COSEWIC
Assessment and Status Report

on the

Tall Woolly-heads
Psilocarphus elatior

in Canada

ENDANGERED
2018

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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COSEWIC would like to acknowledge Matt Fairbarns for writing the status report on Tall Woolly-heads, *Psilocarphus elatior*, prepared under contract with Environment and Climate Change Canada. This report was overseen and edited by Del Meidinger, Co-chair of the COSEWIC Vascular plants Specialist Subcommittee.

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment and Climate Change Canada
Ottawa, ON
K1A 0H3

Tel.: 819-938-4125
Fax: 819-938-3984
E-mail: ec.cosepac-cosewic.ec@canada.ca
http://www.cosewic.gc.ca

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Tall Woolly-heads — Photo by Matt Fairbarns.

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COSEWIC
Assessment Summary

Assessment Summary – April 2018

Common name
Tall Woolly-heads

Scientific name
Psilocarphus elatior

Status
Endangered

Reason for designation
This small annual plant only occurs in a few, small, specialized habitats on southeastern Vancouver Island. Habitat destruction and modification at one site has resulted in significant decline in the Canadian population. Competition from invasive species and management of drainage are the primary continuing threats; other threats include recreational activities, habitat disruption by non-native resident Canada Geese, and haying/mowing.

Occurrence
British Columbia

Status history
Designated Endangered in May 2001. Status re-examined and confirmed in April 2018.

COSEWIC
Executive Summary

Tall Woolly-heads
Psilocarphus elatior

Wildlife Species Description and Significance

Tall Woolly-heads is a small, annual herb rarely growing more than 10 cm tall in Canada. It is green to silvery green when young and silvery grey when mature. It is generally covered with a dense mat of silky-woolly hairs. Its upper leaves densely cup the flower heads. The small, globular flower heads (6-8 mm in diameter) are arranged on a dome-like structure called the receptacle. The individual flowers lack obvious petals and are tightly clustered; thus the entire head appears to be a single flower. Each female flower is enclosed within a sac-like hood around the flower.

Tall Woolly-heads is one of over 50 nationally rare plant species restricted (in Canada) to Garry Oak and associated ecosystems on southern Vancouver Island and the adjacent Gulf Islands.

Distribution

The main range of Tall Woolly-heads extends from southern Vancouver Island, south to northern California and east to western Montana and south-central Idaho. In Canada, Tall Woolly-heads occurs along the east coast of Vancouver Island from the vicinity of Victoria north to near Duncan. The maximum historical extent of Tall Woolly-heads in Canada was approximately 273 km^2. Three historical Canadian subpopulations of Tall Woolly-heads have not been seen since 1913 or earlier; a fourth subpopulation at the University of Victoria was extirpated in 1978. The current extent of occurrence of Tall Woolly-heads in Canada is approximately 66 km^2. Less than 1% of the global range of Tall Woolly-heads lies within Canada.

Habitat

In Canada, Tall Woolly-heads occurs in vernal pools, which are filled with water for much of the autumn, winter and early spring, while experiencing pronounced water deficits in the mid- to late summer.

An estimated 95% of suitable habitat in Canada has been lost since the mid-19^{th} century as a result of clearing for agriculture and residential property development, and fire suppression (which led to forest infilling and ingrowth).

Biology

Tall Woolly-heads is a short-lived annual that germinates in the spring, and matures and dies in late May or June. Most seed-like fruits remain near the parent plant although some may be dispersed in the droppings of animals such as rabbits, on the feet and feathers of birds, or on the clothing and boots of passers-by.

Population Sizes and Trends

In 2015, there were 53,000-64,000 mature individuals of Tall Woolly-heads in Canada. The subpopulations appear to experience extreme fluctuations in number of mature individuals, but if the seeds persist in the soil for many years this may not truly represent an extreme fluctuation in total population size. The largest subpopulation, at Somenos, numbered in the millions in some years but has not exceeded 100,000 since 2006 and only about 3,000 individuals were observed in 2015 despite favourable growing conditions. Because of its rarity in nearby areas of Washington State, there is little prospect of unassisted rescue if the Canadian population became extirpated.

Threats and Limiting Factors

The greatest threats to Canadian subpopulations of Tall Woolly-heads are competition from invasive alien plant species, and water management (principally at Somenos). Secondary threats include trampling by people and dogs, habitat disruption by non- native resident Canada Geese, haying where Tall Woolly-heads occurs along the edge of fields, and mowing to maintain fire breaks in Uplands Park.

Fire suppression has led to forest and shrub ingrowth into previously open areas, and some vernal pools may have long ago become too shaded to support Tall Woolly-heads.

Increased frequency of droughts, storms and flooding associated with global climate change present a threat to Tall Woolly-heads, as would a tsunami created by a major Cascadia earthquake.

Protection, Status and Ranks

The Province of British Columbia has no stand-alone legislation to protect subpopulations of species at risk that are not on federal lands.

Tall Woolly-heads was assessed as Endangered (COSEWIC 2001) and is protected on federal lands under Schedule 1 of the federal *Species at Risk Act* (SARA). It is one of several species addressed in the recovery strategy for rare species of vernal pools and other ephemeral wet areas associated with Garry Oak ecosystems. The recovery strategy established several goals and objectives aimed at restoring Tall Woolly-heads during the 2006-2015 period, but almost none of these goals and objectives have been achieved. None of the Canadian subpopulations of Tall Woolly-heads occur on federal lands. All four subpopulations occur mostly or entirely within municipal parks or provincial protected areas, but they continue to suffer from the impacts of human activities.

TECHNICAL SUMMARY

Psilocarphus elatior

Tall Woolly-heads

Psilocarphe élevé

Range of occurrence in Canada (province/territory/ocean): British Columbia

Demographic Information

Generation time:	5 years (1-7). *Average seed age before germination is unknown. Evidence from closely related species suggests that seeds may remain dormant in soil for 10 or more years. Generation time is suggested as 5 years based on an estimate of the half-life of seeds in the seed bank.*
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes. *Since the previous status report was completed the extent and abundance of the Somenos subpopulation has decreased as a result of dumping of dredge spoils and loss of habitat to encroachment by willows and Reed Canarygrass*
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations].	10 years: likely > 95% reduction *Calculation of declines is complicated by fluctuations. If variations in subpopulation size at Uplands Park and Christmas Hill are considered fluctuations, then losses at Somenos from 2005 to 2015 are approximately a 98% decline in the size of the Canadian population.*
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	15 years: likely > 80% reduction *Calculation of declines is complicated by fluctuations. If variations in subpopulation size at Uplands Park and Christmas Hill are considered fluctuations, then losses at Somenos from 1999 to 2015 are approximately an 85% decline in the size of the Canadian population.*
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Observed and estimated reduction of > 80%.
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. Yes. If the recently deposited dredge spoils at Somenos were removed and beavers allowed to build dams. b. Yes c. No
Are there extreme fluctuations in number of mature individuals?	Likely.

Extent and Occupancy Information

Estimated extent of occurrence	66 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value).	16 km²
Is the population “severely fragmented” i.e., is >50% of its total area of occupancy is in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	a. no b. yes
Number of “locations” (use plausible range to reflect uncertainty if appropriate)	4
Is there an [observed, inferred, or projected] decline in extent of occurrence?	no
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	no
Is there an [observed, inferred, or projected] decline in number of subpopulations?	no
Is there an [observed, inferred, or projected] decline in number of “locations”?	no
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Yes, quality of habitat.
Are there extreme fluctuations in number of subpopulations?	no
Are there extreme fluctuations in number of “locations”?	no
Are there extreme fluctuations in extent of occurrence?	no
Are there extreme fluctuations in index of area of occupancy?	no

Number of Mature Individuals (in each subpopulation)

Subpopulations (give plausible ranges)	**N Mature Individuals (2015)**
Uplands Park	50,000-60,000
Christmas Hill	136
Somenos	2,800-3,200
Mary Tod Island	37
Total	53,000-64,000

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Not done.

Threats (direct, from highest impact to least, as per IUCN Threats Calculator)

Was a threats calculator completed for this species? Yes (June 6th, 2016). Participants: Del Meidinger, Matt Fairbarns, Andy MacKinnon, Daniel Brunton, Dave Polster, Joanna James (Appendix 1).

i. Invasive non-native/alien species
ii. Dams & water management/use
iii. Recreational activities
iv. Problematic native species
v. Agriculture
vi. Work and other activities
vii. Fire & fire suppression
viii. Climate Change: Droughts
ix. Climate Change: Storms & flooding
x. Earthquakes/tsunamis

What additional limiting factors are relevant? N/A

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	Status in Washington State is not ranked; however, there is only one recent record from northern Washington State and it is 58 km from the Canadian distribution, with much of the intervening area being ocean.
Is immigration known or possible?	No
Would immigrants be adapted to survive in Canada?	Unknown. *Probable but not proven.*
Is there sufficient habitat for immigrants in Canada?	No. *Some habitat is present but insufficient to allow immigrants a significant chance of encountering it.*
Are conditions deteriorating in Canada?	Yes. *Invasive species continue to spread into potential habitat.*
Are conditions for the source population deteriorating?	Possibly. *There have been no records of Tall Woolly-heads in northern Washington State since 1968.*
Is the Canadian population considered to be a sink?	No
Is rescue from outside populations likely?	No

Data Sensitive Species

Is this a data sensitive species? No

Status History

COSEWIC: Designated Endangered in May 2001. Status re-examined and confirmed in April 2018. *(This included subpopulations in southwestern British Columbia (Pacific Population) and subpopulations in Alberta/Saskatchewan (Prairie Population). The Prairie Population was subsequently re-identified as Dwarf Woolly-heads, leaving Tall Woolly-heads designated as Endangered at the species level.)*

Status and Reasons for Designation:

Status:	**Alpha-numeric codes:**
Endangered	B1abc(iii,v)+2abc(iii,v)

Reasons for Designation:
This small annual plant only occurs in a few, small, specialized habitats on southeastern Vancouver Island. Habitat destruction and modification at one site has resulted in significant decline in the Canadian population. Competition from invasive species and management of drainage are the primary continuing threats; other threats include recreational activities, habitat disruption by non-native resident Canada Geese, and haying/mowing.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): May meet Endangered, A2ac, based on observed reduction in the number of mature individuals over the past 10 years due to habitat alteration at the largest site. However, calculating declines is complicated by fluctuations in number of mature individuals.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Endangered, B1abc(iii,v) and B2abc(iii,v), due to size of EOO and IAO, there are only four locations, there are extreme fluctuations in number of mature individuals, and there is an observed and projected decline in habitat quality (iii) and number of mature individuals (v). The species is not severely fragmented.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable as total number of mature individuals in the population exceeds thresholds.
Criterion D (Very Small or Restricted Population): D1 not applicable as total number of mature individuals in the population exceeds thresholds. May meet Threatened, D2, as IAO and number of locations are below thresholds but it is unlikely that threats or a stochastic event will drive it to extirpation or near extirpation within 1-2 generations.
Criterion E (Quantitative Analysis): Data not available to conduct analysis.

PREFACE

In May 2001, COSEWIC recognized the existence of two designatable units and designated the Pacific Population of Tall Woolly-heads as Endangered, based on a status report published that year (COSEWIC 2001). In 2006, the other designatable unit (Prairie Population) was re-identified as Dwarf Woolly-heads (*Psilocarphus brevissimus*) and Tall Woolly-heads (*Psilocarphus elatior*) was designated as Endangered at the species level.

Since then, a new subpopulation of Tall Woolly-heads has been discovered at Mary Tod Island, offshore from the District of Oak Bay. Sizable fluctuations have been observed in the subpopulations at Uplands Park and Christmas Hill and while there is no evidence that either subpopulation is increasing in abundance, it is not clear whether the subpopulations are stable or in decline. The subpopulation at Somenos has declined both in extent and abundance since dredge spoils were dumped on a portion of the subpopulation and willows and Reed Canarygrass (*Phalaris arundinacea*) have replaced open creekside meadows subsequent to the removal of beaver dams.

Recovery goals and objectives for Tall Woolly-heads were established in a recovery strategy for multi-species at risk in vernal pools and other ephemeral wet areas in Garry Oak and associated ecosystems in Canada (Parks Canada Agency 2006). The majority of the 10-year objectives established in 2006 have not been initiated and there has been no rigorous monitoring program to track trends in the Canadian population or assess the efficacy of the few recovery objectives that have been implemented.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2018)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment and Climate Change Canada
Canadian Wildlife Service
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Canada

The Canadian Wildlife Service, Environment and Climate Change Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific Name: *Psilocarphus elatior* (A. Gray) A. Gray

Synonyms: *Psilocarphus oregonus* Nuttall var. *elatior* A. Gray

Common English Names: Tall Woolly-heads, Meadow Woollyheads, Tall Woolly-marbles

Common French Name: Psilocarphe élevé

Family Name: Asteraceae (Sunflower Family)

Morphological Description

Tall Woolly-heads (Figures 1-3) is a small, tap-rooted, upright to sprawling, unbranched to densely branched, annual herb rarely growing more than 10 cm tall. It is green to silvery green when young and silvery grey when mature. It is usually covered with a dense mat of silky-woolly hairs. Its leaves are 10-20 mm long and 2-6 mm wide and the upper leaves cup the flower heads. The small globular flower heads (6-8 mm in diameter) are arranged on a dome-like structure called the receptacle. Individual flowers lack obvious petals and are tightly clustered so that the entire head appears to be a single flower. Each female flower is enclosed within a bract (palea) arising from the receptacle. Unlike most other members of the Sunflower Family, in members of the Woolly-heads genus each palea forms a sac-like hood around the flower. Each female flower may form a cylindrical, dry fruit (cypsela) containing a single seed. While many species in the Sunflower Family bear a special structure called a pappus, which sometimes aids in seed dispersal (e.g., dandelion fluff), there is no pappus on the fruits of Tall Woolly-heads. More detailed descriptions may be found in the Jepson Flora Project (2013) and Morefield (2006).

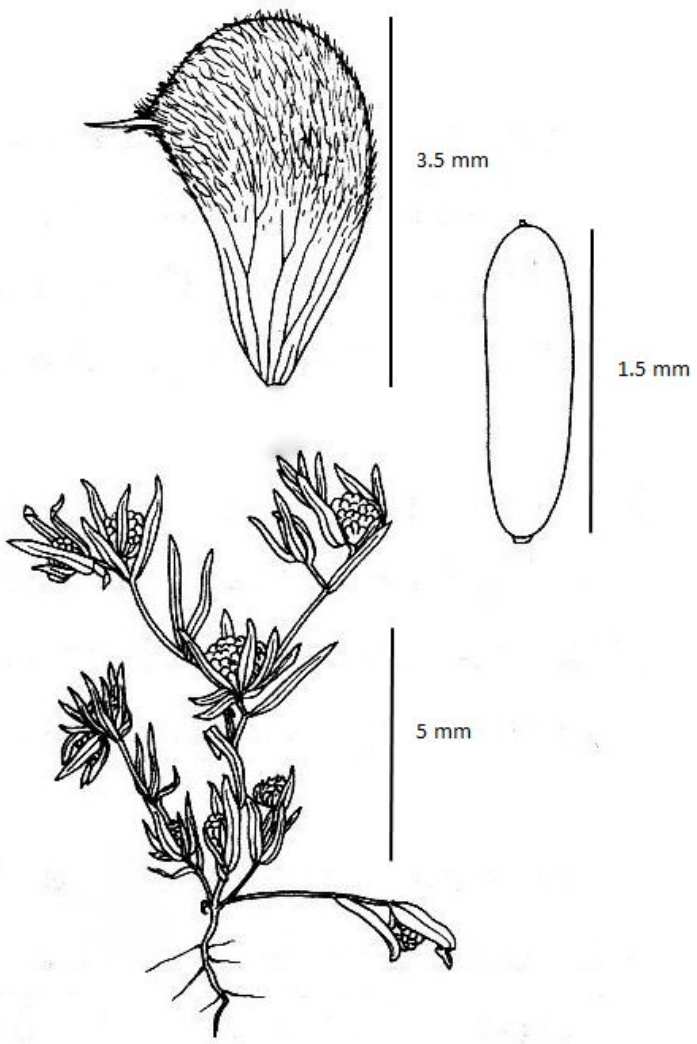

Figure 1. Tall Woolly-heads. Top: palea (receptacle bract). Right: cypsela (fruit). Bottom: general habit. Illustration by J. Rumely from Hitchcock *et al.* 1955 with permission.

Figure 2. Tall Woolly-heads in flower. Photo by Matt Fairbarns, with permission.

Figure 3. Tall Woolly-heads in fruit. Photo by Matt Fairbarns, with permission.

The range of Tall Woolly-heads overlaps with that of Slender Woolly-heads (*Psilocarphus tenellus*), which it closely resembles. The two species can be distinguished as follows:

- The largest Tall Woolly-heads flower heads range from 6-14 mm across when mature, while those of Slender Woolly-heads are 3-6 mm across when mature;
- The paleas of Tall Woolly-heads are hidden by long, silky-woolly hairs and the largest are 2.8-4.0 mm long while the individual paleas of Slender Woolly-heads are usually visible through the hairs and are 2.7 mm or shorter;
- Tall Woolly-head plants tend to be upright whereas Slender Wooly-heads plants tend to be matted; and
- The leaves of Tall Woolly-heads are never spoon-shaped while this is often the case with Slender Woolly-heads.

Casual observers may confuse Tall Woolly-heads with compact individuals of Marsh Cudweed (*Gnaphalium uliginosum*), which grows in similar habitats, but cudweeds have evident flowers while those of woolly-heads are hidden within their hooded palea.

Population Spatial Structure and Variability

There are no studies of genetic differences among Canadian subpopulations or between Canadian subpopulations and those in the United States.

There are eight extant, extirpated, and historical subpopulations in Canada (Table 1)—four of which are extant: Uplands Park, Mary Tod Island, Christmas Hill, and Somenos, all located in extreme southern Vancouver Island, British Columbia.

Table 1. Tall Woolly-heads Subpopulation Data.

Subpopulation	Year	Observer	Mature Individuals	Ownership
Sidney	1912	Davidson	unknown	unknown
	1913	Macoun	unknown	
Ucluelet	1909	Macoun	unknown	unknown
Cedar Hill	1887	Macoun	unknown	unknown
Uplands Park	1966	RBCM	unknown	Municipal Park
	1976	RBCM	unknown	
	1990	Brayshaw	unknown	
	1993	Ryan	40,000-45,000	
	1994	Douglas	30,000-40,000	
	2003	Penny and Fairbarns	> 10,000	
	2009	Costanzo	> 26,000	
	2015	Fairbarns	50,000-60,000	
Christmas Hill	1987	Ceska	400?	Municipal Park
	2001	Douglas	45	
	2004	Miller	> 400	
	2009	Costanzo	2,581	
	2015	Fairbarns	136	
Somenos	1992	Ceska	none	BC Parks
	1993	Douglas	700	
	1994	Douglas	11,000	
	1999	Douglas & Lomer	200,000	
	2003	Roemer	10,000-50,000	
	2004	Roemer	2,350,000	
	2005	Roemer	8,384,000	
	2006	Roemer	86,500	
	2007	Fleming	41,061	
	2008	Fleming	75,200	
	2009	Fleming	32,700	
	2010	Fairbarns	21,175-30,450	
	2015	Fairbarns	2,800-3,200	
University of Victoria	1966	Turner	unknown	University of Victoria
	1976	Ceska	unknown	
	2015	Fairbarns	0	
Mary Tod Island	2013	Fairbarns	unknown	Municipal Park
	2015	Fairbarns	37	

The Canadian population of Tall Woolly-heads is not severely fragmented as most of its total area of occupancy is in habitat patches that support a viable population. The aggregate area of the patches of Tall Woolly-heads at Uplands Park is difficult to determine because of the arbitrary nature of defining small, proximate patches. However, the two largest patches cover more than 1,000 m^2, which exceeds the aggregate area of the patches at the other three Canadian subpopulations (Somenos: 820 m^2; Christmas Hill: 55 m^2; Mary Tod: less than 5 m^2). The Tall Woolly-heads subpopulation at Uplands Park exceeds 40,000 mature individuals and is, therefore, likely to remain viable far into the future, barring new stresses and disturbances. Douglas and Illingworth (2004) indicated that most subpopulations are small and not viable, but many of the subpopulations in their report were found not to be Tall Woolly-heads (see **Canadian Range**).

Designatable Units

There is no evidence of genetic distinctiveness among Canadian subpopulations. Apart from what appears to have been an adventive occurrence near Ucluelet, British Columbia (see **Canadian Range** regarding the Ucluelet collection), there are no natural disjunctions between substantial portions of the species' geographic range in Canada; and Canadian subpopulations all lie within the Pacific National Ecological Area. For these reasons the Canadian subpopulations comprise a single designatable unit.

Special Significance

Tall Woolly-heads is one of over 50 nationally rare species restricted in Canada to Garry Oak (*Quercus garryana*) and associated ecosystems on southern Vancouver Island and the adjacent Gulf Islands.

DISTRIBUTION

Global Range

The main range of Tall Woolly-heads (Figure 4) extends from southern Vancouver Island, south to northern California and east to western Montana and south-central Idaho (B.C. Conservation Data Centre 2015; Consortium of California Herbaria 2015; Consortium of Pacific Northwest Herbaria 2015; Montana Natural Heritage Program 2015). Two subpopulations, considered introduced, have recently been found in Alaska—one on the Alaska Panhandle[1] (Krieckhaus pers. comm. 2012), the other on the Kenai Peninsula[2] (Bowser 2017). The species has not been collected from natural environments in Alaska.

[1] The Alaska panhandle population was collected in 2012 from an old log transfer facility on Chichagof Island (Krieckhaus 1017, August 29, 2012 ALA 248702).

[2] Bowser (2017) considers it likely that seeds of Tall Woolly-heads were transported to Mystery Creek Road on equipment, vehicles, feed, or manure from the lower 48 states.

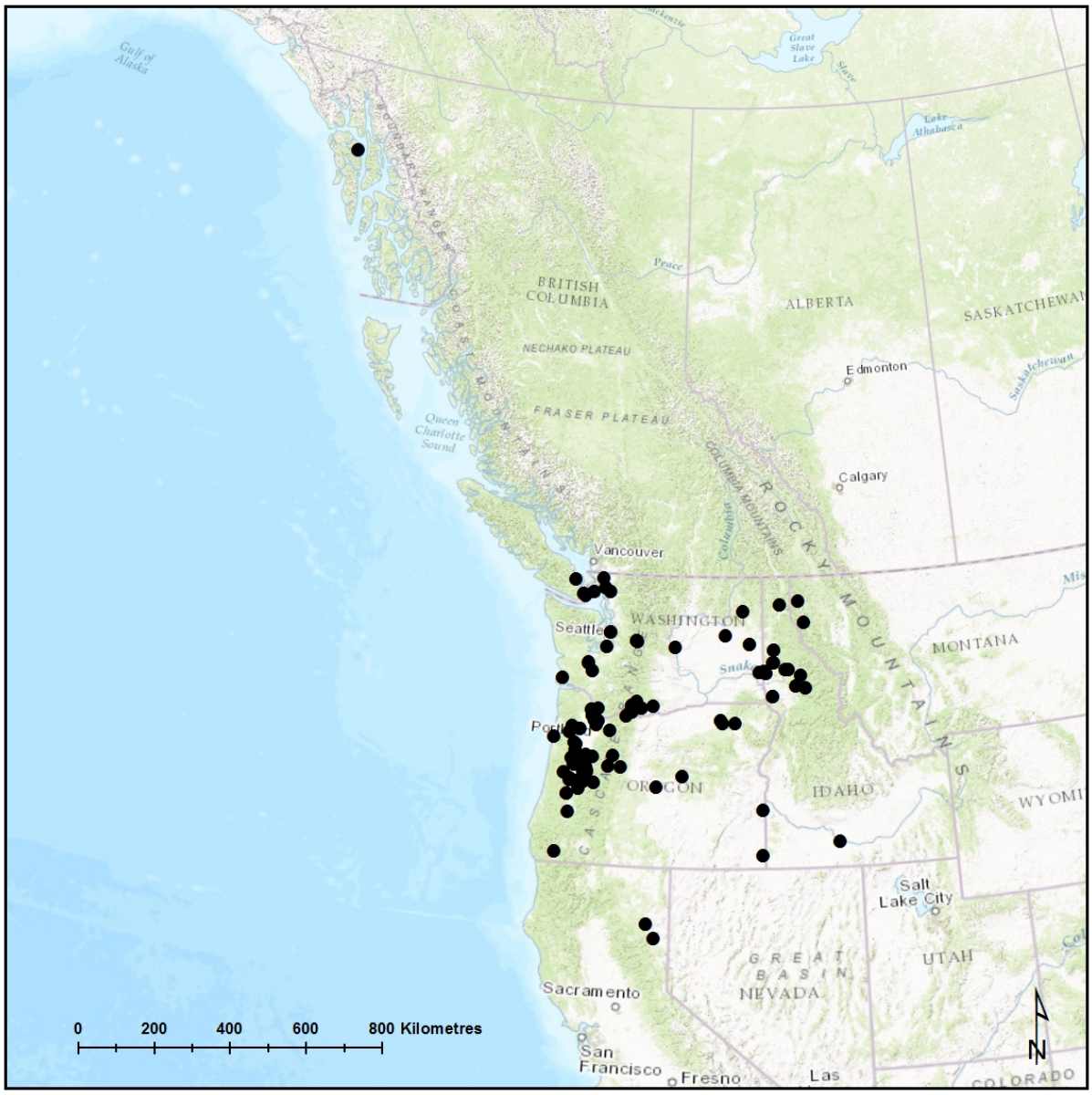

Figure 4. Global Range of Tall Woolly-heads. Note: Introduced population recently found in Kenai Peninsula, Alaska (Bowser 2017) not shown. Map prepared by Alain Filion.

Canadian Range

In Canada, Tall Woolly-heads occurs within the Coastal Douglas-fir Biogeoclimatic Zone along the east coast of Vancouver Island (Figure 5, Table 1) from the vicinity of Victoria north to near Duncan (BC Conservation Data Centre 2015). Less than 1% of the global range lies within Canada. There are four extant sites (Table 1): Uplands Park (Oak Bay), Mary Tod Island (off shore from Oak Bay), Christmas Hill (Saanich), and Somenos (near Duncan).

Figure 5. Canadian Range of Tall Woolly-heads. Map prepared by Alain Filion.

It has also been reported from Ucluelet (BC Conservation Data Centre 2015), on the west coast of southern Vancouver Island, based on a collection (CAN 221916) made by John Macoun (s.n.) in 1909, presumably during his collecting trip in the vicinity of Barkley Sound (Macoun 1979). Tall Woolly-heads has not since been recorded from Barkley Sound, nor has it otherwise been reported from the west coast of Vancouver Island despite a long collecting record in that area. Ucluelet has a climate vastly different from that found in the main range of the species, including the other Canadian localities. Even assuming the location data of the collection to be correct, it is likely that Tall Woolly-heads occurred as an adventive in Ucluelet, as seems to be the case in Alaska. It is also possible that the specimen was collected from elsewhere and incorrectly labelled.

A subpopulation at the University of Victoria was last observed in 1976. The site where it occurred was destroyed when building the University Centre, which opened in 1978. Of the three other historical subpopulations (Ucluelet, presuming this was not a misreported locality; Sidney; and Cedar Hill), none has been seen since 1913. It appears probable that these subpopulations disappeared more than three generations ago.

Erroneous reports of subpopulations of Tall Woolly-heads are based on misidentified collections from Francis-King Park, Vancouver Island (*Melburn* s.n., June 20, 1962; DAO 897140); Cloverdale, Vancouver Island (*Macoun*, s.n., June 23, 1887; DAO 897142); Scafe Hill, Vancouver Island (*Roemer* 96019, June 5, 1996; V168582); and Swartz Bay, Vancouver Island (*Groh* s.n., May 28, 1931; DAO 897141).

Extent of Occurrence and Area of Occupancy

The maximum documented extent of occurrence (EOO) of Tall Woolly-heads in Canada was approximately 2,655 km^2. If the Ucluelet subpopulation is excluded as an adventive or misreported occurrence, then the maximum EOO was approximately 273 km^2. The EOO of extant occurrences is approximately 66 km^2. There has been no decline in EOO in the last 10 years.

The index of area of occupancy (IAO) of extant subpopulations is 16 km^2 (the Uplands Park and Mary Tod Island subpopulation occur within the same 2 km x 2 km cell). There has been no decline in IAO in the last 10 years.

The extent of suitable vernal pools within the Canadian range of Tall Woolly-heads has not been measured but has probably never exceeded 100 hectares.

Search Effort

Many botanists have examined the rare flora of coastal vernal pool habitats on southeastern Vancouver Island and the adjacent Gulf Islands for the presence of Tall Woolly-heads. While records of rare species of vernal pool habitats in the region reach back into the late 19th century, the intensity of search effort rose sharply beginning in the 1970s when A. Ceska and O. Ceska began to scrutinize vernal pool habitats in the region for another rare species, Macoun's Meadowfoam (*Limnanthes macounii*). The establishment of COSEWIC in 1977 and the fieldwork conducted in support of the COSEWIC status report for Macoun's Meadowfoam (Ceska and Ceska 1988) broadened the interest in vernal pool species in the Strait of Georgia region, particularly among botanists associated with the herbaria of the Royal British Columbia Museum and the University of Victoria. Consequently, there was a surge of new reports for vernal pool species in the Victoria area (Fairbarns pers. obs.). In 1991, the provincial government established the BC Conservation Data Centre and hired botanist G. Douglas, who took a special interest in the rare plants of the Victoria area, where most of the key sites could be easily reached and documented. The establishment of the Garry Oak Ecosystems Recovery Team in 2000, and a rare plant working group within the team, gave further impetus to the search for rare species of coastal vernal pools on southeast Vancouver Island and coincided with the publication of the initial status report on Tall Woolly-heads (Fairbarns pers. obs.). Since 2002 there have been systematic surveys for rare vernal species throughout the Canadian range of Tall Woolly-heads, including the work of H. Roemer (who had already been examining rare species of vernal pools for three decades), M. Ryan, M. Miller, and M. Fairbarns. While it is not possible to quantify the time these investigators spent examining vernal pools in coastal areas of southeast Vancouver Island, it certainly amounted to several thousand hours.

Between 2003 and 2015, M. Fairbarns (pers. obs.) conducted directed searches for Tall Woolly-heads in several hundred vernal pools on southeast Vancouver Island and also searched for the species in the Ucluelet area and coastal areas of the Lower Mainland. The geographical distribution of his search effort, which involved approximately 250 person-hours (not including travel time), is shown in Figure 6.

The combined search effort described above likely resulted in the examination of more than 70% of vernal pools within the range of Tall Woolly-heads in the Capital Regional District (the region containing most extant, extirpated and historical subpopulations of Tall Woolly-heads). The search effort was less extensive in the vicinity of the Somenos subpopulation, near Duncan. The Ucluelet area has had a relatively light search effort, because no habitat could be found like that occupied by Tall Woolly-heads elsewhere in its range.

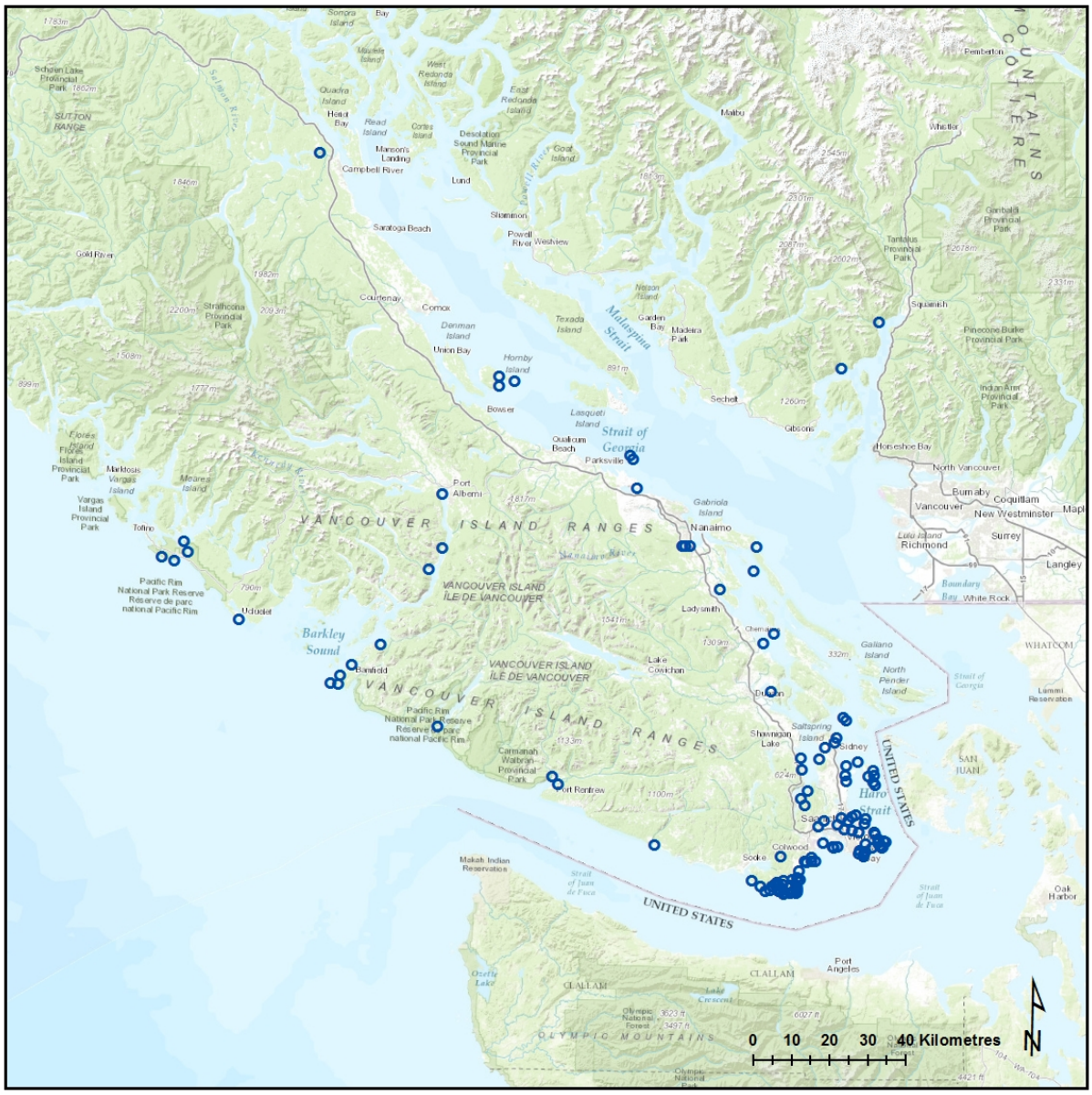

Figure 6. Negative search effort for Tall Woolly-heads. Only negative surveys of directed searches for Tall Woolly-heads conducted by Fairbarns are shown. Most of the dots represent vernal pools; many represent multiple vernal pools. Map prepared by Alain Filion.

HABITAT

Habitat Requirements

In Canada, Tall Woolly-heads is restricted to a small area of southeastern Vancouver Island that coincides with the distribution of Garry Oak.

Southeastern Vancouver Island has a Mediterranean-type climate, with mild wet winters and dry warm summers, and the greatest annual amounts of sunshine in British Columbia. The scarcity of snow and rarity and short duration of hard frosts allow vegetation to remain green throughout the winter. The low-elevation band of coastal environments is narrow and quickly gives way to uplands that lack similar mesoclimatic conditions. Broken terrain over much of the lowland band creates many cool north- and east-facing slopes where forest plants have a competitive advantage. Well to moderately well drained soils favour forests; consequently, potential habitat for Tall Woolly-heads is quite patchy due to natural conditions. The natural patchiness is intensified by the extensive human development in the area.

The vernal pool environments where Tall Woolly-heads occurs are saturated with water for much of the autumn, winter, and early spring, while experiencing pronounced water deficits in mid- to late summer. These constraints make vernal pools inhospitable to woody plants and many native herbaceous species are intolerant either of long periods of saturation during the dormant season or of summer drought (Fairbarns pers. obs.). Some of the vernal pools where Tall Woolly-heads grow may have masses of filamentous algae in the winter and early spring, which coalesce to form thin, flakey crusts as they dry out. Tall Woolly-heads tends to be sparse or absent from areas where these crusts develop (Fairbarns pers. obs.).

Tall Woolly-heads is primarily associated with shallow, vernally moist depressions where it grows with other native annuals, most notably Scouler's Popcornflower (*Plagiobothrys scouleri*), Pink Twink (*Phlox gracilis*), Few-flowered Clover (*Trifolium oliganthum*), Small-flowered Birds-foot Trefoil (*Acmispon parviflorus*), Blinks (*Montia fontana*), and Slender Plantain (*Plantago elongata*). Several rare native annuals have been found growing in vernal pools occupied by Tall Woolly-heads in Canada, including Muhlenberg's Centaury (*Zeltnera muehlenbergii*), Rare-flowered Heterocodon (*Heterocodon rariflorum*), Winged Water-starwort (*Callitriche marginata*), Kellogg's Rush (*Juncus kelloggii*), Spanish-clover (*Acmispon americanus* var. *americanus*), Poverty Clover (*Trifolium depauperatum*), Victoria's Owl-clover (*Castilleja victoriae*), and Macoun's Meadowfoam.

Habitat Trends

The amount of potential habitat has declined greatly over the past century as coastal areas in southeast Vancouver Island have been developed for residential and recreational use.

Because there are no accurate estimates of the historical or current extent of habitat types where Tall Woolly-heads grows, the rate of habitat loss and degradation cannot be estimated. Tall Woolly-heads typically occurs within a matrix of Garry Oak ecosystems, so the decline of these ecosystems provides an indirect measure of habitat loss. The extent and condition of Garry Oak ecosystems in Canada have declined by more than 95% since the mid-19th century (Lea 2006).

The extent of habitat occupied by Tall Woolly-heads at Somenos decreased significantly after a portion of Somenos Creek adjacent to the subpopulation was dredged in the winter of 2008-09 and the dredged material was placed over a portion of the Tall Woolly-heads subpopulation (Fairbarns pers. obs.). The extensive piles of dredged materials were too high to be inundated by the winter flooding that sustains the Tall Woolly-heads subpopulation, leading to a significant decline in the amount of habitat available (Fairbarns pers. obs.). Portions of the Somenos subpopulation were also lost when beaver dams were removed from Somenos Creek and the consequent loss of flooding led to the establishment of dense areas of Reed Canarygrass (*Phalaris arundinacea*), which shaded, outcompeted and eliminated some patches of Tall Woolly-heads (Fairbarns pers. obs.). The area of undisturbed habitat occupied by Tall Woolly-heads at Somenos is less than 50% of the area occupied prior to the dredging and beaver dam removal. Tall Woolly-heads is still absent from the piles of dredged material (Fairbarns pers. obs. 2016).

Much of the remaining potential habitat for Tall Woolly-heads has been heavily altered due to invasion by alien plants (see **Threats**), which has reduced the proportion of vernal pool environments suited to the growth of Tall Woolly-heads.

BIOLOGY

General

Very little has been written about the life history, demography or physiology of Tall Woolly-heads or other species within its genus. A monograph (Cronquist 1950) on the genus remains one of the best sources of information, although some aspects of life history can be inferred from studies of other annual vernal pool species with similar phenological characteristics.

Life Cycle and Reproduction

Tall Woolly-heads is a short-lived annual incapable of clonal growth; garden experiments and observations from native subpopulations revealed that it germinates, matures and dies in fewer than 5 months (Fairbarns pers. obs.). Plants are probably primarily self-pollinated.

Its ability to persist over long periods in the soil seed bank has not been examined. Dwarf Woolly-heads (*Psilocarphus brevissimus*), which has a very similar biology, appears capable of surviving for many years or perhaps even decades between the flooding events, which stimulate germination and growth (COSEWIC 2006). While it is possible that Tall Woolly-heads may have a generation time of only about 12 months (i.e., it lacks a persistent seed bank), it is plausible that its seedbank longevity may be up to a decade or longer. In Uplands Park, where there is a long history of close study, Tall Woolly-heads was found in large numbers at sites that are rarely flooded and from which it occurs only in flood years. Similarly, Dwarf Woolly-heads has been shown to exhibit mass germination in rarely flooded wetlands despite being absent between flood years (COSEWIC 2006). Based on this information, generation length is estimated at 5 years—the potential half-life of seeds in the seed bank. Although there is considerable uncertainty in this estimate, IUCN (2017: 28) notes that seed bank half lives commonly range between <1 and 10 years.

Tall Woolly-heads germinates in the spring after standing water disappears (Fairbarns pers. obs.). Vegetative development, flowering and fruit production appear to be regulated by the rate at which the soil desiccates. The plants die as the soil becomes desiccated in late May or June, in most years. If plants are watered they will continue to grow and flower into July (Fairbarns pers. obs.). Late spring and early summer rains, if they prolong the growing period, increase fecundity. Consistent levels of high moisture in the spring and early summer likely favour an increase in the cover of perennial herbs, which can out-compete Tall Woolly-heads.

Physiology and Adaptability

The physiology of Tall Woolly-heads has not been studied. As an herbaceous annual species, Tall Woolly-heads survives summer drought and winter cold by producing seeds that remain dormant at least until favourable growing conditions return in the late spring (Fairbarns pers. obs.).

There is no record of Tall Woolly-heads being grown to maturity in horticultural environments nor is there any record of attempts to transplant propagated Tall Woolly-heads into natural environments.

Dispersal and Migration

The light, fluffy bracts, which persist around the mature achenes of Tall Woolly-heads, may float when a site is flooded, thereby dispersing achenes short distances throughout a pond or pool (Cronquist 1950). Some of the bracts may catch the wind, dispersing the attached achenes over slightly longer distances.

Generalist mammalian herbivores may also play a role in medium-distance dispersal. In a California study, seeds of Dwarf Woolly-heads (*Psilocarphus brevissimus*) germinated from the droppings of cottontails (*Sylvilagus* spp.) and/or Black-tailed Jackrabbit (*Lepus californicus*) collected from the vicinity of vernal pools, including in artificially created pools. The data suggest that cottontails, though weak dispersers of seeds, may play an important role in the colonization and re-establishment of woolly-heads in habitat patches (Zedler and Black 1992). Eastern Cottontails (*Sylvilagus floridanus*) are introduced and widely established within the Canadian range of Tall Woolly-heads (B.C. Conservation Data Centre 2015).

Some achenes may be carried long distances in mud on the feet of shorebirds and waterfowl (Cronquist 1950). Many of the waterfowl, shorebird and passerine species that frequent vernal pools and moist depressions (Silveira 1998) may serve as vectors. In Uplands Park, Tall Woolly-heads often occurs along heavily used walking trails up to 200 m from the nearest vernal pool patch (Fairbarns pers. obs.) suggesting that fruits may be transported on boots and clothing.

Interspecific Interactions

There is no evidence of herbivory on the plants (Fairbarns pers. obs.). There have not been studies of interspecific interactions involving Tall Woolly-heads, although trampling damage from increasing populations of Canada Geese (*Branta canadensis*) is discussed below (see **Threats**).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

As a species with an annual life cycle, each plant is theoretically capable of reproducing in the year it is observed, but many plants may die prematurely from drought or other conditions and such plants were not included in the count of mature individuals. For the purposes of this report, a mature individual refers to a plant that has produced flowers or fruits.

The 2015 data documenting the status of extant subpopulations of Tall Woolly-heads were gathered through comprehensive surveys of all known subpopulations. All vernal pools within 100 m of each known subpopulation were examined to determine whether there was evidence that the extent of the subpopulation had been underestimated in previous reports. The enumeration of individual subpopulations varied depending on its size. For populations of 500 or fewer mature individuals, each flowering or fruiting plant was counted and the periphery of the subpopulation was mapped using a hand-held Garmin Montana 600 GPS unit generally accurate to 10 m or less.

For larger subpopulations, each patch was mapped using a hand-held GPS accurate to less than 10 m, separately, regardless of the number of mature individuals. For patches with fewer than 20 mature individuals, each flowering or fruiting plant was counted. For patches with more than 20 individuals, the number of mature individuals was estimated with respect to reference units in which the number of flowering or fruiting individuals had been individually counted, the reference units varying according to the size and density of the patch.

Abundance

In 2015, there were 50,000-65,000 mature individuals of Tall Woolly-heads in Canada (Table 1). Total subpopulation counts were not made but approximately 60-70% of all individuals observed were mature. Immature individuals were already senescing and would not have reached maturity later in the growing season due to the deepening summer drought (Fairbarns pers. obs.).

Fluctuations and Trends

The survey data do not reveal fluctuations of more than an order of magnitude in the number of mature plants at Uplands Park; however, in the dry growing seasons of 2011 and 2013 casual observations showed that many patches failed to produce any flowering plants and some of the larger patches produced far fewer plants than normal. The overall impression was of a decline of perhaps as great as 90% from levels of abundance observed in peak years (Fairbarns pers. obs.). The patchy record of subpopulation counts at Uplands Park may obscure extreme fluctuations in the number of mature individuals.

Year to year changes in the Christmas Hill subpopulation of mature plants varied by more than an order of magnitude (Table 1), while changes in the Somenos subpopulation of mature plants varied by four orders of magnitude even before the amount of available habitat was reduced by piling of dredge spoils and consequent changes in vegetation (discussed below). There is an insufficient record to determine the magnitude of fluctuations in the Mary Tod Island subpopulation of mature plants.

The Somenos subpopulation of mature plants numbered in the millions in some years but has not exceeded 100,000 since major habitat alterations began in 2006. Only about 3,000 individuals were observed in 2015 despite favourable growing conditions.

The observed extreme fluctuation in the number of mature plants may be a significant limiting factor if seeds do not persist in the soil for many years. If the seeds are long-persistent in the soil, however, extreme fluctuations in the number of mature individuals may not represent extreme fluctuations in the total population.

Rescue Effect

There are no records of Tall Woolly-heads from the Olympic Peninsula or San Juan Islands of Washington State apart from a single 1968 collection from Lake Terrell (Sundquist 1710, WWB 11,449, June 27, 1968), 58 km from its range in Canada and on the opposite side of the Strait of Georgia. The absence of Tall Woolly-heads from the overwhelming majority of vernal pools within its range in Canada (see Figure 6) suggests that long distance dispersal is a rare event. There is, therefore, little prospect of rescue if the Canadian population became extirpated.

THREATS AND LIMITING FACTORS

Threats

Direct threats facing Tall Woolly-heads assessed in this report are organized and evaluated based on the IUCN-CMP (World Conservation Union-Conservation Measures Partnership) unified threats classification system (Master *et al*. 2012). Threats are defined as the proximate activities or processes that directly and negatively affect the population. Results on the impact, scope, severity, and timing of threats are presented in tabular form in Appendix 1. The overall calculated and assigned threat impact is **Medium**.

Invasive non-native/alien species (IUCN 8.1)

Many invasive alien species are found within patches of Tall Woolly-heads.

In well-defined vernal pools, the complex of invasive species tends to be dominated by annual plants such as Mossy Stonecrop (*Crassula tillaea*), Marsh Cudweed (*Gnaphalium uliginosum*), Red Sand-spurry (*Spergularia rubra*), Small Hop-clover (*Trifolium dubium*), Common Draba (*Draba verna*), Soft Brome (*Bromus hordeaceus*), Early Hairgrass (*Aira praecox*), Silvery Hairgrass (*A. caryophyllea*) and Barren Fescue (*Vulpia bromoides*). Another non-native annual, Carpet Burweed (*Soliva sessilis*) is aggressively moving into vernally wet habitats, especially at Uplands Park. While labour-intensive weeding is slowing the spread of Carpet Burweed at Uplands Park and it has not yet been found in vernal pools with Tall Woolly-heads, Carpet Burweed may become one of its chief competitors over the next decade. A small suite of invasive perennials including Hairy Cat's-ear (*Hypochaeris radicata*), Ribwort Plantain (*Plantago lanceolata*), Sheep Sorrel (*Rumex acetosella*), and Sweet Vernal Grass (*Anthoxanthum odoratum*) may also be present, and sometimes abundant, in the region's vernal pools (Fairbarns pers. obs.).

Where Tall Woolly-heads patches occur on moist areas along heavily trampled foot paths, it is usually outcompeted by Marsh Cudweed. Tall Woolly-heads can thrive in similar sites where trampling is moderate, but where foot traffic is curtailed the sites are rapidly taken over by invasive grasses such as Italian Wildrye (*Lolium perenne*), Creeping Bentgrass (*Agrostis stolonifera*), Orchard Grass (*Dactylis glomerata*) and Common Velvet Grass (*Holcus lanatus*), and Tall Woolly-heads quickly disappears (Fairbarns pers. obs.).

Dams & water management/use (IUCN 7.2)

The Somenos subpopulation lies within the floodplain of Somenos Creek, about 150 m downstream of Somenos Lake. Somenos Lake and the upper portion of Somenos Creek are surrounded by extensive wetlands. Much of the wetland habitat was diked and/or ditched in the early 20th century to create hayfields managed for the production of Reed Canarygrass. The fields that produce the optimal combination of hay quality and quantity are harvested in late June and again in early September. In recent years, the fields have been hayed primarily to maintain good winter habitat (flooded hayfields) for waterfowl in general and for Trumpeter Swans (*Cygnus buccinator*) and Great Blue Herons (*Ardea herodias*) in particular; the commercial value of the hay offsets the cost of having the area hayed but cost is not a primary concern. Somenos Creek, the main outlet of Somenos Lake, was altered to increase water flows throughout the latter half of the 20th century. The last major intervention was in 1982, when Somenos Creek was dredged and straightened. Since then, water levels in Somenos Creek during the critical period in late June have tended to be an average of 20 cm above the point deemed ideal for haying in early July. This was one of the key factors leading to the development of the Somenos Management Plan (Williams and Radcliffe 2001), in 2001. Much of the plan revolves around a goal of achieving a lake level of 4.6 m geodesic by June 15 of each year, to allow for a first cut of hay in early July. To accomplish this, the plan calls for the removal of beaver dams and Reed Canarygrass from Somenos Creek to increase late spring water flow (Williams and Radcliffe 2001).

Somenos Creek was dredged in the winter of 2008-09 and the dredged material was placed over a portion of the Tall Woolly-heads population (Fairbarns pers. obs.). Tall Woolly-heads did not colonize the dredge materials, which were up to 1 m higher than the former soil surface and became dominated by invasive species such as Marsh Cudweed. Beaver dams were removed from Somenos Creek in July 2010 (Fairbarns pers. obs.). By 2011, much of the area that had been flooded in previous years had changed from open meadow habitat with patches of Tall Woolly-heads to thickets of willow and dense swards of Reed Canarygrass (Fairbarns pers. obs.).

In Uplands Park, large areas of wet meadow were drained in the early 20th century and now support thickets and woodlands. Small patches of shallow mineral soils within the open meadows may have once supported patches of Tall Woolly-heads, which can still be found in open muddy patches along trails through the ditched areas (Fairbarns pers. obs.).

Recreational activities (IUCN 6.1)

The Victoria Metropolitan Area includes three of the four extant subpopulations of Tall Woolly-heads and most of the apparently extirpated subpopulations. The human population of metropolitan Victoria has increased from approximately 180,000 in 1966 to 359,454 in 2014 and is projected to increase to 428,600 by 2026 (CRD 2014). As the human population grows, recreational use has increased on the sites where Tall Woolly-heads grows.

The subpopulations at Christmas Hill are protected from trampling by a fence while the Mary Tod Island and Somenos subpopulations receive light trampling because the former site can only be accessed by boat and the latter site is shielded from walkers by a brushy thicket (Fairbarns pers. obs.).

Portions of the Uplands Park subpopulation experience moderate to heavy visitor traffic. The impacts are greatest where Tall Woolly-heads occurs on seasonally wet areas along major hiking trails (about 10% of the total subpopulation). The largest subpopulation, in the central meadow of Uplands Park, experiences light to heavy foot traffic and dog use depending on the year (Fairbarns pers. obs.).

Problematic native species (IUCN 8.2)

The rapidly increasing non-native resident population of Canada Geese has recently become a threat to shoreline areas and poses a significant threat to shoreline subpopulations of Tall Woolly-heads at Uplands Park and Mary Tod Island, where areas of heavy goose use have had an increase in the amount of bare mineral soil, a decrease in the number of native plant species, and an increase in the number of non-native plant species (e.g., replacement of Tall Woolly-heads by Marsh Cudweed). Until approximately 2005, Canada Geese were migrants and sometimes summer visitors in the region. Christmas bird counts did not report Canada Geese until 1958. Since then, transplanted goslings and breeding stock were introduced to coastal British Columbia. These introduced birds, which did not imprint on migratory stock, became year-round residents. Goose numbers have increased rapidly and are predicted to continue their exponential increase unless a new control management regime is adopted. Modelling suggests that Canada Goose numbers in the Capital Regional District will only decline if an egg addling program is implemented along with an annual cull of at least 100 birds, and that the goose population would likely resume exponential growth if the addling + cull program was to be discontinued (EBB Environmental Consulting Ltd. 2012).

Non-native resident Canada Geese were rarely observed on Mary Tod Island until about 2008 (Fairbarns pers. obs.). Since then, resident Canada Geese have begun to feed, roost and nest there and the plant cover of favoured sites is changing from native vegetation to vegetation dominated by low-growing alien plant species. The number and extent of such disturbed habitats have been increasing steadily since geese began to use the island, posing a significant threat to the small subpopulation of Tall Woolly-heads (although the nearest nest was approximately 10 m away in 2015 and no damage to Tall Woolly-heads plants or their habitat has been observed to date (Fairbarns pers. obs.)).

Agriculture (IUCN 2.3)

The northernmost patches of Tall Woolly-heads at Somenos occurred on a seasonally flooded area along the edge of a hay field. Late season haying appears to have extended onto these patches, which have not been seen in recent years.

Work & other activities (IUCN 6.3)

At Uplands Park, some patches of Tall Woolly-heads are mowed by municipal staff as they create fire breaks throughout the park. Mowing itself probably presents little or no threat to the Tall Woolly-heads but the thatch left behind smothers Tall Woolly-heads and serves to spread weed seeds along mowing corridors. Over the past five years, some patches of Tall Woolly-heads at Uplands Park have been covered by wood chips laid down to elevate the trail surface where there is seasonal standing water (Fairbarns pers. obs.).

Fire & fire suppression (IUCN 7.1)

Pre-European fire regimes in the dry coastal belt of southeast Vancouver Island are probably more complex than is generally reported. There is no doubt that First Nations in the area used fire extensively to stimulate the growth of food species—particularly camas (*Camassia* spp.) bulbs that provided a storable form of starch. Fire may also have been used to improve forage for game species (Roosevelt Elk – *Cervus elaphus roosevelti* and Coastal Black-tailed Deer – *Odocoileus hemionus columbianus*) (Turner and Bell 1971).

Frequent low-intensity burns kill young Red Alder (*Alnus rubra*) and Douglas-fir (*Pseudotsuga menziesii*) and check the growth of Trembling Aspen (*Populus tremuloides*) and most shrub species—notably Common Snowberry (*Symphoricarpos albus*) and Nootka Rose (*Rosa nutkana*). The resulting increase in light levels and decrease in competition favour the growth of herbaceous plants. Even the composition of the herb layer alters, because many highly competitive plants decrease under a regime of frequent burning. Fire suppression has led to a shift from open meadows to dense shrubby areas dominated by Common Snowberry in some Garry Oak woodlands (Agee 1996; Chappell and Crawford 1997; Storm and Shebitz 2006; Hamman *et al.* 2011).

Many areas in Uplands Park which were formerly open meadows free of dense shrub communities, as evidenced by old photographs, now have a very dense cover of shrubs dominated by Common Snowberry (Fairbarns pers. obs.). Damp depressions in these former prairies, that may have once been vernal pools suited to Tall Woolly-heads, are now heavily shaded and covered by a layer of surface litter (Fairbarns pers. obs.). Although there has been some interest in re-introducing fire to Garry Oak woodlands in Uplands Park (Dick pers. comm. 2015), this is unlikely to happen unless techniques can be developed to reduce hazards and discomforts to adjacent landowners (Cockle pers. comm. 2015). Furthermore, unplanned fires in Uplands Park have often led to the establishment of a dense sward of alien species on upland sites (Fairbarns pers. obs.), a collateral outcome that diminishes the attraction of prescribed burning as a conservation tool regardless of its potential benefits to vernal pool habitats where Tall Woolly-heads might flourish.

Climate Change: Droughts (IUCN 11.2)

Climate change, particularly changes in precipitation and evaporation, may have devastating effects on vernal pool environments. Small, shallow vernal pools such as those currently supporting Tall Woolly-heads are at greatest risk to changes in the frequency, duration, and seasonal distribution of inundation (Pyke 2005). While the loss of some vernal pool environments may be offset by the improvement of currently marginal habitats, the latter are unlikely to develop subpopulations of Tall Woolly-heads without deliberate human intervention unless they occur near existing subpopulations, because of the species' apparently weak powers of dispersal.

Climate Change: Storms & flooding (IUCN 11.4)

By 2100, the eustatic component of climate change-induced sea level rise may produce a 90-100 cm rise in relative sea level near Victoria. Superimposed on this is an annual cycle of 30-50 cm rise associated with seasonal fluctuations in atmospheric pressure. Another 30-40 cm relative sea level rise would be expected in the most extreme El Niño years. These factors, along with an estimated 100 cm rise associated with a major storm surge during a high spring tide event could raise the relative sea level at Uplands Park by a total of 290 cm (Thomson *et al.* 2008); with consequences similar to those anticipated should a severe tsunami event coincide with storm surges in an El Niño year (see below).

Earthquakes/tsunamis (IUCN 10.2)

Much of the subpopulation at Uplands Park lies below 3 m above sea level. There is a 5-10% probability that a magnitude 9 earthquake will occur within in the next 50 years somewhere along the Cascadia subduction zone (Thomson *et al.* 2008), which extends from northern Vancouver Island to northern California. Should an earthquake of this magnitude result in a tsunami, it could cause temporary rise in the sea level of up to 250 cm in the Uplands area (AECOM 2015). If such a tsunami were to coincide with a major storm surge or a high spring tide it might overrun Tall Woolly-heads patches along the eastern and seaward edge of Uplands Park, scouring vernal pools and moving Tall Woolly-heads plants and seeds to unsuitable habitat. The subpopulations on Mary Tod Island and at Christmas Hill and Somenos occur at sites that are high enough to escape the projected tsunami levels associated with a magnitude 9 earthquake as described above.

Number of Locations

The Christmas Hill and Mary Tod Island subpopulations each occupy very small areas in local parks of separate municipalities—each constitutes a single location where the major threat is invasive species. The Somenos subpopulation, though larger, is contained within a relatively small area where the primary threats (soil disturbance such as dredging in the past and invasive plants at present) are relatively uniform so it too constitutes a single location. The Uplands Park subpopulation consists of numerous small patches over an area of approximately 20 ha but the major threats (trampling, invasive weeds) and their management apply to every patch so the entire subpopulation constitutes a single location. There are four extant locations—equivalent to the number of subpopulations.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

The Province of British Columbia has no stand-alone legislation to protect subpopulations of species at risk on nonfederal lands.

Tall Woolly-heads was assessed as Endangered (COSEWIC 2001) and is protected on federal lands under Schedule 1 of the federal *Species at Risk Act* (SARA) and afforded measures of nominal protection under that legislation.

Tall Woolly-heads has been included within a recovery strategy for rare species of vernal pools and other ephemeral wet areas associated with Garry Oak ecosystems (Parks Canada Agency 2006, 2016). The strategy establishes three goals for the recovery of Tall Woolly-heads in Canada:

1. To maintain extant localities at current levels of abundance or greater,
2. To restore Tall Woolly-heads to its approximate historical extent of occurrence and area of occupancy on the Saanich Peninsula (minimum of five new, independent and self-sustaining populations), and
3. To attain a viable Canadian (Pacific) population with a high probability of persistence.

Over the subsequent nine years there has been no monitoring program of any subpopulation apart from that at Somenos, to determine whether the Canadian population is increasing, decreasing or merely fluctuating without evident trend. Thus, the goal of maintaining existing subpopulations at current or greater levels of abundance cannot be evaluated. There have been no attempts to establish new subpopulations in order to meet the second Recovery Plan goal. The third goal cannot be evaluated because of the lack of comprehensive monitoring data or a population viability analysis to calculate the projected stochastic population growth rate (Parks Canada 2006). Recently (Parks Canada 2016), critical habitat was identified.

The recovery strategy established nine objectives for the 2006-2015 period (Parks Canada 2006). There has been minor satisfaction of these, such as co-operation with private landowners (except at the Somenos site), protective fencing for occurrences at Uplands Park (one patch) and Christmas Hill, and habitat management at Uplands Park, but the majority of objectives remain unfulfilled.

Non-Legal Status and Ranks

In 2001, Tall Woolly-heads was ranked by NatureServe (2012) as G4 (globally apparently secure). NatureServe has not conducted subsequent reviews on its global status. In Canada, the species is ranked as N1 (critically imperilled) according to NatureServe (2012) and has a General Status rank (Canadian Endangered Species Conservation Council 2011) of 1: at risk.

In British Columbia, Tall Woolly-heads is ranked S1 (critically imperilled). It is a priority 1 species under the B.C. Conservation Framework (Goal 3: maintain the diversity of native species and ecosystems) and is included on the British Columbia Red List, which consists of species assessed as endangered, threatened or extirpated based on available information. Inclusion on the Red List confers no legal protection (B.C. Conservation Data Centre 2015).

Tall Woolly-heads has not been ranked in Washington State, Oregon, or Idaho but has been ranked S3.3 (plants about which we need more information; not very threatened) in California. It has been ranked SU (currently unrankable due to lack of information or due to substantially conflicting information about status or trends) in Montana (NatureServe 2012).

Habitat Protection and Ownership

Federal Lands

None of the Canadian subpopulations of Tall Woolly-heads occur on federal lands.

B.C. Protected Areas

The Somenos subpopulation lies within the Somenos Garry Oak Protected Area. This is managed by BC Parks in a special category that allows experimentation to develop effective restoration strategies. Because of this special designation, the Tall Woolly-heads subpopulation at Somenos does not have the full legal protection it might enjoy if it were within a Provincial Park or an Ecological Reserve. The special designation does, however, enable management actions to protect Tall Woolly-heads, action that might be difficult or impossible otherwise, such as the removal of encroaching native shrubs.

Other B.C. Crown Land

There are no subpopulations or partial subpopulations of Tall Woolly-heads on B.C. crown lands, apart from the Somenos lands managed by B.C. Parks (see above).

Municipal Parks

The subpopulations at Uplands Park, Christmas Hill and Mary Tod Island occur within municipal parks. Although neither of the municipalities involved has legislation protecting the subpopulations of Tall Woolly-heads, both currently provide some level of informal support for their management. A small portion of the Uplands Park subpopulation, as well as the entire Christmas Hill subpopulation, has been fenced off to reduce trampling.

Private Land

A small portion of the subpopulation at Somenos extends onto private land. This area, which belongs to a local agricultural concern, is not formally protected from development and the landowner has shown no interest in managing the species (Fairbarns pers. obs.).

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Jennifer Doubt. Chief Collection Manager – Botany. Canadian Museum of Nature. Ottawa, Ontario.

Dr. Jennifer Rowland. Section Head of Policy (Infrastructure and Environment) Governance, Policy, Strategy National Defence.

Dr. Patrick Nantel. Conservation Biologist, Species at Risk Program. Ecological Integrity Branch, Parks Canada Agency. Gatineau, Quebec.

David F. Fraser. Endangered Species Specialist, Ecosystem Branch, Conservation Planning Section. Ministry of Environment, Government of British Columbia. Victoria, British Columbia.

Jenifer Penny. Botanist. British Columbia Conservation Data Centre. Victoria, British Columbia.

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BIOGRAPHICAL SUMMARY OF REPORT WRITER(S)

Matt Fairbarns has a B.Sc. in Botany from the University of Guelph (1980). He has worked on rare species and ecosystem mapping, inventory and conservation in western Canada for approximately 30 years.

COLLECTIONS EXAMINED

Collections at the Royal British Columbia Museum and University of Victoria were examined first-hand. Photographs of collections at the University of British Columbia, Agriculture and Agri-Food Canada, and Canada Museum of Nature were examined. Collections at the University of Washington were consulted through the online database of the Consortium of Pacific Northwest Herbaria (2007-2011).

Appendix 1. Threats Classification Table for Tall Woolly-heads.

THREATS ASSESSMENT WORKSHEET

Species or Ecosystem Scientific Name	Tall Woolly-heads (*Psilocarphus elatior*)		
Element ID		**Elcode**	
Date (Ctrl + ";" for today's date):	06/06/2016		
Assessor(s):	Del Meidinger, Matt Fairbarns, Andy MacKinnon, Daniel Brunton, Dave Polster, Joanna James		
References:			

Overall Threat Impact Calculation Help:

	Threat Impact	**Level 1 Threat Impact Counts** high range	low range
A	Very High	0	0
B	High	0	0
C	Medium	0	0
D	Low	5	5
	Calculated Overall Threat Impact:	Medium	Medium
	Assigned Overall Threat Impact:		
	Impact Adjustment Reasons:		
	Overall Threat Comments	***Generation time: 5 (1-7) years.*** 4 locations - Somenos, Uplands Park, Christmas Hill and Mary Tod Island. Annual plant. Average seed age before germination is unknown. Evidence from closely related species suggests that seeds may remain dormant in soil for 10 or more years. Generation time is suggested as 5 years based on an estimate of the half-life of seeds in the seed bank.	

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential & commercial development						Author suggests that this was likely a past threat, but not a current issue to be concerned about.
1.1	Housing & urban areas						
1.2	Commercial & industrial areas						
1.3	Tourism & recreation areas						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
2	Agriculture & aquaculture	D	Low	Small (1-10%)	Extreme (71-100%)	High (Continuing)	
2.1	Annual & perennial non-timber crops						Hay is produced as part of livestock operation - addressed in section 2.3
2.2	Wood & pulp plantations						
2.3	Livestock farming & ranching	D	Low	Small (1-10%)	Extreme (71-100%)	High (Continuing)	Hay is produced at Somenos site for livestock operation. Area had been hayed last year and author was unable to find any individuals in patch on private land where they were previously found. Extreme severity.
2.4	Marine & freshwater aquaculture						
3	Energy production & mining						
3.1	Oil & gas drilling						
3.2	Mining & quarrying						
3.3	Renewable energy						
4	Transportation & service corridors						
4.1	Roads & railroads						Road construction through the Somenos site was a potential threat in the past (over 10 years ago). There is a chance that this could still be a minor threat, but unlikely.
4.2	Utility & service lines						
4.3	Shipping lanes						
4.4	Flight paths						
5	Biological resource use						
5.1	Hunting & collecting terrestrial animals						
5.2	Gathering terrestrial plants						
5.3	Logging & wood harvesting						
5.4	Fishing & harvesting aquatic resources						
6	Human intrusions & disturbance	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
6.1	Recreational activities	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	Uplands Park has moderate to heavy visitor use, as well as dogs. Large subpopulation has existed with some disturbance over time. Other sites not as impacted. Somenos not as severely impacted - visitors stay on hiking trails (negligible impact off trails). This species is negatively impacted by heavy trampling, but trampling can be beneficial since it could allow species to spread near trails - trampling may reduce heavy grass cover, which chokes out this species (evidence of this near trails). Therefore, trampling could have negative and positive benefits for this species. There is potential for new trail development at Somenos.
6.2	War, civil unrest & military exercises						
6.3	Work & other activities	D	Low	Small (1-10%)	Serious - Moderate (11-70%)	High (Continuing)	Mowing at Uplands Park to create fire breaks affects some patches. Concern due to thatch and potential for weed dispersal. Some patches at Uplands Park have been covered by wood chips to elevate trail surfaces. Wood chips could change the soil chemistry in local vicinity which could affect the growth of this plant, although current larger patches of individuals are not affected by mowing or wood chips. A small amount of Uplands subpopulation is affected by wood chip use (1-5% of total population). Brush cutting work began at Somenos in 2013 but probably didn't have a measurable impact on this species.
7	Natural system modifications	D	Low	Small (1-10%)	Extreme (71-100%)	High (Continuing)	
7.1	Fire & fire suppression	D	Low	Small (1-10%)	Serious (31-70%)	High (Continuing)	Fire suppression has altered habitat at Uplands Park, allowing for woody vegetation to dominate, although this only affects a small area of this species range since most of the population occurs where there is very little shrub growth or potential for shrub growth (soil is too thin). Note: fire suppression here is defined as suppression of traditional first nations burning practices (used to be prevalent in the past). Although prescribed fire is being proposed for Uplands Park, there are no specific plans and the likelihood unknown.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
7.2	Dams & water management/use	D	Low	Small (1-10%)	Extreme (71-100%)	High (Continuing)	Dyking, ditching and dredging; beaver dam removal; and dumping of dredged materials at Somenos Creek subpopulation. Water level was being managed for hay production, not for rare species survival. Somenos subpopulation was formerly about half of the Canadian population. Upstream and downstream portions of subpopulation suffered from different impacts. Along the upstream portion of the population the removal of beaver dams led to a severe reduction in flooding and areas formerly occupied by Tall Woolly-heads and other annual plants became filled in with Willows and Reed Canarygrass leading to a more or less complete loss of Tall Woolly-heads. Along the downstream portion of the subpopulation the dredged materials formed a high berm that covered a major portion of the habitat formerly occupied by Tall Woolly-heads and prevented flooding of the rest of the downstream area where Tall Woolly-heads formerly occurred. The immediate response was a nearly complete loss of the Somenos Tall Woolly-heads subpopulation. More recently, a breach was created in the berm to allow water to flood portions of the lower area and Tall Woolly-heads now grow vigorously in this area. Nevertheless, that portion of the downstream area actually occupied by the berm, and the upstream area where Willows and Reed Canarygrass now predominate, have seen negligible recovery by Tall Woolly-heads.
7.3	Other ecosystem modifications						
8	Invasive & other problematic species & genes	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	
8.1	Invasive non-native/alien species	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Many invasive exotic species occur in vernal pools; some very aggressive, i.e., Carpet Burweed. Weeding of Carpet Burweed at Uplands Park. Although pervasive, non-native species have co-existed in these habitats for many years. There are several invasive grasses near vernal pools, and these are pushing native species out of their optimal habitat. Dense populations of individuals aren't as affected by competition from invasive plants. Carpet Burweed is being controlled, although the long term prospects unclear

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.2	Problematic native species	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	Increasing non-native resident Canada Geese population altering vegetation. Concern on coastal sites, like Mary Tod Island and Uplands Park. Geese have increased exponentially over last few years. Some areas in Uplands don't have geese yet, as lots of people and dogs at this park keeps geese away.
8.3	Introduced genetic material						
9	Pollution						
9.1	Household sewage & urban waste water						
9.2	Industrial & military effluents						
9.3	Agricultural & forestry effluents						
9.4	Garbage & solid waste						
9.5	Air-borne pollutants						
9.6	Excess energy						
10	Geological events		Not Calculated (outside assessment timeframe)	Small (1-10%)	Unknown	Low (Possibly in the long term, >10 yrs)	
10.1	Volcanoes						
10.2	Earthquakes/tsunamis		Not Calculated (outside assessment timeframe)	Small (1-10%)	Unknown	Low (Possibly in the long term, >10 yrs)	Tsunami associated with earthquake could impact on some low-lying areas. The subpopulation present at Mary Tod is located over 3 m above sea level, therefore unlikely tsunami would have an effect. Most of Uplands site unlikely to be affected for same reason however the lowest-lying patches at Cattle Point (in Uplands Park) could be severely impacted by a tsunami, both by being scoured out by the tsunami itself and by habitat degradation if the tsunami deposited gravel and/or driftwood in the low-lying areas (recent, unusually severe storm surges have already left some low-lying area at Cattle Point covered in gravel and driftwood; fortunately, this didn't include low-lying areas with Tall Woolly-heads).
10.3	Avalanches/landslides						
11	Climate change & severe weather	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	
11.1	Habitat shifting & alteration						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11.2	Droughts	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Climate in this area of BC appears to be changing now, so timing 'continuing'. Changes to precipitation and evaporation may impact on vernal pool extent; most models predict higher winter precipitation and drier summers but some models present different outcomes. Moisture/temperature relationships with this species is very subtle. Vernal pools sensitive to changes in period of inundation and timing of onset of droughts. Tall Woolly-heads germinates in the spring, therefore if there was no prolonged period of saturation in winter Tall Woolly-heads would be negatively affected. Prolonged wet conditions in spring may lead to establishment of larger vascular plants (particularly invasive grasses) in areas which are now occupied by low-growing plants including Tall Woolly-heads.
11.3	Temperature extremes						
11.4	Storms & flooding						
Classification of Threats adopted from IUCN-CMP, Salafsky *et al.* (2008).							