

Recovery Strategy for the Behr's Hairstreak (*Satyrium behrii*) in Canada

Behr's Hairstreak



2014



Recommended citation:

Environment Canada. 2014. Recovery Strategy for the Behr's Hairstreak (*Satyrium behrii*) in Canada [Proposed]. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. 26 pp. + Appendix.

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

Cover illustration: Neil K. Dawe

Également disponible en français sous le titre
« Programme de rétablissement du porte-queue de Behr (*Satyrium behrii*) au Canada [Proposition] »

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ISBN

Catalogue no.

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RECOVERY STRATEGY FOR THE BEHR'S HAIRSTREAK (*Satyrium behrii*) IN CANADA

2014

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 Behr's Hairstreak (*Satyrium behrii*) in British Columbia" (Part 2) under Section 44 of the *Species at Risk Act* (SARA). Environment Canada has included an addition which completes the SARA requirements for this recovery strategy.

The federal Recovery Strategy for the Behr's Hairstreak (*Satyrium behrii*) in Canada consists of two parts:

Part 1: Federal Addition to the "Recovery Strategy for Behr's Hairstreak (*Satyrium behrii*) in British Columbia", prepared by Environment Canada.

Part 2: "Recovery Strategy for Behr's Hairstreak (*Satyrium behrii*) in British Columbia", prepared by the Southern Interior Invertebrates Recovery Team for the British Columbia Ministry of Environment.

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**Part 1: Federal Addition to the “Recovery Strategy for
Behr’s Hairstreak (*Satyrium behrii*) 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.

The Minister of the Environment is the competent minister for the recovery of the Behr's Hairstreak and has prepared the federal component of this recovery strategy (Part 1), as per section 37 of SARA. It has been prepared in cooperation with the province of British Columbia. 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 Province of British Columbia provided the attached recovery strategy for the Behr's Hairstreak (Part 2) as science advice to the jurisdictions responsible for managing the species in British Columbia. It was prepared in cooperation with Environment Canada.

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 Behr's Hairstreak 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.

ACKNOWLEDGEMENTS

Many people are to be acknowledged for their involvement in the preparation of this federal recovery strategy addition. This document was prepared by Kella Sadler (Environment Canada, Canadian Wildlife Service (EC CWS) - Pacific and Yukon Region (PYR)) with the input of Dan Shervill (EC CWS-PYR) and Laura Parkinson. Substantial input and/or collaborative support was provided by Leah Westereng, Jennifer Heron, Bryn White, Orville Dyer, Mark Weston, Kirk Safford, and Jim Mottishaw (Government of British Columbia, Dennis St. John (Private Entomologist), Sylvie Desjardins (UBC Kelowna), Geoff Scudder (UBC), and Dennis Knopp (Private Consultant, Sardis). Richard Post, Amos Chow, Clare O'Brien and Sean Butler provided assistance with mapping and figure preparation.

ADDITIONS AND MODIFICATIONS TO THE ADOPTED DOCUMENT

The following sections have been included to address specific requirements of SARA that are not addressed in the "Recovery Strategy for Behr's Hairstreak (*Satyrrium behrii*) in British Columbia" (Part 2 of this document, referred to henceforth as "the provincial recovery strategy") and to provide updated or additional information.

1. COSEWIC Species Assessment Information

This section replaces the "Species Assessment Information from COSEWIC" section in the provincial recovery strategy.

Behr's Hairstreak was first designated as "Threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2000:

Species Assessment Information from COSEWIC (2000)

Date of Assessment: November 2000

Common Name (population): Behr's Hairstreak

Scientific Name: *Satyrrium behrii columbia*

COSEWIC Status: Threatened

Reason for Designation: This species occurs as scattered populations throughout its historic range and uses antelope-brush (*Purshia tridentata*) as its host plant. Significant portions of the *Purshia* habitat have already been lost and the remaining habitat is fragmented. Further habitat losses are expected.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated as Threatened by COSEWIC in November 2000.

Behr's Hairstreak was then re-assessed as "Endangered" (i.e., a higher risk category) by COSEWIC in 2012:

Species Assessment from COSEWIC (2012)

Date of Assessment: May 2012

Common Name (population): Behr's Hairstreak

Scientific Name: *Satyrium behrii*

COSEWIC Status: Endangered

Reason for Designation: This small butterfly is restricted to antelope-brush habitat in British Columbia, a habitat that has decreased considerably in extent in the past century and remains under threat due to land use change (conversion to viticulture, residential and commercial development) and the impact of fire. It rarely disperses much more than 120 m and persists in small, isolated fragments of habitat, which continue to decline in area and quality. Large annual fluctuations in population size, as documented for the largest Canadian population, increase the species' vulnerability and call into question its long term viability.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Threatened in November 2000. Status re-examined and designated Endangered in May 2012.

2. Species Status Information

Legal Status: SARA Schedule 1 (Threatened) (2003).

Table 1. Conservation Status of Behr's Hairstreak (from NatureServe 2013, BC Conservation Data Center 2013 and BC Conservation Framework 2013).

Global (G) Rank*	National (N) Rank*	Sub-national (S) Rank*	COSEWIC Designation	BC List	BC Conservation Framework
G5	Canada (N1) United States (N5)	Canada: British Columbia (S1); United States: Arizona (SNR), California (SNR), Colorado (S5), Idaho (SNR), Nevada (SNR), New Mexico (SNR), Oklahoma (S3?), Oregon (SNR), Texas (SNR), Utah (SNR), Washington (S5), Wyoming (SNR)	Endangered (2012)	Red List (Extirpated, Endangered, or Threatened)	Highest priority: 1, under Goal 3**

*Rank 1– critically imperiled; 2– imperiled; 3– vulnerable to extirpation or extinction; 4– apparently secure; 5– secure; H– possibly extirpated; NR – status not ranked

** The three goals of the BC 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%.

3. Recovery Feasibility

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

Recovery of the Behr's Hairstreak is considered technically and biologically feasible based on the following four criteria for assessing feasibility (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 individuals capable of reproduction available now to sustain the population and/or improve its abundance, present at multiple sites in the South Okanagan Valley. There are, however, knowledge gaps concerning population size, structure, and dispersal abilities at each site.

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

Yes, there is sufficient suitable habitat available to support the species. Behr's Hairstreak occurs in Antelope-brush (*Purshia tridentata*) grasslands in the south Okanagan Valley, primarily in the Antelope-brush/Needle-and-thread Grass plant community.

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

Yes. The primary threats can be mitigated through habitat protection measures and management of Antelope-brush habitat for the conservation of Behr's Hairstreak (including education on butterfly host plants, changes to livestock grazing regimes when deemed necessary, and introduced species control). Ensuring the connectivity and integrity of Antelope-brush grasslands is important to promote the long-term persistence of Behr's Hairstreak at each site.

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

Yes. Recovery techniques focus on mitigating primary threats (i.e., habitat conservation and management, as described above). Conducting further research to address knowledge gaps regarding the life history and habitat requirements of Behr's Hairstreak will facilitate prioritization of habitat for protection.

4. Population and Distribution Objective

This section replaces the "Recovery Goal" and "Rationale for Recovery Goal and Objectives" sections in the provincial recovery strategy.

Environment Canada has determined the Population and Distribution Objective for Behr's Hairstreak to be:

To ensure the persistence of Behr's Hairstreak at all known extant sites¹ (and any new sites) within the species' range in Canada.

Rationale:

Occurrence information for Behr's Hairstreak shows it is extant at seven known sites in Canada. There is one additional historical record at Penticton BC (year of observation, specific location, and current status unknown). The British Columbia Conservation Data Centre and NatureServe databases define "extant" as all observations made within the last 20 years, provided the habitat has not been substantially altered or degraded. Population numbers, including abundance trends, are unknown. Although preliminary population viability analyses have been completed (J. Heron, pers. comm. 2012), there is insufficient information to determine minimum population viability. Likewise, dispersal and re-colonization capabilities of Behr's Hairstreak are unknown, and detailed habitat and life history requirements are unclear. This species reaches the northern extent of its range in the south Okanagan Valley. 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 down-listing of the species, is not appropriate at this time. However, if additional naturally occurring populations are discovered, their persistence should also be ensured. Future population and distribution data may indicate that deliberate attempts to increase abundance would be warranted at one or more sites (for example, where either or both of abundance and/or species' range shows a documented decline).

¹ For the facility of description, sites are named after and based on the general geographical area in which Behr's Hairstreak is known to occur. Sites are defined to match the element occurrences (EOs) (NatureServe 2002) for Behr's Hairstreak determined by the B.C. Conservation Data Centre as closely as possible.

5. Broad Strategies and General Approaches to Meet Objectives: Recovery Planning Table

The approaches listed in the recovery planning table in the provincial recovery strategy Table 1 include specific steps towards addressing habitat protection, habitat management, inventory and monitoring, and research. In reference to these approaches, the points below amend this table to include additional details on information considered necessary to address knowledge gaps, for the purpose of meeting recovery objectives identified in this federal recovery strategy:

- In areas where vegetation surveys have not yet been completed, ground-truth areas delineated as “suitable habitat” to confirm whether or not biophysical attributes necessary to support Behr’s Hairstreak are present, and refine Terrestrial Ecosystem Mapping (TEM) classification type used to indicate “suitable habitat” so that representation of habitat quality for Behr’s Hairstreak is most optimal.
- Research the importance of topographical heterogeneity at the site scale as a component of habitat capable of supporting Behr’s Hairstreak.
- Identify shelter resources necessary to support Behr’s Hairstreak at all stages in its life-cycle.
- Identify movement capabilities and use of corridors for dispersal among sites, as components of sustaining connectivity, and genetic viability of Behr’s Hairstreak in Canada.
- Research the relationship between high and low elevation sites, i.e., investigate the potential for high elevation sites to act as sources for low-elevation sites, and characterize movement activities of Behr’s Hairstreak across elevation gradients.

6. Critical Habitat

6.1 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 2008 provincial recovery strategy for Behr’s Hairstreak does not include an identification of critical habitat, nor is it required in the provincial process. Critical habitat for Behr’s Hairstreak is identified in this document to the extent possible; more precise boundaries may be mapped, and additional critical habitat may be added in the future if additional research supports the inclusion of areas beyond those currently identified. Primary considerations in the identification of critical habitat include the amount, quality, and locations of habitat needed to achieve the population and distribution objectives.

Critical habitat for Behr's Hairstreak is identified at seven sites in British Columbia:

- 1) Kaleden (Figure A1): corresponds with BC CDC EO #11
- 2) Okanagan Falls (Figure A2), Vaseux Lake and McIntyre Bluff (Figure A3): corresponds with BC CDC EO #5
- 3) West of Oliver (Fairview) (Figure A4): corresponds with BC CDC EO #7
- 4) East of Oliver (Figure A5): corresponds with BC CDC EO #15
- 5) South of Oliver (Figure A6): corresponds with BC CDC EO #13
- 6) Osoyoos (Figure A7): corresponds with BC CDC EO #10
- 7) East of Osoyoos (Figure A8): corresponds with BC CDC EO #8

Critical habitat is only partially identified at four of the seven sites: Kaleden, Vaseux Lake and McIntyre Bluff, East of Oliver, and South of Oliver. Environment Canada will work with the applicable organizations to complete the identification of critical habitat at these four sites, as outlined in the schedule of studies (Section 6.2).

The areas containing critical habitat for Behr's Hairstreak are identified based on a combination of (1) all documented occurrences² (including data sets from the BC CDC, the recovery team and the Canadian Wildlife Service (CWS) collected between 2001 and 2013), (2) an estimate of the seasonal dispersal capabilities of adult Behr's Hairstreak butterflies, applied as a 600 m radius³ around each documented occurrence, and (3) selection of all suitable habitat within this occurrence radius. Plant communities containing >10% cover of Antelope-brush (*Purshia tridentata*) were selected as suitable habitat for Behr's Hairstreak (Iverson and Haney 2010), using Terrestrial Ecosystem Mapping (TEM). Ecosystem mapping units associated with individual occurrence records were considered inherently indicative of use by Behr's Hairstreak, and therefore included by default (i.e., regardless of proportion of Antelope-brush).

The biophysical attributes as detailed below summarize known essential elements for Behr's Hairstreak within the areas identified as containing critical habitat. These biophysical attributes are consistent with the habitat attributes outlined in the provincial recovery strategy, the COSEWIC status report (COSEWIC 2006), and other sources (Knopp et al. 2009; James and Nunnallee 2011). These attributes include: larval host plants, nectar host plants, and other structural elements essential for life cycle completion. Detailed information about the composition and spatial relationship of individual biophysical attributes required by Behr's Hairstreak at particular locations, and the relative amount, condition, and density of individual biophysical attributes within areas

² BC CDC occurrence records and/or any other additional occurrence records available.

³ Although there is limited dispersal measurement data available for Behr's Hairstreak, preliminary mark-recapture studies conducted at sites in the south Okanagan valley from 2004-2007 indicated a 100 m average seasonal dispersal (with some variation depending on climatic conditions during the flight season) and a 1200 m maximum dispersal distance (COSEWIC, 2012). The adult lifespan of Behr's Hairstreak is estimated at a minimum of 6 days. In absence of specific information, a daily movement distance of 100 m was considered to be a realistic precautionary estimate. Therefore the consensus of the British Columbia Southern Interior Invertebrates Recovery Team was to consider 600 m (i.e. 6 days x 100 m/day) as representing the best available information on the seasonal dispersal capabilities of Behr's Hairstreak, based on a combination of expert opinion, anecdotal observations, and estimated life-span of adult butterflies (Scott, 1973; S. Desjardins; J. Heron, pers. comm., 2012).

identified as containing critical habitat are currently unknown. The biophysical attributes described are identified as critical habitat wherever they occur within the area identified as containing critical habitat.

Larval Host Plants

Behr's Hairstreak uses Antelope-brush year-round, i.e., for completion of all life history stages. Antelope-brush is the only known larval host plant for Behr's Hairstreak in Canada. Inventory data and observations suggest that Behr's Hairstreak may prefer or require Antelope-brush plants 30 years or older, and/or of minimum size requirements (S. Desjardins, pers. comm. 2012; D. St. John, pers. comm. 2012). Adult butterflies lay their eggs singly on the leaves and branches of the Antelope-brush in the summer, and larvae emerge the following spring; not all plants are used every year (COSEWIC 2012). Behr's Hairstreak larvae have been observed pupating in cover adjacent to larval host plants in United States populations (James and Nunnallee 2011). Although the movement capabilities and/or patterns of Behr's Hairstreak larvae are not known, it is considered reasonable that they would not move farther than 5 m away from larval host plants⁴. As such, all Antelope-brush plants, and the soils/litter occurring within 5 m of these plants, is considered essential to Behr's Hairstreak.

Nectar Host Plants

During the flight period (typically late May to late July), Behr's Hairstreak uses one or more species as nectar host plants (proportion and availability varies by site). Known nectar host plants include: Common Yarrow (*Achillea millefolium*), Smooth Sumac (*Rhus glabra*), Grey Horsebrush (*Tetradymia canescens*), Buckwheat (*Eriogonum* sp.), Creambush Oceanspray (*Holodiscus discolor*), Tall Baby's-Breath (*Gypsophila paniculata*), Sweet-Clover (*Melilotus* sp.) and Fleabane (*Erigeron* sp.). It is suggested that Yarrow is the most important nectar source as it blooms throughout the flight period and is common and widespread (St. John and Bunge, 2003). Although Tall Baby's-Breath and Sweet-Clover are exotic plants in BC, these plants are already widespread and established (E-Flora, BC 2012) and may contribute to the habitat requirements of Behr's Hairstreak at some sites.

Structural Elements

During the flight period, various plants and other features are used by adult Behr's Hairstreak as structural elements for perching and mating, and potentially also for roosting and/or shelter (from exposure, and also predators – including camouflage). Wherever they exist at individual locations, the following features are considered important biophysical attributes of critical habitat: Antelope-brush plants, mature Ponderosa Pine (*Pinus ponderosa*) trees and/or other mature trees scattered within Antelope-brush grasslands, and standing water and any associated peripheral wetted areas. Mature trees can provide shelter from weather, temperature extremes and

⁴ Behr's Hairstreak may have a mutualistic association with ants, in which ants protect the larvae from predation, and the larvae excrete amino acids that the ants consume. Should this association exist in Canadian populations of Behr's Hairstreak, it would occur on or within 5m of host plant Antelope Brush, as this where the larvae would occur.

predators, and nocturnal roosting sites for adult butterflies, and may also facilitate movements within and between habitat patches (Thomas et al., 2011). The presence of water sources may provide important moisture and/or mineral resources for Behr's Hairstreak, and help ensure the continued presence of host plants, particularly in dry years (J. Heron, pers. comm. 2012, St. John and Desjardins 2003). Water-related elements identified as critical habitat include: puddles and/or other forms of standing water and the wetted areas around them, as well as the sources which may produce them (e.g., soil moisture, ephemeral wetlands, non- fish-bearing wetlands, creeks, streams, springs) and/or features where water may pool or form puddles (e.g., depressions, draws, gullies).

The areas containing critical habitat for Behr's Hairstreak are presented in Appendix 1 (Figures A1-A8). Critical habitat for Behr's Hairstreak in Canada occurs within the detailed yellow polygons (critical habitat units) shown on each map where the occurrence radius and habitat type criteria (i.e., TEM habitat mapping) described in this section are met, and where any of the known biophysical attributes exist. Unsuitable habitats such as forested areas without an Antelope-brush component, lakes (below lowest documented water line), anthropogenic features (including active trails, roads, and existing infrastructure such as buildings) do not possess the attributes required by Behr's Hairstreak and they are not identified as critical habitat. Detailed methods and decision-making processes relating to critical habitat identification are archived in a supporting document.

Dispersal and/or movement corridor habitat is that which is required for adult butterflies to move among sites, sub-sites or to unoccupied habitat. Connective habitat is important to prevent further fragmentation and isolation Behr's Hairstreak sites, as this butterfly will not disperse across unsuitable habitat. This species is thought to form a meta-population among Antelope-brush patches (COSEWIC, 2012) and connectivity between sites and sub-sites as facilitated by movement and/or dispersal corridors is thought to be an important factor needed to meet the population and distribution objective (S. Desjardins, pers. comm., 2012). It is recognized that the critical habitat identified above is insufficient to achieve the population and distribution objectives for Behr's Hairstreak because information that would allow for the identification of dispersal and/or movement corridors required by the species is not available at this time and further work is required to complete the identification of critical habitat at Kaleden, Vaseux Lake and McIntyre Bluff, East of Oliver, and South of Oliver sites.

The schedule of studies (Section 6.2) outlines the activities required to identify additional critical habitat necessary to support these objectives.

6.2 Schedule of Studies to Identify Critical Habitat

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

The following schedule of studies (Table 2) outlines the activities required to complete the identification of Behr's Hairstreak in Canada.

Table 2. Schedule of Studies to Identify Additional Critical Habitat.

Description of Activity	Outcome/Rationale	Timeline
Work cooperatively with applicable organizations to complete the identification of critical habitat for Behr's Hairstreak occurring at four sites: (1) Kaleden, (2) Vaseux Lake and McIntyre Bluff, (3) East of Oliver, and (4) South of Oliver, BC	This activity is required such that sufficient critical habitat is identified to meet the population and distribution objectives.	2014 - 2019
Determine movement activities and capabilities and dispersal requirements for Behr's Hairstreak	Movement /dispersal corridors will be included as a component of critical habitat identification, to support all extant sites of Behr's Hairstreak in Canada.	2014 - 2019

6.3 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 3 include those likely to cause destruction of critical habitat for Behr's Hairstreak; destructive activities are not limited to those listed.

Table 3. Activities likely to result in destruction of critical habitat for Behr's Hairstreak

Description of Activity	Description of effect (biophysical attribute or other)	Details and relationship to identified threats
Conversion of natural landscape (within the areas identified as containing critical habitat) for residential, commercial, industrial, recreational, and agricultural development.	Results in the direct loss of critical habitat through vegetation removal and replacement, debris deposition, soil disturbance and compaction, and/or related indirect effects which cause damage or destruction to biophysical attributes required by Behr's Hairstreak.	The primary threat to Behr's Hairstreak is identified as habitat loss, degradation, and fragmentation of Antelope-brush plant communities. This threat is severe, widespread, and continuous.
Fire management strategies that result in long-term fire suppression in Antelope-brush ecosystems, and/or human-caused fire resulting in destruction to existing biophysical attributes of critical habitat.	Continued active fire suppression results in long-term loss of Antelope-brush and associated grassland habitat due to tree encroachment, and alteration of plant community composition such that it no longer contains biophysical attributes required by Behr's Hairstreak. Conversely, where these biophysical attributes do exist, deliberate or accidental human-caused fire can result in their destruction.	Fire suppression by wildfire protection programs is an ecosystem-level threat to the persistence of Antelope-brush and associated grassland habitats in B.C. Where biophysical attributes required by Behr's Hairstreak do occur, local destruction by fire is a potential threat at all sites in Canada.
Grazing practices at any time of year that result in the damage or destruction of larval host plants; grazing practices in the non-dormant phase (March-September inclusive) that results in the destruction of nectar host plants and/or other structural elements identified as essential to the Behr's Hairstreak; grazing practices in the dormant phase (October-February inclusive) that results in compaction or removal of soils associated with larval host plants (within 5 m), permanent net loss of nectar host plants or structural elements, and/or creation of new exposed/disturbed trails or clearings.	Livestock use results in disturbance, removal, and/or compaction of vegetation and ground layer (via grazing or trampling), causing the loss of larval and nectar host plants, essential structural elements (e.g., adult perching plants) and damage to litter required by Behr's Hairstreak eggs and larvae. New disturbance can facilitate establishment of alien invasive species.	The primary threat to Behr's Hairstreak is identified as habitat loss, degradation, and fragmentation of Antelope-brush plant communities. This threat is severe, widespread, and continuous.

Description of Activity	Description of effect (biophysical attribute or other)	Details and relationship to identified threats
Any motorized recreational activities (e.g., ATVs or other vehicles) occurring outside of existing roads or trails, at any time and in all seasons; non-motorized recreational activities (e.g., foot traffic, mountain biking, and horse-back riding) occurring during the non-dormant phase (March-September inclusive) to the extent that larval host plants are damaged or destroyed, or to the extent that nectar host plants and/or other structural elements identified as essential to Behr's Hairstreak are destroyed; non-motorized recreational activities during the dormant period (October-February inclusive) that results in the damage or destruction of larval host plants and/or compaction or removal of associated soils (within 5 m); non-motorized recreational activities at any time of year that (individually, and/or cumulatively) results in the permanent net loss of nectar host plants, structural elements, and/or creation of new roads, trails or clearings.	Results in disturbance of local biophysical conditions, including direct physical damage to or loss of biophysical attributes required by Behr's Hairstreak. Activities may cause vegetation removal (impacting the availability of egg, larval and nectar host plants) and cause trampling or removal of soil and litter which may be required by Behr's Hairstreak larvae and pupae. New disturbance can facilitate establishment of alien invasive species.	The primary threat to Behr's Hairstreak is identified as habitat loss, degradation, and fragmentation of antelope-brush plant communities. This threat is severe, widespread, and continuous.
Introduction of alien invasive ⁵ species	Alien invasive species may cause destruction of habitat available to Behr's Hairstreak by making required biophysical attributes of critical habitat (larval host plants and nectar host plants, and/or required structural elements) functionally unavailable to Behr's Hairstreak, as a consequence of their physical occupation of space and resources.	Some alien invasive grasses may be deliberately introduced for range purposes.
Activities related to the control of invertebrate pests and/or invasive plant species (mechanical or chemical) that are not in accordance with provincial best management practices, where available. This may include on-site activities, and/or pesticide/herbicide drift from adjacent agricultural areas.	Efforts to control invertebrate pests or invasive plants through chemical means (pesticides or herbicides) or by physical means can result in destruction of critical habitat by degrading or removing biophysical attributes required for survival (as a consequence of weed-pulling), or microhabitat toxicity resulting from the application of pesticides and/or herbicides.	The primary threat to Behr's Hairstreak is identified as habitat loss, degradation, and fragmentation of antelope-brush plant communities. This threat is severe, widespread, and continuous.

⁵ Some of the known nectar host plants for Behr's Hairstreak are alien (non-native), i.e., Sweet-Clover, Tall Baby's-Breath. However, deliberate introduction of new alien plants including Sweet-Clover and Tall Baby's-Breath, and/or other alien plant species, would be considered an activity likely to destroy critical habitat. Given competitive advantage, alien species can become invasive (i.e., spread aggressively and cause competitive exclusion of natural habitats) within the Antelope-brush ecosystem.

The primary activity likely to result in the destruction of Behr's Hairstreak critical habitat is considered to be habitat loss by conversion of natural areas for residential, commercial, agricultural and industrial development. There has been a significant decline in the amount and quality of Antelope-brush/Needle-and-thread Grass habitat in the South Okanagan Valley since 1800; as a result, habitats which may support Behr's Hairstreak have become smaller and more fragmented within their historic range in B.C. Development pressure on Antelope-brush habitats in the South Okanagan valley is ongoing (Iverson 2010). Critical habitat may be further damaged by recreation activities that results in expansion of existing roads or trails, and/or creation of new roads, trails, or clearings within areas identified as containing critical habitat. Activities associated with the regular functioning and maintenance of existing roads or trails in these areas are not considered likely to result in the destruction of critical habitat.

In many areas where Behr's Hairstreak occurs, the land management plan and expectation is to suppress fire, which can contribute to the loss of critical habitat. Slow natural succession of pines and other native trees into open areas is ongoing due to long-term fire suppression. In the absence of regularly occurring fires, the size and extent of ecological communities (and associated biophysical attributes) required by Behr's Hairstreak has likely been reduced by tree encroachment at some locations, owing to shading and competition. Conversely, human-caused fires in areas where critical habitat for Behr's Hairstreak is present may result in local destruction of necessary biophysical attributes. Habitat fragmentation and land use have altered natural fire regimes and patterns in Antelope-brush and grassland communities of the south interior of BC. It is estimated that at least half of fires in the Okanagan valley are human-caused (e.g. 56% of fires in the Okanagan fire Zone from 2004-2013 were human-caused; at lower elevations in the Okanagan Valley as much as 80% human-caused) (J. Mottishaw pers. comm. 2014). Further, invasive plants may out-compete native nectar plants post-fire and result in long-term reduction in habitat suitability, unless there is successful deliberate seeding of native species. Therefore in this portion of its range, human-caused wildfire may be more likely to result in critical habitat destruction than fire suppression, depending on historical fire regimes, current land use pressures, local vegetation community characteristics, and the intensity of fire (M. Weston, pers. comm. 2013). Prescribed burning to achieve general thinning or fuel removal at sites (e.g., for maintenance of grassland and/or open forest ecosystems) must take into account the potential negative consequences of fire to Behr's Hairstreak, where semi-isolated populations and/or local biophysical attributes required by the species could be easily and/or irreparably devastated (D. St. John, pers. comm. 2014).

Cattle are present in all of the areas where Behr's Hairstreak has been found in BC. Inappropriate grazing practices resulting in deterioration of grassland (ecosystem) health (such as loss of composition, structure, site stability, etc.) are identified as an activity likely to impact or destroy critical habitat. It is unknown to what level actual stocking rates (and yearly implementation of rates), timing of use, length of use, will affect or impact habitat to the extent that critical habitat is lost. However, it is intuitive that inappropriate use of range with intensive grazing over long periods of time will impact the biophysical attributes necessary for Behr's Hairstreak. It is possible that some level of grazing may

not be detrimental to Behr's Hairstreak at some sites, e.g., where the occurrence, proportion, and abundance of larval and nectar host plants, and required structural elements are demonstrably maintained or increased under existing levels of livestock activity. Additional research is required to determine the grazing practices and/or threshold level(s) of grazing intensity that are consistent with ensuring the long-term persistence of biophysical attributes necessary for Behr's Hairstreak.

7. Statement on Action Plans

One or more action plans will be posted on the Species at Risk Public Registry by 2019.

8. Effects on the Environment and Other Species

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

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

The Antelope-brush/Needle-and-thread Grass plant community is a rare ecosystem in British Columbia (red-listed) and is globally ranked G2 or imperiled (BC Conservation Data Centre 2012). This rare plant community supports one of the highest densities of species at risk of any ecosystem in British Columbia (Iverson 2010); in addition to Behr's Hairstreak these habitats support at least 88 provincially-listed and at least 17 federally-listed species at risk (note some species of federal conservation concern are also provincially listed). Federally listed species at risk that may overlap with Behr's Hairstreak habitat include (but are not limited to): Pallid Bat (*Antrozous pallidus*), Mormon Metalmark – Southern Mountain Population (*Apodemia mormo*), Western Rattlesnake (*Crotalus oreganus*), Western Yellow-bellied Racer (*Coluber constrictor*), Great Basin Gophersnake (*Pituophis catenifer deserticola*), Tiger Salamander (*Ambystoma mavortium*), Great Basin Spadefoot (*Spea intermontana*), Wallis' Dark Saltflat Tiger Beetle (*Cicindela parowana wallisi*), Nuttall's Cottontail *nuttallii* subspecies (*Sylvilagus nuttallii nuttallii*), Lewis's Woodpecker (*Melanerpes lewis*), Short-rayed Alkali Aster (*Symphyotrichum frondosum*), Grand Coulee Owl-clover (*Orthocarpus barbatus*), Branched Phacelia (*Phacelia ramosissima*), Scarlet Ammannia (*Ammannia robusta*), Toothcup (*Rotala ramosior*), Small-flowered Lipocarpha (*Lipocarpha micrantha*), and Columbian Carpet Moss (*Bryoerythrophyllum columbianum*).

The recommended habitat conservation will indirectly benefit other species at risk in the area; increased public education and awareness may limit harmful recreational activities at these sites, and conservation actions to restore and protect grasslands ecosystems for Behr's Hairstreak are likely beneficial to all species that rely on these threatened ecosystems. Likewise, conservation actions underway or proposed to protect the other species at risk are likely beneficial to Behr's Hairstreak – a multi-species approach to conservation planning is recommended. 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 or pesticides, 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 via incidental creation of trails, or inadvertent dispersal of alien species during disposal), unless care is taken to avoid damage.

9. References

BC Conservation Data Centre. 2013. Species Summary: *Satyrium behrii*. BC Minist. of Environment. Available: <http://a100.gov.bc.ca/pub/eswp/> (accessed December 12, 2013).

BC Conservation Framework. 2013. Conservation Framework Summary: *Satyrium behrii*. BC Minist. of Environment. Available: <http://a100.gov.bc.ca/pub/eswp/> (accessed December 12, 2013).

COSEWIC. 2000. COSEWIC assessment and update status report on the Behr's (Columbia) Hairstreak *Satyrium behrii columbia* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. iv + 9 pp.

COSEWIC. 2012. In Press. COSEWIC assessment and status report on the Behr's Hairstreak *Satyrium behrii columbia* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 49 pp. (www.registrelep-sararetistry.gc.ca/default_e.cfm).

E-Flora BC. 2012. Electronic Atlas of the Flora of British Columbia. Available: <http://www.geog.ubc.ca/biodiversity/eflora/> (accessed July 23, 2012).

Government of Canada. 2009. *Species at Risk Act* Policies, Overarching Policy Framework [Draft]. *Species at Risk Act* Policy and Guidelines Series. Environment Canada. Ottawa. 38 pp.

Iverson, K. 2010. Ecosystem Status Report for *Purshia tridentata*/*Hesperostipa comata* Antelope-brush/Needle-and-thread Grass. Prepared for the BC Conservation Data Centre. 25 pp.

Iverson, K., and A. Haney. 2007. Updated Ecosystem Mapping for the South Okanagan Valley. Prepared for Ministry of Water, Land and Air Protection. 30 pp.

Iverson, K., and A. Haney. 2010. Refined and updated ecosystem mapping for the South Okanagan Valley and Lower Similkameen. Unpub. report prepared for the Regional District of the Okanagan Similkameen and South Okanagan – Similkameen Conservation Program.

James, D.G., and Nunnallee. 2011. Life histories of Cascadia butterflies. Oregon State University Press, Corvallis, OR.

NatureServe, 2002. Element Occurrence Data Standard. Available <http://www.natureserve.org/prodServices/eodata.jsp> (Accessed: November 5 2012)

NatureServe. 2013. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available <http://www.natureserve.org/explorer> (accessed December 12, 2013).

Scott, J.A. 1973. Life-span of Butterflies. Journal of Research on the Lepidoptera. 12(4) 225:23

St. John, D., and S. Bunge. 2003. Biogeography of Behr's hairstreak (*Satyrium behrii columbia* McDunnough 1944) in the South Okanagan. Part 1: inventory survey and mapping. Part 2: mark recapture study. Unpublished report. Okanagan University College, Kelowna, British Columbia. 18 pp.

Thomas, J.A., Simcox, D.J. and T. Hovestadt. 2011. Evidence based conservation of butterflies. Journal of Insect Conservation. 15: 241-258.

Appendix 1. Maps of Critical Habitat for Behr's Hairstreak in Canada

Critical habitat for Behr's Hairstreak has been identified at seven known extant sites in the South Okanagan Valley of British Columbia, Canada (Figures A1-A8). Critical habitat is only partially identified at four of these sites (i.e., Kaleden, Vaseux Lake and McIntyre Bluff, East of Oliver, and South of Oliver):

- 1) Kaleden (Figure A1): corresponds with BC CDC EO #11
- 2) Okanagan Falls (Figure A2), Vaseux Lake and McIntyre Bluff (Figure A3): corresponds with BC CDC EO #5
- 3) West of Oliver (Fairview) (Figure A4): corresponds with BC CDC EO #7
- 4) East of Oliver (Figure A5): corresponds with BC CDC EO #15
- 5) South of Oliver (Figure A6): corresponds with BC CDC EO #13
- 6) Osoyoos (Figure A7): corresponds with BC CDC EO #10
- 7) East of Osoyoos (Figure A8): corresponds with BC CDC EO #8

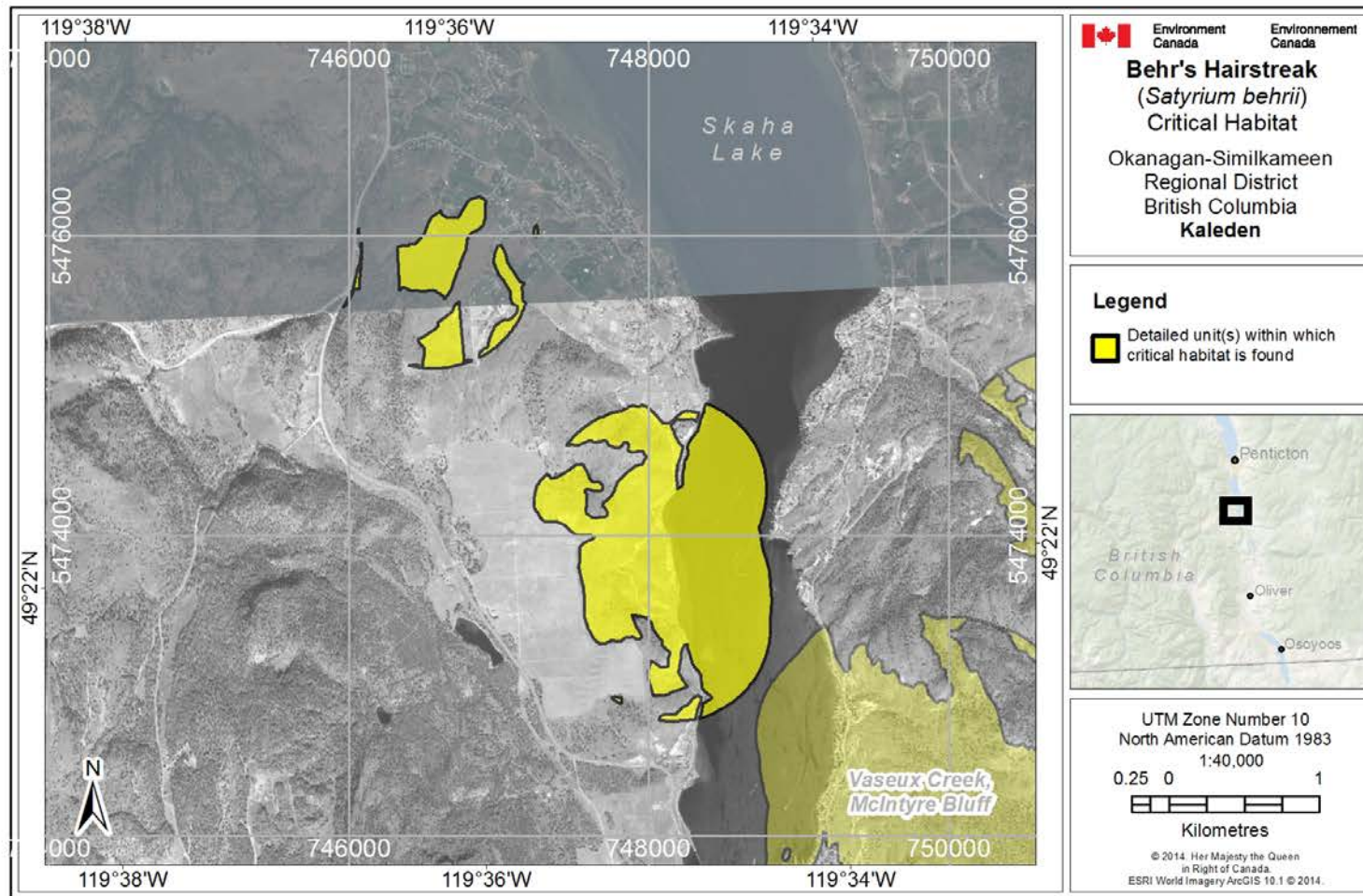


Figure A1. Critical habitat for Behr's Hairstreak at Kaleden, British Columbia (corresponds with BC CDC EO #11) is represented by the shaded yellow polygons (238.3 ha in total), where the criteria and methodology set out in Section 6.1 are met.

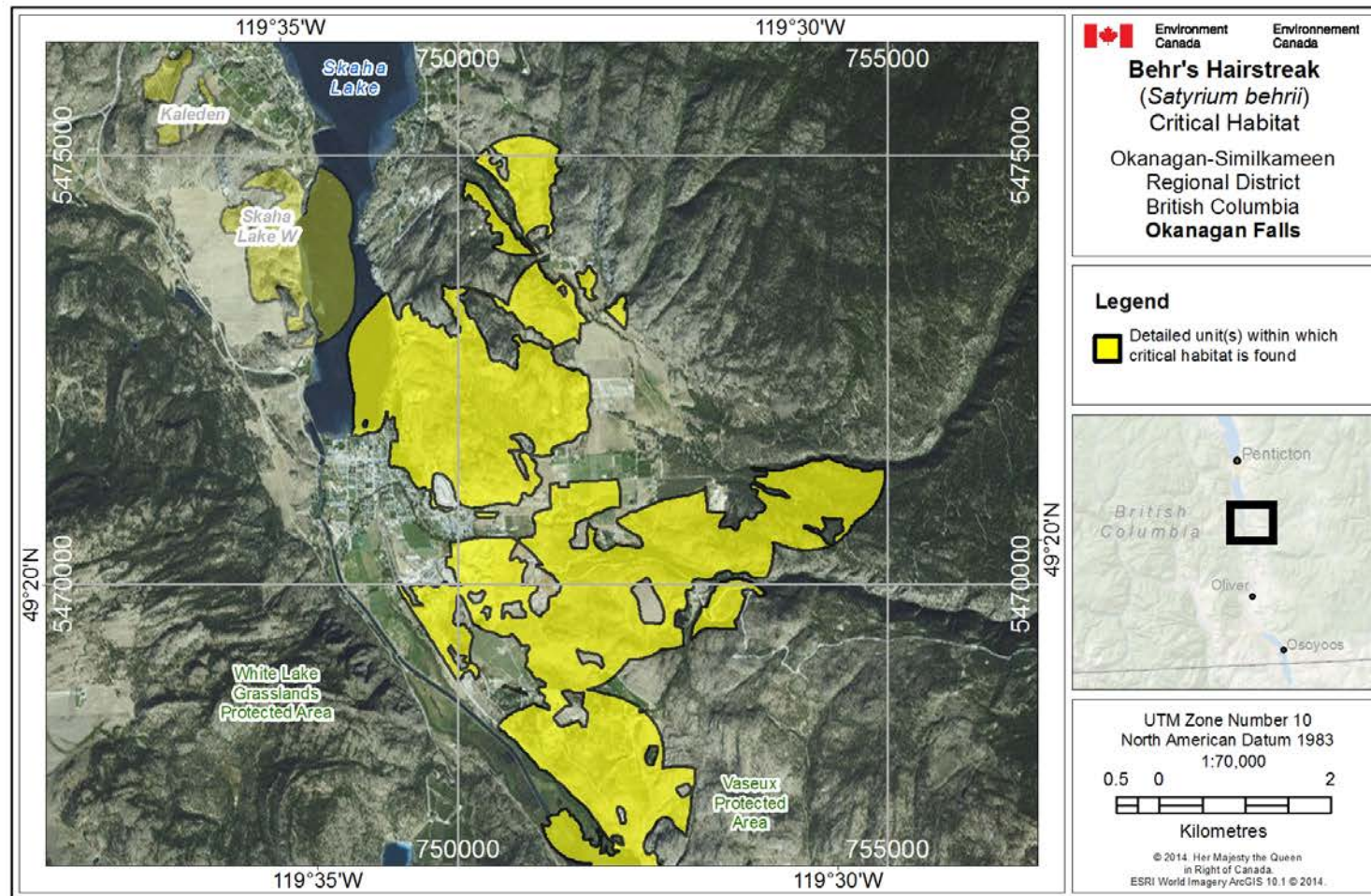


Figure A2. Critical habitat for Behr's Hairstreak at Okanagan Falls, British Columbia (corresponds with BC CDC EO #5) is represented by the shaded yellow polygons (1512.2 ha in total), where the criteria and methodology set out in Section 6.1 are met.

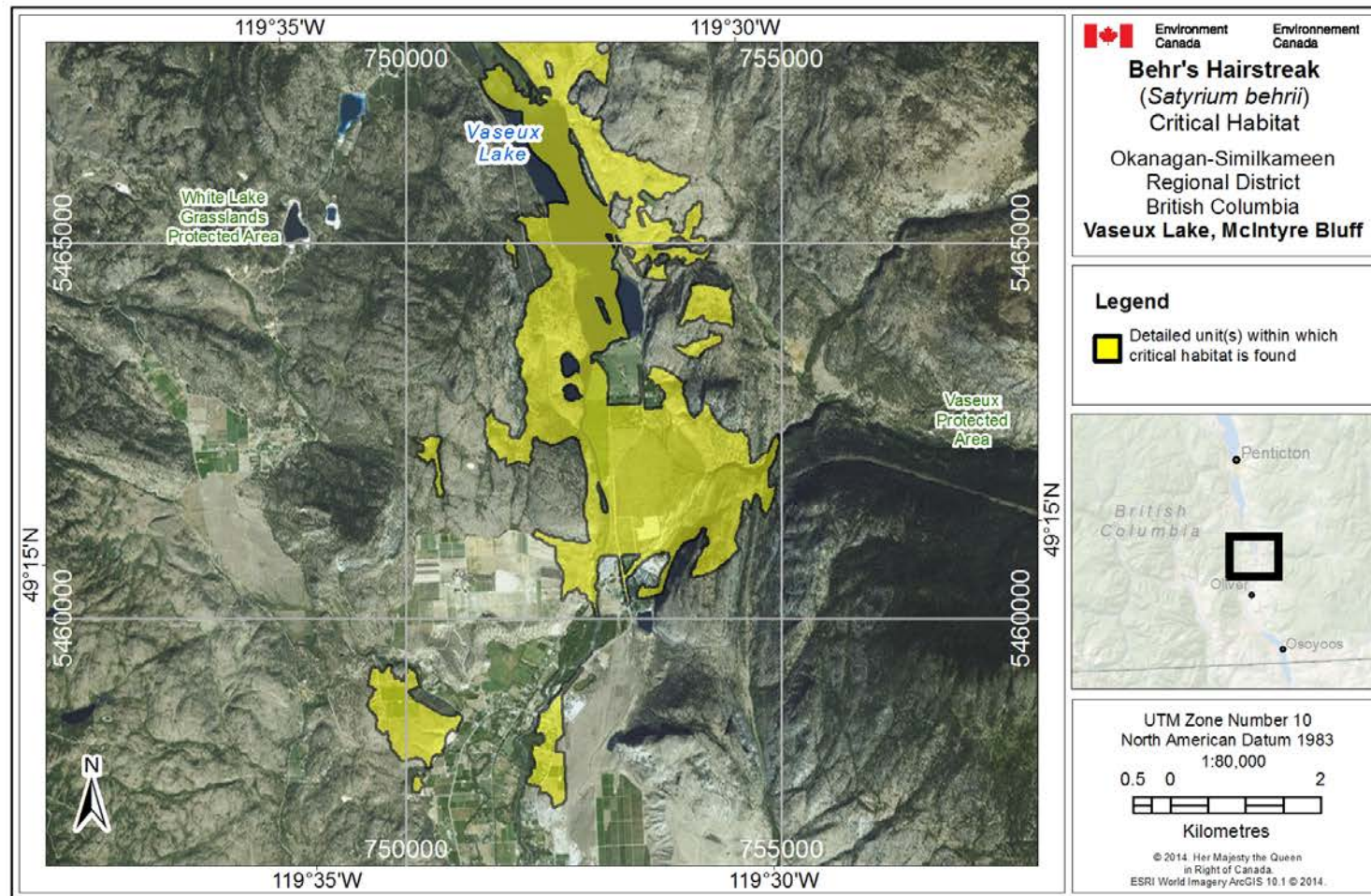


Figure A3. Critical habitat for Behr's Hairstreak at Vaseux Lake and McIntyre Bluff, British Columbia (corresponds with BC CDC EO #5) is represented by the shaded yellow polygons (1273.2 ha in total), where the criteria and methodology set out in Section 6.1 are met.

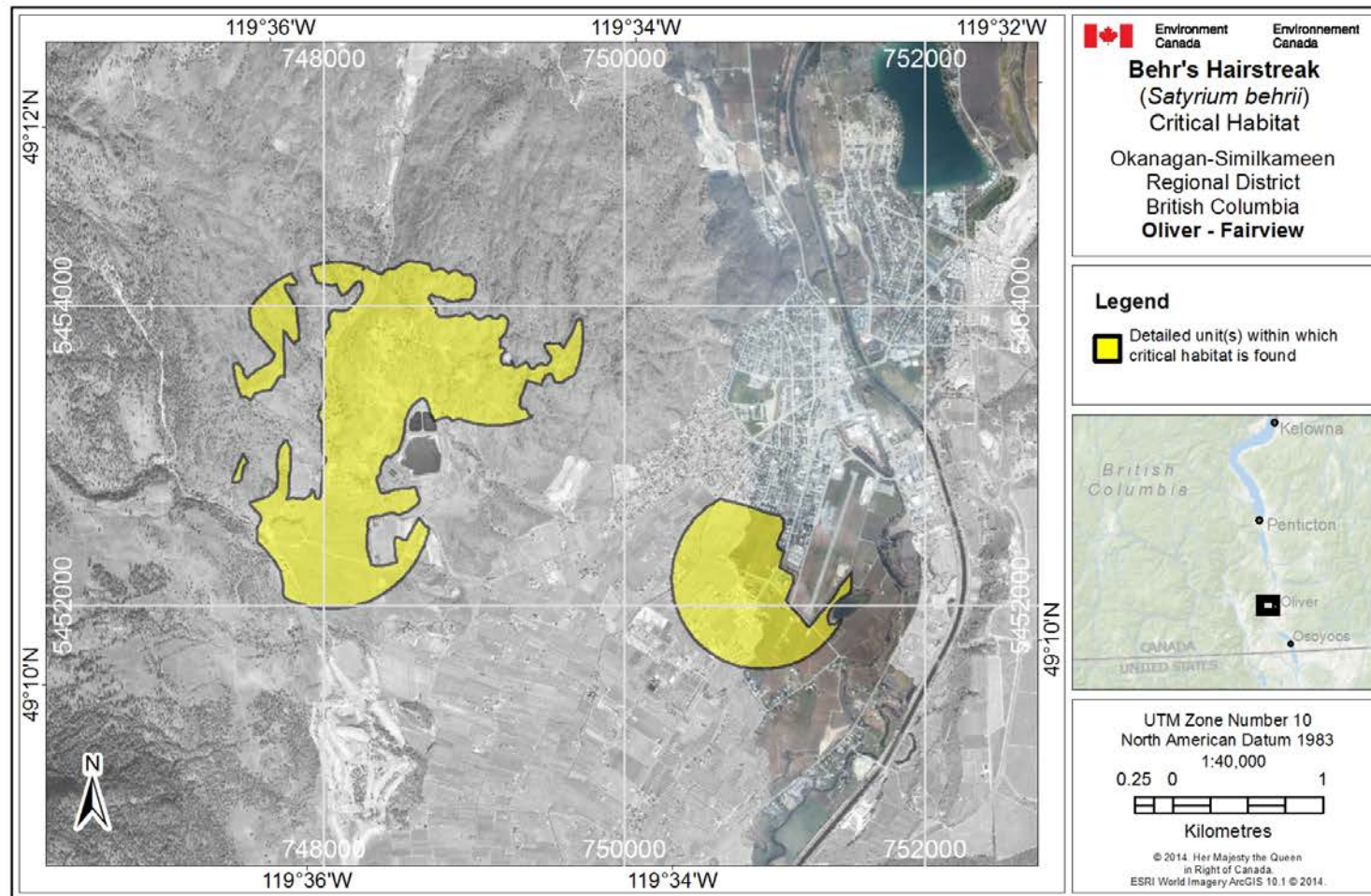


Figure A4. Critical habitat for Behr's Hairstreak at west Oliver - Fairview, British Columbia (corresponds with BC CDC EO #7) is represented by the shaded yellow polygons (306.3 ha in total), where the criteria and methodology set out in Section 6.1 are met.

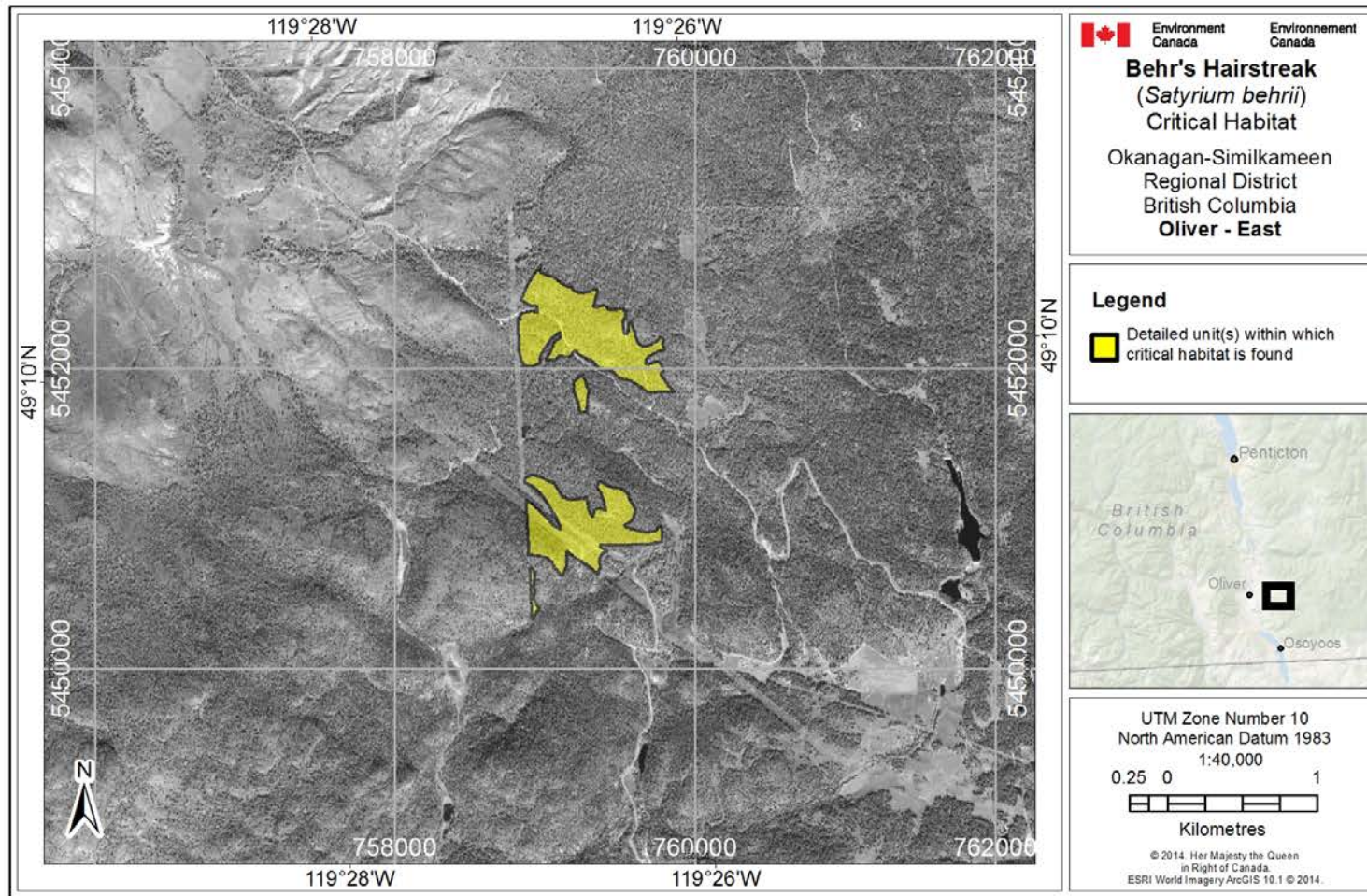


Figure A5. Critical habitat for Behr's Hairstreak at east Oliver, British Columbia (corresponds with BC CDC EO #15) is represented by the shaded yellow polygons (73.7 ha in total), where the criteria and methodology set out in Section 6.1 are met.

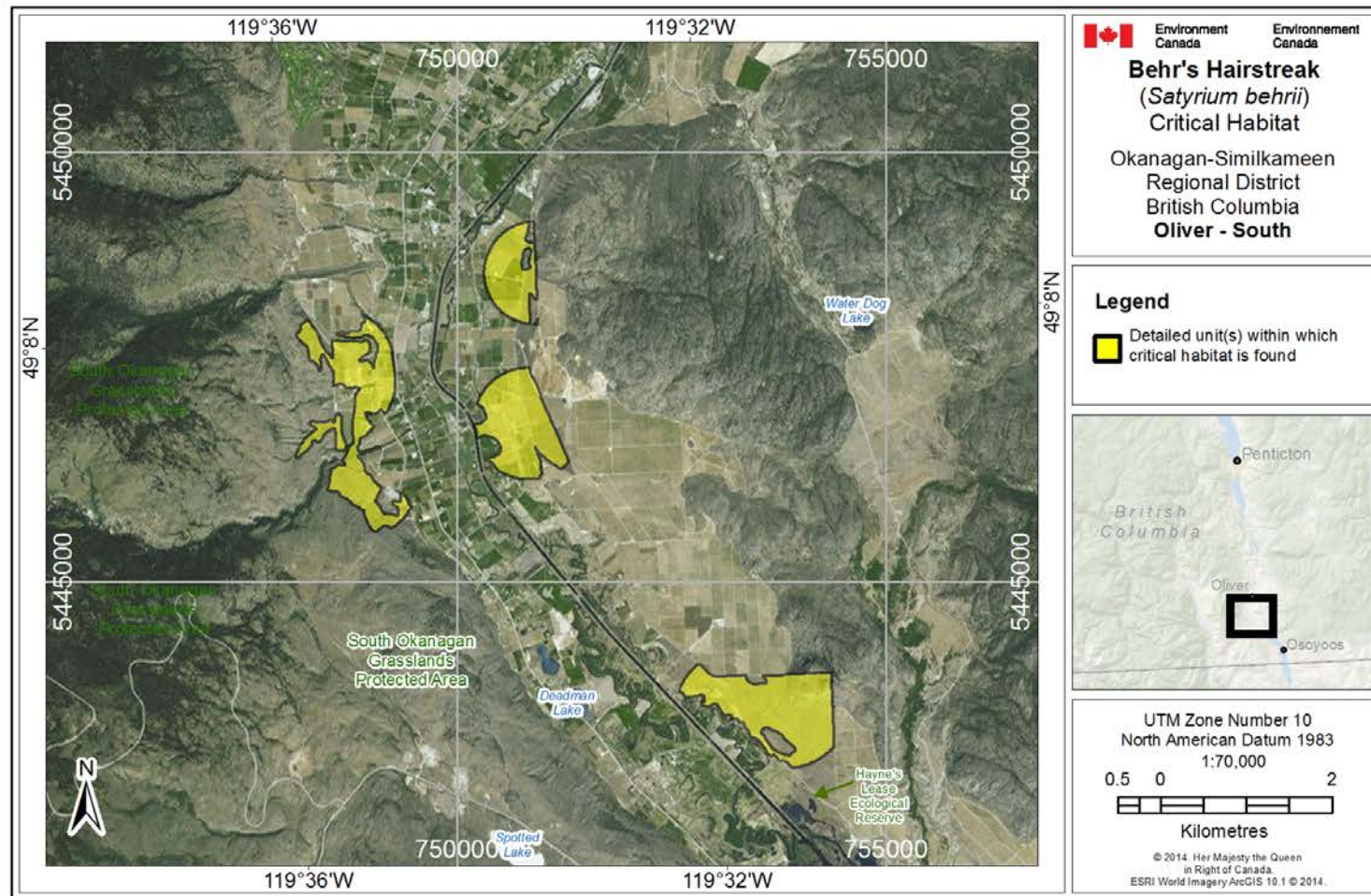


Figure A6. Critical habitat for Behr's Hairstreak south of Oliver, British Columbia (corresponds with BC CDC EO #13) is represented by the shaded yellow polygons (374.0 ha in total), where the criteria and methodology set out in Section 6.1 are met.

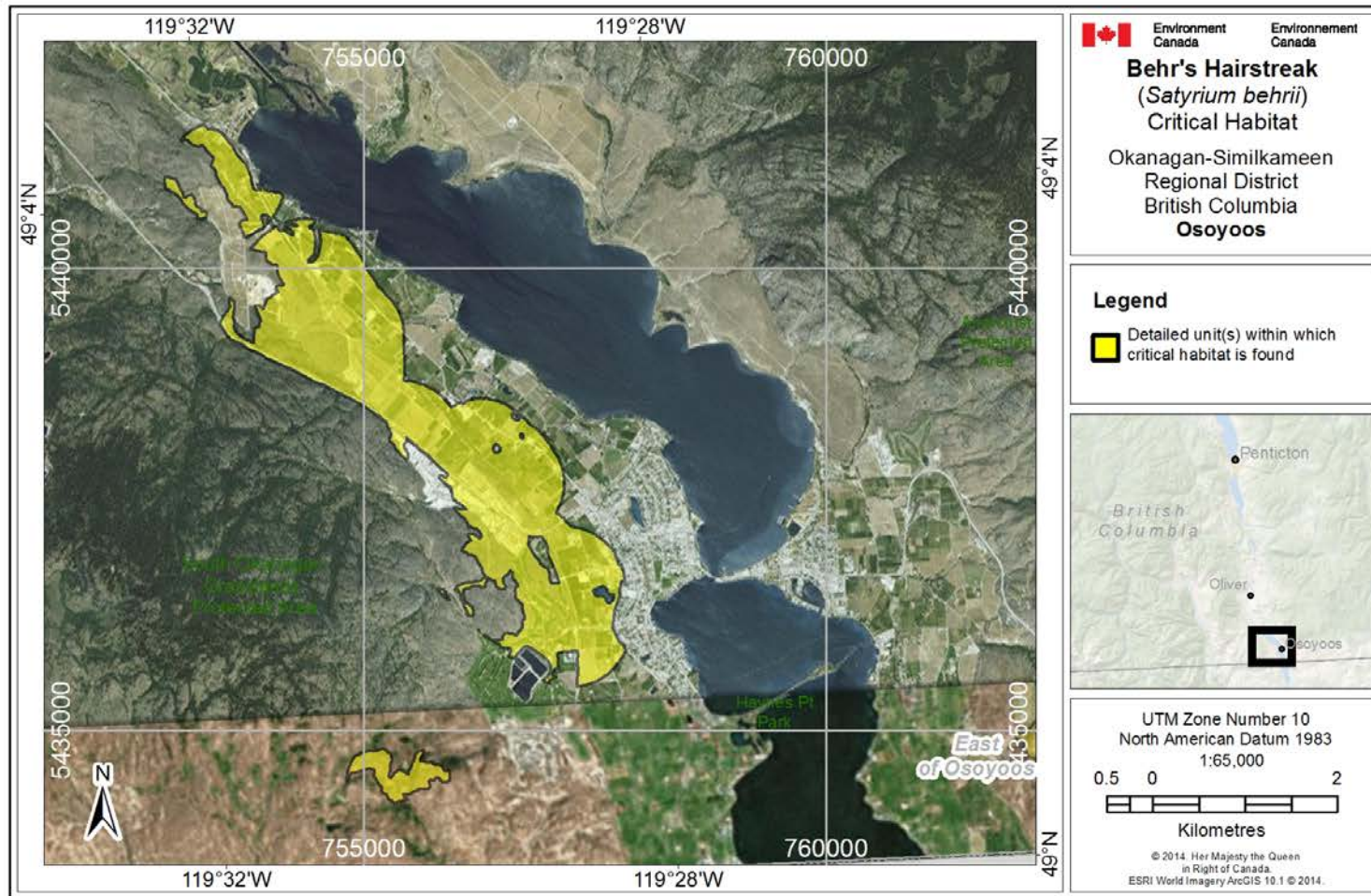


Figure A7. Critical habitat for Behr's Hairstreak at Osoyoos, British Columbia (corresponds with BC CDC EO #10) is represented by the shaded yellow polygons (682.5 ha in total), where the criteria and methodology set out in Section 6.1 are met.

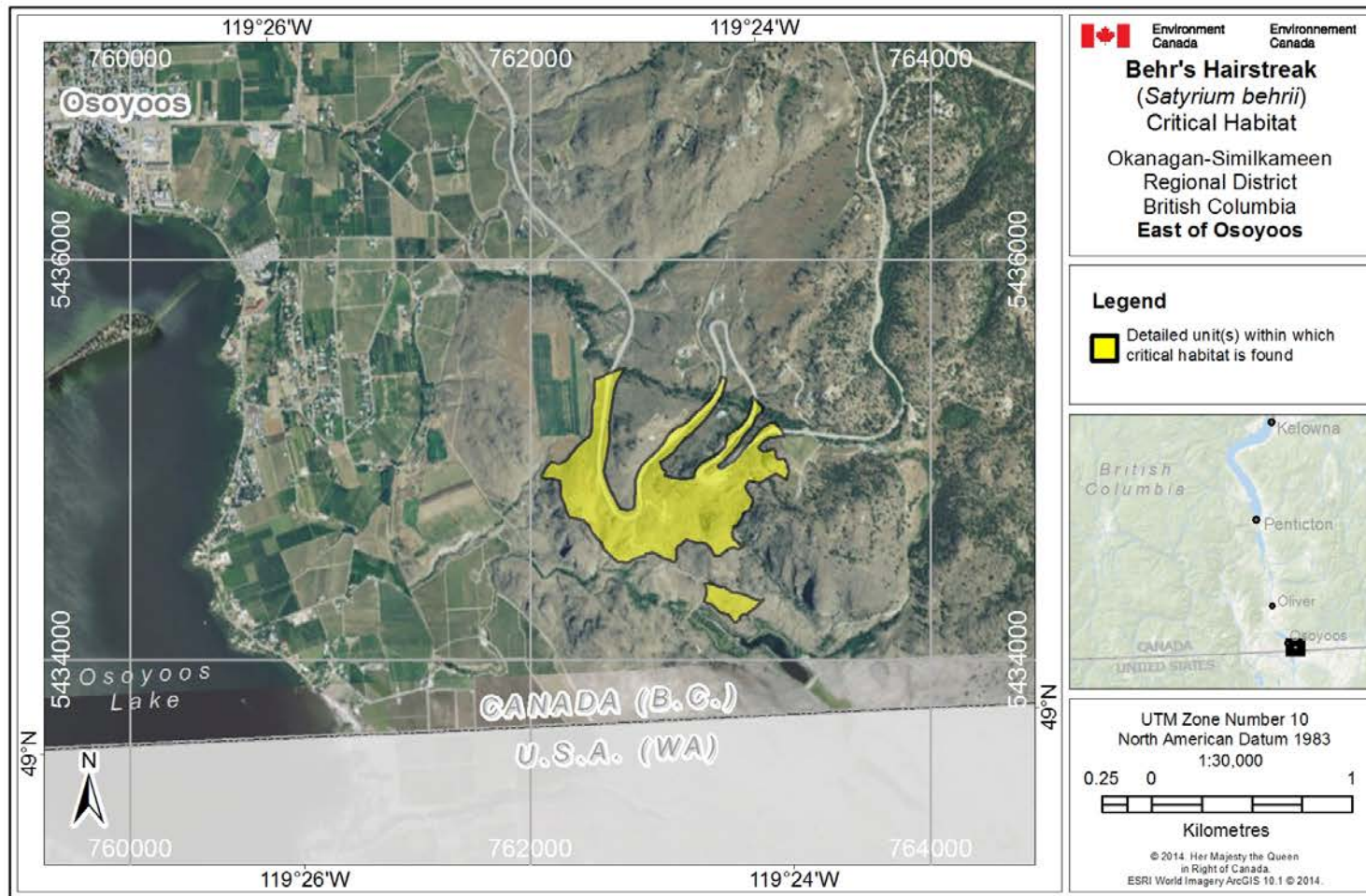


Figure A8. Critical habitat for Behr's Hairstreak at east Osoyoos, British Columbia (corresponds with BC CDC EO #8) is represented by the shaded yellow polygons (51.6 ha in total), where the criteria and methodology set out in Section 6.1 are met.

Part 2: "Recovery Strategy for Behr's Hairstreak (*Satyrium behrii*) in British Columbia", prepared by the Southern Interior Invertebrates Recovery Team for the British Columbia Ministry of Environment

Recovery Strategy for Behr's Hairstreak (*Satyrium behrii*) in British Columbia



Prepared by the Southern Interior Invertebrates Recovery Team



Ministry of
Environment

December 2008

About the British Columbia Recovery Strategy Series

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

What is recovery?

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

What is a recovery strategy?

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

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

What's next?

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

For more Information

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

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

**Recovery Strategy for Behr's Hairstreak (*Satyrium behrii*)
in British Columbia**

Prepared by the Southern Interior Invertebrates Recovery Team

December 2008

Recommended citation

Southern Interior Invertebrates Recovery Team. 2008. Recovery Strategy for Behr's Hairstreak (*Satyrium behrii*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 16 pp.

Cover illustration/photograph

Cover photograph taken by Bob Lincoln.

Additional copies

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

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

Publication Information

ISBN 978-0-7726-6105-0

Cataloguing in Publication: Pending

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Disclaimer

This recovery strategy has been prepared by the Southern Interior Invertebrates 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 their 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 Behr's Hairstreak 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 Behr's Hairstreak.

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RESPONSIBLE JURISDICTIONS

The British Columbia Ministry of Environment is responsible for producing a recovery strategy for Behr's Hairstreak under the *Accord for the Protection of Species at Risk in Canada*. Environment Canada's Canadian Wildlife Service and British Columbia Ministry of Forests and Range also participated in the preparation of this recovery strategy.

ACKNOWLEDGMENTS

This recovery strategy has been a collaborative effort by numerous individuals. Norbert Kondla wrote an earlier version of the strategy. Nick Page drafted the latest version of the recovery strategy. This version was revised by Orville Dyer, Jennifer Heron, and Bryn White. Dennis St. John, Sylvie Desjardins, Mike Sarell, and Howie Richardson contributed a substantial amount of data and scientific expertise to this recovery strategy. Dennis St. John and Sylvie Desjardins provided a scientific review. Bryn White, Crystal Klym, and Tricia Klein assisted with editing. Jeff Brown, David Toews, Laura Darling, and Tory Stevens provided additional comments on the final draft. We thank the recovery team and all contributors for their support and efforts to recover this species.

EXECUTIVE SUMMARY

Behr's Hairstreak (*Satyrrium behrii*) is a small butterfly (2.5 to 2.9 cm) with a flight period from early June through to early July. The dorsal wing surfaces have large, central, orange patches. The ventral wing surfaces are greyish brown base colour with a series of prominent dark spots bordered by white rings.

The Canadian range for Behr's Hairstreak is restricted to antelope-brush (*Purshia tridentata*) habitats in the south Okanagan valley of British Columbia (B.C.). The butterfly depends on its larval host-plant, antelope-brush, in association with nectar-plants such as yarrow (*Achillea millefolium*), smooth sumac (*Rhus glabra*), gray horsebrush (*Tetradymia canescens*), baby's breath (*Gypsophila paniculata*), sweet-clover (*Melilotus spp.*), oceanspray (*Holodiscus discolor*), and buckwheat (*Eriogonum spp.*). In Canada, Behr's Hairstreak is designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and listed by the Species at Risk Act (SARA) as Threatened due to habitat loss and fragmentation related to agricultural and urban development.

The recovery goal is to maintain a viable, well-distributed population of Behr's Hairstreak in protected habitats within the known range in British Columbia.

The Recovery Objectives (2009 to 2013) are to:

1. Protect a minimum of 820 hectares of Behr's Hairstreak habitat by 2013.
2. Replant a minimum of 10 hectares of burned antelope-brush habitat on existing conservation lands that were previously occupied by Behr's Hairstreak, by 2013.
3. Address knowledge gaps associated with habitat quality, threats, population size and annual fluctuation, dispersal barriers, larval and pupal ecology, and population viability by 2013.

Habitat protection may involve following best management practices for maintaining Behr's Hairstreak and its habitat, stewardship agreements, conservation covenants, eco-gifts, or sale of private lands by willing landowners, land use designations and management on Crown lands, and in federal, provincial, and local government protected areas. Habitat protection will overlap with the protection for other species at risk within the south Okanagan Valley.

For successful implementation of species at risk protection measures, there is a strong need for engaging stewardship activities on a variety of land tenures, including private and First Nations lands. Stewardship involves voluntary cooperation of all Canadians to protect species at risk and the ecosystems these species rely upon.

No critical habitat, as defined under the federal *Species at Risk Act* [S.2], is proposed for identification at this time. Critical habitat for Behr's Hairstreak may be identified at a later date in a federal addition by Environment Canada or in an action plan. A draft action plan will be ready for submission to the Province of B.C. by March 2013. This action plan will likely be a multi-species document because recovery actions are similar among species that depend on antelope-brush habitat.

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BACKGROUND

Species Assessment Information from COSEWIC

Date of Assessment: November 2000 (New)

Common Name (population): Behr's (Columbia) Hairstreak*

Scientific Name: *Satyrium behrii columbia*

COSEWIC Status: Threatened

Reason for Designation: This species occurs as scattered populations throughout its historic range and uses antelope-brush (*Purshia tridentata*) as its host plant. Significant portions of the *Purshia* habitat have already been lost and the remaining habitat is fragmented. Further habitat losses are expected.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated as *Threatened* by COSEWIC in November 2000.

Assessment based on a new status report.

* Common names reported in this recovery strategy follow the naming conventions used by the B.C. Conservation Data Centre, which may be different from common names reported by COSEWIC.

Description of the Species

Behr's Hairstreak (*Satyrium behrii*) is classified within Family *Lycaenidae* – gossamer wing butterflies, including coppers, hairstreaks, and blues. In Canada, Behr's Hairstreak is also known as Columbia Hairstreak which refers to the subspecies *columbia* described from Fairview, B.C. (Layberry *et al.* 1998). *Satyrium b. columbia* is the only Behr's Hairstreak subspecies in Canada and when reference is made throughout this document, it is to this subspecies only (see "Populations and Distribution"). Globally, there are two additional subspecies of Behr's Hairstreak, both within the United States, *Satyrium b. behrii* and *Satyrium b. crossii* (The International Lepidoptera Survey [TILS] 2005). In the United States Behr's Hairstreak is also known as Columbia Behr's Hairstreak (The International Lepidoptera Survey [TILS] 2005).

Behr's Hairstreak has four life stages: 1) egg; 2) numerous larval instars (larvae moult numerous times and are larger with each progressive moult); 3) chrysalis (the casing the larvae creates and encloses itself within which to complete metamorphosis); and 4) adult butterfly.

Key identification features for Behr's Hairstreak adults include a wide black margin surrounding large, central, orange patches on the dorsal wing surfaces (Figure 1). The internal edge of the dark margin is indistinct. The ventral surface of the forewing and hindwing have greyish brown base colour, darker near the body, with a row of prominent dark spots with white borders. The marginal line is black, bordered by a submarginal white line, and the wing fringe is grey. The butterfly is tailless. Sexes are similar although when compared side-by-side males are an overall darker tawny-orange and have distinct dark scent patches on the forewings. The wingspan is 2.5 to 2.9 cm.



Figure 1. Behr's Hairstreak adult dorsal wing surface (left) and adult ventral wing surface (right).

Behr's Hairstreak eggs are greenish white and laid singly on the leaves and branches of antelope-brush (*Purshia tridentata*) (Comstock 1928). The eggs turn white just prior to hatching.

Mature Behr's Hairstreak larvae are 1 to 1.5 cm in length, light green overall with a dorsal white line and darker green sides (Comstock 1928; Guppy and Shepard 2001). The dorsal segments of the larvae are ridged. Pale yellow or white shading/streaking on the crest of the abdominal segments of the larvae are present. Behr's Hairstreak chrysalis (cocoon or covering encasing the larvae and within which metamorphosis occurs) is light brown with dark brown speckles or patches and no discernable pattern. The chrysalis is attached to the antelope-brush stem using a silk patch (Guppy and Shepard 2001).

Behr's Hairstreak flight season is once per year from early June to mid-July, with a peak in mid-to late June depending on spring temperatures (COSEWIC 2000; Guppy and Shepard 2001; S. Desjardins, unpubl. data, 2007). Mating and egg-laying coincide with the flight season. Eggs are laid singly on the leaves and branches of the larval host plant antelope-brush and hatch the following spring (Emmel and Emmel 1973). Pupation appears to occur on antelope-brush and the pupa is attached to the stem or twigs using a silk patch (Guppy and Shepard 2001). For further habitat and host plant information, see "Habitat and biological needs".

Populations and Distribution

Globally, Behr's Hairstreak occurs from southern B.C. to southern California and New Mexico. Three subspecies of Behr's Hairstreak occur within North America (see "Description of the Species"). Within Canada, this species is found only in south-central B.C. within the southern portion of the Okanagan Valley (Figure 2). Less than 1% of the global distribution of Behr's Hairstreak is in Canada.

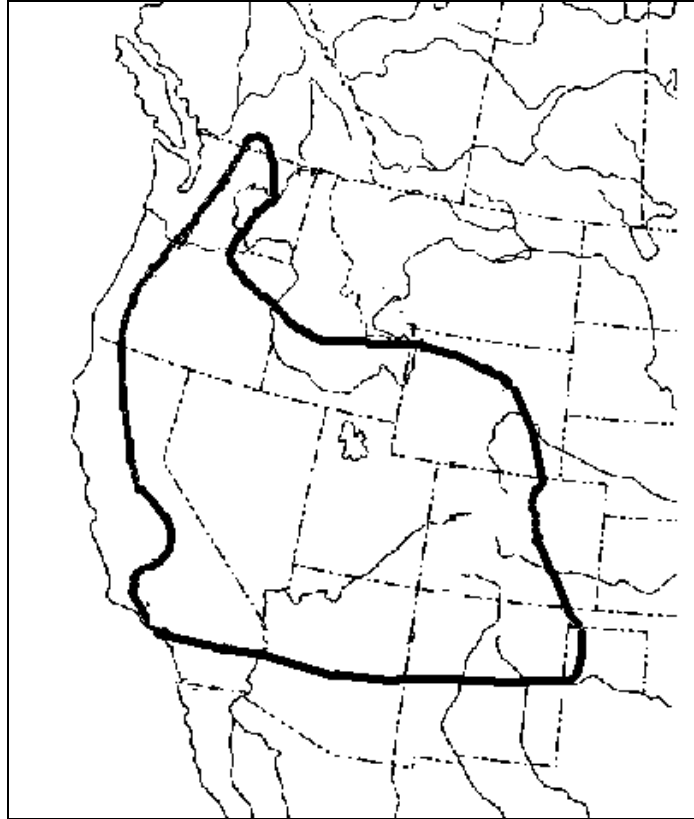


Figure 2. Global range of Behr's Hairstreak, *Satyrium behrii*.

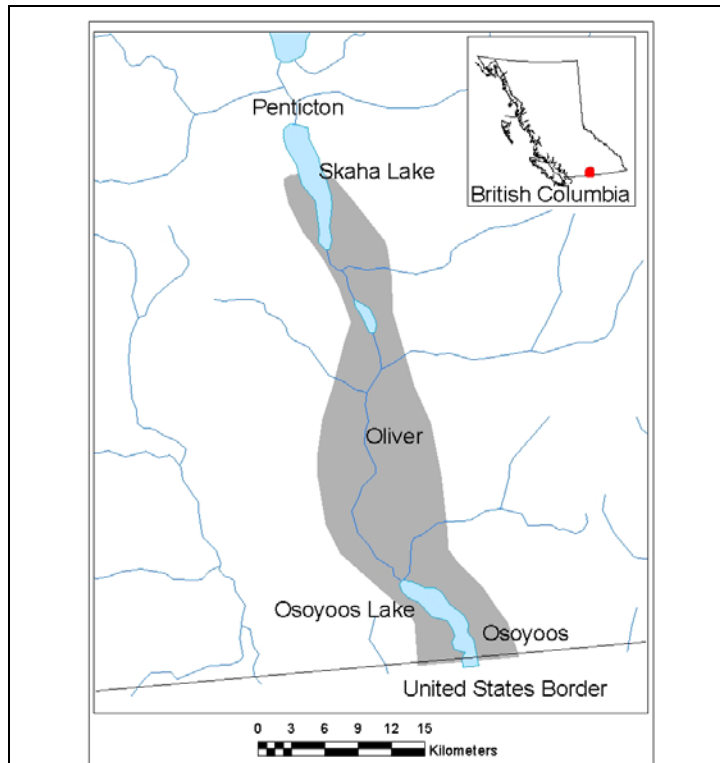


Figure 3. Canadian range of Behr's Hairstreak, *Satyrium behrii* confined to the south Okanagan valley in B.C. Distribution based on recent (past 50 years) records for the butterfly.

In Canada, Behr's Hairstreak occurs in antelope-brush habitats of the southern Okanagan Valley, from Penticton to the U.S. border (Guppy and Shepard 2001) (Figure 3). Little information is available on population numbers or size in B.C., although research is ongoing (S. Desjardins, pers. comm., 2005). Behr's Hairstreak is likely declining due to loss of the antelope-brush plant communities (Schluter *et al.* 1995; Lea 2001) that are necessary for their survival, although trend data are not available for the species. Lea (2008) estimates that 68% of the antelope-brush–needle-and-thread grass plant community in the Okanagan Valley has been lost to development.

Preliminary population viability analysis by Richardson (in prep.) has been completed, but results are not yet available. Results suggest that the current population is viable and will remain viable if a sufficient amount of quality habitat is protected and managed, particularly on the east side of the Okanagan Valley where habitat is less fragmented (H. Richardson, pers. comm., 2007).

Behr's Hairstreak has a global heritage rank of G5 (secure) (NatureServe 2008). The national rank in Canada is N1N2 (critically imperilled/imperilled) and in the United States is N5 (secure). In B.C., the species is ranked S2 (imperilled) (B.C. Conservation Data Centre 2008). It is designated SNR (not ranked) in Arizona, Idaho, Nevada, New Mexico, Oklahoma, Oregon, Texas, Utah, and Wyoming; S5 (secure) in Colorado and Washington; and S4 (apparently secure) in California (NatureServe 2008). Behr's Hairstreak is a priority 1 species under goal 3 of the B.C. Conservation Framework (see <http://www.env.gov.bc.ca/conservationframework/> for details).

Needs of Behr's Hairstreak

Habitat and biological needs

Behr's Hairstreak depends on plant communities dominated by its larval host-plant, antelope-brush. Correlations drawn from inventory data and observations suggest that plant communities with antelope-brush plants more than 30 years old may be more important for Behr's Hairstreak than are early-successional plant communities (S. Desjardins, pers. comm., 2005).

Behr's Hairstreak adults require flowering plants for nectar. The species obtains nectar from native and non-native flowering plants including yarrow (*Achillea millefolium*) (native), smooth sumac (*Rhus glabra*) (native), gray horsebrush (*Tetradymia canescens*), baby's breath (*Gypsophila paniculata*) (non-native), sweet-clover (*Melilotus sp.*) (native and non-native species), oceanspray (*Holodiscus discolor*) (native), and buckwheat (*Eriogonum spp.*) (native) (Pyle 2002; St. John and Bunge 2003). Observations suggest that yarrow is the most important nectar source in B.C. due to its widespread prevalence in antelope-brush communities and its prolonged flowering season (St. John and Bunge 2003).

Correlations from observations and inventory data suggest that Behr's Hairstreak adults may require sparse tree cover, particularly ponderosa pine (*Pinus ponderosa*), for shelter during inclement weather, daytime temperature extremes, and night-time resting (S. Desjardins, pers. comm., 2007). Other factors that may increase habitat quality include the presence of puddling sites (mud puddles where adult butterflies obtain moisture and salt, thus preventing dehydration). The chemical composition of antelope-brush may have an influence on larval ecology of Behr's

Hairstreak, because the plant is important for other vertebrate and invertebrate herbivores (Young and Clements 2002).

Possible mutualistic associations between ants and Behr's Hairstreak may be important for supporting populations of the butterfly (Ballmer and Pratt 1992; Pierce *et al.* 2002). St. John and Bunge (2003) hypothesize that habitat quality may relate to the presence of specific ant species. Harvester ants (*Pogonomyrmex* spp.) are known to be important for antelope-brush habitats. Ants help to create seed-caching mounds and unique plant communities (Young and Clements 2002) that may be of importance to Behr's Hairstreak presence. Like many members of the *Lycaenid* family, Behr's Hairstreak larvae have specialized organs that secrete amino acids that attract ants (Ballmer and Pratt 1988). Based on studies from Behr's Hairstreak populations in California, Ballmer and Pratt (1992) suggest that the larvae are myrmecophilous—larvae have an association with one or more ant species in which the ants protect the larvae from parasites and parasitoids, and in return the larvae provide the ants with food (amino acids secreted from specialized glands) (Fraser *et al.* 2001). However, it is unknown whether these relationships are mutualistic or facultative (benefit from ants but do not require them) (Ballmer and Pratt 1992).

The area of antelope-brush (and other habitat components) necessary to sustain a population of Behr's Hairstreak is unknown. The butterfly likely forms a metapopulation structure among numerous habitat patches, and in some years may only utilize a portion of an apparently suitable antelope-brush patch. These dispersal and recolonization processes are poorly understood.

Ecological role

Behr's Hairstreak is a focal species for the conservation of B.C.'s native antelope-brush grasslands of the southern Okanagan. The species is not considered an essential pollinator of its larval or adult host plants, yet cumulative pollination by many species is essential to overall ecosystem health. Behr's Hairstreak is not known to have significant ecological roles such as food-web dynamics, although it is likely predated upon by small mammals, invertebrate predators, bats, and birds.

Behr's Hairstreak may have a mutualistic association with ants (St. John and Bunge 2003). Ants may be important for Behr's Hairstreak through mutual relationships where the ants protect larvae from predation, and the larvae excrete amino acids that ants consume (Ballmer and Pratt, 1992; Pierce *et al.*, 2002). Harvester ants are known to collect and disperse antelope-brush seeds and they create caches of antelope-brush seeds (Young and Clements 2002). Ants are an important ecological component of arthropod fauna within B.C. grassland environments, contributing to the functioning of an ecosystem not only in their biomass and species richness, but also as soil engineers, seed dispersers, foragers, and scavengers (Hölldobler and Wilson 1990; Folgarait 1998). The effect ants have on other invertebrates in an ecosystem can be drastic and their influences on soil and organic decomposition are significant (Hölldobler and Wilson 1990).

Limiting factors

The main limiting factor for the Behr's Hairstreak is its larval host plant, antelope-brush. Antelope-brush is the species' only known larval host plant, and without this plant the butterfly is unable to complete its life cycle. The age structure of antelope-brush plants and the presence of trees or shrubs may also limit population size at a given location (S. Desjardins, pers. comm., 2006). There is a high correlation between the number of Behr's Hairstreak adults observed and the age of the antelope-brush community: more are found in communities older than 30 years (S. Desjardins, pers. data, 2007).

Behr's Hairstreak adults have a limited number of nectar host plants due to their morphology: the species has a short proboscis (tongue) (D. St. John, pers. data, 2004). The short proboscis means that the adults cannot obtain nectar from flowering plants that have a deep corolla (nectar is at the base of the corolla, inside the flower).

The distribution, abundance, and flowering period of nectar plants may affect Behr's Hairstreak occupancy at antelope-brush locations. Low spring temperatures and/or spring rains may adversely affect early instar larvae (S. Desjardins, pers. comm., 2006), and the impact may be more severe in Canada because the species is at the northern extent of its range.

Behr's Hairstreak adults have limited dispersal capabilities. In the Okanagan Valley, Desjardins (in prep.) documented average dispersal distances of 120 m in 2005 (during warm and dry spring weather) and 80 m in 2006 (cool and rainy spring weather), with a maximum dispersal of 1.2 km (one individual). These observations suggest that recolonization of habitat patches is negatively correlated with an increasingly fragmented landscape (S. Desjardins, in prep.; H. Richardson, in prep.). The probability of recolonization and population numbers at a location likely declines with the frequency and amplitude of stochastic events.

Threats

(in order of importance)

1) Habitat loss or degradation

The primary threat to Behr's Hairstreak is habitat loss, degradation, and fragmentation of antelope-brush plant communities. The larvae depend exclusively on antelope-brush and without this plant the species cannot complete its life cycle. This threat is severe, widespread, and continuous. Approximately 68% of the antelope-brush – needle-and-thread grass plant community within the known range of Behr's Hairstreak in B.C. has been destroyed by agricultural and urban development (Lea 2008). Between 1995 and 2001, the rate of antelope-brush habitat loss was 2% of the remaining habitat per year. This rate increased to 4% per year between 2001 and 2003, and the increase is ongoing, primarily due to agricultural development associated with new vineyards (O. Dyer, pers. comm., 2004). Preliminary results from population viability modelling demonstrate that as fragmentation of antelope-brush plant communities increases, re-occupancy rates after stochastic events decrease, because of the species' poor dispersal capabilities (H. Richardson, in prep.).

2) Ecological dynamics and natural processes

Alteration of the natural fire regime by wildfire protection and suppression programs appears to have increased fire intensity. Wildfires were likely once more common throughout antelope-brush habitats (Young and Clements 2002). Fire suppression results in large stand-replacing fires rather than small less intense surface and patchy fires that otherwise leave patches of the antelope-brush plant community intact. Tree encroachment, in the absence of frequent fire, has likely reduced the size and extent of antelope-brush plants at some sites due to shading and competition. These threats are localized, ongoing, and of moderate severity.

3) Exotic species

Many introduced, invasive plants occur throughout antelope-brush ecosystems, including cheatgrass (*Bromus tectorum*), sulphur cinquefoil (*Potentilla recta*), diffuse knapweed (*Centaurea diffusa*), and Dalmatian toadflax (*Linaria genistifolia* ssp. *dalmatica* L.). Some species, such as sulphur cinquefoil which can form monocultures, may out-compete Behr's Hairstreak nectar host plants and prevent re-establishment of antelope-brush after wildfires. This threat is widespread and ongoing because there are exotic plant species in all sites where Behr's Hairstreak is known to occur. The severity and causal certainty are unclear and require research; the presence of these plants in low numbers does not appear to affect Behr's Hairstreak populations, although should exotic plant densities increase, cumulative impacts could be detrimental.

Parasitic Tachinid flies (Family Tachinidae) have been introduced as a biological control agent for the European Gypsy Moth. These flies are known to have a detrimental effect on all Lepidoptera. Currently, these flies are only introduced in eastern United States and Canada, but they are considered a potential threat to Behr's Hairstreak populations if they establish in interior B.C. There is a possibility these species could be introduced to western North America through natural dispersal mechanisms or intentionally for biological control, so they have been identified as potential threats.

4) Climate and natural disasters

Climate change is a potential but poorly understood threat to Behr's Hairstreak. The climate envelope suitable for antelope-brush growth could potentially increase as a result of climate change (R. Hebda, pers. comm., 2004), which could dramatically increase the range where antelope-brush could theoretically grow. However, current rates of habitat loss and fragmentation within the known range and barriers to antelope-brush seed dispersal and Behr's Hairstreak dispersal are likely to prevent natural expansion of both the antelope-brush plant community and Behr's Hairstreak. Climate change may increase summer drought in southern B.C., potentially resulting in premature senescence of larval and nectar host plants, or may change rain patterns during the larval period, potentially reducing juvenile survival. Additional research is required.

5) Pollution

Pesticide drift from adjacent agricultural areas may detrimentally affect Behr's Hairstreak through direct mortality at localized sites, but impacts are not documented. Herbicide treatments for invasive plants may affect non-target species including antelope-brush and nectar host plants. Impacts to Behr's Hairstreak are not understood, but are likely localized and may be reduced through improved Integrated Pest Management techniques.

6) Accidental mortality

The eggs and larvae of Behr's Hairstreak may be subject to direct mortality or damage by browsing animals. Mule Deer (*Odocoileus hemionus*), California Bighorn Sheep (*Ovis canadensis*) and domestic cattle browse antelope-brush in the south Okanagan (Krannitz 2000). The effect of browsing on Behr's Hairstreak is unknown.

Actions Already Completed or Underway

- Inventory, mapping, and monitoring
 - Inventory and monitoring programs on Crown land (provincial and federal), since 2003.
 - Antelope-brush ecosystems mapped by B.C. Ministry of Environment (2007).
- Public outreach and stewardship
 - Interpretive public education programs through the Osoyoos Desert Centre (Osoyoos), Nk'Mip Desert Cultural Centre (Osoyoos), Okanagan Similkameen Conservation Alliance (Penticton), and annual Meadowlark Festival (Penticton) since 2003. These programs aim to increase awareness and support for antelope-brush and Behr's Hairstreak conservation.
 - South Okanagan Similkameen Conservation Program, established in 2000; a partnership of 41 government and non-government organizations dedicated to conservation of biodiversity in the region. Promotes antelope-brush and Behr's Hairstreak conservation through their partners.
 - A stewardship program involving landowner contact to private lands with antelope-brush; program ongoing since the early 1990s through The Land Conservancy and South Okanagan Similkameen Conservation Program, Stewardship Program.
- Habitat protection
 - Approximately 290 ha of antelope-brush–needle-and-thread grass plant community protected in provincial and federal protected areas.
 - Approximately 250 ha of antelope-brush habitat protected by The Nature Trust of B.C. through partnerships with the Habitat Conservation Trust Foundation, Fortis, and other groups.
- Research
 - Behr's Hairstreak habitat use, demographics, dispersal, and population genetics (since 2005). Research by Sylvie Desjardins, University of British Columbia, Okanagan.
 - Behr's Hairstreak population viability analysis, to model long-term persistence within the south Okanagan antelope-brush habitats (since 2007). Research by Howie Richardson, Okanagan College.

Knowledge Gaps

1. Qualitative habitat measures to support Behr's Hairstreak populations at a given location; age structure of antelope-brush; shelter tree and host plant density (age, health of plants, threats to plants); habitat patch area and connectivity between antelope-brush habitats; threshold of degradation from invasive plants in which a population is able to survive.
2. Quantitative fieldwork on population numbers at each Behr's Hairstreak location.
3. Research impacts from habitat loss and fragmentation on Behr's Hairstreak dispersal and population viability.
4. Research and clarify potential threats, including fire (due to suppression); natural weather processes; pollution (e.g., pesticide run-off, cumulative impacts of pesticide use); accidental mortality (e.g., from grazing); and stochastic events (e.g., washouts through antelope-brush habitats, windstorms and deep freezing that cause antelope-brush loss).
5. Research biological and life history information for Behr's Hairstreak, including population size and annual fluctuation, dispersal barriers, larval and pupal ecology, ant associations, and parasites/parasitoids.
6. Gather further inventory and qualitative habitat information in order to complete further population viability analysis modelling, and improve confidence in model outputs.

RECOVERY

Recovery Feasibility

Recovery of Behr's Hairstreak in Canada is considered biologically and technically feasible based on the following four criteria:

- 1. Are individuals capable of reproduction currently available to improve the population growth rate or population abundance?**
Yes. Stable and persistent populations remain viable within protected areas within the south Okanagan and are available to support recovery.
- 2. Is sufficient habitat available to support the species or could it be made available through habitat management or restoration?**
Yes. Behr's Hairstreak population viability analysis suggests that populations are likely to persist in the south Okanagan valley within currently available habitat (H. Richardson, in prep.).
- 3. Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?**
Yes. The main threat to the species is habitat loss, which can be mitigated through habitat protection measures (see "Existing and Recommended Approaches to Habitat Protection").
- 4. Do the necessary recovery techniques exist and are they known to be effective?**
Yes. Recovery techniques focus on habitat protection.

Recovery Goal

Maintain a viable, well-distributed population of Behr's Hairstreak in protected** habitats within the known range in British Columbia.

****Protected habitat** is habitat (see "Habitat and biological needs") managed to maintain Behr's Hairstreak over a long time period (i.e., 100 years). Management may involve protection in various forms, such as following best management practices for maintaining Behr's Hairstreak and its habitat, stewardship agreements, conservation covenants, eco-gifts or sale of private lands by willing landowners, land-use designations and management on Crown lands, and protection in federal, provincial, and local government protected areas.

Recovery Objectives (2009 to 2013)

Recovery objectives for Behr's Hairstreak are:

1. Protect a minimum of 820 hectares of Behr's Hairstreak habitat by 2013.
2. Replant a minimum of 10 hectares of burned antelope-brush habitat on existing conservation lands that were previously occupied by Behr's Hairstreak, by 2013.
3. Address knowledge gaps associated with habitat quality, threats, population size and annual fluctuation, dispersal barriers, larval and pupal ecology, and population viability by 2013.

Rationale for Recovery Goal and Objectives

Preliminary population viability modelling suggests that the current population is viable and will remain viable if a sufficient amount of quality habitat is protected and managed, particularly on the east side of the Okanagan Valley where habitat is less fragmented (H. Richardson, pers. comm., 2007). Analysis is ongoing and preliminary results from the population viability analysis are not available at this time. At present it is not possible to quantify long-term population and habitat goals because current information is not sufficient to develop these goals.

The recovery goal, *to maintain a viable and well-distributed population*, is to ensure the species will not be extirpated in Canada and is based on recovery team consensus. A short-term (2009 to 2013) habitat protection target (820 ha) is quantified in the objectives section to ensure that reasonable protection is achieved while knowledge gaps are addressed and a quantitative goal is developed.

The habitat protection target includes 540 ha of existing protected areas on provincial and federal Crown land and on private conservation lands owned by The Nature Trust, The Okanagan Region Wildlife Heritage Fund Society, The Land Conservancy, and the Osoyoos Desert Centre (leased land from provincial government). Although these lands are protected from development, management activities may need adapting to ensure that the specific components of Behr's Hairstreak habitat are protected. The habitat protection target also includes 80 ha of proposed protected area on Crown land (federal and provincial), recommended by the Okanagan Shuswap

Land and Resource Management Plan and the Okanagan Land Act Review process. An additional 200 ha of protected habitat, to be achieved through cooperative stewardship, is targeted in order to maintain corridors and reduce fragmentation between protected sites.

The recovery objective to *replant a minimum of 10 hectares of burned antelope-brush habitat on existing conservation lands that were previously occupied by Behr's Hairstreak*, is to ensure that previously occupied Behr's Hairstreak habitats that were burned in recent wildfires are restored to maintain connectivity to other locations. Replanting and restoring these burned habitats will theoretically decrease habitat fragmentation in these protected areas and contribute to achieving the recovery goal.

Approaches Recommended to Meet Recovery Objectives

Approaches recommended to address recovery objectives and threats include *habitat protection, habitat management, inventory and monitoring, research, and public outreach*. These approaches will ideally be accomplished through voluntary stewardship by willing landowners and multi-group partnerships such as the South Okanagan-Similkameen Conservation Program (SOSCP). Habitat protection may include stewardship agreements and conservation covenants on private lands, land use designations on Crown lands (e.g., regulatory mechanisms), and protection in federal, provincial, and local government areas. A multi-species, ecosystem-based approach for habitat protection is recommended due to the high number of COSEWIC designated species in antelope-brush habitats. A single-species approach is required for research.

Table 1. Recovery planning table.

Objective	Threat(s) or concerns addressed	Recommended approach	Priority	Specific steps
1, 2	Habitat loss or degradation	Habitat protection	Urgent	Map antelope-brush habitats into definable polygons using GIS applications, and determine land ownership for these polygons.
			Urgent	Prioritize antelope-brush polygons for protection based on risk of habitat loss and results from preliminary population viability analysis modelling.
			Urgent	Identify habitat protection options for priority polygons.
			Urgent	Protect priority polygons through SOSCP partnerships.
			Necessary	Implement measures to address potential threats from natural disasters (such as fire) that could potentially impact that habitat surveyed.
			Beneficial	Develop communication materials regarding habitat protection actions and achievements.
2	Habitat loss or degradation	Habitat management	Urgent	Identify burned antelope-brush polygons within protected areas that 1) have previous Behr's Hairstreak records; and/or 2) are adjacent to polygons currently populated by Behr's Hairstreak.
			Urgent	Develop antelope-brush restoration plans in cooperation with land managers.
			Urgent	Implement restoration plans.
3	Habitat loss or degradation,	Inventory and monitoring	Necessary	Inventory antelope-brush polygons to determine resident populations, distribution, and occupied polygons.

3	knowledge gaps All	Research	Necessary	Monitor occupied polygons for annual population variation, habitat loss, and changes to habitat from threats.
			Urgent	Develop and implement research partnerships.
			Urgent	Research Behr's Hairstreak habitat needs, including the age structure of antelope-brush, optimal tree and host plant density, antelope-brush polygon area (with occupied Behr's Hairstreak), and connectivity between habitat polygons.
			Urgent	Research importance of ant species for Behr's Hairstreak.
			Necessary	Research impacts from exotic plants on host plants and determine if there is a negative correlation with densities, species (of exotic plants), etc.
			Necessary	Research potential threats from fire regimes, pollution, accidental mortality, and stochastic events.
			Necessary	Improve confidence in population viability analysis using modelling programs or similar techniques.
			Necessary	Implement measures to address potential threats from climate change, accidental mortality, and pollution. Implement measures concurrently with new research on these threats.
			Necessary	Research life history, dispersal barriers, and larval and pupal ecology.

Performance Measures

- 820 ha of high-quality antelope-brush plant community occupied by Behr's Hairstreak protected by 2013.
- 10 ha of burned antelope-brush habitat on existing conservation lands restored by 2013.
- Knowledge gaps addressed by 2013.

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 Behr's Hairstreak will be identified at a later date in a federal addition by Environment Canada or in the action plan for the species. The proposed action plan may be specifically for Behr's Hairstreak, but other action planning items (such as habitat protection and antelope-brush conservation actions) may be completed through recovery actions completed for other SARA-listed species in the area. A schedule of studies outlining the work necessary to identify critical habitat is in Table 2.

The attributes of critical habitat for Behr's Hairstreak will include antelope-brush habitats with abundant host plants and low densities of ponderosa pine within the south Okanagan valley.

Recommended schedule of studies to identify critical habitat

Table 2. Schedule of studies.

Description of activity		Outcome/rationale		Timeline
○	Map antelope-brush polygons and prioritize	○	Potential antelope-brush habitats are	○ 2010

polygons for habitat quality.	identified.	
○ Map Behr's Hairstreak distribution and relative density by habitat polygons.	○ Mapped occupied habitat polygons and larger, densely populated polygons are identified.	○ 2010
○ Map land ownership polygons, including conservation lands.	○ Land ownership and options for habitat protection are clarified.	○ 2010
○ Research knowledge gaps, including population fluctuations, specific habitat needs (e.g., age of antelope-brush, requirement for tree perches, heat requirements and tolerances), impacts of fire and fire recovery, habitat connectivity.	○ knowledge gaps that increase confidence in population viability analysis are addressed.	○ 2013
○ Identify priority antelope-brush polygons using population viability analysis modelling.	○ Priority polygons required for population persistence are identified.	○ 2013

Existing and Recommended Approaches to Habitat Protection

Habitat protection for existing locations can be established through stewardship and other mechanisms by following best management practices, voluntary stewardship agreements, conservation covenants, ecogifting or sale by willing vendors on private lands, land-use designations on Crown lands, and protection in federal, provincial, and local government protected areas.

Portions of the antelope-brush plant community have been protected by The Nature Trust, the provincial government (in parks and the South Okanagan Wildlife Management Area), and the federal government (in the Vaseux Bighorn National Wildlife Area). Note that the antelope-brush plant communities at these sites do not all currently function as habitat for Behr's Hairstreak due to fires removing antelope-brush and other issues relating to habitat quality.

Recovery actions in the South Okanagan valley should be implemented through the South Okanagan Similkameen Conservation Program and coordinated with other recovery teams focusing on the Pallid Bat (*Antrozous pallidus*), Great Basin Spadefoot (*Spea intermontana*), Tiger Salamander (*Ambystoma tigrinum*), Western Rattlesnake (*Crotalus oreganus*), and Gopher Snake (*Pituophis catenifer*), which also depend on antelope-brush habitats.

Effects on Other Species

In addition to Behr's Hairstreak, 88 provincially listed and 17 COSEWIC listed species at risk (note some COSEWIC species are also provincially listed) depend on antelope-brush ecosystems in B.C. (Dyer and Lea, 2003). Protection for Behr's Hairstreak habitat will directly benefit most of these species. Negative impacts on other species at risk are not expected. Conservation strategies are concurrent with South Okanagan-Similkameen Conservation Program.

Socioeconomic Considerations

Recovery of Behr's Hairstreak may impact the following economic sectors: agriculture, urban development, and transportation. The location of impact is low elevation lands in the South

Okanagan Valley, south of Penticton. The magnitude of the impact is unknown but expected to be low due to a strong focus on existing and proposed conservation lands.

Recommended Approach for Recovery Implementation

For successful implementation of species at risk protection measures, there is a strong need for engaging stewardship activities on a variety of land tenures, including private and First Nations lands. Stewardship involves voluntary cooperation of landowners to protect species at risk and the ecosystems they rely upon.

The preamble to the federal *Species at Risk Act* states 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.” Furthermore, the Bilateral Agreement between British Columbia and Canada on Species at Risk states 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.”

Habitat protection for Behr's Hairstreak will use an ecosystem approach for protecting and restoring antelope-brush habitats through SOSCP partnerships. Outreach activities will consider an ecosystem and multi-species approach, including other species at risk that use antelope-brush habitat such as Western Rattlesnake, Tiger Salamander, Badger (*Taxidea taxus*) and Pallid Bat. A single-species approach will be used to conduct research and clarify threats that are specific to Behr's Hairstreak.

Statement on Action Plan

A draft action plan will be ready for submission to the Province of B.C. by March 2013. This action plan will likely be a multi-species document because recovery actions are similar among species that depend on antelope-brush habitat.

REFERENCES

- Ballmer, G.R. and G.F. Pratt. 1988. A survey of the last instar larvae of the Lycaenidae (Lepidoptera) of California. *Journal of Research on the Lepidoptera* 27:1-81.
- Ballmer, G. R. and G. F. Pratt. 1992. Quantification of ant attendance (Myrmecophily) of Iycaenid larvae. *J. of Res. Lepid.* 30: 95–112.
- B.C. Conservation Data Centre Species and Ecosystems Explorer. <<http://a100.gov.bc.ca/pub/eswp/>> [Accessed October 2008].
- Comstock, J.A. 1928. Studies in Pacific coast Lepidoptera. *S. Calif. Acad. Sci. Bull.* 27(2):63–66.
- COSEWIC. 2000. Status report on the Columbia Hairstreak, *Satyrium behrii columbia* (McDunnough, 1944) (Lepidoptera:Lycaenidae) in Canada. Report prepared for Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 10 pp.
- Dyer, O. and T. Lea. 2003. Status and importance of the antelope-brush – needle-and-thread grass plant community in the South Okanagan Valley, British Columbia. *In* R. Seaton, ed. Proceedings, Ecosystems at Risk: antelope-brush restoration, March 2003, Osoyoos, BC. The Society for Ecological Restoration, BC chapter.
- Emmel, T.C. and J.F. Emmel. 1973. The butterflies of southern California. Natural History Museum of Los Angeles County. Science Series 26. 148 pp.
- Folgarait, P.F. 1998. Ant biodiversity and its relationship to ecosystem function: A review. *Biodivers. Conserv.* 7:1221–1244.
- Fraser, A.M., Axén, A. H. and Pierce, N. E. (2001) Assessing the quality of different ant species as partners of a myrmecophilous butterfly. *Oecologia* 129: 452 – 160.
- Guppy, C.S. and J.H. Shepard. 2001. Butterflies of British Columbia. Univ. B.C. Press and the Royal B.C. Museum, Victoria, BC. 414 pp.
- Hölldobler, B. and E.O. Wilson. 1990. The ants. Belknap Press of Harvard Univ. Press, Cambridge, MA.
- Krannitz, P.G. 2000. Browsing of antelope bitterbrush (*Purshia tridentata*: Rosaceae) in the south Okanagan Valley, British Columbia: age preferences and seasonal differences. *Am. Midl. Nat.* 144:109–122.
- Layberry, R., P. Hall, and J. Lafontaine. 1998. The Butterflies of Canada. University of Toronto Press. 280pp.
- Lea, T. 2001. Historical ecosystem mapping for the south Okanagan and Similkameen valleys of British Columbia. B.C. Minist. Sustain. Resour. Manage., Terrestrial Inf. Branch, Victoria, BC.
- Lea, T. 2008. Historical (pre-settlement) ecosystems of the Okanagan Valley and Lower Similkameen Valley of British Columbia – pre-European contact to the present. *Davidsonia* 19(1):3–36.
- NatureServe. 2008. NatureServe Explorer. <<http://www.natureserve.org/>> [Accessed October 2008].

- Pierce, N.E., M.F. Braby, A. Heath, D.J. Lohman, J. Mathew, D.B. Rand, and M.A. Travassos. 2002. The ecology and evolution of ant association in the Lycaenidae (Lepidoptera). *Annu. Rev. Entomol.* 47:733–771.
- Pyle, R.M. 2002. The butterflies of Cascadia: a field guide to all the species of Washington, Oregon, and surrounding territories. Seattle Audubon Society, Seattle, WA. 420 pp.
- Schluter, A., T. Lea, S. Cannings, and P. Krannitz. 1995. Antelope-brush ecosystems. B.C. Minist. Environ., Lands and Parks, Wildl. Branch, Victoria, BC. 6 pp.
- St. John, D. and S. Bunge. 2003. Biogeography of Behr's Hairstreak, *Satyrium behrri columbia* McDunnough, 1944) in the South Okanagan. Part 1: Inventory Survey and Mapping, Part 2: Mark Recapture Study. Unpublished study. 18 pp.
- The International Lepidoptera Survey (TILS). 2005. Standardized common North American butterfly names. <<http://tils-ttr.org/sc-nabn/index.html>> [Accessed February 2005].
- Young, J.A. and C.D. Clements. 2002. *Purshia* the wild and bitter roses. University of Nevada Press, Reno, NV.

Personal communications

- Orville Dyer, B.C. Ministry of Environment, pers. comm., based on analysis of unpublished Ministry of Environment GIS data, 2004.
- Sylvie Desjardins, UBC Okanagan, pers. comm. to Orville Dyer, 2004, 2005, 2006, 2007.
- Richard Hebda, Royal B.C. Museum, pers. comm. to Orville Dyer, 2004.
- Dennis St. John, private consultant, pers. comm. to Orville Dyer, 2004.
- Howie Richardson, Okanagan College, pers. comm., based on preliminary population viability analysis using RAMAS GIS, to Orville Dyer, 2007.