Environment Canada Environnement Canada

Canadian Wildlife Service
Pacific Wildlife Research Centre
5421 Robertson Road
Delta, B.C., V4K 3N2

September 2, 2015

RE: Consultation with associations and other organizations on draft recovery documents for several species at risk in Canada listed under the Species at Risk Act (SARA)

We are seeking your input on the draft recovery documents we are currently developing for several species at risk (listed below). As SARA applies on both federal and non-federal lands (i.e., provincial crown and private lands), it is important that the members of your association or organization be aware of the species at risk that may be positively or negatively impacted by their activities. As your members may also have information that could aid in the recovery of these species at risk, we would appreciate it if you could share this letter and the enclosed documents with them.

We invite you and your members to participate in the development of the enclosed draft recovery documents before they are made available to the general public for comment. We have included an overview of each document as well as a set of questions that may help with your review. You can call us to discuss these documents, we could arrange a meeting, or you can provide written comments.

We are currently working on recovery strategies for the following species:

- **Tall Bugbane** – found within a limited area near Cultus Lake and the Chilliwack River Valley

Developing a recovery strategy is the first step in the federal recovery planning process for threatened and endangered species. These documents establish population and distribution objectives, identify threats, propose broad strategies to address those threats, and provide a schedule of studies to fill knowledge gaps. If enough information is available, habitat critical to the survival or recovery of the species is also identified.

We are currently working on management plans for the following species:

- **Band-tailed pigeon** – found along the coast and islands of BC, as far north as Calvert Island
- **Pacific Great Blue Heron** – found along the coast and islands of BC

Developing a management plan is the first step in the federal recovery planning process for special concern species. These documents set goals and objectives for maintaining sustainable population levels of one or more species that are particularly sensitive to environmental factors, but which are not in danger of becoming extinct. Critical habitat is not identified for special concern species.

The timeline for completing the recovery documents differs for each species listed above, but we hope to have many posted as proposed on the Species at Risk Public Registry (*www.sararegistry.gc.ca*) this year. After this posting, we will update and finalize the

documents based on a review of all information received. After final posting, documents can be updated at any time if significant new information is brought forward.

Thank you for taking the time to consider this information. We look forward to working together on the recovery of these species at risk. Please contact us at your earliest convenience:

The Species at Risk Recovery Team
Environment Canada
Canadian Wildlife Service
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SAR.pyr@ec.gc.ca | (604) 350-1900

We would also like to ask for your assistance with notifying others in your industry about these species and Environment Canada's recovery planning. We would greatly appreciate it if you could post an announcement on your website or provide notification through other communication tools you may use. Please feel free to use the text and images provided in the table below.

Respectfully,

Randal Lake
Head, Species at Risk Recovery
Canadian Wildlife Service
Environment Canada
Pacific and Yukon Region
5421 Robertson Rd, RR1
Delta, BC V4K 3N2

Enclosed:

- Consultation packages for the species listed above (including an overview, a set of questions that may help with your review, and either a draft recovery strategy or a draft management plan)
- Overview of the Species at Risk Act on Private Land

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Band-tailed Pigeon

(Special Concern)

The Band-tailed Pigeon gets its name from the grey band on the end of its dark tail. It looks similar to the city-dwelling Rock Pigeon but it is larger, lighter grey, and has a purple-grey head with a white line along the back of its neck. Its bill and feet are yellow.

HABITAT

- Forest edges and openings, urban yards and parks, golf courses, orchards, temperate evergreen rainforest, and agricultural lands for foraging
- Mineral sites and underground springs with minerals

THREATS TO SURVIVAL OR RECOVERY

- Habitat loss and land use changes from some residential and industrial activities, especially at mineral sites
- Some forestry practices that result in fewer fruit-bearing plants and older trees used for nesting
- Vulnerable to parasite infection (e.g., trichomoniasis)
- Direct and indirect pesticide poisoning at foraging and mineral sites

Great Blue Heron *fannini* Subspecies

(Special Concern)

This bird is over 1 m (~3') tall. Its feathers are blue-grey with white streaks. In its characteristic flight, its wings beat slowly and deeply while it holds its neck in an S-shape. They are found on the coast of British Columbia and associated islands (e.g., Vancouver Island and Haida Gwaii / Queen Charlotte Islands).

HABITAT

- Forages along the seacoast, in fresh/ salt water marshes and along rivers in grassland
- Nests in a variety of species of trees such as Red Alder, Black Cottonwood, Bigleaf Maple, Sitka Spruce and Douglas-fir

THREATS TO SURVIVAL OR RECOVERY

- Habitat loss and colony disturbance due to residential and industrial development, and some logging practices
- Human activities and disturbance (e.g., traffic, noise from people around nest sites)
- Bald eagles preying on Heron eggs, chicks, and adults as well as causing stress which results in loss of productivity

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Tall Bugbane

(Endangered)

This large-leafed plant stands at 1-2 m (~3-6') tall. It is easy to confuse with thimbleberry or baneberry, except when it flowers. Small, white flowers are found in tall groups of 50-900. There are only seven populations in Canada, all found in the Cultus Lake–Chilliwack River area.

HABITAT

- Prefers partially shaded, very damp areas in mixed, older forests
- Typically found near watercourses (e.g., creeks, streams, rivers) but can also be found in drier areas
- Often found with species such as Douglas-fir, Bigleaf Maple, Devil's Club, Sword and Lady Ferns, and Vanilla Leaf

THREATS TO SURVIVAL OR RECOVERY

- Increasing residential development and recreational activities (e.g., hiking, mountain-biking, off-roading)
- Some logging, agricultural, and urban maintenance practices (e.g., land clearing, improper use of herbicides)
- Collecting plants, harvesting Bigleaf Maple, and introducing invasive non-native plants

Canada

SPECIES AT RISK ACT
on private land

Critical Habitat Protection

CRITICAL HABITAT: *The habitat the species needs to recover or survive, as identified in a final recovery strategy or action plan*

- Environment Canada looks to the laws of the provinces and territories to protect critical habitat on non-federal land.
- Environment Canada encourages voluntary stewardship measures on private land to help species recover and survive.
- The goal is to meet the conservation needs of the species while minimizing impacts on and inconvenience to landowners.
- Only if the measures above have not been effective will Environment Canada consider using legislative powers to protect species at risk and their critical habitat.

How Environment Canada can support Landowners to protect Critical Habitat

- Ecological Gifts Program
- Funding programs (e.g., Habitat Stewardship Fund)
- Conservation Agreements
- Information to assist in land use planning

Legal Context for Species at Risk

- The Species at Risk Act applies to all lands and waters in Canada
- How it applies depends on land tenure
- Canada and British Columbia work together through a formal Agreement on Species at Risk
- Provincial and local governments can provide protection for species at risk through existing tools; for example:
    a. Bylaws, zoning, permitting
    b. Water Sustainability Act
    c. Wildlife Act

SPECIES AT RISK ACT
on private land

What it means if Critical Habitat is identified on your land

- It may mean that your current land use is generally compatible with the needs of the species. *Thank you!*
- Local stewardship groups, environmental professionals, and government biologists may be able to provide advice on how to avoid destruction of critical habitat if you are thinking about changing how you use your land.
- Environment Canada will be working with provincial and local governments to assess whether anything more needs to be done to formally protect the habitat.
- If critical habitat is unlikely to be destroyed, more formal protection measures may not be required. If any new bylaws or regulations are being considered, you will be consulted before anything changes.

How we identify Critical Habitat

- "*To the extent possible, based on the best available information*"
- Linked to population & distribution objectives
- Critical Habitat identification is comprised of:
    a. A geographic location or area within which Critical Habitat is found
    b. The particular environmental features (e.g., types of plants, water bodies) the species needs to live and reproduce

Protection & Preventing Destruction

What is "destruction" of Critical Habitat?

- Permanent or temporary degradation of any part of Critical Habitat such that it would not serve its function when the species needs it
- Result of a single action or multiple actions over time (cumulative effects)

Protection of Critical Habitat means preventing activities that could destroy it

Overview of the Federal Management Plan for the Pacific Great Blue Heron

This document highlights information about the Pacific Great Blue Heron, and includes key information about the federal Management Plan for this bird. A Management Plan sets goals for maintaining sustainable population levels of species that are particularly sensitive to environmental factors, but which are not in danger of becoming extinct.

About the species

The population of Pacific Great Blue Heron is shrinking. Each year the number of new hatchlings leaving the nest has been getting smaller. Scientists estimate that there are 4000-5000 Pacific Great Blue Herons remaining in Canada.

The Pacific Great Blue Heron is recognized as a species of "Special Concern" by scientists from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). It is listed on Schedule 1 of the *Species at Risk Act* (SARA), a federal law intended to protect at-risk wildlife species.

What does it look like?

- Pacific Great Blue Herons are the largest herons in North America and stand over 1 m tall
- Adults have blue-grey feathers on their wings and body, and a white head with a distinctive black stripe
- Their legs are stilt-like and trail behind them when they fly
- They have long necks that are often curved into an "S" shape

When and where is it found?

- In Canada, the Pacific Great Blue Heron can be found year-round along coastal British Columbia
- They forage on coastlines, in salt and freshwater marshes, as well as in grasslands and farm fields; they nest high up in trees

Main threats to the Pacific Great Blue Heron

The main threats facing Pacific Great Blue Herons include:

- Habitat loss due to commercial, and residential development
- Bald Eagles that hunt Pacific Great Blue Herons and drive them away from their nests

Other threats include:

- Noise from vehicles and certain recreational activities
- Some agriculture and aquaculture activities
- Habitat loss from forest harvesting

Key information about the Federal Management Plan

Management Objective:

We want to make sure that the Great Blue Heron in Canada does not suffer greater losses in population. The way this is stated in the Management Plan is: *To ensure that all conservation regions across coastal British Columbia have stable or locally increasing numbers of Pacific Great Blue Herons.*

Broad Strategies:

To meet this objective, the Management Plan outlines five broad strategies:

1. Mapping feeding and nesting habitats
2. Protecting current and future suitable feeding and nesting habitats
3. Promoting habitat stewardship and education of land owners about the needs of the Pacific Great Blue Heron
4. Conducting research to fill knowledge gaps
5. Restoring feeding habitats

How you can help the Pacific Great Blue Heron

The recovery document guides the approaches we can take together including:

- Learning more about Pacific Great Blue Heron, its habitat needs, and the threats to its survival
- Avoiding activities that could harm the species
- Working with Environment Canada and/or local conservation groups to protect the species and its habitat
- Contacting Environment Canada – Pacific & Yukon Region's Species at Risk Recovery Unit (SAR.PYR@ec.gc.ca) to provide comments about the Management Plan, ask questions, or request information about other available resources to help protect and recover the Pacific Great Blue Heron

This overview document is not a substitute for the Management Plan for the Pacific Great Blue Heron (*Ardea herodias fannini*) in Canada

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Species at Risk Questionnaire

Species name: _____

To help us learn more about this species, please answer the following questions.

1. **Have you seen this species on or near your land?** Never / Sometimes / Often / I don't know
   Comments: _____

2. **Are there activities going on in your area that could benefit this species or its habitat?** Yes / No / I don't know
   If yes, please describe the activities and how these activities can help the species: _____

3. **Are there activities going on in your area that could harm this species or its habitat?** Yes / No / I don't know
   If yes, please explain: _____

4. **Does your land have some or all of the landscape features (e.g. types of trees, water bodies) used by this species?**
   Yes / No
   Comments: _____

Canada

5. **Do you have any comments on threats to this species?** Yes / No
   Comments: _____

6. **Do you have any additional information that may help us develop recovery plans for this species?**

7. **Is there anything else you would like to add?**

8. **Would you like more information on how you can help conserve species at risk?** Yes / No
   If yes, please provide your contact information below.

Name: _____
Phone: _____
Email: _____
Address: _____

Thank you for your feedback. If there is anything you would like to add or any questions you would like to ask about species at risk please contact us at SAR.pyr@ec.gc.ca or 604-350-1900.

DRAFT

Species at Risk Act
Management Plan Series

Management Plan for the Great Blue Heron *fannini* subspecies (*Ardea herodias fannini*) in Canada

Great Blue Heron, *fannini* subspecies

2015

Environment Canada Environnement Canada

Canada

Recommended citation:

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

Cover illustration: photo by Ross Vennesland

Également disponible en français sous le titre
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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 management plans for listed species of special concern and are required to report on progress five years after the publication of the final document on the SAR public registry.

The Minister of the Environment as Minister responsible for both Environment Canada and Parks Canada Agency is the competent minister under SARA for the Great Blue Heron *fannini* subspecies has prepared this management plan as per section 65 of SARA. To the extent possible it has been prepared in cooperation with the province of British Columbia as per section 66(1) of SARA.

Success in the conservation 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 plan and will not be achieved by Environment Canada, the Parks Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Great Blue Heron *fannini* subspecies and Canadian society as a whole.

Implementation of this management plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

ACKNOWLEDGMENTS

This management plan was authored by Ross Vennesland of the Parks Canada Agency, and Dan Shervill and Holly Middleton of Environment Canada. Input was provided by the British Columbia chapter of the Canada/US Heron Working Group (www.heronworkinggroup.org) including Kym Welstead (BC MFLNRO), Trudy Chatwin (BC MFLNRO), Berry Wijdeven (BC MFLNRO) and Rob Butler (Pacific WildLife Foundation.

EXECUTIVE SUMMARY

The Great Blue Heron *fannini* subspecies (*Ardea herodias fannini*) (hereafter Pacific Great Blue Heron) is a large wading bird that is mostly blue-grey in colour, with accents of chestnut and blue, streaks of white, and long plume-like feathers. The Pacific Great Blue Heron was assessed as Special Concern in 1997 and again in 2008 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) due to a small population size, declining productivity, and threats related to eagle predation, habitat loss, and human disturbance. The species was listed on Schedule 1 of the *Species at Risk Act* (SARA) in 2010.

Pacific Great Blue Herons are found in coastal British Columbia and from Washington State to Southeast Alaska. The most recent population estimate for the Pacific Great Blue Heron is 4000 to 5000 nesting adults with evidence suggesting that nesting productivity has fallen along with declines in population size during winter and possibly the breeding season as well. It forages along the seacoast, on tidal mudflats, in fresh and saltwater wetlands, along rivers, lakes, and in grassy field habitats. Pacific Great Blue Herons typically nest in small or large woodlands near foraging areas. Nesting colony locations are dynamic, especially in areas of high disturbance.

The main threats facing Pacific Great Blue Herons are increased colony abandonment and decreased colony productivity due to Bald Eagle (*Haliaeetus leucocephalus*) predation and nesting and foraging habitat loss due to commercial and residential development. Other threats include habitat loss from forest harvesting and utility line creation and maintenance, lost productivity due to disturbance by human activities and risk of mortality from roads, and aquaculture operations.

The management objective for Pacific Great Blue Heron is:

To ensure that all four recognized Pacific Great Blue Heron Conservation Regions in coastal British Columbia have stable or locally increasing numbers of Pacific Great Blue Herons.

The broad strategies and conservation measures to achieve the management objective include: habitat mapping; habitat protection; habitat stewardship and education; research to fill knowledge gaps; and habitat restoration.

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1. COSEWIC SPECIES ASSESSMENT INFORMATION

Formatted: Numbering: Continuous

Date of Assessment: April 2008

Common Name (population): Great Blue Heron *fannini* subspecies

Scientific Name: *Ardea herodias fannini*

COSEWIC Status: Special Concern

Reason for Designation: In Canada, this subspecies is distributed along the coast of British Columbia with a relatively small population that is concentrated at a few breeding colonies in southern British Columbia. There is evidence of declines in productivity and it is unclear whether the population is stable or declining. Threats from eagle predation, habitat loss and human disturbance are ongoing, particularly in the southern part of the range where concentrations of birds are highest.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Special Concern in April 1997 and April 2008.

2. SPECIES STATUS INFORMATION

The Great Blue Heron *fannini* subspecies (*Ardea herodias fannini*; hereafter Pacific Great Blue Heron) has been assessed as a species of Special Concern in Canada (COSEWIC 2008) and has been listed on Schedule 1 of the federal *Species at Risk Act* since 2010. Canada holds approximately half the global population of the Pacific Great Blue Heron.

Table 1: List and Description of Various Conservation Status Ranks for the Pacific Great Blue Heron (Natureserve, 2013)

Global (G) Rank*	National (N) Rank*	Sub-national (S) Rank*	COSEWIC Status	B.C. List	B. C. Conservation Framework**
T4 (apparently secure)	Breeding season N3 (vulnerable); Non-breeding season N4 (apparently secure)	Sub-national (Province of British Columbia): Breeding season S2S3 (imperiled to vulnerable);	SC (Special Concern)	BLUE	Priority 1 under Goal 3

		Non-breeding season S4 (apparently secure)			

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

** The three goals of the B.C. Conservation Framework are: 1. Contribute to global efforts for species and ecosystem conservation; 2. Prevent species and ecosystems from becoming at risk; 3. Maintain the diversity of native species and ecosystems

3. SPECIES INFORMATION

3.1. Species Description

The Pacific Great Blue Heron is a large wading bird that stands more than one metre tall. It has long rounded wings, a long neck, short tail and its legs resemble stilts. It is generally mostly blue-grey in colour, with accents of chestnut and blue, streaks of white and long plume-like feathers. When flying, it uses deep and slow wing beats and carries its head tucked into an S shape between its shoulders.

The Pacific Great Blue Heron forages along the seacoast, mostly in fresh and saltwater wetlands, along rivers and lakes, but also in grassy areas such as farmer's fields, irrigation ditches and highway right-of-ways. Pacific Great Blue Herons typically nest in woodlands near foraging areas. They typically nest colonially (2-400 pairs) using large stick nests built in mature trees between 20 and 30 m above the ground, and within 10 km of suitable marine or freshwater foraging grounds. Nesting colony locations can be dynamic, especially in areas of high disturbance. Heron colony locations can be dynamic or relatively static, with large colonies sometimes staying in one location for several decades, but smaller ones relocating every few years (COSEWIC 2008, Vennesland and Butler 2011). Clutch size is 3-5 eggs (Butler 1997; Vennesland and Butler 2011) which is smaller than the *A. h. herodias* subspecies (COSEWIC 2008). Eggs are semi-oval and a dull pale blue (Vennesland and Butler 2011). Nestlings are semi-altricial and fledge about 60 days after hatching (Butler 1989).

For more detailed information on the Pacific Great Blue Heron, please see COSEWIC (2008), Butler (1997) and Vennesland and Butler (2011).

3.2. Population and Distribution

Populations and Their Distribution

About 4000-5000 Pacific Great Blue Herons are found in Canada (all in British Columbia) compared to 9500-11000 globally (COSEWIC 2008). In Canada, the Pacific Great Blue Heron resides year round on the north and south coasts of British Columbia including Vancouver Island, Haida Gwaii, and other offshore islands (Figure 1 and Figure 2). All known nesting occurrences of the Pacific Great Blue Heron are within the Coastal Western Hemlock and Coastal Douglas Fir Biogeoclimatic Zones (Figure 1 and

Figure 2; COSEWIC 2008). Four Conservation Regions are recognized based on degree of isolation, population sizes, and differences in trends and threats; Haida Gwaii, Vancouver Island, Lower Fraser River Valley, and Mainland Coast (Figure 3).

Population size has been difficult to estimate for the Pacific Great Blue Heron because colonies are not stable entities and herons are difficult to identify individually (COSEWIC 2008). Most coastal areas outside the Strait of Georgia, which comprises a portion of both the Lower Fraser River Valley and Vancouver Island Conservation Regions (Figure 2), have not been systematically surveyed (Butler 1997; COSEWIC 2008). In future, adoption of a standard tracking method (Vennesland and Norman 2006) can provide consistent monitoring throughout the subspecies' Canadian range. Nevertheless, the most recent published estimate of population size for the Pacific Great Blue Heron in British Columbia is 4000-5000 nesting adults in Canada, with approximately 3200 of these individuals occurring in the Strait of Georgia area (COSEWIC 2008; CDC 2014).

Figure 1: Northern Canadian Range of the Pacific Great Blue Heron, showing potential area of occupancy.

Figure 2: Southern Canadian range of the Pacific Great Blue Heron showing potential area of occupancy. For the entire range, potential area of occupancy is defined as terrestrial areas within the Coastal Douglas Fir and Coastal Western Hemlock Biogeoclimatic zones that are less than 10 km from a potential foraging area. Potential foraging areas are defined as the entire coastline and major river systems.

Figure 3. Four Pacific Great Blue Heron Conservation Regions in British Columbia.

Status and Trends of Populations

Population status and trends have been assessed using various sources of information, primarily using measures of nesting productivity, annual changes in colony occupancy, and various population indices. The following information is from COSEWIC (2008), with updated analyses, where available.

Productivity trends

Nesting productivity (number of chicks fledged per active nest) has declined significantly since the 1970's, perhaps as much as 50% (COSEWIC 2008). Vennesland (unpubl. data) recently updated analyses used for COSEWIC (2008) using data from 1987 to 2009 and found that the decline in nesting productivity has intensified (the declines have increased over time and the statistical significance of the declines have become stronger). Furthermore, productivity declines appear to be high at large colonies that produce most of the fledglings for the sub-species. These colonies are concentrated in the Lower Fraser River Valley where there is a large and growing human population resulting in declines in suitable foraging and nesting habitat, as well as high levels of disturbance from humans and potential predators such as eagles, raccoons and other urban animals (COSEWIC 2008).

The demographic analysis reported in COSEWIC (2008) concluded that only the Lower Fraser River Valley Conservation Region is producing enough young to sustain its numbers. Fledglings from this region may disperse to Vancouver Island and augment areas that appear to have low productivity, but are still maintaining their populations (COSEWIC 2008; Chatwin et al. 2009). It is unclear if this situation is sustainable over the long term. The Lower Fraser River Valley individuals are thus crucial to the sub-species as a whole, and this small geographic area (about 5000 km^2 in extent) essentially may represent the only area of effective breeding of the Pacific Great Blue Heron in Canada (i.e., the only area producing sufficient numbers of fledglings to remain sustainable). Further, this important area is also under the greatest threat from human and Bald Eagle disturbance and has the highest level of habitat destruction on the coast (COSEWIC 2008).

Changes in range and colony occupancy

One portion of the Mainland Coast Region (the Sunshine Coast) has seen a strong decline in nesting population size and one portion of the Vancouver Island Region (north-eastern Vancouver Island) has seen a complete absence of productivity in recent years (Chatwin pers. comm. 2014; COSEWIC 2008). Based on these data, a range retraction may be occurring along the northern margin of the southern range.

COSEWIC (2008) analyzed the flux in the numbers of active nests in colonies to identify changes in colony size from nesting surveys. That analysis summed the annual changes in colony sizes for individual colonies that had available data. The analysis was

designed to identify trends in colony occupancy. COSEWIC (2008) reported stable colony occupancy for nesting Pacific Great Blue Herons in the Strait of Georgia up to 2005. However, a re-analysis using data up to 2009 (R. Vennesland, unpubl. data) has shown the decline in colony occupancy is intensifying, with an overall decline of 357 active nests over all years summed (Figure 4). It must be noted that this analysis was limited to colonies with consecutive observations over consecutive years and thus may not provide a full picture of population trends. Nevertheless, large changes in colony occupancy should be apparent, and thus the change from a stable to a negative sum is notable.

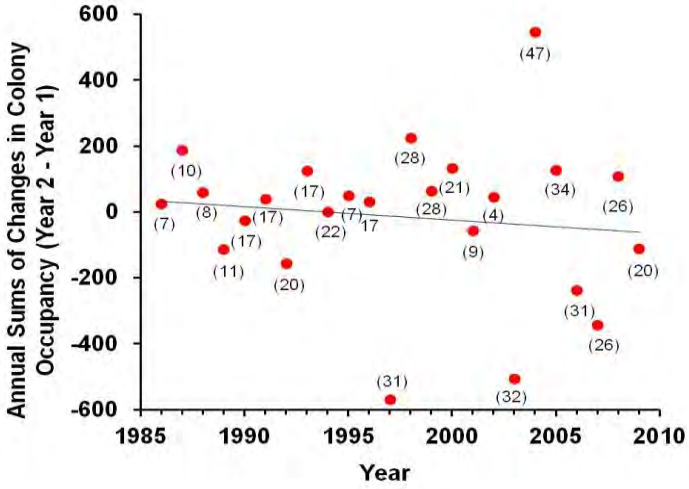

Figure 4. Annual sums of increases and decreases in the number of nesting pairs at Pacific Great Blue Heron colonies in south-coastal British Columbia from 1986 to 2009. Sample sizes of colonies included in annual sums are provided in brackets.

Winter counts

In a recent analysis, Bird Studies Canada's Coastal Waterbird Survey (CWS) data from the winters of 1999 to 2009 showed a significant decline in the Pacific Great Blue Heron numbers in the Strait of Georgia, averaging -2.3% per year (Crewe et al. 2011). Assuming an average age of 5.6 years in the Pacific Great Blue Heron population (COSEWIC 2008), this rate of decline would mean a decline in the population of 39% over 3 generations (the time period relevant to status assessments by the Committee on the Status of Endangered Wildlife in Canada; COSEWIC). As the Coastal Waterbird Survey methodology is robust, this likely represents a real decline in the winter numbers in the Strait of Georgia. It is not clear if this winter decline represents a decline in the breeding numbers, but considering that the *fannini* sub-species is non-migratory, and the apparent decline in colony occupancy reported above, breeding numbers may also be in decline.

3.3. Needs of the Great Blue Heron *fannini* subspecies

Pacific Great Blue Herons require productive areas to forage in both the breeding and non-breeding seasons. In the breeding season, they require safe nesting locations within 10 km of their foraging areas and usually within 2.9km (Butler et al. 1995). Due to the propensity of this species to relocate nesting colonies from time to time (COSEWIC 2008), they also require sufficient alternate nesting habitat near to foraging areas to facilitate future breeding.

Additionally, the Pacific Great Blue Heron requires the threats listed in Section 4 of this document to be managed (e.g., human disturbance, habitat loss to development) or mitigated (e.g., Bald Eagle predation) in all its foraging and nesting areas.

The following section is a brief description of the habitat needs of the Pacific Great Blue Heron. For more detailed information on the habitat requirements of this species, please see Butler (1995, 1997); Gebauer and Moul (2001); COSEWIC (2008); and Vennesland and Butler (2011).

Foraging Habitat Requirements

The Pacific Great Blue Heron forages in marine, brackish and fresh water, as well as in some terrestrial environments such as grass and farm fields (Vennesland and Butler 2011). Important foraging habitats include aquatic areas such as tidal mudflats (especially those with beds of Common Eelgrass; *Zostera marina*), riverbanks, lakeshores, and wetlands (Butler 1997; Gebauer and Moul 2001). During winter, when aquatic prey are more difficult to hunt due to a lack of low tides during daylight, fallow farm fields and associated ditches become important foraging habitat for both adult and juvenile herons (Butler 1995; 1997). The number of Pacific Great Blue Herons that use non-aquatic foraging habitats has not been documented, but the Strait of Georgia holds a large number of Pacific Great Blue Herons (COSEWIC 2008), so it is likely that these non-aquatic habitats are important for a significant number of Pacific Great Blue Herons. This species is a prey generalist, foraging on a wide variety of animals, including fish (shiner perch (*Cymatogaster aggregata*), gunnel (*Apodichthys* spp and *Pholis* spp.), juvenile herring (*Clupea pallasii*), bay pipefish (*Syngnathus griseolineatus*) and sculpin (*Cottus* spp.)), small mammals, insects, amphibians, and crustaceans (Butler 1995; 1997; Vennesland and Butler 2011).

Since tracts of potential foraging habitat appear to be vacant during the year, it is believed that foraging habitat is not limiting on the overall Pacific Great Blue Heron population in Canada (COSEWIC 2008). It is possible that the use of suitable foraging habitat in certain urban localized areas is limited by the availability of undeveloped nesting habitat (e.g., the heavily developed Burrard Inlet).

Nesting Habitat Requirements

Pacific Great Blue Herons nest primarily in trees; their colonies are commonly situated in forests near to (usually within 3 km of, but up to 10 km from) suitable foraging areas (Azerrad 2012; Butler 1995; Vennesland and Butler 2011). Nest sites are often chosen in areas that minimize the potential for disturbance by human activities, but frequently they nest in more developed areas, including small woodlands and even solitary trees in rare cases (Butler 1997; Vennesland and Butler 2011). Pacific Great Blue Herons usually nest in colonies from 2 to 400 nests (Vennesland and Butler 2004) although they sometimes nest solitarily. Primary tree species used for nesting include Red Alder (*Alnus rubra*), Black Cottonwood (*Populus balsamifera*), Bigleaf Maple (*Acer macrophyllum*), Sitka Spruce (*Picea sitchensis*), and Douglas Fir (*Pseudotsuga menziesii*) (Gebauer and Moul 2001). See Gebauer and Moul (2001) for a more comprehensive list of tree species used for nesting.

In the Lower Fraser River Valley, where about 60% of the Canadian population occurs, nesting habitat is thought to be to be limited. For example, it has been shown that around Boundary Bay, Pacific Great Blue Herons have little forested habitat remaining within 10 km of foraging areas and are thus nesting in untraditional habitats such as hedgerows (B. Smith, unpubl. data; GBHE Working Group pers. comm. 2013). Loss of nesting habitat is likely not limiting numbers in all portions of its Canadian range (e.g., less developed areas of the coast, such as the Mainland Coast and Haida Gwaii).

Furthermore, within the Lower Fraser River Valley, Pacific Great Blue Herons were shown to select nesting locations within 200 m of an active Bald Eagle nest (Jones 2010). This could be an additional restriction on the extent of suitable nesting habitat in developed areas (R. Butler pers. comm. 2014; Kenyon 2005). The relationship between eagles and herons is discussed in greater detail in the Threats section.

Pacific Great Blue Heron colonies tend to move in relation to predation events or human disturbance. Therefore, it is important that Pacific Great Blue Herons have sufficient habitat for both current and future nesting needs. Large colonies (those above 50 nests) tend to stay in one location for a substantial amount of time (sometimes many decades), but smaller colonies may relocate every few years (Butler 1997; Vennesland 2000; Vennesland and Butler 2011). Pacific Great Blue Herons require nesting areas where human disturbance is minimized throughout the breeding season as they can be sensitive to disturbance (e.g., noise). Therefore, it is important that Pacific Great Blue Herons have sufficient habitat for both current and future nesting needs. In areas where high levels of human and Bald Eagle disturbance occur, the need for alternate nesting habitat is greater because Pacific Great Blue Herons may relocate more often as they try to find sites relatively free of disturbance. Pacific Great Blue Herons will return to an abandoned nesting location after one or more years of absence, though this is uncommon (Moul et al. 2001; Chatwin et al. 2006).

4. THREATS

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4.1. Threat Assessment

The threat classification below is based on the World Conservation Union–Conservation Measures Partnership (IUCN-CMP) unified threats classification system (CMP website, IUCN CMP 2006). Under this system, threats may be observed, inferred, or projected to occur in the near term, and are characterized in terms of scope, severity, and timing. Threat "impact" is calculated from scope and severity. For information on how the values are assigned, see Master et al. (2009) and table footnotes. Overall threat score for Pacific Great Blue Heron is calculated as 'Medium' as a result of the cumulative impact of a large number of low-level and one medium-level threats.

Table 2. Threat Assessment Table

Threat No.	Threat Description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Low	Small	Serious-Moderate	High
1.1	Housing & urban areas	Low	Small	Moderate-Slight	High
1.2	Commercial & industrial areas	Low	Small	Serious-Moderate	High
1.3	Tourism & recreation areas	Negligible	Negligible	Moderate-Slight	High
2	Agriculture & aquaculture	Low	Small	Extreme-Serious	High
2.1	Annual & perennial non-timber crops	Negligible	Negligible	Extreme-Serious	High
2.2	Wood & pulp plantations	Negligible	Negligible	Extreme-Serious	High
2.4	Marine & freshwater aquaculture	Low	Small	Moderate-Slight	High
3	Energy production & mining	Negligible	Negligible	Extreme-Serious	Moderate
3.2	Mining & quarrying	Negligible	Negligible	Extreme-Serious	Moderate
4	Transportation & service corridors	Low	Large	Slight	High
4.1	Roads & railroads	Low	Large	Slight	High
4.2	Utility & service lines	Low	Large	Slight	High
4.4	Flight paths	Negligible	Negligible	Slight	High
5	Biological resource use	Low	Small	Slight	High

5.1	Hunting & collecting terrestrial animals	Negligible	Small	Negligible	High
5.3	Logging & wood harvesting	Low	Small	Slight	High
6	Human intrusions & disturbance	Low	Large	Slight	High
6.1	Recreational activities	Low	Large	Slight	High
6.3	Work & other activities	Negligible	Negligible	Slight	High
7	Natural system modifications	Negligible	Small	Negligible	High
7.2	Dams & water management/use	Negligible	Small	Negligible	High
7.3	Other ecosystem modifications	Negligible	Negligible	Unknown	High
8	Invasive & other problematic species & genes	Medium	Pervasive	Moderate	High
8.1	Invasive non-native/alien species	Negligible	Negligible	Unknown	High
8.2	Problematic native species	Medium	Pervasive	Moderate	High
9	Pollution	Unknown	Pervasive	Unknown	High
9.2	Industrial & military effluents	Unknown	Pervasive	Unknown	High

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

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

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or 3-generation timeframe. For this species a generation time of 5.6 years (COSEWIC 2008) was used resulting in severity being scored over a 17.8-year timeframe. It is usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit $\geq$ 0%).

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

4.2. Description of Threats

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The overall threat score for Pacific Great Blue Heron is medium due to the cumulative impact of a large number of low impact and one medium impact threats. The single largest impact score ('medium') is the threat from an increasing instance of Bald Eagle predation at colonies. Habitat loss to residential and commercial development is predicted to have a low overall impact on the Pacific Great Blue Heron population in Canada over a 10 year period. Although the severity of this threat is predicted to be moderate to serious, the scope is small because over such a short period of time only a small number of herons will be directly impacted.

IUCN – CMP Threat 1. Residential and Commercial Development

Threat 1.1 - Housing and Urban Areas; Threat 1.2 - Commercial and Industrial Areas; Residential and Commercial development can threaten Pacific Great Blue Heron colony placement and nesting success due to direct habitat loss associated with development and colony disturbance as a result of noise and human activity. Construction work has resulted in the abandonment of Pacific Great Blue Heron nests (Simpson 1984; Simpson and Kelsall 1978). The largest development pressure is expected in the Lower Fraser River Valley and southern portions of Vancouver Island. Over the next ten year period, it is anticipated that a small number of existing colonies will be affected by housing or industrial development on terrestrial landscapes. Commercial developments in nearby marine areas (e.g., shipping terminals) and upland foraging areas (e.g., residential and commercial development in farmland) are expected to have a small negative impact at the Tsawwassen colony, the largest colony in Canada, as well as other smaller nearby colonies.

Loss of Nesting Habitat

Loss of nesting habitat has been widespread and continuous throughout the Strait of Georgia, especially near urban areas such as Victoria and Vancouver (Moore 1990; Butler 1997; Gebauer and Moul 2001; COSEWIC 2008). About 80% of the Canadian population of the Pacific Great Blue Heron nests in the two most heavily developed Conservation Regions on the coast of British Columbia: Lower Fraser River Valley and Vancouver Island (COSEWIC 2008). Intensive monitoring of Pacific Great Blue Heron colonies from 1972 to 1985 and from 1998 to 1999, documented at least 12 colony abandonments due primarily to habitat destruction in the Strait of Georgia (Forbes et al. 1985; Vennesland 2000).

Loss of Foraging Habitat

Few data are available on the loss of foraging habitat, but similar to nesting habitat, the most important foraging habitats for the Pacific Great Blue Heron in Canada are around the most developed areas of the coast, and especially at the western margin of the Lower Fraser River Valley. On a 2009 survey from the BC Ferries causeway near

Tsawwassen, nearly 700 Pacific Great Blue Herons were counted within 500 m north and 500 m south of the causeway (R. Vennesland unpub. data). This count over an estimated 1 km^2 accounts for approximately 14% of the entire Canadian population of the Pacific Great Blue Heron (COSEWIC 2008). In the Lower Fraser Basin from Vancouver to Hope, 85% of bogs, marshes, swamps and fens were dyked and converted for urban and agricultural use between 1827 and 1990 (Boyle et al. 1997). Loss of estuarine foraging habitat on Vancouver Island to sawmill and pulpmill expansion and paving of estuaries is ongoing (T. Chatwin, pers. comm. 2014).

Interplay of nesting and foraging habitat

Pacific Great Blue Herons require nesting areas within 10 km of foraging habitat (Butler 1995). Knight (2010) examined the location and productivity of colonies on the south coast of British Columbia and found that Pacific Great Blue Herons are being pressured by human development as they try to nest in areas that avoid human development while remaining near suitable foraging areas. It is essential that threats are adequately mitigated in a coordinated manner for both nesting and foraging habitat – a significant challenge in the highly developed Strait of Georgia. This is an example of the additive nature of threats for this species, which results in an overall medium threat score, even though most individual threats are considered to have a low impact (over a 10 year period).

A minor loss of nesting trees and foraging habitat will impact a small proportion of the Pacific Great Blue Heron population, primarily in the Lower Fraser River Valley, where development pressure is greatest. Habitat loss to development will be of moderate to serious severity for breeders displaced by nest tree loss and wintering immatures who find themselves in stiffer competition for foraging areas not lost to commercial development.

IUCN – CMP Threat 2. Agriculture & aquaculture

Threat 2.4 Marine & freshwater aquaculture

Netting and other structures surrounding shellfish aquaculture, salmon operations and hatcheries can negatively impact Pacific Great Blue Herons. Herons can become ensnared in netting, causing injury or death. This threat will impact a small proportion of the overall population with a moderate to slight severity to those individuals. Commercial development on agricultural land, such as greenhouses, is discussed under Threat 1.

IUCN – CMP Threat 4. Transportation and Service Corridors

Threat 4.1 Roads & railroads

Birds flying over a road encounter the risk of a collision while birds foraging in roadside ditches may be disturbed or killed by traffic. A large proportion of the Canadian population of Pacific Great Blue Heron encounter at least one road each day (GBHE

working group pers. comm. 2014). Herons at the largest colony on the South Coast (Tsawwassen, about 700 nesting individuals) must fly over the BC Ferries causeway multiple times per day to reach their intertidal foraging grounds. Roads associated with commercial development in the South Coast are slated to be built in the near future, further increasing this danger. This predicted impact of this threat is low. Although the number of birds struck may be small, the threat from roads affects a large proportion of the population.

Threat 4.2 Utility and Service Lines

The building and maintenance of utility corridors can be an additional cause of habitat loss and colony disturbance. A large proportion of the Pacific Great Blue Heron population regularly crosses powerlines or is potentially disturbed by powerline maintenance adjacent to a colony (K. Welstead pers. comm. 2015). There are at least two recent examples where the clearing and maintenance of utility corridors have come in close proximity to active Pacific Great Blue Heron colonies. It should be noted that neither colony was abandoned due to the work (GBHE working group pers. comm. 2013). As powerline maintenance and construction is primarily in heavily developed areas, as are the largest colonies, a large proportion of individuals are predicted to be affected. However, the overall impact of this threat is predicted to be low because the severity of powerline activity is slight.

IUCN – CMP Threat 5. Biological Resource Use

Threat 5.3 Logging and Wood Harvesting

Logging of suitable nest trees and habitat adjacent to colonies can result in both direct habitat loss and disturbance (Forbes 1985b; Vennesland 2000). There is at least one recent case where logging occurred within a few hundred metres of nest trees and may have contributed to colony abandonment (GBHE working group pers. comm. 2013). Affected individuals likely move to another colony with a resulting short-term decrease in productivity. Loss of nest trees and associated disturbance is considered a low threat since displacement of a small proportion of the population will have a slight impact on displaced individuals.

IUCN – CMP Threat 6. Human Intrusions and Disturbance

Threat 6.1 Recreational Activities

Recreational activities in this context are broadly defined as any human leisure activity that can disturb Pacific Great Blue Herons (e.g., use of parkland, dogs running offleash, paddleboarding, etc). Recreation can disturb nesting Pacific Great Blue Herons (Vos et al. 1985; reviewed by Parnell et al. 1988; Vennesland and Butler 2011). Colony abandonments have been linked to repeated pedestrian intrusions (Mark 1976; Rodgers and Smith 1995; Vennesland and Butler 2004; Eissinger 2007). Even low level pedestrian activity near colonies has been linked with reduced nesting productivity (Vennesland and Butler 2004). People and their pets come into contact with colonies and foraging grounds while walking in the forest, on dykes and beaches, allowing their

dogs off leash, fishing in shallow intertidal areas, and the use of small watercrafts, such as paddleboarding (GBHE working group pers. comm. 2014).

Pacific Great Blue Herons nesting in highly developed areas of British Columbia sometimes become habituated to human activities (e.g., Stanley Park in Vancouver and Beacon Hill Park in Victoria; Butler 1997; Vennesland 2000). However, rural colonies respond to disturbances at greater distances. At one colony on Vancouver Island (Quamichan Lake, Duncan), adults flushed from their nests when a human approached within 200 m (prior to eggs being laid), 100 m (after eggs were laid), and 10 m (after chicks were hatched; Butler 1991).

Although Pacific Great Blue Herons at some urban sites may not noticeably respond to human activity, productivity at these locations has been negatively correlated with the level of human activity near colonies (Vennesland 2000; Vennesland and Butler 2004).

Disruption of nesting activities by recreational disturbance is a low impact threat to Pacific Great Blue Herons. Although a large proportion of the Canadian population will be affected through impacts to nesting success and colony dynamics, the overall severity is slight.

IUCN – CMP Threat 8. Invasive and Problematic Species and Genes

Threat 8.2 Problematic Native Species

Bald Eagles are the primary predator of the Pacific Great Blue Heron and represent an important threat for the Canadian population (COSEWIC 2008). Raptor populations have been recovering after heavy population declines in the mid-20th century due to contaminants such as dichlorodiphenyltrichloroethane (DDT) (Bednarz et al. 1990; Kjellen and Roos 2000; Butler and Vennesland 2000; Elliott and Harris 2001; Jones 2010). Bald Eagle numbers on the south coast of British Columbia have recovered significantly since the mid-1980s (Elliott and Harris 2001; Jones 2010). Jones (2010) reported that the number of known Bald Eagle nests in the Lower Fraser River Valley increased more than threefold from 1987 to 2006. As Bald Eagle numbers have increased, attacks on Pacific Great Blue Herons appear to have increased. Norman et al. (1989) found one eagle attack/10.3 hours in 1988, while Vennesland and Butler (2004) found one eagle attack/4.3 hours in 1999. Bald eagle attacks are considered to be a primary reason for reduced nesting productivity and higher rates of colony abandonment in recent years (Butler et al. 1995; Vennesland and Butler 2004). Bald Eagles also occasionally attack and kill adult and juvenile herons (Butler 1997; Vennesland and Butler 2011).

Pacific Great Blue Herons appear to have responded to increasing Bald Eagle predation by shifting from nesting in a few large colonies to either nesting in smaller colonies or nesting in close proximity to an active eagle nest (Jones 2009). By nesting near an active Bald Eagle nest, some Pacific Great Blue Herons pay a cost in lost eggs, nestlings and adults but the colony many benefit from reduced overall predation as

territory defense by the nesting eagles reduces the incidence of depredation by other juvenile and non-territorial Bald Eagles (Jones et al. 2013). However, if a nesting pair of eagles fails or abandons their territory then the Pacific Great Blue Herons are once again vulnerable to increased predatory incursions (Jones 2010).

The effects of Bald Eagle predation on both nesting productivity and adult mortality is pervasive throughout the Canadian range of the Pacific Great Blue Heron and is predicted to have a moderate severity on the affected population. This threat thus has the highest overall impact score of all threats considered for this species, with a predicted impact of medium.

IUCN – CMP Threat 9. Pollution

Threat 9.2 Industrial and Military Effluents

Pacific Great Blue Herons rely year round on near shore and intertidal environments for foraging (Butler 1997, COSEWIC 2008). foraging areas are concentrated in a narrow strip along shorelines, and in rich foraging locations (such as Boundary Bay on the Fraser River delta) where hundreds of herons can gather to feed. Due to the large number of commercial and recreational ships that use this area, and the small zone of the marine environment available for heron foraging, these habitats are under threat from pollution from both large acute emissions (e.g., catastrophic oil spills) and smaller chronic emissions (e.g., small oil emissions from sewers or recreational boaters). The impact of these pollution sources has not been quantified for Pacific Great Blue Herons, but is a threat to populations, especially in the Strait of Georgia.

Pollution from industrial contaminants in the environment (e.g., organochlorine pesticides, polychlorinated biphenyls, dioxins, furans) were seen historically as a significant threat to Pacific Great Blue Heron populations (reviewed by Butler 1992). But recent research has shown that the prevalence of some of these contaminants has decreased and no longer poses a significant threat to this species (reviewed by Vennesland and Butler 2011). However, although society has successfully reduced many contaminants in the environment, new chemicals are emerging that might pose a threat to the Pacific Great Blue Heron in the future. In particular, concentrations of polybrominated diphenyl ethers (PBDEs) have been reported to be increasing exponentially in Pacific Great Blue Heron tissues in British Columbia and might be close to toxicologically significant levels (Elliott et al. 2005). The implications of this situation are not well understood, but this is seen as a potential threat for the Pacific Great Blue Heron (Elliott et al. 2005).

5. Management Objective

To ensure that all conservation regions across coastal British Columbia have stable or locally increasing numbers of Pacific Great Blue Herons.

Rationale for management objective

In the context of this management objective, stability for each Great Blue Heron Conservation Region is defined as sufficient nesting success/productivity to ensure a stable population persists over the long term without relying on immigration from more productive conservation regions (noting that in some regions, numbers may be naturally limited). Population data is lacking from Haida Gwaii and the Mainland Coast (including associated islands), but in the south it appears that only the Lower Fraser River Valley is currently producing enough young to maintain a stable population (COSEWIC 2008). For population targets, historical population size is difficult to confirm due to a lack of sufficient data on population size prior to the 1980s, but likely would have been larger than at present due to the impact of various threats (e.g., the interaction between humans and Bald Eagles causing significant disturbance; Vennesland and Butler 2004). Consequently, the 2008 population size of 4715 nesting adults should be viewed as a baseline from which population dynamics should be measured.

In the short term (five years), numbers within each conservation region should be determined and managed to remain stable (or increasing). Over the longer term (ten years), research should clarify more objective targets for each conservation region to ensure population targets that will ensure viability over the longer term (see Broad Strategies and Conservation Measures below).

6. Broad Strategies and Conservation Measures

6.1 Actions Already Completed or Currently Underway

Habitat Protection and Threat Mitigation:

- Adult birds and their nests, eggs and nestlings are protected under *Migratory Birds Convention Act* (MBCA) and BC *Wildlife Act*. Unlike other species protected under MBCA, Pacific Great Blue Herons nests (and thus their nest trees) are protected year round by Section 34 of the *Wildlife Act*.
- Develop with Care factsheets (Ministry of Forests, Lands and Natural Resource Operations 2014) have been published to set environmental guidelines for urban and rural land development in British Columbia. These factsheets outline legal protection for Pacific Great Blue Herons and their colonies and recommend best practices for development for landowners and land managers.
- Many of the large colonies are under various levels of protection including municipal and regional parks, while others remain unprotected. For a list of both nesting and foraging areas with some existing protection please see the COSEWIC status report (COSEWIC 2008).

Habitat Mapping and Research to Fill Knowledge Gaps:

- There has been a long term nesting success and productivity study program on Vancouver Island and the South Coast. This program has been supported by the

Province of BC, Environment Canada, Parks Canada, the Habitat Conservation Trust Fund, and volunteers. The program tracks active colonies, maps location of nesting habitat, and reports on colony numbers and productivity.

- Contaminant sampling in Pacific Great Blue Herons has been carried out by Environment Canada scientists (Elliott et al. 2005).

6.2 Broad Strategies

The following broad strategies will guide conservation of the Pacific Great Blue Heron in Canada.

1. Habitat mapping – the location of nesting (woodland) and foraging habitat (eelgrass beds, freshwater and estuarine marshes, grassy habitats, ditches, and riversides) needs to be mapped to support its conservation by responsible jurisdictions and landowners. Mapping also needs to be done to identify habitat that should be set aside for future nesting (alternate habitat is required because Pacific Great Blue Heron colonies move locations from time to time).

2. Habitat protection –secure those habitats considered necessary for conservation of the species including existing and alternate habitat. Since many Pacific Great Blue Heron colonies are on private land, a program of incentives (such as Natural Areas Protection Tax Exemption Program and Ecological Gifts Program) could provide landowners incentives for protection of nesting trees and buffers. Promote land stewardship agreements and both provincial and federal protection via Wildlife Habitat Areas and Wildlife Management Areas for nesting and foraging grounds.

3. Habitat stewardship and education –working with individual landowners to ensure that they understand the needs of Pacific Great Blue Herons and adjust landscaping and other human activities accordingly. Create awareness through signage and meeting with community groups to highlight negative effects of human recreation on foraging Pacific Great Blue Herons. Responsible jurisdictions and land owners need to ensure that human disturbance is adequately mitigated on lands they manage or own that have been identified as necessary for the management of the Pacific Great Blue Heron.

4. Research to fill knowledge gaps – Research is required to assess potential methods for mitigation of threats from human disturbance and Bald Eagle predation (CDC 2014), as well as the importance of emerging industrial contaminants (such as PBDEs; COSEWIC 2008). The threat from Bald Eagle predation is currently not well understood, so until further research is conducted, it is not clear what appropriate mitigation options (if any) can be employed. Population modeling is required to better understand the meta-population dynamics between Haida Gwaii, Mainland Coast, Vancouver Island and Lower Fraser River Valley and the numbers required for viability in each of those Conservation Regions. Juvenile herons from wildlife rescues might be able to increase recruitment in some populations; however, more research into this technique is required. Attaching radio or satellite tags onto rehabilitated juveniles could provide valuable information about heron movement patterns.

5. Habitat restoration – Restoration of marine foraging habitat (e.g., eelgrass enhancement, spartina removal) and upland foraging habitat (e.g., planting old field and grassy cover that promote small mammal populations) in the more heavily-developed areas of the coast (especially in the Lower Fraser River Valley), as well as restoration of selected habitats by planting alders or other beneficial vegetation will help ensure that priority nesting and foraging locations remain as functional as possible. This will help to reduce the risk of colonies frequently relocating and provide mature trees for nesting in future.

6.3 Conservation Measures

Table 3. Conservation Measures and Implementation Schedule

Conservation Measure	Priority[a]	Threats	Timing
Broad Strategy 1: Habitat mapping			
Map the location of all nesting locations including buffer areas required for management Ensure maps accessible to landowners and managers	Medium	– 1.1 Housing and Urban Areas – 1.2 Commercial & Industrial Areas – 4.1 Roads & Railroads – 4.2 Utility & Service Lines – 6.1 Recreational Activities	Five years after final posting of the management plan
Map the location and extent of all priority foraging locations (all that are < 10km of important nesting locations) and ground-truth data	Medium	– 1.2 Commercial & Industrial Areas – 2.1 Annual & perennial non-timber crops 6.1 Recreational Activities	Five years after final posting
In regions with potentially limiting nesting habitat, map suitable woodlands for identification as potential alternate nesting locations	Low	– 1.1 Housing and Urban Areas – 1.2 Commercial & Industrial Areas – 4.1 Roads & Railroads – 4.2 Utility & Service Lines – 6.1 Recreational Activities	Five years after final posting
Broad Strategy 2: Habitat protection			
Complete the Heron Working	Low	– 1.1 Housing and	Five years after final

Conservation Measure	Priority[a]	Threats	Timing
Group's online atlas (housed at the Community Mapping Network) as a centralized warehouse of habitat mapping for responsible jurisdictions and landowners		Urban Areas – 1.2 Commercial & Industrial Areas – 2.1 Annual & perennial non-timber crops – 4.1 Roads & Railroads – 4.2 Utility & Service Lines – 6.1 Recreational Activities	posting
Work with responsible jurisdictions and landowners towards the effective conservation of all known nesting and foraging locations and alternate habitat. Implement Wildlife Habitat Areas and Wildlife Management Areas where feasible and appropriate. Institute Natural Areas Protection Incentive Program to gain private landowner support and adopt bylaws in official community plans to protect Great Blue Heron nest sites such as those in Comox Valley RD and Cowichan Valley RD. Protect nesting birds from nest predators such as raccoons.	Medium	– 1.1 Housing and Urban Areas – 1.2 Commercial & Industrial Areas – 2.1 Annual & perennial non-timber crops – 4.1 Roads & Railroads – 4.2 Utility & Service Lines – 6.1 Recreational Activities	Five years after final posting
Broad Strategy 3: Habitat stewardship and education			
Educate those working near, and responsible for managing, heron habitats on how to avoid disturbance	Medium	– 1.1 Housing and Urban Areas – 1.2 Commercial & Industrial Areas – 2.4 Marine & Freshwater Aquaculture – 4.1 Roads & Railroads – 4.2 Utility & Service Lines – 6.1 Recreational Activities	Five years after final posting
Educate the general public on how to avoid disturbance of herons. Work with Wildlife Rescues to promote rehabilitation and release	Low	– 1.1 Housing and Urban Areas 6.1 Recreational Activities	Five years after final posting

Conservation Measure	Priority[a]	Threats	Timing
of birds.			
Broad Strategy 4: Research to fill knowledge gaps			
Conduct ongoing colony monitoring to track numbers and assess efficacy of management activities	Medium	– All	ongoing
Determine effective methods for mitigating the impact of Bald Eagles	High	– 8.2 Problematic Native Species	Five years after final posting
Conduct population modelling to understand metapopulation dynamics, define population viability, and set population targets	Medium	– All	2020
Engage wildlife rescues to foster and release nestlings and track yearlings upon release to investigate metapopulation dynamics	Medium	– All	ongoing
Work with toxicologists to ensure further understanding and monitoring of contaminants	Medium	– Pollution	ongoing
Broad Strategy 5: Habitat restoration			
Where opportunities exist, restore forested nesting habitat in areas where habitat is currently limiting, or will be in the future	Low	– 1.1 Housing & Urban areas – 1.2 Commercial & Industrial areas – 4.1 Roads & railroads – 4.2 Utility & Service Lines – 5.3 Logging and wood harvesting	ongoing
Where opportunities exist, restore marine and upland foraging habitat in areas where habitat is likely to be limiting in the future and map habitat likely to be restored	Low	– 1.1 Housing & Urban areas – 1.2 Commercial & Industrial areas – 2.1 Annual & perennial non-timber crops – 4.1 Roads & railroads	ongoing

[a] Priority reflects the degree to which the measure contributes directly to the conservation of the species or is an essential precursor to a measure that contributes to the conservation of the species. High priority measures are considered those most likely to have an immediate and/or direct influence on attaining the management objective for species. Medium priority measures may have a less immediate or less direct influence on reaching the management population and distribution objectives, but are still important for

management of the population. Low priority recovery measures will likely have an indirect or gradual influence on reaching the management objectives, but are considered important contributions to the knowledge base and/or public involvement and acceptance of species.

7. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the management objective. Every five years, success of this management plan implementation will be measured against the following performance indicators:

- Research has been conducted to better understand and manage disturbance by Bald Eagles and humans and threats from pollutants.
- Nesting and foraging habitats have been mapped.
- In areas where nesting habitat may be limiting, unoccupied woodlands have been identified for alternate nesting habitat.
- Ongoing colony monitoring has improved tracking of numbers, breeding success, and measures of the efficacy of management activities.
- Information regarding Pacific Great Blue Heron colonies and habitat has been integrated into a centralized data warehouse.
- Land owners and land managers have received proper guidance and education to effectively manage lands with priority nesting and foraging habitats and habitat protection measures such as WMAs and NAPI have been explored.
- Population modeling has been conducted to better assess numbers, viability, and set targets.
- Habitat restoration projects have been identified and completed in areas where habitat may be limiting.
- Ensure Pacific Great Blue Heron numbers persist in all currently occupied Conservation Regions of coastal British Columbia.

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9. PERSONAL COMMUNICATIONS:

Butler, Rob. Heron expert. Pacific WildLife Foundation via email to Holly Middleton 2014.

Chatwin, Trudy. Species at Risk Biologist, British Columbia Ministry of Forests, Lands and Natural Resource Operations via phonecall to Holly Middleton 2014.

Great Blue Heron Working Group comprised of Ross Vennesland (PCA), Trudy Chatwin (BC MFLNRO), Myke Chutter (BC MFLNRO), Berry Wijdeven (BC MFLNRO) via phonecall to D. Shervill 2013.

Great Blue Heron Working Group comprised of Ross Vennesland (PCA), Trudy Chatwin (BC MFLNRO), Myke Chutter (BC MFLNRO), Berry Wijdeven (BC MFLNRO) via Phonecall to D. Shervill 2014.

Welstead, Kym. Species at Risk Biologist, British Columbia Ministry of Forests, Lands and Natural Resource Operations via email to Holly Middleton 2015.

APPENDIX A: 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 and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[1] goals and targets.

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

Conservation and management of foraging habitat for Pacific Great Blue Heron may have indirect benefits for intertidal ecosystems and the species associated with them, including salmon, eel grass beds and migrating shorebirds. Conservation and management of nesting habitat in the Coastal Douglas Fir Biogeoclimatic Zone may provide indirect benefits for over 100 species including breeding passerine birds. By conserving Pacific Great Blue Heron habitat a multitude of species that rely on the same habitats will also benefit. There are not thought to be any negative impacts of management implementation for other species at risk.

[1] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1

Canadian Wildlife Service (CWS)

Comment Table Species at Risk Draft Recovery Documents

Species: _____

Management Plan or Recovery Strategy: _____

Date: _____

Review completed by: _____

Please add rows to the table if more space is needed. Return comments to: SAR.pyr@ec.gc.ca.

General Comments	Response

Recommended References:

Line Number / Table	Comment	CWS Response to Comment
Cover Page / Preface / Acknowledgments		

Line Number / Table	Comment	CWS Response to Comment
EXECUTIVE SUMMARY		
RECOVERY FEASIBILITY SUMMARY		
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5. POPULATION AND DISTRIBUTION OBJECTIVES		

Line Number / Table	Comment	CWS Response to Comment
6. BROAD STRATEGIES AND GENERAL APPROACHES TO MEET OBJECTIVES		
6.1 Actions Already Completed or Currently Underway		
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7. CRITICAL HABITAT		
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Line Number / Table	Comment	CWS Response to Comment
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Thank-you!!

Band-tailed Pigeon
(Special Concern)

The Band-tailed Pigeon gets its name from the grey band on the end of its dark tail. It looks similar to the city-dwelling Rock Pigeon but it is larger, lighter grey, and has a purple-grey head with a white line along the back of its neck. Its bill and feet are yellow.

HABITAT

- Forest edges and openings, urban yards and parks, golf courses, orchards, temperate evergreen rainforest, and agricultural lands for foraging
- Mineral sites and underground springs with minerals

THREATS TO SURVIVAL OR RECOVERY

- Habitat loss and land use changes from some residential and industrial activities, especially at mineral sites
- Some forestry practices that result in fewer fruit-bearing plants and older trees used for nesting
- Vulnerable to parasite infection (e.g., trichomoniasis)
- Direct and indirect pesticide poisoning at foraging and mineral sites

Environment Canada Environnement Canada

Species at Risk Questionnaire

Species name: _____

To help us learn more about this species, please answer the following questions.

1. **Have you seen this species on or near your land?** Never / Sometimes / Often / I don't know
   Comments: _____

2. **Are there activities going on in your area that could benefit this species or its habitat?** Yes / No / I don't know
   If yes, please describe the activities and how these activities can help the species: _____

3. **Are there activities going on in your area that could harm this species or its habitat?** Yes / No / I don't know
   If yes, please explain: _____

4. **Does your land have some or all of the landscape features (e.g. types of trees, water bodies) used by this species?**
   Yes / No
   Comments: _____

Canada

5. **Do you have any comments on threats to this species?** Yes / No
   Comments: _____

6. **Do you have any additional information that may help us develop recovery plans for this species?**

7. **Is there anything else you would like to add?**

8. **Would you like more information on how you can help conserve species at risk?** Yes / No
   If yes, please provide your contact information below.

Name: _____
Phone: _____
Email: _____
Address: _____

Thank you for your feedback. If there is anything you would like to add or any questions you would like to ask about species at risk please contact us at SAR.pyr@ec.gc.ca or 604-350-1900.

DRAFT

Species at Risk Act
Management Plan Series

Management Plan for the Band-tailed Pigeon (*Patagioenas fasciata*) in Canada

Band-tailed Pigeon

2015

Environment Environnement
Canada

Recommended citation:

Environment Canada. 2015. Management Plan for the Band-tailed Pigeon (*Patagioenas fasciata*) in Canada [Draft]. *Species at Risk Act* Management Plan Series. Environment Canada, Ottawa. ii + 18pp.

For copies of the management plan, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the SAR Public Registry[1].

Cover illustration: © Bruce Whittington

Également disponible en français sous le titre
« French document title»

ISBN ISBN to be included by SARA Responsible Agency
Catalogue no. Catalogue no. to be included by SARA Responsible Agency

[1] www.registrelep.gc.ca/default_e.cfm

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[2] agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of management plans for species listed as Special Concern and are required to report on progress five years after the publication of the final document on the SAR public registry.

The Minister of the Environment is the competent minister under SARA for the management of the Band-tailed Pigeon and has prepared this management plan, as per section 65 of SARA. It has been prepared in cooperation with the province of British Columbia and Parks Canada Agency as per section 66(1) of SARA.

Success in the conservation 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 plan and will not be achieved by Environment Canada or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this plan for the benefit of the Band-tailed Pigeon and Canadian society as a whole.

Implementation of this management plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Acknowledgments

A draft management plan was prepared by Canadian Wildlife Service Atlantic Region. Greg Ferguson and Holly Middleton of Environment Canada finalized the management plan with input from the Province of British Columbia (Trudy Chatwin, Myke Chutter and Peter Fielder), and a regional species expert (Andre Breault).

[2] http://registrelep-sararegistry.gc.ca/default.asp?lang=En&n=6B319869-1%20

Executive Summary

The Band-tailed Pigeon (*Patagioenas fasciata*) is similar to the familiar Rock Pigeon (*Columba livia*), but has a faster, more direct flight, white crescent on the back of the head, and a dark tail with a grey terminal band. The species is listed as Special Concern under Schedule 1 of the *Species at Risk Act*.

The Canadian breeding range is restricted to southern British Columbia, mainly on southern Vancouver Island and along the mainland coast. The Canadian population is estimated very roughly at 43,000-170,000 individuals, which is about 5% of the global population. At the time of the last COSEWIC status report in 2008, its population may have declined by 11.2% over the preceding three generations, but possibly increased over the last five years.

Primary threats to the Band-tailed Pigeon include forestry practices, urban and industrial development and climate change.

The management objective for the Band-tailed Pigeon is to maintain the Canadian population at its current population size and distribution.

The broad strategies and conservation measures required to achieve the management objective are presented in Section 6. Conservation measures in this management plan fall under three broad strategies: population monitoring and surveys, habitat conservation and stewardship, and research.

Table of Contents

1. COSEWIC Species Assessment Information

Date of Assessment: November 2008

Common Name: Band-tailed Pigeon

Scientific Name: *Patagioenas fasciata*

COSEWIC Status: Special Concern

Reason for Designation: This large pigeon has suffered long-term declines throughout its range in the western mountains of North America, due in part to overhunting. Harvest has been severely limited in Canada for the past 16 years. Although population surveys (e.g. Breeding Bird Survey and mineral site counts) have low precision, they do suggest a stabilization of the population in the last decade. The species is long-lived (up to 22 years) and has a slow reproductive rate; females typically lay only one or two eggs per year. Forestry may negatively affect habitat in the long term, creating dense second-growth forests with few berry-producing shrubs; the pigeons also are susceptible to disturbance at isolated mineral sources needed for their nutrition.

Canadian Occurrence: British Columbia
COSEWIC Status History: Designated Special Concern in November 2008.

COSEWIC – Committee on the Status of Endangered Wildlife in Canada

2. Species Status Information

The Band-tailed Pigeon (*Patagioenas fasciata*) is listed as Special Concern[3] under SARA. The species is also listed as Least Concern by the International Union for Conservation of Nature (IUCN) (2014). Natureserve ranked the species as G4[4] (2000) globally, N3N4B[5] (2011) in Canada and S3S4B[6] (2009) in British Columbia. The species is Blue-listed by the British Columbia Conservation Data Centre (B.C. CDC 2009). The entire Canadian population resides in British Columbia and comprises approximately 5% of the global population.

3. Species Information

3.1. Species Description

The Band-tailed Pigeon is a large dark pigeon (length 40 cm, weight 350 g), superficially similar to the familiar Rock Pigeon (*Columba livia*), but with a fast direct flight, purple-grey head, white crescent on the back of the neck, dark tail with a grey terminal band, and yellow bill and feet. Six morphologically and geographically distinct subspecies are recognized, but only one of these subspecies occurs in Canada, *P. f. monilis*.

3.2. Populations and Distribution

The Band-tailed Pigeon breeds from British Columbia (B.C.) to northern Argentina (Figure 1). In Canada, they breed only in B.C.; mainly on southern Vancouver Island and along the mainland coast north to Alta Lake. Their occurrence in B.C. is highest on the south coast of the mainland and Vancouver Island with smaller numbers stretching as far north as Hazelton and Fort Saint James and eastward into the Kootenay Region. Most birds breeding in Canada winter in the US Pacific Coast states, especially California. A few stay in B.C. year-round. The species is sometimes observed in other Canadian provinces as far east as New Brunswick (COSEWIC 2008). Current population estimates based on Breeding Bird Surveys are considered poor (COSEWIC

[3] Special Concern (SARA): A wildlife species that may become a threatened or endangered species, because of a combination of biological characteristics and identified threats.
[4] G4: Global status apparently secure
[5] N3N4B: National status vulnerable and apparently secure
[6] S3S4B: Provincial status vulnerable and apparently secure

2008).The Canadian population may be 43,000-170,000 individuals, but this estimate is neither precise nor robust (COSEWIC 2008). The population appears to have declined historically (COSEWIC 2008). However, improved population monitoring (using counts at mineral sites) conducted between 2001 and 2005 suggested that numbers within the Pacific Flyway were again increasing (COSEWIC 2008).

Figure 1. North American range of the Band-tailed Pigeon (COSEWIC 2008).

3.3. Needs of the Band-tailed Pigeon

The Band-tailed Pigeon eats mainly grain, fruit, acorns, pine nuts, and the flowers and new buds of shrubs and trees, with the relative amounts of each varying seasonally (Neff 1947, Jarvis and Passmore 1992, Keppie and Braun 2000). Oak (*Quercus* spp.), Pacific Madrone (*Arbutus menziesii*) *Rubus* spp., *Prunus* spp., cascara (*Rhamnus purshiana*) and elderberries (*Sambucus* spp.) are important food sources for breeding and wintering birds in Canada (Campbell et al. 1990, Keppie and Braun 2000). They usually feed in small flocks, mostly in early morning, depleting one food source before moving to the next, and usually roosting for prolonged periods afterward (Braun 1976, Keppie and Braun 2000). Feeding areas can be far removed from nesting areas (Keppie and Braun 2000), averaging 5 km and to a maximum of 50 km in one U.S. study

(Leonard 1998). Food availability affects the timing of breeding (Gutierrez et al. 1975) and likely affects nesting success (Braun 1994).

During the breeding season (March through September) (Keppie and Braun 2000), the Band-tailed Pigeon uses a variety of habitats in coastal B.C., including forest edges and openings, urban backyards, urban parks, bushland, golf courses, and orchards (Campbell et al. 1990). Farther from the coast they mainly breed in coniferous rainforest up to 300 m elevation (Keppie and Braun 2000), although in the interior they do occur in montane forest (Campbell et al. 1990). Proximity to food sources (particularly oak and madrone) appears to be an important habitat requirement (Keppie and Braun 2000). Studies in the U.S. suggest that mature, closed-canopy conifer stands are preferred for breeding (Manuwal 1991, Carey et al. 1991, Leonard 1998).

Mineral sites are an important habitat feature. On rangeland, this may be satisfied by salt licks (Packard 1946) and in the interior of B.C., by strongly basic grit (Braun 1994). The essential mineral appears to be sodium, which is needed to counteract an overload of potassium that the birds gain from feeding on fruit (Sanders and Jarvis 2000). Mineral sites for the Band-tailed Pigeon usually occur where underground springs come to the surface. Along B.C.'s coast this usually occurs in estuaries (COSEWIC 2008). Favoured mineral sites tend to have nearby perches, trees and shrubs for cover, low disturbance from humans, and historical use by large numbers of Band-tailed Pigeons (Sanders and Jarvis 2000, Casazza 2006).

During winter and migration, the Band-tailed Pigeon uses open areas with food supplies, including backyard bird feeders. Winter habitat includes open woodland and edges with berries and acorns. Fall migrants use open coniferous habitat near farmland, shorelines with mineral sites, riparian habitat, railways, farmyards, and regenerating clearcuts (Campbell et al. 1990, COSEWIC 2008).

Intrinsic factors limiting Band-tailed Pigeon include low annual productivity and the seasonal reliance on mineral sites. They are long-lived (up to 22 years) and have a low reproductive rate, laying one or two one-egg clutches per year (although populations in the U.S. are known to have 2 broods per year). Therefore, populations are slow to recover from declines (COSEWIC 2008). The sparse distribution of mineral sites may limit the distribution of the Band-tailed Pigeon in Canada (COSEWIC 2008).

4. Threats

4.1. Threat Assessment

Table 1. IUCN threats summary for the Band-tailed Pigeon in Canada

Threat No.	Threat Description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Low	Small	Moderate	High

1.1	Housing & urban areas	Low	Small	Moderate	High
1.2	Commercial & industrial areas	Low	Small	Slight	High
2	Agriculture & aquaculture	Low	Small	Slight	High
2.1	Annual & perennial non-timber crops	Low	Small	Slight	High
2.4	Marine & freshwater aquaculture	Negligible	Negligible	Slight	High
5	Biological resource use	Low	Restricted	Moderate	High
5.1	Hunting & collecting terrestrial animals	Negligible	Negligible	Negligible	High
5.3	Logging & wood harvesting	Low	Restricted	Moderate	High
6	Human intrusions & disturbance	Low	Small	Slight	High
6.1	Recreational activities	Low	Small	Slight	High
8	Invasive & other problematic species & genes	Low	Small	Slight	Moderate
8.1	Invasive non-native/alien species	Negligible	Negligible	Slight	High
8.2	Problematic native species	Low	Small	Slight	Moderate
9	Pollution	Low	Small	Slight	High
9.3	Agricultural & forestry effluents	Low	Small	Slight	High
11	Climate Change & Severe Weather	Low	Restricted	Moderate	High
11.1	Habitat shifting & alteration	Low	Restricted	Moderate	High

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

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

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or 3-generation timeframe. For this species a generation time of 6 years (COSEWIC 2008) was used resulting in severity being scored over a 18-year timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

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

4.2. Description of Threats

Although no single threat to the Band-tailed Pigeon scores above a low impact level, the cumulative score is medium as a result of a large number of low-level threats. Of the threats listed below, the most important are those associated with land use activities that have the potential to impact habitat availability and quality at a large scale.

IUCN Threat 1. Residential & Commercial Development

Threat 1.1 - Housing & Urban Areas; Threat 1.2 - Commercial & Industrial Areas

In the last few decades of the last century, urbanization and industrialization resulted in the loss of second-growth mixed forest along the Fraser River and on southeastern Vancouver Island (Cooper 2002). The Band-tailed Pigeon is found in urban environments, particularly in older neighbourhoods that have abundant trees and shrubs, but they are rare in newer developments where most of the trees have been removed (A. Breault, pers. comm, 2014). Industrial activities, in particular road paving and associated traffic, have caused disturbance at mineral sites in British Columbia (COSEWIC 2008). As a result of the small scope of development, these two threats are considered low concern to the recovery of the Band-tailed Pigeon.

IUCN Threat 2. Agriculture & aquaculture

Threat 2.1 Annual & perennial non-timber crops

Crop cover in the agricultural lands of the eastern Fraser Valley has resulted in the loss of hedgerows and shrubby areas where the Band-tailed Pigeon feeds and in an increase in berry production (primarily blueberries). The use of noise cannons at some blueberry farms to deter fruit-eating birds might adversely impact foraging and mineral site use near these farms (A. Breault, pers. comm., 2014). This threat impacts a small proportion of the B.C. population and is considered to be of low concern to the recovery of the Band-tailed Pigeon.

Threat 2.4 Marine & freshwater aquaculture

The Baynes Sound area of Vancouver Island supports the highest concentration of aquaculture operations in B.C.. Aquaculture intertidal leases are tended (i.e., put into operation) at regular intervals and there is one report of disturbance associated with aquaculture operations that has kept the Band-tailed Pigeon from accessing an intertidal mineral site (A. Breault, pers. comm., 2014). Information on the distribution and abundance of mineral sites in intertidal areas is insufficient to assess potential interactions between aquaculture operations and the Band-tailed Pigeon. Given the footprint of aquaculture operations in southwestern B.C., the broad range of the Band-tailed Pigeon on the B.C. Coast and the fact that aquaculture operations are not tended on a daily basis, this threat is considered to be of low concern to the recovery of the Band-tailed Pigeon.

IUCN Threat 5. Biological Resource Use

Threat 5.1 Hunting & collecting terrestrial animals

The Band-tailed Pigeon is hunted in both Canada and the US. Although hunting is currently at a sustainable level in both countries, historical overhunting was likely a causal factor of severe population declines in the past. The species is particularly easy to overhunt because of its propensity to flock, even in areas where they are hunted, and even when shot at (COSEWIC 2008). Moreover, hunting may have a particularly strong population-level effect on this species because of its slow reproductive rate, with high

adult survival rate but low clutch size (COSEWIC 2008). The restrictions implemented on the Band-tailed Pigeon hunt in B.C. since 2002 (i.e. shortened season from 30 to 15 days, delayed season opening date from September 1 to September 15, and reduced bag limit from 10 to 5 daily) and the low number of active hunters (mean = 80 hunters from 2002 to 2013) have resulted in a low estimated harvest (mean = 117 from 2002-2013) for the species (B.C. Wildlife Branch, unpubl. data). The current harvest is sustainable and is considered to be of little concern to the recovery of the Band-tailed Pigeon, but will continue to be monitored by the Canadian Wildlife Service.

Threat 5.3 Logging & wood harvesting

The Band-tailed Pigeon likely benefitted from past logging practices of the 19th century which resulted in forests with varied seral[7] stages. Conversely, recent replacement of structurally complex old growth forest with more even-aged stands is thought to have contributed to recent population declines, especially in the US (COSEWIC 2008). Herbicide use on deciduous vegetation to promote conifers probably also degrades habitat by killing fruit-bearing shrubs and trees (eg. cascara) (Braun 1994, Mathewson 2005). As this threat impacts up to 30% of the B.C. population and can have a moderate level of severity on the population, this threat is among those of highest concern for the recovery of the Band-tailed Pigeon.

IUCN Threat 6. Human Intrusions & Disturbance

Threat 6.1 Recreational activities

In Oregon, 20% of mineral sites were likely abandoned because of human disturbance (Overton et al. 2006). Recreational use of hot springs appears to account for decreases in pigeons at adjacent mineral sites (Overton 2003, Overton et al. 2006). Forms of human disturbance noted at British Columbia mineral sites include the regular presence of joggers, vehicle traffic, and photographers (COSEWIC 2008). As a result of the small scope of disturbance, this threat is considered low concern to the recovery of the Band-tailed Pigeon.

IUCN Threat 8. Invasive & Problematic Species and Genes

Threat 8.1 Invasive non-native/alien species

Although unproven, it seems likely that rats (*Rattus* sp.), domestic cats (*Felis catus*) and Gray Squirrels (*Sciurus carolinensis*) may predate Band-tailed Pigeon nests. This unconfirmed threat likely impacts a small proportion of the B.C. population and is considered to be of low concern to the recovery of the Band-tailed Pigeon.

Threat 8.2 Problematic native species

[7] An intermediate stage found in ecological succession in an ecosystem advancing towards its climax.

The parasite *Trichomonas gallinae* infects the Band-tailed Pigeon (Stabler and Braun 1979). Large outbreaks have killed tens of thousands of Band-tailed Pigeons in California in 1988 (Braun 1994) and 2007 (Girard et al. 2014). Trichomoniasis outbreaks are undocumented in Canada and are expected to be infrequent in timing. Native hawks and falcons are suspected to kill adult birds and Common Raven (*Corvus corax*), Steller's Jay (*Cyanocitta stelleri*), and tree squirrels (*Sciurus* and *Tamiasciurus* spp.) are likely the main predators of eggs and nestlings. The threat from trichomonas and native predators is considered low concern to the recovery of the Band-tailed Pigeon.

IUCN Threat 9. Pollution

Threat 9.3 Agriculture & forestry effluents

The Band-tailed Pigeon has been poisoned with avicides, and are exposed to various agricultural chemicals because they rely heavily on agricultural areas for foraging. Many mineral sites are in estuaries, which concentrate agricultural and industrial chemicals, such as heavy metals, hydrocarbons, and PCBs (COSEWIC 2008). Exposure to pollutants is expected to be of a small scope and slight severity to the population, therefore, this threat is considered low concern to the recovery of the Band-tailed Pigeon.

IUCN Threat 11. Climate change & severe weather

Threat 11.1 Habitat shifting & alteration

Climate change could benefit the Band-tailed Pigeons in Canada if Pacific Coast summers become longer and warmer, and coastal forests develop higher densities of fruiting shrubs used by the pigeon as food source plants (COSEWIC 2008). However, increases in the frequency and several of droughts could offset that by reducing food availability seasonally. Overall, the impact of climate change is considered low.

5. Management Objectives

The management objective for the Band-tailed Pigeon is to maintain the Canadian population at its current size and distribution.

Rationale:

The species was designated as Special Concern because, while it appears to have been stable recently, it still faces several potential threats from which it may be slow to recover. Also, although the longevity of individuals is high, their overall reproductive rate is low. Thus this management objective is chosen to guard against possible future declines.

6. Broad Strategies and Conservation Measures

6.1. Actions Already Completed or Currently Underway

Population and trend assessment:

1- Monitoring mineral sites is currently believed to be the most effective means of assessing Band-tailed Pigeon trends at the population level. The Canadian Wildlife Service started identifying mineral sites in British Columbia in 2001 and will continue to do so annually on an ongoing basis. The Canadian Wildlife Service has monitored three to four mineral sites annually since 2002 (COSEWIC 2008) and a fifth mineral site since 2013 to determine regional trends and contribute to the Pacific Flyway trend assessment (A. Breault, pers. comm. 2014).

2- The Canadian Wildlife Service's National Harvest Survey (NHS) (which consists of the Harvest Questionnaire Survey and the Species Composition Survey) annually assesses the number of active hunters and the Band-tailed Pigeon harvest. The NHS will continue to be conducted annually to ensure that hunting is kept at a sustainable level. CWS and the B.C. Ministry of Forests, Lands and Natural Resources Operations work together to ensure that hunting limits are set to reflect population status and threats. The Province also estimates harvest and supplies this data to CWS.

3- The Canadian Wildlife Service will continue to monitor band returns of birds hunted to determine population trends, demography and population connectivity.

6.2. Broad Strategies

In order to achieve the management objective, conservation measures will be organized under the following three broad strategies:

1. Population monitoring and surveys
2. Habitat conservation and stewardship
3. Research

6.3. Conservation Measures

Table 2. Conservation measures and implementation schedule.

Conservation Measure	Priority[8]	Threats or Concerns Addressed	Timeline
Broad strategy: Population monitoring and surveys			
Develop population monitoring plan	High	All	2015-2017
Identify new and used mineral sites	High	All	2015-2017
Conduct counts at mineral sites at regular intervals	High	All	2015-2024
Use mark-recapture methods at mineral sites to refine population estimates	Medium	All	2015-2024
Continue to monitor harvest and regulate at sustainable levels	High	IUCN Threat 5.1	2015-2024
Broad strategy: Habitat conservation and stewardship			
Identify the ownership and conservation status of known mineral sites	High	IUCN Threats 1.1, 2.4, 6.1	2015-2017
Examine approaches to the conservation of mineral sites on private lands, including: conservation easements, donations, and acquisition	High	IUCN Threats 1.1, 2.4, 6.1	2015-2017
Contact land managers and owners at known mineral sites and engage them in stewardship activities	Medium	IUCN Threats 1.1, 2.4, 6.1	2015-2024
Broad strategy: Research			
Determine effects of forestry practices, particularly seral diversity, on breeding habitat	High	IUCN Threat 5.3	2015-2024
Identify set-back distances, vegetative cover, and perch availability needed to minimize disturbance at mineral sites	Medium	IUCN Threat 1.1, 2.4, 5.3, 6.1	2015-2018
Determine impact of parasitism and identify approaches to mitigate future outbreaks	Medium	IUCN Threat 8.2	2015-2024
Identify levels of contaminants in the Band-tailed Pigeon in documented foraging habitats and mineral sites, and determine physiological and population effects	Medium	IUCN Threat 9.3	2015-2024

[8] Priority reflects the degree to which the measure contributes directly to the conservation of the species or is an essential precursor to a measure that contributes to the conservation of the species. High priority measures are considered those most likely to have an immediate and/or direct influence on attaining the management objective for species. Medium priority measures may have a less immediate or less direct influence on reaching the management population and distribution objectives, but are still important for management of the population. Low priority recovery measures will likely have an indirect or gradual influence on reaching the management objectives, but are considered important contributions to the knowledge base and/or public involvement and acceptance of species.

Determine whether predation is a concern at the population level	Low	IUCN Threat 8.1 and 8.2	2015-2024

6.4. Narrative to Support Conservation Measures and Implementation Schedule

A population monitoring plan will be developed to track whether the management objectives are being met. Identification of currently unknown mineral sites used by the pigeons will contribute to better population estimates and will also help to direct stewardship and conservation efforts. Counts at mineral sites appear to be the best available method for monitoring population trends, provided they are applied consistently (Casazza 2006). Banding large numbers of birds can provide an index of population size, survival and harvest rate and marking a subset of birds with satellite transmitters at mineral sites will allow for a better characterization of habitat use and home range of the species. Current population estimates based on Breeding Bird Surveys are considered poor (COSEWIC 2008).

Habitat conservation and stewardship efforts should focus on mineral sites, because these are particularly important and sensitive locations for this species (COSEWIC 2008). The objective will be to minimize fragmentation, pollution and disturbance. Land ownership and existing conservation measures varies at each site. Therefore, identifying the most appropriate conservation approach for each site is important. A separate, but equally important conservation measure is hunting regulation; overhunting in the US has led to population declines in the past, so the successful current restrictive harvest regulations, and monitoring of hunting, should be maintained.

Research is needed to fill knowledge gaps so that further conservation measures can be identified. Particularly pressing is the need for better characterization of the forest and land use types that support the species and forestry practices that improve or degrade breeding habitat. Evidence from U.S. studies (reviewed in COSEWIC 2008) suggests that replacement of more structurally variable old–growth forests by even–aged stands can lead to declines in habitat, including the fruit bearing shrubs and trees that are important food sources for the species. However, documented evidence is scarce. The effects of disturbance on mineral site use is well documented but research is needed to establish appropriate set-back distances for human activity, and retentions targets for vegetative cover and perch features (COSEWIC 2008). Recurring trichomoniasis outbreaks are likely. Research into population level impacts of outbreaks and the efficacy of parasitism mitigation measures are warranted. The impacts of pollution and introduced predators are poorly understood. Key research activities will include measuring contaminant levels and their physiological and population effects on the Band-tailed Pigeon across representative habitats and measuring predation rates and their effects on the viability of the Canadian population.

7. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the management objectives for the Band-tailed Pigeon. Success of the implementation of this management plan will be evaluated every five years against the following indicators:

- the population size of Band-tailed Pigeons is maintained
- the distribution of Band-tailed Pigeons is maintained

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APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*[9]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or achievement of any of the Federal Sustainable Development Strategy's[10] (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of management plans 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 management plan itself, but are also summarized below in this statement.

This management plan will clearly benefit the environment by promoting the conservation of the Band-tailed Pigeon. The potential for the management plan to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this plan will clearly benefit the environment and will not entail any significant adverse effects. The reader should refer to the Species Information and the Conservation Measures and Implementation Schedule sections of the document.

[9] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[10] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1

Canadian Wildlife Service (CWS)

Comment Table Species at Risk Draft Recovery Documents

Species: _____

Management Plan or Recovery Strategy: _____

Date: _____

Review completed by: _____

Please add rows to the table if more space is needed. Return comments to: SAR.pyr@ec.gc.ca.

General Comments	Response

Recommended References:

Line Number / Table	Comment	CWS Response to Comment
Cover Page / Preface / Acknowledgments		

Line Number / Table	Comment	CWS Response to Comment
EXECUTIVE SUMMARY		
RECOVERY FEASIBILITY SUMMARY		
1. COSEWIC SPECIES ASSESSMENT INFORMATION		
2. SPECIES STATUS INFORMATION		

Line Number / Table	Comment	CWS Response to Comment
3. SPECIES INFORMATION		
3.1 Species Description		
3.2 Population and Distribution		
3.3 Needs of the Species X		
4. THREATS		
4.1 Threat Assessment		
4.2 Description of Threats		
5. POPULATION AND DISTRIBUTION OBJECTIVES		

Line Number / Table	Comment	CWS Response to Comment
6. BROAD STRATEGIES AND GENERAL APPROACHES TO MEET OBJECTIVES		
6.1 Actions Already Completed or Currently Underway		
6.2 Strategic Direction for Recovery		
6.3 Narrative to Support the Recovery Planning Table		
7. CRITICAL HABITAT		
7.1 Identification of Species X Critical Habitat		
7.2 Schedule of Studies to Identify Critical Habitat		

Line Number / Table	Comment	CWS Response to Comment
8. MEASURING PROGRESS		
9. STATEMENT ON ACTION PLANS		
10. REFERENCES		
APPENDIX 1:		
APPENDIX 2:		
APPENDIX 3:		

Thank-you!!

Overview of the Federal Recovery Strategy for Tall Bugbane

This document highlights information about the Tall Bugbane, and includes key information about the federal recovery strategy for this endangered species. A recovery strategy describes what a species needs to live, including the critical habitat it depends on, and the ways in which we can reduce the threats to its survival.

About the species

Tall Bugbane is a perennial large-leafed, shade loving plant. There are 7 known populations of Tall Bugbane remaining in Canada, with no more than 60 individuals in each population. Tall Bugbane is listed as "Endangered" on Schedule 1 of the federal Species at Risk Act (SARA).

What does it look like?

- Tall Bugbane grows 1 to 2 meters tall
- Its stems are branched, with round bulbs at the joints
- The leaves look similar to leaves on maple trees but have short hairs on the undersides
- When its flowers are blooming they are snowy white coloured and are found in long clusters that are sometimes described as looking like a bottle brush

Where is it found?

- Tall Bugbane grows in shady, moist areas in mature and old-growth forests
- In Canada, Tall Bugbane only exists in few locations within the lower Fraser Valley of British Columbia
- There are seven known populations of Tall Bugbane listed in the recovery strategy, all within about 20km of each other

Main threats to this species' survival – Why is it threatened?

This plant is being lost as a result of various threats including:

- Loss and damage of forests from timber harvesting, urbanization, and road building
- Disturbance and damage from some recreational activities (hiking, mountain biking, off-road vehicles, etc.)
- Other damage and changes to its habitat such as introduction of invasive species

Key information about the federal recovery strategy

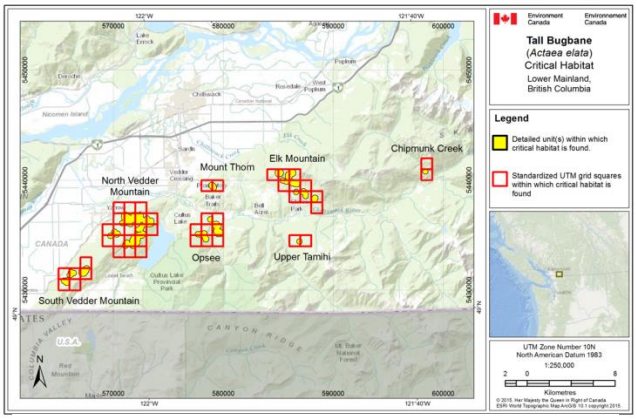
Population and Distribution Objectives:

We want to make sure that the Tall Bugbane is not lost from Canada. The way this is stated in the recovery strategy is: "*To ensure that the number of populations and quality and quantity of occupied habitat remains stable or increases across the species existing range, and where feasible, to restore additional populations and connective habitat within the species' historical range in B.C.*"

Critical Habitat:

Critical habitat is the habitat needed for the survival or recovery of a species. Critical habitat is identified by describing the area that a species uses and (within that area) the particular environmental features (e.g., amount of moisture) the species needs to live and reproduce. These features are called "biophysical attributes" in the recovery strategy. For Tall Bugbane the environmental features include:

- Elevations below 1600m with gentle to steep, moist slopes, usually in shaded areas around creeks, stream and rivers
- Mature to old-growth forests composed of mixed Douglas-fir or Western Red Cedar–Western Hemlock, with some Big-leaf Maple



The recovery strategy includes several maps including this one. The shaded portion of this map shows areas containing Tall Bugbane's critical habitat.

Examples of Activities Likely to Result in the Destruction of Critical Habitat for Tall Bugbane:

- Forest harvest activities that make the forests where Tall Bugbane live no longer suitable.
- Changes to the landscape such as expansion of existing recreational areas or trails, that alter the habitat to the extent that it is no longer suitable for Tall Bugbane.

How You Can Help Tall Bugbane

The recovery document guides the approaches we can take together including:

- Learning more about Tall Bugbane, its habitat needs, and the threats to its survival
- Avoiding activities that could harm the species
- Working with Environment Canada and/or local conservation groups to protect critical habitat
- Contacting Environment Canada – Pacific & Yukon Region's Species at Risk Recovery Unit (SAR.PYR@ec.gc.ca) to provide comments about the recovery strategy, ask questions, or request information about other available resources to help protect and recover the Tall Bugbane

This overview document is not a substitute for the Recovery Strategy for the Tall Bugbane (*Actaea elata var. elata*) in Canada. To request a copy of the complete recovery strategy please contact: SAR.PYR@ec.gc.ca

Environment Canada Environnement Canada

Species at Risk Questionnaire

Species name: _____

To help us learn more about this species, please answer the following questions.

1. **Have you seen this species on or near your land?** Never / Sometimes / Often / I don't know
   Comments: _____

2. **Are there activities going on in your area that could benefit this species or its habitat?** Yes / No / I don't know
   If yes, please describe the activities and how these activities can help the species: _____

3. **Are there activities going on in your area that could harm this species or its habitat?** Yes / No / I don't know
   If yes, please explain: _____

4. **Does your land have some or all of the landscape features (e.g. types of trees, water bodies) used by this species?**
   Yes / No
   Comments: _____

Canada

5. **Do you have any comments on threats to this species?** Yes / No
   Comments: _____

6. **Do you have any additional information that may help us develop recovery plans for this species?**

7. **Is there anything else you would like to add?**

8. **Would you like more information on how you can help conserve species at risk?** Yes / No
   If yes, please provide your contact information below.

Name: _____
Phone: _____
Email: _____
Address: _____

Thank you for your feedback. If there is anything you would like to add or any questions you would like to ask about species at risk please contact us at SAR.pyr@ec.gc.ca or 604-350-1900.

Draft

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

Recovery Strategy for the Tall Bugbane (*Actaea elata*) in Canada

Tall Bugbane

2015

Recommended citation:

Environment Canada. 2015. Recovery Strategy for the Tall Bugbane (*Actaea elata*) in Canada [Draft]. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. iii+ XX pp.

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

Cover illustration: ©Thomas N. Kaye

Également disponible en français sous le titre
« French document title »

ISBN ISBN to be included by SARA Responsible Agency
Catalogue no. Catalogue no. to be included by SARA Responsible Agency

[1] http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1

RECOVERY STRATEGY FOR THE TALL BUGBANE (*Actaea elata*) IN CANADA

2015

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 Plan for the Tall Bugbane (*Actaea elata* var. *elata*) in British Columbia" (Part 2) under Section 44 of the *Species at Risk Act* (SARA). Environment Canada has included an addition (Part 1) which completes the SARA requirements for this recovery strategy.

The federal recovery strategy for the Tall Bugbane in Canada consists of two parts:

Part 1 – Federal Addition to the "Recovery Plan for the Tall Bugbane (*Actaea elata* var. *elata*) in British Columbia", prepared by Environment Canada.

Part 2 – Recovery Plan for the Tall Bugbane (*Actaea elata* var. *elata*) in British Columbia prepared by the Tall Bugbane Recovery Team for the British Columbia Ministry of Environment.

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PART 1 - Federal Addition to the "Recovery Plan for the Tall Bugbane (*Actaea elata* var. *elata*) 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)[2] agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years after the publication of the final document on the SAR Public Registry.

The Minister of the Environment is the competent minister for the recovery of the Tall Bugbane 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 as per section 39(1) of SARA. 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 plan for the Tall Bugbane (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 Tall Bugbane 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.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When the recovery strategy identifies critical habitat, there may be regulatory implications as SARA sets out a process to evaluate existing protection mechanisms under other Acts of Parliament and provincial and territorial legislation, and if necessary, to put in place additional protection under SARA. For critical habitat located on federal lands outside of federal protected areas the Minister of the Environment must either report on existing legal protection or make an order to provide protection. The Minister of the Environment will assess whether critical habitat is effectively protected on non-federal lands. The discretion to protect critical habitat that is not effectively protected rests with the Governor in Council.

[2] http://registrelep-sararegistry.gc.ca/default.asp?lang=en&n=6B319869-1#2

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 Plan for the Tall Bugbane (*Actaea elata* var. *elata*) in British Columbia" (Part 2) or provide updated or additional information.

Environment Canada is adopting the British Columbia Recovery Plan (Part 2) with the exception of section 7.1: Description of the Species' Survival and Recovery Habitat, Appendix 2: Survival habitat polygons for Tall Bugbane, and Appendix 3: Best management practices for Tall Bugbane. In place of section 7.1, Environment Canada has developed a section on critical habitat (i.e., section 1 below).

Under SARA, there are specific requirements and processes set out regarding the protection of critical habitat. Therefore, statements in the provincial recovery plan referring to protection of the species' habitat may not directly correspond to federal requirements, and are not being adopted by Environment Canada as part of the federal recovery strategy. Whether particular measures or actions will result in protection of critical habitat under SARA will be assessed following publication of the federal recovery strategy.

1. Critical Habitat

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

The 2015 provincial recovery plan for Tall Bugbane includes a written and geospatial description of survival and recovery habitat. Environment Canada accepts the description of survival and recovery habitat provided in the provincial recovery plan, as the basis for critical habitat identification in the federal recovery strategy, with modification (as follows) to address specific requirements of SARA. More precise boundaries may be mapped, and additional critical habitat may be added in the future if additional information supports the inclusion of areas beyond those currently identified.

Critical habitat for the Tall Bugbane can only be partially identified at this time. Critical habitat cannot yet be identified for six populations owing to a high level of location uncertainty and/or unknown status: Chilliwack River (Population #8), Mount Cheam (Population #9), Cheam Peak (Population #10), Sumas Mountain (Population #11), Liumchen Mountain (Population #12), and Tamihi Trail (Population #13). Additional, broader-scale connective habitat between Tall Bugbane populations is also required, to allow for population dispersal, dynamics, and response to changing habitat conditions in the presence of climate change and/or local threats. When the relevant knowledge gaps relating to these factors are addressed, critical habitat should be identified to maintain

broad-scale connectivity. A schedule of studies (Section 1.2) outlines the activities required to identify additional critical habitat necessary to support the population and distribution objectives for the species. The identification of critical habitat will be updated when the information becomes available, either in a revised recovery strategy or action plan(s).

1.1 Identification of the Species' Critical Habitat

Tall Bugbane is found in moist, old-growth and mature forests in the Pacific Northwest. In Canada, it is known only from areas west of the Coast-Cascade Mountains in the Cultus Lake–Chilliwack River drainage of southwest British Columbia. It is a partial shade-loving species, preferring high understory light. It is a rhizomatous species that uses canopy gaps that naturally occur with mature to old-growth forests composed of mixed Douglas-fir (*Pseudotsuga menziesii*) or Western Red Cedar (*Thuja plicata*) – Western Hemlock (*Tsuga heterophylla*), with some amount of Bigleaf Maple (*Acer macrophyllum*) representation. Tall Bugbane prefers moist habitats, typically occurring near shaded watercourses (creeks/streams/rivers), moist slopes, or seepage areas with stable hydrological conditions provided by subsurface moisture. It has generally been reported from low to mid-elevations 30–950 m, but may occur as high as 1600 m.

Critical habitat is identified for seven extant populations of Tall Bugbane; these are linked with the population numbers provided in the provincial recovery plan:

- North Vedder Mountain (Population #1)
- South Vedder Mountain (Population #2)
- Upper Tamihi (Population #3)
- Chipmunk Creek (Population #4)
- Elk Mountain (Population #5)
- Mount Thom (Population #6)
- Opsee (Population #7)

The area containing critical habitat for Cliff Paintbrush is based on three additive components: (1) the area occupied by all previously observed individual plants or patches of plants, including the associated potential location error from GPS units (ranging from 5 m to 25 m uncertainty distance); (2) a 50-m radius critical function zone distance[3] surrounding all documented occupied areas, which includes the areas immediately adjacent to the observation points; and (3) an additional 200 m distance to support the broader-scale ecosystem processes occurring in mature, mixed coniferous forests that are integral to the production and maintenance of suitable microhabitat conditions for Tall Bugbane, and to retain some degree of connective habitat between sub-populations of plants. As the species occurs in canopy gaps (a relatively transient habitat type), it is important to recognize that microhabitat suitability, and

[3] Critical function zone distance has been defined as the threshold habitat fragment size required for maintaining constituent microhabitat properties for a species (e.g., critical light, moisture, humidity levels necessary for survival). Existing research provides a logical basis for suggesting a minimum critical function zone distance of 50 m is identified as critical habitat for most rare plant species occurrences.

correspondingly the species' local population and distribution, may shift in space and time within this broader-scale ecosystem radius.

The areas containing critical habitat for Tall Bugbane (totalling 1304.7 ha) are presented in Figure 1. The critical function zone, and ecosystem context areas as described above comprise the biophysical attributes of critical habitat for this species, and therefore the shaded yellow polygons (units) shown on each map represent a close approximation of actual critical habitat. Unsuitable habitat including elevations above 1600 m, and existing anthropogenic features (e.g., building surfaces, running surfaces of paved roads and railways) do not possess the attributes required by Tall Bugbane and they are not identified as critical habitat. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that highlights the general geographic area containing critical habitat, for land use planning and/or environmental assessment purposes.

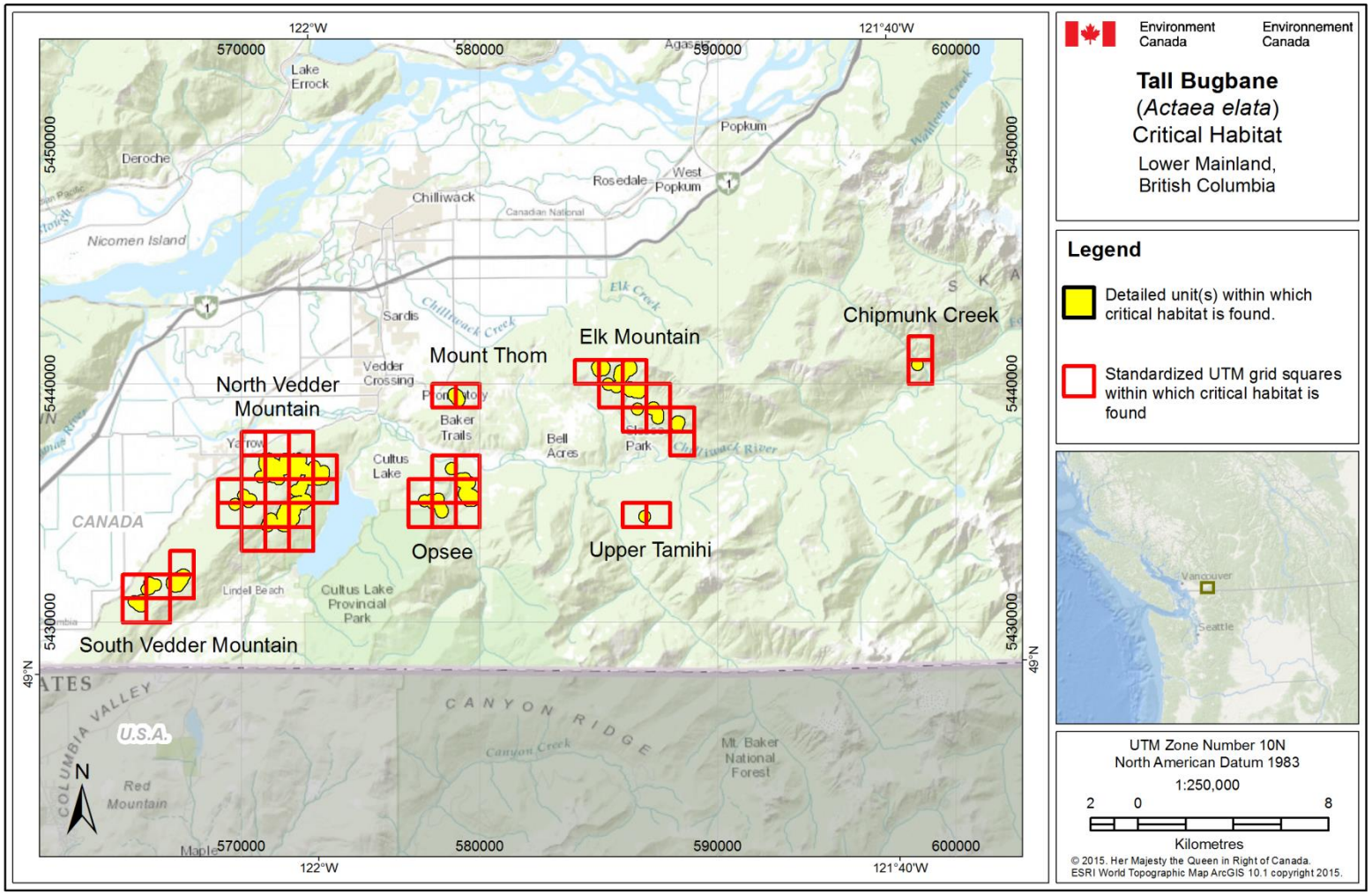

Figure 1. Critical habitat for Tall Bugbane in Canada is represented by the yellow shaded polygons (units) where the criteria and methodology set out in Section 1.1 are met. The detailed polygons show a total of 1304.7 ha containing critical habitat for Tall Bugbane at North Vedder Mountain (577.2 ha), South Vedder Mountain (160.3 ha), Upper Tamihi (19.6 ha), Chipmunk Creek (19.6 ha), Elk Mountain (291.6 ha), Mount Thom (39.7 ha), and Opsee (196.7 ha). The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

1.2 Schedule of Studies to Identify Critical Habitat

The following schedule of studies (Table 1) outlines the activities required to complete the identification of critical habitat for Tall Bugbane; population numbers are provided in reference to those in the provincial recovery plan.

Table 1. Schedule of Studies to Identify Critical Habitat for Tall Bugbane

Description of activity	Rationale	Timeline
Undertake repeated, comprehensive surveys in sites with records of high location uncertainty and unknown status: Chilliwack River (Population #8), Mount Cheam (Population #9), to identify the location of these records. These sites could not be mapped and land tenure could not be determined.	Critical habitat could not be identified for two populations owing to their "unknown" extant status, and the high location uncertainty associated with records. Recent, comprehensive, targeted surveys are lacking. Without further information on the status and location of these populations, it is unknown whether there is sufficient critical habitat identified for Tall Bugbane.	2015-2020
Undertake repeated, comprehensive surveys in sites with historical records: Cheam Peak (Population #10), Sumas Mountain (Population #11), Liumchen Mountain (Population #12), and Tamihi Trail (Population #13), to reconfirm and identify any additional Tall Bugbane plants occurring in remaining patches of suitable habitat, and investigate the feasibility of habitat restoration at these sites so that Tall Bugbane can reestablish (via natural dispersal from adjacent populations, and/or deliberate reintroduction).	Critical habitat could not be identified for four populations owing to their “historical" status; it is unknown if suitable habitat for Tall Bugbane persists at these sites, and/or if it could be made suitable with restoration. In addition, recent, comprehensive, targeted surveys are lacking. Further information on the status and location of these populations, and site habitat suitabilities are required to identify sufficient critical habitat for Tall Bugbane.	2015-2020
Address knowledge gaps relating to longevity, population dynamics, genetic strength, pollination, dormancy, and response to changing habitat conditions in the presence of climate change and/or local threats	Further information is required to adequately identify critical habitat to maintain broad-scale connectivity between populations.	2015-2020

1.3 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. The provincial recovery strategy provides a description of limitations and potential threats to Tall Bugbane.

Activities described in Table 2 include those likely to cause destruction of critical habitat for the species; destructive activities are not limited to those listed.

Table 2. Examples of activities likely to result in destruction of critical habitat for Tall Bugbane in Canada. IUCN Threat numbers are in accordance with the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system (CMP 2010).

Description of activity	Rationale	Additional Information
Forest harvest activities and/or removal of any Bigleaf Maple trees within the area containing critical habitat.	Forest harvest can result in direct loss of habitat by removal or burial of attributes required by Tall Bugbane, and/or indirect loss by alteration of local microsite conditions (such as light and moisture) such that the habitat is no longer suitable for Tall Bugbane; loss of forest habitat in surrounding areas also prevents the natural development of new canopy gaps for recruitment. Forest harvest can have further indirect effects in degrading habitat, by increasing the potential establishment of alien invasive plants, and/or ingrowth of competing vegetation.	Related IUCN-CMP Threat: #5.3 Forest harvest is a threat at several sites. To date, at least 2 B.C. populations have been lost due to clearcutting. Logging operations contribute to slow regeneration, and habitat fragmentation.
Conversion of landscape for human use and development: creation of new structures, houses, roads, railroads, stream crossings or diversions (including culverting).	Conversion of landscape for human use and development can result in direct loss of habitat by removal or burial of attributes required by Tall Bugbane. Indirect loss of critical habitat can also occur by alteration of local microsite conditions (such as light and moisture, hydrological conditions) to the extent that it is no longer suitable for Tall Bugbane.	Related IUCN-CMP Threat: #1.1, 1.3, 4.1 The Fraser Valley continues to be an area of concentrated land development and increasing urbanization. This is particularly true near Promontory and the Ryder Lake areas in Chilliwack and surrounding areas. Developments further promote establishment of alien invasive species, and unmanaged recreational activities.
Recreation activities: creation and/or expansion of existing recreational areas or trails (hiking, dirt-biking, ATVs, etc.).	Conversion of landscape for recreation activities can result in direct loss of habitat by removal or burial of attributes required by Tall Bugbane. Indirect loss of critical habitat can also occur by alteration of local microsite conditions (such as light and moisture, hydrological conditions) to the extent that it is no longer suitable for Tall Bugbane.	Related IUCN-CMP Threat: #6.1 The development of recreation areas on Vedder and Elk Mountains is an increasing concern.

Description of activity	Rationale	Additional Information
Roadside (or other linear development) maintenance activities such as vegetation clearing, infilling or depositing materials beyond running surface of existing roads.	Roadway grading, as well as grass trimming and brush cutting, can result in removal or burial of habitat required by Tall Bugbane plants and seeds.	Related IUCN-CMP Threat: #7.3 Roadside maintenance activities pose a threat to at least one known population of tall bugbane on Elk Mountain (#5) and likely other populations on Vedder Mountain (#1 and #2) and Mount Thom (#6)
Pesticide and herbicide use; also use of pesticides and herbicides on lands adjacent to areas containing critical habitat that cause inadvertent pollution, for example by not adhering to best management practices to control drift.	Efforts to control invasive plants or agricultural pests through mechanical or chemical means (non-specific herbicides) can result in habitat toxicity and alteration such that it is no longer suitable for Tall Bugbane.	Related IUCN-CMP Threat: #9.3 Herbicides used for road maintenance, agriculture, invasive species management, and silviculture are a concern at several sites. Pesticides used on surrounding agricultural areas and land clearing can have a detrimental impact on the availability of pollinators for native species including Tall Bugbane.

2. Statement on Action Plans

One or more action plans for Tall Bugbane will be posted on the Species at Risk Public Registry by 2020.

3. 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[4]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[5] goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national

[4] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[5] http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1

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 provincial recovery plan for Tall Bugbane contains a section describing the effects of recovery activities on other species (i.e., Section 9). Environment Canada adopts this section of the provincial recovery plan as the statement on effects of recovery activities on the environment and other species. Recovery planning activities for Tall Bugbane will be implemented with consideration for all co-occurring species at risk, such that there are no negative impacts to these species or their habitats.

4. References

CMP (Conservation Measures Partnership). 2010. Threats Taxonomy. Available: http://www.conservationmeasures.org/initiatives/threats-actions-taxonomies/threats-taxonomy.

PART 2 - Recovery Plan for the Tall Bugbane (*Actaea elata* var. *elata*) in British Columbia, prepared by the Tall Bugbane Recovery Team for the British Columbia Ministry of Environment

[to be added, published online at: http://a100.gov.bc.ca/pub/eirs/viewDocumentDetail.do?fromStatic=true&repository=BDP&documentId=12100]

Recovery Plan for the Tall Bugbane (*Actaea elata* var. *elata*) in British Columbia

Prepared by Tall Bugbane Recovery Team

BRITISH COLUMBIA | Ministry of Environment

October 2014

About the British Columbia Recovery Strategy Series

This series presents the recovery documents that are prepared as advice to the Province of British Columbia on the general approach required to recover species at risk. The Province prepares recovery documents to ensure coordinated conservation actions and 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 provincial recovery document?

Recovery documents summarize the best available scientific and traditional information of a species or ecosystem to identify goals, objectives, and strategic approaches that provide a coordinated direction for recovery. These documents outline what is and what is not known about a species or ecosystem, identify threats to the species or ecosystem, and explain what should be done to mitigate those threats, as well as provide information on habitat needed for survival and recovery of the species. This information may be summarized in a recovery strategy followed by one or more action plans. The purpose of an action plan is to offer more detailed information to guide implementation of the recovery of a species or ecosystem. When sufficient information to guide implementation can be included from the onset, all of the information is presented together in a recovery plan.

Information provided in provincial recovery documents may be adopted by Environment Canada for inclusion in federal recovery documents that federal agencies prepare to meet their commitments to recover species at risk under the *Species at Risk Act*.

What's next?

The Province of British Columbia accepts the information in these documents as advice to inform implementation of recovery measures, including decisions regarding measures to protect habitat for the species.

Success in the recovery of a species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this document. All British Columbians are encouraged to participate in these efforts.

For more information

To learn more about species at risk recovery in British Columbia, please visit the B.C. Ministry of Environment Recovery Planning webpage at:
<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>

Recovery Plan for the Tall Bugbane (*Actaea elata* var. *elata*) in British Columbia

Prepared by the Tall Bugbane Recovery Team

October 2014

Recommended citation

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Cover illustration/photograph

Photograph by Kym Welstead, used with permission.

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>

Disclaimer

This recovery plan has been prepared by the Tall Bugbane Recovery Team, as advice to the responsible jurisdictions and organizations that may be involved in recovering the species. The British Columbia Ministry of Environment has received this advice as part of fulfilling its commitments under the *Accord for the Protection of Species at Risk in Cana*da 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 tall bugbane 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 plan. The B.C. Ministry of Environment encourages all British Columbians to participate in the recovery of tall bugbane.

ACKNOWLEDGEMENTS

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- Kym Welstead, for overseeing the preparation, updates, and revisions leading to the final version of this recovery plan.

RECOVERY TEAM MEMBERS

Name	Affiliation	Organization or position
Voting members:		
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Ann Peter	Forests, Lands and Natural Resource Operations (MFLNRO)	Stewardship Forester, Chilliwack Forest District
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Matt Wealick	Industry	Ch-ihl-kway-uhk Forestry Limited Partnership
Denis Knopp	Environmental Non-governmental Organization	B.C.'s Wild Heritage
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Enrique Sanchez	BC Timber Sales	Planning Forester
Alternates:		
Marie Goulden (Angela's Alternate)	Department of National Defence (Chilliwack), Government of Canada	Department of National Defence (Chilliwack)
Rose Klinkenberg (Brian's Alternate)	Academic	UBC Herbarium

EXECUTIVE SUMMARY

Tall bugbane (*Actaea elata* var. *elata*) is a Pacific Northwest endemic, perennial vascular plant species found globally only in Oregon, Washington, and British Columbia (B.C.). Within B.C., it is currently restricted to 7 known populations within the Chilliwack area of the lower Fraser Valley. When in flower, tall bugbane is a distinguished plant with showy white "bottle brush" flowers reaching 1–2 m high.

Tall bugbane was designated in 2001 as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). It is listed as Endangered in Canada on Schedule 1 of the *Species at Risk Act* (SARA). In B.C., tall bugbane is ranked S1 (critically imperiled) by the Conservation Data Centre and is on the provincial Red list. The B.C. Conservation Framework ranks the tall bugbane as priority 1 under goals 1 and 3 (1 = contribute to global efforts for species and ecosystem conservation; 3 = maintain the diversity of native species and ecosystems). It is also listed as a species that requires special management attention to address the impacts of forest and range activities under the *Forest and Range Practices Act* (FRPA) and/or the impacts of oil and gas activities under the *Oil and Gas Activities Act* (OGAA) on Crown land (as described in the Identified Wildlife Management Strategy). Recovery is considered to be biologically and technically feasible.

Threats include canopy removal from timber harvest, urbanization including roads, recreational activities (e.g., hiking, mountain biking, off-roading), plant collecting, poaching/harvesting of bigleaf maple, herbicides, and the introduction of invasive species through human disturbance. Such threats may directly or indirectly result in habitat degradation and fragmentation, loss of connection corridors, loss of pollinators, influx of invasive species as competitors, and increased herbivory.

The biological factors that limit the prevalence of this species (resulting in a restricted range, and natural rarity in the landscape throughout that range) include high habitat specificity and limited availability of suitable habitats, occurrence in small isolated populations, and limited mechanisms for dispersal. The nature of small and isolated populations results in lack of genetic exchange between populations, and makes this species more vulnerable to population loss by stochastic events.

The recovery (population and distribution) goal for this species is:

To ensure that the number of populations and quality and quantity of occupied habitat remains stable or increases across the species' existing range, and where feasible, to restore additional populations and connective habitat within the species' historical range in B.C.

The recovery objectives for this species are:

1. to remove or manage threats, and protect[1] and restore habitat at all extant populations;
2. to assess, restore, or enhance habitat, and re-establish populations at historical sites where feasible;
3. to conduct further inventory within the known range of the species in B.C. to prevent inadvertent loss of populations that have not yet been identified within suitable habitat;
4. to determine the effectiveness of habitat protection/enhancement measures and recovery actions by monitoring population status; and
5. to inform and refine management decisions by improving our understanding of threats, population ecology, and habitat requirements.

This document outlines survival and recovery habitat for tall bugbane. Given the limited and sporadic distribution of this endangered plant, it is important to protect all known occurrences.

RECOVERY FEASIBILITY SUMMARY

The recovery of tall bugbane in B.C. is considered technically and biologically feasible based on the criteria outlined by the 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, current sites contain plants that are reproducing and, if protected, will sustain population numbers. Individuals capable of reproduction are currently available to improve the population growth and abundance. Additionally, given that this species exhibits belowground dormancy, and because semi-dormant (non-flowering) individuals are difficult to see, it is possible that more populations of the species exist within the region in deeply shaded undisturbed areas, and that true population sizes may be larger than previously thought.

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

   Yes, sufficient suitable habitat is currently available to support the species, and more may be made available in the future through habitat restoration.

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

   Yes, primary threats to the species and its habitat (e.g., urbanization, timber harvest and herbicides) can be mitigated and/or avoided through recovery actions. The necessary techniques and management tools exist (e.g., establishment of Wildlife Habitat Areas and general wildlife measures) and have already been implemented for some sites.

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

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 exist to achieve the population and distribution objectives (e.g., threat mitigation and habitat restoration) in a timely manner. Techniques such as deliberately augmenting and/or re-introducing populations by propagation (e.g., sexual reproduction by seed germination, and/or asexual reproduction by division of the plant or by sections of the rhizome) can be applied to recover this species. Kaye (2001) has developed methods for successful seed germination and plant translocation in the United States that could be applied in B.C.

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1 COSEWIC* SPECIES ASSESSMENT INFORMATION

Assessment Summary: May 2001
Common Name:** Tall Bugbane
Scientific Name:** *Cimicifuga elata*
Status: Endangered
Reason for Designation: A perennial herb of mature forests occurring naturally as very small populations at scattered sites throughout a single river valley and adjoining mountain slopes where logging continues to impact populations, and to reduce its preferred forest habitats.
Occurrence: British Columbia
Status History: Designated Endangered in May 2001

* Committee on the Status of Endangered Wildlife in Canada.
** Common and scientific names reported in this recovery plan henceforth follow the naming conventions of the British Columbia Conservation Data Centre (e.g., for tall bugbane the provincial naming convention is *Actaea elata* var. *elata)*.

2 SPECIES STATUS INFORMATION

Tall bugbane[a]		
Legal Designation:		
FRPA:[b] Species at Risk OGAA:[b] Species at Risk	B.C. *Wildlife Act:* [c] No	SARA:[d] Schedule 1 – Endangered (2003)
Conservation Status[e]		
B.C. List: Red B.C. Rank: S1 (2005)	National Rank: N1 (2011)	Global Rank: G3TNR (2004)
Other Subnational Ranks:[f] Oregon (S3), Washington (S3)		
B.C. Conservation Framework (CF)[g]		
Goal 1: Contribute to global efforts for species and ecosystem conservation.		Priority:[h] 1 (2009)
Goal 2: Prevent species and ecosystems from becoming at risk.		Priority: 6 (2009)
Goal 3: Maintain the diversity of native species and ecosystems.		Priority: 1 (2009)
CF Action Groups:[g]	Compile Status Report; List under *Wildlife Act*; Send to COSEWIC; Planning; Habitat Protection; Habitat Restoration; Private Land Stewardship; Species and Population Management	

[a] Data source: B.C. Conservation Data Centre (2013) unless otherwise noted.
[b] Species at Risk = a listed species that requires special management attention to address the impacts of forest and range activities on Crown land under the *Forest and Range Practices Act* (FRPA; Province of British Columbia 2002) and/or the impacts of oil and gas activities on Crown land under the *Oil and Gas Activities Act* (OGAA; Province of British Columbia 2008) as described in the Identified Wildlife Management Strategy (Province of British Columbia 2004).
[c] No = not designated as wildlife under the B.C. *Wildlife Act* (Province of British Columbia 1982).
[d] Schedule 1 = found on the List of Wildlife Species at Risk under the *Species at Risk Act* (SARA).
[e] S = subnational; N = national; G = global; T = refers to the subspecies level; X = presumed extirpated; H = possibly extirpated; 1 = critically imperiled; 2 = imperiled; 3 = special concern, vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant, and secure; NA = not applicable; NR = unranked; U = unrankable.
[f] Data source: NatureServe (2013).
[g] Data source: B.C. Ministry of Environment (2010).
[h] Six-level scale: Priority 1 (highest priority) through to Priority 6 (lowest priority).

3 SPECIES INFORMATION

3.1 Species Description

Tall bugbane (*Actaea elata* var. *elata*)[2] is a 1–2 m tall, shade-loving, herbaceous vascular plant species that is found in the understory layer of mature or old-growth forests. It is a rhizomatous[3] perennial species with short, dark tuberous rhizomes. The leaves are usually divided into 3 lobes, but may sometimes have 5–7 lobes, and have 5 principal veins (Figure 1). Tall bugbane flowers from mid-June to early August. Flowers are white and are found in an elongated, simple, or compound cluster (a raceme) with 50–900 small white flowers with no petals. Because the flowers lack petals, the inflorescence[4] actually consists of hundreds of tiny, tufted, white stamens that resemble a bottlebrush (D. Knopp, pers. comm., 2003). Fruits are short, stout, pea-pod–like dried capsules that split open down one side (follicles); each contains 10 red to purple-brown heavy seeds (Penny and Douglas 1999). Notably, this species can also occur as small, semi-dormant plants, which are not readily observed (D. Knopp, pers. comm., 2003).

Figure 1. Tall bugbane characteristics. The maple-like leaves of tall bugbane have hairs on the underside and on the bulbous stem joint.

When in flower, this species is readily identified because of its large size and raceme of flowers. It is more challenging to identify when not in flower. Tall bugbane leaf-shape strongly resembles both maple (*Acer* spp.) and thimbleberry leaves (*Rubus parviflorus*) (D. Knopp, pers. comm., 2003). Non-flowering plants can also be confused with non-flowering red baneberry (*Actaea rubra*) (Penny and Douglas 1999). However, larger non-flowering plants can be distinguished by

[2] Formerly known as *Cimicifuga elata*. *Actaea elata* var. *elata* is the only variety of tall bugbane found in B.C. and Canada.
[3] Having an underground stem.
[4] A flowering cluster.

the presence of slightly bulbous basal wings on the leaf stalks that clasp the stem and hairs on the underside of the leaves (see Figure 1).

3.2 Populations and Distribution

Tall bugbane is endemic to the Pacific Northwest (Figure 2) and is restricted in distribution globally to Oregon, Washington, and southwestern British Columbia (NatureServe 2013). In B.C., known populations are limited to areas west of the Coast-Cascade Mountains in the Cultus Lake–Chilliwack River area. Approximately 5% of the global distribution occurs in British Columbia (the B.C. population areal extent is 40,700 ha). There are approximately 100 populations in Oregon, 30 in Washington (Kaye 1994), and 7 in B.C. Given that the closest population in Washington State occurs on Vedder Mountain (an extension of the B.C. populations on Vedder Mountain), there is a possible chance of rescue effect (immigration from an outside source). In B.C., this species occurs in the lower Fraser Valley, which is the northern-most limit of its distribution in North America, and is a species that is naturally rare in the landscape.

Figure 2. Global distribution of tall bugbane.
Map prepared by Kym Welstead. U.S. distribution based on Kaye and Kirkland (1994).

There are 7 known extant tall bugbane populations[5] in B.C. (Figure 3; Table 1, sites 1–7). There are 6 historical populations (Table 1, sites 8–13): 2 populations (sites 8 and 9) are not mapped

[5] B.C. populations are defined as plants within 1 km of each other, which is the standard used by NatureServe (2004). Several populations previously considered as distinct populations have been merged into single, larger populations as new occurrences were discovered between them. The locations of the existing populations suggest continuity within a range of 600–800 m, which lends support to using a separation of 1000 m to define a population. This differs from the distance of 500 m suggested in the Identified Wildlife Management Strategy (Province of British Columbia 2004).

given the ambiguity in their location descriptions; 2 populations (sites 10 and 11) were not relocated during field surveys in 2005 and 2006 (Iredale and Barsanti 2006); and the other 2 populations (sites 12 and 13) are presumed extirpated since the locations where the plants were reported from were clear-cut after their discovery.

In Canada, tall bugbane is known only from the Cultus Lake–Chilliwack River area in the Coastal Western Hemlock (CWH) biogeoclimatic zone (subzones/variants CWHdm, CWHxm, CWHms1) and in the Mountain Hemlock moist maritime (MHmm2) variant (Douglas *et al.* 2002; Province of British Columbia 2004).

Population trends are not well understood, but where populations have been monitored (e.g. Mayberry 2008) they were either observed and/or predicted to be in decline based on measured rates of change (Mayberry and Elle 2010).

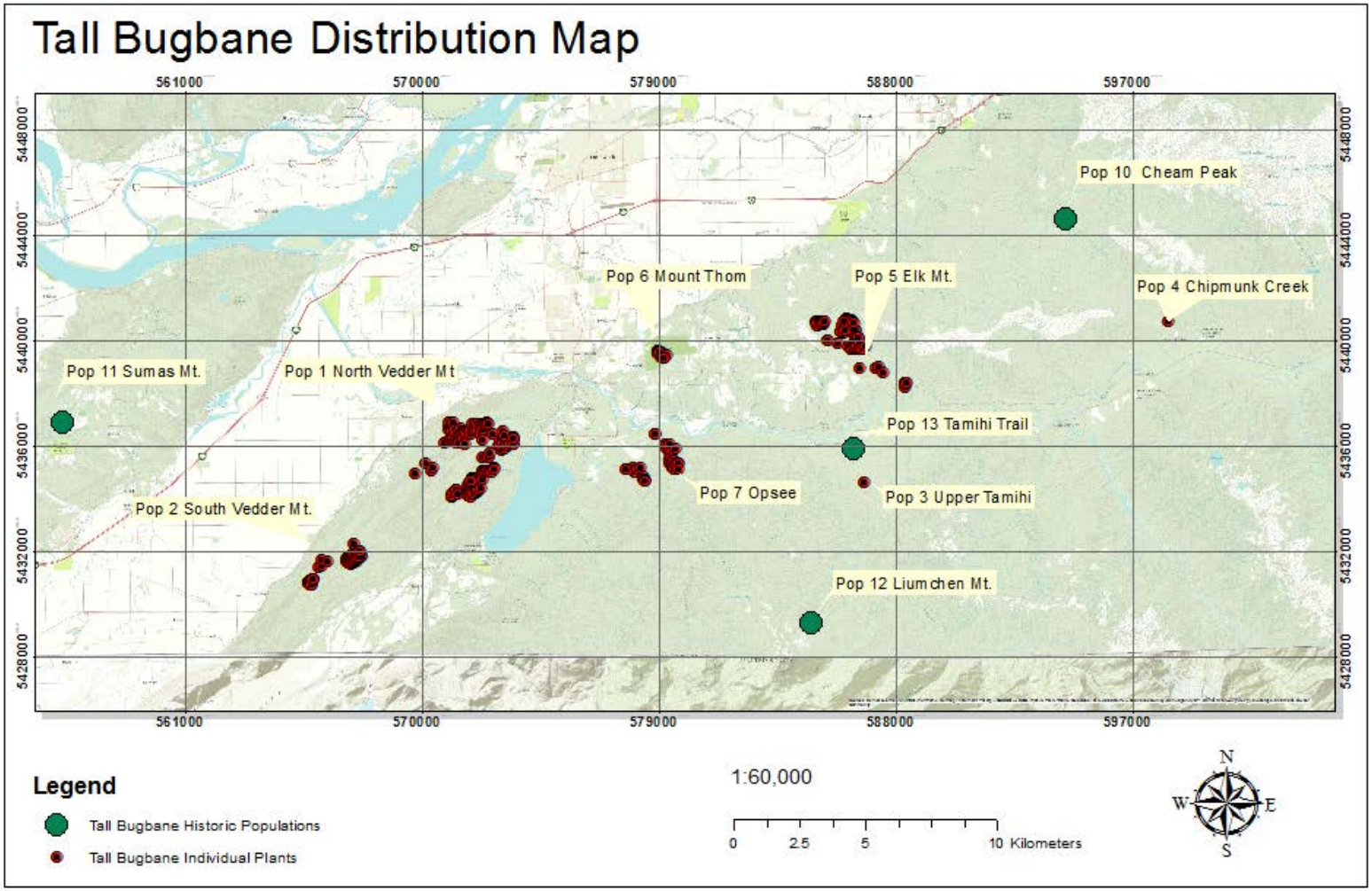

Figure 3. Distribution of tall bugbane in British Columbia, data current to March 2013.
Map by Kym Welstead. Two populations (Chilliwack River, Mount Cheam) are not mapped, owing to location uncertainty.

Table 1. Summary of tall bugbane sites in British Columbia as of March 2013.

Population no. [a]	Location	# of plants (or site status)	Last year observed	Observers	Land tenure
1	North Vedder Mountain	571	2009	D. Knopp	Provincial Crown
2	South Vedder Mountain	621	2009	D. Knopp	Private/ Provincial Crown
3	Upper Tamihi	Present	1997	J. Penny and S. Hartwell	Provincial Crown
4	Chipmunk Creek	Present	1997	Fontaine and S. Hartwell	Provincial Crown
5	Elk Mountain	218	2009	D. Knopp	Provincial Crown/ First Nations Woodlot/ Municipal
6	Mount Thom	43	2007	K. Welstead, T. Kerr, N. Libal, S. Ramey, and Z. Slater	Municipal/ Provincial Crown
7	Opsee	107	2010	D. Knopp	Federal leasehold (Department of Defense)/ Provincial Crown
10	Cheam Peak	Historical	1989 [b]	Scagel	Provincial Crown
11	Sumas Mountain	Historical	~1986 [b]	G. Ryder	Municipal /Provincial Crown
12	Liumchen Mountain	Historical (presumed extirpated)	1957	Beamish/Vrugtman	Provincial Crown
13	Tamihi Trail	Historical (presumed extirpated)	1982	Scagel	Provincial Crown
8 [c] (Not mapped)	Chilliwack River	Status unknown	1901	Macoun	Unknown
9 [c] (Not mapped)	Mount Cheam	Status unknown	1895	Gowan	Unknown
TOTAL		**~1580**			

[a] Note that population numbers are simply a label; they are not necessarily in sequence and are not meant to indicate the total number of sites.
[b] Revisited in 2005 and 2006 by Barsanti and Iredale but not found.
[c] Due to the uncertainty in the location of this record this site could not be mapped and land tenure could not be determined. Given the large area, the location could cover the status of the site is also unknown.

3.3 Needs of the Tall Bugbane

3.3.1 Habitat and Biological Needs

Tall bugbane is a rhizomatous, partial shade-loving species (preferring high understory light) species in moist, old-growth and mature forests in the Pacific Northwest (Alverson 1986; Wentworth 1996; Penny and Douglas 2001).

Associated species
In the CWH zone, tall bugbane is found in moist mixed Douglas-fir–bigleaf maple (*Pseudotsuga menziesii–Acer macrophyllum)* sites (Kaye and Kirkland 1994). These mixed or coniferous mature to old-growth forests, structural stages 5–7,[6] age 70 to 150+ years, which have distinct canopy layers; typically shade-tolerant shrubs and herbs are present in the understory. Besides bigleaf maple and Douglas-fir trees, tall bugbane can also co-occur with western redcedar (*Thuja plicata*), red alder (*Alnus rubra*), and western hemlock (*Tsuga heterophylla*). Common associated shrubs and perennials are sword fern (*Polystichum munitum*), western trillium (*Trillium ovatum*), red elderberry (*Sambucus racemosa*), vanilla leaf (*Achlys triphylla*), and lady fern *(Athyrium filix-femina*) (Schreiner 1995; Penny and Douglas 2001) and frequently co-occurs with devil's club (*Oplopanax horridus*) (Knopp and Larkin 2005). Mayberry and Elle (2009) found associated plant species to include alpine enchanter's nightshade (*Circaea alpina*).

Cover and shade requirements
Tall bugbane prefers partial to moderate shade conditions (Wentworth 1996) with moisture, and uses gaps in the canopy when available to expedite growth, reproduction, and colonization.

Mature and old-growth forests naturally have scattered gaps in canopy (small blowdowns and tree fall) that provide the optimal light conditions for tall bugbane (Alverson 1986). Gap openings in mature and old-growth forest can re-invigorate small plants of *Actaea elata* that may have been persisting in a static state for many years (T. Kaye, pers. comm., 2003). Natural gaps in a mature forest can be large, or quite small, sometimes only a few meters across, and a small gap located in a matrix of surrounding forest would see minimal change to site conditions other than increased light. Unfortunately, natural gaps rarely occur in more uniform young to intermediate-age second-growth stands (Alverson 1986) unless they are managed to achieve mature stand attributes. Mixed stands can also provide the optimal conditions for growth as deciduous trees form an open canopy in the spring (primarily by bigleaf maple).

Canopy gaps increase the amount of light reaching the understory. High understory light under open canopies or in canopy gaps was found to increase sexual reproduction in tall bugbane (Czembor 2004). Increased light levels tend to increase flowering, seed production, seedling recruitment, and survivorship (Kaye and Cramer 2002; Mayberry and Elle 2009).

[6] For definitions of structural stages, see B.C. Ministry of Forests and Range and B.C. Ministry of Environment (2010).

Tall bugbane has been found in some anthropogenically created habitats such as forest road edges and/or early clearcuts. It appears to tolerate some forms of anthropogenic canopy opening (T. Kaye and P. Keddy, pers. comm., 2003) but ultimately overgrowth and out-competition ultimately cause decline. Out-competition by regenerating forest weeds and saplings appears to be the main cause of population loss in early seral stages. It is absent in dense managed stands of intermediate age (20–30 years) (Kaye and Cramer 2002). Old-growth stands typically contain natural canopy openings. Tall bugbane plant size and reproductive capability appear to remain fairly constant in old-growth stands (Kaye and Cramer 2002).

Moisture

Tall bugbane plants prefer moist habitats (Kaye and Kirkland 1994; Mayberry and Elle 2009). Field observations indicate that tall bugbane requires high moisture levels and is often near watercourses (creeks, streams, rivers, and subterranean flows) and upslope seepages, although often in the drier portions of these sites (D. Knopp, pers. comm., 2003).

Soil type and substrate

Wentworth (1996) describes tall bugbane species as occurring in moderately rich forest soils such as silt loams, silty clay loams, or clay loams and, in Washington, specifically occurring on soils derived from basaltic rock, argillaceous sandstone and shale, and gravelly or alluvial deposits.

Based on the *Soil Landscapes of Canada* (Centre for Land and Biological Resources Research 1996), most tall bugbane populations occur within the region mapped as mineral non-calcareous well-drained soils with a root depth of 20–75 cm (B.C. Ministry of Environment, Lands and Parks 2001). More detailed soil surveys would be beneficial to clarify site specific soil types.

Slope, aspect, and elevation

In B.C., tall bugbane occurrences appear to be linked to mesic to wet-mesic mid-slope benchlands with a slope, variance from 1 to 49°. Tall bugbane has been found at one location on a slope that was almost 50° (D. Knopp, pers. comm., 2008). The literature on tall bugbane (e.g., Kaye 1995, 1999, 2000) indicates that this species occurs preferentially on north-facing slopes, with some populations occurring on other aspects. However, in overlaying the occurrences of B.C. plants, it is apparent that while some populations do occur on north-facing slopes (Population 1), portions of populations also occur on south-facing slopes (Populations 2, 5, 7) or west-facing slopes (Populations 1, 2, 6, 7) and even east-facing slopes (part of Population 1) .

In B.C., tall bugbane is reported from low to mid-elevations 30–950 m (Ramsey 1987, 1997; Wentworth 1996; Penny and Douglas 2001; Klinkenberg 2003a, 2003b). One exception is an historical population 10 reported by Scagel near the top of Mount Cheam (Ceska 1996) that apparently occurred at a much higher elevation (1200–1600 m).

3.3.2 Biology

Lifespan

Tall bugbane is reported as having a relatively long lifespan (Alverson 1986), with a median life span of between 4 and 6 years and possibly longer (Kaye 2000; T. Kaye, pers. comm., 2003). Kaye (pers. comm., 2003) has indicated these are average lifespans, and that the length of time that an individual plant (as a rhizome and/or plant) can persist in low light conditions is unknown but could be as long as 50 years.

Reproductive conditions, biology, and dormancy

Flowering

Tall bugbane flowers in British Columbia from mid to late June through to late July and early August (Penny and Douglas 2001). The plants can produce several racemes featuring 50–900 small white, showy spray-like white flowers and collectively form a bottlebrush appearance. Flowering is sequential, with not all flowers in bloom at a time (Pellmyr 1985a, 1985b; Wentworth 1996). Each flower of tall bugbane can produce 1, and sometimes 2–3, capsules containing 6–12 “heavy” seeds (Kaye 2000; Wentworth 1996; Penny and Douglas 2001).

Within old-growth forest habitat, tall bugbane plants appear to have greater reproductive success in locations that are farther from trees (greater direct canopy openness), with relatively higher herb cover, greater moisture, and more moss cover (Mayberry 2008; Mayberry and Elle 2009). Mayberry and Elle (2009) found alpine enchanter’s nightshade (*Circaea alpina*) to be a strong indicator of flowering tall bugbane. In unfavorable conditions, such as low light, tall bugbane will become dormant. During these times the plants occur in a reduced vegetative state, awaiting a canopy opening that will facilitate more extensive growth and reproduction. This species exhibits short periods of dormancy of usually 1, or sometimes 2 years, with 7.5–12.4% of a population being dormant at any one time, depending on the population studied (Kaye 2000). In B.C., dormancy was observed at a noticeable rate (6%) at only 1 of 4 populations monitored from 2005 to 2007 (Mayberry 2008).

Seed germination

Seeds are produced during the summer months and are dispersed by gravity within a few metres of the parent plant (Kaye and Kirkland 1994; Wentworth 1996). Kaye (2000) found that new seedlings become small vegetative plants the following year, but only a few individuals will mature, with the rest remaining small and vegetative. Mortality is reported as highest for seedlings and lowest for reproductive plants (Kaye 2000). Germination trials (Kaye and Kirkland 1994; Kaye 2001b) indicated that warm stratification (i.e., seeds placed under moist conditions and subjected to alternating daily temperature regime) at 15°C and 25°C for 2 weeks and followed by cold stratification at 5°C for 3 months was required to break dormancy. No seeds germinated when only using cold stratification at 4°C.The length of seed viability in the soil is unknown (Wentworth 1996). Kaye (pers. comm., 2003) feels long-term viability is limited, and this may limit seed banking opportunities for this species. However, given the potential conservation value of seed banks, this may warrant further investigation.

Root morphology
Tall bugbane is classed as a rhizomatous geophyte (Klinkenberg and Klinkenberg 2003a). A rhizome is a modified underground stem, and the stem tissue is the primary storage tissue. As such, every node on a rhizome is capable of asexual reproduction and can potentially produce roots and shoots. As well, this underground stem allows this perennial plant to overwinter below ground.

Pollination biology
Tall bugbane is a nectarless species that is structured both for self-fertilisation (selfing) and out-crossing. However, the primary reproductive mechanism appears to be selfing (Pellmyr 1986).

Tall bugbane pollinators may include bumblebees, solitary bees, the introduced honeybee, hoverflies, beetles, and pollen-foraging flies, with solitary bees observed more often than any other pollinator (Penny and Douglas 2001). Mayberry (2008) found that tall bugbane flowers in B.C. were visited infrequently by pollinators (2.78 visits per hour) and less than that reported for other *Actaea* species (Pellmyr 1986). All of these visitors were hoverflies and no bumblebees were recorded during observations. However, Mayberry (2008) also found that tall bugbane fruit production in B.C. was not limited by pollen deposition. Specifically, flowers to which pollen had been applied by investigators did not produce more fruit than those without pollen addition. Additionally, flowers that had been excluded from pollinators had similar rates of fruit production to those flowers that had been left open to pollinators. It is unknown whether there is reduced fitness due to breeding amongst related individuals (i.e., inbreeding depression), which affects the quality of seed in this species (Mayberry 2008).

Genetics
A genetic diversity survey of B.C. populations suggests there is little genetic variation within or between populations (Mayberry 2008). Liston and Gray (1998) also found that there is limited gene flow between populations of tall bugbane, stating “this is consistent with the observation of self-compatibility and limited pollen movement.”

3.4 Limiting Factors

Limiting factors are generally not human induced and include characteristics that make the species or ecosystem less likely to respond to recovery/conservation efforts (e.g., inbreeding depression, small population size, and genetic isolation; or likelihood of regeneration or recolonization for ecosystems).

In its natural, undisturbed state, this species is potentially limited by a number of biological factors that commonly affect all plant populations, but which may have more serious effects on rare species that occur in low numbers in few populations. Rarity itself imposes limitations (Caughley and Gunn 1996).

Rare and small populations

This species is naturally rare in the landscape with few known extant populations, typically comprised by a relatively low number of individuals. These small and rare populations leave the species vulnerable to environmental and demographic stochastic events. Catastrophic disturbances, both natural and anthropogenic, can devastate an entire population when numbers are low (Caughley and Gunn 1996).

Species with low population numbers are precarious because of the potential impact of the founder effect and genetic drift (Menges 1991; Fischer, Husi, *et al*. 2000; Fischer, van Kleunen, *et al*. 2000). These authors have also pointed out that in other rare clonal *Ranunculus* species,[7] such as lesser spearwort (*Ranunculus reptans)*, genetic drift occurs despite the long-lived and clonal nature of the species. Genetic drift may cause gene variants to be removed from a population, reducing genetic variation. In addition, the founder effect can occur when a new population is established by a very small number of individuals from the larger population. This means the new population does not contain the full representation of genes, which results in the loss of genetic variation.

Liston and Gray (1998) examined populations (included 2 B.C. populations) throughout the range of tall bugbane and found them to be genetically distinct and isolated from other populations. This is different from the findings of Mayberry (2008) who found little genetic variation within or between populations in BC.

Habitat specificity

Tall bugbane occurs in the Coastal Western Hemlock (CWH) zone within the dry maritime subzone, the warmest subzone (mean annual temperature of 9.8°C), which has the greatest number of months with a mean temperature greater than 10°C (5.7 months) (Meidinger and Pojar 1991). This climatic restriction as well as habitat specificity and availability within the CWH zone with limited mixed or coniferous mature to old-growth forests, structural stages 5–7, age 70 to 150+ years remaining limits the species' occurrence in B.C. and in the Fraser Valley.

Dispersal

Limited dispersal mechanisms for this species may influence population expansion and recovery. The seed capsules of tall bugbane split open down one side (dehisce) and seeds are dispersed by gravity to within a few metres of the parent plants (Wentworth 1996). Other dispersal strategies may be on the hooves of deer and perhaps other mammals, such as mountain beaver, which have overlapping habitat requirements (D. Knopp, pers. comm., 2003). Keddy (pers. comm., 2003) speculates that other species of *Actaea* may have been dispersed by bears in the past, and that decline in bear populations may reduce the potential for dispersal.

[7] A clonal colony is a group of genetically identical individuals.

4 THREATS

Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future, the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational) (Salafsky *et al.* 2008). For purposes of threat assessment, only present and future threats are considered.[8] Threats do not include limiting factors, which are presented in Section 3.4.[9]

For the most part, threats are related to human activities, but they can be natural. The impact of human activity may be direct (e.g., destruction of habitat) or indirect (e.g., invasive species introduction). Effects of natural phenomena (e.g., fire, hurricane, flooding) may be especially important when the species or ecosystem is concentrated in one location or has few occurrences, which may be a result of human activity (Master *et al.* 2009). As such, natural phenomena are included in the definition of a threat, though should be applied cautiously. These stochastic events should only be considered a threat if a species or habitat is damaged from other threats and has lost its resilience, and is thus vulnerable to the disturbance (Salafsky *et al.* 2008) so that these types of events would have a disproportionately large effect on the population/ecosystem compared to the effect they would have had historically.

4.1 Threat Assessment

The threat classification below is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system and is consistent with methods used by the B.C. Conservation Data Centre and the B.C. Conservation Framework. For a detailed description of the threat classification system, see the CMP website (CMP 2010). Threats may be observed, inferred, or projected to occur in the near term. Threats are characterized here in terms of scope, severity, and timing. Threat "impact" is calculated from scope and severity. For information on how the values are assigned, see Master *et al.* (2009) and table footnotes for details. Threats for the tall bugbane were assessed for the entire province (Table 2).

[8] Past threats may be recorded but are not used in the calculation of Threat Impact. Effects of past threats (if not continuing) are taken into consideration when determining long-term and/or short-term trend factors (Master *et al.* 2009).

[9] It is important to distinguish between limiting factors and threats. Limiting factors are generally not human induced and include characteristics that make the species or ecosystem less likely to respond to recovery/conservation efforts (e.g., inbreeding depression, small population size, and genetic isolation; or likelihood of regeneration or recolonization for ecosystems).

Table 2. Threat classification table for tall bugbane in British Columbia.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]	Population #
1	Residential & commercial development	Medium	Restricted	Serious	High	
1.1	Housing & urban areas	Low	Restricted	Moderate	High	2, 6, 11
1.3	Tourism & recreation areas	Medium	Restricted	Serious	High	1, 2, 3, 4, 5, 6
4	Transportation & service corridors	Low	Restricted	Moderate	High	
4.1	Roads & railroads	Low	Restricted	Moderate	High	1, 2, 11
5	Biological resource use	High	Large	Moderate	High	
5.2	Gathering terrestrial plants	Low	Small	Serious	High	All
5.3	Logging & wood harvesting	High	Large	Moderate	High	1, 2, 3, 4, 5, 7,
6	Human intrusions & disturbance	High	Large	Moderate	High	
6.1	Recreational activities	High	Large	Moderate	High	1, 2, 5, 6, 11
7	Natural system modifications	Low	Small	Moderate	High	
7.1	Fire & fire suppression	Unknown	Small	Unknown	Low	All
7.3	Other ecosystem modifications	Low	Small	Moderate	High	All
8	Invasive & other problematic species & genes	Unknown	Restricted	Unknown	High	
8.1	Invasive non-native/alien species	Unknown	Restricted	Unknown	High	All
8.2	Problematic native species	Negligible	Restricted	Negligible	High	All
9	Pollution	Medium	Restricted	Serious	High	
9.3	Agricultural & forestry effluents	Medium	Restricted	Serious	High	1, 2, 3, 4 ,5, 7,
10	Geological events	Low	Small	Moderate	High	
10.3	Avalanches/landslides	Low	Small	Moderate	High	All
11	Climate change & severe weather	Unknown	Small	Unknown	Moderate	
11.2	Droughts	Unknown	Small	Unknown	Moderate	All

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment (e.g., timing is insignificant/negligible [past threat] or low [possible threat in long term]). Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.
[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).
[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or 3-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).
[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

4.2 Description of Threats

The overall province-wide threat impact for this species is very high.[10] The overall threat impact considers the cumulative impacts of multiple threats. Major threats include logging and recreation activities (Table 2). Details are discussed below under the Threat Level 1 headings.

IUCN-CMP Threat 1. Residential & commercial development

1.1 Housing & urban areas
The Fraser Valley continues to be an area of concentrated land development and increasing urbanization. This is particularly true near Promontory and the Ryder Lake areas in Chilliwack and surrounding areas where extensive ongoing housing developments will likely impact not yet discovered populations. The Chilliwack population growth rate is projected to be an average of 8.3% per year over the next 10–15 years which is higher than the B.C. average and population numbers are expected to reach 109,000 people in 2026 (Decision Support Services 2010). Additionally, there is currently extensive clearing for housing developments on Sumas Mountain in Abbotsford where a historical tall bugbane occurrence has been documented.

1.3 Tourism & recreation areas
The development of recreation areas on Vedder and Elk mountains is an increasing concern. The expansion of the trail system through several of the sites has damaged habitat and resulted in the loss of plants through mud bogging, dirt biking trails, as well as hiking and mountain biking (see IUCN-CMP Threat 6.1). Dirt biking trail construction is an issue at the Sumas Mountain historical site, where ground cover is often completely eradicated, trees felled for “bridging” to create crossings over inaccessible areas, and other bike trail activities occur (Iredale and Barsanti 2006). With the ever-increasing population in the Fraser Valley and housing development in and around Chilliwack and Abbotsford, the numbers of trails and people using them is expected to continue to grow.

IUCN-CMP Threat 4. Transportation & service corridors

4.1 Roads & railroads
Clearing for roads at any sites may cause direct mortality and indirect changes to the habitat suitability, change microclimate conditions, alter hydrological conditions (e.g., through culverting), and result in canopy removal. Tall bugbane on Elk Mountain does inhabit a portion of the damp roadsides but these roads are narrow dirt forestry roads that do retain cover and are not ideal habitat given spraying, soil erosion, and other threats. Roads also increase access to the sites, which may enable other threats such as invasive species, plant harvesting, trails, camping, mud bogging, etc. On Elk Mountain, a newly constructed road has potentially impacted that population both from direct and indirect increase in access. Illegally created roads are often

[10] The overall threat impact was calculated following Master *et al.* (2009) using the number of Level 1 Threats assigned to this species where Timing = High or Moderate, which included 2 High, 2 Medium, and 3 Low (Table 2).

created to access off-roading and mudding bogging sites. On Vedder Mountain, legal and illegally created roads continue to be accessed and cleared.

IUCN-CMP Threat 5. Biological resource use

5.2 Gathering terrestrial plants

The collecting of plants and plant parts for native plant gardening and herbal medicine is a concern. Tall bugbane is listed on several web sites and has been reported in general references as having medicinal value (Moore 1993). On rare occasions, the plant may be collected for use in alternative medicine; this activity is likely infrequent because the plant is poisonous. Whole plants of tall bugbane may also be dug up for use as propagation stock by native plant nurseries.

5.3 Logging & wood harvesting

Tall bugbane is threatened by logging operations that both directly and indirectly impact plant populations through canopy loss, clearing of larger than natural gaps that are slow to regenerate, and habitat fragmentation. To date, at least 2 B.C. populations have been lost due to clearcutting (Penny and Douglas 2001; D. Knopp, pers. comm., 2011). Logging activities may include edge effects (Chen *et al.* 1992) that alter environmental conditions such as growing conditions, light, and moisture into the forest adjacent to the road making the habitat less suitable. Edge effects will vary from site to site, and depend on proximity to the plants, the slope and aspect of the site, and prevailing air movement patterns. Related effects of logging operations that lead to other threats are scored separately and include clearing for access (roads, helipads; see Threat 4.1), increased access (trampling and recreational use; see Threat 6.1), influx of invasive species as competitors (see Threat 8.1), and post-logging treatments that include spray drift[11] and seeding (see Threat 9.3).

Logging is a threat at several sites. Seven Wildlife Habitat Areas (WHAs) were approved for tall bugbane in 2007, with general wildlife measures that afford some level of mitigation for the threat of logging (B.C. Ministry of Environment 2013). However, since 2007, 80% of the known occurrences of tall bugbane have been discovered outside the existing WHAs and may be susceptible to the threat of logging until additional WHAs that prevent or moderate this activity are approved. One site is found in a municipal park where logging does not currently occur.

Both illegal and legal (by permits issued through the Ministry of Forests Lands and Natural Resource Operations) removal of large individual trees of bigleaf maple affects tall bugbane due to the ecological changes that occur. For instance, significant loss of canopy cover and changes in site hydrology and soil structure will reduce the suitability of the site for tall bugbane. The frequency of this threat is increasing with removal of bigleaf maple both with and without permits in the Chilliwack Valley (R. Vennesland, pers. comm., 2007). The wood is highly desired for use in construction of guitars and other wood-based products (Barsanti *et al.* 2007).

[11] Spray drift is the physical movement of a pesticide through air at the time of application or soon thereafter, to any site other than that intended for application.

IUCN-CMP Threat 6. Human intrusions & disturbance

6.1 Recreational activities

Recreational activities are a concern at nearly all populations. In particular dirt biking is an issue at the historical population 11 Sumas Mountain site where any ground cover is often completely eradicated (Iredale and Barsanti 2006). Recreational trails managed under Recreation Sites and Trails BC and illegal trails are also pervasive across Elk and Vedder mountains (populations 1, 2, and 5), directly impacting these populations. Population 1 on North Vedder Mountain was partially impacted by mud bogging in 2013 even though it was within a WHA area (WHA 2-146; K. Welstead, pers. comm., 2013). Mud bogging is the repeated driving of off-road vehicles over and through an area, which can result in changes in the hydrology and soil conditions of that area. In the case of the Population 1, all that remains is a deep flooded rectangular muddy ditch where some of the plants previously grew. Population 6 is adjacent to several park trails and requires careful management.

IUCN-CMP Threat 7. Natural system modifications

7.1 Fire & fire suppression

Fire suppression was identified as a threat to this species' survival in the COSEWIC status report (Penny and Douglas 2001). Kaye (2000) mentions fire suppression as a potential threat to this species, as this species may require a fire regime to reach maximum densities, a response to reduced competition, increased light, and a nutrient flush. Additionally, fire suppression could result in high fuel loading resulting in more intense fires. This may in turn kill seeds and rhizomes that might be able to resist mild surface fires. Alverson (1986) and Wentworth (1994) describe the presence of several populations of tall bugbane at U.S. sites where fires are known to occur and plant population numbers are high, indicating some degree of fire tolerance. However in B.C., the CWHdm subzone has a "natural disturbance type 2 (NDT2)," characterized by large-scale, catastrophic fires (average 5–50 ha) with a return interval averaging 150–350 years (B.C. Ministry of Forests 1995). In the Chilliwack River Valley, a severe fire was documented for the area in 1938 (Chilliwack Forest District 2003; G. MacInnes, pers. comm., 2003). Populations in this area have persisted despite these intense low frequency fires but the degree of fire resistance is still not quantified and the role of the fire cycle in sustaining healthy viable populations is unknown.

7.3 Other ecosystem modifications

Roadside maintenance activities pose a threat to at least one known population of tall bugbane on Elk Mountain (population 5; Figure 6) and likely other populations on Vedder Mountain (populations 1 and 2) and Mount Thom (population 6). Roadway grading, as well as grass trimming and brush cutting, can damage habitat and smother plants.

Pesticides used on surrounding agricultural areas and land clearing can have a detrimental impact on the availability of pollinators for native species including tall bugbane.

Figure 4. Tall bugbane plant upslope from a road.
Photo credit: Brian Klinkenberg.

IUCN-CMP Threat 8. Invasive & other problematic species & genes

8.1 Invasive non-native/alien species

An indirect impact from increased access and logging roads is the increasing distribution of non-native species. For example, the invasive species small touch-me-not (*Impatiens parviflora*) has been documented at several tall bugbane sites. Other fast-growing opportunistic species such as Himalayan blackberry (*Rubus armeniacus*) may outcompete and shade out tall bugbane. Mayberry (2008) also found wall lettuce (*Mycelis muralis*) and Robert's geranium (*Geranium robertianum*), which may act as competitors.

8.2 Problematic native species

Mayberry and Elle (2010) found that although populations were more stable in coniferous stands than broadleaved stands, recruitment was lower in coniferous stands. Broadleaved stands at Vedder Mountain have greater herbivory and higher reproduction, but also higher mortality and notably smaller leaves compared to the coniferous stand at Elk Mountain. This suggests that the plants may be stressed due to herbivory. As a result of habitat modifications in the Chilliwack area herbivore numbers are increasing. Herbivores reported for tall bugbane include Deer, Elk, and Mountain Beaver (Kaye and Cramer 2002).

In studies in the U.S., Kaye (2000, 2001a, 2001b, 2001c, 2002) reports high levels of herbivory for some populations, although herbivory levels fluctuate from year to year. Kaye (1999) also concludes that herbivory by Deer and Elk is more frequent in clearcuts and edges than in unmanaged old-growth forests.

IUCN-CMP Threat 9. Pollution

9.3 Agriculture & forestry effluents
Spray drift from herbicide treatment is a direct threat since the species is susceptible to herbicide and can cause direct mortality. The threat of spray drift depends on slope and prevailing air movement. The Elk Mountain population 5 has been subjected to herbicide spraying - glyphosate to control roadside vegetation (Barsanti *et al.* 2007). Herbicides used for road maintenance, agriculture, invasive species management, and silviculture are a concern at several other sites in particular populations 1 and 2 on Vedder Mountain. Populations 3, 4, and 7 are also susceptible depending on the adjacent land use, proximately to roads and silviculture prescription.

IUCN-CMP Threat 10. Geological events

10.3 Avalanches/landslides
As many of the populations are associated with seepage areas, the likelihood of natural and induced landslides is substantial. Road cuts and clearing for helicopter landing pads (population 5), and clearcut logging (populations 3, 4, 10, and 12), particularly on steeper slopes, can increase the risk of slides, slumps, or erosion (especially over time). Slides or slumps can change the soil structure and habitat suitability for tall bugbane. Although this is a potential threat at all locations, the scope of this threat is small as only a small portion of the populations would ever be effected during any given 10-year period.

IUCN-CMP Threat 11. Climate change & severe weather

Droughts
The impact of climate change on the hydrology and forest composition is unknown. It will be crucial to monitor these impacts as tall bugbane is closely associated with moist forest and seepage areas thus droughts may have an impact on the species.

5 RECOVERY GOAL AND OBJECTIVES

5.1 Recovery (Population and Distribution) Goal

The overall recovery (population and distribution goal) of tall bugbane in B.C. is:

To ensure that the number of populations and quality and quantity of occupied habitat remains stable or increases across the species existing range, and where feasible, to restore additional populations and connective habitat within the species' historical range in B.C.

5.2 Rationale for the Recovery (Population and Distribution) Goal

Tall bugbane has a restricted geographic range (peripheral species) and is naturally rare on the landscape. Because of this, it is unlikely that tall bugbane will ever be down-listed to a status of threatened. As such, the population and distribution goal has been set to ensure the long-term persistence of this species. With only 13 sites ever known in B.C. (7 extant populations, 6 unconfirmed/historical), it is important that all 7 known extant sites and any newly discovered sites (i.e., plants/populations that may be found during future inventories) are maintained. Without adequate protection, the probability of species extirpation from B.C. is considered high (COSEWIC 2001).

Based on the threats and population assessments in B.C., Mayberry and Elle (2010) suggest that conservation measures should include preventing mortality and increasing recruitment at occupied sites as well as historical sites. If the quantity of occupied habitat is known to be decreasing at a site, it may be necessary to increase recruitment through augmentation. To ensure the persistence and long-term viability of tall bugbane in B.C., historical sites should be restored to the extent possible. Restoring populations will likely require re-introduction through propagules. As this species is naturally rare and has a restricted distribution, artificial expansion of populations beyond its naturally occurring range and confirmed sites is not recommended unless unexpected conditions occur that modify the habitat significantly (e.g., through climate change). Although artificial expansion is not recommended, there is a need to retain connecting habitat between plants and populations to allow for population dispersal, dynamics and response to changing habitat conditions as needed in the presence of climate change or to respond to threats.

5.3 Recovery Objectives

The recovery objectives for this species are:

1. to remove or manage threats, and protect[12] and restore habitat at all extant populations;
2. to assess, restore, or enhance habitat, and re-establish populations at historical sites where feasible;
3. to conduct further inventory within the known range of the species in B.C. to prevent inadvertent loss of populations that have not yet been identified within suitable habitat;
4. to determine the effectiveness of habitat protection/enhancement measures and recovery actions by monitoring population status; and
5. to inform and refine management decisions by improving our understanding of threats, population ecology, and habitat requirements.

[12] Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations, and protected areas.

6 APPROACHES TO MEET OBJECTIVES

6.1 Actions Already Completed or Underway

The following actions have been categorized by the action groups of the B.C. Conservation Framework (B.C. Ministry of Environment 2010). Status of the action group for this species is given in parentheses.

Compile Status Report (complete)

- COSEWIC report completed (Penny and Douglas 2001).
- Genetic research using allozyme markers on populations in B.C. have been completed (Mayberry 2008).
- A demographic study has been undertaken at 4 populations, resulting in 3 years of data (2005–2007; Mayberry 2008).

Send to COSEWIC (complete)

- Tall bugbane assessed as Endangered (Penny and Douglas 2001). Re-assessment was due in 2011.

Planning (complete)

- BC Recovery Plan completed (this document, 2014).

Habitat Protection and Private Land Stewardship (in progress)

Table 3. Existing provisions for habitat protection for tall bugbane.

Existing habitat protection	Threat[a] or concern addressed	Site No.
Wildlife Habitat Areas (7 established)	5.3	Portions of sites 1, 2, 5
Municipal park bylaws	1.1, 4.1, 5.3, 9.3	Site 6
Wildlife Tree Patch	5.3	Portion of site 2
"Visual landscape" reserve	5.3	Portion of site 2

[a] Threat numbers according to the IUCN-CMP classification (see Table 2 for details).

- Tall bugbane is listed as a species that requires special management attention to address the impacts of forest and range activities under the *Forest and Range Practices Act* (FRPA) and/or the impacts of oil and gas activities under the *Oil and Gas Activities Act* (OGAA) on Crown land (as described in the Identified Wildlife Management Strategy; Province of British Columbia 2004).
- 7 Wildlife Habitat Areas (WHAs) in the Chilliwack Forest District were established in 2007 for tall bugbane. Most of the WHAs were established to have a 50-m core area surrounding each tall bugbane population, with a 200-m management zone extending beyond the core depending on site-specific characteristics (as described in the Identified Wildlife Management Strategy; Province of British Columbia 2004).
- To date, 71 ha of the 348 ha of core survival habitat described in Section 7 is protected by WHAs (B.C. Ministry of Environment 2013).

- General Wildlife Measures that apply within WHAs address access issues, forest harvesting and silviculture, pesticide use, and range activity (Penny 2004). The following key measures describe what is currently in place (but are not limited to):
  - do not harvest within WHA core area for tall bugbane, except for treatments aimed at maintaining or improving stand characteristics for this species.
  - use partial harvesting systems in the WHA management zone for tall bugbane that maintain 60% basal stem area.
  - remove 40% basal stem area in small openings with a minimum of only a few crowns per gap.
  - retain *Acer* species, particularly *Acer macrophyllum*. Retain at least 20–30% from inventory distribution.
- Ecological monitoring by the B.C. Conservation Corps has been initiated at several sites to obtain baseline information to monitor logging impacts (Iredale and Barsanti 2006; Barsanti *et al.* 2007).
- Predictive habitat mapping has been undertaken for this species in the lower Fraser Valley, south of the Fraser River (Klinkenberg 2005; See Appendix 1).

6.2 Recovery Planning Table

Table 4. Recovery planning table for tall bugbane.

Conservation Framework action group	Actions to meet objectives	Threat[a] or concern addressed	Priority[b]
Objective 1. To remove or manage threats, and protect and restore habitat at all extant populations			
Habitat protection; Land stewardship	• Expand established WHAs and implement new WHAs to include all tall bugbane populations.	5.3	Essential
	• Encourage inclusion of plants at risk under the *Wildlife Act*.	5.2, 5.3, 6.1, 1.1	Necessary
	• Work with the Ministry of Forests, Lands and Natural Resource Operations (FLNRO) to ensure permits for recreational use, logging, and bigleaf maple harvest are not be issued in habitats ranked as high likelihood (i.e., both red- and orange-shaded areas in Figure 4), as per the predictive modeling (see Appendix 1).	1.3, 5.3	Necessary
	• Work with trails and recreations groups, City of Chilliwack (Mt. Thom), FLNRO, Recreation Sites and Trails BC to deactivate problem trails and prohibit new trail building and mud bogging that impact tall bugbane populations especially within their core habitat.	1.3, 6.1	Essential
	• Mitigate road-side impacts from spraying and maintenance activities by ensuring the City of Chilliwack and logging road maintenance crews are aware of tall bugbane locations on road right-of-ways. Work with them to develop a schedule of when to brush roadsides and restrict activities (e.g., road widening) where populations may be harmed. Assess the appropriateness of relocation of individual plants threatened on the road right-of-way.	7.3 4.1	Necessary
	• Retain a degree of connectivity and soft edge (i.e., transition habitat, as compared to a “hard” edge, which is an abrupt line	Genetic variation	Necessary

Conservation Framework action group	Actions to meet objectives	Threat[a] or concern addressed	Priority[b]
	with no vegetative transition interface; see Voller 1998) between the populations to enable long-term dispersal, growth, and natural dispersal in response to habitat changes, stochastic events, or climates changes.		
Habitat restoration	• Reduce access points through road and trail deactivation.	5.2, 6.1	Beneficial
	• Restore impacted sites (e.g., clearcut sites, road sides, and helipad sites) to ensure the ecosystem/habitat is regenerating in a way that would support future tall bugbane recovery.	4.1, 5.3, 10.3	Beneficial
Objective 2. To assess, restore, or enhance habitat, and re-establish populations at historical sites where feasible			
Habitat restoration	• Assess the suitability of historical sites including surrounding areas and connecting sites (adjacent to occupied sites). Consider the potential to repopulate each site.	Knowledge gap; Small population and genetic variation	Beneficial
	• Restore or enhance habitat if needed to ensure that the historical sites remain or become suitable to allow recolonization or re-establishment.	All	Beneficial
Species and population management	• Investigate augmenting and re-introduction techniques giving consideration to maintaining genetic composition. Assess genetic work and ecological implications of population enhancement (including seed collection).	Knowledge gap; Genetic variation	Necessary
	• Investigate population management options where recruitment rates are low.	Knowledge gap; Genetic variation	Beneficial
	• Re-established plants in historical locations, if feasible.	Small population	Necessary
Objective 3. To confirm distribution of the known range of the species in B.C. to prevent inadvertent loss of populations that have not yet been identified within suitable habitat			
Habitat protection; Land stewardship	• Survey known extant populations and conduct targeted inventory including a thorough search of all potential habitats (using the predictive habitat model; see Appendix 1) to assess the prevalence of tall bugbane on the landscape and to obtain accurate estimates of populations sizes and distribution.	Knowledge gap	Necessary
	• Develop an awareness campaign for related stakeholders (forestry, recreational users, and authorities) alerting them to the presence of tall bugbane in their work area, conducting field trips to help practitioners identify the species in the field, using the tall bugbane brochure as a key information source.	5.2, 5.3, 6.1, 7.3, 9.3	Necessary
	• Ensure mapping of survival and recovery habitat is current and accessible. Distribute maps to stakeholders, First Nations, and other land managers to aid them in identifying areas where they should use caution or seek expert advice.	1.1, 5.2, 5.3, 6.1, 7.1, 7.3, 9.3	Necessary
	• Educate outdoor user groups regarding the long-term threat to tall bugbane from recreational trail development and expansion and how to identify this species; partner with stewardship groups such as South Coast Conservation Program and BC Stewardship Centre to develop an extension strategy for tall bugbane in combination with other species at risk.	5.2, 6.1	Beneficial
Objective 4. To determine the effectiveness of habitat protection/enhancement measures and recovery actions by monitoring population status			
Habitat protection	• Establish a monitoring program to determine the effectiveness		

Conservation Framework action group	Actions to meet objectives	Threat[a] or concern addressed	Priority[b]
	of WHA. Set up monitoring plots to:		
	o Evaluate the effectiveness of protective measures, such as evaluate the effectiveness of implemented buffer in WHAs;	1.3, 5.2, 5.3, 6.1, 7.3	Necessary
	o Provide early detection and mitigation of site-level threats (e.g., plant collectors, adjacent land use, new trails, poaching of bigleaf maple); and	1.3, 5.2, 5.3, 6.1	Necessary
	o Track potential effects of climate change or natural geological events.	11.2	Beneficial
Objective 5. To inform and refine management decisions by improving our understanding of threats, population ecology, and habitat requirements.			
Species and Population management	• Conduct research to study longevity, genetic strength, pollination, dormancy, and population fluctuations.	Knowledge gap;	Beneficial
	• Conduct research to study site attributes for tall bugbane.	Knowledge gap	Beneficial
	• Monitor and mitigate impacts from invasive species.	8.1	Beneficial
	• Asses the impacts of herbivory and mitigate (e.g., exclusion fencing) where needed.	8.2	Beneficial
	• Establish a 10-year monitoring program of seed set, recruitment, dormancy, population health, and viability.	Knowledge gap	Necessary

[a] Threat numbers according to the IUCN-CMP classification (see Table 2 for details).
[b] Essential (urgent and important, needs to start immediately); Necessary (important but not urgent, action can start in 2–5 years); or Beneficial (action is beneficial and could start at any time that was feasible).

6.3 Narrative to Support Recovery Planning Table

The two main threats to tall bugbane at all sites in B.C. are direct and indirect impacts from forest management practices and recreational activities causing habitat loss and degradation. Where established, WHAs have alleviated much of this threat (K. Welstead, pers. comm. 2014; see also Appendix 3). Remaining threats, including herbicide spraying, invasive weeds, roadways, and other threats, can be mostly addressed through the implementation of the approaches listed in Table 3. WHAs have been recommended for all but one site (Mount Thom is in a municipal park). WHAs allow for the establishment of a protected core area surrounded by a “managed” buffer zone (see Section 6.1, “Actions Already Completed or Underway”).

Continuing to conduct targeted inventory following *Protocols for Rare Vascular Plant Surveys* (Penny and Klinkenberg 2013) will increase our understanding of the population dynamics of this species. This will include a thorough search of all potential habitats so that rarity can be effectively gauged; and to obtain accurate estimates of populations sizes and distribution, so that appropriate conservation measures can be taken. If new populations are identified, habitat management, protection, and stewardship should be initiated.

7 INFORMATION ON HABITAT NEEDED TO MEET RECOVERY GOAL

Threats to tall bugbane habitat have been identified. Survival and recovery habitats have been determined for this species to aid in threat mitigation. The description of survival and recovery habitat provided will also facilitate other actions that are required to meet the recovery (population and distribution) goal, such as land management and habitat protection efforts.

7.1 Description of the Species' Survival and Recovery Habitat

The currently known occurrences of tall bugbane are used as a basis for defining **survival habitat** within the context of this recovery plan. Any newly found sites with plants should also be included as survival habitat.

The known historical occurrences of tall bugbane where suitable habitat exists or can be restored are used as a basis for describing **recovery habitat** within the context of this recovery plan.

Actions in the recovery planning table (Section 6.2) include conducting additional surveys in the range of tall bugbane, which may result in the discovery of other occupied sites. This will provide additional information necessary to refine the description of survival/recovery habitat that is needed to meet the recovery (population and distribution) goal. The description of survival/recovery habitat is based on the best available science and will be updated as more information becomes available.

7.1.1 Biophysical Attributes of Survival and Recovery Habitat

The following description of biophysical attributes of survival and recovery habitat is based on the best available knowledge of this species and its habitat in B.C. This description should be updated as information collected as a result of recovery actions or research adds to our scientific knowledge of this species.

The known biophysical attributes of survival and recovery habitat that are required to support tall bugbane are (COSEWIC 2001):

- best supported by intact mature to old-growth forests (> 70 years old);
- primarily in mixed Douglas-fir or western redcedar–western hemlock stands with at least 20–30% bigleaf maple (*Acer macrophyllum*) representation;
- having natural gap formation through senescence but are windfirm[13] to prevent large-scale blowdowns;
- having distinct canopy layers and relatively sparse understory providing natural partial to moderate shade through scattered openings in the canopy;
- gentle to steep slopes with stable hydrological conditions provided by subsurface moisture typically within riparian areas of shaded watercourses such as creeks/streams/rivers or proximate to moist slopes or seepage areas; and
- generally below 1600 m in elevation.

[13] Windfirm refers to a stand that is unlikely to blow down.

7.1.2 Description of Survival Habitat

Where populations are known to be extant[14] (i.e., for the 7 known sites, as of 2013, and including any populations that may be identified in the future), survival habitat[15] is identified as:

- All individual occurrences plus 50 m surrounding them, described as "core area";
- Occurrence "core area" boundaries that are within 200 m of each other are adjoined as one continuous polygon. For example, plants that were within 200 m of each other were adjoined as one continuous polygon allowing up to 100 m of additional core area to be included between them; and
- A 200-m "management zone" surrounding all core areas (as described above) is applied.

Note that areas where existing infrastructure persists on the landscape (e.g., roads, railways, and buildings) are not considered survival habitat.

A 50-m "core area" around each plant is needed to retain macro- and microclimate conditions. Tall bugbane has a strong association with aquatic features and soil moisture thus ensuring water quality and quantity are necessary to retain those features. Chen *et al.* (1990) have demonstrated soil temperature and moisture changes extend 60–120 m into Douglas-fir forests from the edge of clearcuts in Washington. Brosofske *et al.* (1997) conclude that at minimum a 45-m buffer each side of a stream is necessary to maintain a natural riparian microclimatic environment in Washington, which can be applied to retaining stable hydrological conditions provided by subsurface moisture typically proximate to a creek/stream/river/seep.

Loss of suitable connecting habitat can be a barrier to dispersal and thus gene flow. As such, plant occurrence "core area" boundaries within 200 m of each other were adjoined as one continuous polygon to connect habitat between plants within a population. Although seeds seem to not disperse far from their natal plants there is a need for this connecting/dispersal habitat. Natural expansion of populations on Vedder Mountain has been observed where the habitat was left to regenerate, effectively closing the gap between sites (K. Welstead, pers. comm., 2014). This natural process is encouraging and essential to the species recovery given the few sites in Canada. The larger (number of individuals) and more expansive (extent) the populations, the more resilient they will be (Caughley and Gunn 1996).

The 200-m "management zone" is needed to keep the core area windfirm and retain conditions/habitat attributes within it. Trees have become stressed and weakened with increases in mortality along edges of clearings (Saunders *et al.* 1991; Chen *et al.* 1992). Shirley (2004) found there was a significant drop in the deciduous tree density contributable to loss through wind damage in stands within 36–44 m of a hard edge, compared to that with a stand 100–144 m wide or greater. The management zone is needed to help preserve these mixed deciduous stands that tall bugbane requires.

The management zone is also required to protect plants from other forest edge effects such as increased herbivory and loss of moisture, as well as to maintain interior forest conditions and

[14] Extant sites are based on the most recently verified sightings (i.e., last 17 years, back to 1997) of tall bugbane.
[15] Survival habitat as described here made up of a core area and a management zone is consistent with the conservative areas recommend in the Identified Wildlife Management Strategy (Penny 2004).

provide options for population dispersal. Chen *et al.* (1990) found that air temperature and humidity change extent 120–240 m from clearcut edges into old-growth forests in the Pacific Northwest. Chen *et al.* (1995) describe declining soil moisture up to 90 m from the edge of forests. Nyberg and Janz (eds., 1990) found that edge species such as deer and other herbivores flourish in edge habitats. Kaye and Kirkland (1999) found the frequency of herbivory on tall bugbane to be 2 to 3 times greater in edges and thinned stands when compared to unmanaged stands. To protect from edge effect, Voller (1998) recommends a 200-m wide buffer to retain interior habitat.

7.1.3 Description of Recovery Habitat

Where populations are known to be extirpated and where sufficient location information is available (e.g., sites 10–13 in Table 1), recovery habitat is identified as 1000-m management zone around each historical occurrence

Note that areas where existing infrastructure persists on the landscape (e.g., roads, railways, and buildings) are not considered recovery habitat.

Historical occurrences of tall bugbane were used as a basis for describing recovery habitat. Historical sites were included as recovery habitat only if suitable habitat was known to exist or was deemed restorable. It was not possible to determine the status of the habitat associated with 2 earlier records (e.g., population 8 and 9) due to the lack of specific location data and the large area each site could cover. As such it was not possible to map these sites or use them in the description of recovery habitat.

There is uncertainty regarding the specific locations of all historical tall bugbane records. To allow for this location uncertainty, a larger management zone of 1000 m was set to describe recovery habitat. This management zone will also allow options for future recovery efforts such as habitat assessments, restoration actions, and population recruitment either from natural dispersal from adjacent populations or reintroduction. Once new or re-introduced tall bugbane occupies a site, it will be used to identify additional survival habitat and the geospatial information for survival habitat will be updated accordingly.

7.1.4 Geospatial Description of Survival and Recovery Habitat

A map showing areas with survival habitat (i.e., sites 1–7 as identified in Table 1) and recovery habitat (i.e., sites 10–13 as identified in Table 1) for tall bugbane is shown in Figure 5.

Detailed maps of areas within which survival habitat at each known site (i.e., sites 1–7 as identified in Table 1) is found is in Appendix 2 (Figures 7–13). The total area within which survival habitat occurs is currently 1445 hectares, 348 hectares of which is core area. This does not take into account areas that would be excluded (i.e., existing roads and infrastructure features and any other habitat that is deemed unsuitable or not able to be restored). This geospatial information on survival habitat to support land management decisions and protection of the

species and its habitat is available upon request by contacting the Species at Risk Biologist at the B.C. Ministry of Forests, Lands and Natural Resource Operations, Surrey, B.C.

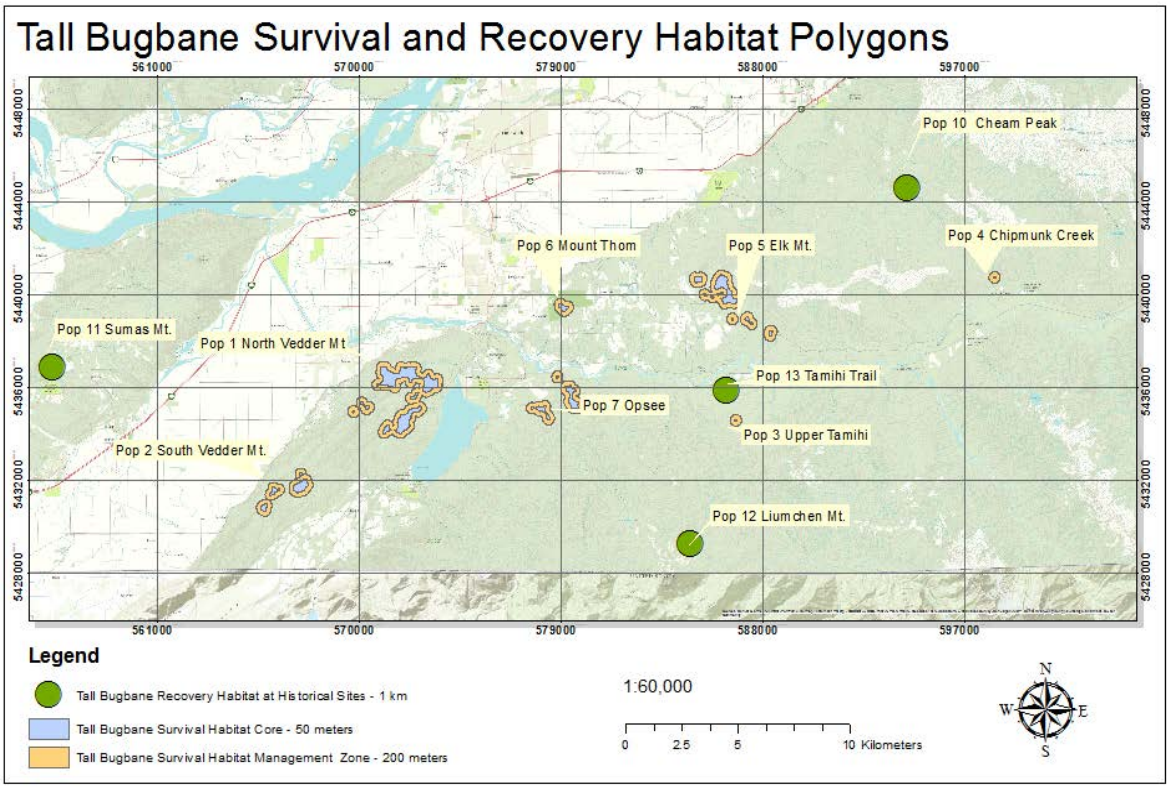

Figure 5. Survival and recovery habitat for tall bugbane.
Areas within which survival habitat is found in B.C. are shown by a 50-m core area around each plant (shaded blue) and a 200-m management zone that extends from the core zone (shaded orange). Areas within which recovery habitat is found in B.C. are shown by a 1000-m management zone (green shaded circle) mapped around historical records of plants.

7.1.5 Human Activities to Mitigate and Avoid in Tall Bugbane Habitat

Please refer to Appendix 3 for recommended best management practices aimed to prevent negative impacts to tall bugbane habitat. These best management practices address some of the activities that are to be mitigated or avoided in survival or recovery habitat polygons.

8 MEASURING PROGRESS

If population monitoring indicates that the number of extant populations is stable or naturally increasing and recolonization of historical sites has occurred where feasible, then the population and distribution goal for tall bugbane will have been met.

The following performance indicators provide a way to define and measure progress toward achieving the recovery (population and distribution) goal and objectives. Performance measures are listed below for each objective.

Measurables for Objective 1

- Protection of the 7 known extant populations is in place by 2016.
- Stabilization (no declines) or increases in the number of sites and/or the number of individuals has occurred over the next 5 years.
- Habitat restoration has been initiated at 2 occupied sites by 2020 (e.g., bring the helipad site at Elk Mountain back into productive habitat, and reduce road maintenance/spraying impacts). These sites are within existing mapped survival habitat polygons as they are adjacent to occupied populations.

Measurables for Objective 2

- Historical sites and surrounding areas have been surveyed by 2018.
- Where feasible, available habitat has been replanted or managed at historical sites by 2020 so that habitat will in the future be capable of supporting populations of tall bugbane.
- At least one tall bugbane population has been re-established at a historical site by 2024.

Measurables for Objective 3

- Extensive inventory has been conducted at 75% of the predicted range (as per the predictive map in Appendix 1) of the species to determine presence of tall bugbane by 2016.
- Protection measures of any newly discovered populations have been put into place.

Measurables for Objective 4

- Annual monitoring, each site measured in rotation a minimum of once every 2 years starting in 2014 to assess change in the size of populations, recruitment, level of herbivory, etc.
- The effectiveness of WHAs has been evaluated and results used to refine management recommendations where needed by 2020.

Measurables for Objective 5

- Evaluation and management of invasive species was conducted every 2 years in conjunction with the population monitoring and has been initiated by 2016.
- Research to elucidate habitat associates and improved understanding of threats and population ecology completed by 2018.

9 EFFECTS ON OTHER SPECIES

Recovery activities taken on behalf of tall bugbane will have direct beneficial effects on several other species at risk that overlap in occurrence and have similar biophysical requirements with tall bugbane including Mountain Beaver (*Aplodontia rufa*), Coastal Giant Salamander (*Dicamptodon tenebrosus*), Western Toad (*Anaxyrus boreas*), Pacific Water Shrew (*Sorex*

bendirii), and Northern Red-legged Frog (*Rana aurora*). No negative effects on any species are expected.

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Appendix 1. Predictive habitat mapping and modeling

A predictive model for tall bugbane distribution was developed using locality information from B.C. observation records applied onto digital Terrestrial Resource Information Management (TRIM) and B.C. Ministry of Forest cover maps in addition to habitat information from recent studies in the United States (B. Klinkenberg and R. Klinkenberg, pers. comm., 2008). The predictive map is shown in Figure 6.

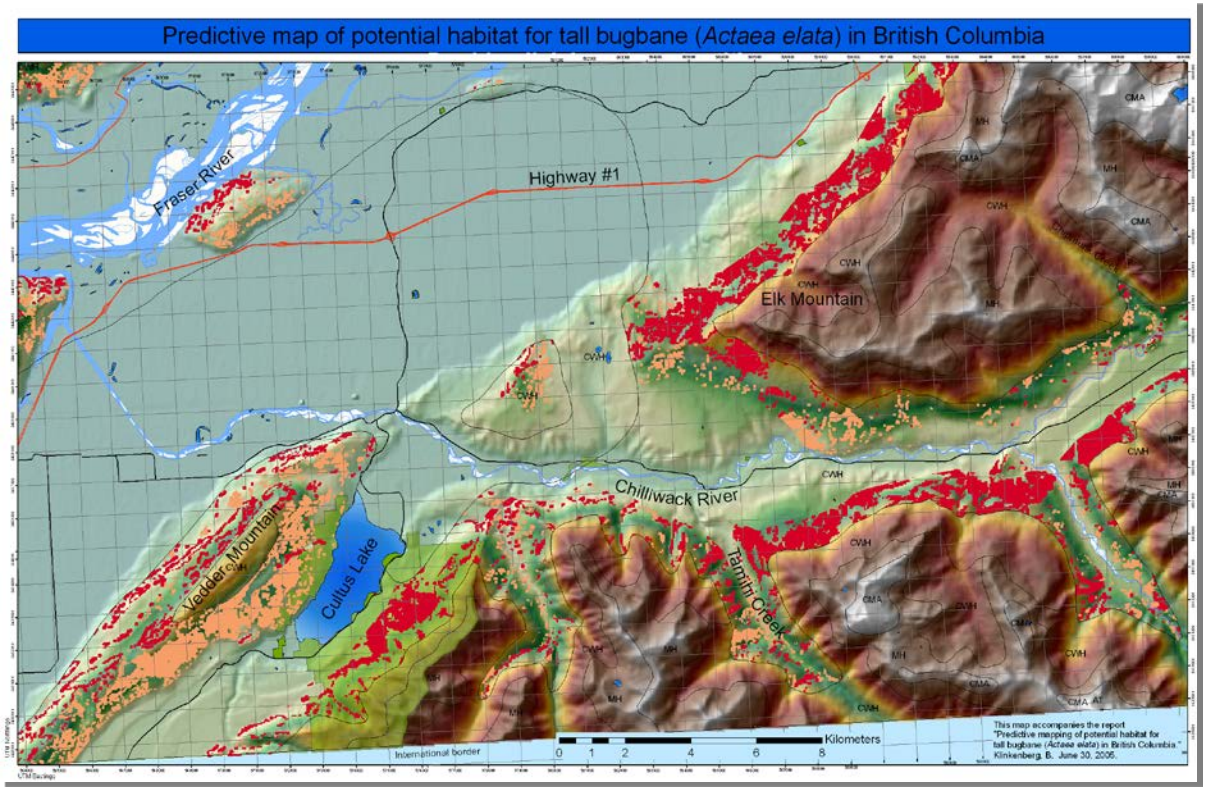

Figure 6. Predictive habitat mapping for tall bugbane.
The red- and orange/tan-coloured areas represent areas identified by the model as having the greatest likelihood of supporting tall bugbane populations. 69% of the known populations fall within a red-coloured area; a further 17% of the populations occur within the orange-coloured areas. Source: Klinkenberg (2005).

Appendix 2. Survival habitat polygons for tall bugbane

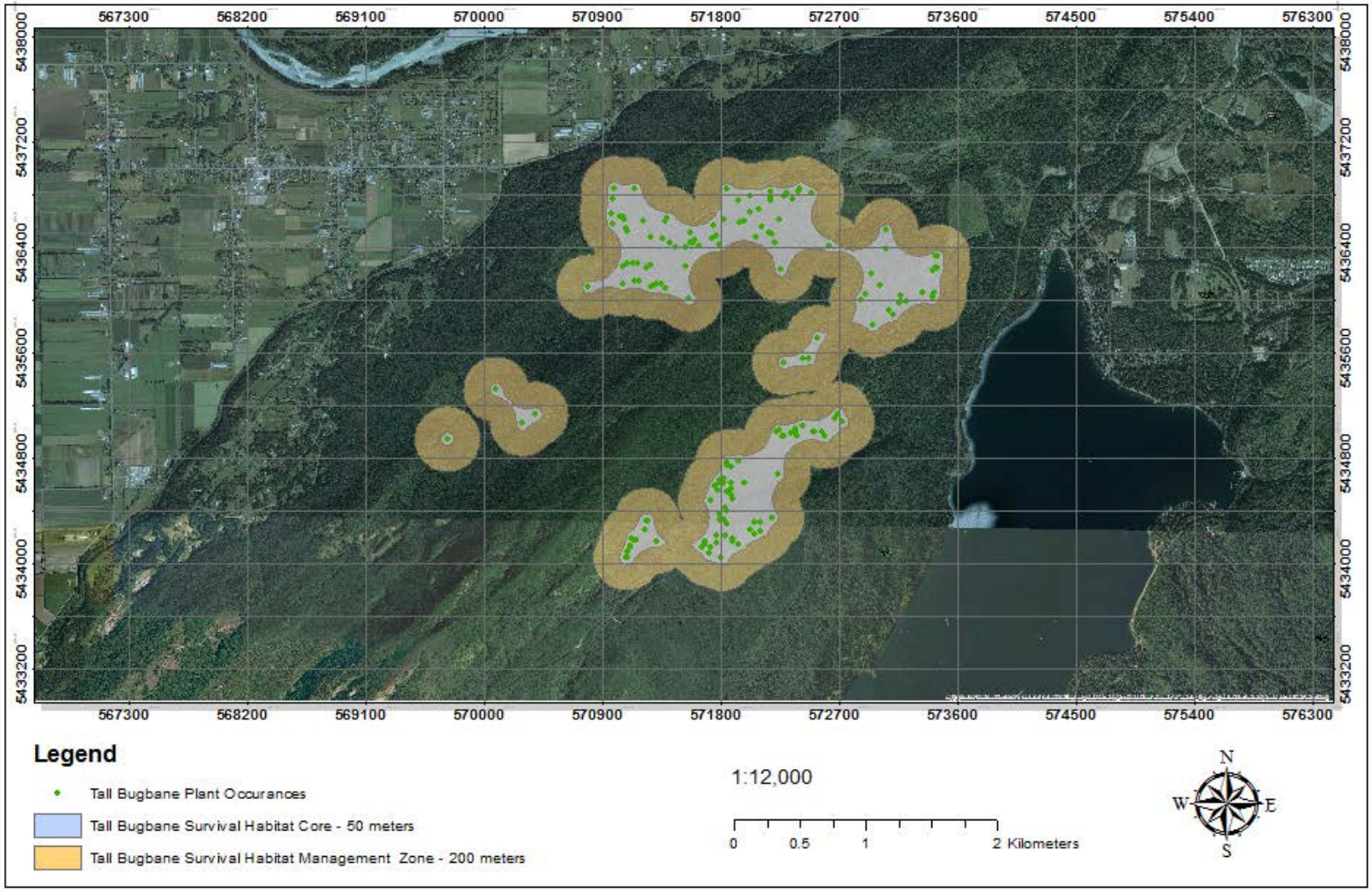

Figure 7. Area within which survival habitat for tall bugbane is found at North Vedder Mountain, B.C.

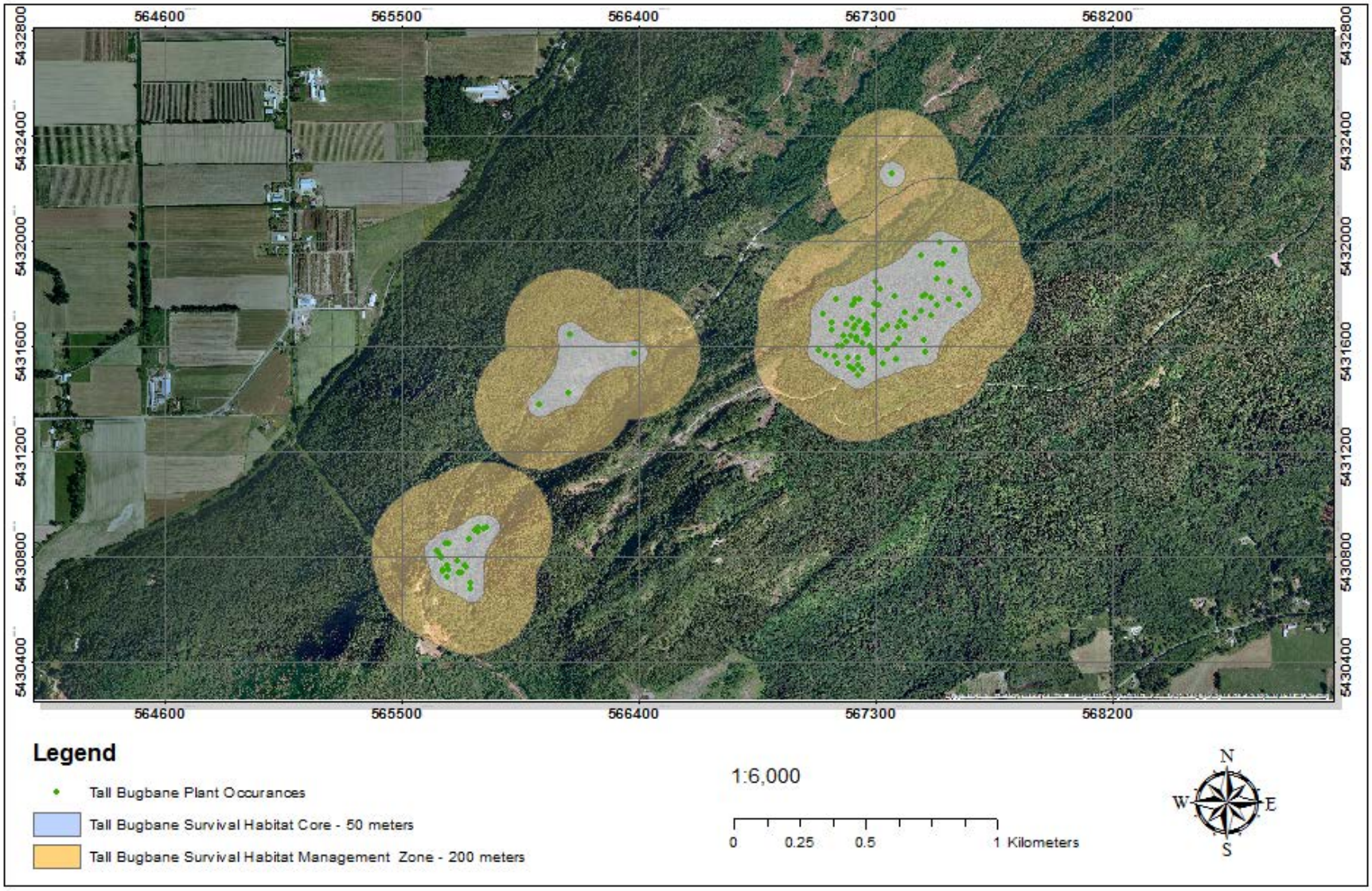

Figure 8. Area within which survival habitat for tall bugbane is found at South Vedder Mountain, B.C.

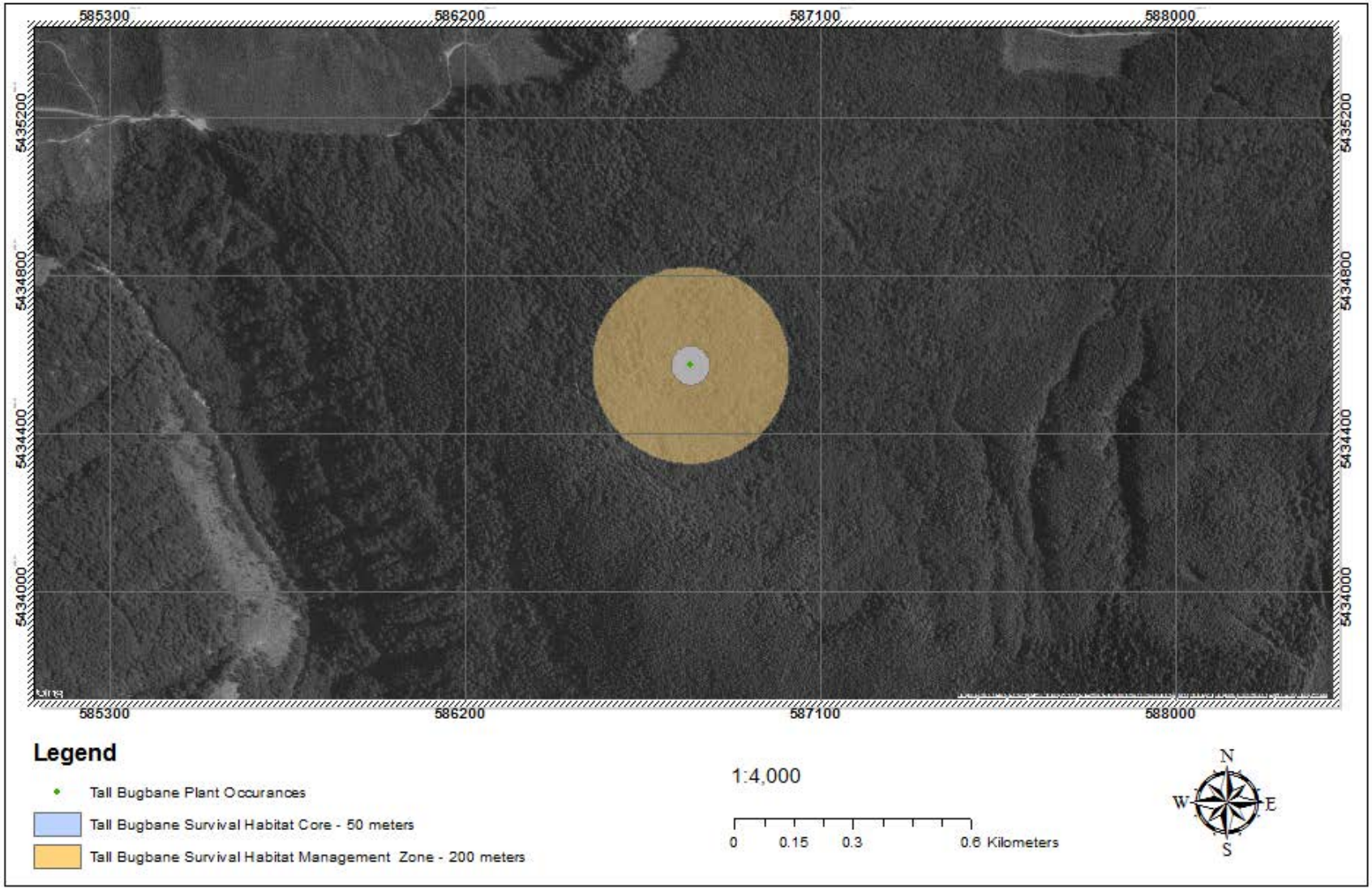

Figure 9. Area within which survival habitat for tall bugbane is found at Upper Tamihi, B.C.

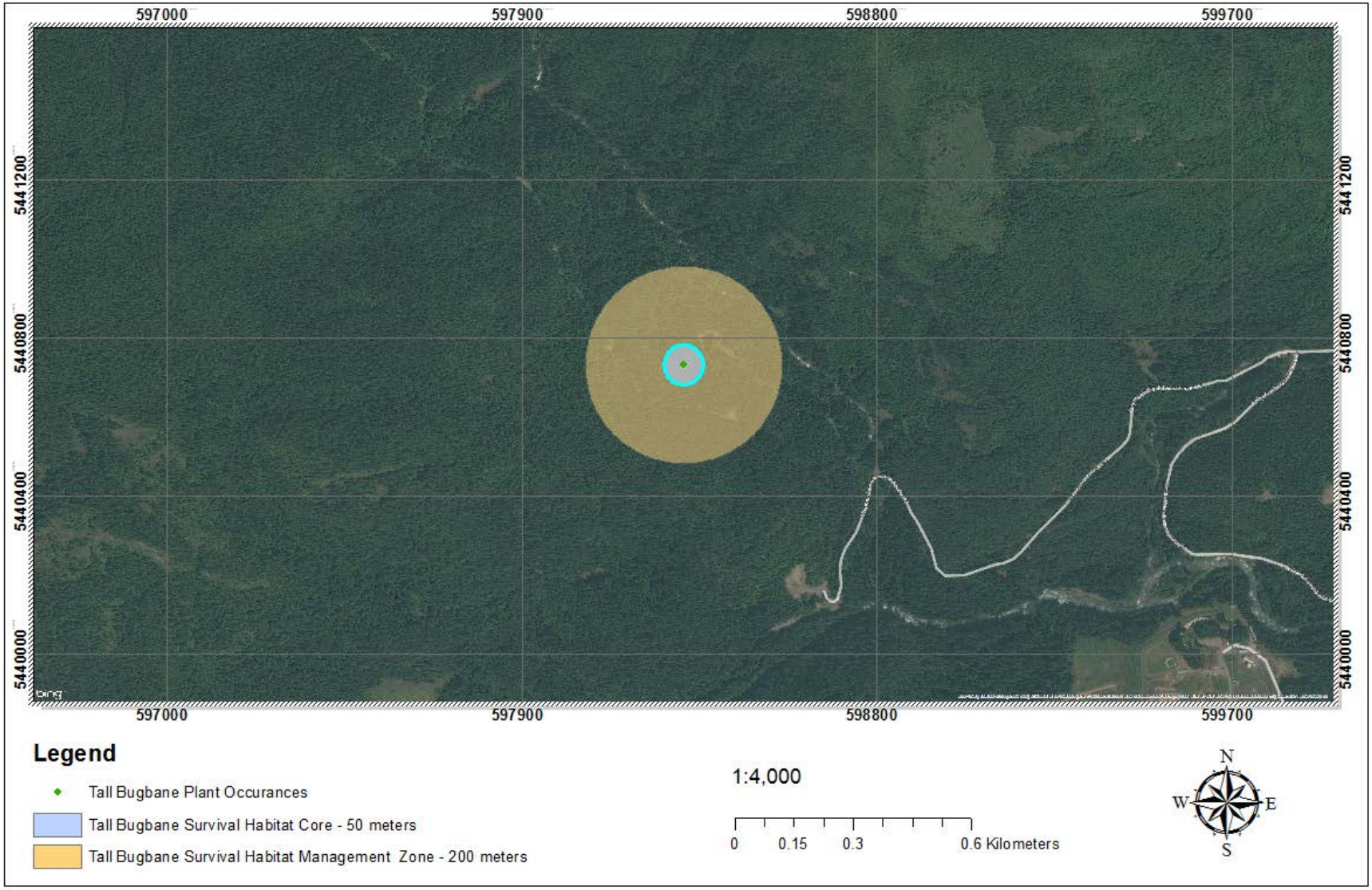

Figure 10. Area within which survival habitat for tall bugbane is found at Chipmunk Creek, B.C.

Figure 11. Area within which survival habitat for tall bugbane is found at Elk Mountain, B.C.

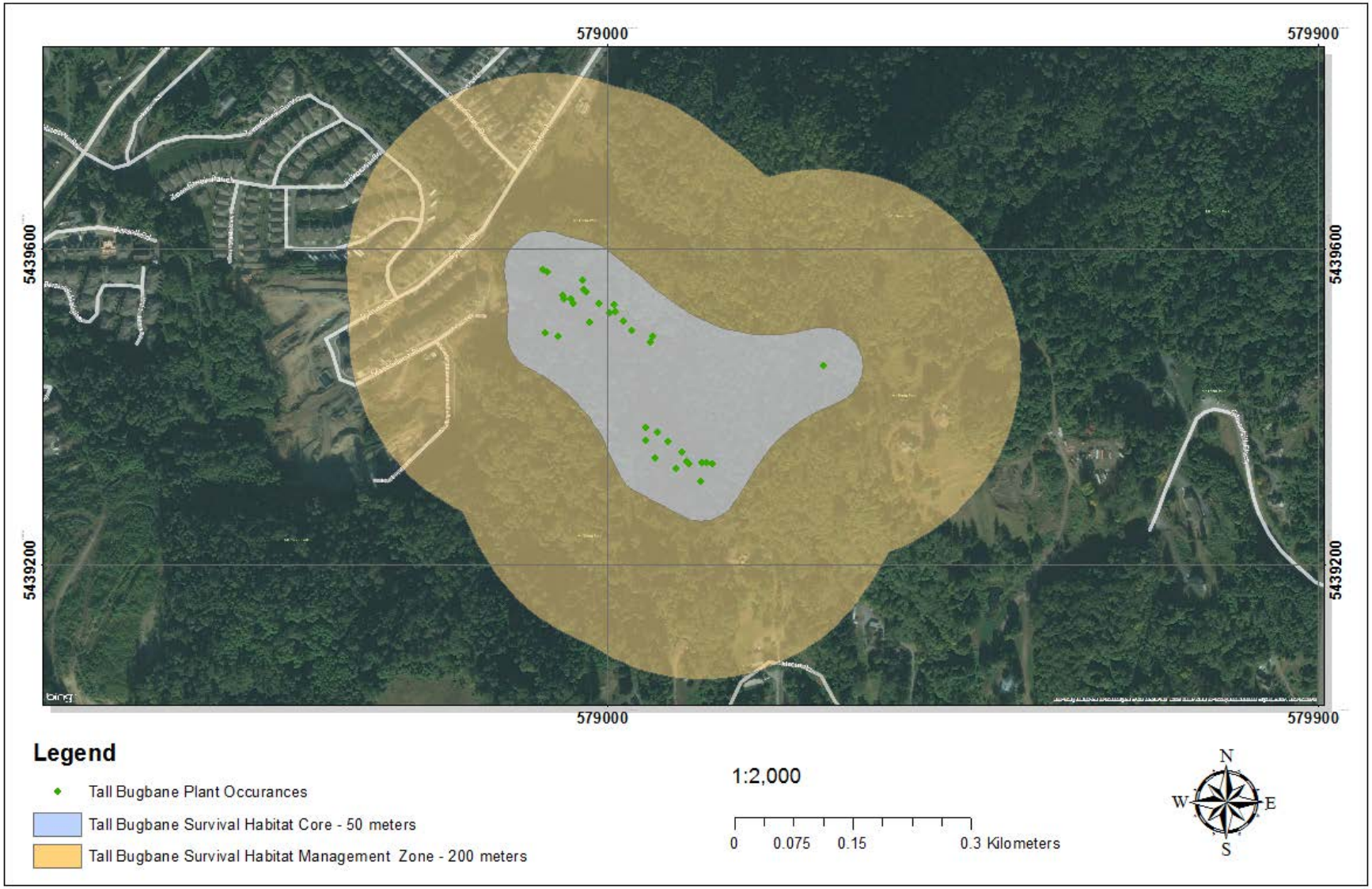

Figure 12. Area within which survival habitat for tall bugbane is found at Mount Thom, B.C.

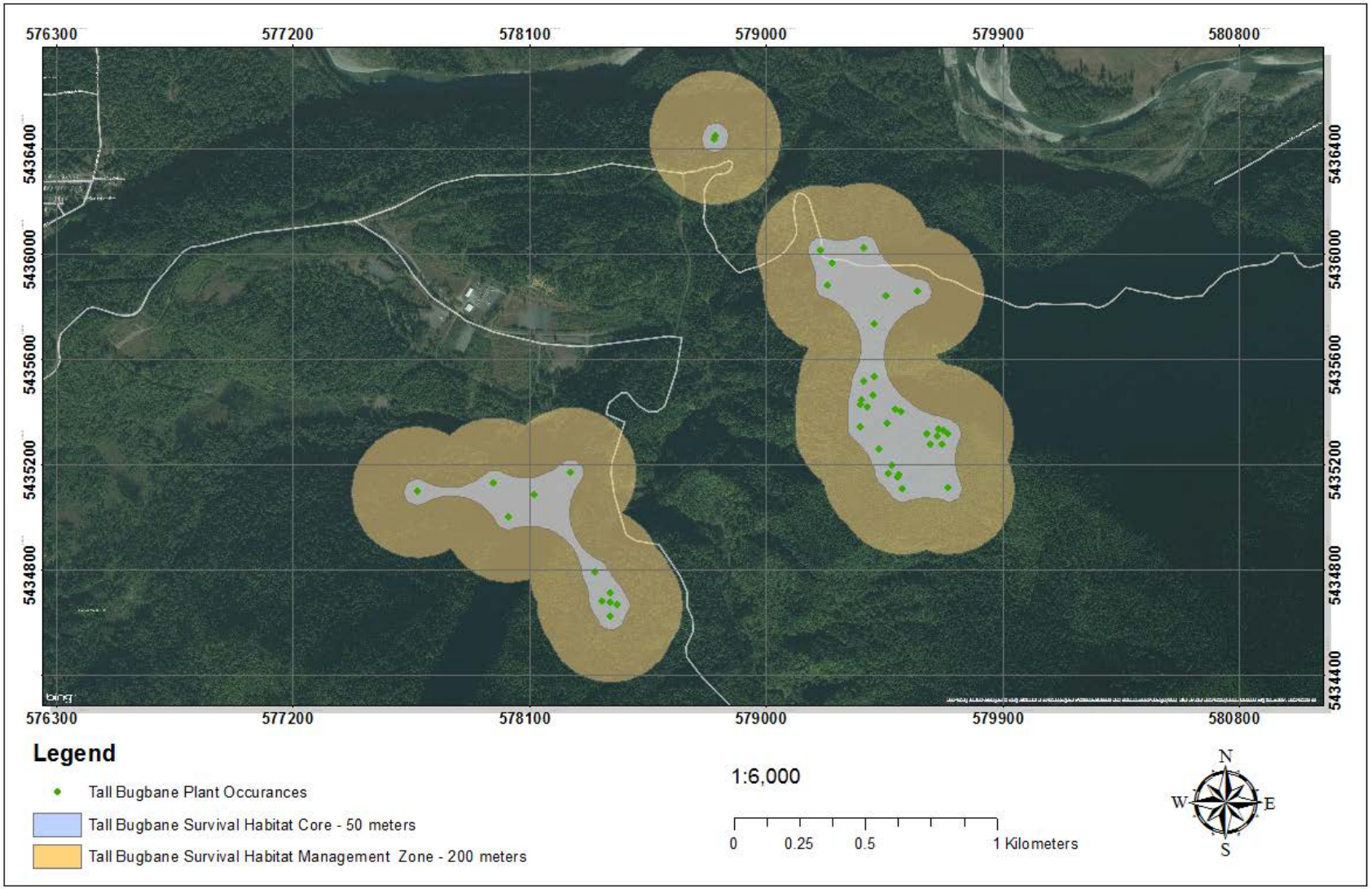

Figure 13. Area within which survival habitat for tall bugbane is found at Opsee, B.C.

Appendix 3. Best management practices for Tall Bugbane habitat

The best management practices below are aimed to prevent negative impacts to survival or recovery habitat. Survival habitat would be considered damaged if part of the survival habitat were degraded, either permanently or temporarily, such that it would not serve its function when used by the species. Damage may also result from single or multiple activities at one point in time or from the cumulative effects of one or more activities over time.

These best management practices address some of the activities that are to be mitigated or avoided in survival habitat polygons. They are intended to be broad in scope and do not cover all possible threats that could impact survival habitat for tall bugbane. Thus specific threats discussed in Section 4.2 should be assessed at each site and used to determine if an activity is permitted. Where a situation does not clearly fit within the activities listed below, but has a potential impact on tall bugbane habitat, the proponent is advised to contact the responsible jurisdiction for guidance on the activity.

The General Wildlife Measures that apply within WHAs are designed to address access issues, forest harvesting and silviculture, pesticide use, and range activity (Penny 2004). These measures have thus far shown to be effective, where the buffers are implemented and enforced, with 10 years of supporting data indicating that tall bugbane plants are doing well, i.e., the size and number of populations, and quality and quantity of occupied habitat is remaining stable or increasing at known sites across the species' existing range (K. Welstead, pers. comm., 2014). These management approaches should be considered as best management practices for areas within the survival habitat that are not within WHAs:

- No removal of canopy within the core area or from the recovery habitat.
- Use partial harvesting systems that maintain no less than 60% basal stem area[16] in the management zone.
- Trails and recreational activities in the management zone should not result in a combined loss of greater than 40% basal stem area.
- No removal of deciduous species and the loss of diverse stand structural components (e.g., *Acer* spp., canopy gaps) within the core.
- No loss of greater than 80% of the *Acer* species from the management zone.
- Avoid the construction of roads or stream crossings within 50 m of the plant or upstream from the population.
- No new recreational trails or structures, or the expansion of existing trails within the core area.
- No pesticide or herbicide use within the management zone or core areas to prevent plant mortality and habitat loss.
- No seeding with non-native species.
- No changes or modification to the hydrological characteristics in the survival habitat core area through culverting or stream diversions or indirectly through upstream canopy removal.

[16] Basal stem area is the area of a given section of land that is occupied by the cross-section of tree trunks and stems at their base.

Canadian Wildlife Service (CWS)

Comment Table Species at Risk Draft Recovery Documents

Species: _____

Management Plan or Recovery Strategy: _____

Date: _____

Review completed by: _____

Please add rows to the table if more space is needed. Return comments to: SAR.pyr@ec.gc.ca.

General Comments	Response

Recommended References:

Line Number / Table	Comment	CWS Response to Comment
Cover Page / Preface / Acknowledgments		

Line Number / Table	Comment	CWS Response to Comment
EXECUTIVE SUMMARY		
RECOVERY FEASIBILITY SUMMARY		
1. COSEWIC SPECIES ASSESSMENT INFORMATION		
2. SPECIES STATUS INFORMATION		

Line Number / Table	Comment	CWS Response to Comment
3. SPECIES INFORMATION		
3.1 Species Description		
3.2 Population and Distribution		
3.3 Needs of the Species X		
4. THREATS		
4.1 Threat Assessment		
4.2 Description of Threats		
5. POPULATION AND DISTRIBUTION OBJECTIVES		

Line Number / Table	Comment	CWS Response to Comment
6. BROAD STRATEGIES AND GENERAL APPROACHES TO MEET OBJECTIVES		
6.1 Actions Already Completed or Currently Underway		
6.2 Strategic Direction for Recovery		
6.3 Narrative to Support the Recovery Planning Table		
7. CRITICAL HABITAT		
7.1 Identification of Species X Critical Habitat		
7.2 Schedule of Studies to Identify Critical Habitat		

Line Number / Table	Comment	CWS Response to Comment
8. MEASURING PROGRESS		
9. STATEMENT ON ACTION PLANS		
10. REFERENCES		
APPENDIX 1:		
APPENDIX 2:		
APPENDIX 3:		

Thank-you!!