

Recovery Strategy for Lyall's Mariposa Lily (*Calochortus lyallii*) in British Columbia



Prepared by the Southern Interior Rare Plants Recovery Implementation Group



Ministry of
Environment

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About the British Columbia Recovery Strategy Series

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

What is recovery?

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

What is a recovery strategy?

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

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

What's next?

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

For more information

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

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

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Disclaimer

This recovery strategy has been prepared by the Southern Interior Rare Plants Recovery Implementation Group, as advice to the responsible jurisdictions and organizations that may be involved in recovering the species. The British Columbia Ministry of Environment has received this advice as part of fulfilling its commitments under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada – British Columbia Agreement on Species at Risk*.

This document identifies the recovery strategies that are deemed necessary, based on the best available scientific and traditional information, to recover Lyall's mariposa lily populations in British Columbia. Recovery actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations. These goals, objectives, and recovery approaches may be modified in the future to accommodate new objectives and findings.

The responsible jurisdictions and all members of the recovery team have had an opportunity to review this document. However, this document does not necessarily represent the official positions of the agencies or the personal views of all individuals on the recovery team.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this strategy. The Ministry of Environment encourages all British Columbians to participate in the recovery of Lyall's mariposa lily.

RECOVERY TEAM MEMBERS

Southern Interior Rare Plants Recovery Implementation Group

- Harold Baumbrough, Biologist, Naramata, BC
- Brenda Costanzo (co-chair), Senior Vegetation Specialist, B.C. Ministry of Environment, Victoria, BC
- Orville Dyer (co-chair), Wildlife Biologist, B.C. Ministry of Environment, Penticton, BC
- Matt Fairbarns, Botanist, Victoria, BC

Former recovery team members

- George Douglas, Botanist, Duncan, BC (deceased)
- Pam Krannitz (retired), Canadian Wildlife Service, Vancouver, BC
- Ted Lea (retired), Vegetation Ecologist, Victoria, BC

Technical advisors

- Ron Hall, Osoyoos Indian Band, Osoyoos, BC

AUTHORS

See Acknowledgements.

RESPONSIBLE JURISDICTIONS

The British Columbia Ministry of Environment is responsible for producing a recovery strategy for Lyall's mariposa lily under the *Accord for the Protection of Species at Risk in Canada*. Environment Canada's Canadian Wildlife Service participated in the development of this recovery strategy.

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Norbert Kondla (Novus Consulting) prepared the initial draft of the recovery strategy. It was subsequently revised and updated by the Southern Interior Rare Plants Recovery Implementation Group and Dr. Michael T. Miller. This strategy was prepared through a partnership between the B.C. Ministry of Environment and Environment Canada. B.C. Ministry of Environment and the Habitat Conservation Trust Fund funded preparation of this strategy. Okanagan College administered funding. The B.C. Conservation Data Centre provided valuable information on species locations.

EXECUTIVE SUMMARY

This recovery strategy addresses the recovery of Lyall's mariposa lily (*Calochortus lyallii*). In Canada, the species is found only in extreme south-central B.C. where it inhabits semi-arid, mid-elevation grasslands between the Okanagan Valley and Similkameen River (an area known as East Chopaka, mainly in what is now the South Okanagan Grasslands Protected Area). Over 90% of identified Lyall's mariposa lily habitat in Canada is currently regulated by the B.C. *Park Act*. Because of its highly localized distribution, potential threats from livestock grazing, and loss of habitat from forest encroachment (afforestation), the species was designated as Threatened by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2001. Currently, four factors pose potential ongoing threats to Lyall's mariposa lily. In approximate order of importance these are: encroachment by invasive alien plant species; livestock grazing; forest encroachment (secondary succession) and fire suppression; and, potentially, overcollecting by botanical enthusiasts.

The overall recovery goal for Lyall's mariposa lily is *to maintain four secure and self-sustaining populations with at least 3 populations consisting of multiple (2 or more) subpopulations within Canada.*

Recovery objectives for Lyall's mariposa lily are:

1. To control and, if possible, eradicate invasive alien species in all known Lyall's mariposa lily sites on an ongoing basis.
2. To minimize livestock grazing impacts at four known Lyall's mariposa lily sites during critical phenological periods by 2010.
3. To assess the threats of invasive alien species encroachment, livestock grazing, and secondary succession (forest encroachment) due to fire suppression, by monitoring at all known Lyall's mariposa lily populations.
4. To increase protection¹ for all extant populations by 2012.

Recovery to this level is deemed to be ecologically and technically feasible, and will primarily entail reducing or eliminating current threats to survival and habitat. Broad strategies for addressing threats will include (1) development of mitigation measures to reduce impacts from invasive alien species, secondary succession, and livestock grazing; (2) monitoring to reduce threats; (3) obtaining increased protection for Lyall's mariposa lily; and (4) ecological research.

No critical habitat can be identified for Lyall's mariposa lily in Canada at this time, but it may be identified at a later date in a federal addendum by Environment Canada, or in a future action plan. It is expected that critical habitat will be proposed following the completion of outstanding work required to quantify specific habitat and area

¹ Protection can be achieved through various mechanisms including: voluntary stewardship agreements; conservation covenants; sale by willing vendors on private lands; land use designations on Crown lands; and legal and other protection on federal, provincial, and local government lands.

requirements for this species are completed. Consultation with affected landowners and organizations will also be necessary.

A recovery action plan will be completed by 2012.

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BACKGROUND

Species Assessment Information from COSEWIC

Date of assessment: May 2001 (New)

Common name (population): Lyall's mariposa lily

Scientific name: *Calochortus lyallii* Baker

COSEWIC status: Threatened

Reason for designation: Very few highly localized populations occupying a very small area, but generally present as large populations of many thousands of plants with threats from cattle grazing and loss of habitat from afforestation.

Canadian Occurrence: British Columbia

COSEWIC status history: Designated Threatened in May 2001. Assessment based on a new status report.

Description of the Species

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 its 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 three petals (inner series of floral parts) and three 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 comprise a distinct series (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 (Ownby 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 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 in colour), 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.

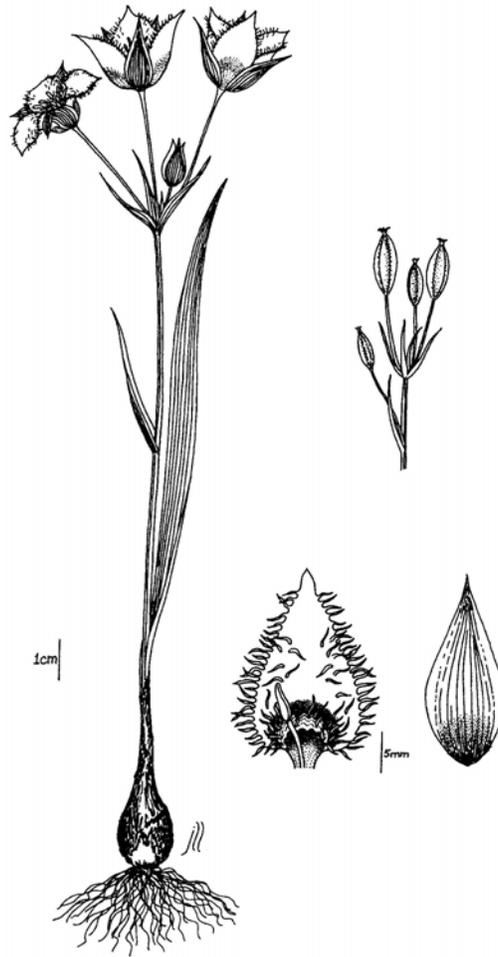


Figure 1. Illustration of Lyall's mariposa lily (*Calochortus lyallii*). Line drawing by J. Ling in Douglas *et al.* (2001). © Province of British Columbia.

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 is 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 not appear above-ground at all (i.e., it becomes dormant). Alternatively, a plant might remain vegetative for several years before flowering (producing one flower 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).

Populations and 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 relatively 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 (Miller and Douglas 1999; Figure 3).

All confirmed Canadian populations occur within 5 km of one another and all are within 5 km of the U.S. border. The Canadian extent of occurrence (EO) is approximately 5 km², and the current area of occupancy (AO) is approximately 4.2 ha. This likely represents less than 1% of the total global distribution. Lyall's mariposa lily has a Canadian conservation ranking of N2S2 (imperiled) and a global conservation ranking of G3 (vulnerable) (NatureServe 2005). Despite its narrow range, the species is not formally tracked in Washington (NatureServe 2005), and no population estimates are available for the state.



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

Population size and trends: A total of 15 subpopulations of Lyall's mariposa lily are confirmed in Canada (Table 1; Figure 3) grouped into 5 populations (J. Penny, pers. comm., 2005). All populations are situated within 5 km of one another, and some subpopulations are separated by less than 0.2 km with the exception of 1 population on private land (containing two subpopulations) in the Kilpoola Lake area. The remaining 4 populations are within the boundaries of the South Okanagan Grasslands Protected Area. Estimated subpopulation sizes range from a few hundred to

over 100 000 individuals (Table 1). The total population within B.C. may exceed 0.5 million individuals (Miller and Douglas 2001).

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” (Ownby 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 2007 and 2008 confirmed the presence and current abundance of all 5 extant populations/15 subpopulations² (Table 1). Population estimates for 2007 are less than for 1997, and it is unclear if the reduced numbers reflect a long-term decline or a temporary fluctuation. However, the populations remain healthy and are in no imminent danger of extirpation (Mike Miller, pers. comm. 2008).

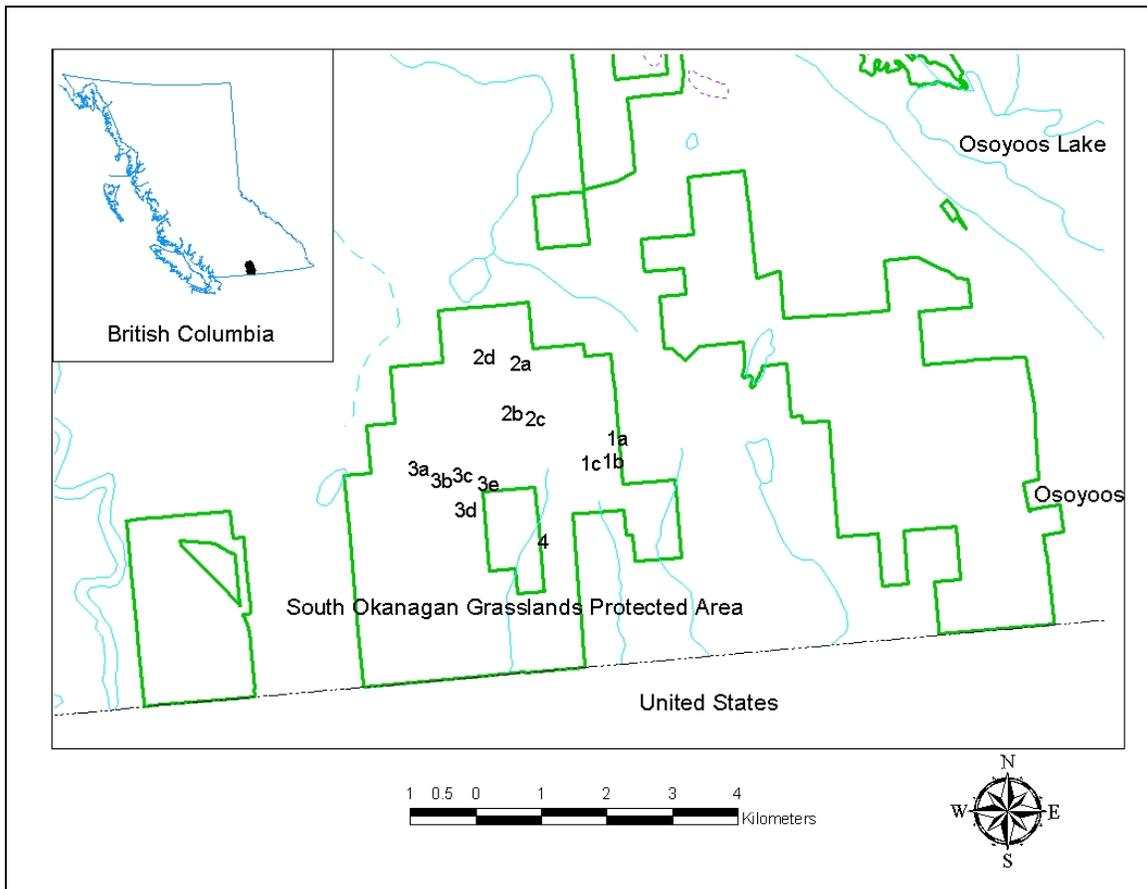


Figure 3. Lyall’s mariposa lily sub-populations in South Okanagan Grasslands Protected Area. Private land locations are not shown here to protect the privacy of the landowner.

² Populations are separated by >1 km and are one occurrence; subpopulation are within 1 km of each other.

Table 1. Subpopulation sites, observation dates, abundance (1997 and 2007), and land tenure for Lyall's mariposa lily populations in Canada (Mike Miller, pers. comm. 2008).

Population	Subpopulation site	First year observed and observer ¹	Estimated abundance 1997 ²	Estimated abundance in 2007 (total indiv./mature indiv.)	Land tenure
1	1a	1984 SC	15 000+	5000–10 000/ 1500–3000	B.C. Parks
	1b	1996 MM	2500+	1000–2000/ 300–600	B.C. Parks
	1c	2008 (new) SB	N/A	20–30 (2008 blooming and non-blooming plants above ground)	B.C. Parks
2	2a	1984 SC	400 000+	50 000–100 000/ 5000–10 000	B.C. Parks
	2b	1996 MM	7200+	1000–2000/ 200–400	B.C. Parks
	2c	1997 MM	14	4/ 4	B.C. Parks
	2d	2008 (new) SB	N/A	2000–3000 (2008 blooming and non-blooming plants above ground)	B.C. Parks
3	3a	1991 MS	65 000+	8000–12 000/ 2000–3000	B.C. Parks
	3b	1996 MM	39 000+	30 000–40 000/ 7000–10 000	B.C. Parks
	3c	1997 MM	200+	3000–4000/ 800–1000	B.C. Parks
	3d	2005 SB	N/A	15 000–20 000/ 4000–5000	B.C. Parks
	3e	2008 (new) SB	N/A	8000–10 000 (2008 blooming and non-blooming plants above ground)	B.C. Parks
4	4 MM	2000	N/A (200 plants in 2000)	50 000–100 000 (blooming and non-blooming plants above ground)	½ B.C. Parks (extending onto private land)
5	5a	1997 MM	1200+	N/A	Private
	5b	1997 MM	40+	N/A	Private

¹ SC: S. Cannings; MS: M. Sarell; MM: M. Miller; SB: S. Bunge.² Data from 2001 status report unless noted as 'new'.

Needs of the Lyall's Mariposa Lily

Habitat³ 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. populations are found on typically sloping grassy areas dominated by bluebunch wheatgrass (*Pseudoroegneria spicata*) and Idaho fescue (*Festuca idahoensis*). Prairie junegrass (*Koeleria cristata*) and pinegrass (*Calamagrostis rubescens*) are common associates.

Associated herbs include death camas (*Zygadenus venenosus*), yellow bell (*Fritillaria pudica*), arrow-leaved balsamroot (*Balsamorhiza sagittata*), silky lupine (*Lupinus sericeus*), and blue-eyed Mary (*Collinsia parviflora*). On drier sites, bitterroot (*Lewisia rediviva*) and big sagebrush (*Artemisia tridentata*) comprise part of the association. Shrub cover is generally sparse, but includes birch-leaved spirea (*Spiraea betulifolia*), squaw currant (*Ribes cereum*), and saskatoon (*Amelanchier alnifolia*). A few invading/residual Douglas-fir trees are also present at most of the sites. The B.C. range of Lyall's mariposa lily lies within the IDFxh1, the Okanagan very dry hot variant of the Interior Douglas-fir biogeoclimatic zone (Lloyd *et al.* 1990; Bryan 1996). The climate is predominantly continental, with warm dry summers and cool winters (Meidinger and Pojar [eds.] 1991).

The substrate at East Chopaka 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 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).

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 and small mammals regularly forage on the bulbs, and halictid bees (*Duforea* spp.) are the primary pollinators. (Miller *et al.* 2004).

³ Adapted from Miller and Douglas (1999).

Threats

Description of the threats

In designating Lyall's mariposa lily as nationally at risk, COSEWIC (2001) cited the "few highly localized populations occupying a very small area...combined with threats from cattle grazing and loss of habitat from afforestation." With the establishment of the South Okanagan Grasslands Protected Area in 2001, direct threats from forestry activities have now largely been abated. Fencing improvements on Black Mountain have also helped limit (but not eliminate) the movements and thus impacts of cattle. The following is an updated assessment of threats to the survival of Lyall's mariposa lily, considering these recent developments. Threats have been listed in perceived order of significance.

Invasive alien species encroachment: A number of invasive alien plant species have become established where Lyall's mariposa lily is found and these include: knapweed (*Centaurea* spp.), Canada thistle (*Cirsium arvense*), hound's tongue (*Cynoglossum officinale*), mullein (*Verbascum thapsus*), toadflax (*Linaria* spp.), prickly lettuce (*Lactuca serriola*), sulfur cinquefoil (*Potentilla recta*) and cheatgrass (*Bromus tectorum*). Three of these species (cheatgrass, mullein, and hound's tongue) currently grow within Lyall's mariposa lily sites, but their numbers were low and impacts appeared minimal at all sites, except for the private lands that were not visited (Klym *et al.* 2007). Prickly lettuce is not very abundant in the Lyall's mariposa lily sites (M.T. Miller, pers. comm., 2007) and hound's tongue was manually removed. There has been a biocontrol project for toadflax in the area, and only one plant was seen in 2005 (M.T. Miller, pers. comm., 2007). Infestations of knapweed, a highly aggressive competitor that forms dense monospecific 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.

Until recently, most Lyall's mariposa lily populations have remained largely free of aggressive introduced species. Provided timely action is taken, it may still be possible to prevent the establishment and spread of these weeds into Lyall's mariposa lily sites.

Livestock grazing: East Chopaka has had a long history of livestock grazing. Grazing continues to be managed under a range use plan (RUP) administered by the Ministry of Forests and Range. The current RUP for Crown land on upper Black Mountain allows for 160 head of cattle to be grazed, with grazing scheduled to occur from May 1 to May 31 (A. Mclean, pers. comm., 2005). This period corresponds to the main growing season for Lyall's mariposa lily.

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. However, damage due to trampling is a potential 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 (M. Miller, unpubl. data, 2008). 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. In

addition, any intensive grazing could facilitate the spread of invasive alien species into Lyall's mariposa lily sites.

Due to the rugged terrain in some areas, not all Lyall's mariposa lily sites are used by livestock. Areas where cattle do have relatively easy access include sites 1a, 1b, 2b, 2c, 3b, 4, 5a, and 5b (Table 1). Cattle grazing impacts were low at all sites in 2007 (Klym *et al.* 2007). Lyall's mariposa lily is recognized as a species of concern in the RUP and management actions will be taken to minimize impacts. There has been no grazing by the authorized agreement holder for a number of years but range use is expected in the near future. However, there have been cattle trespass issues where the protected area borders private land. All cattle grazing will be monitored.

Forest encroachment 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 sub-climax 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 build-up and thereby maintaining germination safe sites, and (4) reducing fuel loads. In the absence of fire, the upper slopes of Black Mountain 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). A wild fire burned many of the sites in 1994. Tree encroachment, as a result of fire suppression, currently is minimal. It is being monitored and will be controlled on a site basis, if impacts become significant (Klym *et al.* 2007).

Overcollection: For the moment, overcollection remains a potential threat, as we are unaware of any recent abuses in this regard. However, Lyall's mariposa lily may be of interest to gardening enthusiasts, as numerous garden societies and commercial plant nurseries list wild-collected seeds and bulbs of *Calochortus* spp. on their webpages.

Actions Already Completed or Underway

- Lyall's mariposa lily management actions currently being updated in range use plan.
- Stewardship plan with B.C. Parks (Dyer *et al.* 2007) (see Annex 1).
- Inventory, monitoring, and removal invasive alien plants (Klym *et al.* 2007).
- Population research Ph.D. thesis (Miller 2004).

Knowledge Gaps

Habitat attributes: Additional information on the habitat attributes of occupied sites would assist in their management and also in identifying and classifying potential recovery habitat in other areas. In particular, it would be useful to have site-specific information on biogeoclimatic features such as soil type, site association, site series, site type, and site phase. This information should be compiled

following standards and protocols of the provincial biogeoclimatic ecosystem classification (BEC) system and associated data standards.⁴

Ecosystem and community dynamics: Another gap in current knowledge relates to the responses of ecosystems and communities at East Chopaka to disturbances such as grazing (or its removal) and to restoration efforts (e.g., invasive alien species control). Grasslands can differ greatly in composition, and some evidence shows that different grassland sites also respond individually to disturbance. If this variability in response is widespread, then management recommendations cannot be applied uniformly over sites. Management planners would also benefit from a more detailed understanding of the successional dynamics of these systems.

Grazing: Additional information on the effects of grazing on Lyall's mariposa lily productivity and survival in the long-term is needed, and what would be the acceptable degree of grazing pressure on populations. As well, in the absence of fire, research on whether grazing can potentially act as a partial substitute for fire disturbance could be investigated.

RECOVERY

Recovery Feasibility

In Canada, Lyall's mariposa lily is neither extremely rare (if rarity is measured strictly in terms of numbers of individuals) nor is its range highly fragmented (all confirmed populations occur within 5 km of one another). Furthermore, much of the habitat remains in relatively good condition, and since 2001 has been regulated under the B.C. *Park Act*. Most populations are large, recruitment is occurring, and population dynamics appear to be stable overall. On this basis, "recovery" for Lyall's mariposa lily may be defined as "maintenance of a viable self-sustaining population able to withstand stochastic events and other environmental variables of a non-catastrophic nature" (National Recovery Working Group 2004). Recovery to such a level is deemed to be ecologically and technically feasible (Table 2). The level of effort required for recovery is expected to be minimal. Recovery success will be tied primarily to threat reduction through ecosystem management and habitat stewardship, in combination with long-term population monitoring.

Table 2. Recovery feasibility of Lyall's mariposa lily. Suggested "feasibility criteria" are taken from Environment Canada *et al.* (2005).

Feasibility criteria	
1. Are individuals capable of reproduction currently available to improve the population growth rate or population abundance?	Yes
2. Is sufficient suitable habitat available to support the species or could it be made available through habitat management or restoration?	Yes

⁴ BEC is a land classification system that groups together ecosystems with similar climate, soils, and vegetation. Developed in British Columbia, this classification is widely used as a framework for resource management as well as for scientific research.

- | | |
|--|-----|
| 3. Can significant threats to the species or its habitat be avoided or mitigated through recovery actions? | Yes |
| 4. Do the necessary recovery techniques exist and are they demonstrated to be effective? | Yes |
-

Recovery Goal

To maintain four secure and self-sustaining populations within Canada, with at least 3 populations consisting of multiple (2 or more) subpopulations.

Rationale for Recovery Goal

The total population of Lyall's mariposa lily in Canada consists of up to 0.5 million individuals in 5 populations. One population occurs on private land with approximately 1240+ individuals, <1% of the total population. This private land population is 2km away from the next nearest population and subject to similar types of large scale events such as climate change impacts. The remaining 99% of the population occurs within the South Okanagan Grasslands Protected Area. The recovery team believes that maintaining habitat for >99% of the total population, within the four populations that occur within the protected area, will maintain the species in Canada, if threats are addressed. Formal protection of Lyall's mariposa lily plants on private land is not required to maintain the population in Canada, but voluntary stewardship is encouraged.

Recovery Objectives

1. To control and, if possible, eradicate invasive alien species in all known Lyall's mariposa lily sites on an ongoing basis.
2. To minimize livestock grazing impacts at four known Lyall's mariposa lily populations during critical phenological periods by 2010.
3. To assess the threats of invasive alien species encroachment, livestock grazing, and forest encroachment (secondary succession) due to fire suppression, by monitoring at all known Lyall's mariposa lily populations.
4. To increase protection⁵ for all extant populations by 2012.

Approaches Recommended to Meet Recovery Objectives

The general approaches that will be taken to address identified threats are:

- Development mitigation measures to reduce impacts from invasive alien species encroachment, fire suppression and secondary succession, and livestock grazing (see approved stewardship plan with B.C. Parks in Annex 1);

⁵ Protection can be achieved through various mechanisms including: voluntary stewardship agreements; conservation covenants; sale by willing vendors on private lands; land use designations on Crown lands; and legal and other protection on federal, provincial, and local government lands.

- Conduct long-term monitoring to better determine threats, population, and habitat trends;
- Obtain increased protection for Lyall’s mariposa lily; and
- Carry out ecological research to determine the habitat attributes and site-specific information on biogeoclimatic features.

Associated research and management activities, together with expected outcomes, are summarized in Table 3.

Recovery planning table

Table 3. Broad approaches recommended for addressing threats and affecting recovery.

Priority	Obj.	Broad approach	Threat addressed	Research and management activities	Outcomes or deliverables
High	1–3	Site management	All threats	<ul style="list-style-type: none"> • Manage threats in the South Okanagan Grasslands Protected Area (SOGPA) • Control invasive alien species, minimize livestock grazing impacts through revising the range use plan, and control forest encroachment, if necessary, at Lyall’s mariposa lily sites within SOGPA • Monitor invasive alien species and effects of treatments, livestock grazing impacts and effects of revised range use plan and forest encroachment at Lyall’s mariposa lily sites within SOGPA every 2 years 	<ul style="list-style-type: none"> • Stewardship plan • Threats reduced • Standardized monitoring protocol • Periodic assessments of recovery progress for better improved management
Necessary	1–3	Monitoring	All threats	<ul style="list-style-type: none"> • Develop and implement standardized protocols for monitoring population and habitat trends • Report monitoring results biannually and assess trends in populations, area of occupancy, and habitat condition every 5 years • Assess trends and improve management actions, if necessary 	<ul style="list-style-type: none"> • Protection of population on private land • Ecological information relevant to management
Beneficial	4	Species protection	All threats	<ul style="list-style-type: none"> • Voluntary stewardship agreement or covenant for private land should be attempted. 	<ul style="list-style-type: none"> • Ecological information relevant to management
Beneficial	1–3	Research	All threats (except the potential threat from over collection)	<ul style="list-style-type: none"> • Conduct research to determine: <ul style="list-style-type: none"> -pattern and extent of invasive alien species invasions at East Chopaka -optimal burning regime for Lyall’s mariposa lily -ongoing population viability of Lyall’s mariposa lily 	<ul style="list-style-type: none"> • Ecological information relevant to management

Performance Measures

The success of the recovery program will be determined primarily through monitoring of populations and threats through time. Where possible, measurable objectives have been established for meeting recovery goals and addressing threats; these will provide the primary basis for evaluation. The recovery strategy will be reviewed in 5 years to assess progress and to identify additional approaches or changes that may be required to achieve recovery.

Potential short-term performance measures include:

- Completion of detailed recommendations for critical habitat in a recovery action plan;
- Stewardship plan with B.C. Parks which includes the control of invasive alien species and forest encroachment due to fire suppression and secondary succession, and minimizing livestock grazing impacts through revising the range use plan for SOGPA;
- Number of sites improved through invasive alien species control; and
- Completion of revised range use plan.

Critical Habitat

Identification of the species' critical habitat

No critical habitat, as defined under the federal *Species at Risk Act* (Environment Canada 2004), is proposed for identification at this time.

No critical habitat can be identified for Lyall's mariposa lily in Canada at this time, but it may be identified at a later date in a federal addendum by Environment Canada, or in a future action plan. It is expected that critical habitat will be proposed following the completion of outstanding work required to quantify specific habitat and area requirements for this species are completed. Consultation with affected landowners and organizations will also be necessary.

A schedule of studies outlining the work necessary to identify critical habitat is found below.

Recommended schedule of studies to identify critical habitat

The following schedule of studies (Table 4) is recommended before finalizing critical habitat recommendations.

Table 4. Schedule of studies.

	Description of activity	Outcome/rationale	Timeline
1.	Using established survey and mapping techniques (applied during phenologically appropriate periods), delimit the boundaries of all proposed critical habitat. Boundary lines of the South Okanagan Grasslands Protected Area (SOGPA) may require surveying to confirm legal tenure of some sites.	Delineation of proposed critical habitat in SOGPA	Recommended completion date: 2011
2.	Delimit an appropriate ecological buffer zone around all proposed critical species at risk habitat (following guidelines that will be outlined in the recovery action plan), while considering relevant terrain features and practicalities of land tenure.	Delineation of buffer zone for management of surrounding habitat for proposal critical habitat	Recommended completion date: 2011
3.	Identify, map, and rank for recovery potential all suitable unoccupied habitat patches above 1000 m elevation.	Delineation of potential habitat	Recommended completion date: 2011

Existing and Recommended Approaches to Habitat Protection

The establishment of the South Okanagan Grasslands Protected Area in 2001 represented a significant administrative step in securing permanent protection for the habitat of Lyall's mariposa lily. About 90% of identified Lyall's mariposa lily habitat in Canada is now regulated under B.C.'s

Park Act. A stewardship plan detailing management actions has been developed with B.C. Parks (Annex 1).

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.

This recovery strategy 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.

Socioeconomic Considerations

Lyall's mariposa lily occupies a very small area of land (~4 ha). Although recovery actions at East Chopaka could affect some socioeconomic sectors, in all instances the effects are expected to be very minor. Recovery actions could affect the livestock grazing and recreation sectors.

Recommended Approach for Recovery Implementation

A single-species approach, focusing on threat abatement through a stewardship plan and potential stewardship agreement, is recommended.

Statement on Action Plans

A recovery action plan will be completed by 2012.

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ANNEX 1

Stewardship Plan for the Lyall's Mariposa Lily in the South Okanagan Grasslands Protected Area

2008 to 2012



Approved February 7, 2008

**Original Signed by Drew Carmichael, Regional Manager, Okanagan Region, B.C.
Ministry of Environment**

Background:

Lyall's Mariposa Lily (LML) was designated by COSEWIC as Threatened in May 2001 and is listed on the SARA Schedule 1. The reason for listing is "very few highly localized populations occupying a very small area but generally present as large populations of many thousands of plants with threats from cattle grazing and loss of habitat from afforestation." LML occupies 12 habitat patches in Canada, 10 of which occur in the South Okanagan Grasslands Protected Area (SOGPA). Within SOGPA, habitat is protected from destruction and loss by the Park Act but could be impacted or degraded by potential threats from invasive alien plants, cattle grazing and forest encroachment.

The Draft LML Recovery Strategy (October 2007) identifies three (3) major threats related to habitat degradation and recommends that they be addressed to conserve LML populations. These threats are:

1. invasive alien plants;
2. cattle grazing; and,
3. forest encroachment due to fire suppression.

This Stewardship Plan is designed to address these threats.

STEWARDSHIP PLAN COMMITMENT:

This plan provides effective protection for the LML in SOGPA by addressing and monitoring major threats, as identified in the recovery strategy.

The Ministry of Environment, Parks and Protected Areas Section, Okanagan Region will:

- implement the following stewardship actions between 2008 and 2012 **OR**
- inform the South Okanagan Rare Plants Recovery Team, if this plan cannot be implemented at any time in the future, so alternate stewardship implementation strategies can be cooperatively developed.
- review, reassess and update this agreement in 2012

This plan:

- Is based on the Draft Lyall's Mariposa Lily Recovery Strategy (October 2007).
- Recognizes B.C. Parks' approved Management Direction Statement, dated March 2003, for SOGPA, which states "special consideration may be required" for LML.
- Acknowledges that occupied habitat in SOGPA is protected from development.
- Assumes that the population will be effectively protected if the three major threats are addressed.
- Assumes that the plan will be implemented in good faith but is subject to priorities as well as budgetary and staffing constraints of participants.

SUMMARY OF STEWARDSHIP ACTIONS:

The Ministry of Environment, Parks and Protected Areas Section, Okanagan Region will lead implementation of the following actions at all identified LML habitat patches in SOGPA (Appendix 1) following methods presented in Appendix 2.

- **Train** staff working in SOGPA to recognize LML (Appendix 4) and be aware of known LML locations in SOGPA (Appendix 1). This will facilitate opportunistic, cost-effective inventory for new sites and monitoring of known sites. Document any new sites that are identified.
- **Monitor** invasive alien plants, cattle grazing, forest encroachment and unauthorized use/activities at known LML sites in early June (~June 5-10) every 1 to 2 years, depending on evaluation of previous monitoring results and current grazing status.
- **Identify additional potential threats**, if they are observed.
- **Manage invasive alien plants**, with consideration of potential impacts to LML, in accordance with the Regional Invasive Plant Strategy and Pest Management Plan every 1 to 2 years. Invasive plants at LML sites will be controlled manually or with biological agents. LML sites will be excluded from herbicide treatment. If more aggressive controls appear necessary, an environmental impact assessment to ensure LML is benefited will be completed before proceeding.
- **Work with MoFR's, Range Management Program** to incorporate best management practices and appropriate strategies (i.e. pasture rotation schedule) into the approved RUP to protect LML.
- **Monitor for range impacts and non-compliance** with the Range Use Plan (RUP) and cattle trespass at LML sites. Report infractions to Ministry of Forests and Range (MoFR) Compliance and Enforcement program staff.
- Assess the need for control of **forest encroachment** (it is not required in from 2008 to 2012) and recommend actions to benefit LML, if necessary, by 2012.
- **Report** all actions annually by updating Klym et al. (2007), available through the Regional Wildlife Biologist. Submit the report to the Regional Wildlife Biologist who will ensure it is passed to the South Okanagan Rare Plants Recovery Team and Ecocat.

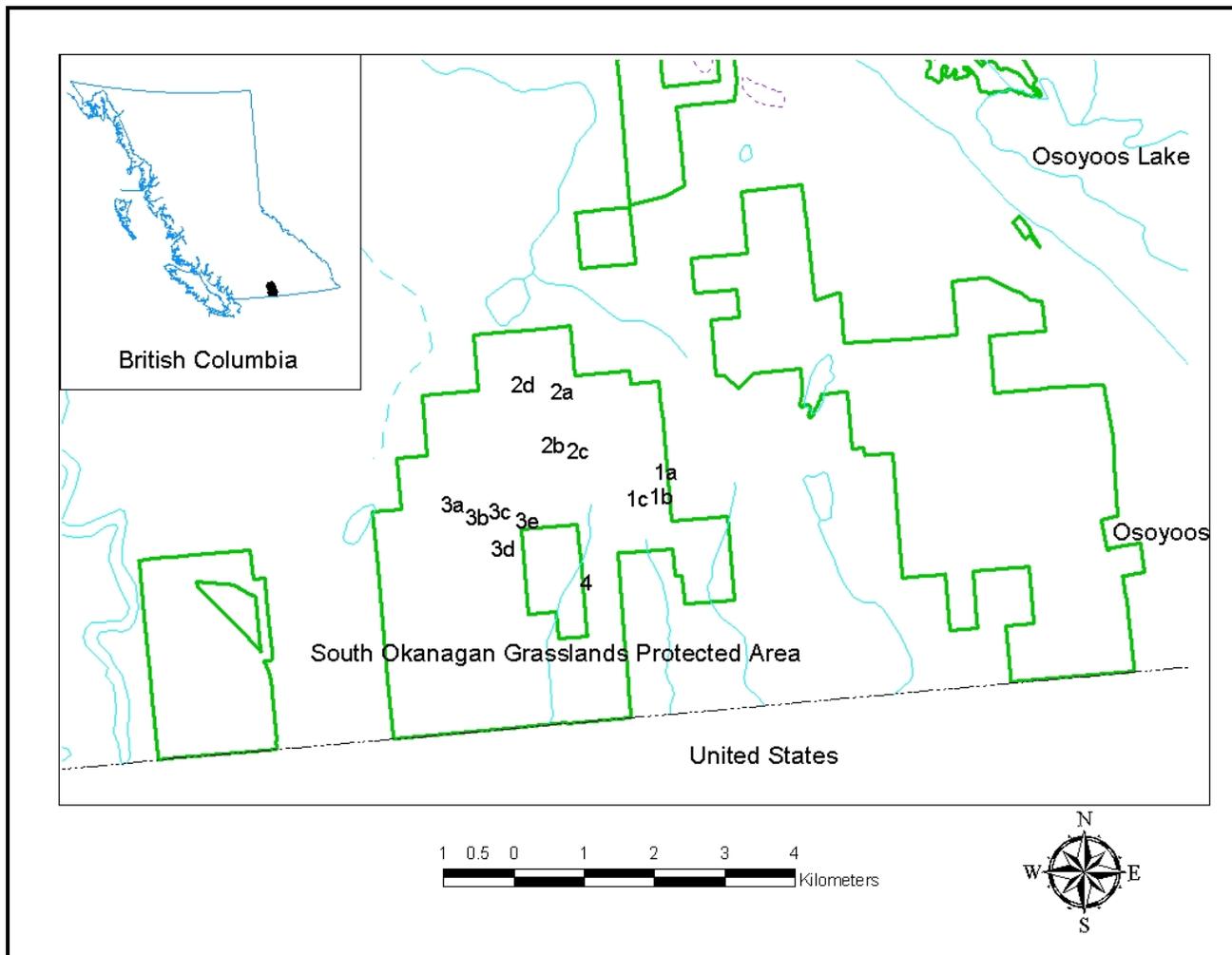
Evaluation:

The methods will be evaluated and revised, if necessary, after three (3) years. The plan will be evaluated and revised after five (5) years based on documented results. Note that preliminary site visits suggest threats are not consistent among sites and are not expected to change annually. Therefore, monitoring time may be reduced to every 2 years or more at some sites, following evaluation of monitoring data, thus reducing costs.

Estimated costs every 1 to 3 years:

- Option 1: 2 rangers (1 experienced) X 3 days each = ~\$900
- Option 2: 2 technical contractors X 3 days = min. \$1800
- Option 3: involvement of volunteer (s) such as individuals, groups, organizations, academic partnerships or other opportunities.

Appendix 1 Maps and Site UTM's



Note: Three new locations were found after this agreement was approved, therefore only 10 locations are discussed in the text.

Appendix 2 Monitoring Methods at LML Sites

Site Locations

Visit each LML site using the map, site number and associated UTM coordinates provided in Appendix 1.

GPS Flower Distribution

Use a handheld GPS unit (set to UTM, NAD83) to create waypoints representing the plant distribution both around the perimeter and within the colony. Map when the plants are in flower (first two weeks of June, ideally June 5 to 10).

Monitoring Form (Appendix 5)

Monitor and Control Invasive Plants

Fill out MoFR's Site and Invasive Plant Inventory Record as required: invasive plant species present, approximate area (size), density (plants/m²) and distribution. Check for biological control agents and, if found, fill out MoFR's Biological Control Agent Release & Monitoring Record. If small numbers of plants are found, pull them and record control action on MoFR's Chemical or Mechanical Control Record. All records completed in the field are to be entered into the IAPP application. See Appendix 3 for more information on invasive plant treatment options. Provide a subjective impact rating of Nil, Low, Moderate or High for each site.

Monitor Cattle Grazing

Observe and record signs of cattle use within or adjacent to LML colonies. Signs of cattle use may include, but are not limited to, cow dung, broken or bitten off LML plant stems, disturbance or compaction of soil, hoof marks, and cattle trails. In addition, note what (if any) cattle use may occur that year and whether there have been any issues pertaining to out-of-rotation grazing or over-utilization. Provide a subjective impact rating of Nil, Low, Moderate or High for each site.

Forest Ingrowth

Observe and record the approximate number of young trees (under 2 metres in height), their estimated average height and their species name occurring within LML sites. Provide a subjective impact rating of Nil, Low, Moderate or High for each site.

Unauthorized Use or Potentially Damaging Activities

Observe and record unauthorized activities including, but not limited to, off road vehicles, camping, mountain bikes, and trespass grazing/livestock.

Reporting

Provide a written summary of notes for each site and add the notes and subjective ratings to Klym et al. (2007). This report is intended to be a "*living document*" that will consistently be updated to include all inventory, monitoring

and stewardship actions for LML within SOGPA, which allows for easy future reference. Save the updated report as version *Year* (i.e. 2008) and submit the update to the Regional Wildlife Biologist, who will submit it to the South Okanagan Rare Plant Recovery Team and to Ecocat.

Appendix 3 Invasive Plant Control Information

Invasive plant information provided in this section is a combination of observational recommendations made by Crystal Klym (former Invasive Plant Program Co-ordinator with Ministry of Environment) as well as integrated management recommendations provided by "Weeds BC" (www.weedsbc.ca).

Dalmatian Toadflax - Mechanical (hand-digging/pulling) may be useful for small infestations particularly in areas with sandy soils where all vegetative parts can be removed. Biocontrol is recommended for larger (~0.5ha) infestations where mechanical control will not be effective or efficient. Note: check to see if there are bioagents present before implementing control measures. Hand-dig plants if the infestation is small (e.g. 15m x 15m), if the seeds haven't set, and if individual plants are sparsely distributed.

Weeds BC recommendations are as follows:

Mechanical: Cutting plants reduces top growth seed reproduction but will not kill the plant. Hand-pulling toadflax before seed-set each year can be an effective management method for new and small populations, especially if a seed bank has not developed.

Biocontrol: Five agents occur in BC: *Brachypterolus pulicarius* (beetle), *Calophasia lunula* (moth), *Eteobalea intermediella* (moth), *Gymnaetron antirrhini* (weevil), and *Mecinus janthinus* (beetle). *Mecinus janthinus* has established well in several areas of the province and reduction in toadflax populations have been recorded (Dr. R.DeClerk-Floate: Personal communication to Dr. Brian M. Wikeem).

Sulphur cinquefoil - Mechanical control may be useful for small infestations or in areas where herbicides cannot be applied. Hand-digging sulphur cinquefoil, when densely distributed, can cause significant damage to the biological crust due to the plant's extensive root system. Biological control agents are currently unavailable for this species. Hand-dig plants if the infestation is small (e.g. 15m x 15m), if the seeds haven't set, and if individual plants are sparsely distributed.

Weeds BC recommendations are as follows:

Mechanical: Small infestations can be managed by hand-digging.

Integrated Management Summary: Integrated management should focus on prevention of new infestations through grazing management and maintaining vigorous perennial plant communities. Cultural controls, such as hand-pulling, can be effective on new infestations but should be followed up to ensure that the plant has been eradicated. Seed disturbed areas to perennial grasses to provide competition. Use appropriate herbicides for larger infestations, along with other management techniques.

Hound's-tongue - Mechanical control may be useful for small infestations (e.g. 15m x 15m) or in areas where herbicides cannot be applied. Hand-pulling or cutting the plant below the root-crown can be effective but please note that if the plant has gone to flower it can still seed if cut; therefore, 'chopping' the plant in a few sections is recommended. Also, cutting and bagging seeds, even in larger infestations, is also helpful in reducing the spread of the species. Biocontrol is recommended on larger (~0.5ha) infestations. Note: check to see if there are bioagents present before implementing control measures.

Biocontrol: *Mogulones cruciger* (weevil) was released in BC in 1998, and preliminary results indicate the insect is having a significant impact on hound's-tongue. Research continues on other specialized insects as well. Two indigenous diseases, *Erysiphe cynoglossi* and *Phoma pomorum*, cause a mildew and brown lesions on the leaves, respectively.

Note: *Mogulones cruciger* was released in April 2005 in South Okanagan Grasslands Protected Area – East Chopaka site at UTM 309266, 5433284. This site is central to all of the LML sites within East Chopaka.

Weeds B.C. Links:

http://www.weedsbc.ca/pdf/hounds_tongue.pdf
http://www.weedsbc.ca/pdf/dalmation_toadflax.pdf
http://www.weedsbc.ca/pdf/sulphur_cinquefoil.pdf

Appendix 4 Lyall's Mariposa Lily Identification

- peak bloom is approximately June 5 to 10; easiest time to find and identify it
- usually <20cm in height
- flowers with 3 whitish petals (~2-3cm long) and 3 greenish sepals (1 to 12/stem)
- flower margins fringed
- single leaf, ~1cm wide and flat (note: sagebrush mariposa lily leaf is thinner and not flat; it is folded along a central rib, looking channelled in cross section)
- note that sagebrush mariposa lily is usually >20cm in height with purple petals that are not fringed



Appendix 5

Site No.	Survey Date	Surveyor(s)	Invasive Plant Information			Cattle Grazing Impacts (N,L,M,H)	Cattle Grazing Observations	Forest Ingrowth Impacts (N,L,M,H)	Forest Ingrowth Observations
			Invasive Plant Impacts (N,L,M,H) ⁶	Size/Distribution	Control Action Taken or Recommended				
1	June 8 2006	Example: Sara Bunge, Stacy Wall	L	HT: ~40 plants at 310554E 5434031N MU: Few plants	HT hand pulled.	L	No significant cattle use.	N	No young trees.

⁶ N: Nil, L: Low, M: Moderate, H: High