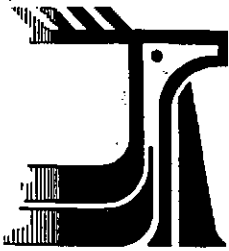


36126320



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 BLUE PHLOX
PHLOX ALYSSIFOLIA

IN CANADA

BY

BONNIE SMITH

QL
88
573
1996

STATUS ASSIGNED IN 1996
NOT AT RISK

REASON:

COMMON WITHIN ITS RESTRICTED RANGE AND
HABITATS.

OCCURRENCE:

ALBERTA, BRITISH COLUMBIA AND SASKATCHEWAN

COSEWIC - A committee of representatives from
federal, provincial and private agencies which
assigns national status to species at risk in
Canada.

CSEMDC - Un comité de représentants d'organismes
fédéraux, provinciaux et privés qui attribue un
statut national aux espèces canadiennes en péril.



38 508 574

STATUS REPORT ON PLANTS AT RISK IN CANADA

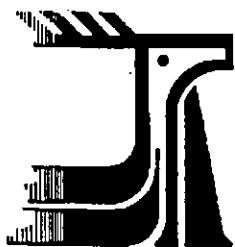


Blue Phlox
Phlox alyssifolia

COSEWIC
COMMITTEE ON THE STATUS
OF ENDANGERED WILDLIFE
IN CANADA



CSEMDC
COMITÉ SUR LE STATUT
DES ESPÈCES MENACÉES
DE DISPARITION AU CANADA



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 (ONTARIO) K1A 0H3
(819) 997-4991

JUNE 1994

NOTES

1. This report is a working document used by COSEWIC in assigning status according to criteria listed below. It is released in its original form in the interest of making scientific information available to the public.
2. Reports are the property of COSEWIC and the author. They may not be presented as the work of any other person or agency. Anyone wishing to quote or cite information contained in status reports may do so provided that both the author and COSEWIC are credited. Reports may be cited as in the following example:

Bredin, E.J. 1989. Status report on the Northern Prairie Skink, Eumeces septentrionalis, in Canada. Committee on the Status of Endangered Wildlife in Canada. 48 pp.

3. Additional copies of this report may be obtained at nominal cost from The Canadian Nature Federation, 1 Nicholas Street., Suite 520, Ottawa, Ontario, K1N 7B7 or from the Co-ordinator, COSEWIC Secretariat, c/o Canadian Wildlife Service, Environment Canada, Ottawa, Ontario., K1A 0H3.

DEFINITIONS

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.
NOT AT RISK: (NAR)	A species that has been evaluated and found to be not at risk.
INDETERMINATE: (I)	A species for which there is insufficient scientific information to support status designation.

COSEWIC - A committee of representatives from federal, provincial and private agencies which assigns national status to species at risk in Canada.

CSEMDC - Un comité de représentants d'organismes fédéraux, provinciaux et privés qui attribue un statut national aux espèces canadiennes en péril.

STATUS REPORT ON THE BLUE PHLOX
PHLOX ALYSSIFOLIA

IN CANADA

BY

BONNIE SMITH
6808 SILVER RIDGE WAY N.W.
CALGARY, AB
T3B 4R4

STATUS ASSIGNED IN 1996
NOT AT RISK

EXECUTIVE SUMMARY

Description

Phlox alyssifolia Greene or blue phlox, is a member of the Polemoniaceae or Phlox Family. *P. alyssifolia* is a perennial, nearly prostrate plant growing from a woody root. Plants are up to 1 dm tall with numerous stems. Leaves are oblong-linear, 10-18 mm long, 2-5 mm wide, cuspidate, rather thick, with white, hard, ciliate margins. The calyx is glandular-hairy, 7-8 mm long, united below by a scarious margin. Flowers are solitary, or 2-3, sessile or short-stalked, at the end of branches. The corolla is salverform, pale-bluish, purple or white, 15-18 mm wide. Stamens are inserted at different levels on the corolla tube. The fruit is an ellipsoidal, 3-valved capsule. The only other species of *Phlox* found within the range of *P. alyssifolia* is *P. hoodii* Richards, which has much smaller, white flowers, 8-10 mm long.

Distribution

Blue phlox is endemic to North America, extending from north central Colorado to southern Saskatchewan (Rock Glen, Big Muddy Valley, Matador) to the British Columbia/Alberta boundary. Blue Phlox is recognized as rare in North Dakota. Blue phlox occurs mainly on unglaciated sites. In Saskatchewan the species is restricted to the Rock Glen/Big Muddy Valley area with a disjunct population at Matador, northwest of Diefenbaker Lake. In British Columbia, blue phlox is known only from the Crowsnest Pass, just west of the Alberta boundary. In Alberta the species is restricted to the area from Del Bonita west to Waterton Lakes National Park, north to the Porcupine Hills and east to Pincher Creek. The species is quite common within its restricted range in Alberta and Saskatchewan.

Population Size and Trends

The total Alberta population is estimated to be in the mid to upper tens of thousands of specimens. The total Saskatchewan population is estimated to be ten thousand plus specimens within a restricted range. There are several sites in Saskatchewan and Alberta with good local populations but none are as extensive or contain as many plants as the Rock Glen and Del Bonita locations. Populations appear to be stable but the species apparently remains restricted to site specific locations. In many cases, mostly in Saskatchewan, there are no other suitable habitats as all surrounding lands are cultivated.

Habitat

Phlox alyssifolia is found only on the unglaciated, gravelly, cobbly soils on areas of steep relief in the Grassland Natural Region. In Alberta, the species is found in the Foothills Grassland. In Saskatchewan the species is found in the Mixed Grassland. The apparent common factor they all share is absence of recent glacial modification. Blue phlox is usually associated with *Oxytropis sericea*, *Phlox hoodii*, *Astragalus crassicaarpus*, *Eriogonum flavum*, *Cryptantha macounii*, *Hymenoxys richardsonii*, *Artemisia frigida* and *Juniperus horizontalis*. Blue phlox is

commonly associated with other rare or uncommon species, especially *Erigeron radicans* Hook. and *Hymenopappus filifolius* Hook. in Saskatchewan and *Oxytropis lagopus* Nutt. in Alberta.

General Biology

Phlox alyssifolia is a perennial species. It reproduces sexually by pollen production. Plants are actively producing fruit and setting seed at most sites. Little is known about the role the species plays in the ecosystem.

Limiting Factors

The steepness of most blue phlox habitat makes further cultivation difficult except for the low-lying areas of the Big Muddy Valley. Any increase in resource extraction - gravel removal, oil, gas, mining - might eradicate a particular population. One site in Alberta, near Mountain View, is threatened as a result of road building. Grazing may produce a change in species association, thereby limiting the use of available habitat, restricting the species to the more inaccessible upper slopes. Any change in management of grazing leases or development of any kind on the sites should be closely monitored.

Protection

There are no regulatory or other measures to protect this species. While the populations are stable at most locations, *Phlox alyssifolia* is restricted to a very limited range in Canada. Therefore, it is important to protect all sites within this range.

Conclusions

Phlox alyssifolia is recommended for listing as a **vulnerable** species in Canada in consideration of the restricted range of the species in Canada and the United States but also its limited ability to spread to other suitable habitat. The prognosis for the species survival is very good if the existing habitat is not compromised. Development should be restricted, especially in the area surrounding Rock Glen and Del Bonita. Cultivation practices should be monitored at the Saskatchewan locations, especially the sites within the Big Muddy Valley. Development of resources should be monitored at all locations. Studies should be undertaken to determine the affects of grazing on population distribution patterns.

NOTE

COSEWIC has designated this species as presently Not at Risk because it is common within its specific habitats and restricted range. No threats have been identified.

Erich Haber

Chairman, Subcommittee for Vascular Plants, Mosses and Lichens

November, 1996

TABLE OF CONTENTS

I Species Information

1. Classification and Nomenclature	1
2. Description	1
3. Biological and Economic Significance	2
4. Distribution	2
4.1 British Columbia	2
4.2 Alberta	2
4.3 Saskatchewan	3
5. General Environmental and Habitat Characteristics	3
5.1 Climate	4
5.2 Physiography, Hydrology and Edaphic Factors	4
5.3 Biological Characteristics	5
6. Population Biology and Ecology	5
6.1 Reproductive Ecology	9
6.2 Population Ecology	9
7. Land Ownership and Management Responsibility	10
8. Management Practices and Experience	10
8.1 Cultivation	11
8.2 Current Management Policies	11
9. Evidence of Threats to Survival	11
9.1 Gravel Removal	12
9.2 Grazing	12
9.3 Cultivation	13
9.4 Road Construction	14
9.5 Hiking and Trail Use	14
9.6 Invasive Species	14
10. Present Legal or Other Formal Status	14

II Assessment of Status

11. General Assessment	15
12. Status Recommendation	16
13. Recommended Critical Habitat	16
14. Conservation Recommendation	17

III Information Sources

15. References Cited in Report	17
16. Collections Consulted	19
17. Fieldwork	19
18. Knowledgeable Individuals	20

IV Authorship

19. Initial Authorship of Status Report	20
20. Maintenance of Status Report	20

Appendices

Appendix 1: Detailed Locality Citations	21
Appendix 2: Habitat Site Descriptions	27
Appendix 3: Critical Habitat Recommendations	34

LIST OF MAPS AND FIGURES

Map 1: Distribution of *Phlox alyssifolia* Greene.

Map 2: Distribution of *Phlox alyssifolia* Greene in British Columbia, Alberta and Saskatchewan.

Map 3: Potential and critical habitat recommendations for *Phlox alyssifolia* Greene in the Del Bonita area, Alberta. (Site 1)

Map 4: Potential habitat of *Phlox alyssifolia* Greene in the Rock Glen (Site 1) - Big Muddy Valley (Site 2) area, Saskatchewan.

Map 5: Critical habitat of *Phlox alyssifolia* Greene in the Rock Glen area, Saskatchewan. (Site 1)

Figure 1: *Phlox alyssifolia* Greene.

Figure 2: Blue phlox and stony, semi-barren habitat.
Site 1A: Ross Lake Community Pasture, Alberta.

Figure 3: Blue phlox (large white, upper right) with associated species: *Oxytropis lagopus* (purple, center); *Oxytropis sericea* (yellow, upper left); *Phlox hoodii* (small white, lower center beneath *Oxytropis lagopus*).
Site 1B: West of Lake Shanks, Alberta.

Figure 4: Blue phlox habitat, high ridges, hills. Note cultivated lands in background (upper left). Site 2: Whiskey Gap, Alberta.

Figure 5: Blue phlox (white) stony hilltop habitat. Note *Oxytropis lagopus* (purple), also a vulnerable species. Site 2: Whiskey Gap, Alberta.

Figure 6: Blue phlox habitat, yellow flowers mostly *Oxytropis sericea*.
Site 1C: South of Lake Shanks (in photo), Alberta.

Figure 7: Note large patches of Blue phlox (foreground).
Site 1C: South of Lake Shanks, Alberta.

Figure 8: *Phlox alyssifolia* Greene (white) amongst taller grasses.
Site 2: Whiskey Gap, Alberta.

- Figure 9:** High ridges, preferred Blue phlox habitat. Note farmland in background.
Site 1B: West of Lake Shanks, Alberta.
- Figure 10:** Blue phlox habitat, semi-barren, high ridge. Site 6: Pincher Creek, Alberta.
- Figure 11:** *Phlox alyssifolia* Greene in rock crevices. Site 6: Pincher Creek, Alberta.
- Figure 12:** Blue phlox, single stems, in grassland.
Site 3: Police Outpost Provincial Park, Alberta.
- Figure 13:** *Phlox alyssifolia* Greene habitat, grassland.
Site 3: Police Outpost Provincial Park, Alberta.
- Figure 14:** Blue phlox habitat, semi-barren high ridges near Rock Glen, Sask.
(Site 1) Note haying and farmland at lower elevation.
- Figure 15:** Blue phlox habitat (in July), semi-barren steep hills.
Near Rock Glen townsite, Sask. (Site 1)
- Figure 16:** High ridges near Rock Glen townsite, Sask., Site 1.
Upper slopes are prime blue phlox habitat.
- Figure 17:** Semi-barren, rocky hilltops (white-pink patches are blue phlox). Near Rock Glen townsite, Sask., Site 1.
- Figure 18:** Large patches of blue phlox (pinkish flowers in background are fading). Site 1: Rock Glen, Sask.
- Figure 19:** Lowland habitat, base of high ridges. White-flowered *Phlox alyssifolia* Greene in foreground. Site 1: Rock Glen, Sask.
- Figure 20:** Blue phlox habitat, foreground. Note high ridge, background.
Site 2: Big Muddy area, 3 km north of U.S. boundary, Sask.
- Figure 21:** Cultivation practices showing habitat loss on hills and lowlands.
Site 2: Big Muddy area, 3 km north of U.S. boundary, Sask.
- Figure 22:** The wide Big Muddy valley, Sask., Site 2.
Ridges in background are blue phlox habitat.
- Figure 23:** Steep, grassy slopes of Big Muddy valley ridge.
Blue phlox habitat. Site 2, Sask.

I. Species Information

1. Classification and Nomenclature

The scientific name for blue phlox is *Phlox alyssifolia* Greene. It is a member of the family Polemoniaceae in the order Solanales. The genus contains about 70 species and is one of the largest genera in the family (Cronquist 1981).

There are 13 species of phlox in Canada. *Phlox alyssifolia* was first described by Greene, a renowned botanist. (Gray's Herbarium Index (1968) lists blue phlox as follows: *Phlox alyssifolia* Greene. Pittonia 3:27. 1896 - Assiniboia). Three subspecies and one form are recognized, namely, ssp. *abdit*a (A. Nels.) Wherry, Not. Nat. Acad. Sci. Phil. no. 146:8. 1944; ssp. *collina* (Rydb.) Wherry, same as above; ssp. *vera* Wherry, same as above; ssp. *vera* f. *seversa* (A. Nels.) Wherry, same as above. The type collection is listed as Macoun 11813, Twelve-Mile Lake, Wood Mtn., Sask. Hitchcock *et al.* (1961) does not recognize varieties.

Hitchcock *et al.* (1961) lists the following synonyms for *Phlox alyssifolia* Greene: *Phlox collina* Rydb. Mem. N.Y. Bot. Gard. 1:136. 1900. *P. kelseyi* var. *collina* Brand, Pflanzenr. IV. 250:80. 1907. *P. alyssifolia* ssp. *collina* Wherry, Not. Nat. Acad. Phila. 146:8. 1944 (Tweedy 154, Madison Co., Mont.); *P. variabilis* Brand, Pflanzenr. IV. 250:87. 1907. *P. kelseyi* ssp. *variabilis* Wherry, Not. Nat. Acad. Phila. 87:8. 1941. (Hall & Harbour 454, Rocky Mts. of Colo., lat. 39-41 degrees); *P. albita* A. Nels. U. Wyo. Pub. Bot. 1:128. 1926. *P. alyssifolia* f. *seversa* Wherry, Not. Nat. Acad. Phila. 146:8. 1944. (A. Nelson 9116, Lusk, Converse Co., Wyo.).

2. Description

Phlox alyssifolia Greene is a perennial, nearly prostrate plant, growing from a somewhat woody root. Plants are up to 1 dm tall, the numerous stems spreading-hairy, especially above, and commonly becoming glandular near the mostly glandular-hairy calyx. Leaves are mostly oblong-linear, 10-18 mm long, cuspidate, rather thick, with white, hard, ciliate margins. Larger leaves are (7)10-25 mm long, 2-5 mm wide. The calyx is 7-8 mm long, glandular-hairy, the teeth bristle-pointed. Sepals are united below by a scarious margin. Calyx-lobes are firm but flattened and the midrib is not very conspicuous. Flowers are solitary or 2-3, sessile or short-stalked, at the end of branches. The corolla is salverform, the limb showy, pale-bluish, purple or white, and 15-18 mm long, less than twice as long as the calyx. The corolla lobes are broad, 7-13 mm long. Stamens are inserted at different levels on the corolla tube. The style is 6-12 mm long. The fruit is an ellipsoidal capsule, enclosed by the calyx, 3-valved and few-seeded (Moss 1983, Hitchcock *et al.* 1964, Looman and Best 1979, Scoggan 1978). See Figures 1-3. The name *Phlox* is from the Greek, meaning a flame, in allusion to the brilliant flowers of some species (Everett 1981).

The two Alberta species of *Phlox* are easy to separate. Moss phlox (*Phlox hoodii* Richards.), has much smaller flowers (8-10 mm long) and awl-shaped leaves, less than 2mm wide, with cobwebby hairs (Moss 1983). Both species are illustrated in Figure 3. (Figure 3, *P. alyssifolia*, upper right hand corner; *P. hoodii*, center below purple *Oxytropis lagopus*).

Within the family Polemoniaceae the genus *Phlox* is quite distinctive. The simple, entire, opposite leaves and the perennial, mat-forming nature of the plants separate *Phlox*, at least in Alberta, from other genera within the family (Moss 1983, Hitchcock *et al.* 1964).

3. Biological and Economic Significance

Phlox is an important horticultural genus. Horticultural grouping for the genus are as follows: spring-blooming perennials, summer-blooming annuals and alpine kinds. One of the easiest alpine phloxes to grow is *P. alyssifolia*. Other genera in the Polemoniaceae are of little economic importance (Everett 1981, Cronquist 1981).

4. Distribution

The Polemoniaceae is best developed in temperate North America, especially in the Cordilleran region, but extend south to western South America and north to Alaska and thence across most of temperate Eurasia (Cronquist 1981). All species of *Phlox*, except *P. sibiricus* (Siberia), are native to North America. (Everett 1981). In North America, *Phlox alyssifolia* extends from north central Colorado to southern Saskatchewan to the British Columbia/Alberta boundary region. In the United States blue phlox is distributed wholly east of the continental divide and occurs in southwest Montana, western North Dakota and South Dakota, and north central Colorado (Map 1). In Canada (Map 2), the species is known only from the southern area between the B.C./Alberta boundary to Saskatchewan (Moss 1983, Hitchcock *et al.* 1963, Scoggan 1978).

Precise locality data and land ownership, if known, is on file with COSEWIC and the appropriate provincial/territorial jurisdictions. This information is generally available unless the localities are considered to be publicity-sensitive.

4.1 British Columbia

In British Columbia (Map 2), blue phlox occurs at only two nearby sites just west of the Alberta boundary in the Crowsnest Pass (Straley *et al.* 1985).

4.2 Alberta

Blue phlox occurs across southern Alberta from just west of Pincher Creek south to Mountain View and west to the Del Bonita area. Actually, the southern Alberta distribution of blue phlox is very sporadic and restricted to specific small sites, especially in the far west near Waterton Lakes National Park and Pincher Creek. The greatest zone of continuous distribution occurs

between Whiskey Gap and just east of Lake Shanks, in the Del Bonita uplands. Even within this area (Map 2) the species occurs only on the high ridges and hills associated with the North Milk River. Lowlands, which are mostly cultivated, separate the sites creating islands of distribution (Smith 1993, Argus and White 1978).

4.3 Saskatchewan

Blue phlox occurs sporadically across southern Saskatchewan north of the western end of Diefenbaker Lake (Matador) and south at Rock Glen and east to the Big Muddy (Map 2).

Various sites within the range of the species in southwestern Alberta and southern Saskatchewan were examined and rated as potential habitat for blue phlox. Other sites were examined but habitat was found to be unsuitable for a variety of reasons (Map 3, 4).

5. General Environment and Habitat Characteristics

The Grassland Natural Region contains three sub-regions - the Mixed, Northern Fescue and Foothills Grassland. In Alberta, populations of blue phlox occur in the Foothills Grassland, which occupies a narrow belt along the western margins of the Mixed Grassland between the Mixed Grassland and the Foothills Parkland, and the Mixed Grassland. Some areas of the Foothills Grassland merge directly into the Rocky Mountain Montane. The southern Foothills Grassland is restricted to areas surrounding Ross Lake and west to Waterton National Park and to two small areas in the Cypress Hills of Alberta and Saskatchewan (PCAP 1989-1994, Alberta Recreation and Parks 1989).

In Alberta, the southernmost Foothills Grassland have an abundance of plants that are either rare or at the periphery of their range, including blue phlox. The prime area of significance of Foothills Grassland is the Ross Lake area on the Milk River Ridge. The region consists of broad, flat to gently rolling plains with few major hill systems (Cottonwood Consultants 1983, Alberta Recreation and Parks 1989). Blue phlox is found on rolling steppe or dry grassland on rocky and gravelly soil often on unglaciated terrain on the Milk River Ridge (Argus and White 1978). See Figures 4-7, 9. Also, blue phlox is found on hills or ridges along the eastern edge of the foothills at Pincher Creek (Figures 10-11) and northeast of Waterton Lakes National Park and at Police Outpost Provincial Park in grassland (Figures 12-13) (Wallis *et al.* 1986, Packer and Bradley 1984).

In Saskatchewan, blue phlox is located on grassy slopes and exposed rocky ridges within the Mixed Grassland sub-region. The region consists of a variety of grassland with a few major hill systems. Blue phlox is found on rocky and gravelly soil often on unglaciated terrain, mostly around Rock Glen and the Big Muddy Valley (Figures 14-23). Also, blue phlox is found on the Mixed Grassland north of the western end of Diefenbaker Lake at Matador (Maher *et al.* 1979, Smith 1994).

Blue phlox is usually associated with *Oxytropis sericea*, *Phlox hoodii*, *Astragalus crassicaupus*, *Eriogonum flavum*, *Cryptantha macounii*, *Hymenoxys richardsonii*, *Artemisia frigida* and *Juniperus horizontalis* (Smith 1994).

There may be a comparison between the Del Bonita unglaciated ridge and hill systems around the western and southern areas of Lake Shanks in Alberta with the unglaciated Rock Glen ridge and hill systems around the western and southern areas of Fife Lake. An interesting study of patterns of distribution of rare plants found on unglaciated locations could be undertaken using these two sites as examples. Blue phlox is commonly associated with other rare or uncommon species, especially *E. radicans*. *Oxytropis lagopus* has only been found at the Del Bonita site while *Hymenopappus filifolius* has only been found at the Rock Glen site. *P. alyssifolia* is very common at both sites (Smith 1994).

Detailed site habitat information was provided to the chairman of the Plants Subcommittee for inclusion in the COSEWIC file for this species.

5.1 Climate

The Prairies Climatic Region, encompassing the Alberta site and Saskatchewan sites, is characterized by low winter precipitation. The Alberta and Saskatchewan sites lie in the northern cool-temperate zone characterized by low annual precipitation, high evaporation rates and fast runoff. Rainfall occurs mainly in early summer, causing a late season moisture deficit. Precipitation is approximately 30 mm less during the growing season than in the mixed prairie ecoregion. In Alberta, the Foothills Grassland is an uncommon grassland type in North America, found in the foothills area where greater rainfall and cooler temperatures provide more available moisture (Prairie Conservation Action Plan 1989-1994, Stamp 1988, Richards 1969).

5.2 Physiography, Hydrology, and Edaphic Factors

The Alberta and Saskatchewan sites are similar in physiography as they both occur in the Great Plains physiographic region. The Great Plains region slopes chiefly to the east. The majority of the Foothills Grassland Sub-Region drains into the Saskatchewan River system, however a small portion drains into the Milk River system. The southern slopes of the Cypress Hills, the Wood Mountain and Missouri Coteau, and the slopes of the Sweet Grass Hills, are drained by the Frenchman and Milk Rivers, and numerous smaller streams, the waters of which flow into the Missouri River and eventually to the Gulf of Mexico. The areas surrounding the North Milk River drain into the Milk River (Coupland 1950, Wershler and Wallis 1986, Alberta Recreation and Parks 1989).

Much of the strongly rolling and hilly land is excessively drained due to loss of precipitation through runoff. Low lying flats and depressions are characterized by varying degrees of restricted drainage (Coupland 1950).

In Alberta, the bedrock, which is best exposed along the Milk and Lost Rivers, is composed of four formations: the Milk River, Pakowki, Foremost, and Oldman (Spalding 1980). In Alberta, the majority of sites, and most of the population base, of blue phlox occurs on the preglacial sediments associated with the North Milk River, Whiskey Gap to just west of Lake Shanks. A smaller population has been located just west of Pincher Creek on a protruding rocky ridge and others on the hills at the southeastern end of Waterton Lakes National Park. These areas may also have remained unglaciated as a result of their elevation.

In Saskatchewan, the areas around Matador represent the Bearpaw Formation. Those in the Wood Mountain Uplands near Rock Glen and the Big Muddy Valley represent the Wood Mountain and Ravenscrag Formations. The Wood Mountain Formation is unique to this region in Saskatchewan (Richards 1969). Populations occur in unglaciated areas on hills around Rock Glen and in the Big Muddy valley on steep valley ridges and lower hills near the Montana border. These areas are part of the Wood Mountain Uplands with the more easterly regions of the Big Muddy Valley and the Roche Percee site lying on the Missouri Coteau. Again, the distribution is restricted to sporadic occurrences of unglaciated hilly terrain amongst the mostly cultivated valleys. The Matador site also sits on the Missouri Coteau (Richards 1969).

Brown chernozemic soils characterize the Milk River sites in Alberta (Coupland 1950). Black chernozemic soils characterize the fescue grassland sites in Alberta and Saskatchewan (PCAP 1988). Valley complexes, chiefly regosolic soils of valley slopes and bottoms, combined with brown chernozemic soils, characterize the southern sites at Rock Glen and the Big Muddy Valley in Saskatchewan (Richards 1969).

.5.3 Biological Characteristics

Blue phlox is a perennial. Reproduction is primarily sexual. As the season progresses, flowers change from the early dark, light blue or white to a more purple or pink.

6.0 Population Biology and Ecology

Alberta

Site 1 - Del Bonita and Environs (Map 2,3)

Ross Lake Community Pasture (Site 1A, Figure 2)

It was found that *Phlox alyssifolia* becomes less common away from a 30 m wide area centred on the plateau rim and upper slopes. Below and above this strip, the grassland is lush and apparently too dense to support the species. Blue phlox is less common on southwest-facing rims where the exposure is drier and grazing is heavier. This is the typical distribution pattern noted for the species. Plants are generally two to four decimetres apart, in some cases in small mats. The total population at this site was about 1000 specimens. Habitat was fairly restricted at this site.

West of Lake Shanks, South of Highway #62 Crossing of North Milk River (Site 1B, Figures 3,9)

The population on the steep ridge site was estimated in the mid to upper-thousands on the northern range of ridges west of Lake Shanks. Clumps ranged in size up to 1 dm x .5 dm and spread sometimes in a fairly continuous mat. Single stems were infrequent but noted to occur in a sparse distribution. Although the species could be found commonly in some spots it was not distributed evenly over the ridge system. There were many areas along the ridge where the species was not found at all. The southern range of ridges was not checked but is also good potential habitat for the species (Map 3). The population for the two ridges west of Lake Shanks is estimated to be ten thousand plus. A more intensive survey of this exceptional site is required to fully document the population distribution along these ridge systems (Smith 1993).

Immediately South of Lake Shanks (Site 1C, Figures 6-7)

Blue phlox was common on the upper slopes and just below the plateau rim of the steep ridge system. The species was restricted mainly to the northwest-facing slopes of the ridge but often occurred just over the top of the plateau rim. Again the distribution was not continuous. Again, many thousands of specimens were noted at this site. Additional suitable habitat was noted to exist further west and east of the area surveyed (Map 3) (Smith 1993).

Southeast of Lake Shanks, Road from Del Bonita to Twin Rivers (Site 1D)

The site consists of a series of low hills, sharply rising from the surrounding area. The first and second hills each contained at least a thousand plants. This set of low hills is estimated to contain in the upper thousands of plants. There is a larger hill to the southeast which also appears to be good habitat. It would not be surprising to the author if this hill series was found to contain in excess of 10,000 plants (Smith 1993).

Overlooking North Milk River, Ranch Road West of Lake Shanks (Site 1E)

Plants were found scattered amongst taller grasses at this site. A population of several hundred specimens were estimated for this site (Smith 1993).

Crossing of North Milk River, Between Whiskey Gap and Del Bonita (Site 1F)

Common, carpeting upper steep slopes. The white-flowered form of the phlox can be observed from the highway which crosses the North Milk River. Mid-thousands of specimens (Smith 1993).

Shanks Creek, North of Del Bonita (Site 1G)

Common at this site on the hilltops and upper ridges. Several thousand specimens (Smith 1993).

West of North Milk River Crossing, Between Whiskey Gap and Del Bonita (Site 1H)

Site not surveyed during 1993/94.

Site 2 - Whiskey Gap (Map 2, Figures 4-5, 8)

Sommerfeldt Ranch

Blue phlox was found in bloom every year (1986 to present) since the May Flower Count was undertaken by Barbara Sommerfeldt at this site (Sommerfeldt, pers. comm.). On May 22, 1993, *P. alyssifolia* was very common at this site. There appeared to be up to 10,000 plants. The hills, in places, were white with blue phlox. On May 14, 1994 the species was less evident. There were signs of a hard winter. Phlox numbers appeared to be lower this year (low thousands) but they were still quite evident. Perhaps the species would have been more evident a week or so later, as in 1993. Regardless, this is the most westerly site containing a large population of blue phlox. The ridge systems in this area provide excellent habitat for the species. Blue phlox spread down the mid-slopes of the hill (Figure 8), in places growing with the taller grasses (Smith 1993, 1994).

Site 3 - Police Outpost (Map 2, Figures 12-13)

Blue phlox was infrequent at this site. The species was restricted to a 30 m x 9 m area amongst big rocks. It was fairly common only in this area. The total population numbered in the low hundreds. No *P. alyssifolia* was seen on the surrounding hills. The plant was mostly found as tiny patches on the hilltop. The occasional single stems, probably no more than 20-50, were noted on the upper hillsides occurring amongst grasses. Most of the population is restricted to the hilltop. It is possible that there are other sites within the park, but populations are probably low. When *P. alyssifolia* is in full bloom it is very difficult to overlook, even casually, if its numbers are substantial (Smith 1994).

Site 4 - Mountain View (Map 2)

The population of blue phlox, at this site, numbered in the mid-thousands. The plants, although common, were not carpeting the area. The sloping hills and hilltops were the centre of distribution. The species did not occur on lower slopes or mid-slopes. Blue phlox is apparently restricted to just this river crossing area. Sites further east and west were checked but no blue phlox was found (Smith 1994).

Site 6 - Pincher Creek (Map 2, Figures 10-11)

The area was checked on May 14, 1994. Populations were mostly restricted to the tops of the semi-barren ridges, especially on the grazed side of the ridge. The ridge is bisected by a fence. On the western side cattle are actively grazed; on the eastern side no cattle are presently grazed. On the ungrazed end of the ridge the blue phlox spreads down into the lush grasses. The

ungrazed side is about twice as long as the grazed side of the ridge. Blue phlox is common on lower slopes and right in amongst grasses. Plants occurs in clumps of many flowering stems. There are low thousands of plants on the ungrazed side and perhaps a thousand on the ridge top on the grazed side. Twenty (100 stems) are located just south of the ridge top on the ungrazed side. Neither side of the fence is carpeted by blue phlox, rather the species is sparsely distributed, mostly in patches (Smith 1994).

Saskatchewan

Site 1 - Rockglen and Environs (Map 2,4, Figures 14-19)

Blue phlox was abundant on the tops and slopes of the ridges, but, in places, also was capable of growing down to the lower slopes near the highway as long as suitable semi-barren habitat was available. Blue phlox preferred the upper slopes of the ridges and hills. The widespread population in the Rockglen area is best summarized and represented on a individual map for the area (Map 4) as the population is fairly complicated in its distribution.

At the Quantock site blue phlox was common. Some 400+ clumps of Phlox were counted. Some carpeted the ground forming beds to 1 m in width. Phlox preferred the sw-facing upper ridges near the road. An additional estimate of 200 clumps were counted in the grasses near the road. Scattered patches were noted to occur sporadically outside these two areas of population concentration. The Canopus site looks similar to this site. (Map 4, 5)

At Rockglen 10-20 plants were counted south of the road but blue phlox preferred the top, southwest and northeast-facing slopes of the upper ridges and hills. Blue phlox was very common in these locations and became less common but still scattered on the lower slopes. Blue phlox was noted to occur on most of the surrounding hilltops. An observer could see the white flowers covering the hills from quite a distance. The total population estimate for the Rock Glen area is estimated to exceed 10,000 plants (Map 4, 5).

Site 2 - Big Muddy and Environs (Map 2,4, Figures 20-23)

Site 2A

3 km North of U.S. Boundary Crossing, Highway #34 to Big Beaver (Map 4, Figures 20-21)

Blue phlox was not common at the Big Beaver site. Rather it occurred as scattered plants associated with *Oxytropis sericea*. Blue phlox exhibited a continuous distribution pattern occurring from the bottom to the top of the low hills but preferring the top and the upper third of the hills. The total population of blue phlox estimated for the area is 300-400 plants. Blue phlox was not found on all of the hills but seemed restricted to those hills on which it was associated with *Oxytropis sericea*.

Site 2B

Big Muddy Valley (Map 4, Figures 22-23)

At the Big Muddy Valley site, blue phlox was again restricted mostly to the top quarter of the ridge overlooking the valley. Approximately 100 plants formed the population at this particular site. An estimated 1000 plants occupy the entire ridge along the valley.

The Harptree (Map 2, 4) appears to be similar to the Big Muddy Valley site. This site was not sampled but simply observed from the road. With continual travel and observation of the species it becomes apparent that the blue phlox is restricted in population distribution to islands of high ridges and hills within a sea of cultivated lands. All lower areas, including many lower hills, have been cultivated, especially as one proceeds east into the Big Muddy Valley.

Other areas within the range of the species were checked but no specimens of blue phlox were found (Map 3-5). The ridges along Willow Bunch Creek looked like they had potential but no plants were found. This area may be just north of the range of the species. Blue phlox was occasionally found to be inexplicably rare from habitat which appeared to fit all the criteria for its presence. This was also found to be true of various low hills in the Big Beaver area. For no apparent reason, some had blue phlox whereas others did not (Smith 1993/4).

6.1 Reproductive Ecology

Little data is available on the reproductive ecology of blue phlox.

At Site 6, Pincher Creek, Alberta, plants were at the beginning of their full bloom on May 14, 1994. About 5-10% had gone to fruit. Flowers turn pinkish-purple as they go from full bloom to the fruiting stage (Smith 1994).

At Site 4, May 15, 1994, Mountain View blue phlox were in full bloom. The petals had just started (5%) to turn pinkish (Smith 1994).

Phlox alpestris has been found in flower on the last weekend of May from 1986 to the present by Sommerfeldt (a participant in the spring flowering survey) on their ranch at Whiskey Gap. During 1993 (May 22) the author found blue phlox in full bloom. During the 1994 (May 15) visit the author found the species in bloom but not quite all specimens were flowering. It was still a little early.

In Saskatchewan, the Rock Glen site was examined on May 21 and 22. At the Quantock location, the petals of 80% of the population were turning pinkish. At the townsite of Rock Glen the petals of the blue phlox were 30% pinkish on the northeast-facing slopes and only about 5% pinkish on the southwest-facing slopes.

Blue phlox is obviously an early flowering plant at its Canadian locations, flowering from mid-

May to the end of May.

6.2 Population Ecology

No information was found on *Phlox alyssifolia* population ecology.

7. Land Ownership and Management Responsibility

Alberta

The Police Outpost site (Site 3) lies in Police Outpost Provincial Park. The Piegan Reserve site (Site 8) occurs in the Piegan Timber Reserve in the southern Porcupine Hills. The Whiskey Gap site (Site 2) is on crown land under grazing lease to the Sommerfeldt Ranch. The Birdseye Butte site (Site 5) occurs on the Birdseye Ranch. The Pincher Creek (Site 6), Mountain View (Site 4), and Del Bonita (Site 1) are on crown land under various grazing leases. The Fort Macleod site (Site 7) was not relocated.

Saskatchewan

The Rock Glen site (Site 1) is held under grazing leases or occurs on land under the administration of the town of Rock Glen. The Big Muddy Valley sites occur on land held by grazing lease or is marginal land amongst cultivated fields. The Wood Mountain site (Site 4) is extirpated but lies on private property. The Roche Percee site was not visited. The Matador site occurs within the Matador Community Pasture, about 10 km NNE of the Matador Research/Field Station.

8. Management Practices and Experience

There is very little protection for areas of Foothills Grassland which is found almost entirely in Alberta. The area of Foothills Grassland protected within Waterton Lakes National Park is very small. Another area with significant habitats and species is Police Outpost Provincial Park. Elkwater and Cypress Hills Provincial Parks provide a degree of protection for the more easterly fescue grassland. There are no protected areas within the range of *Phlox alyssifolia* within Alberta, except for the Police Outpost Provincial Park, which offers little protection (Wallis 1987, Alberta Recreation and Parks 1989). The most critical sites, the unglaciated high ridges and hills, in the vicinity of Del Bonita, are not protected (Smith 1993, 1994).

There are no protected sites within Saskatchewan. The species is most under threat in this province as a result of the cultivation practices in the critical Rock Glen and Big Muddy Valley areas (Smith 1994).

Future uncertainty regarding possible construction of dams, changes in grazing patterns, clearing for cultivation or resource development pose problems regarding the survival of the species within its limited Alberta and Saskatchewan range. Loss of primary habitat as well as

destruction of specific sites is a serious concern regarding survival of endangered species (Wallis 1987).

8.1 Cultivation

Phlox alyssifolia is one of the easier alpine phloxes to grow. There are two subspecies in horticultural use - ssp. *abditata*, is taller and fuller, and ssp. *collina*, is smaller and not glandular. Cultivation of alpine species is generally difficult and requires trial and error methods in an attempt to mimic the natural environment. The species requires harsh winters and dry summers with moisture commonly more abundant in spring and fall. Excellent soil drainage, earth that is not too rich, exposure to full sun and exposed sites are the most favorable conditions. Use of seeds is the most reliable means of propagation. Cuttings taken in fall are a recommended alternative. Most species of *Phlox* are desirable rock garden subjects. Blue phlox may be planted in rock gardens, shallow pots, alpine cold frames and greenhouses (Everett 1981).

8.2 Current Management Policies

The North Milk River sites are currently managed under grazing leases. The Whiskey Gap site is managed by the Sommerfeldt Ranch of southwestern Alberta. Access is limited to the area. Permission to go on the land must be obtained from the ranchers (Smith 1993). Sommerfeldt has informed the author that they have no intention of harming the sites; rather, they have a continuing interest in the local flora. Most other sites within Alberta are also operated under grazing leaseholds. One site occurs within a provincial park (Police Outpost, Site 3). One site is held by the Peigan Tribe as a Timber Reserve (Site 8).

In Saskatchewan, many areas of suitable habitat have already been lost. The lower hills are now planted in crops in many locations in the Rock Glen and Big Muddy Valley areas (Lisieux, Twelve Mile Lake, Big Beaver). If this practice continues further habitat loss can be expected, particularly in the Big Beaver area with its low rolling topography. Most remaining sites in the Rock Glen area are safe from further cultivation as a result of their inaccessibility due to their topography. Most of the Saskatchewan sites are inaccessible to cattle due to steepness of slope but in some areas (Big Muddy Valley) cattle have caused great damage, not through grazing, but as a result of trampling in the formation of cattle trails up the steep slopes. In the north, the Matador site appears to be mostly free from disturbance but at the Matador Research/Field Station, operated by the Univ. of Saskatchewan, Saskatoon, lands are overgrazed and offer little suitable habitat (Smith 1994).

9. Evidence of Threats to Survival

The Grasslands Natural Region is one of the most threatened natural regions in Alberta and Saskatchewan. In Alberta, owing to cultivation, fescue grassland has been reduced to 27% of its original area (PCAP 1988). The government of Alberta has prioritized the threatened grassland region for representation and protection in the form of ecological reserves but overall representation of ecological reserves in this region of Alberta is very poor to date. At Police

Outpost Provincial Park, blue phlox is found growing on fescue grassland.

Critical habitat is defined by Wallis (1987) as "most crucial to the survival of population, species, races or form. When these critical habitats are disturbed there will be major effects on the plants and animals that depend upon them." Over half of the birds and mammals now listed by COSEWIC are found in the three prairie provinces as a result of habitat loss in Western Canada (Hummell 1987).

9.1 Gravel Removal

Because of the abundance of gravel on the sites preferred by blue phlox along the North Milk River ridge, gravel operations are the single most important threat to the future security of the species in Alberta (Wallis *et al.* 1986). There is a gravel pit near Site 1A (Map 3) in Alberta. At present, gravel is not being removed from this location but has been in the recent past. Saskatchewan sites occur on the same type of gravelly-cobbly soil and could be in similar danger (Site 1, Saskatchewan, Map 2).

9.2 Grazing

The Sommerfeldt Ranch is grazed by cattle in winter and by wildlife in all seasons. At this site, the species has remained common since 1986 and no change in distribution or population has been noted over this period (Smith 1993, Sommerfeldt per. comm. 1993). Perhaps the high elevations and gravelly sites preferred by blue phlox are not choice sites for grazing. The continued grazing probably indicates only winter range use or a tendency of livestock to avoid the species. In any case, grazing does not appear to have substantially adversely affected the survival of the species. Plants are thriving and readily setting seed (Smith 1993, 1994).

At Site 1B, west of Lake Shanks, there was no indication that *Phlox alyssifolia* was subjected to grazing. The area was fenced and the *Phlox alyssifolia* was found growing amongst *Festuca idahoensis* and other taller grasses. This is not typical of other sites where *Phlox alyssifolia* was usually found only on the upper plateau rims away from the denser grassy areas. Perhaps the absence of grazing allows the species to survive in more marginal or atypical habitat. If this is the case then grazing might cause the species to become more restricted to the less accessible upper ridge slopes and semi-barren plateau rims. Also, at Site 1D (southeast of Lake Shanks), where grazing was noted to be less intensive than at sites 1C and 1G near Lake Shanks, *Phlox alyssifolia* was found to be able to survive on mid-slopes right to the edge of the grassier areas. Perhaps grazing does influence population distribution even if it is not apparently a serious threat to the survival of the species at present levels and patterns. At Police Outpost Provincial Park, Site 3, under a no grazing regime, blue phlox was able to grow, mostly as single stems, amongst the taller grasses on the upper and middle areas of the hills. Thorough studies of the effects of grazing on blue phlox would be useful (Smith 1993, 1994).

The effect of grazing on limiting distribution is confirmed at the Pincher Creek site. A fence bisects the site; about 1/3 of the ridge is grazed, 2/3 ungrazed. On the ungrazed side blue phlox

spreads down from the ridge top to the midslopes and allows the species to grow amongst grasses of the upper slopes. The grazed, well-trampled, side shows obvious signs of damage to the limber pine and some patches of blue phlox. Where grazing occurs, blue phlox is restricted to the ridge tops and is less abundant. This site is one of the best examples showing the effects of overgrazing on blue phlox populations. Only haying is evident on the lower slopes of the ungrazed side of the ridge (Smith 1994).

At the Mountain View, Alberta, site, grazing was heavy. The population at this site is apparently thriving although the restricted hilltop distribution pattern was also noted at this site (Smith 1994).

At most Saskatchewan sites, grazing effects were not as noticeable. Exceptions to this generalization were found at the overgrazed Matador Agricultural Research Station and the trampled steep slopes of the Big Muddy Valley. Most areas within the Rockglen and Big Muddy Valley sites are fenced for grazing but not being actively grazed, at least during the summer of 1994. At Rock Glen, fences are in disrepair and obviously the sites near the town haven't been grazed recently (Smith 1994).

9.3 Cultivation

Only 27% of original fescue grassland remains. Areas of extensive cultivation surround the Alberta habitat for the species (Figures 4-5, 7). Cultivation of natural habitats has eliminated many sites but the steepness of most remaining areas makes further cultivation difficult in Alberta (Wallis *et al.* 1986, Smith 1993/94).

In Saskatchewan, cultivation is the greatest threat to the survival of the species. Blue phlox occurs in sporadic locations, mostly on high ridges and hills, which are afforded a natural protection from cultivation due to the steepness of topography. Nonetheless, *Phlox alyssifolia* now exists in Saskatchewan as disjunct islands of distribution within a sea of cultivation. As well, many of the lower hills in the Rock Glen and Big Muddy Valley areas have already been lost to cultivation (Figure 14,20). The former collection site at Lisieux, north of Rock Glen is extirpated as is the holotype location near Twelve Mile Lake as a result of cultivation practices. Other areas in the southern Big Muddy Valley near the U.S. boundary are in danger of loss of habitat due to the low rolling topography of the area. Most of this region is already under cultivation for cropland. The steepness of the ridges and hills surrounding the townsite of Rock Glen protects these sites from cultivation but it is the only extensive site within Saskatchewan that is afforded a natural boundary of protection. As a result, the protection of the Rock Glen Saskatchewan sites is of primary importance (Smith 1994).

North of the Big Muddy Valley nearly all lands are cultivated. The unglaciated island habitats for blue phlox are the main remnants of presumably a broader range that included some of the presently cultivated lands.

9.4 Road Construction

The Mountain View site (Alberta, Site 4, Map 2) is in danger of eradication if road widening, observed in the summer of 1994 (Smith), continues westward from Mountain View. The site is close to the existing road and would probably be mostly, if not totally, destroyed by the widening process, especially if fill were dumped or the Belly River crossing required more extensive modification.

9.5 Hiking and Trail Use

Both the Police Outpost Provincial Park and the Rockglen sites could be damaged by continued use of existing trails or increased hiking amongst the Rockglen hills. Since the Police Outpost population is small, and grows in a somewhat atypical grassy habitat, any stress might endanger the population. Its location at the main lookout towards Chief Mountain lies on a particularly well-used trail (Smith 1994).

9.6 Invasive Species

Several sites have been invaded by yellow sweet clover (*Melilotus officinalis*). For example, at the site along the Big Muddy Valley (Site 2, Sask.) Yellow sweet clover occurs commonly to 2/3 of the way up the steep ridge and into the blue phlox habitat. The effect of weedy species on the distribution pattern of blue phlox is not known and requires further study.

At present, *Phlox alyssifolia* does not appear to be substantially threatened at any of its Alberta locations, with the exception of the Mountain View (Site 4) location. Blue phlox is substantially threatened in Saskatchewan as a result of cultivation practices. Two sites have already been lost. The best populations of blue phlox occur in sites around the town of Rock Glen and are protected by the steep relief of the ridges and hills. Should management practices change leading to adverse effects on the species, i.e., resumption of gravel extraction, switch in grazing pattern or intensity, resource extraction, or continued loss of habitat to cultivation, then the security of the species would have to be re-evaluated.

10. Present Legal or Other Formal Status

Argus and Pryer (1990) list the following rank designations for *Phlox alyssifolia* Greene: Nature Conservancy Rank: G5; Canada Rank: N2; Alberta S2, British Columbia S1, Saskatchewan S1; U.S. rank: North Dakota S1; Canadian Priority: 3. No specific legal status is accorded *Phlox alyssifolia* in any part of Canada. Alberta has no legislation which covers plant or endangered species.

In Canada, blue phlox occurs naturally only in southwestern Alberta and south central Saskatchewan with very little representation in British Columbia. As a result of this limited distribution the species is considered rare from a national perspective. Rare plant species lists from Alberta, Saskatchewan and British Columbia include blue phlox (Argus *et al.* 1978, Packer

and Bradley 1984, Maher *et al.* 1979, Straley *et al.* 1985). The species is also designated as rare in North Dakota (Argus and Pryer 1990).

All the lists of rare species for the prairie provinces are relatively long. The most recent Alberta list (Packer and Bradley 1984) contains 360 species, representing 24% of the native flora.

Kershaw (1987) describes three major groups of distribution patterns of rare species in the prairie provinces. Over 80% of the "rare" species in the prairie provinces appear to belong to a group composed of species extending into the provinces from nearby (non-disjunct) widespread populations. Such populations add considerably to the species diversity of the provinces, probably accounting for more than 20% of the total floras. *Phlox alyssifolia* belongs to this group. A second group is composed of species extending into the province as small disjunct populations and makes up less than 10% of the number of rare species in the prairie provinces. A third group, composed of endemic species, is limited to a local area and is restricted geographically (Kershaw 1987).

In Alberta, the entire Milk River area is a unique region. The reasons for this are numerous and varied. Numerous species of plants and animals whose range barely extends into Alberta are found here. Some 400 species of native plants occur in the Milk River Canyon area. The only exposures of igneous rock found in western Canada occur along the Milk River. There are massive sandstone outcrops along the Milk River (Anderson 1986).

II. Assessment of Status

11. General Assessment

The following criteria have been used to assess the status of *Phlox alyssifolia* Greene in Canada:

abundance (Blue phlox is common within its restricted range in Alberta and Saskatchewan.)

distribution (restricted in Canada to southern Alberta and Saskatchewan, range barely extends to sw British Columbia in the Crowsnest Pass. Noted to be a rare species in North Dakota.)

habitat distribution (restricted throughout its range in Canada, Alberta, Saskatchewan, British Columbia and in northwestern United States east of the continental divide.)

habitat stability (in Alberta, apparently stable at this time. Gravel removal, road building, grazing and trail use are the primary threats to continued viability. In Saskatchewan, cultivation practices threaten stability of habitat although the highest populations occur in the reasonably stable habitat around the town of Rock Glen.)

population trend (locations in Alberta, mid to upper tens of thousands of specimens within a restricted range; locations in Saskatchewan, ten thousand plus specimens within a restricted range, mostly around Rock Glen; locations in British Columbia, not surveyed in 1994; too early to recognize trends.)

reproductive potential (initial observation indicates a stable population, actively reproducing, more study required.)

international standing (assigned Global Rank G5 by Argus and Pryer (1990) indicating species stability.)

protective status (low, no formal designation, concern about future landowners, management of grazing leases, cultivation practices, and potential development on sites)

In Canada, *Phlox alyssifolia* is known from limited sites within a restricted range. Continuity of populations may be affected by many factors including changes in land use, increase in habitat destruction mostly through cultivation and grazing patterns in the remaining known and potential habitats. The lack of formal protection for potential sites with a viable management plan is a critical problem for the species' survival in Canada.

12. Status Recommendation

Blue phlox (*Phlox alyssifolia* Greene) is proposed for listing as a **vulnerable** species in Canada as a result of its substantial population base and relative freedom from threats to its continued success within its restricted distribution in southwestern Alberta. The species is under considerable threat in Saskatchewan as a result of cultivation practices but its substantial population on fairly inaccessible habitat around Rock Glen affords the species a degree of protection. Should further sites be lost to cultivation or gravel operations be increased to any scale within the species range the status recommendation should be reevaluated. This species has limited distribution within the United States and is considered rare in at least one of these states (North Dakota), but is fairly widespread and common within the majority of its American range.

13. Recommended Critical Habitat

The Del Bonita site in Alberta is recommended for designation as primary critical habitat. The Rockglen area in Saskatchewan is recommended for designation as secondary critical habitat.

Detailed information was provided to the chairman of the Plants Subcommittee for inclusion in the COSEWIC file for this species.

14. Conservation Recommendations

Detailed monitoring plans should be prepared for *Phlox alyssifolia* as a means of ensuring that habitat loss does not escalate to a point where status designation should be reconsidered. There must be a clear recognition of the value of foothills grassland for rare plants and animals. Changes in land use and development should be considered as necessary in order to assure continuation of populations of blue phlox in Canada.

Management of the native habitats should be undertaken to enhance or maintain both species richness and key individual species. Species such as blue phlox should have priority. The management plan should place restrictions on further development of roads, oil and gas pipelines, and cultivation in the North Milk River and Rockglen areas. Further developments of these types, especially gravel extraction, could have serious consequences for this species. It is recommended that gravel operations be sited in areas away from the plateau rims where there is the greatest concentration of rare species. Abundant gravel is found on lower terraces which do not seem to support the diversity of rare species. Future developments such as dugouts, dams, and fencing should be reviewed during the planning stage to avoid impacts on significant resources. A designated vehicle route plan should be formulated for all users of the areas. Plans to limit off-trail vehicle activity should be drawn up and implemented (Wershler and Wallis 1986).

III. Information Sources

15. References Cited in Report

Alberta Recreation and Parks. 1989. Ross Lake Candidate Ecological Reserve. Alberta Recreation and Parks, Edmonton, Alberta.

Anderson, Ronnene. 1986. "Alberta's Crown Jewels." Environment Views 8, No. 5.

Argus, George W. and K. Pryer. 1990. Rare vascular plants in Canada. National Museum of Natural Sciences. National Museums of Canada, Ottawa.

Argus, George W. and David J. White. 1978. The Rare vascular plants of Alberta. National Museum of Natural Sciences, Syllogeus Series No. 17. National Museums of Canada, Ottawa.

Booth, W.E. and J.C. Wright. 1959. Flora of Montana. Montana State University, Bozeman.

Cottonwood Consultants. 1983. A Biophysical Systems Overview for Ecological Reserves Planning in Alberta: Vol. 1. Regional Overviews. Alberta Recreation and Parks, Edmonton.

Coupland, Robert T. 1950. Ecology of mixed prairie in Canada. *Ecological Monographs* 20(4):273-315.

Cronquist, Arthur. 1981. An Integrated system of classification of flowering plants. Columbia University Press, New York.

Everett, Thomas H. 1981. The New York Botanical Garden illustrated encyclopedia of horticulture. Vol. 5. Garland Publishing Inc., New York.

Harms, Vernon L., Peggy Ann Ryan and Judy A. Haraldson. 1992. The Rare and endangered plants of Saskatchewan. University of Saskatoon, SK.

Hitchcock, C.L., A. Cronquist, M. Ownbey and J.W. Thompson. 1964. Flora of the Pacific Northwest. Vol. 4. Ericaceae to Campanulaceae. University of Washington Press, Seattle, Washington.

Hummel, Monte. 1987. Prairie conservation, pp. 21-26 in "Proceedings of the workshop on endangered species in the prairie provinces" by Geoffrey L. Holroyd *et al.* Provincial Museum of Alberta Natural History Occasional Paper No. 9, Edmonton, Alberta.

Kershaw, Linda. 1987. Rare plants in the prairie provinces: a discussion of terms and distribution characteristics, pp. 103-107, in "Proceedings of the workshop on endangered species in the prairie provinces" by Geoffrey L. Holroyd *et al.* Provincial Museum of Alberta Natural History Occasional Paper No. 9, Edmonton, Alberta.

Looman, J. and K.F. Best. 1979. Budd's flora of the Canadian prairie provinces. Publication 1662. Agriculture Canada, Ottawa.

Moss, E. 1983. Flora of Alberta. 2d ed. (revised by J.G. Packer) University of Toronto Press, Toronto.

Packer, John G. and Cheryl E. Bradley. 1984. A Checklist of the rare vascular plants in Alberta. Natural History Occasional Paper No. 5. Provincial Museum of Alberta and Alberta Culture, Historical Resources Division, Edmonton, Alberta.

PCAP. 1988. Prairie conservation action plan 1989-1994. World Wildlife Fund Canada.

Richards, J. Howard, ed. 1969. Atlas of Saskatchewan. University of Saskatchewan, Saskatoon.

Scoggan, H.J. 1978. Flora of Canada. Part 2. Publications in Botany, No. 7. National Museum of Natural Sciences. National Museums of Canada, Ottawa.

Smith, Bonnie. 1993-1994. Blue phlox field observations, population and habitat data,

Alberta and Saskatchewan.

Sommerfeldt, Barbara. 1993. Personal communication.

Spalding, David A.E. 1980. A Nature guide to Alberta. Provincial Museum of Alberta Publication No. 5. Hurtig Publishers, Edmonton.

Wallis, Clifford A. et al. 1986. Oldman River Project. Alberta Forestry, Lands and Wildlife, Edmonton, Alberta.

Wallis, Clifford A. 1987. Critical, threatened and endangered habitats in Alberta, pp. 49-63, in "Proceedings of the workshop on endangered species in the prairie provinces" by Geoffrey L. Holroyd *et al.* Provincial Museum of Alberta Natural History Occasional Paper No. 9, Edmonton, Alberta.

Wershler, Cleve and Clifford Wallis. 1986. Lost River significant features assessment. Alberta Forestry, Lands and Wildlife, Edmonton.

16. Collections Consulted

The following botanical collections have been consulted:

Canadian Museum of Nature (CAN) and Agriculture Canada (DAO), Ottawa, ON
University of Calgary (UAC), Calgary, AB
University of Alberta (ALTA), Edmonton, AB
Provincial Museum of Alberta (PMAE), Edmonton, AB
University of Lethbridge (LEA), Lethbridge, AB
University of Saskatchewan (SASK), Saskatoon, SK
University of Regina (USAS), Regina, SK

17. Fieldwork

During the summer of 1993, the author visited the known sites and general area between Whiskey Gap and Lake Shanks in an attempt to verify known locations as well as to search for additional locations. As well, several additional sites were located, notably sites west, south and southeast of Lake Shanks (Sites 1B, 1C, 1D, Alberta, Map 3). Site 1F (Milk River Crossing) and Site 1G (Shanks Creek) were also located. Population counts were undertaken for all sites visited. As well, various areas within the range of the species were examined for suitable species habitat (Map 3-5).

During the summer of 1994, the author visited several sites within southern Alberta; namely, Pincher Creek, Mountain View, Whiskey Gap, and Police Outpost Provincial Park. Population surveys and habitat descriptions were undertaken for all sites.

During the summer of 1994, the author visited the Saskatchewan sites, with the exception of the Roche Percee site. The Matador sites were inaccessible due to impassability of roads as a result of rainy conditions. The area around Rockglen and the Big Muddy were the focus of the summers fieldwork as these areas contained the majority of the known sites where blue phlox had been found previously.

Also, in 1986, Barbara Sommerfeldt discovered the species on her ranch just north of Whiskey Gap, Alberta. She has a long standing interest in botanical fieldwork and sends her specimens to the Northern Forestry Centre Herbarium for verification and/or identification by Derek Johnson. She has participated in the spring flowering count since 1986. During these counts Sommerfeldt listed the species as being in flower from 1986 to present on her ranch (Sommerfeldt, pers. comm.).

18. Knowledgeable Individuals

1. Barbara Sommerfeldt, Whiskey Gap, AB Phone: (403) 653-2136.

- collected Whiskey Gap specimen, has kept field data since 1986 on the Whiskey Gap site and area.

IV. Authorship

19. Initial Authorship of Status Report

The initial author of this report was:

Bonnie Smith, 6808 Silver Ridge Way NW, Calgary, AB T3B 4R4. Phone: (403) 288-4724.

20. Maintenance of Status Report

Bonnie Smith, 6808 Silver Ridge Way NW, Calgary, AB T3B 4R4. Phone: (403) 288-4724, will be responsible for receiving new information and making revisions and corrections to this status report and passing information on to COSEWIC.

APPENDIX 1

Detailed Locality Citations

The known British Columbia locations include:

1. Border Ranges, Crowsnest Pass.

The known Alberta locations include:

Site 1 Del Bonita and environs

Specimens

1. Del Bonita, 3 miles N of the U.S. border, Highway #493; June 1, 1976; Fred Fodor (#13); determined by B.M. Hallworth; UAC 21859.
2. W of Del Bonita on gravel road running parallel to U.S. border, North Milk River, ca 49 02'N 112 55'W; open grassy hillside; June 8, 1974; Dumais (#6693); ALTA.
3. MacIntyre Ranch, 40 miles S of Lethbridge, Milk River Ridge; near summit of steep canyon, uncommon; July 18, 1950; Dore and Breitung; ALTA.
4. South of Magrath, "The Ridge"; on rocks; June 23, 1932; McCalla (#3863); ALTA.
5. Milk River Ridge north of Del Bonita; eroded cliffs on north side of ridge; July 10, 1974; Job Kuijt (#4722); LEA.
6. Ross Community Pasture, NE of Whiskey Gap, 6-2-22-W4; Edge of old gravel pit, semi-barren slope, abundant in spots on hilltops and dry hillsides; May 22, 1993; B.M. Smith (#1046); UAC s.n.
7. E. Whiskey Gap, bridge over N. Milk River; clay, gravel slope along road, growing locally but not common; flower pale blue to white; June 13, 1966; B. de Vries (#3312-66); UAC 21860.

Field Observations

8. Just south of crossing of North Milk River, Highway 62, north of Del Bonita, southern Alberta; SE 32-1-21-W4; 49°4.5'N 112°46'W; May 23, 1993; Bonnie Smith (field obser.).

9. Overlooking North Milk River, west of access road to ranch, NW of Del Bonita, southern Alberta; NE 26-1-22-W4; 49°04'N 112°50'W; May 23, 1993; Bonnie Smith (field obser.).

10. South side of Lake Shanks and junction of roads, NE of Del Bonita, southern Alberta; NE 22-1-21-W4, SE 27-1-21-W4; 49°3.5'N 112°44'W; May 23, 1992; Bonnie Smith (field obser.).

11. Southeast of Lake Shanks and road to Twin Rivers from Del Bonita, southern Alberta; NW 12-1-21-W4; 49°1.5'N 112°41'W; May 23, 1993; Bonnie Smith (field obser.).

12. Just north of highway from Whiskey Gap to Del Bonita at crossing of North Milk River, east side, NW12-1-23-W4; dry steep cobbly hillsides, with *Oenothera caespitosa*, *Phlox hoodii*, *Oxytropis viscida*, common, carpeting upper steep slopes; May 23, 1993; B.M. Smith (field obser.).

13. Shanks Creek, north hills overlooking valley, north of Del Bonita, east side of road, SW20-1-21-W4; top of hill, rangeland, with *Phlox hoodii*, *Oxytropis viscida*, *Townsendia hookeri*, grasses (similar to Sommerfeldt Ranch site); May 23, 1993; B.M. Smith (field obser.).

Site 2 Whiskey Gap

14. Sommerfeldt Ranch, north side of road, north of Whiskey Gap; top of ridge, abundant in thousands; May 22, 1993; B.M. Smith (#1012); UAC s.n.

15. Sommerfeldt Ranch, same as above; May 15, 1994; B.M. Smith; UAC s.n.

16. Whiskey Gap; flowers white to very pale mauve, dry denuded hillside; May 17, 1941; Moss; ALTA.

Site 3 Police Outpost

17. Police Outpost Provincial Park, (49 00'N 113 28'W), 6-1-26-W5M; elev. 4500 ft., prairie grassland on a rocky ridge, occasional; June 21, 1974; Barbara Danielson and Susan Crack, Field No. 59; UAC 21861.

18. SW of Police Lake, SW Alberta; fescue grassland, elev. 4500 ft.; June 11, 1974; Shaw (#2386); ALTA.

19. Chief Mountain Lookout, SW of Outpost Lake, Police Outpost Provincial Park, just off interpretive trail by sign; top of hill amongst big rocks, partly barren grassland; low hundreds in population; May 15, 1994; B.M. Smith; UAC s.n.

Site 4 Mountain View

20. West of Mountain View at crossing of Belly River, hills east and west of Belly River; *Juniperus horizontalis*, *Phlox hoodii*, *Psoralea argentea*, grasses; mid-thousands in population; May 15, 1994; B.M. Smith; UAC s.n.

Site 5 Birdseye Butte

21. Birdseye Ranch; dry rocky slope of Birdseye Butte, also common below gas well on N slope of Birdseye Butte, elev. 5300 ft.; May 9, 1977; D. Coxson and J. Kuijt; ALTA, LEA.

Site 6 Pincher Creek

22. 5 miles W of Pincher Creek; exposed position, rocky ridge; June 19, 1940; S.S. Survey (#807); ALTA.

23. West Castle; first treed ridge west of Pincher Creek; Zoratti farm, rocky area west of ridge, 4300 ft.; July 11, 1972; Job Kuijt (#4570); LEA.

24. 6 miles W of Pincher Creek; on rocks with limber pine, rocky ridge; June 29, 1939; Moss; S.S. Survey (#146); ALTA.

25. 7 km west of Pincher Creek access road and 1 km south on gravel road; on rocky east-west running ridge, mostly barren rocky ridge tops in crevices and on cobbly-grassy hilltops, with juniper and limber pine; low thousands in population; May 14, 1994; B.M. Smith; UAC s.n.

Site 7 Fort Macleod

26. Fort Macleod, 20 miles west of Lethbridge, dry prairies and open slopes; August 25-27, 1964; Scoggan; ALTA.

27. South tip of Head-Smashed-In Buffalo Jump; from draw closest to road, south-facing roadside, 1/2 mile west of #259; May 31, 1982; J. Campbell-Snelling (#272J); LEA.

Site 8 Piegan Reserve

28. Piegan Reserve, 147 B, Porcupine Hills, (49°42'N 113°58'W), 9-30-W4M; elev. 5000 ft., rocky ridge; July 10, 1975; Barbara Danielson, Field No. 363; UAC 21862.

29. Porcupine Hills; 49°43'N 113°56'W; open meadow, edge of scattered *Pinus flexilis* - *Pseudotsuga menziesii*, below ridge top; May 13, 1978; D. Coxson (#5336); LEA.

The known Saskatchewan collections include:

Site 1 Rockglen and environs

1. SW of Lisieux, (49 17'N 105 58'W); Eroded slope, elev. 830 m; Looman, J. (#19708); 29 05 1974; SASK 115000(SCS).
2. 2 milles au sud de Rockglen, Riviere aux Trembles, branche Est; (49 08'N 105 57'W); Vallee laterale de la coulee, Zone arbustive; Boivin, B. & J.M. Gillet, (#8898); 13 08 1951; DAO #130988.
3. 1 mile NW of Rockglen, (49 11'N 105 58'W); NW 1/4 Sec. 10 T03 R30 W2; High non-glaciated hill, 2900 ft., associated with *P. hoodii*, *Erigeron compositus*, *Astragalus lotiflorus*, *A. triphyllus*; Ledingham, G.F. and J.H. Hudson (#2031); 28 05 1955; USAS #12676.
4. Rock Glen, (49 11'N 105 57'W); Eroded calcareous soils on hilltop and slopes, elev. 2950 ft.; Looman, J. (#8015); 04 07 1963; SASK 115001(SCS).
5. Rock Glen, see above; May 22, 1994; B.M. Smith; UAC s.n.
6. Rockglen, SW corner NE 1/4 Sec 15 T03 R01 W3, (49 13'N 106 04'W); Dry eroded cobbly Willowbunch clay outcrop, With *Geum triflorum*, *Potentilla concinna*, Locally abundant; Hudson, J.H. (#3765); 27 05 1979; SASK #68701, USAS #12675, DAO #336046.
7. 1 1/2 mi E of Quantock, McIntyre Creek, SE 1/4 Sec 3 T03 R01 W3, (49 11'N 106 04'W); N-facing slopes above McIntyre Creek, ca 3000' alt, Abundant and very showy; Ledingham, G.F., (#7156); 18 05 1981; USAS #1398.
8. 3 km east of Quantock, see above; abundant; May 22, 1994; B.M. Smith; UAC s.n.
9. 1 mile SSE of Canopus, (49 11'N 106 11'W), SE 1/4 Sec. 3 T03 R02 W3; Dry, eroding, S-facing bank above wooded valley, ca 3000 ft.; Ledingham, G.F., Don Blood and others (#6917); 07 08 1980; USAS s.n.
10. 3 miles W and 1 mile S of Quantock, (49 09'N 106 09'W), NW 1/4 Sec. 25 T02 R02 W3; Dry hilltop, ca 3000 ft. alt., above sandstone outcrop; Ledingham, G.F., Don Blood and others (#6858); 07 08 1980; USAS #1399.

Site 2 Big Muddy Valley and environs

11. Bengough, 10 mi S, (49 16'N 105 09'W); Dry open barren hills above Big Muddy; Ledingham, G.F. (#838); 18 06 1950; USAS #12673.

12. Bengough, 10 mi S, W of Big Muddy, (49 16'N 105 08'W); Dry exposed clay banks W of Big Muddy; Ledingham, G.F. and J.M. Hudson (#1904); 25 05 1954; USAS #12674.

13. Bengough, Big Muddy Valley, (49 15'N 115 10'W), SE1/4 Sec 27 T03 R24 W2; Small eroded gravelly knoll, badlands in Big Muddy Valley; Ledingham, G.F. and J.H. Hudson (#1451); 25 05 1954; DAO s.n.

14. 2 miles S of Big Muddy Creek on Highway #34, S of Bengough, (49 14'N 105 09'W); SW-facing ridge, associated with *Agropyron dasystachyum* and *Stipa comata*; Romo, Jim (s.n.); 27 05 1990; SASK 90782.

15. 2 miles S of Big Muddy Creek, see above; SE-facing slopes of Big Muddy Valley; May 23, 1994; B.M. Smith; UAC s.n.

16. 3 km north of U.S. border crossing, Highway #34 to Big Beaver; ne-nw-facing slope, low rolling hills; scattered plants; May 23, 1994; B.M. Smith; UAC s.n.

17. Near Buffalo Gap, (49 07'N 105 16'W); Eroded hilltop, elev. 800 m.; Looman, J. (#20019); 02 07 1974; SASK 114999(SCS).

18. District de Wood Mountain, Harptree, 5 milles au nord-est, (49 21'N 105 23'W); Ecorre de la coulee; Boivin, B. & J.M. Perron, (#11872); 04 06 1958; SASK #63413, DAO #131379.

19. Big Muddy Valley area, N end of dam over Big Muddy Lake, (49 09'N 104 45'W), Sec 28 T02 R21 W2; Grassy slope at N end of dam, quite common in area; Morrison, H. and G.F. Ledingham (#68-17); Verified by H. Morrison 1969; 15 05 1968; SASK 36780, USAS 12672.

Site 3 15 km East of Roche Percee

20. Pinto- Souris, IBP Area 71-22, On the Souris River, 15 km E of Roche Perce, (49 06'N 102 36'W); Adam, C.I.G.; 1985; Univer., Lit. rep.

Site 4 Wood Mountain

21. Wood Mountain, 12 Mile Lake, (49 29'N 106 14'W); Hillsides; **ISOTYPE!**; Macoun, J. (#11813); Verified by A.J. Breitung; 05 06 1894; 1957; CAN 93474.

Site 5 Matador

22. E of Matador, (50 48'N 107 57'W); Steep stony and eroded, calcareous slope, elev. 750 m; Looman, J. (#12225); 22 05 1969; DAO 640183, SCS s.n.

23. Matador Community Pasture, East, (50 48'N 107 45'W); Eroded slope, *Astragalus caespitosus*, elev. 800 m.; Looman, J. (#13801); 25 05 1970; SCS s.n.
24. Matador Community Pasture, S field, (50 48'N 107 45'W) Prairie slope, elev. 660 m., Looman, J. (#20446); 02 06 1975; SASK 115002(SCS).
25. Matador Community Pasture, ca 56 km N of Swift Current, ca 11 km N of Lake Diefenbaker, ca 2.5 miles east and 5 miles N of University of Saskatchewan Matador Research area, (50 47'N 107 40'W), SW 1/4 Sec. 18 T21 R12 W3; Grassland along old road-cut on W aspect, associated *Astragalus triphyllus* and *Oxytropis campestris*; Romo, Jim (s.n.); 09 05 1990; SASK 90952.

APPENDIX 2

Habitat Site Description

The Alberta sites occur in the Foothills Grassland Sub-Region of the Grasslands Natural Region. The major natural vegetation of this area is rough and Idaho fescues and intermediate oat grasses. There are more forbs in this grassland type, including some found in the mountain areas to the west, such as perennial lupine, sticky purple geranium, and common yarrow. These grasslands are characterized by a much greater variety and cover of forbs than exist in the Northern Fescue Grasslands (Alberta Recreation and Parks 1989).

Five basic types of vegetation were mapped within the Ross Lake area; namely, fescue grassland (the most common, occurring on flatter upland surfaces), mixed meadow on the slopes of the area containing more forb species than on the flatter uplands, sage prairie on drier hilltops and well-drained gravel deposits which is more sparsely vegetated, rich meadows of grasses, sedges and forbs on coulee bottoms, and thickets of shrubs which grow on sheltered, moist north-facing slopes of a few coulees. Blue phlox prefers the sage prairie of the drier hilltops (Alberta Recreation and Parks 1989).

The sage prairie is characterized by good drainage and strong exposure to sunshine. This makes for drier conditions and the grasses give way to a community of smaller, hardy forbs dominated by sage. The most common plants here are the sages, prairie sagewort and pasture sagewort, along with small-leaved everlasting, alpine goldenrod and moss phlox. Some grasses like June grass, spear grass and northern wheat grass are found here as well as some drought-tolerant grasslike plants (graminoids) like rushes and sedges. The sage prairie communities at Ross Lake tend to be found in rather small patches, occurring on valley ridges, south-facing slopes or gravelly deposits, wherever drier conditions are found (Alberta Recreation and Parks 1989). These areas are somewhat more common west and south of Lake Shanks (Figures 6-9).

Blue phlox occurs on the Mixed Grassland Sub-region of the Grasslands Natural Region. The areas around Matador are characterized by wheat grass. June grass prairie. The areas surrounding the more southernly sites are characterized by spear grass, blue grama, wheat grass and June grass prairie. As well, there are a variety of valley complexes around Fife Lake and Big Muddy Lake and associated waterways (Richards 1969).

Phlox alyssifolia apparently requires a combination of factors including the following: unglaciated terrain, brown chernozemic soils, steep relief in most cases, a semiarid climate, and a drainage system which, for the most part, eventually empties into the Gulf of Mexico.

British Columbia

Site 1 - Crowsnest Pass

This site has not been examined as its exact location is uncertain. The location is given as border ranges, British Columbia.

Alberta

Site 1 - Del Bonita and Environs (Map 2, 3, Figures 2-3, 6-9)

Ross Lake Community Pasture (Site 1A, Figure 2)

This site was situated on a southeast-facing, gravelly, unglaciated plateau rim. *Phlox alyssifolia* was found growing with numerous other low-growing plants including *Cryptantha nubigena* (Greene) Payson, *Hymenoxys richardsonii* (Hook.) Cockerell, *Bupleurum americanum* Coult. & Rose, *Artemisia frigida* Willd. (dominant plant), *Poa* sp., *Phlox hoodii* Richards., *Selaginella densa* Rydb., *Hymenoxys acaulis* (Pursh) Packer on the upland portion and *Oxytropis viscida* Nutt., *Thermopsis rhombifolia* (Nutt.) Richards., *Oxytropis sericea*, *Eriogonum flavum* Nutt., *Musineon divaricatum* (Pursh) Nutt. and *Oxytropis lagopus* Nutt. (a nationally rare species, Argus and Pryer 1981) on the downslope portion. Away from the 10 m wide area along the plateau rim *Phlox alyssifolia* becomes less common as the grassland below and above this strip is lush and apparently too dense to support this species (Smith 1993).

Smith (1993) found the following species, in addition to those listed above, associated with *P. alyssifolia* on the plateau rim at the Ross Lake Community Pasture site: *Draba oligosperma* Hook., *Poa cusickii* Vasey, *Erigeron compositus* Pursh, *Potentilla concinna* Richards., *Androsace septentrionalis* L., *Heuchera flabellifolia* Rydb., and *Carex pensylvanica* Lam. var. *digyna* Boeckl. The grassy slopes below the area which supports *P. alyssifolia* were dominated by *Festuca idahoensis* Elmer and *Lupinus sericeus* Pursh. *Arabis nutallii* Robinson, *Poa cusickii*, *Hedysarum sulfurescens* Rydb., and *Thermopsis rhombifolia* were also scattered along the grassy slopes of the lower ridge area.

West of Lake Shanks, south of Highway #62 crossing of North Milk River (Site 1B, Figures 3, 9)

This site is again fairly typical of those described above. *Antennaria umbrinella* (both male and female plants) were very common on the upper ridge areas but the major associates of *Phlox alyssifolia* were *Oxytropis lagopus*, *Festuca brachyphylla* Schultes, *Carex pensylvanica* var. *digyna*, and *Astragalus crassicaulus*, *Oxytropis sericea*, and *Phlox hoodii*. *Cryptantha nubigena*, *Artemisia campestris*, *Eriogonum flavum*, *Physaria didymocarpa*, and *Poa cusickii* were less common (Smith 1993).

Immediately south of Lake Shanks (Site 1C, Figures 6-7)

Very similar to the Site 1B west of Lake Shanks. *Phlox alyssifolia* was found growing on the upper slopes of the plateau rim as well as on the gravelly plain on top of the plateau, and the upper slopes of the steep hills. Again the habitat was semi-barren with common *Oxytropis lagopus* and *Artemisia campestris* (Smith 1993).

Southeast of Lake Shanks, Road from Del Bonita to Twin Rivers (Site 1D)

Blue phlox was common here and was found growing not only on the typical gravelly plateau rims and upper slopes but extended right to the edges of the grassy middle slopes. Otherwise, the site was very similar to sites 1B and 1C, immediately south and west of Lake Shanks (Smith 1993).

Overlooking North Milk River, Ranch Road West of Lake Shanks (Site 1E)

This site was rather different than those described above. *Phlox alyssifolia* was found growing in association with grasses, mostly *Festuca idahoensis* as well as *Thermopsis rhombifolia*. Neither species was found associated with *Phlox alyssifolia* at its other locations, except Police Outpost Provincial Park. Other species found at the site were as follows: *Oxytropis sericea*, *Artemisia frigida*, *Plantago canescens*, and *Antennaria microphylla* Rydb. No *Oxytropis viscida* was found at this site. The grass was taller and less grazed than at other sites. The area was fenced and there was no indication of active grazing (Smith 1993).

Crossing of North Milk River, Between Whiskey Gap and Del Bonita (Site 1F)

Dry, steep, cobbly hillsides growing with *Oenothera caespitosa*, *Phlox hoodii* and *Oxytropis viscida*. Otherwise, similar to other locations within Site 1 (Smith 1993).

Shanks Creek, North of Del Bonita (Site 1G)

Top of hill overlooking valley above creek. Rangeland with *Phlox hoodii*, grasses, *Oxytropis viscida*, *Townsendia hookeri*. Otherwise, similar to other locations within Site 1 (Smith 1993).

West of North Milk River crossing, Between Whiskey Gap and Del Bonita (Site 1H)

Open grassy hillside.

Site 2 - Whiskey Gap (Map 2, Figures 4-5, 8)

Sommerfeldt Ranch

Barbara Sommerfeldt has been an active participant in the spring flowering count project since

1986. She has compiled a list of nearly 300 species which occur on her ranch. She has sent specimens to the Northern Alberta Forestry Station for identification or confirmation. *P. alyssifolia* again is mostly restricted to the gravelly plateau rims and upper slopes on the ridges north of Whiskey Gap.

The upper slopes and plateau rim are very similar to the Ross Lake Community Pasture site, in fact, they are located on the same ridge system. In addition to those species previously described *Antennaria umbrinella* Rydb., *Astragalus gilviflorus* Sheldon, *Penstemon nitidus* Dougl., *Arabis nuttallii*, *Erigeron radicans* Hook. (a nationally rare species, Argus and Pryer 1981), *Plantago canescens* Adams, *Physaria didymocarpa* (Hook.) A. Gray, *Minuartia rubella* (Wahl.) Graebn., and *Artemisia campestris* L. were also found on the ridge tops and upper gravelly slopes in conjunction with *Oxytropis lagopus* and *Phlox alyssifolia*. *Oxytropis viscida* and *Oxytropis sericea* were rather common on the ridge tops (Smith 1993/94).

Site 3 - Police Outpost (Map 2, Figures 12-13)

Blue phlox was found in one location at this site. The species occurred in the middle of a fescue grassland on a slightly barren, rocky hilltop beside an interpretive sign. Associated species: *Potentilla fruticosa*, *Phlox hoodii*, *Anemone patens*, *Oxytropis viscida*, *Juniperus horizontalis* (Smith 1994).

Site 4 - Mountain View (Map 2)

Populations of blue phlox occur on low hills east and west of the Belly River. The general area is quite grassy. *P. alyssifolia* is mostly found on the somewhat more rocky hilltops in slightly barren (10%) areas. The entire area, close to the Waterton Ranges, is very hilly. Associated species: *Juniperus horizontalis*, *Arctostaphylos uva-ursi*, *Phlox hoodii* and blue phlox are the dominant species. Also, *Anemone patens*, *Psoralea argophylla*, *Antennaria neoidea*, *Comandra umbellata*, *Astragalus gilviflorus*, *Oxytropis viscida*, *Smilacina stellata*, *Potentilla fruticosa*, *Elaeagnus commutata* (1-2' height) (Smith 1994).

Site 5 - Bird's-eye Butte (Map 2)

This site was not visited during the summer of 1994 (Smith). The habitat is probably similar to that described for Mountain View.

Site 6 - Pincher Creek (Map 2, Figures 10-11)

High east-west running ridge, sandstone dike. Blue phlox grows in rock crevices (Fig. 10) on the protruding rock dike and on rocky ridge tops. Populations extend downslope to the edges of grassy mid-slopes. Associated species: *Juniperus horizontalis*, scattered *Pinus flexilis* (6"-2' height), *Astragalus vexilliflexus*, *Penstemon*, *Oxytropis sericea*, *Eriogonum flavum*, *Antennaria umbrinella*, *Astragalus crassicaulis*, *Phlox hoodii*, *Artemisia frigida*, *Cryptantha macounii*, *Draba*, *Potentilla fruticosa* (few). *Koeleria macrantha* and *Thermopsis rhombifolia* overtakes

habitat for blue phlox as proceed west. This habitat is quite different from the other Alberta sites, not in species composition (with the exception of *Pinus flexilis*) but in site characteristics. This is the only site in which a steeply protruding rocky ridge dominated the hilltop (Smith 1994).

Site 7 - Fort Macleod (Map 2)

This site was not visited during the summer of 1994.

Site 8 - Piegan Reserve (Map 2)

This site was not visited during the summer of 1994.

Saskatchewan

Site 1 - Rockglen and Environs (Map 2, 4, Figures 14-19)

All sites surrounding the town of Rockglen were situated on an extensive unglaciated ridge system which extended from north of Scout Lake to south and just east of Rock Glen and west to Quantock. Actual and potential sites were examined twice in the summer of 1994 (Smith), once in mid-May and again in mid-July. The absence of glacial modification has produced a distinctive vegetation pattern at these sites as was also noted in the Del Bonita uplands in Alberta. Both *P. alyssifolia* and *Erigeron radicans* (rare species) were common over the high ridges during the May trip but neither were much in evidence during the second trip in July.

The ridge systems and hills, from a distance, look brownish and are in places up to 50% barren of vegetation. Most commonly the upper slopes and hilltops are between 20 to 30% barren. Blue phlox was found on a variety of habitats over the ridge system but was most common on the cobbly, stony, steep semi-barren tops and upper slopes of the hills. There are areas of steep stony slides on the upper slopes. Blue phlox was also found less commonly down near the highway on the grassy lower slopes. There was an peculiar mixture of low and tall vegetation on the upper slopes and hilltops. Grasses were mostly restricted to the lower slopes and roadside areas.

The upper slopes and tops of the Rockglen ridges and hills have remained mostly unglaciated. The following is a site description for blue phlox which is fairly standard for all locations included within the Rockglen site. Common with Phlox alyssifolia: *Eriogonum pauciflorum*, *Juniperus horizontalis*, *Astragalus gilviflorus*, *Erigeron compositus*, *Phlox hoodii*, *Haplopappus armerioides*, *Erigeron radicans*, *Lesquerella arenosa*, *Hymenoxys richardsonii*, *Chrysothamnus nauseosus* (scattered), *Hymenopappus filifolius*, *Eriogonum flavum*, *Selaginella densa*, lichens. All of the preceding were very common on the tops and upper semi-barren gumbo slopes. Other species found less commonly on the upper slopes and hilltops include the following: *Musineon divaricatum*, *Penstemon nitidus*, *Cryptantha macounii*, *Eurotia lanata*, *Oxytropis sericea*. Other species, mostly from the lower grassy slopes, include the following: *Castilleja sessiliflora*,

Astragalus pectinatus, *Artemisia cana*, *Thermopsis rhombifolia*, *Koeleria macrantha*, *Solidago missouriensis*, *Potentilla fruticosa*, *Petalostemon purpureum*, *Oenothera caespitosus*, *Astragalus vexilliflexus*, *Gaillardia aristata*, *Antennaria microphylla*, *Stipa comata*, *Erigeron caespitosus*, *Anemone patens*, *Psoralea esculenta*, *Anemone multifida*, and *Linum rigidum*. There is a distinct habitat gradation from the hilltop to the lower grassy slopes as would be expected. The hills are very striking. The entire area is unique - its scenery, vegetation, and geology.

There may be a comparison between the Del Bonita unglaciated ridge and hill systems around the western and southern areas of Lake Shanks in Alberta with the unglaciated Rock Glen ridge and hill systems around the western and southern areas of Fife Lake. An interesting study of patterns of distribution of rare plants found on unglaciated locations could be undertaken using these two sites as examples. *E. radicans* and *P. alysifolia* have been found on both systems. *Oxytropis lagopus* has only been found at the Del Bonita site while *Hymenopappus filifolius* has only been found at the Rock Glen site. *P. alysifolia* is very common at both sites (Smith 1994).

Site 2 - Big Muddy and Environs (Map 2,4, Figures 20-23)

3 km North of U.S. Boundary Crossing, Highway #34 to Big Beaver (Figures 20-21)

Site 2A

Low rolling hills on northeast and northwest-facing slopes. Associated species: *Oxytropis sericea*, *Juniperus horizontalis*, *Phlox hoodii*, lichens, *Potentilla fruticosa* (1' height), *Artemisia cana*. *P. alysifolia* seems to be particularly associated with *Oxytropis sericea* at this site. Wherever *O. sericea* was found so was blue phlox. Blue phlox can occur from the bottom of the hills to the hilltops but prefers the top 1/3 of the slopes. There are cobbly, stony areas at the bottom of the low hills in spots but *P. alysifolia* does not occur on these sites. *Oenothera caespitosa* frequents the stony areas.

Site 2B

Big Muddy Valley (Figures 22-23)

Southern hill on the western side of Highway #34 was examined for blue phlox. Southeast-facing grassy very steep slope on very high ridges of the Big Muddy Valley. Blue phlox occurs on the 50% barren muddy open area on the ridgetop and the semi-barren top 1/4 of the ridge. Associated species on steep upper slopes of ridges: *Artemisia cana*, *Geum triflorum*, *Gutierrezia sarothrae*, *Lesquerella arenosa*, *Penstemon nitidus*, *Phlox hoodii*, *Haplopappus armerioides*, *Opuntia polyacantha*. Associated species on ridgetop: *Eurotia lanata* (6" height), *Haplopappus armerioides*, *Astragalus gilviflorus*, *Eriogonum flavum*, *Oxytropis sericea*, *Penstemon nitidus*, *Cryptantha macounii*, *Psoralea esculenta*, *Comandra umbellata*, *Hymenoxys richardsonii*.

Site 3 - 15 km east of Roche Percee (Map 2)

Site not visited during the summer of 1994. Furthest east site for the species, literature citation only. Should be checked in the future.

Site 4 - Wood Mountain (Map 2)

The site is cultivated right up to the edges of the Twelve-Mile Lake on both the north and south sides. This site can be considered extirpated, which is unfortunate since it is the type location for the species (Macoun 1894).

Site 5 - Matador (Map 2)

This site was inaccessible during the spring of 1994 when visited. The access road was impassable due to recent heavy rainfall. The author did gain access to the western end of the Matador Community pasture but no specimens were noted during that time. Other sites around the edges of the community pastures were visited but no specimens were found.

In July the area was examined once again. The Matador University Research Station site has great potential for blue phlox. The mid-July sampling was too late in the season for specimens of blue phlox to be found. The site was characterized by steep 50% barren slopes with *Hymenopappus filifolius*, *Eriogonum flavum*, *Artemisia frigida*, *Artemisia cana* (few, 6" tall), *Haplopappus spinulosus*, *Astragalus gilviflorus*, *Psoralea esculenta*, *Opuntia polyacantha*, *Koeleria macrantha*, and *Psoralea argentea*. The habitat is similar to that preferred by blue phlox (Smith 1994).

3
1

APPENDIX 3

Critical Habitat Recommendations

The Del Bonita uplands site is recommended for designation as primary critical habitat for the survival of blue phlox within Alberta and Canada. It is the most populous and most extensive site within Canada (Map 3). The Rockglen area is recommended for designation as secondary critical habitat. This site is the most populous and most extensive site within Saskatchewan (Map 4, 5). Naturally, given the limited Canadian distribution of the species, all of its sites are important and should be protected but these areas, representing collection sites, are by far the most well represented and, if managed properly, should ensure the survival of the species in Canada.



Figure 1: *Phlox alyssifolia* Greene
(E. Haber, after Hitchcock et al.)

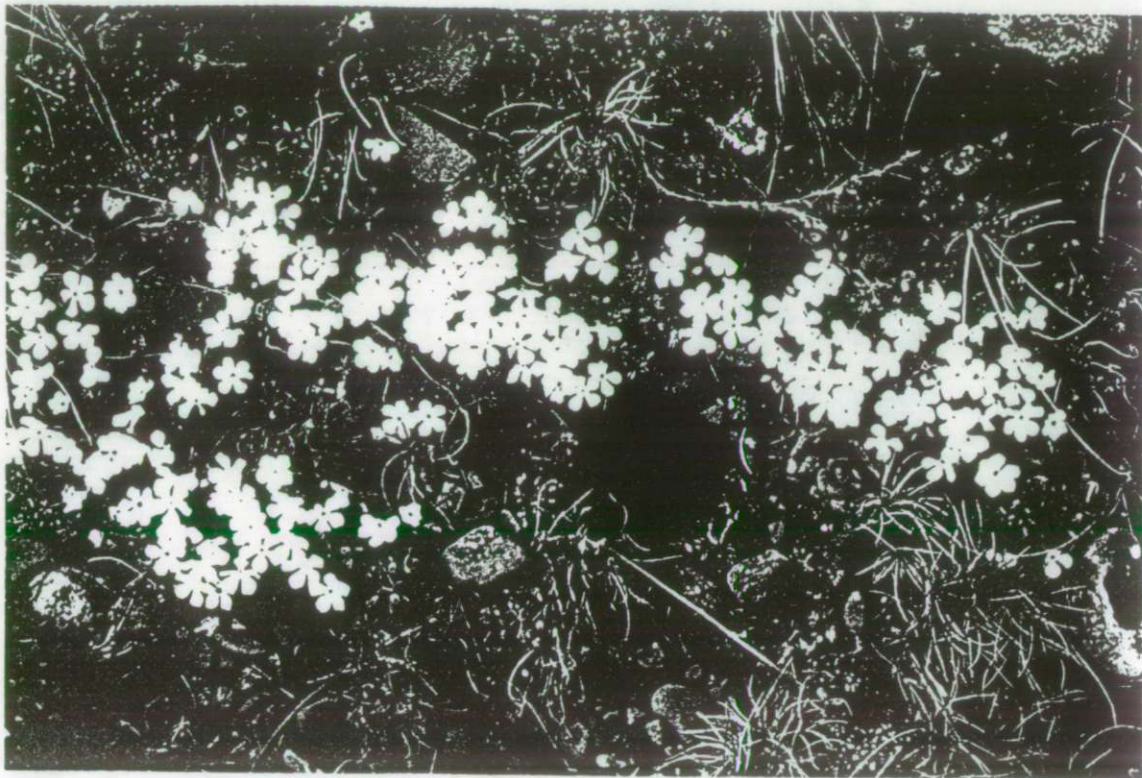


Figure 2: Blue phlox and stony, semi-barren habitat.
Site 1A: Ross Lake Community Pasture, Alberta.



Figure 3: Blue phlox (large white, upper right) with associated species.
Oxytropis lagopus (purple, center); *Oxytropis sericea* (yellow, upper left);
Phlox hoodii (small white, lower center beneath *Oxytropis lagopus*).
Site 1B: West of Lake Shanks, Alberta.



Figure 6 Blue phlox habitat, yellow flowers mostly *Oxytropis sericea*
Site 1C: South of Lake Shanks (in photo), Alberta.

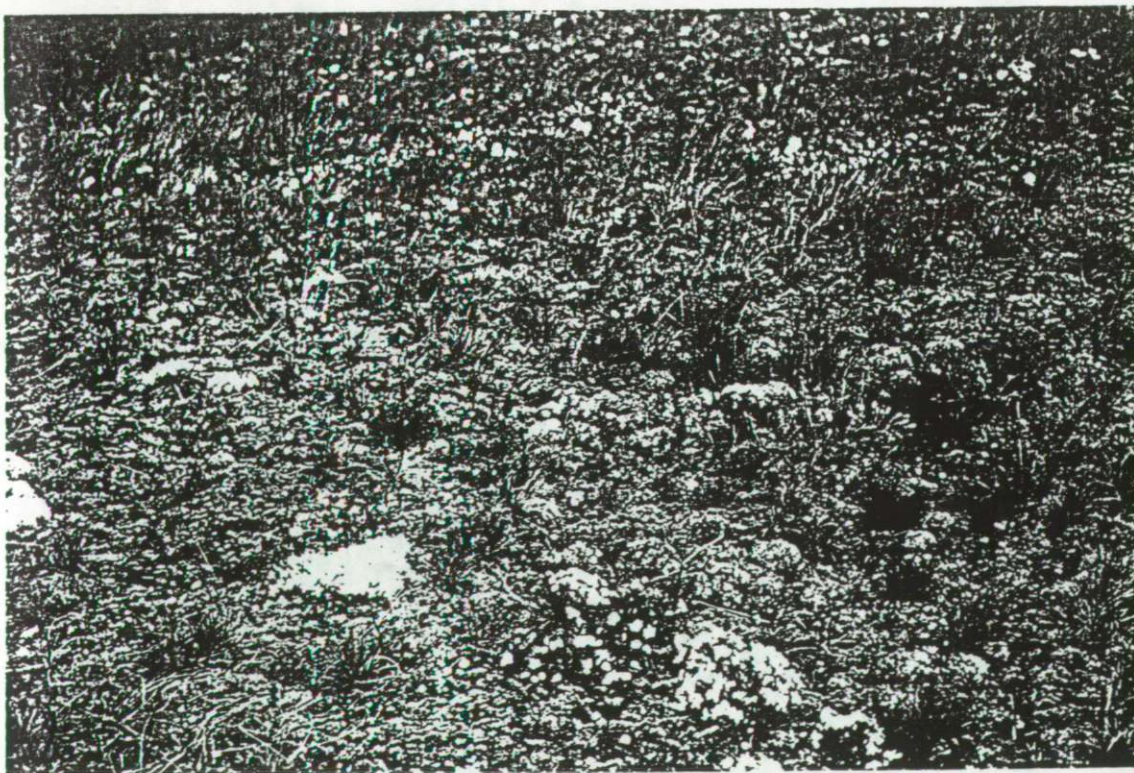


Figure 7: Note large patches of Blue phlox (foreground).
Site 1C: South of Lake Shanks, Alberta.

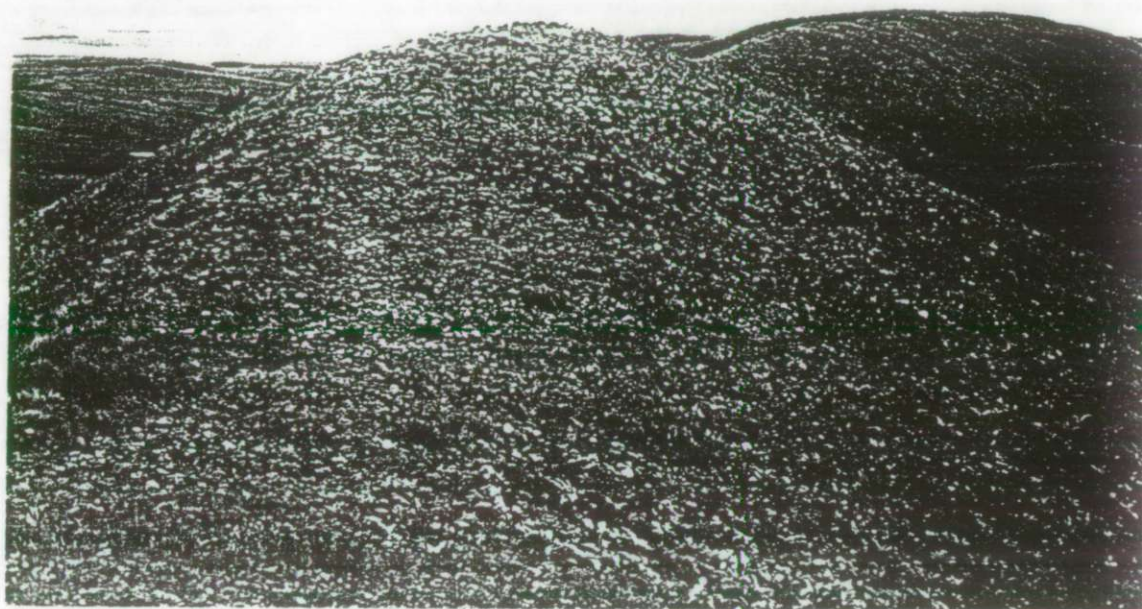


Figure 4 Blue phlox habitat, high ridges, hills. Note cultivated lands in background (upper left). Site 2: Whiskey Gap, Alberta.

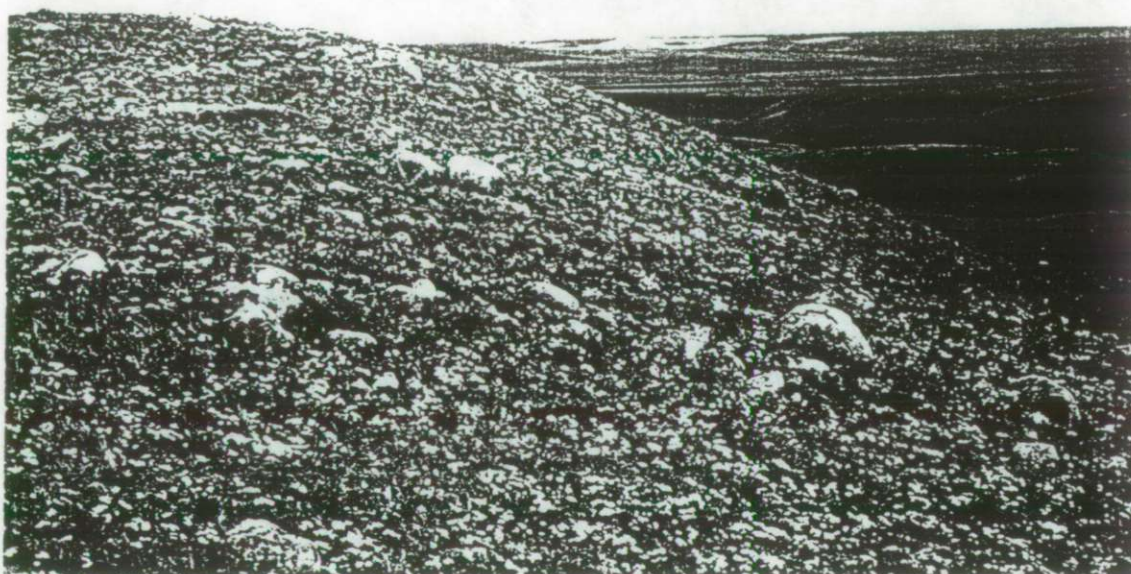


Figure 5 Blue phlox (white) stony hilltop habitat. Note *Oxytropis lagopus* (purple), also a vulnerable species. Site 2: Whiskey Gap, Alberta.



Figure 8 *Phlox allysifolia* Greene (white) amongst taller grasses
Site 2: Whiskey Gap, Alberta.

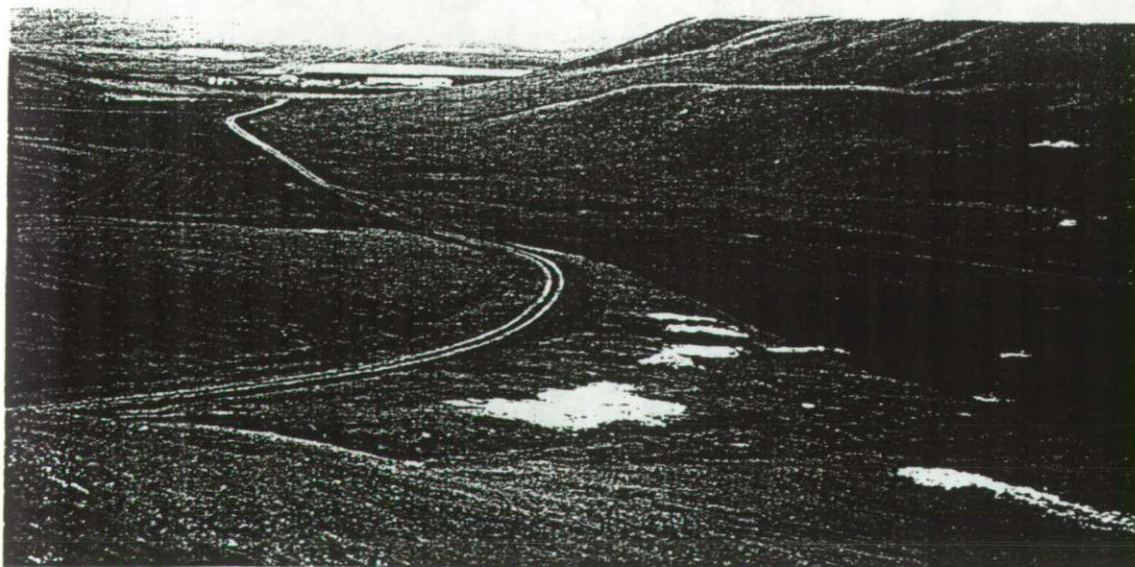


Figure 9 High ridges, preferred Blue phlox habitat. Note farmland in background
Site 1B: West of Lake Shanks, Alberta.



Figure 10 Blue phlox habitat, semi-barren, high ridge. Site 6. Pincher Creek, Alberta

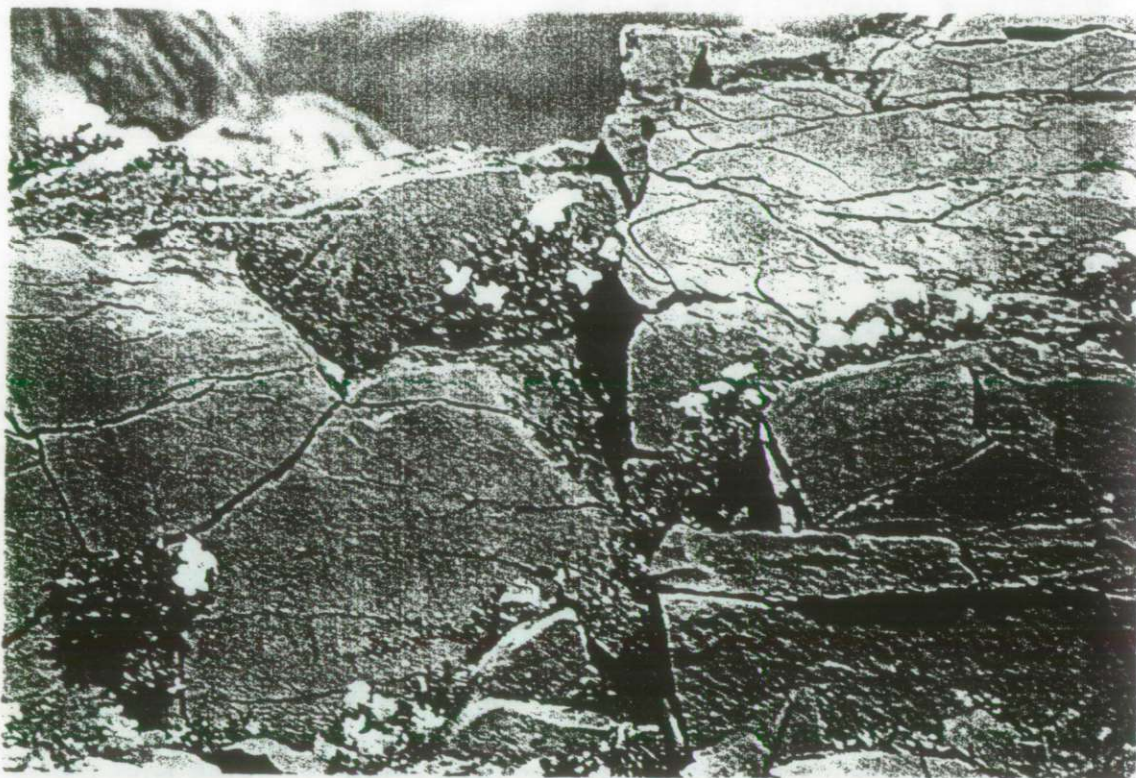


Figure 11 *Phlox alyssifolia* Greene in rock crevices. Site 6. Pincher Creek, Alberta

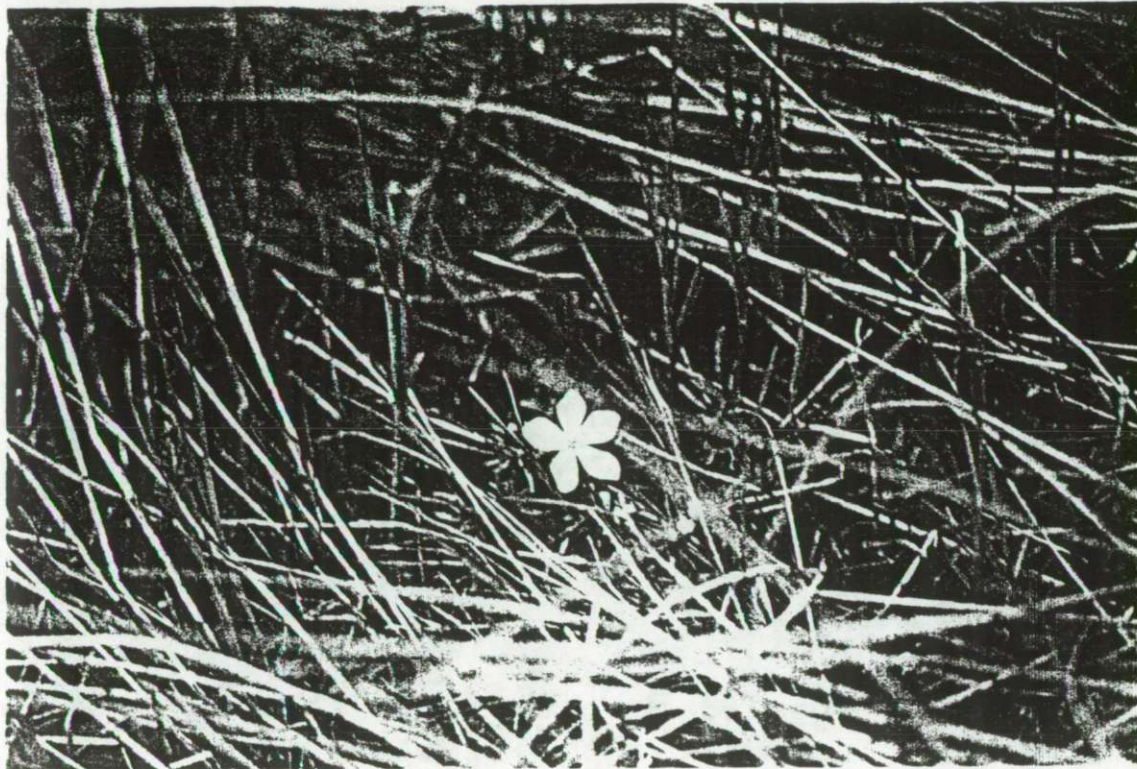


Figure 12: Blue phlox, single stems, in grassland
Site 3: Police Outpost Provincial Park, Alberta



Figure 13: *Phlox alyssifolia* Greene habitat, grassland.
Site 3: Police Outpost Provincial Park, Alberta.

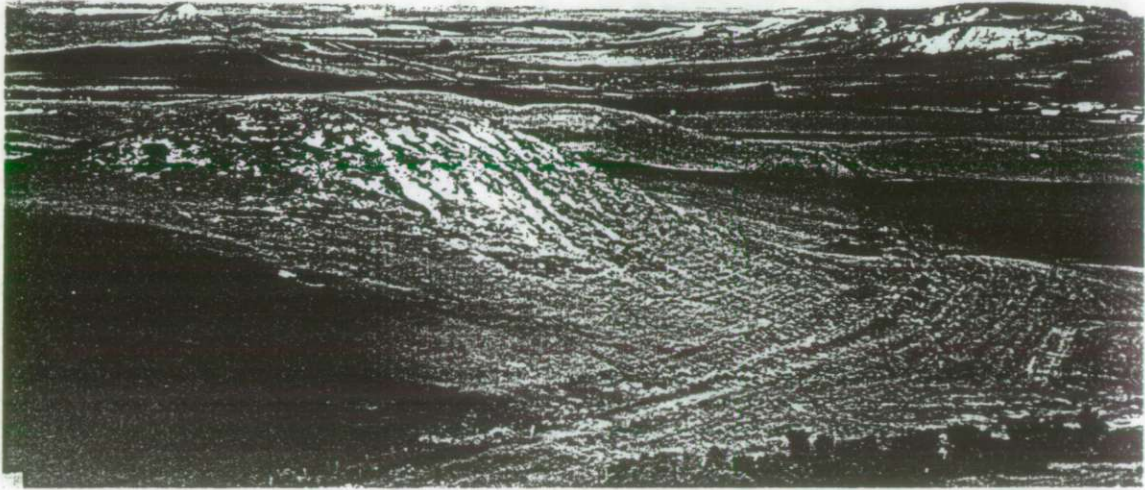


Figure 14 Blue phlox habitat, semi-barren high ridges near Rock Glen, Sask.
(Site 1) Note haying and farmland at lower elevation.



Figure 15: Blue phlox habitat (in July), semi-barren steep hills
Near Rock Glen townsite, Sask. (Site 1)

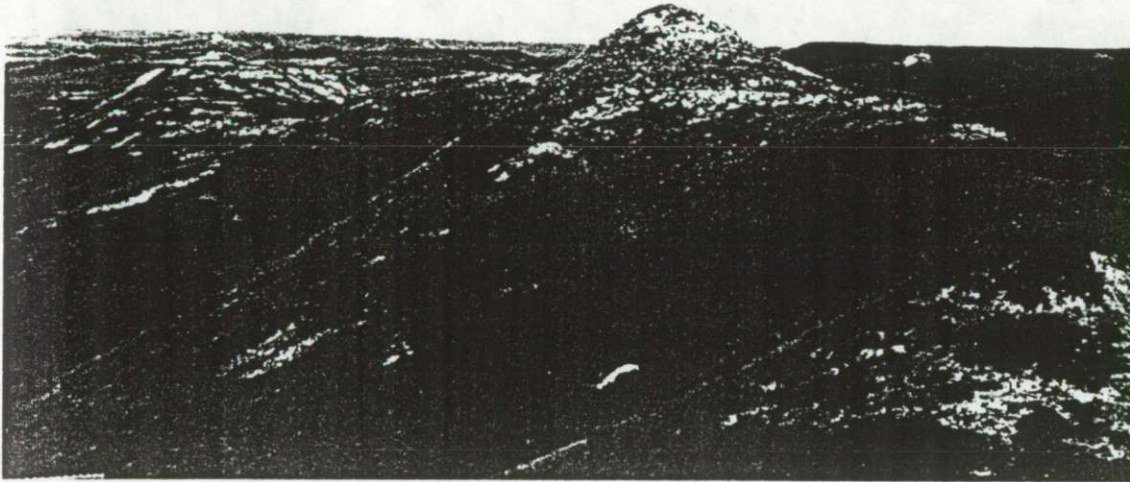


Figure 16 High ridges near Rock Glen townsite, Sask., Site 1
Upper slopes are prime blue phlox habitat

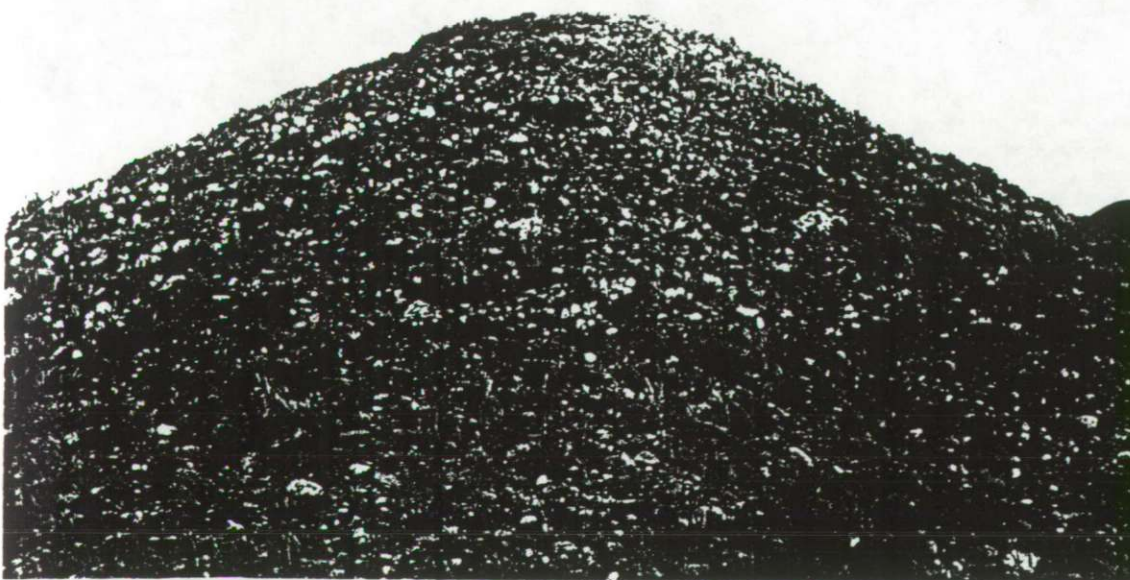


Figure 17 Semi-barren, rocky hilltops (white-pink patches are blue phlox). Near Rock Glen townsite, Sask., Site 1.



Figure 18: Large patches of blue phlox (pinkish flowers in background are fading). Site 1: Rock Glen, Sask

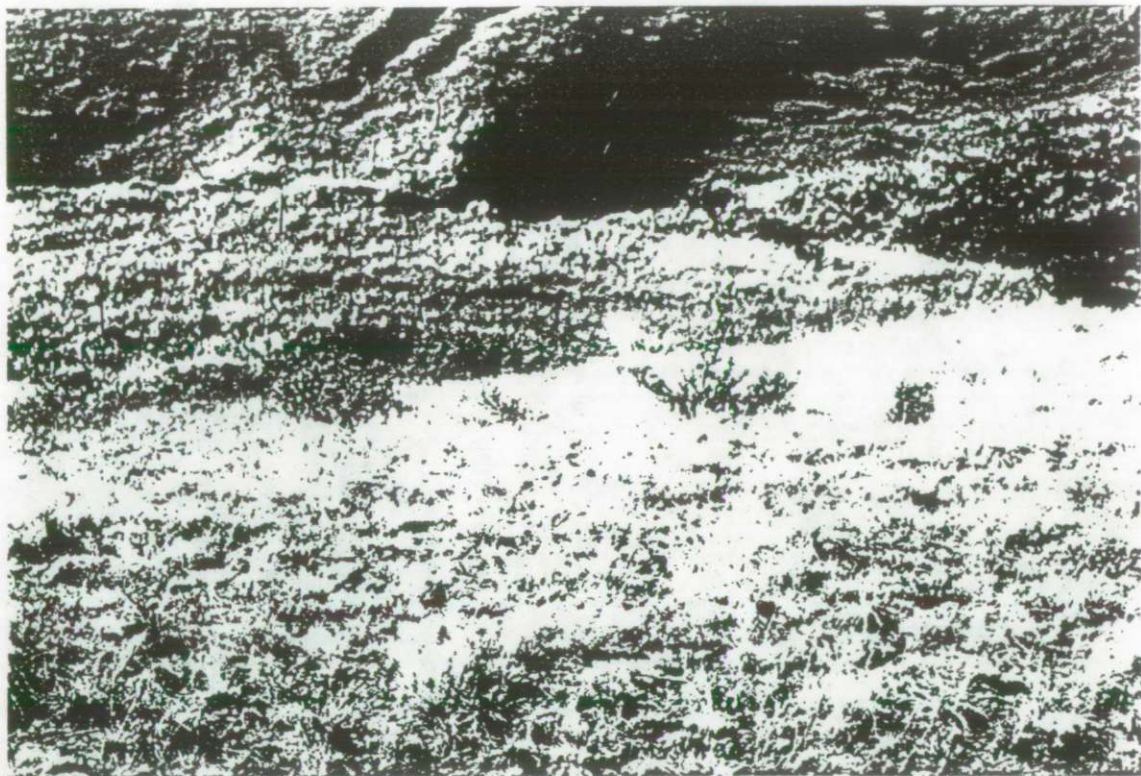


Figure 19: Lowland habitat, base of high ridges. White-flowered *Phlox alyssifolia* Greene in foreground. Site 1: Rock Glen, Sask.

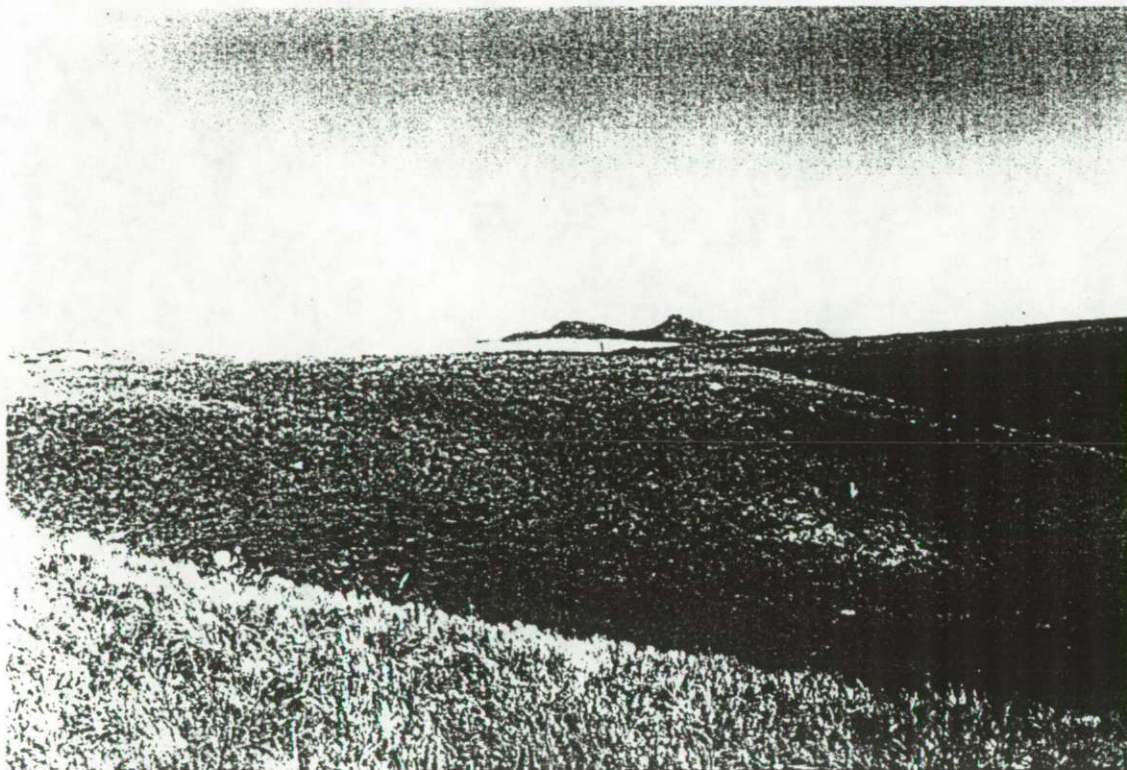


Figure 20 Blue phlox habitat, foreground. Note high ridge, background
 Site 2: Big Muddy area, 3 km north of U.S. boundary, Sask.

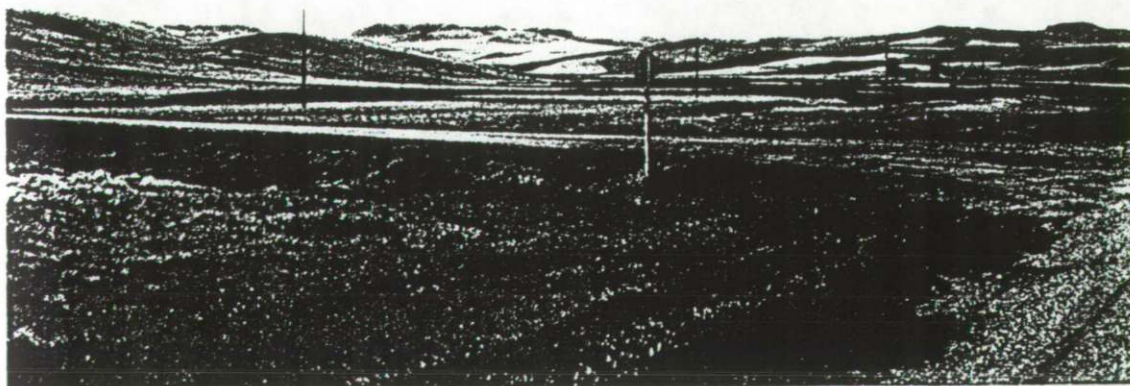


Figure 21: Cultivation practices showing habitat loss on hills and lowlands.
 Site 2: Big Muddy area, 3 km north of U.S. boundary, Sask.

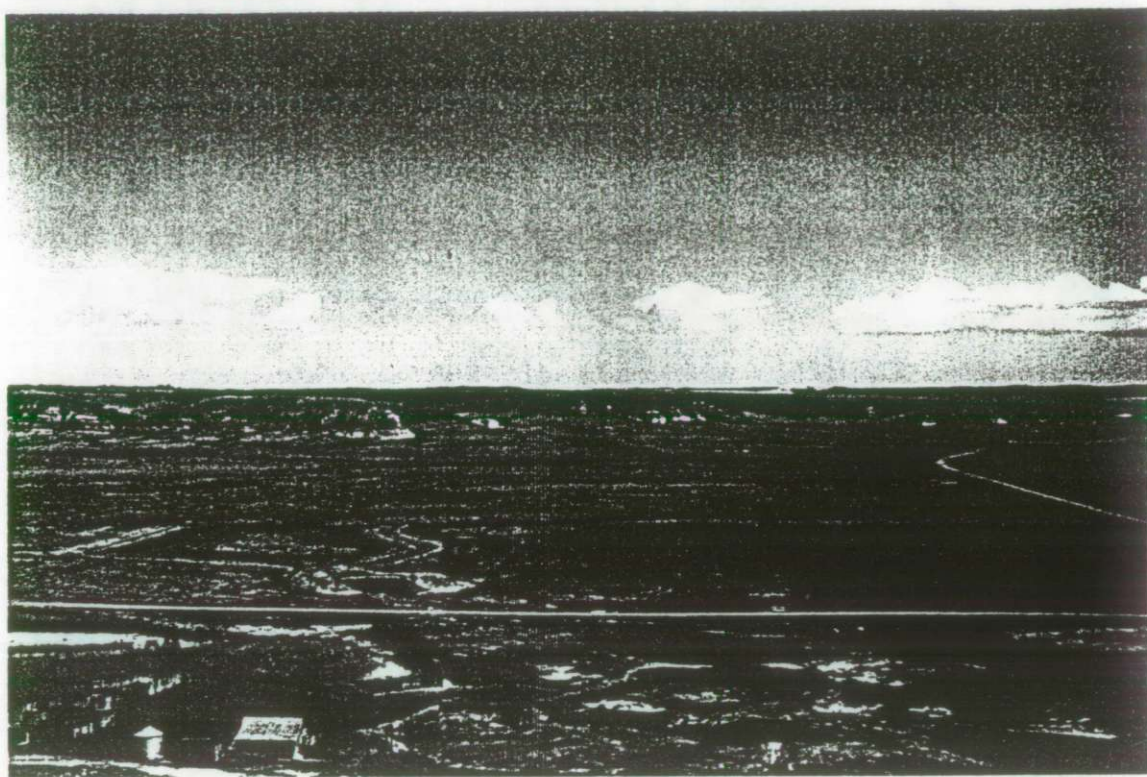
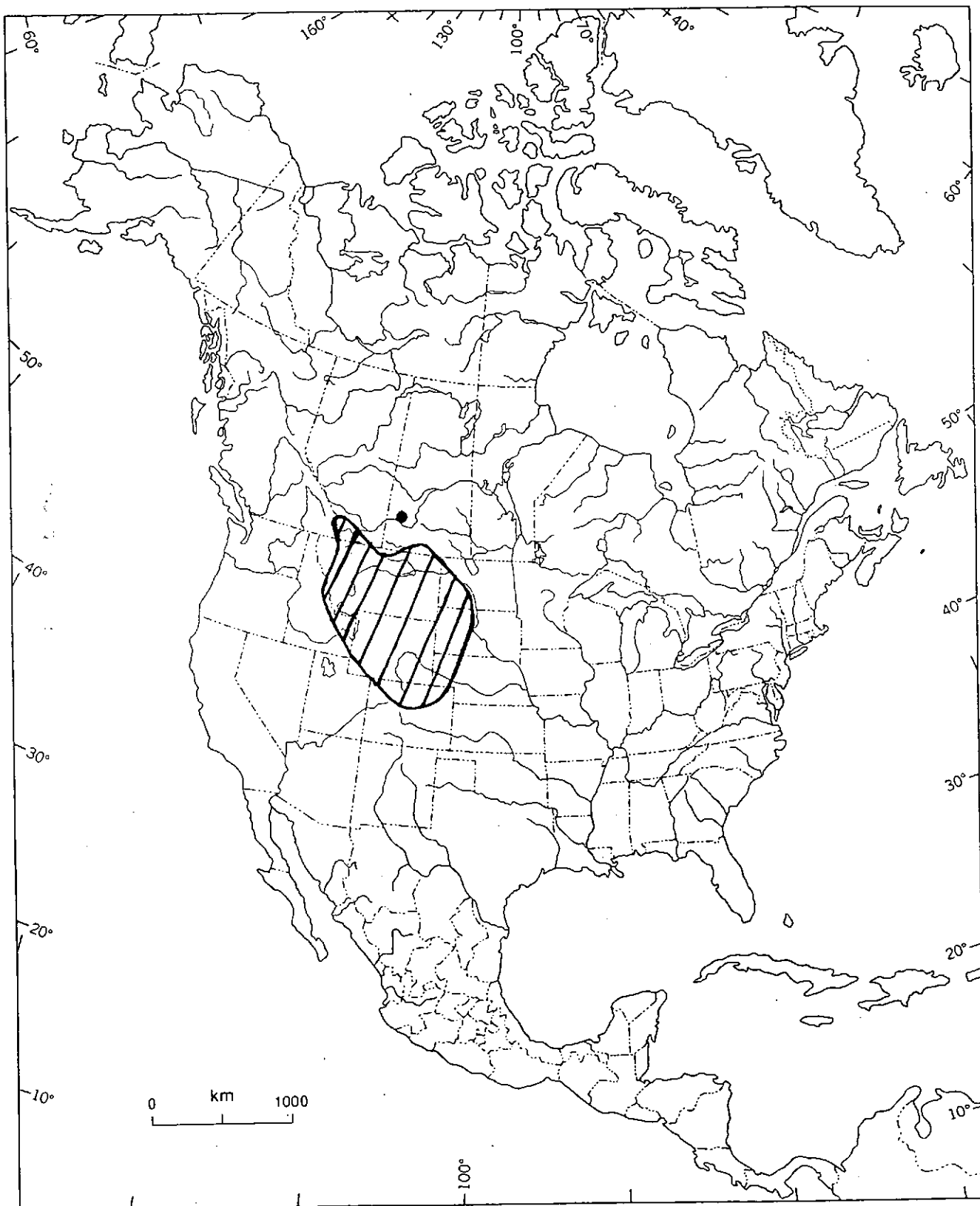


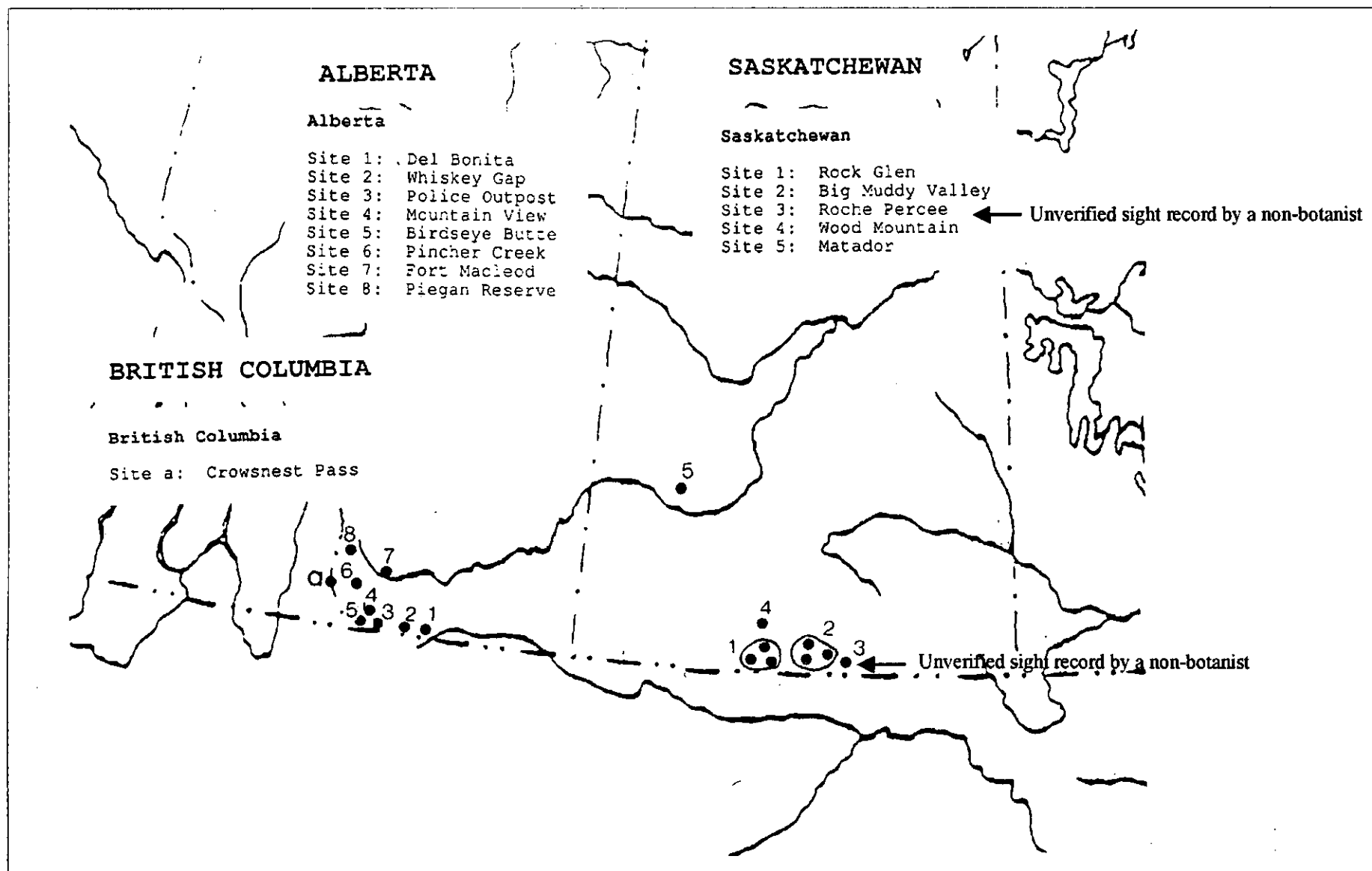
Figure 22 The wide Big Muddy valley, Sask., Site 2.
Ridges in background are blue phlox habitat



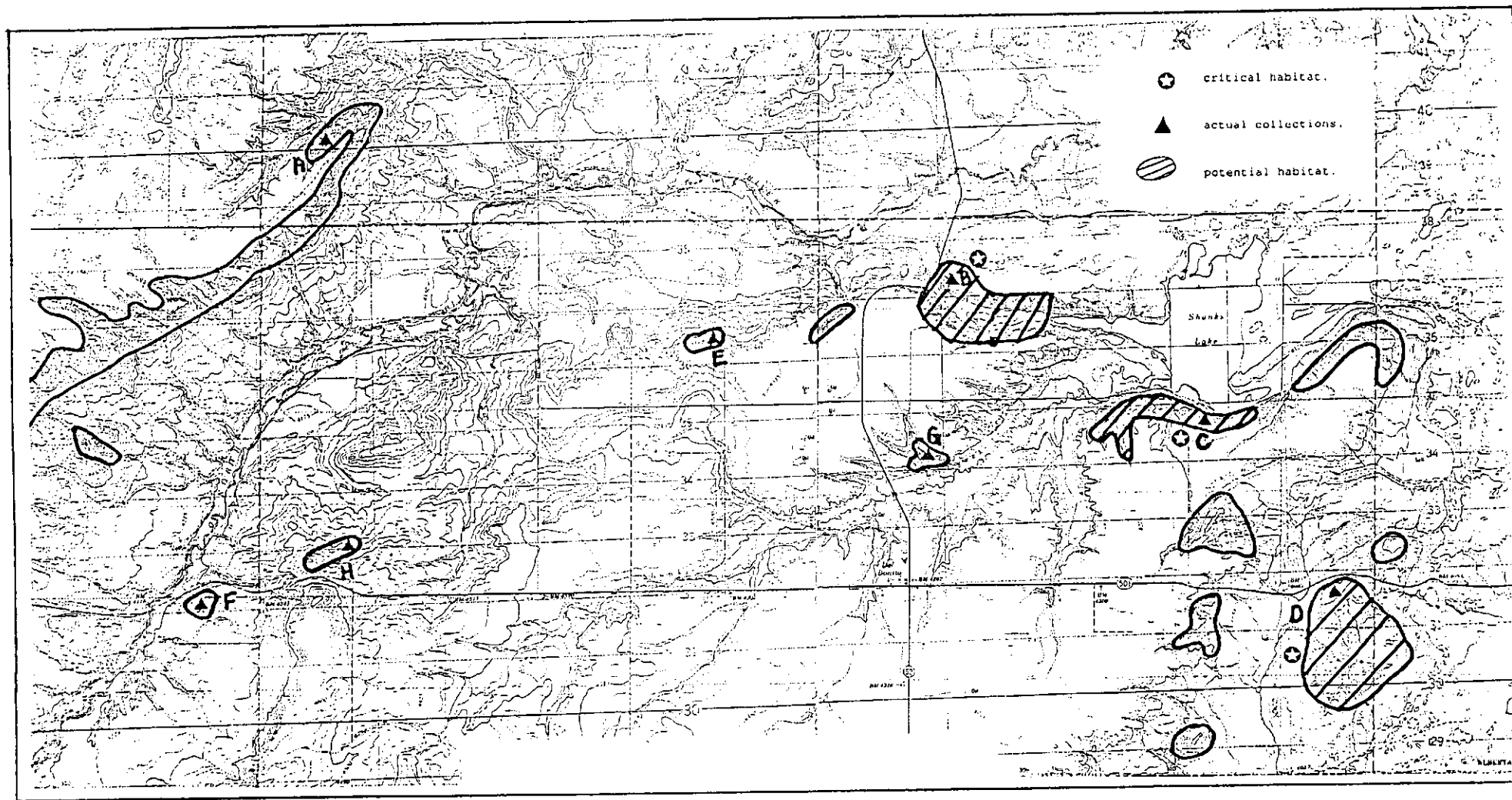
Figure 23 Steep, grassy slopes of Big Muddy valley ridge.
Blue phlox habitat Site 2, Sask.



Map 1: Distribution of *Phlox alyssifolia* Greene.

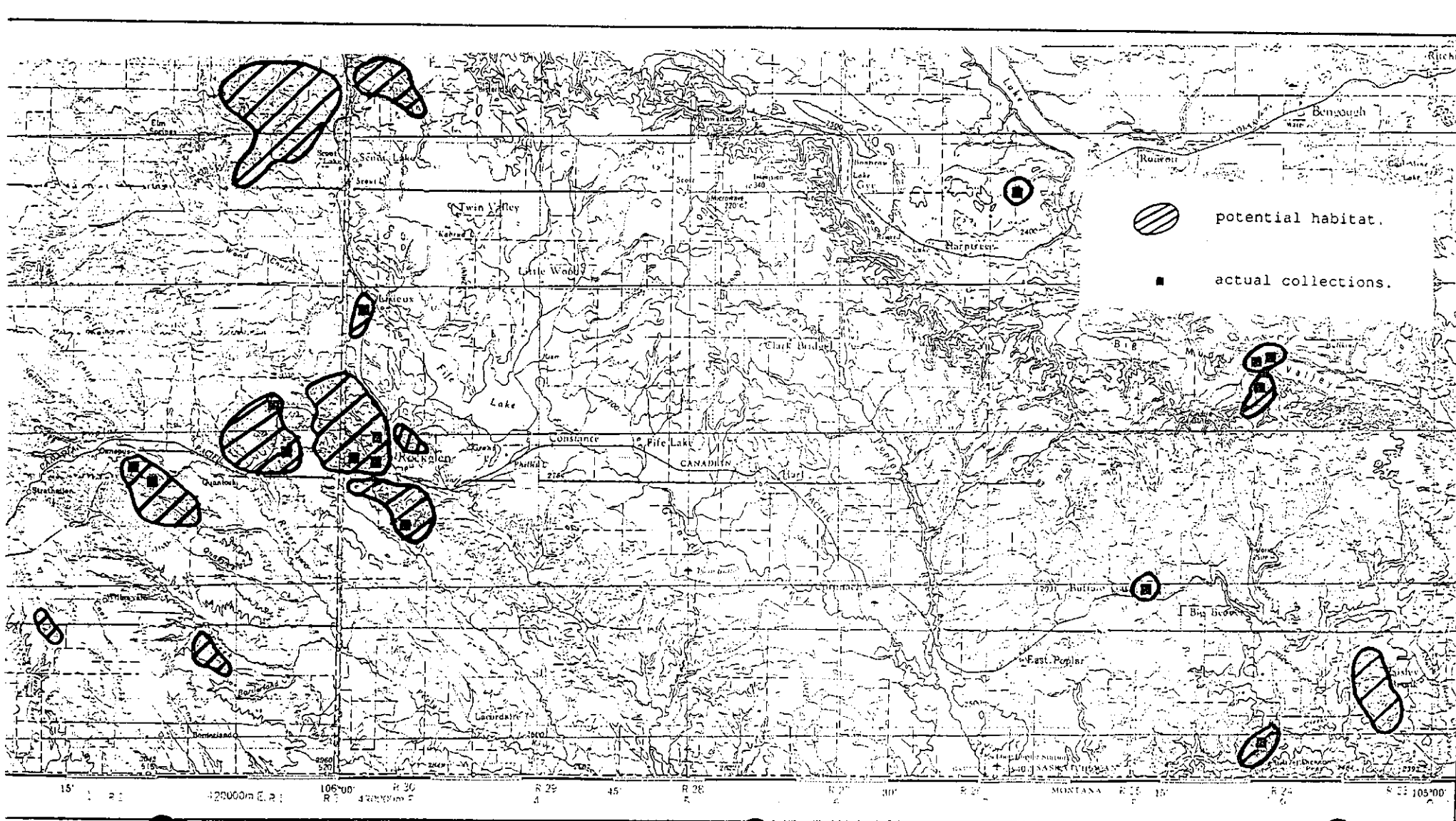


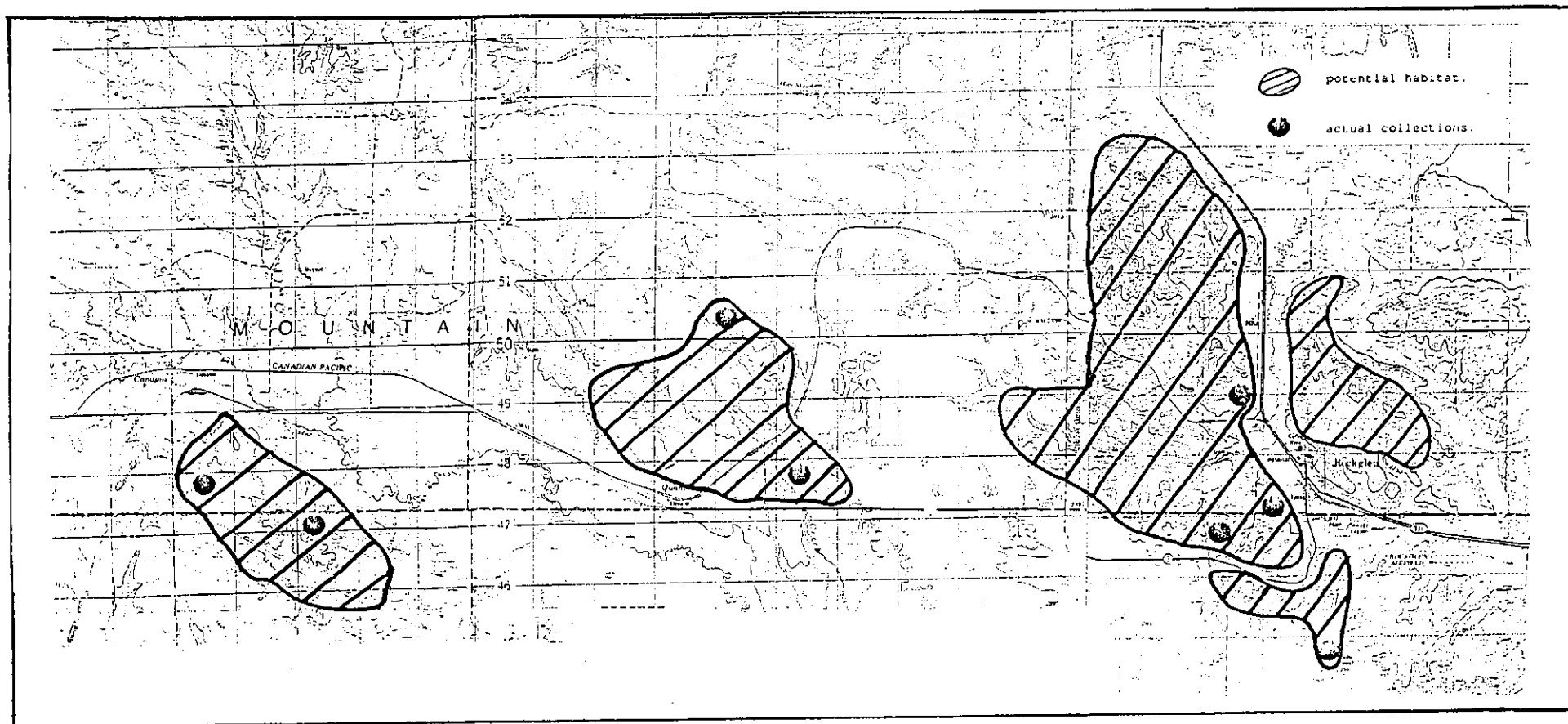
Map 2: Distribution of *Phlox alyssifolia* Greene in British Columbia.



Map 3: Potential and critical habitat recommendations for *Phlox alyssifolia* Greene in the Del Bonita area, Alberta. (Site 1)

Map 4: Potential habitat of *Phlox alyssifolia* Greene in the Rock Glen (Site 1) - Big Muddy Valley (Site 2) area, Saskatchewan.





Map 5: Critical habitat of *Phlox alyssifolia* Greene in the Rock Glen area, Saskatchewan. (Site 1)