COMMITTEE ON THE
STATUS OF ENDANGERED
WILDLIFE IN CANADA

OTTAWA, ONT. K1A 0H3
(819) 997-4991

COMITÉ SUR LE STATUT
DES ESPÈCES MENACÉES
DE DISPARITION AU
CANADA

OTTAWA (ONT.) K1A 0H3
(819) 997-4991

STATUS REPORT ON THE PRAIRIE LUPINE *LUPINUS LEPIDUS* VAR. *LEPIDUS* IN CANADA

BY

MICHAEL RYAN

AND

GEORGE W. DOUGLAS

STATUS ASSIGNED IN 1996
ENDANGERED

REASON: SEVERAL REMAINING HABITATS OVERGROWN WITH EXOTIC SHRUBS AND GRASSES MAY STILL HARBOUR A FEW PLANTS.

OCCURRENCE: BRITISH COLUMBIA

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Prairie Lupine

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COSEWIC

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JUNE 1994

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SPECIES:	"Species" means an indigenous species, subspecies, variety or geographically defined population of wild fauna and flora.
VULNERABLE: (V)	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
THREATENED: (T)	A species likely to become endangered if limiting factors are not reversed.
ENDANGERED: (E)	A species facing imminent extirpation or extinction.
EXTIRPATED: (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
EXTINCT: (X)	A species that no longer exists.
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STATUS REPORT ON THE PRAIRIE LUPINE *LUPINUS LEPIDUS* VAR. *LEPIDUS* IN CANADA

BY

MICHAEL RYAN

AND

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CONSERVATION DATA CENTRE
BRITISH COLUMBIA MINISTRY OF ENVIRONMENT, LANDS AND PARKS
VICTORIA, BRITISH COLUMBIA
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STATUS ASSIGNED IN 1996
ENDANGERED

Executive Summary

Description

Lupinus lepidus is a multistemmed perennial herb, 2-4.5 dm tall, with palmate compound leaves. The racemose, pea-like blue flowers are similar to those of other Fabaceae species. The pods contain three to five large seeds. It is distinguished from most other species of *Lupinus* by its small stature, the white appressed hairs covering the stems and leaves and the thick caudex at the base of the plant.

Distribution

The range of *Lupinus lepidus* var. *lepidus*, as based on the type specimen, ranges from southwestern British Columbia to northwestern Oregon, west of the Cascade Mountains. In the U.S. it is a common species in Washington and Oregon while in Canada, it is rare on southern Vancouver Island, British Columbia.

Population Size and Trends

Of the seven Canadian sites from which *L. lepidus* has been collected, populations are extirpated at three sites. Its status at three of four other sites remains uncertain. Little is known regarding the size of most populations except the extirpated population located near Somenos Lake. Plants numbered 250, 1, 0, and 1 in 1991, 1992, 1993 and 1994, respectively. It is likely the size and number of populations in Canada have declined, particularly within the past 100 years.

Habitat

Lupinus lepidus appears to inhabit xeric sites ranging from grass-dominated meadows to steep rocky slopes where the vegetation is comprised of scattered clumps of *Pseudotsuga menziesii*, *Arbutus menziesii*, and *Pinus contorta* var. *contorta*. These sites are restricted to southeastern Vancouver Island where rainfall is low compared to other coastal areas in British Columbia. and, during the summer, often experience an extended period of drought. Associated species include *Cytisus scoparius*, *Cynosurus echinatus*, *Anthoxanthum odoratum*, several species of *Bromus*, and *Camassia quamash*.

General Biology

Little is known regarding the biology of *Lupinus lepidus* although it likely shares many of the same characteristics observed in other *Lupinus* species. It is likely to be associated with nitrogen-fixing *Rhizobium*. It is suspected that *Lupinus lepidus* is a short-lived colonizer of recently disturbed sites in open and exposed areas where it persists for several years but eventually declines, possibly from competition with more aggressive species that either directly compete for resources or prevent the establishment of seedlings. The seeds may not have any dormancy requirements but like other legumes, *L. lepidus* seeds probably have a hard seed coat which may delay germination for several months or years. Nothing is known regarding pollination, seed set, and survival rates.

Limiting Factors

The most direct threat to *Lupinus lepidus* is habitat destruction. This is of particular concern in the grass-dominated meadows which have been altered or destroyed as a result of agricultural or residential development. Introduced species including *Cytisus scoparius*, *Cynosurus echinatus* and *Anthoxanthum odoratum* which now dominant *Lupinus lepidus* habitats also likely threaten this species. Fire suppression has probably contributed to the decline of *L. lepidus*.

Protection

There is no legislation in British Columbia for the protection of rare and endangered species. Some populations of *Lupinus lepidus*, whose status is unknown, are also protected to a certain extent by their location on public property which is not likely to be developed in the near future. No efforts have been made to either rehabilitate or introduce this species into new habitats.

Conclusions

Lupinus lepidus has been collected at very few sites in Canada of which all are confined to southeastern Vancouver Island. It is believed to be extirpated at three of these sites and has not been confirmed at three of the remaining four sites. Given the limited distribution and abundance of this species in Canada, it is recommended that *L. lepidus* be considered an endangered species. The prognosis for this species is not good considering the extent to which suitable habitats have been altered or destroyed by residential and agricultural development and the introduction of aggressive European species. Furthermore, fire, which is now actively suppressed, was likely an important agent in the continued existence of *L. lepidus* in British Columbia. It is essential that research be initiated on the biology and ecology of *L. lepidus* and the habitats in which it occurs so that the necessary actions can be formulated and carried out to ensure its survival in Canada.

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I. SPECIES INFORMATION

1. Classification and Nomenclature

Scientific name:

Lupinus lepidus Dougl. ex Lindl. var. *lepidus*

Bibliographic citation:

Bot. Reg. 14: pl. 1149. 1828.

Pertinent synonyms:

None

Common Names:

Prairie lupine

Family Name:

Fabaceae

Major Plant Group:

Angiosperm

History of taxon:

The confusion observed in the genus *Lupinus* is also mirrored in the taxonomy of *L. lepidus*. Hitchcock and Cronquist (1961) state that although the *L. lepidus* complex is distinct, the variation within this group has resulted in a large number of proposed subspecies and varieties of which some are considered to be distinct species by other workers. According to Phillips (1955), the nomenclature is even more confusing, and the number of synonyms is greater for *L. lepidus* than for any other *Lupinus* species. The work of Detling (1951), Phillips (1955) and Dunn and Gillett (1966) has improved the nomenclature and delineation of *Lupinus* species but many problems remain.

The type specimen of *L. lepidus* was collected by David Douglas from "... Fort Vancouver to the Great Falls of the Columbia". Subsequently, Hitchcock and Cronquist (1961) recognized five varieties of *L. lepidus* of which two, var. *lepidus* and var. *lobbii* (Gray) C.L. Hitchc., are reported to occur in British Columbia. The latter variety is considered to be a separate species (*L. lyallii* A. Gray) in more recent floras of Canada and British Columbia

(eg., Dunn and Gillett 1966, Taylor 1974, Scoggan 1978-1979, Douglas 1990) and occurs on well-drained soils in subalpine and alpine areas (Douglas 1990, Douglas and Bliss 1977).

Lupinus lepidus, as recognized by Hitchcock and Cronquist (1961) and Douglas (1990), also encompasses *L. minimus* Dougl. which is considered by some researchers to be a separate species (eg., Cox 1973a, 1973b; Dunn and Gillett 1966; Scoggan 1978-1979; Taylor 1974). Douglas *et al.* (1995), after examination of much more material, now agrees with Dunn and Gillett (1966) that *L. minimus* is a separate entity. The latter has been reported to occur in the Columbia River drainage of southern British Columbia (Dunn and Gillett 1966, Taylor 1974), but no specimens have been located. It is also reported to occur in the Crowsnest area of Alberta (Dunn and Gillett 1966) and more recently, in and adjacent to, Waterton Lakes National Park (Argus and White 1978, Kuijt 1982) and at six locations located near the southern Alberta border (Packer 1983). Both Kuijt (1982) and Packer (1983) consider *L. minimus* to be a synonym of *L. lepidus*.

2. Description

Taxonomic Description

Lupinus lepidus var. *lepidus*

[Description from Hitchcock and Cronquist (1961)]

General: Perennial, caespitose from a caudex, 20-45 dm tall.

Stems: Slender, 2-5 mm in diameter, sericeous with some longer pilose ascending hairs.

Leaves: Mostly basal, the petioles 2-5 times as long as the blade, leaflets 5-9, oblanceolate, copiously silky-hairy, cauline leaves 1-4, similar to basal ones.

Flowers: In compact racemes, the peduncles 9-10 cm long, pedicels 2 mm long; petals 8-13 mm long, blue, the banner often lighter or darker, reflexed below the midpoint, wings glabrous, keel ciliate; calyx silky-hairy, both lips 6-7 mm long, the upper bifid for at least half their length.

Fruits: Pods 1-2 cm. long, hairy: seeds 2-4, brown.

Illustrations

1) see *Lupinus lepidus*, fig. 36 (a-e) p. 47 in Dunn and Gillett (1966).
2) see *Lupinus lepidus* var. *lepidus*, p.317 in Hitchcock and Cronquist (1961).

Diagnostic Features

In British Columbia, there are four small *Lupinus* species (less than 50 cm tall) with blue flowers and densely whitish-hairy leaves. In the field they are easily separated by their range. *Lupinus lepidus* var. *lepidus* is restricted to coastal lowlands on southeastern Vancouver Island, *L. lyallii (L. lepidus* var. *lobbii* (A. Gray) C.L. Hitchc., *L. lobbii* A. Gray) is a subalpine/alpine plant of the southern Coastal and Cascade Mountains, *L. kuschei* Eastw. is a montane species of northern British Columbia while *L. wyethii* S. Wats. occurs in the steppe/montane zones of southern British Columbia, east of the Coast-Cascade Mountains.

3. Distribution

The range of *Lupinus lepidus* var. *lepidus*, as based on the type specimen, was considered by Dunn and Gillett (1966) and Hitchcock and Cronquist (1961) to extend from southwestern British Columbia to northwestern Oregon, west of the Cascade Mountains. This concept has been followed in the present status report.

Reports of *L. lepidus* from Alberta (Kuijt 1982, Packer 1983) are based on specimens of *L. minimus* sensu Dunn and Gillett (1966). References to *L. lepidus* from other U.S. States in western North America (eg., Davis 1952, Booth and Wright 1966, Welsh *et al.* 1987 and Sholars 1993) are based on the numerous variations created by several taxonomists (see Smith 1944, Hitchcock and Cronquist 1961 and Sholars 1993). Hultén (1968) reported *L. lepidus* from southeast Alaska (on the panhandle just north of the Queen Charlotte Islands) but Welsh (1974) considers this to be an introduced species in Alaska. It is more likely, however, that the report is in error due to misidentification or mislabelling (R. Lipkin, AK Natural Heritage Program, pers. comm.).

4. Climate

The climate of the southeastern side of the island is characterized by mild wet winters and warm dry summers in which the bulk of the rainfall (95%) occurs during the winter months. Annual rainfall is particularly low in the southeastern corner of Victoria. This area receives about one-third of the rainfall to that west of Victoria (Figure 1).

5. Habitat

The vegetation on the eastern side of Vancouver Island and some of the Gulf Islands is remarkably different to that found elsewhere along the west coast of British Columbia due to the unique climate. On mesic sites the vegetation is dominated by *Pseudotsuga menziesii*, a fire-climax conifer species. In dry areas, where rainfall is low or soils are shallow, particularly in the Victoria region, the vegetation is characterized by open stands or discontinuous clumps of *Quercus garryana* mixed with grass-dominated meadows or rock outcrops.

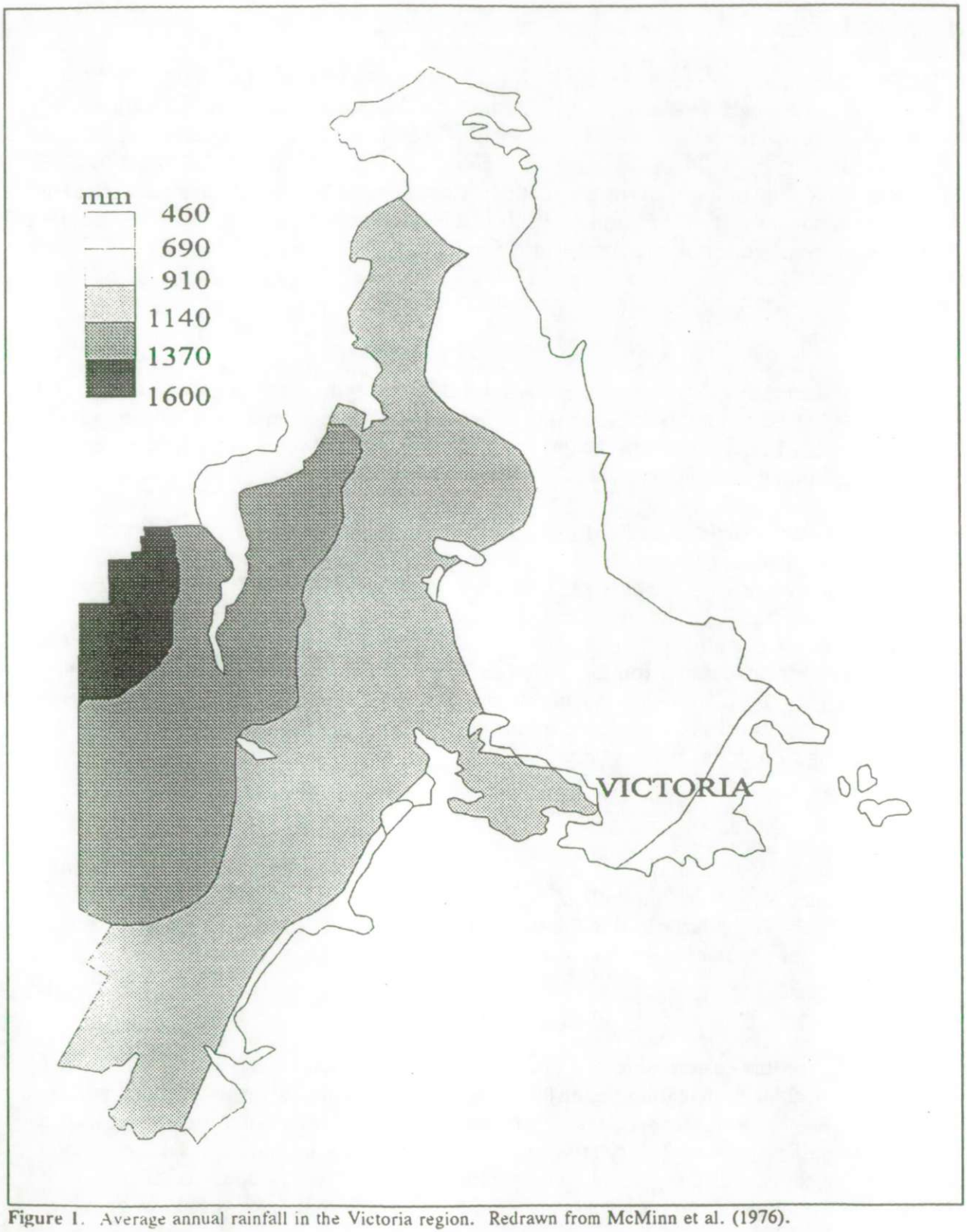

Figure 1. Average annual rainfall in the Victoria region. Redrawn from McMinn et al. (1976).

Lupinus lepidus has been observed at only a few sites on southern Vancouver Island thus precise habitat information is not available. However, based on the few locations in which it has been collected in the past, this species appears to inhabit xeric sites ranging from the grass-dominated meadows along the eastern edge of Vancouver Island to steep rocky slopes located north and west of Victoria where the vegetation is comprised of scattered clumps of *Pseudotsuga menziesii*, *Arbutus menziesii*, and *Pinus contorta* var. *contorta*. Two of the recently observed *Lupinus lepidus* populations were growing on dry, gravelly disturbed sites.

6. Population Size and Trends

L. lepidus has been recorded at seven sites in British Columbia (Table 1). Of the seven sites, only single plants were observed at two locations during either 1992 or 1993. Both of these populations were destroyed in 1994. The status of populations at five other sites remains uncertain although one of these is probably extirpated (Figure 2). Three of the remaining four were recently searched but no plants were observed. It is possible that these populations may have been overlooked if they were only comprised of a few plants.

Table 1. Status of *Lupinus lepidus* populations in Canada.

Collection Site	Last Observation	Collector	Population
Langford Plains (Victoria)	1908	Macoun	Extirpated (?)
Mount McDonald (Victoria)	1915	Newcombe	?
Observatory Hill (Little Saanich Mountain, Victoria)	1960	Hardy	?
Koksilah River Valley (Duncan)	1973	Brayshaw	?
Cattle Point (Victoria)	1991	Brayshaw	?
Beacon Hill (Victoria)	1993	Ryan	Extirpated
Somenos Lake (Duncan)	1994	Douglas	Extirpated

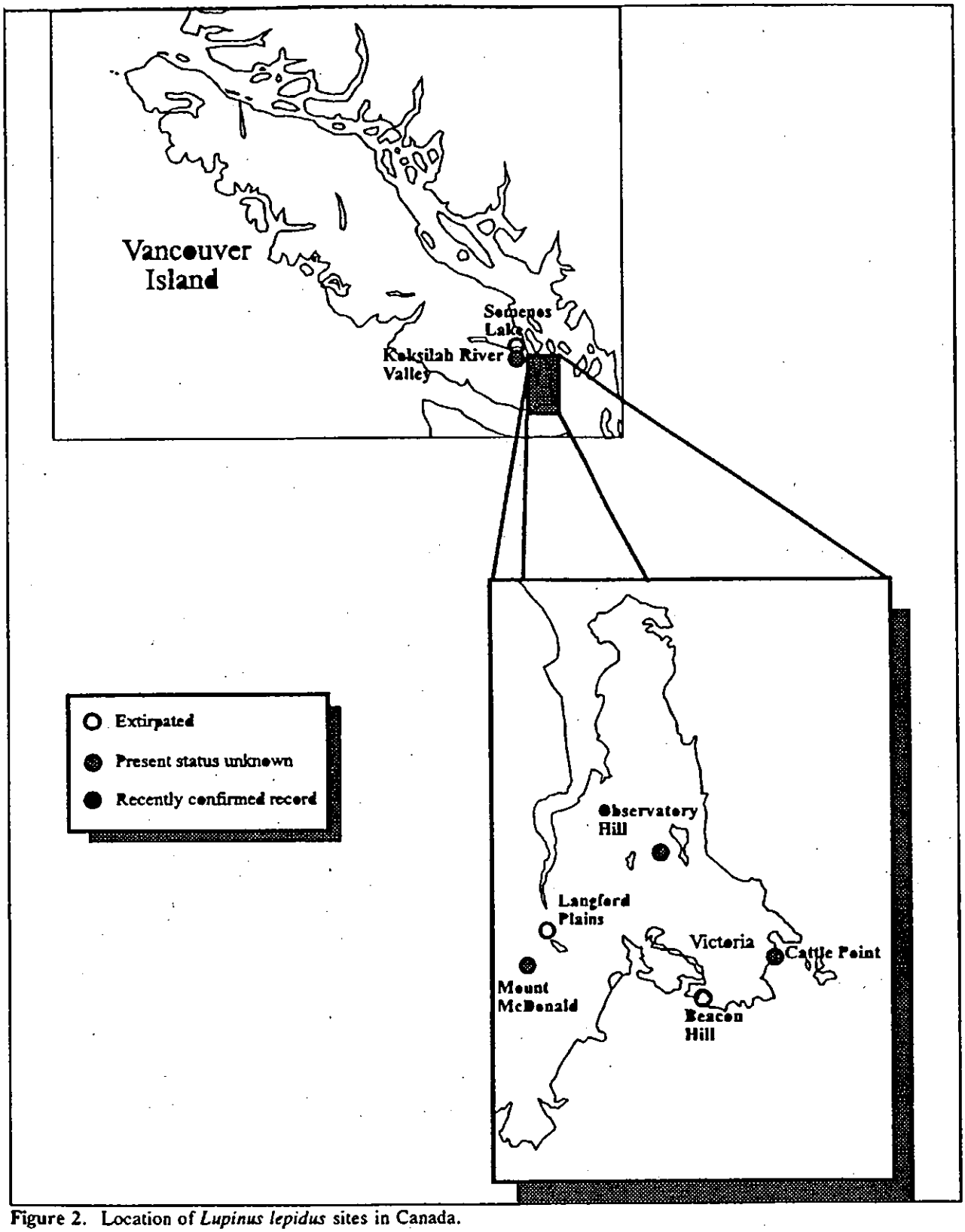

Figure 2. Location of *Lupinus lepidus* sites in Canada.

Nonverified Populations

Cattle Point (Victoria)

Cattle Point is a park located along the eastern shoreline in Victoria and encompasses several types of vegetation. Much of the western portion of the park is composed of grass-dominated meadows and short stands (< 10 m tall) of *Quercus garryana* dominated in the understorey by a dense shrub layer. The eastern portion of the park is mostly open and consists primarily of exposed bedrock or shallow soil overlying bedrock with the vegetation dominated almost entirely by herbaceous species. A portion of the shoreline is characterized by steep eroding banks with shrubby *Quercus garryana*, *Cytisus scoparius*, and a large number of forbs and grasses. The habitat type in which *Lupinus lepidus* was collected is not known. It may be extirpated if it occurred in an area now dominated by shrubs. It is also likely to be extirpated if it occurred in the open and exposed eastern portion of the park which has been heavily trampled by the general public in recent years. If this population is extant, it will most likely be found in the grass-dominated meadows on the eastern portion of the property.

Observatory Hill (Little Saanich Mountain, Victoria)

Observatory Hill is located north of Victoria in the Municipality of Saanich. *Lupinus lepidus* was collected here in 1960 with only minimal label data. It is likely that it was located in *Quercus garryana* stands or adjacent open and exposed areas located on the western or southern slopes of the 220 m high mountain. These relatively large areas are characterized by dry, shallow soils over bedrock. At the present time *Cytisus scoparius* is a major invader. A survey of the area in 1993 for *Lupinus lepidus* was unsuccessful. It is possible, however, that *L. lepidus* still exists since it could easily be overlooked considering the rugged terrain and the numerous clumps of *Cytisus scoparius*.

Mount McDonald (Victoria)

Mount McDonald is located west of Victoria where the annual amount of rainfall is substantially higher, hence, *Quercus garryana* is largely absent except as scattered stunted specimens on very shallow soils. Much of Mount McDonald is composed of steep rocky terrain in which the exposed bedrock forms a series of ledges and cliffs. The area's vegetation typifies these xeric conditions. Where soils are sufficiently deep, scattered trees composed of stunted *Pseudotsuga menziesii*, *Arbutus menziesii*, and *Pinus contorta* var. *contorta* are present. *Cytisus scoparius*, *Holodiscus discolor*, and *Arctostaphylos columbiana* also occur either beneath trees or in open and exposed areas on sufficiently deep soils. Shallow soils overlying bedrock support a large number of herbaceous species including *Aira praecox*, *A. caryophyllea*, *Anthoxanthum odoratum*, *Elymus glaucus*, and *Epilobium minutum*. Much of the bedrock is covered by the moss, *Rhacomitrium canescens*, a common xerophytic species of southern Vancouver Island.

Lupinus lepidus could not be located at this site but given the size of the area and the steep rugged terrain, it may easily have been overlooked. This site will have to be revisited several times before the status of this species can be confirmed.

Koksilah River Valley (Duncan)

Although the exact location where *Lupinus lepidus* was collected is unknown, there are a number of steep rocky sites supporting vegetation that is similar to that found on Mount McDonald. Since these rugged sites have not been heavily impacted by human activities it is possible that *Lupinus lepidus* populations in this area are extant.

Extirpated Populations

Beacon Hill (Victoria)

Although a number of plants once existed at this site, only a single plant was present in 1993. It occurred on a west-facing, open and exposed road bank. Disturbance obscures the original type of vegetation at this site but it was likely a grass-dominated meadow or *Quercus garryana-Bromus* stand. Associated species include *Aira praecox*, *A. caryophyllea*, and a single mowed shrub of *Cytisus scoparius* less than 25 cm in height. Other common species in the area include *Cynosurus echinatus*, *Plantago lanceolata*, *Rumex acetosella*, *Hypochoeris radicata*, and *Lolium perenne*.

During the winter of 1994, workmen, removing old posts along the roadbank, destroyed the *Lupinus lepidus* site. Field checks during the remainder of 1994 failed to locate any specimens along the roadbank.

Langford Plains (Victoria)

Langford is a small community west of Victoria where, at one time, a significant portion of the vegetation comprised *Quercus garryana* stands and grass-dominated meadows mixed with stands dominated by *Pseudotsuga menziesii*. Since 1908, this area has been subjected to rapid residential and business development thus very little of this vegetation remains except for remnant *Quercus garryana* trees. It is unlikely that *Lupinus lepidus* is extant given the lack of suitable habitats and the absence of records of this species within the past 85 years.

Somenos Lake (Duncan)

This site is located between the Trans-Canada Highway and the Esquimalt & Northern Railroad tracks near Somenos Lake. This is a disturbed area created when the railroad grade was constructed prior to 1962 on old lacustrine sands. It may also have been redisturbed at a later date during highway construction. The area is now dominated by *Cytisus scoparius* and *Rhacomitrium canescens*. Other species include *Hypochoeris radicata*, *Rumex acetosella*, *Aira praecox*, and *Lupinus polycarpus*. *Lupinus lepidus* was first recorded from this site in

1962 and then collected periodically over the years. A survey in 1991 revealed a total of 250 plants over a 4 x 60 m area. In 1992 the population was reduced to a single plant and in 1993 no plants were recorded.

In 1994, a resurvey of the site revealed a single, healthy specimen. It is not surprising, given the characteristics of *L. lepidus*, that a viable seed bank persisted at this site. Later, in July of 1994, the BC Conservation Data Centre (BC CDC) learned of a projected sewer line through the small *L. lepidus* site. Talks by the BC CDC and the North Cowichan Municipality (where the site was located) succeeded in having the alignment changed to avoid the area. Although the ditch for the sewer line avoided the site, it was subsequently destroyed by the heavy equipment used in the project. The ground was turned up to depth of one to two feet, far below the potential seedbank, and it is unlikely that plants will be seen here in the future.

7. General Biology

Little direct information is available on the biology of *Lupinus lepidus* in British Columbia and the United States. However, many species of *Lupinus* share common traits of which some likely characterize *L. lepidus*.

It is well known that, like other leguminous genera, the roots of *Lupinus* species have nodules containing *Rhizobium* which has the ability to fix nitrogen. Hence, *Lupinus* species often invade sites where soils are low in nitrogen including recently disturbed areas. Because of these characteristics, some species have been used as cover crops to enrich soils (Gladstone 1972). However, some species are poisonous to cattle and sheep although the toxicity appears to vary with season, habitat conditions, and the phenological state of the plant; the seeds contain a much higher concentration of alkaloids of which some forms are believed to be the toxic (Dunn and Gillett 1966). Everett (1960) reports that horticultural varieties and hybrids, including *L. polyphyllus*, have a short life span and decline within a few years when grown in the garden.

L. lepidus occurs primarily on xeric, exposed sites on porous soils that are likely to be low in nutrients. It is a short-lived colonizing species that persists for several years but eventually disappears due to competition or lack of vigour in mature plants. Germination is sporadic and sites may remain devoid of plants from time to time. Hence, unless there is some form of periodic disturbance, *L. lepidus* may disappear after a few years at a given site. This appears to have occurred at the Duncan site where a large number of plants were at one time present, but eventually declined over time. Whether the short-lived nature of this species is based on competitive interactions with other species or is an inherent genetic characteristic of the genome is not clear. The single plant located at Beacon Hill seemed to be doing poorly even though there was little or no competition from other species. Judging from the size of the basal stem, this plant appeared to be at least two or three years old. Despite the large size of this specimen in 1993, it produced only a single raceme which failed to set seed.

8. Limiting Factors

Specific Threats

The most direct and immediate threat to *Lupinus lepidus* is habitat destruction. This is of particular concern in the grass-dominated meadows often associated with *Quercus garryana-Bromus* stands that are limited to the southeastern side of Vancouver Island and some of the Gulf Islands. Both types of vegetation are believed to have been much more common before colonization by European settlers. Although few records indicate the extent of these communities prior to, and during, colonization by European settlers, it is likely they once encompassed much of the area now occupied by the city of Victoria (see map pp. 9-10 in McMinn *et al.* 1976). In fact, Roemer (1972) believed that the attractiveness of *Quercus garryana* vegetation was one of the reasons for the establishment of Fort Victoria. Their destruction has continued to the present resulting in the elimination of almost all sites occurring outside parks or ecological reserves. These sites are the most vulnerable to destruction because of their location on gentle slopes near the most populated and climatically-favourable areas on Vancouver Island making them particularly susceptible to agricultural and residential development. The BC CDC (BC Ministry of Environment, Lands, and Parks) has assigned a rank of S1 to *Quercus garryana-Bromus* vegetation which indicates this vegetation is, "critically imperiled because of extreme rarity (5 or fewer extant occurrences or very few remaining individuals) or because some factor(s) making it especially vulnerable to extirpation or extinction" (C. Cadrin, pers. comm.). Although grass-dominated meadows have not been designated a ranking, it is likely they are even more limited in area and are just as much at risk as *Quercus garryana-Bromus* vegetation.

At this time, pressures to develop unprotected grass-dominated meadows and *Quercus garryana* stands for the expansion of the urban infrastructure of Victoria, and other population centres on Vancouver Island, are intense. Currently a number of stands are threatened or are in the process of being destroyed as a result of residential development and the expansion of services associated with it. Loss of these habitats severely limits the availability of sites for the establishment of *L. lepidus* and imposes severe limitations on the longterm survival of this species in British Columbia.

Fortunately, the steep rocky xeric sites located to the west and north of Victoria are less at risk. These sites have no agricultural potential and are unsuitable for most forms of development. However, their value for residential development may increase given the rapid expansion of Victoria and many eastern Vancouver Island communities. Despite the steep rocky terrain, these sites may become very valuable real estate because of the broad panoramas they provide of the surrounding landscape.

Historically, *Quercus garryana* communities and grass-dominated meadows have always been heavily influenced by human activity. Aboriginal peoples set fire to these stands to maintain them as an important habitat for wildlife and for harvesting *Camassia*, a member of the

Liliaceae whose bulbs were an important source of starch in the diet of aboriginal people (Roemer 1972, Turner and Bell 1971). Roemer (1972) believed that without human interference some of these stands would have eventually been replaced by *Pseudotsuga menziesii* forests.

The suppression of fire within the past century may have contributed to the demise of *Lupinus lepidus* populations. All of the sites in which *L. lepidus* has been collected were likely maintained in the past as a result of periodic episodes of fire. This would have destroyed much of the competing vegetation resulting in newly-created habitats where *L. lepidus* might have become established. However, since that time, these sites have experienced little disturbance, resulting in the invasion and expansion of other species at these sites including the shrubs *Symphoricarpos albus* and *Cytisus scoparius*.

The introduction of European species has resulted in substantial changes not only to the grass-dominated meadows associated with *Quercus garryana* but also the rocky xeric sites north and west of Victoria where *Lupinus lepidus* has been collected in the past. One of the most troublesome species is *Cytisus scoparius* which has become a dominant species on xeric, exposed sites throughout much of eastern Vancouver Island and the Gulf Islands. It is likely that *Lupinus lepidus* is similar in ecology to *Cytisus scoparius* in that both colonize disturbed xeric sites, are associated with nitrogen-fixing *Rhizobium*, have rapid growth rates, and produce seeds with hard seed coats that remain viable in the soil for many years. Unfortunately, *Cytisus scoparius* grows much taller and lives substantially longer than *Lupinus lepidus*. Hence, if both species are present at a site, it is likely that *Cytisus scoparius* will competitively exclude *Lupinus lepidus*.

Similarly, the herbaceous vegetation observed today in grass-dominated meadows and rocky xeric sites is substantially different from that which occurred before Europeans colonized coastal British Columbia. Much of the vegetation is composed of introduced grasses which likely make up greater than 90% of the biomass of the herb layer. These species include *Anthoxanthum odoratum, Dactylis glomerata, Cynosurus echinatus, Aira praecox*, and several species of *Bromus*. As noted by Roemer (1972), with respect to *Quercus garryana* vegetation, it is not possible to know which native species and to what extent they have been displaced because all sites are now composed primarily of introduced species and there are no longer any examples of "pre-European" vegetation. This would also apply to the rocky xeric sites west and north of Victoria where *Lupinus lepidus* has been collected in the past. What impact these species may have on the growth and establishment of *L. lepidus* remains unclear but it is likely that the dense turf formed by grasses prevents the establishment of *L. lepidus* from buried viable seed.

Changes in Populations

Of the known sites at which *Lupinus lepidus* has been collected in British Columbia, three populations are probably extirpated and surveys failed to confirm three of four others. The extent to which *L. lepidus* may have occurred in British Columbia in the past is not known.

Given the degree to which suitable habitats have been altered or destroyed, fires have been suppressed, and European species have been introduced, it is likely that the size and number of *L. lepidus* populations are now at their lowest levels. An examination of pollen from soil cores sampled on southern Vancouver Island suggests that *Quercus garryana* was much more extensive several thousand years ago. If climatic conditions were more conducive to the growth of *Quercus garryana*, it is probable that suitable habitats for *Lupinus lepidus* were also much more abundant.

9. Protection

Regulatory Measures

There is no specific legislation for the protection of rare and endangered vascular plants in British Columbia. Since most of the *Lupinus lepidus* sites are located on public property, a certain amount of protection is usually assumed. This was not the case, however, for the plant in Beacon Hill Park or on the highway right-of-way at Duncan.

Cattle Point (Victoria)

If *Lupinus lepidus* is extant at this site, it is protected to a certain extent by its location in a municipal park. There appears to be very little management of the vegetation, hence it has not been altered to the same extent as that observed in Beacon Hill Park. Unfortunately, many areas of the park are heavily used by pedestrians and mountain bike enthusiasts. Furthermore, during the summer months, tour buses arrive at this park every few minutes resulting in large numbers of people trampling the vegetation along the shoreline and adjacent rock outcrops. As a result of these activities, much of the vegetation has been degraded to the point where the number of potentially suitable habitats for the establishment of *L. lepidus* are far fewer today than in the past. Although no information is available, it is unlikely this species can withstand heavy trampling.

Observatory Hill (Little Saanich Mountain, Victoria)

Observatory Hill is owned by the federal government and is the location of the Dominion Astrophysical Observatory. Much of the vegetation has remained undisturbed and access is limited to a single road with a locked gate at the base of the hill. Although further development on the hill is unlikely to occur, many of the suitable habitats in which *Lupinus lepidus* is likely to be found are infested with *Cytisus scoparius*.

Mount McDonald (Victoria)

Mount McDonald is located within the Greater Victoria Watershed District (which supplies drinking water to Victoria and adjacent communities) where public access is prohibited. However, Mount McDonald is located adjacent to a public road and there is no fence barring access to this site. Furthermore, there is a gravel road, with a locked gate, leading to the summit where a microwave tower is located. Fortunately, because the hill is very steep, and there are few trails, there is little indication that the vegetation has been degraded to the same extent as that observed in more accessible areas near Victoria. It is unlikely any development will occur at this site given its location in the Greater Victoria Watershed and the lack of resources which would attract most forms of development.

Somenos Lake (Duncan)

The population which once existed at this site is situated in a disturbed area between the Trans-Canada Highway and the Esquimalt and Northern Railroad tracks. Although no longer present, it is possible that viable seeds of *Lupinus lepidus* are buried in the soil. Compaction and turning of the soil during recent sewer line construction reduce the chances of germination markedly.

Koksilah River Valley

Because the specific site at which *Lupinus lepidus* has been collected in the past is not known, it is not possible to provide any information on the extent to which this population is protected. However, if it is located on a steep, rocky, xeric site similar to those found on Mount McDonald, it is unlikely to be threatened in the near future by development or habitat destruction.

Rehabilitation Efforts

No attempts have been made to introduce *Lupinus lepidus* into suitable habitats or increase the number of individuals at current locations. Unfortunately, any effort to do so would be through trial and error because so little is known regarding the ecology and management of this species.

It is likely *L. lepidus* is similar to other *Lupinus* species in that it produces seeds with hard seed coats that remain viable in the soil for long periods of time and are slow to germinate unless scarified or, as suggested by Kruckeberg (1982), soaked in hot water for an hour. Unfortunately, it is not known if *L. lepidus* can be successfully transplanted or established in the wild. At the present time, the University of British Columbia Botanical Garden is growing plants of *L. lepidus* from seed taken from the Somenos Lake site.

Some introduced grass species which now dominate meadows and dry rocky sites may also pose a threat to *L. lepidus* either by smothering or shading individual plants but more likely

by preventing the germination and establishment of *L. lepidus* seedlings. Unfortunately, the control of most species is likely to be difficult, if not impossible, although further investigations are required before threats posed by these species can be adequately assessed.

Fire, as it was historically used by the aboriginal peoples of BC, may have benefited the habitats in which *L. lepidus* occurred by eliminating dense thickets of shrubs and maintaining open, barren areas. At the present time, fire does not appear to be a viable management option for a number of reasons:

1) Burning is likely to encourage the germination and spread of many species which have been introduced within the past 100 years, particularly *Cytisus scoparius*.

2) Most of the sites in which *L. lepidus* has been collected are in parks or near residential areas where burning is not likely to be permitted.

3) Burning may have devastating impacts on *L. lepidus*. Unfortunately, because this species is known from so few locations, it would be unwise to attempt such a drastic form of management without a better understanding of its ecology.

4) Most areas in which *L. lepidus* has been collected have not been burned in many years which has resulted in the excessive buildup of woody fuels. To burn these sites now would likely result in fires that are so intense that they may kill many species.

Unfortunately, even if those sites inhabited by *L. lepidus* could be protected, it is likely these populations would require some form of active management to prevent their elimination, particularly if they require episodes of disturbance to maintain the populations.

II. ASSESSMENT OF STATUS

10. Comments on Status

Globally, *Lupinus lepidus* is ranked as a G5 species by the BC CDC. Despite the taxonomic problems associated with this species, it is known to be a common species in Washington and northwest Oregon. This ranking indicates that, on a global scale, it is considered to be "common to very common; demonstrably secure and essentially ineradicable under present conditions".

In British Columbia, *L. lepidus* is ranked as an S1 species which indicates it is "critically imperiled because of extreme rarity (5 or fewer extant occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extirpation or extinction." This is the most critical status which can be applied to a species at the provincial level.

11. Status Recommendation

Lupinus lepidus should be ranked as an endangered species for the following reasons:

1) The number of *L. lepidus* populations in Canada are few in number and, of these populations, two were recently destroyed and none of the others have been confirmed.

2) Extant populations are likely threatened by introduced species, particularly *Cytisus scoparius* which has invaded and dominated many of the habitats where *Lupinus lepidus* would likely occur.

3) Populations in British Columbia represents the northern range limit of *L. lepidus* (except for the report of its occurrence in southeast Alaska) and may represent genetically distinct populations to those found elsewhere.

4) Although, the status of most populations is not known, it is likely this species is declining in British Columbia because of fire suppression and the introduction of European species which probably compete with mature plants or prevent the establishment of seedlings.

12. Prognosis

The prognosis for this species is not good. Although *Lupinus lepidus* has been collected in areas which are protected from human activities, it is likely this species may still become extirpated because of the suppression of fire and the introduction of European species. Unfortunately, *L. lepidus* appears to be a short-lived colonizer of dry, exposed sites where competition likely eliminates this species over time unless some form of disturbance occurs along with the concomitant control of competing species, particularly *Cytisus scoparius*. Unfortunately, the intensity and type of disturbances which are favourable to the establishment and growth of *Lupinus lepidus* are not clearly understood although it is likely fire would be beneficial whereas trampling would not.

The management of *L lepidus* is hampered because very little is known regarding the ecology of this plant and its relationship to the environment and other species. In particular, demographic information is lacking and it subsequently remains unclear as to which factors influence the establishment, growth, and decline of populations.

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