PROPOSED

Species at Risk Act
Management Plan Series
Adopted under Section 69 of SARA

Management Plan for the Lyall's Mariposa Lily (*Calochortus lyallii*) in Canada

Lyall's Mariposa Lily

2017

Government of Canada
Gouvernement du Canada

Canada

Recommended citation:

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

Cover illustration: Kella Sadler, Environment and Climate Change Canada

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

MANAGEMENT PLAN FOR THE LYALL'S MARIPOSA LILY (*Calochortus lyallii*) IN CANADA

2017

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 *Management Plan for the Lyall's Mariposa Lily (*Calochortus lyallii*) in British Columbi*a (Part 2) under section 69 of the *Species at Risk Act* (SARA). Environment and Climate Change Canada has included a federal addition (Part 1) which completes the SARA requirements for this management plan.

The federal management plan for the Lyall's Mariposa Lily in Canada consists of two parts:

Part 1 – Federal Addition to the *Management Plan for the Lyall's Mariposa Lily (*Calochortus lyallii*) in British Columbia*, prepared by Environment and Climate Change Canada.

Part 2 – *Management Plan for the Lyall's Mariposa Lily (*Calochortus lyallii*) in British Columbia*, prepared by B.C. Ministry of Environment.

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Part 1 – Federal Addition to the *Management Plan for the Lyall's Mariposa Lily (*Calochortus lyallii*) in British Columbia*, prepared by Environment and Climate Change 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 management plans for listed species of special concern 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 Environment and Climate Change is the competent minister under SARA for the Lyall's Mariposa Lily and has prepared the federal component of this management plan (Part 1), as per section 65 of SARA. To the extent possible, it has been prepared in cooperation with the B.C. Ministry of Environment, as per section 66(1) of SARA. SARA section 69 allows the Minister to adopt all or part of an existing plan for the species if the Minister is of the opinion that an existing plan relating to wildlife species includes adequate measures for the conservation of the species. The Province of British Columbia provided the attached management plan for the Lyall's Mariposa Lily (Part 2) as science advice to the jurisdictions responsible for managing the species in British Columbia. It was prepared in cooperation with Environment and Climate Change Canada.

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 and Climate Change Canada or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this plan for the benefit of the Lyall's Mariposa Lily 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.

[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 the federal *Species at Risk Act* (SARA) that are not addressed in the *Management Plan for the Lyall's Mariposa Lily (*Calochortus lyallii*) in British Columbia* (Part 2 of this document, referred to henceforth as "the provincial management plan") and/or to provide updated or additional information.

Under SARA, prohibitions regarding the protection of species and their habitat do not apply to species of special concern. Conservation measures in the provincial management plan dealing with the protection of individuals and their habitat are still adopted to guide conservation efforts but would not result in federal legal protection.

1.0 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*[3]. 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[4] (FSDS) goals and targets.

Conservation 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.

The provincial management plan for Lyall's Mariposa Lily contains a section describing the effects of recovery activities on other species (i.e., Section 8). Environment and Climate Change 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 Lyall's Mariposa Lily 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. Some management actions for Lyall's Mariposa Lily (e.g., invasive alien species control) may promote the conservation of other species at risk that overlap in distribution and rely on similar habitat attributes.

[3] www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[4] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1

Part 2 – *Management Plan for the Lyall's Mariposa Lily (*Calochortus lyallii*) in British Columbia*, prepared by B.C. Ministry of Environment

Management Plan for Lyall's Mariposa Lily (*Calochortus lyallii*) in British Columbia

Prepared by the B.C. Ministry of Environment

BRITISH COLUMBIA | Ministry of Environment

April 2015

About the British Columbia Management Plan Series

This series presents the management plans that are prepared as advice to the Province of British Columbia. Management plans are prepared in accordance with the priorities and management actions assigned under the British Columbia Conservation Framework. The Province prepares management plans for species' that may be at risk of becoming endangered or threatened due to sensitivity to human activities or natural events.

What is a management plan?

A management plan identifies a set of coordinated conservation activities and land use measures needed to ensure, at a minimum, that the target species does not become threatened or endangered. A management plan summarizes the best available science-based information on biology and threats to inform the development of a management framework. Management plans set goals and objectives, and recommend approaches appropriate for species or ecosystem conservation.

What's next?

Direction set in the management plan provides valuable information on threats and direction on conservation measures that may be used by individuals, communities, land users, conservationists, academics, and governments interested in species and ecosystem conservation.

For more information

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

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

Management Plan for Lyall's Mariposa Lily (*Calochortus lyallii*) in British Columbia

Prepared by the B.C. Ministry of Environment

April 2015

Recommended citation

B.C. Ministry of Environment. 2015. Management Plan for Lyall's mariposa lily (*Calochortus lyallii*) in British Columbia. B.C. Ministry of Environment, Victoria, BC. 19 pp.

Cover illustration/photograph

Michael T. Miller

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

The B.C. Ministry of Environment has prepared this management plan, as advice to the responsible jurisdictions and organizations that may be involved in managing the species.

This document identifies the management actions that are deemed necessary, based on the best available scientific and traditional information, to prevent Lyall's mariposa lily populations in British Columbia from becoming endangered or threatened. Management 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 management approaches may be modified in the future to accommodate new objectives and findings.

The responsible jurisdictions have had an opportunity to review this document. However, this document does not necessarily represent the official positions of the agencies.

Success in the conservation 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 management plan. The B.C. Ministry of Environment encourages all British Columbians to participate in the conservation of Lyall's mariposa lily.

ACKNOWLEDGEMENTS

Brenda Costanzo (B.C. Ministry of Environment [MoE]) prepared this management plan. This management plan builds on the recovery strategy that was prepared by the Southern Interior Rare Plants Recovery Implementation Group (2008). Additional assistance was provided by: Sara Bunge (MoE, Parks), Marta Donovan (BC Conservation Data Centre [CDC]), Orville Dyer (B.C. Ministry of Forests, Lands and Natural Resource Operations), Dave Fraser (MoE), Jenifer Penny (BC CDC), Mike Miller (botanical consultant), Kirk Safford (MoE, Parks), and Mark Weston (MoE, Parks).

EXECUTIVE SUMMARY

Lyall's mariposa lily (*Calochortus lyallii*) is found only in the extreme south-central B.C. where it inhabits semi-arid, mid-elevation grasslands between the Okanagan Valley and Similkameen River. It is known from only 5 populations, containing 18 subpopulations. Lyall's mariposa lily was designated as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2011). This plant was formerly designated as Threatened, but most of the area where it occurs has been designated as a provincial protected area. Of the two subpopulations that were on private land at the time of the last COSEWIC assessment, one is now within the Sage and Sparrow Conservation Area owned by the Nature Conservancy of Canada. It is expected that the current listing of Threatened in Canada on Schedule 1 of the *Species at Risk Act* (SARA) will be changed to Special Concern to align with the current COSEWIC assessment. In B.C., the Lyall's mariposa lily is ranked S3 (special concern, vulnerable to extirpation or extinction) by the B.C. Conservation Data Centre and is on the provincial Blue list. The B.C. Conservation Framework ranks Lyall's mariposa lily as priority 1 under goal 1 (contribute to global efforts for species and ecosystem conservation), priority 6 under goal 2 (prevent species and ecosystems from becoming at risk), and priority 1 under goal 3 (maintain the diversity of native species and ecosystems).

The management goal for this species is to maintain all known populations within British Columbia, as they are currently represented by subpopulation sizes and distribution.

The following are the management objectives for this species:

1. Assess and mitigate livestock impacts at 3 known Lyall's mariposa lily populations and 2 of the known subpopulations during critical phenological periods.
2. Assess and mitigate the threats of invasive alien species encroachment and forest encroachment (secondary succession) due to fire suppression.
3. Monitor all known Lyall's mariposa lily populations every 3–5 years.

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1 COSEWIC* SPECIES ASSESSMENT INFORMATION

Assessment Summary May 2011
Common Name: ** **Lyall's Mariposa** Lily
Scientific Name: ** *Calochortus lyallii*
Status: Special Concern
Reason for Designation: This species is a distinctive, long-lived perennial with a small range in Canada. It is known from only 5 populations in forest openings and sagebrush grasslands in southern B.C., near Osoyoos. Plants emerge from underground bulbs in late spring, but are capable of remaining dormant for one or more years. This plant was formerly designated Threatened, but most of the area where it occurs has been designated as a provincial protected area, and the main threats, related to grazing and forest management have now been mitigated.
Occurrence: B.C.
Status History: Designated Threatened in May 2001. Status re-examined and designated Special Concern in May 2011.

* Committee on the Status of Endangered Wildlife in Canada.
** Common and scientific names reported in this management plan follow the naming conventions of the B.C. Conservation Data Centre, which may be different from names reported by COSEWIC.

2 SPECIES STATUS INFORMATION

Lyall's mariposa lily[a]		
Legal Designation:		
FRPA:[b] No OGAA:[b] No	B.C. *Wildlife Act*:[c] No	SARA:[d] Schedule 1 – Threatened (2003)
Conservation Status[e]		
B.C. List: Blue	B.C. Rank: S3 (2011)	National Rank:[f] N3 (2011) Global Rank: G3G4 (2011)
Other Subnational Ranks:[f] Washington: SNR		
B.C. Conservation Framework[g] **(CF)**		
Goal 1: Contribute to global efforts for species and ecosystem conservation.		Priority:[h] 1 (2010)
Goal 2: Prevent species and ecosystems from becoming at risk.		Priority: 6 (2010)
Goal 3: Maintain the diversity of native species and ecosystems.		Priority: 1 (2010)
CF Action Groups: [f]	Compile Status Report; Planning; Send to COSEWIC; Habitat Protection; Habitat Restoration; Private Land Stewardship	

[a] Data source: B.C. Conservation Data Centre (2014) unless otherwise noted.
[b] No = not listed in one of the categories of wildlife 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).
[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). This species was recently reassessed by COSEWIC as Special Concern. This assessment will be reviewed by the Governor in Council (GIC) who will make a decision as to whether to amend the List to reclassify this species as Special Concern
[e] S = subnational; N = national; G = global; 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.
[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

Lyall's mariposa lily is a long-lived, bulbous perennial native to the Columbia Basin region of western North America (cover photo; Figure 1). Plants produce a single, strap-shaped leaf at their base and a single stalk with 1–12 white or purplish-tinged, star-shaped flowers. (In non-reproductive individuals, only a single basal leaf is produced.) The flowers are borne on slender erect stalks and have 3 petals (inner series of floral parts) and 3 sepals (outer series of floral parts). The petals are 2–3.5 cm long, clawed, broadly lance-shaped, with fringed margins and a bearded, crescent-shaped gland toward the base. The sepals are distinct from the petals (they are narrower and greenish), a feature that sets this genus apart from most other groups in the lily family. The fruit is an erect, smooth, three-winged capsule (Ownbey 1940; Hitchcock and Cronquist 1973; Fiedler and Zebell 2002).

Seedlings and vegetative shoots both emerge in April, usually before the last patches of snow have completely melted. The seedlings, which are about the size and dimension of a 4 cm long toothpick, remain green for about 3 weeks before dying back to the new bulb, at which point the young plants enter dormancy until the following year. Flowering on adult plants commences in early June, with seed set occurring in July and August. Upon maturation, the seeds are gravity-dispersed (Miller 2004).

Lyall's mariposa lily often occurs in association with a second species of *Calochortus*, the sagebrush mariposa lily (*Calochortus macrocarpus*). Although the two species are easily distinguished when in bloom (the flowers of sagebrush mariposa are larger, tulip-shaped, and lavender), distinguishing the seedlings, juveniles, and vegetative stages in the field can be difficult. The leaves are a distinguishing feature: the single leaves of sagebrush mariposa are usually linear and channeled in cross-section, whereas those of Lyall's mariposa are always flat.

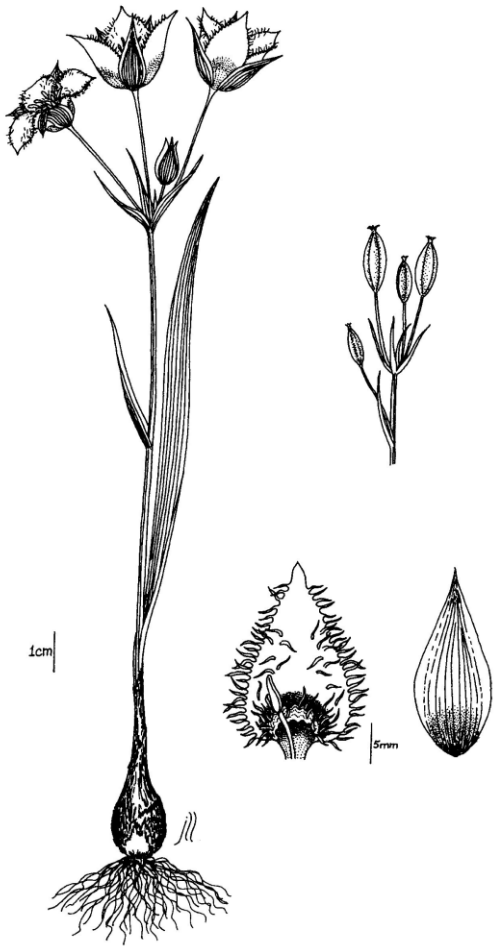

Figure 1. Illustration of Lyall's mariposa lily.
Reprinted by permission from J. Ling in Douglas *et al.* (2001). © Province of British Columbia.

Demography

Lyall's mariposa lily has a complex life cycle composed of several, more or less discrete, stages or states: seeds, seedlings, juveniles or subadults, flowering plants, vegetative (non-flowering) individuals, and dormant bulbs. Transitions among these different states are not necessarily linear, as stasis and retrogression are both common (Miller 2004). That is, a plant that produces flowers one year may, in the following year, produce only a single small vegetative leaf, or it may be dormant and not appear above-ground at all. Alternatively, a plant might remain vegetative for several years before flowering (producing one or many flowers), after which it may either continue to flower in subsequent years or revert to a vegetative state. In a typical year, a population may be composed of approximately 15% seedlings, 40% juveniles/subadults, 20% flowering plants, 15% vegetative plants, and 10% (occasionally up to 18%) dormant bulbs (Miller 2004).

Dormancy episodes typically last a single year, although episodes as long as 4 years have been recorded (Miller *et al.* 2004). This ability of bulbs to remain dormant for prolonged periods is an important life history feature that should not be ignored when conducting censuses or population counts (Miller *et al.* 2004). Prolonged dormancy due to underground bulb banks is thought to be

similar to seed-banking in that it allows the plant to buffer against catastrophic events (Miller *et al.* 2012).

3.2 Populations and Distribution

Distribution
The range of Lyall's mariposa lily extends in a narrow band east of the Cascade Mountains and west of the Columbia River from Yakima County, Washington, north to south-central British Columbia (Hitchcock and Cronquist 1973; Fiedler and Zebell 2002; Figure 2). The species is somewhat common within this restricted range, with the largest population concentrations occurring in the Methow Valley region of north-central Washington (M. Miller, pers. observation, 2007). In Canada, Lyall's mariposa lily is restricted to the area known as "East Chopaka," which separates the Okanagan and Similkameen River valleys west of the town of Osoyoos and south of Richter Pass, B.C. (Miller and Douglas 1999; Figure 3).

In B.C., over 90% of the area where Lyall's mariposa lily occurs is within the South Okanagan Grasslands Protected Area (SOGPA); the rest is within the Sage and Sparrow Conservation Area (Nature Conservancy of Canada) with one small subpopulation on private land (Table 1).

All confirmed B.C. populations occur within 5 km of one another and all are within 5 km of the U.S. border. The B.C. extent of occurrence is approximately 9 km^2, and the current area of occupancy is approximately 4.2 ha. This likely represents less than 1% of the total global distribution.

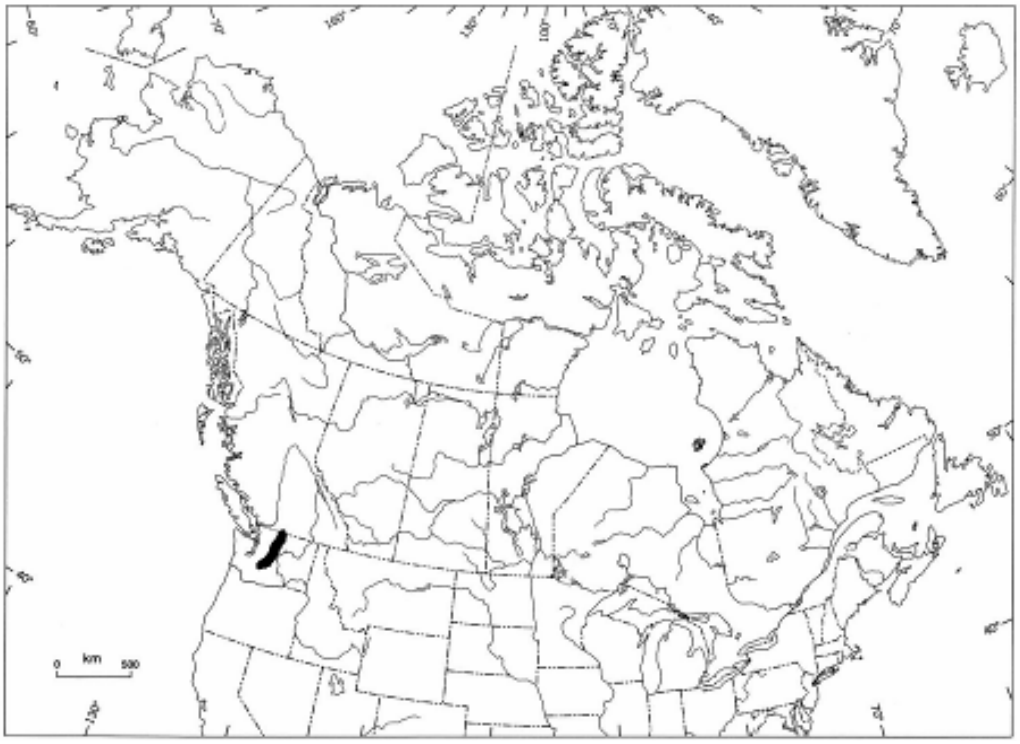

Figure 2. Global range of Lyall's mariposa lily.

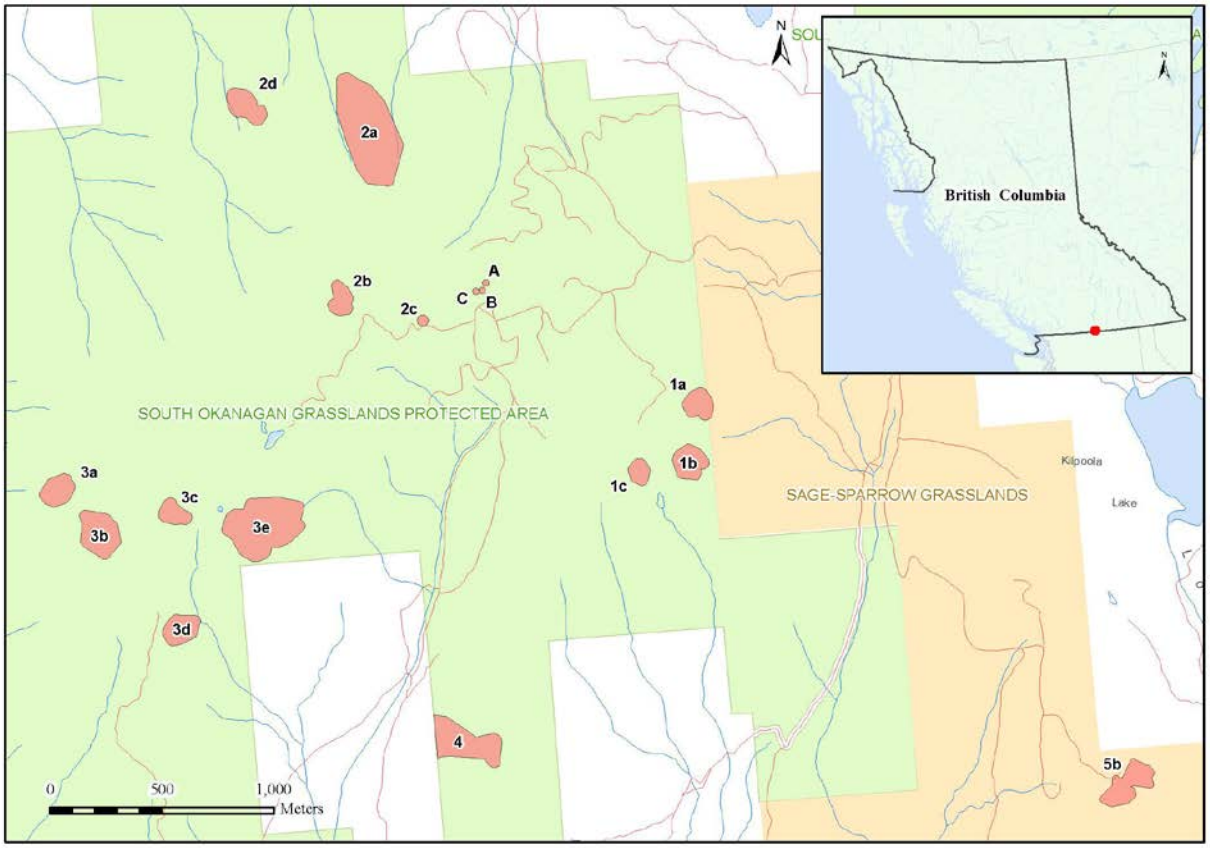

Figure 3. Lyall's mariposa lily subpopulations in South Okanagan Grasslands Protected Area and the Sage and Sparrow Conservation Area. Subpopulation locations on private lands (i.e., a portion of subpopulation 4, and all of 5a) are not shown here to protect the privacy of the landowner.

Population size and trends

A total of 18 subpopulations of Lyall's mariposa lily are confirmed in B.C. (Table 1; Figure 3) grouped into 5 populations[1] (B.C. Conservation Data Centre 2014). The total population within B.C. was over 800,000 mature individuals in 2009 (COSEWIC 2011).

Little information is available on long-term population trends for this species. The first B.C. collection, by Macoun in 1905, was made from "open hilltops near the Similkameen River" (Ownbey 1940). However, the exact location and status of this historical population are unknown. The species was not recorded again in B.C. until 1978, when 3 populations (possibly including the one recorded by Macoun) were identified on the upper slopes of East Chopaka (i.e., Black Mountain). Subsequent surveys between 1995 and 2008 yielded several additional records for Lyall's mariposa lily at East Chopaka. Surveys in 2009 of four of the populations confirmed their presence and abundance (Table 1).The total population numbers are approximately the same between 1997 (about 855,000 individuals) and 2009 (about 812,000 individuals)

[1] Populations are separated by > 1 km and are one occurrence; subpopulations are within 1 km of each other.

(COSEWIC 2011), although the 2009 total includes estimates for one additional population (i.e., population 4, discovered in 2000).

No information on population estimates and trends for nearby Washington Lyall's mariposa lily populations are available as the state does not formally track this species currently (NatureServe 2013).

Table 1. Status and description of Lyall's mariposa lily populations in B.C.

Population & subpopulation[a]	Status and description	Land tenure
1a	M. Miller (2009) observed 9,000 ± 900 mature plants.	BC Parks
1b	M. Miller (2009) observed 4,550 ± 460 mature plants	BC Parks
1c	M. Miller (2009) observed 300 ± 50 mature plants	BC Parks
2a	M. Miller (2009) observed 368,000 ± 37,000 mature plants	BC Parks
2b	M. Miller (2009) observed 23,400 ± 2,340 mature plants	BC Parks
2c[b]	M. Miller (2009) observed 21 mature plants	BC Parks
2d	M. Miller (2009) observed > 150 mature plants	BC Parks
2A-C	M. Weston (2012) observed 150 mature plants	BC Parks
3a	M. Miller (2009) observed 59,400 ± 5,9400 mature plants	BC Parks
3b	M. Miller (2009) observed 94,700 ± 9,470 mature plants	BC Parks
3c	M. Miller (2009) observed 14,380 ± 1,438 mature plants	BC Parks
3d	M. Miller (2009) observed 81,200 ± 8,120 mature plants	BC Parks
3e	M. Miller (2009) observed 75,824 ± 7,580 mature plants	BC Parks
4	M. Miller (2009) observed 81,160 ± 8,120 mature plants	BC Parks/private
5a	M. Miller (1997) observed 1,800 ± 500 mature plants	Private
5b	M. Miller (1997) observed 60 mature plants	Private
5b	J. Penny (2013) observed 100's of plants (incomplete counts)	Nature Conservancy of Canada

Total mature plants: 814,395 ± 81,918

[a] Population is represented by a number; subpopulation by letters.

[b] Artificial colony planted by M. Miller in 1996, from 50 seeds harvested from Population 2.

3.3 Habitat[2] and Biological Needs

Lyall's mariposa lily inhabits sagebrush slopes, grasslands, and open forests in the steppe and montane zones (Hitchcock and Cronquist 1973; Douglas *et al.* 2001). In B.C., Lyall's mariposa lily is generally limited to pocket grasslands and natural openings in Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) forests at elevations ranging from 900 to 1300 m. The B.C. range of Lyall's mariposa lily lies within the Okanagan very dry hot variant of the Interior Douglas-fir biogeoclimatic zone (IDFxh1; Lloyd *et al.* 1990; Bryan 1996). The climate is predominantly continental, with warm dry summers and cool winters (Meidinger and Pojar, eds. 1991).

[2] Adapted from Miller and Douglas (1999).

Lyall's mariposa lily is typically found on sloping grassy areas dominated by bluebunch wheatgrass (*Pseudoroegneria spicata*) and Idaho fescue (*Festuca idahoensis*). Junegrass (*Koeleria macrantha*) and pinegrass (*Calamagrostis rubescens*) are common associates (Miller 2004). Associated herbs include death-camas (*Zigadenus elegans ssp. elegans*), yellow bell (*Fritillaria pudica*), arrow-leaved balsamroot (*Balsamorhiza sagittata*), silky lupine (*Lupinus sericeus*), and small-flowered blue-eyed Mary (*Collinsia parviflora*). On drier sites, bitterroot (*Lewisia rediviva*) and big sagebrush (*Artemisia tridentata* spp. *tridentata*) comprise part of the association. Shrub cover is generally sparse, but includes birch-leaved spirea (*Spiraea betulifolia* ssp. *lucida*), squaw currant (*Ribes cereum* var. *cereum*), and prairie saskatoon (*Amelanchier alnifolia* var. *alnifolia*). A few invading/residual Douglas-fir trees are also present at most of the sites.

The substrate at East Chopaka, the area where Lyall's mariposa lily is found, is composed mainly of glaciated granodiorite, known as Kruger Syenite, overlain by glacial till (Bryan 1996). Soils at occupied sites range in depth from less than 5 cm to over 30 cm, and typically consist of coarse, well-drained, nitrogen-rich sandy loams. The soil types at these sites have not been formally analyzed, but presumably consist of Eutric Brunisols or dark Chernozems (Bryan 1996).

An analysis of Lyall's mariposa lily abundance gradients at two sites in East Chopaka on Black Mountain yielded few correlations with any of soil moisture, soil depth, litter depth, percent moss cover, or exposure (Miller 2004). However, at a third, drier site, plots containing seedlings had significantly deeper soil, more plant cover, more litter cover, and more soil moisture than plots without seedlings, suggesting that microsite availability is limiting for recruitment at some sites but not others (Miller 2004).

3.4 Ecological Role

Insects are known to graze on the herbage of Lyall's mariposa lily. Some insects lay their eggs in the developing fruit capsules, small mammals (e.g., Northern Pocket Gophers, *Thomomys talpoides*) regularly forage on the bulbs, and halictid bees (*Dufourea dilatipes*) are the primary pollinators (Miller *et al.* 2004; C. Sheffield, pers. comm., 2014).

3.5 Limiting Factors

Lyall's mariposa lily is a fire-adapted species, so it may need fire to maintain open habitats for its continued survival (COSEWIC 2011) and to decrease competitive exclusion by later successional species. Lyall's mariposa lily increased in numbers of individuals after a fire at the East Chopaka site in 1994 (Miller and Douglas 1999).

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) (adapted from Salafsky *et al.* 2008). For purposes of threat assessment, only present and future threats are considered.[3] Threats presented here do not include limiting factors[4] which are presented in Section 3.5.

For the most part, threats are related to human activities, but they can also be natural. The impact of human activity may be direct (e.g., destruction of habitat) or indirect (e.g., introduction of invasive species). Effects of natural phenomena (e.g., fire, flooding) may be especially important when the species is concentrated in one location or has few occurrences, which may be a result of human activity (Master *et al.* 2012). As such, natural phenomena are included in the definition of a threat, though they should be considered 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. In such cases, the effect on the population would be disproportionately large compared to the effect experienced historically (Salafsky *et al.* 2008).

[3] 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.* 2012).

[4] 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).

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. For a detailed description of the threat classification system, see the Open Standards website (Open Standards 2014). 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.* (2012) and table footnotes for details. Threats for the Lyall's mariposa lily were assessed for the entire province (Table 2).

Table 2. Threat classification table for Lyall's mariposa lily in B.C.

Threat #[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]	Population(s) or location(s) or site(s)
1	Residential & commercial development	Negligible	Negligible	Unknown	Unknown	One
1.1	Housing & urban areas	Negligible	Negligible	Unknown	Unknown	Potentially on private part of 4
2	Agriculture & aquaculture	Medium-low	Pervasive	Moderate-slight	High	All
2.3	Livestock farming & ranching	Medium-low	Pervasive	Moderate-slight	High	All
5	Biological resource use	Negligible	Negligible	Negligible	Moderate	All
5.2	Gathering terrestrial plants	Negligible	Negligible	Negligible	Moderate	All
5.3	Logging & wood harvesting	Not a threat	Negligible	Neutral or potential benefit	Insignificant /Negligible	All
6	Human intrusions & disturbance	Negligible	Negligible	Negligible	High	All except private part of 4; and 5a
6.1	Recreational activities	Negligible	Negligible	Negligible	High	All except private part of 4; and 5a
7	Natural system modifications	Low	Large	Slight	High	All?
7.1	Fire & fire suppression	Low	Large	Slight	High	All
8	Invasive & other problematic species & genes	Low	Large	Slight	High	All
8.1	Invasive non-native/alien species	Low	Large	Slight	High	All
8.2	Problematic native species	Unknown	Unknown	Unknown	Unknown	All
11	Climate change & severe weather	Not calculated	Pervasive	Unknown	Low	All

Threat #[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]	Population(s) or location(s) or site(s)
11.2	Droughts	Not calculated	Pervasive	Unknown	Low	All
11.3	Temperature extremes	Not calculated	Pervasive	Unknown	Low	All

[a] Threat numbers are provided for Level 1 threats (i.e., whole numbers) and Level 2 threats (i.e., numbers with decimals).

[b] **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. The median rate of population reduction 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.

[c] **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%).

[d] **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 15 years was used resulting in severity being scored over a 45-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 $\geq$ 0%).

[e] **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 Medium-Low.[5] This overall threat considers the cumulative impacts of multiple threats. Threats included agriculture and aquaculture (livestock grazing), natural system modification (forest encroachment due to fire suppression), and invasive and other problematic species and genes (invasive alien encroachment) (Table 2). Details are discussed below under the Threat Level 1 headings.

IUCN-CMP Threat 2. Agriculture & aquaculture

East Chopaka has a long history of livestock grazing. Grazing continues to be managed under a range use plan (RUP) administered by the Ministry of Forests, Lands and Natural Resource Operations on Black Mountain (Barber Mountain). Due to the rugged terrain in some areas, not all Lyall's mariposa lily sites are used by livestock, however, sites that are more readily accessible to cattle include:1a, 1b, 2b, 2c, 3b, 4, 5a, and 5b (Table 1) (COSEWIC 2011). Cattle have not been on East Chopaka under the RUP due to the inability to access the site through private land in the past 9 years. However, there has been cattle trespass on some occasions (K. Safford, pers. comm., 2015).

The current RUP for Crown land on upper Barber Mountain allows for 157 head of cattle to be grazed, with grazing scheduled to occur from May 1 to May 31 (B.C. MFLNRO 2009). Unfortunately, this period corresponds to the main growing season (flowering period) for Lyall's mariposa lily. The RUP is up for renewal, however, this may not be completed until 2016. In the meantime, it is expected that the tenure holder will place cattle in East Chopaka within the May 1 – 31 timing subject to range readiness criteria and water availability (K. Safford, pers. comm., 2015).

In contrast to the co-occurring sagebrush mariposa lily (*Calochortus macrocarpus*), which is frequently browsed by ungulates (Miller 2004), Lyall's mariposa lily does not appear to be a favoured forage of livestock but livestock damage plants due to trampling (e.g., one site trampled by 17% in 1996 (Miller and Douglas 1999). Fencing improvements at East Chopaka on Barber Mountain have also helped limit (but not eliminate) the movements and thus impacts of cattle (COSEWIC 2011). Although cattle grazing impacts were determined to be low at all sites in 2007 (Klym *et al.* 2007), grazing will resume on Barber Mountain in East Chopaka in 2015 after approximately 9 years of no livestock grazing. It is unknown to what extent Lyall's mariposa lily sites will be impacted by the re-introduction of cattle; impacts may vary depending on local factors such as water availability, range condition, and fencing. Lyall's mariposa lily is recognized as a species of concern in the RUP, however, the RUP states that Lyall's is "not affected by grazing". As there is no known data to substantiate this statement, there is currently an ongoing pilot study at one site within SOGPA (subpopulation 3d) to assess the effects of

[5] The overall threat impact was calculated following Master *et al.* (2012) using the number of Level 1 Threats assigned to this species where Timing = High or Moderate. This includes 1 Medium-Low and 2 Low (Table 2).The overall threat considers the cumulative impacts of multiple threats.

livestock grazing, as well as the effects of invasive plants, Northern Pocket Gopher) use, and vehicle traffic (e.g., all-terrain vehicles) (K. Safford, pers. comm. 2015, K. Sadler, pers. comm. 2014).

Although impacts due to cattle foraging may be minimal (see Miller and Douglas, 1999), damage due to trampling by cattle is a concern. Trampling on its own is probably not fatal for established plants due to their deep-seated bulbs; however, free-ranging cattle can substantially damage above-ground reproductive structures. For example, at population 2, 17% of all flowering stems were broken off as a result of livestock trampling during one season, leading to a substantial reduction in seed production for that year. Trampling could also be fatal for seedlings (which do not possess deep-seated bulbs), especially if grazing occurs early in the year (April-May) when seedlings are still above-ground (Southern Interior Rare Plants Recovery Implementation Group 2008). Grazing also causes soil compaction that will have an effect on seed germination rates and seedling survival (Miller and Douglas 1999). In addition, any grazing could facilitate the spread of invasive alien species into Lyall's mariposa lily sites (see IUCN-CMP Threat 8.1).

Additional information on the effects of livestock on Lyall's mariposa lily productivity and survival in the long term is needed, as well as what would be an acceptable level and correct timing of livestock use. As part of a Stewardship Plan for Lyall's mariposa lily in SOGPA, BC Parks have monitored cattle grazing trespass for range impacts and non-compliance with the RUP and cattle trespass at Lyall's mariposa lily sites (Dyer *et al.* 2007); however, this Stewardship Plan ran from 2008 to 2012 and monitoring for range impacts will not continue at this time (K. Safford, pers. comm., 2014).

IUCN-CMP Threat 5. Biological resource use

For the time, over collection of this plant is negligible and wild-harvesting does not pose a threat. There are Bulbs of this species are sold commercially in North America, but most are grown in nurseries from seed (COSEWIC 2011). Direct threats from forestry activities have now largely been abated since most populations are within conservation or protected areas.

IUCN-CMP Threat 7. Natural system modifications

7.1 Fire and & fire suppression

Lyall's mariposa lily prefers open grassy habitats with minimal shading. At East Chopaka, the species is confined to small pockets of bunchgrass grassland within a more or less continuous stand of Douglas-fir forest. These grassy areas likely represent a subclimax community maintained by periodic fire (Bryan 1996). The bulbiferous habit of Lyall's mariposa lily makes it well adapted to withstand surface burns (Miller 2004). Periodic fire likely benefits Lyall's mariposa lily by (1) preventing forest and shrub encroachment into open habitat, (2) providing nitrogen inputs to the soil, (3) reducing thatch (herbaceous material) build-up and thereby maintaining germination safe sites, and (4) reducing fuel loads (arising from trees/shrubs). In the absence of fire, the upper slopes could presumably revert to a closed canopy Douglas-fir forest over time, eliminating much of the available lily habitat, although areas with very shallow soil, such as rocky outcrops, might not be so affected. Conifers surround all of the Lyall's mariposa lily sites in East Chopaka and conifer seedlings could establish within a 10-year timeframe. All

populations (except for 3d) are under potential threat of ingrowth, with subpopulations 1a and 2a being at the lower risk factor (M. Weston, pers. comm., 2014). It is thought that conifer encroachment could become a more significant threat in the long term, as most subpopulations are surrounded by coniferous forests, and greater conifer cover and ingrowth is anticipated as result of natural succession (K. Safford, pers. comm., 2014). However, further assessment has not occurred, and due to other projects and resource constraints within BC Parks, it is unlikely that there will be management for forest encroachment in the SOGPA in the near future.

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

8.1 Invasive non-native/alien species

A number of invasive alien plant species have become established where Lyall's mariposa lily is found in SOGPA, including: knapweed (*Centaurea* spp.), Canada thistle (*Cirsium arvense*), common hound's-tongue (*Cynoglossum officinale*), great mullein (*Verbascum thapsus*), toadflax (*Linaria* spp.), prickly lettuce (*Lactuca serriola*), sulphur cinquefoil (*Potentilla recta*), and cheatgrass (*Bromus tectorum*) (Southern Interior Rare Plants RIG 2008).

Three of these species (cheatgrass, great mullein, and common hound's-tongue) currently grow within Lyall's mariposa lily sites, but their numbers were low and impacts appeared minimal (Klym *et al.* 2007). Cheatgrass could become a problem for Lyall's mariposa lily in the future; this species can increase rapidly in open sites, which Lyall's mariposa lily could potentially use for seed germination. As well, grazing could create conditions for the further establishment of cheatgrass in open areas that cattle frequent (K. Safford, pers. comm., 2014). Prickly lettuce is not very abundant in the Lyall's mariposa lily sites (M.T. Miller, pers. comm., 2007). Hound's-tongue was manually removed from all sites, except for 2 sites (1a and 1b) that were recommended for biocontrol (COSEWIC 2011). A toadflax biocontrol project was undertaken in the south Okanagan in early 2000 with releases made by the province (L. Scott, pers. comm., 2015). Only one toadflax plant was seen in 2005 (M.T. Miller, pers. comm., 2007). No follow-up surveys for this species have been done. Infestations of knapweed, a highly aggressive competitor that forms dense, mono-specific stands with the potential to eliminate all or most indigenous plants in the vicinity (Meyers and Bazely 2003), have advanced to within 1 km of many Lyall's mariposa lily populations (K. Safford, pers. comm., 2014). If livestock grazing continues within the SOGPA, there is a potential for cattle to exacerbate or bring in further infestations of invasive plants over time.

Until recently, most Lyall's mariposa lily populations have remained largely free of aggressive introduced species. BC Parks will be monitoring for invasive plants within the 2 plots established at population 3d in East Chopaka (K. Safford, pers. comm., 2014), and also will be doing visual checks on some of the other populations during routine visits (S. Bunge, pers. comm., 2014).

5 MANAGEMENT GOAL AND OBJECTIVES

5.1 Management Goal

The management goal for this species is to maintain all known populations within British Columbia, as they are currently represented by subpopulation sizes and distribution.

5.2 Rationale for the Management Goal

The total population of Lyall's mariposa lily in B.C. consists of up to approximately 814,400 (± 81,918) individuals in 5 populations. All known occurrences (except for one subpopulation and part of a population on private lands) are either within the South Okanagan Grasslands Protected Area or the Nature Conservancy of Canada (NCC) Sage and Sparrow Conservation Area (about 99%), which are afforded some level of protection (except from livestock presence). The Lyall's mariposa lily was recently assessed as Special Concern based on this protection and believing that the main threats related to grazing and forest management have been mitigated. Although direct threats from forestry activities have now largely been abated, range use is still in effect in the SOGPA. The goal of maintaining all known populations at these locations was set to ensure that this species does not become more at risk (i.e., remains assessed as Special Concern). As this species has always been restricted to a narrow range found only in the area known as East Chopaka, a management goal to increase its distribution would not be appropriate.

5.3 Management Objectives

The threats of livestock grazing, encroachment of invasive species and of natural forest succession due to fire suppression need to be monitored periodically to determine the effects on the populations over the longer term. Thus the management objectives are:

1. Assess and mitigate livestock impacts at 3 known Lyall's mariposa lily populations and 2 of the known subpopulations during critical phenological periods.
2. Assess and mitigate the threats of invasive alien species encroachment, and forest encroachment (secondary succession) due to fire suppression.
3. Monitor all known Lyall's mariposa lily populations every 3–5 years.

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 (COSEWIC 2011).

Send to COSEWIC (complete)

- Lyall's mariposa lily assessed as Special Concern (COSEWIC 2011).

Planning (complete)

- BC Management Plan completed (this document, 2015).

Habitat Protection, Habitat Restoration, and Private Land Stewardship (ongoing)

- Inventory, monitoring, and removing invasive alien plants (Klym *et al.* 2007).
- The establishment of the South Okanagan Grasslands Protected Area in 2001 secured protection for the habitat of Lyall's mariposa lily as afforded under the *Protected Areas of British Columbia Act*. About 90% of identified Lyall's mariposa lily habitat in Canada is now regulated under this act (see Table 1 for land tenure information). A stewardship plan detailing management actions, developed with B.C. Parks for 2008–2012, can be used to guide future management.
- A private land subpopulation parcel (Table 1, subpopulation 5b) containing Lyall's mariposa lily was purchased by NCC in 2013 and has been added to the Sage and Sparrow Conservation Area.

6.2 Recommended Management Actions

Table 3. Recommended management actions and suggested implementation schedule for Lyall's mariposa lily.

Obj.	Actions to meet objectives	Performance measures	Threat[a] or concern addressed	Priority[b]
1–2	Monitor and manage threats in the South Okanagan Grasslands Protected Area (SOGPA) and Nature Conservancy of Canada (NCC) area every 3–5 years. Assess trends and improve management actions if necessary.	Populations are stable or increasing by 2019.		Necessary
	• Determine livestock impacts and review RUP with respect to minimizing impacts of livestock at occupied sites (e.g., correct timing of livestock use with respect to phenology of Lyall's; acceptable level of livestock use; whether livestock are eating or trampling Lyall's, or causing soil compaction and/or other indirect effects resulting from microhabitat alteration) and use this information to inform RUP update;	Reduction in amount of time grazing occurs during critical flowering and seed set period by 2015.	2.3	Necessary
	• Control forest encroachment (natural succession due to fire suppression);	No new conifer tree seedlings become naturally established near Lyall's mariposa lily by 2019.	7.1	Necessary
	• Control/eradicate invasive alien species, including monitoring of effects of any treatments.	Reduction in the percent cover of invasive plants near Lyall's mariposa lily by 2019.	8.1	
3	Develop and implement standardized protocols for monitoring population and habitat trends.	Standardized protocols for monitoring population and habitat trends developed by 2016.	Knowledge gaps	Beneficial
	Monitor and assess trends in populations, area of occupancy, and habitat condition every 5 years.	Report trends in populations, area of occupancy, and habitat condition starting in 2019.	Knowledge gaps	Beneficial
	Develop research to investigate whether livestock grazing could be a partial substitute for fire disturbance.	Research to investigate grazing as a partial substitute initiated by 2019.	Knowledge gaps	Beneficial

[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

There are still knowledge gaps with respect to the impact of livestock use in and around the populations; whether invasive plants will increase and impact the population over time by decreasing habitat; and whether forest encroachment due to fire suppression will infill the habitat that Lyall's mariposa lily currently uses, causing a decline in population health and numbers of mature individuals.

The responses of ecosystems and plant communities at East Chopaka to disturbances such as livestock use (or removal) and to restoration efforts (e.g., invasive alien species control) are not known. As well, the role of fire or fire suppression in relation to livestock use and/or invasive alien species is not understood, in terms of interacting effects on Lyall's mariposa lily habitat. Grasslands can differ greatly in composition, and some evidence shows that different grassland sites also respond individualistically to disturbance, which may be positive or negative in impact. If this variability in response to disturbance is widespread, then management recommendations cannot be applied uniformly over sites: therefore, there is a need for a more detailed understanding of the successional dynamics of these systems with respect to disturbance.

7 MEASURING PROGRESS

Performance indicators are presented in Table 3 as a way to define and measure progress toward achieving the management goal and objectives.

8 EFFECTS ON OTHER SPECIES

Currently, one case of a provincially Red-listed plant, flat-topped broomrape (*Orobanche corymbosa* ssp. *mutabilis*), co-occurs with Lyall's mariposa lily. In the NCC conservation lands, a Blue-listed plant, oniongrass (*Melica bulbosa*), was found in the vicinity of Lyall's mariposa lily (J. Penny, pers. comm., 2014).

This management plan recognizes the importance of preserving an intact grass-forb community at East Chopaka. By emphasizing an ecosystem approach to the restoration and preservation of native grassland qualities and characteristics, the management activities recommended here (e.g., invasive alien species control) should allow most native species to maintain or increase existing populations.

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