhabitat properties at that site. It is understood that activities in areas proximal to an occurrence will affect local microhabitat properties. The distance at which proximal effects will impact rare plant occurrences may vary, depending on circumstance. Since it is unlikely that all factors contributing to local microhabitat can be identified, it is reasonable to include as critical habitat a minimum distance to ensure the maintenance of required microhabitat properties, wherever specialized information is lacking.

Existing research has identified bryophytes (mosses and liverworts) and lichens as uniquely sensitive indicators of microhabitat change. Lacking roots, bryophytes take up the majority of water and nutrients through atmospheric inputs, and as well as passively from the substrata on which they grow (Schofield 1985). As such, this group of plants has been used in monitoring a range of environmental effects, including acid raid, air pollution, and identifying threshold habitat fragment size for maintaining constituent microhabitat properties (light, moisture, humidity).

Studies that have used bryophytes or lichens to identify edge effect thresholds in mixed forest and coniferous forests (Esseen & Renhorn 1998, Baldwin & Bradfield 2005) have identified effects up to a distance of 45-50 m into remnant habitat fragments. Similarly, a study on microenvironmental gradients at habitat edges, i.e., light, temperature, litter moisture, vapor pressure deficit, humidity (Matlack 1993), and a study of edge effects as evidenced by changes in plant community structure and composition (Fraver 1994), each showed that effects could be detected to 50 m into habitat fragments. Forman and Alexander (1998) and Forman et al. (2003) found that most roadside edge effects on plants resulting from construction and repeated traffic have their greatest impact within the first 30 to 50 m. These data provide a logical basis for suggesting a minimum critical function zone distance of 50 m to ensure microhabitat properties for rare plant species occurrences are incorporated in the identification of critical habitat.

Once a critical function zone distance has been determined (minimum = 50 m), and where additional information exists, these boundaries may be built on or extended to account for factors identified previously (context, connectivity, special circumstances and threats). Ecosystem features that are discrete, identifiable, and which are logically associated with an occurrence should be included in the identification of critical habitat. That is, critical habitat should be identified such that relevant ecosystem dynamics (i.e., that directly contribute to spatial, and temporal perpetuation of the species) are included, wherever they can be determined, using the best available knowledge. Where habitat is consistent between existing occurrences, connectivity should be maintained. Finally, special circumstances should also be considered which may support a critical function zone distance that is greater than the standard minimum (50 m), e.g., proximity to dominant invasive alien species and/or roadside planting that would rapidly reduce or alter existing habitat (Jordan et al. 2008, Van Riper and Larson 2009), or proximity to heavy roadside or industrial emissions that would result in increased deposition of deleterious chemicals and alteration of existing habitat. Some species may be particularly sensitive to atmospheric deposition, which is detectable in plants and soils up to 1 to 2 km away from the source (Meshalkina et al. 1996, Hao et al. 2006, Kochy and Wilson 2001). In some cases, and based on supporting evidence, site- and species-specific factors could logically modify the placement or distance of critical habitat boundaries, based on the area required to maintain necessary resources for plant survival.

Anthropogenic features including roads, well-established trails, and associated developed urban and residential landscape are not identified as critical habitat for Grand Coulee Owl-clover, even when they occur within the minimum critical function zone distance. It is not clear at this time whether or to what extent these features contribute to local habitat quality, where they occur in close proximity to extant occurrences. Based on existing distribution information, it is presumed that these features do not provide essential ecological function to support Grand Coulee Owl-clover populations.

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4. Maps of critical habitat for Grand Coulee Owl-clover in Canada

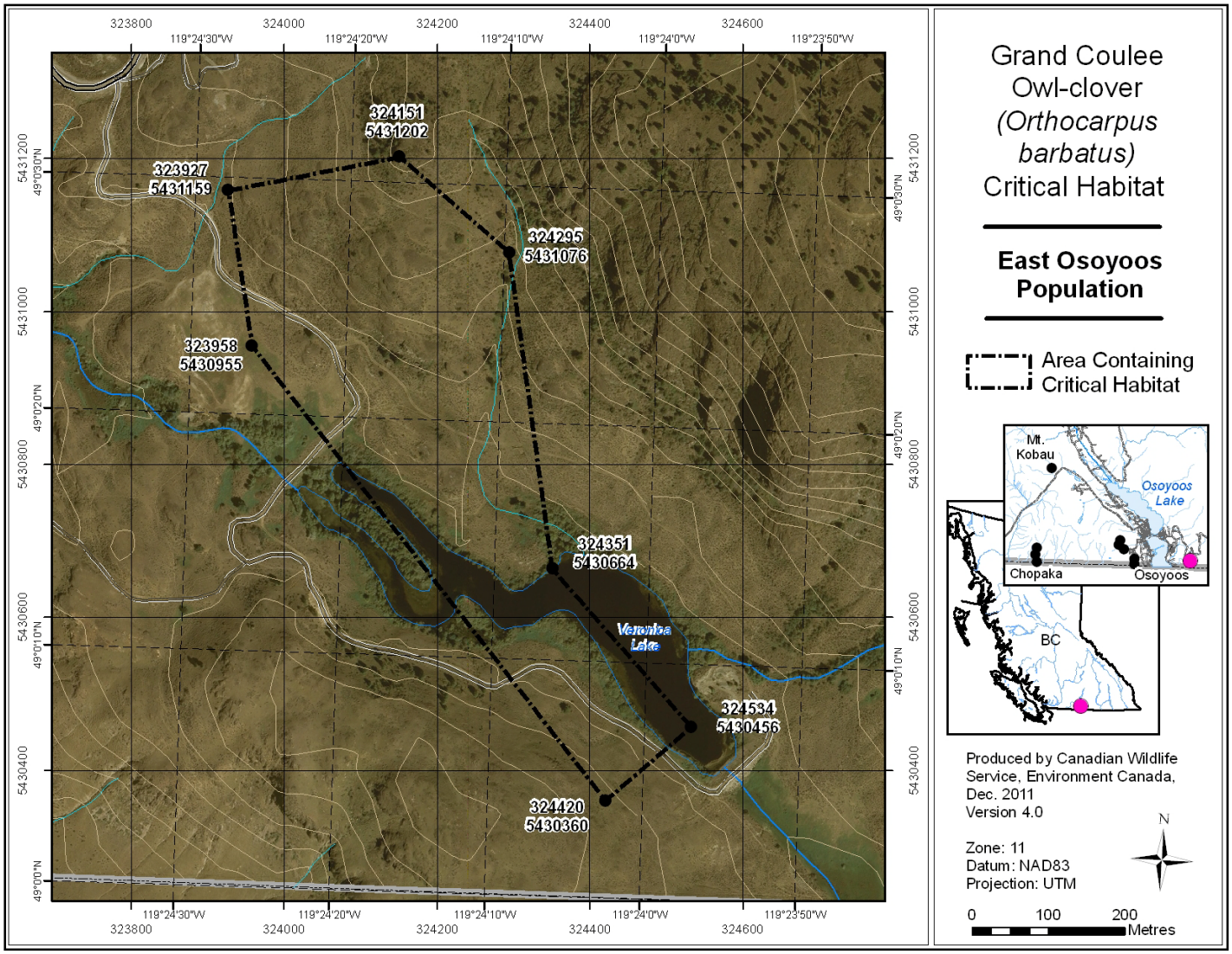

Figure A1. Critical Habitat for Grand Coulee Owl-clover near Osoyoos, British Columbia; the East Osoyoos Population corresponds with the “East of Osoyoos” population in the provincial recovery strategy.

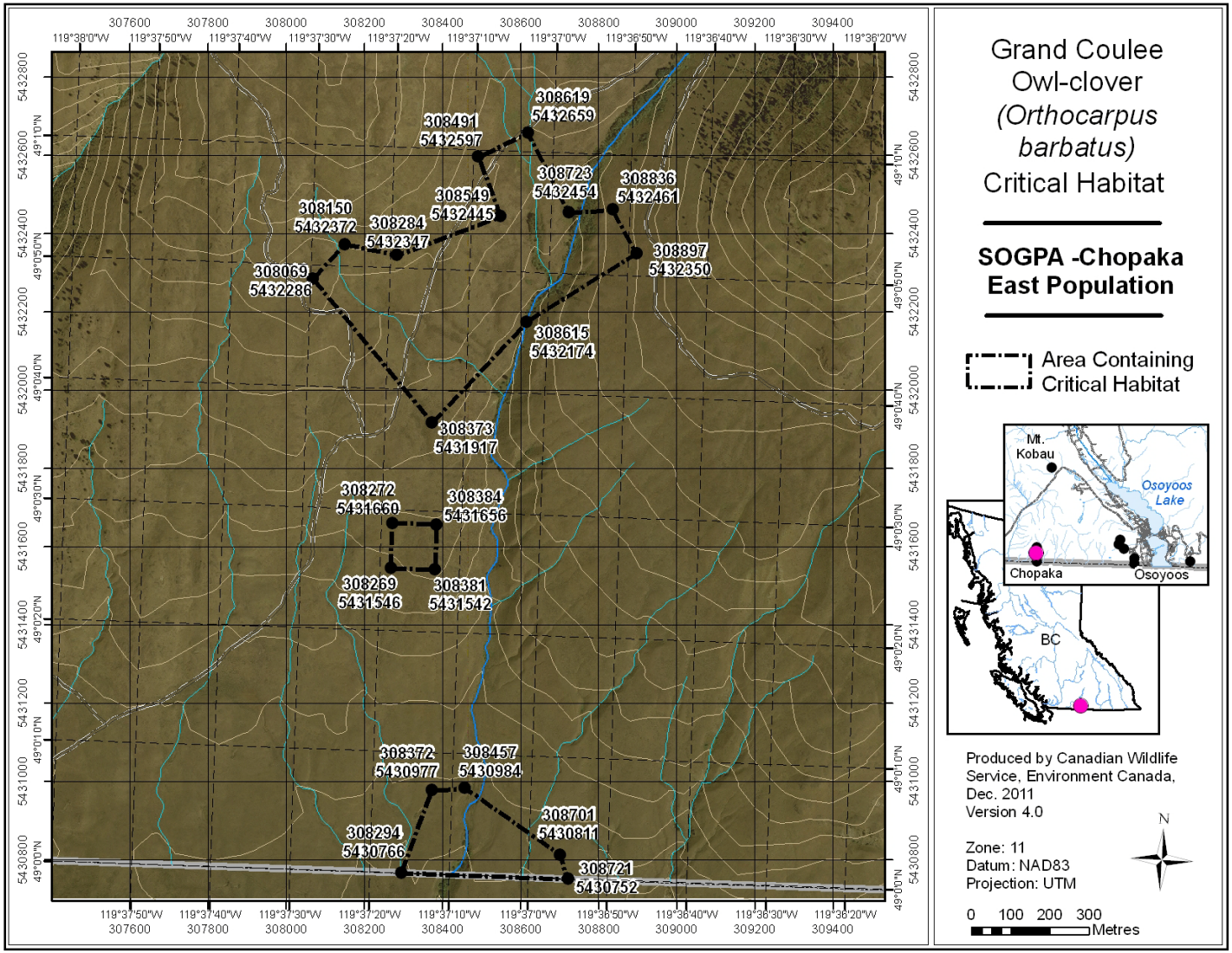

Figure A2. Critical Habitat for Grand Coulee Owl-clover near Osoyoos, British Columbia; South Okanagan Grasslands Protected Area (SOGPA) – Chopaka East Population corresponds with the “Kilpoola” population in the provincial recovery strategy. These polygons reflect 2011 survey data, including two new sub-populations to the south (not described in the provincial recovery strategy).

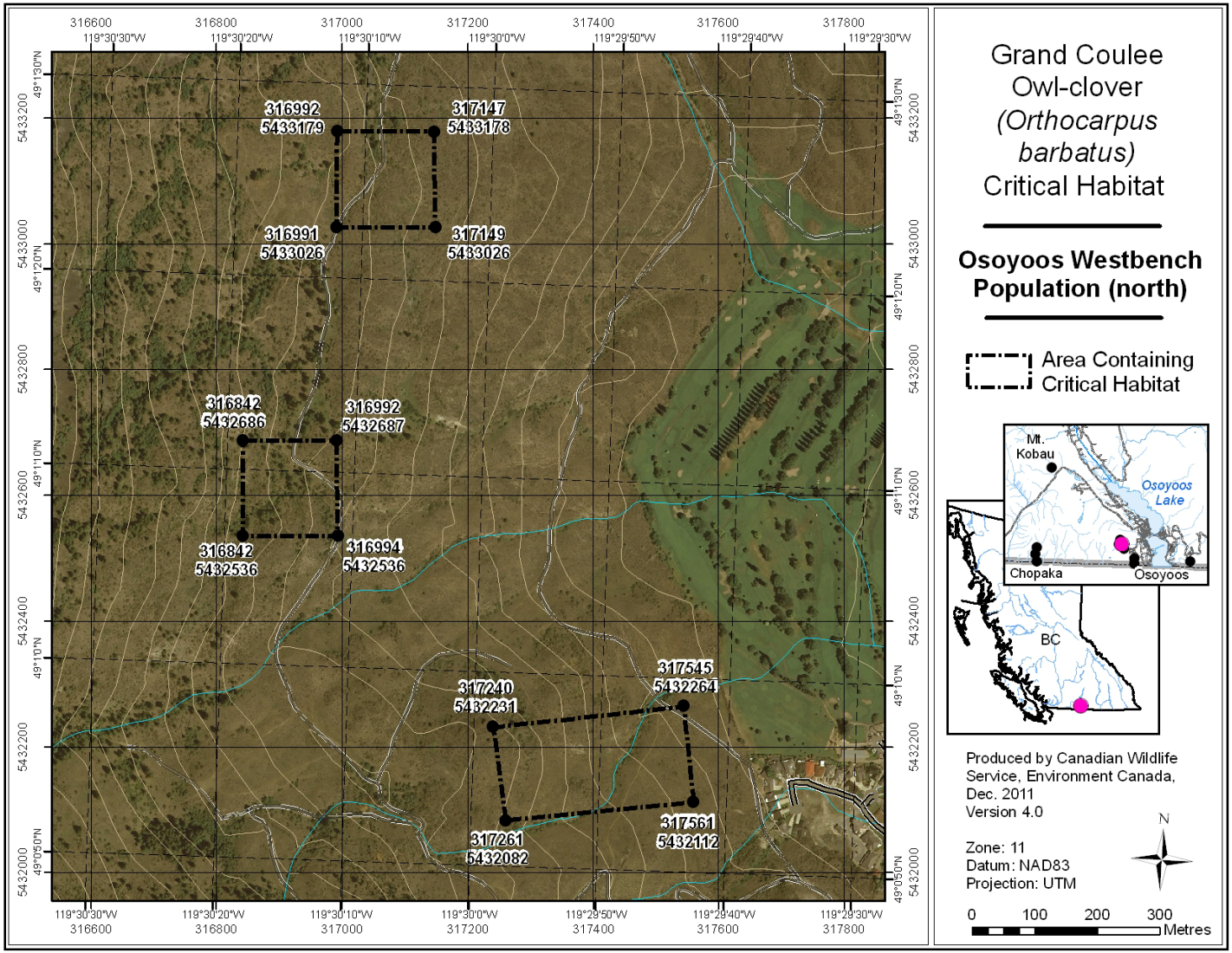

Figure A3. Critical Habitat for Grand Coulee Owl-clover near Osoyoos, British Columbia; the Osoyoos Westbench Population (north) corresponds with the “Mt. Kruger above golf course” population in the provincial recovery strategy.

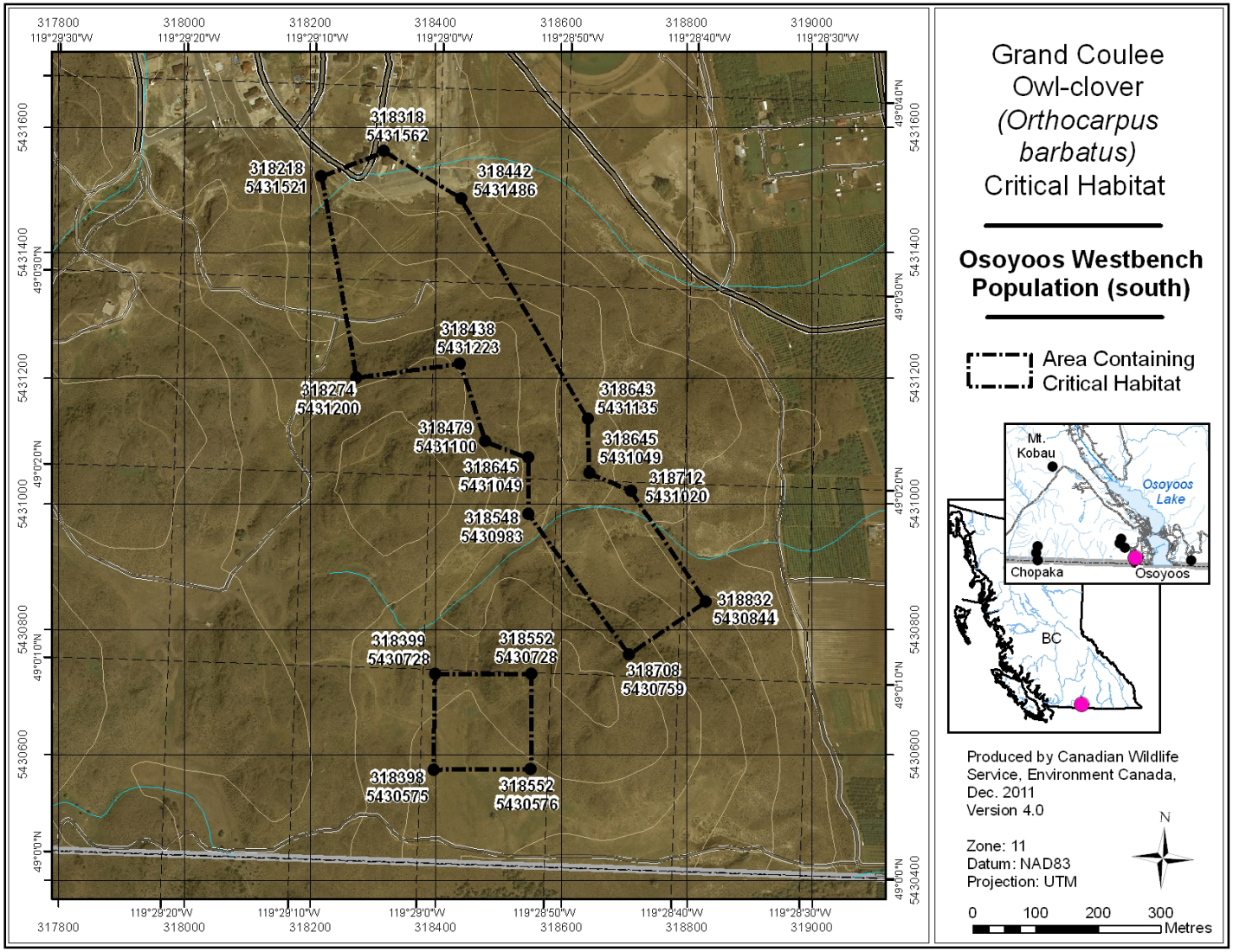

Figure A4. Critical Habitat for Grand Coulee Owl-clover near Osoyoos, British Columbia; the Osoyoos Westbench Population (south) corresponds with the “Mt. Kruger above racetrack” population in the provincial recovery strategy.

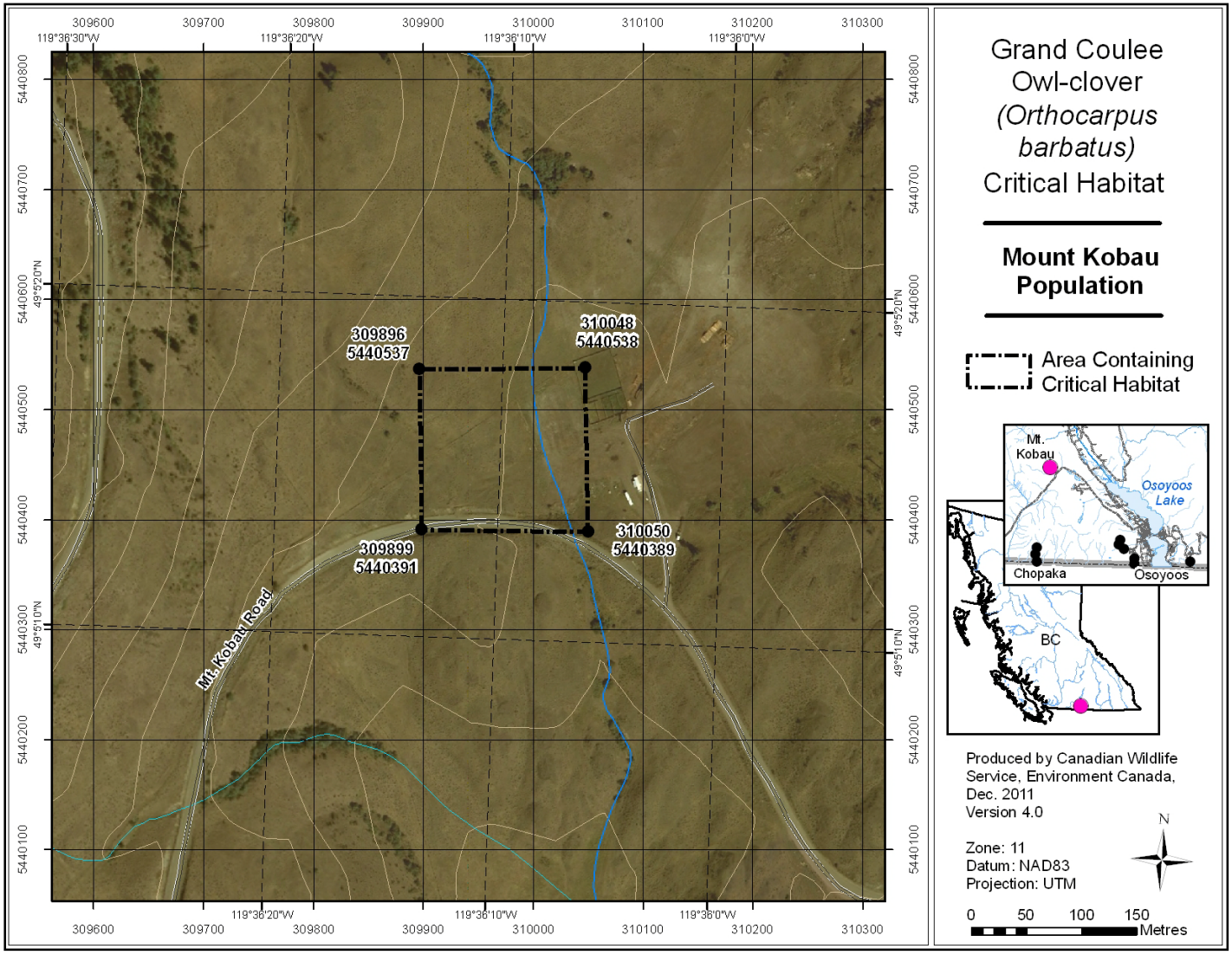

Figure A5. Critical Habitat for Grand Coulee Owl-clover near Osoyoos, British Columbia; the Mount Kobau Population corresponds with the “Mt. Kobau” population in the provincial recovery strategy.

PART 2: Recovery strategy for the Grand Coulee owl-clover (*Orthocarpus barbatus*) in British Columbia”, prepared by the Southern Interior Rare Plants Recovery Team for the B.C. Ministry of Environment

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

Prepared by the Southern Interior Rare Plants Recovery Team

BRITISH COLUMBIA
The Best Place on Earth

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>

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

Prepared by the Southern Interior Rare Plants Recovery Team

November 2007

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Additional copies

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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.

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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

The B.C. Ministry of Environment funded the preparation of the first draft of this report by. Further comments were provided by members of the Southern Interior Rare Plants Recovery Team.

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^2 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.

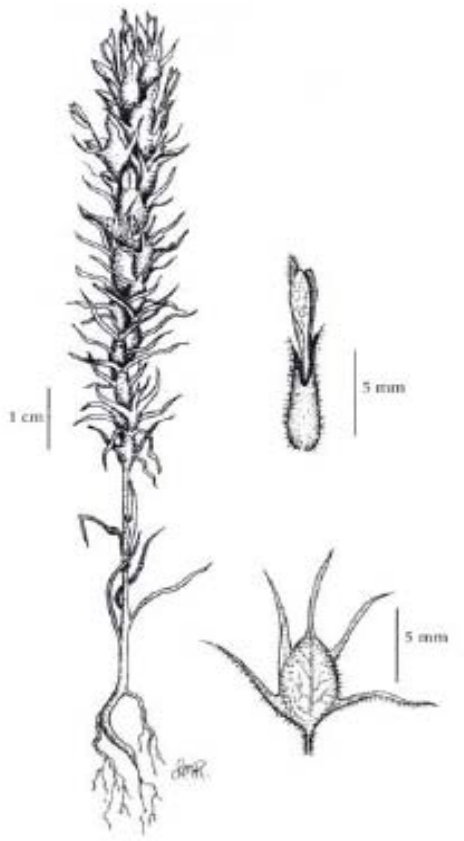

Figure 1. Illustration of *Orthocarpus barbatus.*
Plant habit (left), flower (top right) and characteristic bract subtending the flowers. (Line drawing by Lora May Richards in Pojar 2000; by permission.)

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

Location	Rank	Rank description
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).

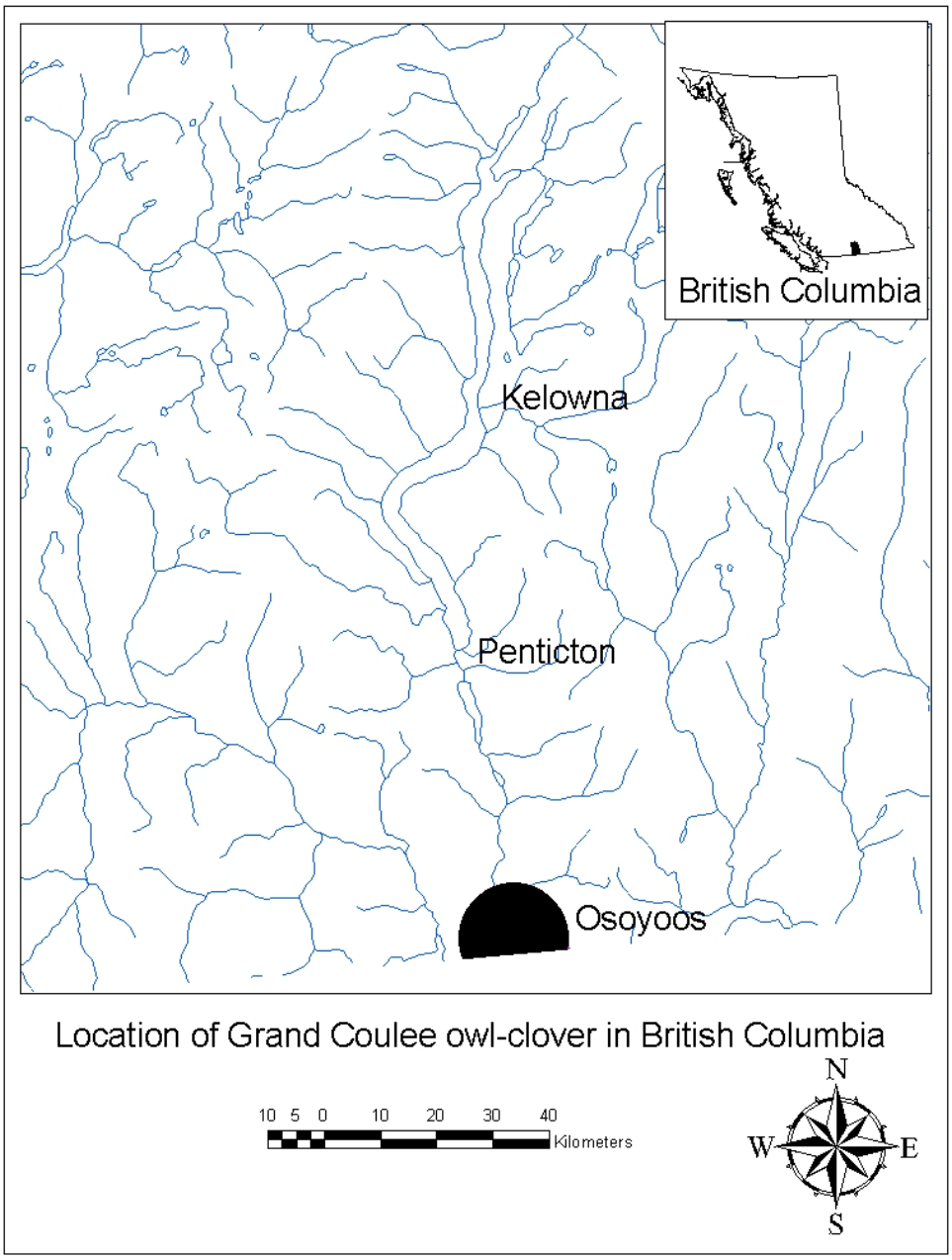

Figure 3. Distribution of Grand Coulee owl-clover in Canada.

Based on the most recent field visits, the extent of occurrence in Canada is about 86 km^2 (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 m² (2002)	Private
Mt. Kruger above racetrack	Five subpopulations between 153 and 4058 plants occupying ~282 m² (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 m²	Partially private and partially crown protected area
Mt. Kruger above golf course	Two subpopulations of 190 plants occupying an area of ~25 m² (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

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

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

Criteria	Feasibility
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[1] the five known populations of Grand Coulee owl-clover by 2012.

[1] 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.

2. To develop, by 2008, and implement a research program to determine the feasibility/necessity of population reintroduction by addressing knowledge gaps 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.

[1] 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.

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

Priority	Broad approach/ strategy	Threat	General description
Objective 1	Habitat and species protection	• Residential and recreational development • Agricultural development	• 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). • Establish protection for the 5 known populations.
Objective 1	Habitat stewardship	• Invasive plants • Grazing • Dispersed recreation activities	• Prepare Best Management Practices to support landowners in habitat stewardship activities. • Consider designation as an Identified Wildlife Management Species and prepare an Identified Wildlife Management Account for occurrences on Crown land subject to grazing. • Identify which private and public landowners have populations of Grand Coulee owl-clover on their lands. • Contact landowners through the landowner contact program of SOSCP. • Engage the cooperation of all involved landowners and land managers in habitat stewardship.
Objectives 1, 2	Research	• Demographic collapse • Invasive plants • Grazing	• Inventory habitat attributes for Grand Coulee owl-clover and identify important habitat attributes. • Determine whether bottlenecks are affecting pollination/reproduction, dispersal, seed production, recruitment, and recruit survival. • Determine minimum viable population size. • Determine appropriate restoration and adaptive management techniques for existing populations of Grand Coulee owl-clover and their habitat. • Develop techniques and priorities to establish new populations.

Priority	Broad approach/ strategy	Threat	General description
Objectives 1, 2, 3	Mapping and inventory	• Demographic collapse • Grazing • Invasive plants	• Identify and delineate critical habitat for the species. • Identify and prioritize areas for inventory. • Conduct inventory surveys to determine whether any populations are undocumented (i.e., to determine necessity of re-introductions). • Assess low elevation grasslands throughout the extent of occurrence to prioritize for establishment of new populations. • Monitor extant populations.
Objectives 1, 2	Population restoration	• Demographic collapse	• Increase the area of occupancy and abundance of existing populations above minimum viable population size if necessary. • Develop and implement a population restoration plan for locations with existing populations (including a monitoring component) if necessary. • Conduct trials for Grand Coulee owl-clover population establishment and augmentation. • If required, develop and implement a translocation plan to establish new populations of Grand Coulee owl-clover.
Objectives 1, 2	Public education and outreach	• Residential and recreational development • Invasive plants • Agricultural land development • Grazing • Dispersed recreation activities	• Increase public awareness of the existence and conservation value of Grand Coulee owl-clover and associated species at risk. • Develop priorities, in conjunction with SOSCP, to deliver public education and outreach concerning species at risk, and their habitats and management to key audiences.

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.

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