COMMITTEE ON THE
STATUS OF ENDANGERED
WILDLIFE IN CANADA

OTTAWA, ONT. K1A 0H3
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COMITÉ SUR LE STATUT
DES ESPÈCES MENACÉES
DE DISPARITION AU
CANADA

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

STATUS REPORT ON THE DWARF FLEABANE *ERIGERON RADICATUS* IN CANADA

BY

BONNIE SMITH

STATUS ASSIGNED IN 1996
NOT AT RISK

REASON: NATURALLY RARE GLACIAL REFUGIA RELICT WITH WIDELY DISPERSED STABLE POPULATIONS AND NO PERCEIVED THREATS.

CCURRENCE: ALBERTA AND SASKATCHEWAN

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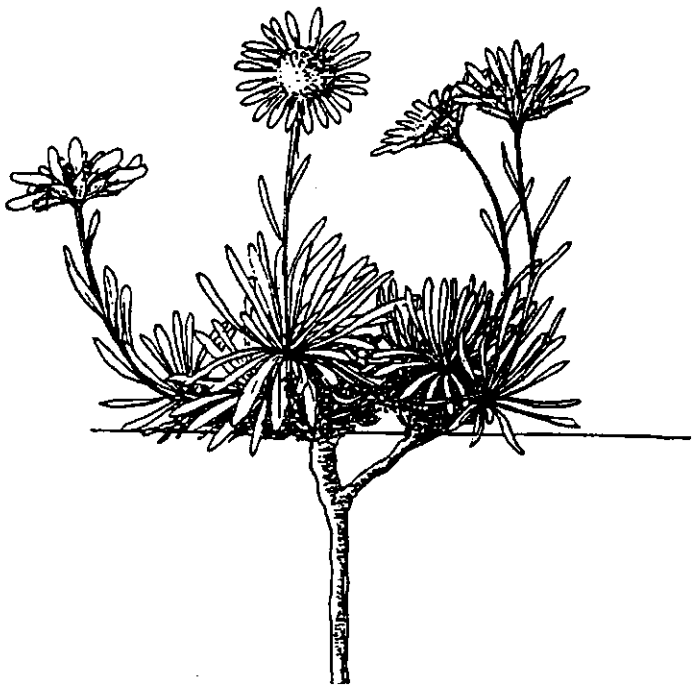
STATUS REPORT ON PLANTS AT RISK IN CANADA



Dwarf Fleabane

Erigeron radicatus

COSEWIC
COMMITTEE ON THE STATUS
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BY

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JUNE 1994

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

Description

Erigeron radicatus Hook., or dwarf fleabane, is a member of the Asteraceae or Sunflower Family. E. radicatus is a perennial, with a branching caudex and a taproot. Stems are 5 cm tall or less and hairy, especially upwards. Leaves are nearly all in a basal cluster, up to 2 cm long. There may be 2 or 3 small, linear cauline leaves. Involucres woolly-villose. The flowering head is solitary with white ray florets, 5-8 mm long, and central yellow disc florets. The disc is 7-10 mm wide. Achenes are commonly 2-nerved. It is fairly difficult to separate the 24 Alberta species of *Erigeron*. The short, entire leaves, white ray florets, greater than 5 mm long, solitary flowering heads, short plant height, and woolly-villose involucres all aid in properly identifying the species.

Distribution

Dwarf fleabane is native and distributed sporadically on 'island' glacial refugia extending from the Cardinal Divide to Whiskey Gap along the Front Ranges in Alberta and from southeastern Diefenbaker Lake to Rock Glen to Cypress Hills in Saskatchewan. In the United States Dwarf Feabane extends from Montana to Wyoming to North Dakota. The species is considered rare in Montana, Wyoming, Idaho and North Dakota. Dwarf fleabane is known from only 5 widely distributed locations in Alberta. Populations are low at all locations but are probably best represented in the Cardinal Divide in Alberta. In Sasakatchewan, dwarf fleabane is known from 9 areas, mostly in southern Saskatchewan but extending north to the Aquadell site, southeastern Diefenbaker Lake. The population is most concentrated at the Rock Glen location.

Population Size and Trends

The total Alberta population is estimated at less than 1000 plants within the Alberta range. The total Saskatchewan population is estimated at less than 3000 plants, 2000 of which occur on the high ridges and hills in the Rock Glen area. There are several sites in Saskatchewan and Alberta with good local populations (100 - 200 plants) but none are as extensive or contain as many plants as the Rock Glen location. Populations appear to be stable but the species is also apparently unable to migrate from their steep hilltop habitats. In many cases, mostly in Saskatchewan, there is no other suitable habitat as all surrounding lands are cultivated.

Habitat

Erigeron radicatus is found only on the unglaciated, gravelly, cobbly soils on areas of steep relief in a variety of Natural Regions. In Alberta, the species is found in the Rocky Mountain (Montane), Foothills (Main) and Grassland (Foothills) Natural Areas. In Saskatchewan the species is found in Grassland Natural Park. Dwarf fleabane sites are usually characterized by distinctive bedrock features. The apparent common factor they all share is absence of recent glacial modification. Dwarf fleabane usually is associated with *Oxytropis sericea, Eriogonum flavum, Artemisia frigida* and *Juniperus horizontalis* at southern lowland sites and *Dryas octopetala, Kobresia myosuroides and Arctostaphylos uva-ursi* at northern or alpine sites. Dwarf

fleabane is commonly associated with other rare or uncommon species, especially *Phlox alyssifolia*, *Oxytropis lagopus* and *Hymenopappus filifolius* at southern sites and *Erigeron pallens* at northern sites.

General Biology

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

Limiting Factors

Loss of habitat to cultivation practices in Saskatchewan poses the primary threat to the continued success of the species in Canada. The steepness of most remaining areas makes further cultivation difficult. Any increase in resource extraction - gravel removal, oil, gas, mining - might eradicate a particular site. 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 low but stable at most locations, *E. radicatus* is inexplicably rare or absent from most apparently suitable habitat.

Conclusions

Erigeron radicatus is recommended for listing as a **threatened** species in Canada in consideration of not only the species restricted range in Canada and the United States but also its low population base and 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. Cultivation practices should be monitored at the Saskatchewan locations. 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 evaluated this species as being presently Not at Risk because it is a widely dispersed species that is naturally rare within relict glacial refugia. The populations appear to be stable and no significant threats have been identified.

Erich Haber
Chairman, Subcommittee for Vascular Plants, Mosses and Lichens
November 1996

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I. Species Information

1. Classification and Nomenclature

The scientific name for dwarf fleabane is *Erigeron radicatus* Hook. It is a member of the family Asteraceae (alternatively known as Compositae) in the order Asterales. The Asteraceae has been organized into about 13 tribes. *Erigeron* belongs to the tribe Astereae (Cronquist 1981).

There are 32 species of *Erigeron* in Canada. The species *Erigeron radicatus* was first described by Hooker, a renowned botanist. Type collection by Drummond from the mts. near Jasper's Lake, Rocky Mts., Alta. Hitchcock *et al.* (1961) does not recognize varieties. Scoggan (1978) lists the following synonyms: *Erigeron peucephyllus* sensu Macoun 1884 not Gray, revised by Cronquist to *E.? leiomeris* sensu Rydberg 1972, not Gray.

Of the 32 species of *Erigeron* in Canada, 24 species occur within Alberta (Moss 1983). Dwarf fleabane is restricted in the wild to west-central and southern Alberta and southwestern Saskatchewan (Scoggan 1978).

2. Description

Erigeron radicatus Hook. is a perennial, with a branching caudex and a taproot. Stems are 5 cm high or less, finely hirsute or villose, especially upwards. Leaves are all or nearly all in a basal cluster, oblanceoloate or ciliate, up to 2 cm long and 2.5 mm wide. Cauline leaves, when present, are 2 or 3, small, linear and pubescent. The flowering head is solitary borne on a sub-naked peduncle. Receptacle flat or nearly so, naked, disc 7-10 mm wide. The involucre is about 5 mm high, viscid and finely short-villose, the bracts are narrowly lanceolate to oblong, greenish. Ligules are 20-50, white, 5-8 mm long. Disc corollas 2.3-3.0 mm long. Style appendages are short, up to 0.5 mm long, rarely obsolete. The pappus is double, the inner of 6-12 fragile bristles, the outer of fine squamellae or setae. Achenes commonly 2-nerved, occasionally up to 14-nerved. 2n=36. (Moss 1983, Hitchcock *et al.* 1961, Looman and Best 1979, Scoggan 1978). See Figures 1-2, 4, 7.

The 24 Alberta species of *Erigeron* are somewhat difficult to separate. A combination of characteristics are required to properly identify dwarf fleabane. These include the following traits: not producing leafy stolons, entire leaves, rays present and longer than 5 mm, involucres at least 6 mm high, involucre not glandular, peduncles straight, rays white, plants less than 10 cm high, heads solitary, involucres woolly-villose, leaves linear or narrowly oblanceolate, leaves less than 2 cm long, and plants with a branching caudex (Moss 1983).

The smallest of the fleabanes, *Erigeron radicatus*, may be recognized by being essentially acaulescent with no stem leaf or only a small one. It is also glabrous or nearly so, thus being yellow-green in distinction to the related species tufted fleabane (*E. compositus*) which is ashy-pubescent, and plains fleabane (*E. pumilus*) which is villous with long white hairs. All three

species have white ligules, only rarely feebly pinkish (Hudson 1994).

Within the family Asteraceae the genus *Erigeron* is quite distinctive, but may sometimes be confused with the genus *Aster*. The involucral bracts of *Aster* are in 2 or more series, commonly imbricate and commonly foliaceous. The involucral bracts of *Erigeron* are usually in one series, not imbricate and usually not foliaceous. *Erigeron* usually flower earlier than *Aster*, in spring and early summer; whereas, *Aster* flowers mostly in late summer and fall. Dwarf fleabane is much shorter than most species of *Aster*. Its radiate heads, white rays, pappus of capillary bristles, and naked receptacle help in separating *Erigeron* from other genera within the family (Moss 1983, Hitchcock *et al.* 1964).

The name *Erigeron* is from the Greek *Eri*, early, and *geron*, old man, probably referring to the early flowering and fruiting of most species (Hitchcock *et al.* 1964).

3. Biological and Economic Significance

Mountain species of *Erigeron* may be grown in gritty screes and moraines in rock gardens and in shallow pots. They are propagated by seeds which should be planted in spring. Both *E. compositus* and *E. aureus*, western Canadian alpine species, are mentioned as species which may be grown horticulturally. *E. radicatus*_ possesses many of the characteristics of these species and should also be suitable as a horticultural species (Everett 1981).

4. Distribution

The Asteraceae is cosmopolitan in distribution and is best represented in temperate or subtropical regions that are not densely forested (Cronquist 1981). The majority of the nearly 200 species of *Erigeron* occur in North and South America, Europe and Asia. Nearly all are of temperate or boreal regions, or mountainous areas in tropical America. More than 130 species occur in North America north of Mexico, centering in the western cordillera (Hitchcock *et al.* 1964). In the United States (Map 1), *E. radicatus* is known from Montana, Idaho, North Dakota, Idaho and perhaps Colorado. In Canada (Map 1, 2), the species is known only from Alberta (Ram Mountain-Prospect Creek area, Waterton Lakes National Park, Whiskey Gap) and southwestern Saskatchewan (Cypress Hills to Rockglen and northward to near Lake Diefenbaker at Aquadell; 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 Alberta

Dwarf fleabane occurs in three separate regions in Alberta (Map 2); namely, the Main Foothills (Cardinal Divide and Ram Mountain sites), Montane (Waterton and Black Mountain sites), and Foothills Grassland (Whiskey Gap site). It is postulated that *E. radicatus* occurs in isolated

glacial refugia stretching from the Cardinal Divide to Waterton along the Front Ranges (including potential sites at White Goat Wilderness and Plateau Mountain) (Smith 1993, Wallis *et al.* 1986, Achuff 1985).

4.2 Saskatchewan

Dwarf fleabane occurs across far southern Saskatchewan (Map 2) from Cypress Hills to Rockglen in scattered locations and north in disjunct locations at Table Butte, Simmie and Aquadell, wherever appropriate habitat exists. Populations are very limited in distribution and remain as small populations on ridge and hilltops.

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

5. General Environment and Habitat Characteristics

Erigeron radicatus occurs in three of Alberta's six natural regions; namely, the Rocky Mountain (Montane), Foothills (Main) and Grassland (Foothills) Natural Regions. The Montane sub-region is restricted to a strip running from the U.S. border to the Crowsnest Pass to west of High River along the eastern edge of the Rocky Mountains. Another montane area lies west of Calgary on the route to Banff National Park (Spalding 1980). Two of the Alberta sites, Black Mountain and Waterton Lakes National Park, occur in the Montane subregion. One aspect of the montane forest site is characterized by limber pine on sandstone ridges, the preferred location of dwarf fleabane (Finlay 1987).

Two other dwarf fleabane sites occur in the Main Foothills subregion of the Foothills Natural Region; namely, the Ram Mountain and Cardinal Divide sites. The Main Foothills sub-region is located along the eastern edge of the Rocky Mountains from southwest of Calgary north to the British Columbia border. The foothills rise abruptly above the interior plains (Provincial Museum of Alberta 1980).

The Grassland Natural Region contains three sub-regions - the Mixed, Northern Fescue and Foothills Grassland. The Whiskey Gap population of dwarf fleabane 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. The Saskatchewan sites occur on Fescue Prairie.

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. The other Saskatchewan sites occur on the Mixed Grassland (PCAP 1988) Alberta Recreation and Parks 1989). Dwarf fleabane occurs on dry montane slopes and hillsides (Argus and White 1978).

The southernmost Foothills Grassland have an abundance of plants that are either rare or at the periphery of their range, including dwarf fleabane. 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). Dwarf fleabane is found on rolling steppe or dry grassland on gravelly soil often on unglaciated terrain on the Milk River Ridge (Figure 2) at Whiskey Gap (Wallis *et al.* 1986, Packer and Bradley 1984).

Dwarf fleabane is usually associated with *Oxytropis sericea, Eriogonum flavum, Artemisia frigida* and *Juniperus horizontalis* at southern lowland sites and *Dryas octopetala, Kobresia myosuroides* and *Arctostaphylos uva-ursi* at northern or alpine sites. Dwarf fleabane is commonly associated with other rare or uncommon species. 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 (Map 4). An interesting study of patterns of distribution of rare plants found on unglaciated locations could be undertaken using these two sites as examples. *E. radicatus* and *P. alyssifolia* 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. alyssifolia* is very common at both sites, while *E. radicatus* prefers the Rock Glen site and is only found at Whiskey Gap in the North Milk River area (Smith 1994).

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

5.1 Climate

The Montane subregion of the Rocky Mountains is drier and warmer than both the Subalpine and Alpine Zones due to the strong influence of Pacific air masses. Waterton Lakes has the highest chinook frequency in the province (Provincial Museum of Alberta 1980, Wilkinson 1990).

The climate of the Main Foothills is intermediate between that of the plains to the east and the higher elevations to the west, with short moderately warm summers and long relatively cold winters. Topography causes many variations. July is the warmest month, with a mean temperature of about 13°C, and June is the wettest month, with 10 cm of precipitation, although the northern foothills may be equally wet in July. About 70% of the 510 cm to 610 cm of annual precipitation occurs in the summer months, May to September. The frost-free period ranges only between 60 and 80 days. Evaporation is low, and the water surplus from the eastern slopes is very important, providing up to 90% of the water needs downstream for areas with a deficiency (Spalding 1980). Specific data on the climatic conditions present at the Cardinal Divide and Ram Mountain sites are available in Achuff (1984) and Johnson (1975). Climatically both areas are in the same group in Powell's classification (Achuff 1984).

The Prairies Climatic Region, encompassing the Alberta site and Saskatchewan sites, is

characterized by low winter precipitation (Stamp 1988). 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 searson moisture deficit. Precipitation is approximately 30 mm less during the growing season than in the mixed prairie ecoregion (Richards 1969). In Alberta, the Foothills Grassland (Whiskey Gap site) is an uncommon grassland type in North America, found in the foothills area where greater rainfall and cooler temperatures provide more available moisture (PCAP 1988).

5.2 Physiography, Hydrology, and Edaphic Factors

Alberta

The Alberta Whiskey Gap site 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 areas surrounding the North Milk River are drained into the Milk River (Coupland 1950). 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).

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). The surface geological deposits and parent materials of the soil are chiefly of glacial origin. There are areas of preglacial gravels along the North Milk River which have remained as surface features since before the Wisconsin glacial period. Such gravels are uncommon in southern Alberta, being confined to the Del Bonita uplands in the south with a few smaller outliers to the north and west (Whiskey Gap, Ross Lake areas). The driest areas composed of preglacial gravels, right at the edge of the hillcrests, support several rare species including blue phlox. Dwarf fleabane occurs on these areas (Wershler and Wallis 1986, Alberta Recreation and Parks 1989).

The Waterton Lakes National Park site probably occurs on one of the 'islands' of habitat near the tops of mountains which served as plant refugia and remained unglaciated during the last glacial period (Kuchar 1973).

The two Main Foothills sites are located in the Cardinal Divide and on Ram Mountain. In the Cardinal Divide area, bedrock is composed mainly of limestones, dolomites, sandstones and shales with lesser amounts of siltstones and conglomerates. Bedrock age is from Upper Devonian to Upper Cretaceous (Achuff 1989). Bedrock geology at Ram Mountain is probably the same but comparable information is not available for Ram Mountain. The Cardinal Divide area has greater diversity of landform due to its greater size (Johnson 1975).

The Cardinal Divide was apparently glaciated only by Cordilleran ice during the Pleistocene. It is considered that areas of the Cardinal Divide remained free of ice during this time forming

glacial refugium but the extent to which the area was ice-free is not clear from current information. Evidence from glacial history suggests that the Cardinal Divide may have been ice-free during the late Pleistocene and may have been part of a series of ice-free areas within an ice-free corridor along the Front Ranges (Achuff 1989). During the most recent glacial advance the Ram Mountain area may not have been glaciated or only covered by ice for a very short period of time (Johnson 1975).

Saskatchewan

Sites in the Wood Mountain Uplands near Rock Glen represent the Wood Mountain and Ravenscrag Formations. The Wood Mountain Formation is unique to this region in Saskatchewan. The area around Eastend, Ravenscrag and the Frenchman River are typified by predominantly Ravenscrag Formations with representation by the following formations as well: Eastend, Whitemud, Battle, Frenchman, and Boissevain formations. The entire Eastend-Ravencrag-Rockglen area is unique in Saskatchewan although the Ravenscrag does extend across southeastern Saskatchewan nearly to the border of Manitoba. The Grasslands National Park area has representation by these formations as well as the Bearpaw and Oldman formations. The Cypress Hills area is represented by the Cypress Hills and Swift Current Creek formations as well as the Bearpaw formation. The bedrock geology of southern Saskatchewan is very unique and interesting from a Canadian perspective (Richards 1969).

The Saskatchewan sites which occur outside this southern distribution all occur on distinct bedrock. The Table Butte and Simmie sites occur on Swift Current formations (Richards 1969). The site west of Ravenscrag occurs on Cypress Hills formation. The Wideview, Aquadell, southeast of Eastend, east of Ft. Walsh at Adams Creek sites are found on the edges of Whitemud formations (Hudson 1994).

Within Saskatchewan, populations occur in unglaciated areas on hills around Rock Glen and Eastend-Ravenscrag, southern areas on steep valley ridges and lower hills near the Montana border. Dwarf fleabane sites have been found on the Cypress Hills Uplands (Cypress Hills, Eastend, Ravenscrag sites, Simmie, Table Mountain), the Wood Mountain Uplands (Wood Mountain, Grasslands National Park, Wideview, Rock Glen sites), and the Missouri Coteau (Aquadell site). Again, the distribution is restricted to sporadic occurrences of unglaciated hilly terrain amongst the mostly cultivated valleys (Richards 1969).

The existence of a series of ice-free areas along an ice-free corridor would offer an explanation for the existence of *E. radicatus* in various seemingly isolated locations along the Front Ranges (Cardinal Divide, White Goat Wilderness, Ram Mountain, Plateau Mountain, Black Mountain, Waterton Lakes National Park). This finding would also validate assertion that *E. radicatus* is a plant associated with glacial refugia both at its Alberta and Saskatchewan locations. In the intervening time since the last glacial period it would appear that *E. radicatus* has not migrated downslope from its previous locations and may, therefore, be one of those species which simply cannot do so. This would lead to the consideration that protection of the unglaciated sites is of vital importance to the survival of the species.

Soils

Brown chernozemic soils characterize the Milk River sites. The clay loam solonetzic soils developed on thin boulder clay and were modified by preglacial sediments (Coupland 1950, Wershler and Wallis 1986). Black chernozemic soils characterize the fescue grassland (PCAP 1988). Much of the Cardinal Divide area, especially at higher elevations, is covered by nonsoil, that is less than 10 cm of unconsolidated material over bedrock. Elsewhere, soils of the Regosolic and Brunisolic Orders are most common, and small amounts of Gleysolics and Organics also occur (Achuff 1989). Most soils at Ram Mountain are youthful and immature, with thin profiles. Some soil pockets do develop on lee slopes and certain protected cracks, crevices and ledges (Johnson 1975). Brown chernozemic soils also characterize the Saskatchewan sites at Rock Glen, Grasslands National Park, Aquadell and Wideview. Dark brown soils characterize the Eastend, Table Mountain, Cypress Hills and Simmie. At Eastend, brown chernozemic soils may also occur. As well, valley complexes, chiefly regosolic soils of valley slopes and bottoms characterize the southern sites at Rock Glen and Eastend (Richards 1969).

5.3 Biological Characteristics

Dwarf fleabane is a perennial species. Reproduction is primarily sexual.

6.0 Population Biology and Ecology

Site 1 - Whiskey Gap

Sommerfeldt Ranch

Dwarf fleabane was found at this site from 1987 to present by Sommerfeldt (pers. comm.) (Figure 2). The species was never very common but was located both in 1993 and 1994 in one small area near Sommerfeldt's western fenceline. The very restricted range of the species measured 9 m x 6 m on one hilltop. There were fewer than 100 specimens. Although the ridges on the Sommerfeldt Ranch had been searched by Sommerfeldt over the years and in 1993 and 1994 rather extensively by the author no other sites have been found in this area.

Site 2 - Waterton Lakes National Park

Again, known only from one site in a cirque on Sofa Mountain. With all the fieldwork conducted in the park over the years no other sites have been found. The author did not visit this site in 1994 but the restricted range of the species given the amount of fieldwork conducted would indicate a very limited distribution within the park.

Site 3 - Black Mountain

One collection has been made from this site (Wallis 1979). The species was not relocated during fieldwork conducted by the author in 1994. Abundant *E. compositus* was found but not dwarf fleabane. The species was originally found only in one spot on the side of the mountain. It is obviously not widely distributed and apparently exhibits similar restricted occurrence even within seemingly abundant habitat as has been noted at most other sites.

Site 4 - Ram Mountain (Map 2, Figures 9-10)

According to Johnson (pers. comm. 1994) *E. radicatus* was never common at any site on Ram Mountain. Rather, the plants occurred sporadically and only a few together. Again, apparently abundant habitat exists on the mountain top. Dwarf fleabane was found only in two locations (Sites 4A, 4B; Figures 9, 10).

Site 5 - Cardinal Divide

Dwarf fleabane is known from several locations within the Cardinal Divide. The species was found at Cadomin by Pegg in 1968 with *E. pallens*, another rare species, but was noted to be rare and not seen elsewhere. The species was also collected from Cheviot Mountain, Prospect Creek, and Prospect Mountain. All sites are located close together within the Divide. It is probable, once again, that the species is not common at any site within the Cardinal Divide. The author was unable to visit this area during 1994.

Saskatchewan

Site 1 - Cypress Hills Provincial Park

Known historically from several sites within the park, with the extant site being that recorded by the 1975 Ledingham collection. Not revisited in 1994. Although substantial fieldwork has been undertaken over the years, only one location is now known within the park.

Site 2 - Ravenscrag - Eastend (Map 2, 5)

Dwarf fleabane is known from two nearby locations at Ravenscrag. Hudson (1988) noted only a few plants to be present at one of the locations. There is a third location at Eastend which was collected in 1955 by Looman and has not been relocated to date. Hudson (1994) listed a sight report for a local population on the Whitemud River plateau southeast of Eastend (Map 5). The author investigated the area for other potential habitats (Map 5). The author noted the potential habitat southeast of Eastend prior to Hudson's publication of a sight report of dwarf fleabane from 1988. Other potential sites might prove to be equally interesting and should be investigated. Although the species appears to occur in low numbers at sites within the Ravencrag - Eastend area this site remains interesting as a result of the number of collections.

[Addendum: also known from Fairwell Creek, west of Ravenscrag. Dr. Vernon Harms, Saskatchewan]

Site 3 - Wideview

The site was surveyed, the exact associated species were found but no specimens of *E. radicatus* were discovered. It would be quite likely that the species was still present (Smith 1994). Hudson noted in 1988 that the species was local and plentiful with about 200 plants present.

Site 4 - Grasslands National Park

Two locations are known, one within the park and one within the area proposed to become park territory. Neither was relocated during a 1993 vegetation survey (Michalsky and Ellis 1994). Although one site is protected the other is still on private ranching property. Since the original specimens were collected in 1989 it is likely that populations still exist but probably only in low numbers. The author checked the site outside park boundaries but could find no specimens. This area is typical of the Wideview site.

Site 5 - Rockglen and Environs (Map 2-4, Figures 5-8)

E. radicatus was located on two of the more easterly hills near the townsite of Rock Glen. Dwarf fleabane was found to be more common on the lower slopes facing Rock Glen in Juniper beds. 55 plants were counted in these beds. Dwarf fleabane was found less commonly on the upper slump, cobbly slopes near the hilltops. 20 plants were counted. 10-15 plants were counted in the silty upper hill benches. 5 plants were counted on the two hilltops. Dwarf fleabane patches were 2-8" across and consisted of 1-10 stems. The total dwarf fleabane population on the lower slopes was estimated to be 200+ on the four-hill ridge system near Rock Glen. The total dwarf fleabane population for the area surrounding Rock Glen was estimated to be 1000+ plants. *Phlox alyssifolia* and *Hymenopappus filifolius*, both rare plants, were far more abundant in the Rock Glen area than *E. radicatus*.

At the site north of Scout Lake (Map 3) only 10-12 dwarf fleabane were found in a scattered but restricted population. The estimated population for the entire area of suitable habitat (Map 3) is 50 plants.

[Addendum: This area actually comprises several sites spread out over more than 20 km. Dr. Vernon Harms, Saskatchewan]

Site 6 - Wood Mountain

Known only from historical collection from 1895 (Macoun). Not relocated in 1994 (Smith).

Site 7 - Simmie

Very limited distribution on upper cobbly, stony ridge slopes and hilltop. Dwarf fleabane was noted to be "infrequent" by Hudson in 1955. Presently it still occurs with reasonable frequency. The total population for the area was estimated to be between 100 and 200 plants (Smith 1994).

Site 8 - Table Butte

Not examined in 1994 (Smith) but potential habitat was mapped for the site. Originally collected in 1956 (Looman).

Site 9 - Aquadell (Map 2, Figures 3, 4)

Very limited distribution on gravelly, cobbly hilltop. Populations were only found on the eastern end of the ridge overlooking Payson Lake. 50 ft. x 20 ft. distribution area. Counted 90 plants in population. In a separate area at the eastern end of the ridge overlooking Payson Lake found another small patch with 80 plants. A third more northerly nearby location on the upper slope of the hilltop had 6 patches of dwarf fleabane. Dwarf fleabane is mostly restricted to the tops of the ridge only. The total population for the species is estimated to be between 200 and 300 plants (Smith 1994). Hudson (1989) noted that the species was locally abundant. The entire area, including the Vermillion Hills to the west, should be surveyed for further populations. Most of the surrounding area is in cultivated fields.

Other areas (Map 3) within the range of the species were checked but no specimens of dwarf fleabane were found (Smith 1993/4).

6.1 Reproductive Ecology

Little data is available on the reproductive ecology of dwarf fleabane.

Erigeron radicatus was found in flower on the last weekend of May (1987 to present) by Sommerfeldt (a participant in the spring flowering survey) on their ranch at Whiskey Gap, Alberta (Site 3, Map 2).

In Rock Glen the plants at the site north of Scout Lake were 90% past flowering by May 21, 1994. At the site near the Rock Glen townsite the dwarf fleabane flowers were just starting to fade by May 22, 1994. During the July field trip to the Rock Glen area only 1 dwarf fleabane patch was found on the upper slopes (Figure 7). This plant was in fruit and setting seed well (Smith 1994).

The Simmie and Aquadell sites were similar in flowering pattern. Populations were in full flower on May 21, 1994. About 5% of the flowers had begun to turn pinkish as they started to go out of flower (Smith 1994).

On Ram Mountain *E. radicatus* was found to flower from late June to late August (Johnson 1975). Specimens were collected in flower July 3,12,19 from Ram Mountain (Johnson, Bird, Dumais).

The Cardinal Divide locations were collected in flower July 2,7,8. The specimen collected in on July 15, 1971 by Packer was subsequently grown in the University of Alberta Greenhouse and flowered March 19, 1973.

Southern populations of dwarf fleabane flower at the end of May, except for the late-July flowering Waterton site, while those further north in Alberta flower in early to mid-July.

6.2 Population Ecology

No information was found on *Erigeron radicatus* population ecology.

7. Land Ownership and Management Responsibility

Two sites occur in National Parks - the Waterton Lakes and Grassland National Parks. Two sites occurs in provincial parks - Cypress Hills and Wood Mountain Provincial Park in Saskatchewan. The Black Mountain, Cardinal Divide and Ram Mountain sites are found in forested crown land. The Whiskey Gap site is on crown land under grazing lease to the Sommerfeldt Ranch. Several sites are on private property including the site near Grasslands National Park boundaries which lies on the Dixon Ranch and the Table Butte site. The east end of Table Butte is owned by Clarence Targerson. Wayne Sabin owns the west end of the Butte. The Simmie, Aquadell and Rock Glen sites are likely on private land, as well. All have ranches nearby. Some areas of the ridge systems of Rock Glen are under private ownership. The other sites are on crown land under various grazing leases

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. Elkwater and Cypress Hills Provincial Parks provide a degree of protection for the more easterly fescue grassland. Their are no protected areas within the range of *Erigeron radicatus* within Alberta except for the site within Waterton Lakes National Park. Plants may only be collected by permit within the park (Wallis 1987, Alberta Recreation and Parks 1989). In Saskatchewan, the Cypress Hills and Wood Mountain sites falls within a protected area, although, plants have no particular protection. The site within Grasslands National Park is afforded the protection of the national park system.

Future uncertainty regarding possible contruction of dams, changes in grazing patterns, clearing for cultivation or resource development pose problems regarding the survival of the species within its limited Alberta range. Loss of primary habitat as well as destruction of specific habitats is a serious concern regarding survival of endangered species (Wallis 1987).

8.1 Cultivation

Everett (1981) notes that species of *Erigeron* are best adapted to cultivation in sunny rock gardens. One specimen of *Erigeron radicatus*, collected in 1971, was subsequently grown for two years in the University of Alberta Greenhouse and flowered March 19, 1973.

8.2 Current Management Policies

The Waterton Lakes and Grasslands National Park sites are managed by the national parks system which offers rare species a degree of protection. For plant collecting in the provincial park sites at Cypress Hills and Wood Mountain collecting permits are required [Dr. Vernon Harms, Saskatchewan]. 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. Foothills and montane sites on crown land have no particular protection. Sites on privately owned land are mostly under the control of the landowners. Some sites on crown land are operated under grazing leaseholds. Only the national park sites are afforded any degree of protection. Unfortunately, these park systems only contain two sites with a third potential site up for acquisition by Grasslands National Park.

9. Evidence of Threats to Survival

The Grasslands Natural Region in Alberta and Saskatchewan is one of the most threatened natural regions. Fescue Grassland has been reduced to 27% of its original area owing to cultivation (PCAP 1988). 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). The government of Alberta has priorized 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. In Saskatchewan, Grasslands National Park protects significant grasslands habitat, although the very significant areas surrounding Eastend and Rock Glen are not protected.

The Montane area in Alberta is a fairly rare habitat. Unfortunately, the pleasant weather conditions and other factors associated with this area make it of prime interest for development. There is a collision of interests from developers, wildlife, tourists, etc. for the resources these areas offer. Until firm policy is enacted to protect significant portions of this area any populations of rare species (Black Mountain) cannot be considered safe from destruction.

9.1 Grazing

The Sommerfeldt Ranch, Alberta (Site 3, Map 2) is grazed by cattle in winter and by wildlife in all seasons. The species has remained common since 1986 at this site 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 which the species perfers acts as a deterrent. 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 1993/94).

The site at Table Butte (Site 8, Sask., Map 2) is presently being grazed. The author was informed that the Butte contains an important Native Heritage site (Smith 1994). The Aquadell site is actively grazed but grazing mostly occurs on the lower elevations as is also the case at the Rock Glen site. The areas around the town of Rock Glen are apparently not grazed at this time but areas north of the town are fenced for grazing (Smith 1994).

Perhaps the high elevations and gravelly sites which the species perfers acts as a deterrent. 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.

9.2 Cultivation

In Saskatchewan, cultivation of lands remains the greatest threat to the survival of the species. Dwarf fleabane 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, *E. radicatus* now exists in Saskatchewan as islands of distribution within a sea of cultivation. As well, many of the lower hills in the Rock Glen and other southern areas have already been lost to cultivation (Figure 8, Lisieux). 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 and most remaining sites in Saskatchewan from cultivation. The protection of the these Saskatchewan sites from further loss to cultivation practices is of primary importance (Smith 1994).

North of the these southern regions nearly all lands are cultivated. These unglaciated remnants are often all the native habitat that remains within the range of dwarf fleabane. Further north in Saskatchewan, the Table Butte, Simmie and Aquadell sites remain as disjunct islands of habitat.

In Alberta, only 27% of the original fescue grassland remains. Areas of extensive cultivation surround the Alberta habitat for the species. Cultivation of natural habitats has eliminated many sites but the steepness of most remaining areas makes further cultivation difficult (Wallis *et al.* 1986).

9.3 Hiking and Trail Use

The Rockglen sites could be damaged by continued use of existing trails or increased hiking amongst hte Rockglen hills. This is potentially true of sites in the national and provincial parks, as well. Achuff (1985) indicates in his report that the sensitive alpine tundra is currently abused by uncontrolled off highway vehicles in the Cardinal Divide, Alberta. These vehicles may be disrupting wildlife as well.

9.4 Resource Extraction

Any mining, gas or oil extraction could be potentially devastating to the site specific dwarf fleabane. Since the species mostly occurs in very small areas within larger habitat types the positioning of any developments would be of utmost concern. Particularly sensitive are the northern foothills sites at Ram Mountain and the Cardinal Divide as well as the site at Black Mountain in the Porcupine Hills of southwestern Alberta.

In summary, *Erigeron radicatus* does not presently appear to be substantially threatened at any of its known Alberta locations although there are significant threats to the Saskatchewan locations as a result of cultivation practices. Should management practices change leading to adverse effects on the species, i.e. resumption of gravel extraction, switch in grazing pattern or intensity, further cultivation of natural regions, or resource extraction, then the security of the species would have to be reevaluated.

10. Present Legal or Other Formal Status

Argus and Pryer (1990) list the following rank designations for *Erigeron radicatus* Hook.: Nature Conservancy Rank: G3; Canada Rank: N2; Alberta S1, Saskatchewan S1; U.S. rank: North Dakota S?, Idaho S2, Montana S4, Wyoming S1; Canadian Priority: 2. No specific legal status is accorded *Erigeron radicatus* in any part of Canada. Neither Alberta nor Saskatchewan has legislation which covers plant or endangered species.

In Canada, dwarf fleabane occurs naturally only in Alberta and Saskatchewan. As a result of this limited distribution the species is considered rare from a national perspective. Argus and White (1978) and Packer and Bradley (1984) identified dwarf fleabane as rare in Alberta. Dwarf fleabane is also designated as rare in North Dakota, Idaho, Montana and Wyoming. (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) acknowledges 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. *Erigeron radicatus* belongs to this group. A second group is composed of species extending into the province as small disjunct populations and is composed of less than 10% of the number of total 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).

The entire Milk River area is a very unique region. It is a major area for numerous species of plants and animals whose range barely extends into Alberta from their main area of distribution to the south (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 (dwarf fleabane is rare within its restricted range in Alberta and rare to locally frequent within its restricted range in Saskatchewan.)

distribution (restricted in Canada to Alberta and southwestern Saskatchewan. Noted to be a rare species in 4 northern American states.)

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

habitat stability (apparently stable at this time, cultivation practices, gravel removal, trail use and resource extraction are the primary threats to continued viability.)

population trend (5 locations in Alberta, fewer than 1000 specimens within a restricted range; 8 locations in Saskatchewan, fewer than 3000 thousand specimens within a restricted range; too early to recognize trends.)

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

international standing (ranked G3, rare or uncommon)

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

All preceding criteria are items of concern in assessing the status of this species. In Canada, *Erigeron radicatus* 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 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

Dwarf fleabane (*Erigeron radicatus* Hook.) is proposed for listing as a **threatened** species in Canada as a result of its low population base in Canada, restricted to a few areas in two provinces. Also, the species is considered rare in the four adjoining American states. The species is apparently rare throughout its range, occurring only sporadically on specific unglaciated sites. Therefore, any threat to its Canadian population base would have to be taken as a serious threat to the species' continued survival.

13. Recommended Critical Habitat

Within Canada, only Saskatchewan has substantial populations of dwarf fleabane. The Rock Glen site is recommended for designation as primary critical habitat. The Ravenscrag-Eastend site 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 *Erigeron radicatus* as a means of ensuring that habitat loss does not esculate 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 dwarf fleabane in Canada.

Management of the native habitats should be undertaken to enhance or maintain both species richness and key individual species. Endangered species such as dwarf fleabane 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. 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).

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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 Saskatchewan (SASK), Saskatoon, SK

17. Fieldwork

During the summer of 1993, the author visited the known site at Whiskey Gap in an attempt to verify known locations as well as to search for additional locations (Site 3, Map 2). Population counts were undertaken for this site. As well, various areas within the range of the species were examined for suitable species habitat.

During the summer of 1994, the author visited the Saskatchewan sites. The area around Rockglen was the focus of the summer's fieldwork as this area contained the majority of the population of the species. As well the sites at Aquadell, Simmie, Table Butte, Ravenscrag, Eastend, Wideview and Grasslands National Park were examined.

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 during from 1987 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 N.W., Calgary, AB T3B 4R4. Phone: (403) 288-4724.

20. Maintenance of Status Report

Bonnie Smith, 6808 Silver Ridge Way N.W., 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 Alberta locations include:

Site 1 Whiskey Gap

1. Sommerfeldt Ranch, north side of road, north of Whiskey Gap; tops of semi-barren hills, infrequent; May 22, 1993; B.M. Smith, No. 1021; UAC s.n.

2. Sommerfeldt Ranch, see above; May 15, 1994; B.M. Smith; UAC s.n.

3. Sommerfeldt Ranch, Whiskey Gap, 49 01'N 113 01'W; dry hilltop, rough fescue grassland, elev. 1280-1400 m; May 30, 1987; B. Sommerfeldt; det. by J.D. Johnston, verified by C.W. Crompton, 1989, with note: "This matches our material from the Cypress Hills, Sask."; Nor. Forestry Centre 880114.

Site 2 Waterton Lakes National Park

4. Waterton Lakes National Park, Sofa Mountain; 49 02'N 114 48'W, small cirque in middle of north face; rocky valley floor and sides, alt. 6200 ft.; July 24, 1971; J. Kuijt and M. Gadd, #4370; det. by J. Kuijt as *E. ochroleucus*, corr. Cronquist, March 1978 as *E. radicatus*, "very characteristic"; LEA s.n.

Site 3 Black Mountain

5. Black Mountain; west-facing ridge, elev. 5000 ft., limber pine-Douglas fir; June 5, 1979; C. Wallis; ALTA 84662.

Site 4 Ram Mountain

6. Ram Mountain, 52 21'N, 115 47'W; elevation 6500-6700 ft., sloping meadows iwth widely scattered white spruce, giveing way to talus slopes; July 3, 1974; Derek Johnson, No. 588; UAV 27429.

7. Ram Mountain, 52 21'N, 115 47'W, 14+15-39-13-W5; elevation 6400-6900 ft., above or around timberline, on soil; July 12, 1971; C.D. Bird, No. 28137; UAC 27430.

8. Ram Mountain, 52 20'N 115 45'W, west of Rocky Mountain House on Strachan road between North Ram and North Saskatchewan Rivers, SW of Nordegg; scree slope below tower; July 19, 1974; M. Dumais, #7557; det. by G.W. Douglas; ALTA 72685.

Site 5 Cardinal Divide

9. Cadomin, 52 56'N 117 22'W, Sec 2-46-24-W5M; dry slope, on open, stony, alpine ridge, growing in vicinity of *E. pallens*, rare and not seen elsewhere; July 7, 1968; George Pegg, #3042; det. by George Pegg; Prov. Mus. of Alberta B71.3.15. Duplicate exists c #B88.1.18277.

10. Prospect Creek, below Cheviot Mountain, Mountain Park; dry, alpine fell-field; Chromosome number determined from this material 2n=36; July 2, 1981; J.G. Packer, #81-29; ALTA 90417.

11. Mountains above Prospect Creek at top of raod, Mountain Park; elev. c 6500 ft., dry fell-field; grown in Greenhouse at University of Alberta, flowered March 19, 1973; July 15, 1971; J.G. Packer; ALTA 91131.

12. Prospect Mountain, 10 miles SW of Cadomin, 52 55'N 117 20'W, Front Range, Rocky Mountains; dry, rocky terraces of *Arctostaphylos uva-ursi*, found on terrace top; July 8, 1976; P. Mortimer, #555; ALTA 75219.

The known Saskatchewan locations include:

Site 1 Cypress Hills Provincial Park

1. Cypress Hills, 49 40'N 109 30'W; dry hilltops, uncommon; 25 07 1947; Breitung, A.J., #B5046; verified by A.J. Breitung, 1954; SASK 23223, Sask 89281.

2. Cypress Hills, 35 miles SW of Maple Creek, 1/4 mile SW of biology lab, 49 34'N 109 54'W; high calcareous hill; 15 06 1975; Ledingham, G.F., #5672; USAS 14967.

3. Cypress Hills, 49 40'N 109 30'W; 00 00 1880; Macoun, J.; Scoggan, H.J. 1978-1979; Unver., lit. rep.

4. Cypress Hills, 49 40'N 109 30'W; 25 06 1894; Macoun, J.; MO 211411, DAO 2936, SASK s.n.; Scoggan, H.J. 1978-1979.

5. Valley of Adams Creek, east of Fort Walsh, SE 1/4 8-7-28 W3rd; cobble-stones lapping over edges of Whitemud Formation; 03 06 1988; Hudson, J.H.; sight record, no specimen; (Hudson, Blue Jay 52(3). 1994)

Site 2 Ravenscrag - Eastend

6. Ravenscrag, 49 29'N 109 12'W, LSD 12 in Sec 20 T06 R24 W3; steep windy NW slope of cobbly knoll, with Hymneoxys, Cruptantha macounii, Musineon, Chamaerhodos, Astragalus aboriginum, a few plants; 29 05 1988; Hudson, J.H., #4778; SASK 88809, USAS 14968, CAN 537227.

7. Eastend, 49 31'N 108 49'W; hillside; 31 05 1955; Looman, J., #504; SCS s.n.

8. Whitemud River Plateau, southeast of Eastend, LSD 13 in 35-5-20 W3rd.; cobble-stones lapping over the edges of Whitemud formation; 23 05 1988; Hudson, J.H.; sight record, no specimen; Hudson (Hudson, Blue Jay 52(3). 1994)

9. Fairwell Creek, 49 30'N 109 13'W; Astragalus caespitosus, elev. 1080 m; 16 05 1958; Looman, J., #1003; SASK 118733 (SCS).

Site 3 Wideview

10. Wideview, 49 08'N 107 09'W, LSD 11 in Sec 21 T02 R09 W3; on eroded sandy slope, lowest part of Whitemud formation, facing SE, alt. 3250 ft., with *E. compositus, Lesquerella arenosa*, locally plentiful; 12 05 1988; Hudson, J.H., $4775; SASK 88812, USAS 1599, CAN 537252.

Site 4 Grasslands National Park

11. Grasslands Park, S of Frenchman River, 49 02'N 107 13'W, NW1/4 Sec 12 T01 R10 W3; 28 07 1989; Hooper, E.R.; USAS 1598b.

12. Grasslands Park, S of Frenchman River, 4 miles NE of Rosefield, S 20-22, 49 06'N 107 27'W, NW1/4 Sec 5 T02 R11 W3; high hills of Frenchman River; 19 07 1989; Hooper, E.R., #10970; USAS 1598.

Site 5 Rockglen and Environs

13. Ca 1/2 mile S of Canopus, 49 11'N 106 12'W, NE1/4 Sec 3 T03 R02 W3; high eroding butte, alt. 3150 ft., whole plant poorly developed this very dry spring; 20 05 1981; Ledingham, G.F., #7224; SASK 77761.

14. 1/4 mile N of Quantock, 49 11'N 106 05'W, SW1/4 Sec 4 T03 R01 W3; crest of small eroded hill, alt. 3000 ft.; 19 05 1981; Ledingham, G.F., #7173; USAS 1600.

15. Rock Glen, 49o11'N 105o57'W; eroded calcareous soils on hilltop and slopes, elev. 2950 ft.; May 22, 1994; B.M. Smith; UAC s.n.

16. Rock Glen, see above; several fruiting stalks; July 12, 1994; B.M. Smith; UAC s.n.

17. North of Scout Lake, 49o25'N 105o59'W, see above; slump slopes, 30% barren, cobbled areas, sparse; May 22, 1994; B.M. Smith; UAC s.n.

18. Pickthall, 49 25'N 105 59'W, SW1/4 Sec 28 T05 R30 W2; bare bench on E side valley, soil Ravenscrag silt with little or no till; 28 05 1955; Ledingham, G.F. and J.H. Hudson, #1600; SASK 79466, JHH, DAO.

Site 6 Wood Mountain

19. Old Wives Creek and Wood Mountain, near the USA boundary SW of Moose Jaw, ca 49 00'N 106 45'W; 31 05 1895; Macoun, J., #10860; CAN 104094; Scoggan, H.J. 1978-1979; Breitung, A.J., 1957.

20. Wood Mountain, Medicine Lodge, ca 49 28'N 106 14'W; 14 06 1895; Macoun, John; CAN 104098

Site 7 Simmie

21. Simmie, 49 57'N 108 08'W, NE1/4 Sec 33 T11 R16 W3; dry eroded SE-facing slope in coulee, quartzite cobbles common; 09 06 1955; Hudson, J.H., #1615; SASK 79465, JHH.

Site 8 Table Butte

22. Table Butte, 50 10'N 107 23'W; eroded bench, elev. 870 m; 07 06 1956; Looman, J., #584; SCS s.n.

Site 9 Aquadell

23. Aquadell, 50 42'N 106 47'W, LSD 1 in Sec 16 T20 R06 W3; on quartzite cobble flats and juniper-covered wash slopes around Whitemud outcrops, with Hymenoxys rich., Haplopappus nutt., locally abundant; 19 06 1989; Hudson, J.H., #4854; SASK 89088, USAS 14966, CAN 544302.

24. Shooting hill, see above; limited distribution, approx. 90 plants; May 22, 1994; B.M. Smith; UAC s.n.

APPENDIX 2

Habitat Site Descriptions

Forests in the Montane Region tend to be open with trees interspersed with grassy areas. Douglas fir and limber pine are characteristic southwestern Montane but they are often less abundant than trees such as lodgepole pine, white spruce and aspen poplar. Above tree-line is the Alpine zone, where tree growth is limited to occasional krummholz islands. Wide diversity of species is possible over short distances in response to snow accululation, snow melt patterns, degree of protection from wind, drainage and soil development. More well-drained, exposed areas (preferred by dwarf fleabane) are dominated by carpets of white mountain avens (Wilkinson 1990).

In the Main Foothills the Cardinal Divide and Ram Mountain contains portions of the Alpine and Subalpine Ecoregions. Most of the area is in the Alpine Ecoregion which is treeless and occurs above about 2200 m. Above timberline is found the windswept alpine tundra, a zone of low-growing cushion or mat plants, such as white mountain avens, alpine cinquefoil, the saxifrages, moss campion, and others. *Kobresia myosuroides* and wheat grass, together with many other grasses and sedges, are prevalent in the alpine tundra meadows. *E. radicatus* is usually found in the Herb-Dwarf Shrub vegetation typically with avens, *Kobresia*, bearberry or shrubby cinquefoil (Johnson 1975, Achuff 1984).

The Alberta site at Whiskey Gap occurs in the Foothills Grassland Sub-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, occuring 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. Dwarf fleabane prefers the sage praire on 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 Whiskey Gap (Figure 4) tend to be found in rather small patches, occuring on valley ridges, south-facing slopes or gravelly deposits, wherever drier conditions are found (Alberta Recreation and Parks 1989).

In Saskatchewan, dwarf fleabane occurs on drier ridge and hilltops above prairie that is characterized by spear grass, blue grama, wheat grass, and June grass. It also occurs in fescue prairie. Habitats in Saskatchewan are very similar to those at Whiskey Gap in Alberta. Saskatchewan sites tend to be more stony (Richards 1969).

Erigeron radicatus apparently requires a combination of factors with particular bedrock characteristics, unglaciated origin, and, usually, steep relief. Dwarf fleabane mostly occurs as islands of distribution in Saskatchewan on land which is difficult to cultivate. In Alberta, the species mostly occurs on high elevation sites in the foothills or montane areas with only the Whiskey Gap site in the foothills grassland.

Alberta

Site 1 - Whiskey Gap (Map 2) (Figure 2)

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. *Erigeron radicatus* again is mostly restricted to the gravelly plateau rims on the ridge north of Whiskey Gap. Sommerfeldt has listed dwarf fleabane as being in flower on the last weekend of May since 1987.

Dwarf fleabane prefers depression areas on the unglaciated, gravelly, ridge tops where it grows with *Phlox alyssifolia* (a rare species) and near but not together with the very common *Erigeron compositus*. Dwarf fleabane was found at only one small site on the high ridge system although the ridges were surveyed extensively on the Sommerfeldt Ranch. Also, the North Milk River ridge and the Del Bonita upland areas were surveyed. No dwarf fleabane was found at any other site in the area, although many other sites have remained unglaciated as well.

Erigeron radicatus 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., *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. *Antennaria umbrinella* Rydb., *Astragalus gilviflorus* Sheldon, *Penstemon nitidus* Dougl., *Arabis nuttallii*, *Plantago canescens* Adams, *Physaria didymocarpa* (Hook.) A. Gray, *Minuartia rubella* (Wahl.) Graebn., and *Artemisia campestris* L. were also found (Smith 1993/94).

Site 2 - Waterton Lakes National Park (Map 2)

Small cirque, in middle of north face on the rocky valley floor and sides of Soft Mountain at moderately high elevation (6200 ft.). Known only from one site in the park. Site not examined by the author. Dwarf fleabane is found in the stable rocky meadows in the Alpine Zone. Probable associated species include the following: *Androsace lehmanniana, Anemone drummondii, Antennaria alpina, A. umbrinella, Arenaria capillaris, Astragalus alpins, Draba spp., Erigeron compositus, Eriogonum androsaceum and E. ovalifolium, Hedysarum sulphurescens, Oxytropis campestris, Potentilla diversifolia, P. ledebouriana, P. nivea, and P. plattensis, Poa alpina, Sibbaldia procumbens and Silene acaulis* (Kuijt 1982).

Site 3 - Black Mountain (Map 2)

South Porcupine Hills in the limber pine-douglas fir zone of the montane forest. Upper slopes, semi-barren with abundant Erigeron compositus (Wallis 1979). This site was surveyed in 1994 (Smith) but although abundant *Erigeron compositus* was found on the semi-barren upper slopes no dwarf fleabane was found. It may occur only sporadically as it does at the Whiskey Gap site (Site 1).

Site 4 - Ram Mountain (Map 2)

Sloping meadows with widely scattered white spruce giving way to talus slopes at high elevations (6400 - 6900 ft.). The species occurs above or around timberline. Also found on scree slopes. According to Johnson (1975) *E. radicatus* was found with *Dryas integrifolia - Kobresia myosuroides - Potentilla fruticosa* generally on elevated, southerly-facing slopes subject to desiccation by the prevailing southwesterly winds. Dwarf fleabane was found to occur in two of the six such plant communities identified during Johnson's study of bighorn sheep range on Ram Mountain. (Figures 9, 10) Both sites occur in sparsely vegetated meadows. The first site (Site 4A, Figure 9) is bounded on the east and south by white spruce and on the north and west by rock faces and talus slopes. Elevation 6300 ft. Slope is not extreme, but soil development is poor and shallow, with plant cover scattered due to the rocky nature of the terrain. The second site (Site 4B, Figure 10) lies in a meadow. The terrain is undulating, with rocks, gravel and vegetation-soil patches. Elevation 6600 ft. The soil is relatively shallow and light in colour occurring over a gravel base. Solifluction is evident in portions of the area. Some white spruce is present lower down on the north-facing slope.

Other associated species at the two sites on Ram Mountain: *Arctostaphylos rubra, Salix nivalis, Anemone drummondii, Androsace chamaejasme, Antennaria alpina, Arenaria rossii, Arenaria rubella, Arnica alpina, Aster alpina, Aster sibiricus, Bromus pumpellianus, Calamagrostis*

purpurascens, Carex petricosa, Carex scirpoidea, Elymus innovatus, Gentiana prostrata, Gentiana propinqua, Hedysarum mackenzii, Oxytropis sericea, Poa alpina, Polygonum viviparum, Solidago multiradiata.

Site 5 - Cardinal Divide (Map 2)

Dry slope on open, stony, alpine ridge growing in vicinity of *E. pallens* (also a rare species). Also, dry alpine fell-fields at high elevations around 6400 ft. Also, on dry, rocky terraces of *Arctostaphylos uva-ursi*. *E. radicatus* was found in the *Dryas octopetala - Kobresia myosuroides - Arctostaphylos uva-ursi* plant community. This vegetation type occurs on subxeric to mesic Upper Subalpine to Alpine sites throughout the Cardinal Divide area usually on southerly aspect slopes and ridge tops. Soils are well drained Regosolics and Brunisolics on morainal and colluvial landforms. The sites are wind-swept and have low winter snow cover. Other associated species: *Polygonum viviparum, Oxytropis podocarpa, Silene acaulis*. Bryoid cover is low with lichens such as *Cetraria cucullata* and *Cetraria nivalis* frequent.

Reported Locations (Map 2)

Achuff (1985) lists *E. radicatus* as occurring at the following sites: White Goat Wilderness, Siffleur Wilderness and Plateau Mountain. Achuff (1985) reports that these areas are in many aspects similar to the Cardinal Divide area. Also, Johnson (1975) reported Dumais indicated Porsild's (1974) report of a single collection of *E. radicatus* from Alberta that is believed to be from Shunda Mountain which is on the north side of the North Saskatchewan River across from Ram Mountain.

Saskatchewan

Site 1 - Cypress Hills Provincial Park (Map 2)

E. radicatus was found on dry hilltops and high calcareous hills (Ledingham 1975). Dwarf fleabane is known only from this location in the park (Ledingham, 1990).

Site 2 - Ravenscrag - Eastend (Map 2, 5)

Steep, windy northwest slope of cobbly knoll, with *Hymenoxys richardsonii, Cryptantha macounii, Musineon divaricatum, Chamaerhodos erecta, Astragalus aboriginum and Astragalus caespitosus*. Also, on bare bench on Ravenscrag silt with little or no till. (Hudson, various dates) Hudson (1994) reports a sight record southeast of Eastend (Map 2, 5) which grows among the cobble-stones lapping over the edges of a Whitemud outcrop. Smith (1994) noted that the Eastend-Ravenscrag area contained considerable potential habitat. Potential habitat was surveyed in 1994 (Map 5).

The recent discovery of the *Tyrannosaurus Rex* fossil skeleton at Eastend made fieldwork in that area very difficult. The access road to the site was closed as it was the same route to the dinosaur discovery.

Site 3 - Wideview (Map 2)

Area sampled, exact habitat found as described on the collection label but no specimens of dwarf fleabane were located. It is likely that the species occurs on the dry rocky slopes along the upper edges of various coulees in the area. Previously collected on eroded sandy slope, lowest part of Whitemud formation, facing southeast, elevation 3250 ft., with *Erigeron compositus*, and *Lesquerella arenosa* (Hudson 1988). The site is very similar to those found in the nearby Grasslands National Park.

Site 4 - Grasslands National Park (Map 2)

High hills of the Frenchman River (Hooper 1989). Known from two locations from the western block of Grasslands National Park. One site is presently enclosed within land held by the park but the other is located on proposed land not yet within the park boundaries. Neither was relocated during Wellsworth's extensive vegetation survey of Grasslands National Park in 1993. The site just outside the park's boundaries was checked by the author in 1994 but no specimens were located. Associated vegetation include the following species: *Eriogonum pauciflorum, Haplopappus armerioides, Sarcobatus vermiculatus, Artemisia cana* (6" height), *Koeleria macrantha, Thermopsis rhombifolia*. Very dry.

Site 5 - Rockglen and Environs (Map 2, 3, Figures 5-8)

North of Scout Lake the dwarf fleabane occurs on slump slopes, 30% barren, high ridges and hills, with *Artemisia cana, Hymenopappus filifolius, Eriogonum pauciflorum, Phlox hoodii, Oxytropis sericea, Gutierezzia sarothrae, Hymenoxys richardsonii, Lesquerella arenosa, Astragalus gilviflorus and Erigeron compositus* (Smith 1994).

Dwarf fleabane was also found on the high ridges just southwest of the townsite of Rock Glen. *E. radicatus* was found on the more easterly of the two hills, more commonly on the lower slopes growing in *Juniperus horizontalis-Artemisia frigida* beds. The species also occurs on the upper cobbly slump areas and infrequently on the semi-barren hilltops (Smith 1994).

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. (Map 3, 4) Actual and potential sites were examined twice in the summer of 1994 (Smith), once in mid-May and again in mid-July. Both *E. radicatus* and *Phlox alyssifolia* (rare species) were common over the high ridges during the May trip but neither were much in evidence during the second trip in July. In July, neither of these species were much in evidence but *Hymenopappus filifolius*, also a rare species, was now a very noticeable component of the vegetation. This illustrates the obvious importance of continual sampling over the summer

season.

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. Dwarf fleabane was found on a variety of habitats over the ridge system but was most common on the steep stony slides on the upper slopes and, less frequently, on the hilltops. Dwarf fleabane was also found more commonly on the lower slopes with *Juniperus horizontalis* and *Artemisia frigida*. 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. Ledingham (1981) found dwarf fleabane on high, eroding buttes, elevation 3000-3150 ft. and eroding calcareous soils on hilltops and slopes.

The upper slopes and tops of the Rockglen ridges and hills have remained mostly unglaciated. The following is a site description for dwarf fleabane which is fairly standard for all locations included within the Rockglen site. Common with *Erigeron radicatus*: *Phlox alyssifolia, Eriogonum pauciflorum, Juniperus horizontalis, Astragalus gilviflorus, Erigeron compositus, Phlox hoodii, Haplopappus armerioides, 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 sessilliflora, 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.

Site 6 - Wood Mountain (Map 2)

Represented only by historical collections (John Macoun) from the late 1890's. This site was not relocated during the summer of 1994 (Smith). The Macoun site was located on Old Wives Creek which is now Wood River. From Macoun's account of the trip this site must have been taken along Lynthorpe Creek - the terrain along modern Wood River exhibits none of the bedrock outcrops to which the plant is confined (Hudson 1994).

Site 7 - Simmie (Map 2)

Excellent *E. radicatus* habitat. Upper slopes are stony/cobbly and semi-barren on steep ridge tops as preferred (Smith 1994). Dry, eroding southeast-facing slope in coulee, quartzite cobbles common (Hudson 1955). Similar to the Aquadell site.

Site 8 - Table Butte (Map 2)

Site appears to be excellent dwarf fleabane habitat. The area was examined too late in the season to locate specimens. Good habitat on top of Table Butte is fairly extensive. The site should be examined in the spring (Smith 1994). Previously found on an eroded bench (Looman 1956).

Site 9 - Aquadell (Map 2, Figures 3-4)

Dwarf fleabane located on gravelly/cobbly high ridge top above Payson Lake. The species is associated with *Oxytropis sericea, Astragalus gilviflorus, Phlox hoodii, Hymenoxys richardsonii, Eriogonum flavum, Cryptantha macounii, Penstemon nitidus, Opuntia polyacantha, Lesquerella arenosa, Erigeron compositus, Musineon divaricatum* and grasses. Grasses are very short. Hudson (1989) describes the site as occurring on quartzite cobble flats and juniper-covered wash slopes around Whitemud outcrops, with *Hymenoxys richardsonii* and *Haplopappus nuttallii*.

APPENDIX 3

Recommended Critical Habitat

The Rock Glen, Saskatchewan site (Site 5, Map 2) should be designated as primary critical habitat. The total population on the ridges and hills surrounding Rock Glen is estimated to be greater than the combined population of all other Canadian sites. It is, by far, the best site in Canada and would serve to protect the only region within Canada with a strong population base for the species. See Map 3 and 4 for actual site location and potential habitat.

The only other site with any concentration of collections is the Ravenscrag - Eastend, Saskatchewan site (Site 2). This area is recommended for designation as secondary critical habitat (Map 5). The area contains three known locations plus one sight record and considerable potential habitat for the species. Although the total population of the species is estimated to be quite low at this site in comparison to the Rock Glen site, the population may be fairly widespread on the higher hills and ridges and could be determined to be somewhat greater than is presently known.

Most other sites support small to moderate local populations. There are no sites within Alberta with a significant concentration of collections. All sites represent local populations with restricted distribution of specimens. The northern Alberta site at the Cardinal Divide (Map 2) would be the best candidate for protection if an Alberta site was chosen but even this site contains only three very closely spaced locations around Prospect Mountain, west of Mountain Park.

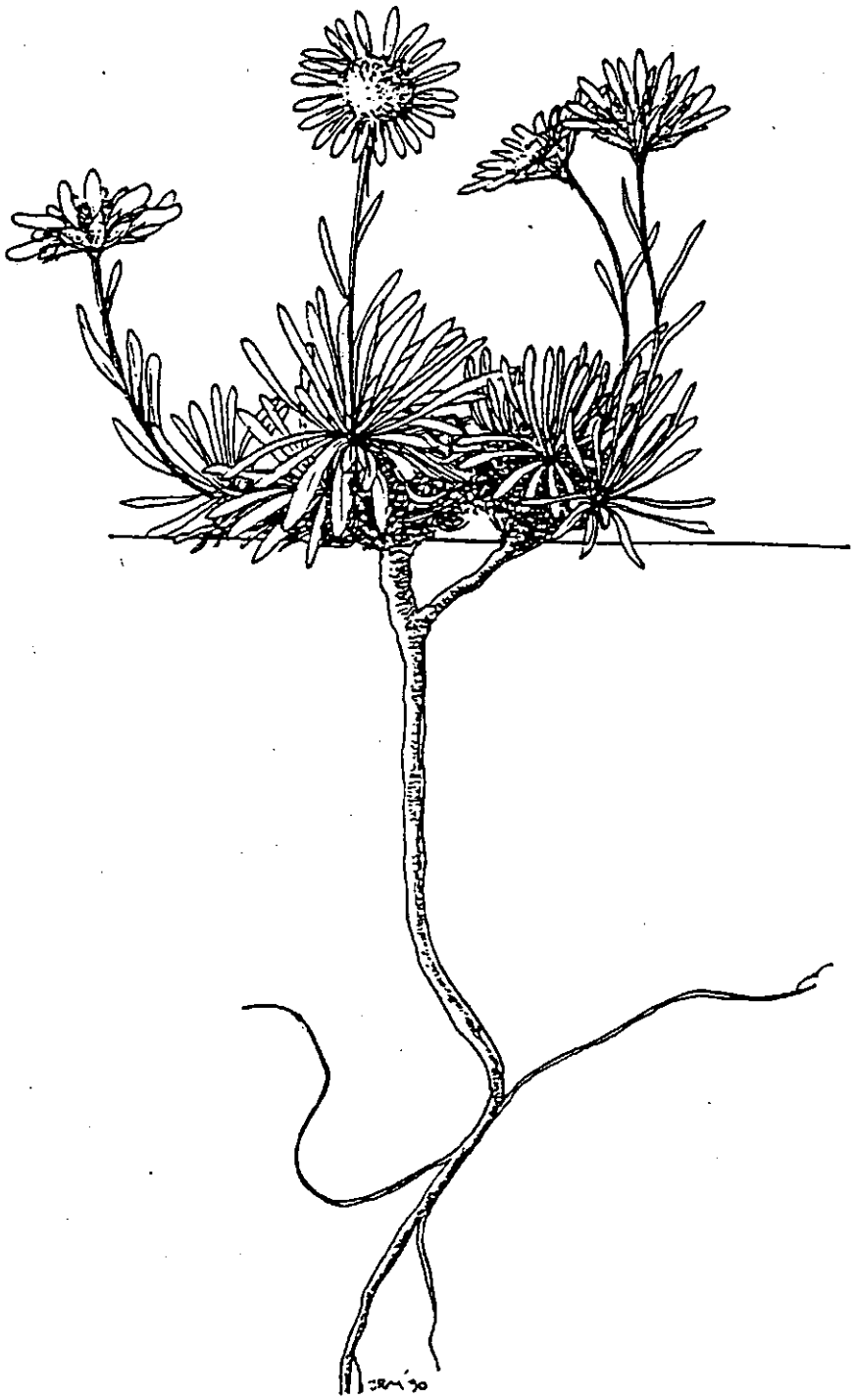


Figure 1: *Erigeron radicatus* Hook.

(Provincial Museum of Alberta)

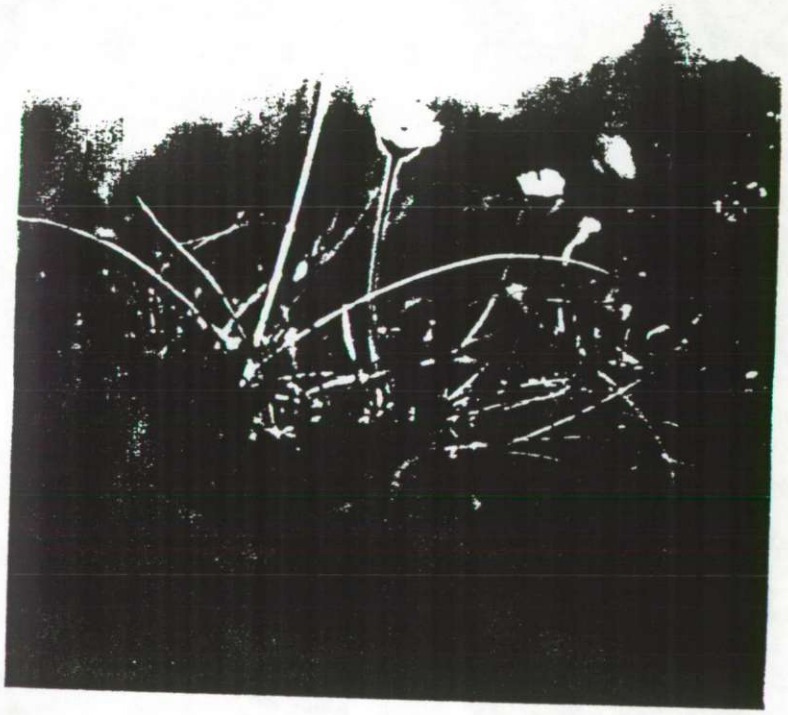


Figure 2: *Erigeron radicatus* Hook. Site 1: Whiskey Gap, Alberta.

Figure 3 Dwarf fleabane, cobble-stone habitat.
Site 5: North of Scout Lake, Saskatchewan.

Figure 4 Dwarf fleabane, population amid cobble-stones.
Site 5: North of Scout Lake, Saskatchewan.

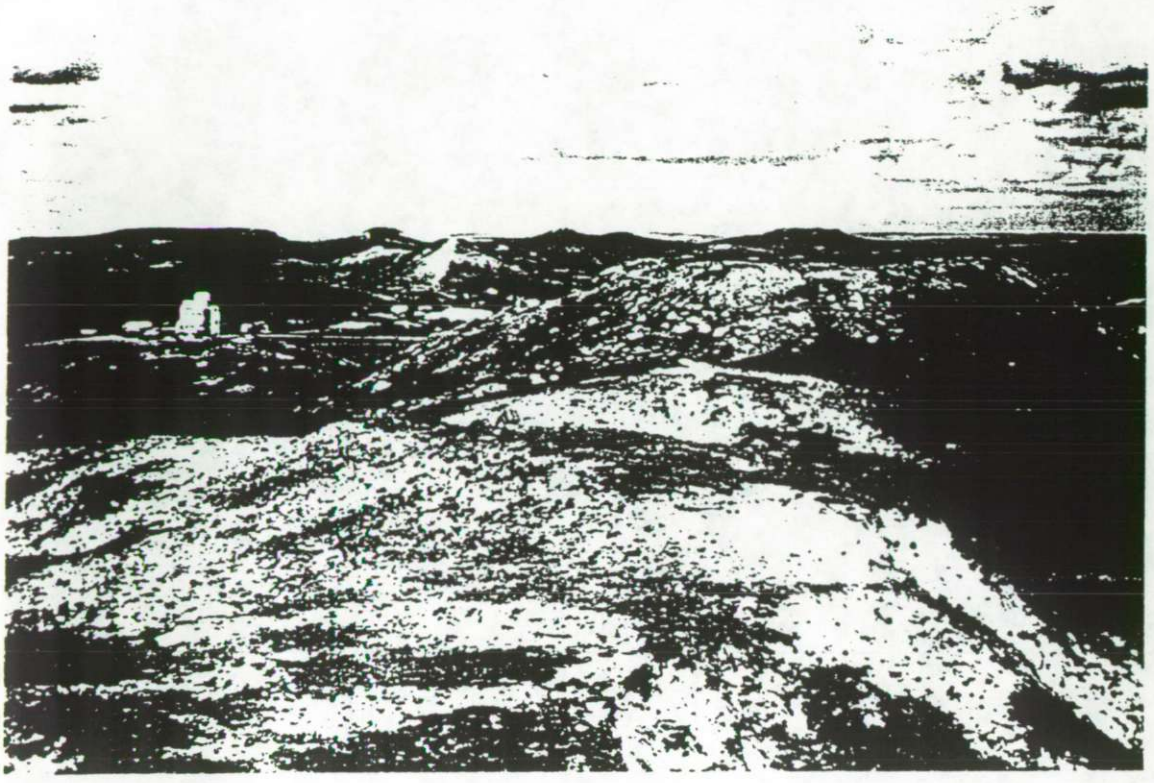


Figure 5. Rock Glen townsite, Sask. (Site 5)
Dwarf fleabane habitat, semi-barren high hills and ridges.

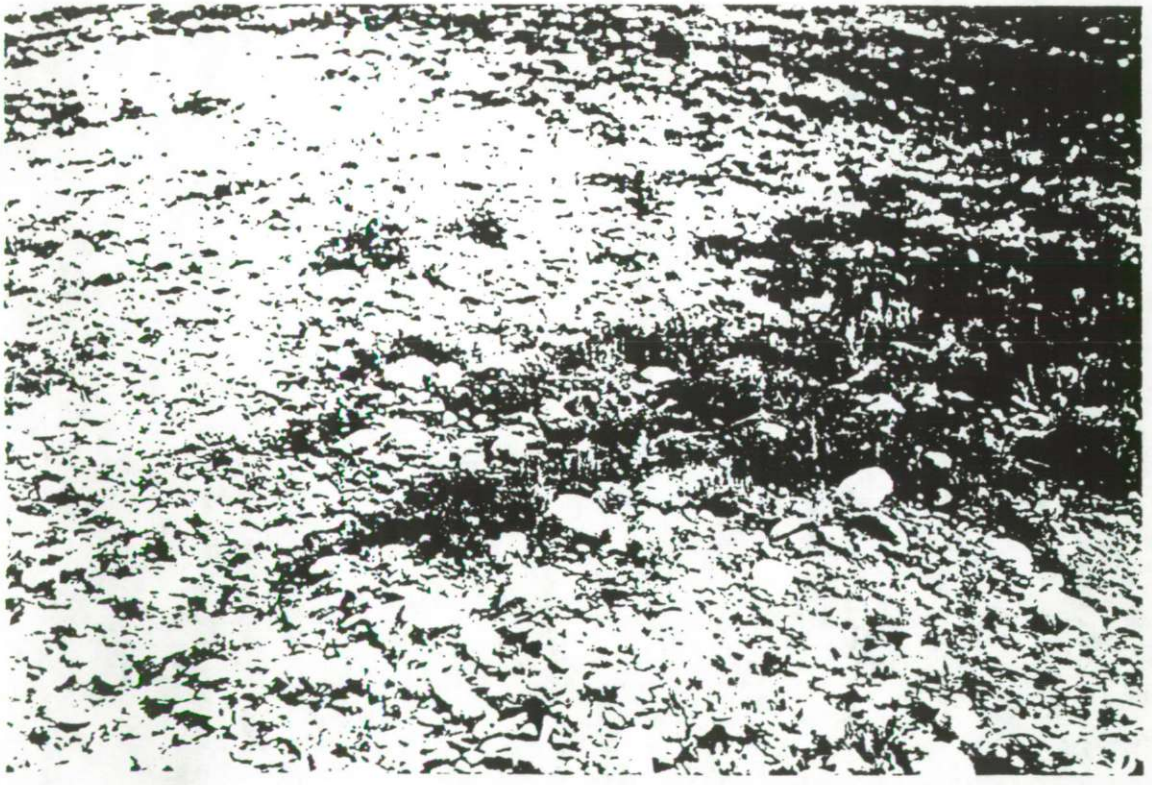


Figure 6. Cobble-stone habitat with creeping juniper (center).
Site 5: Rock Glen, Sask.

Figure 7: *Erigeron radicatus* Hook. in fruit (center). Site 5: Rock Glen, Sask.

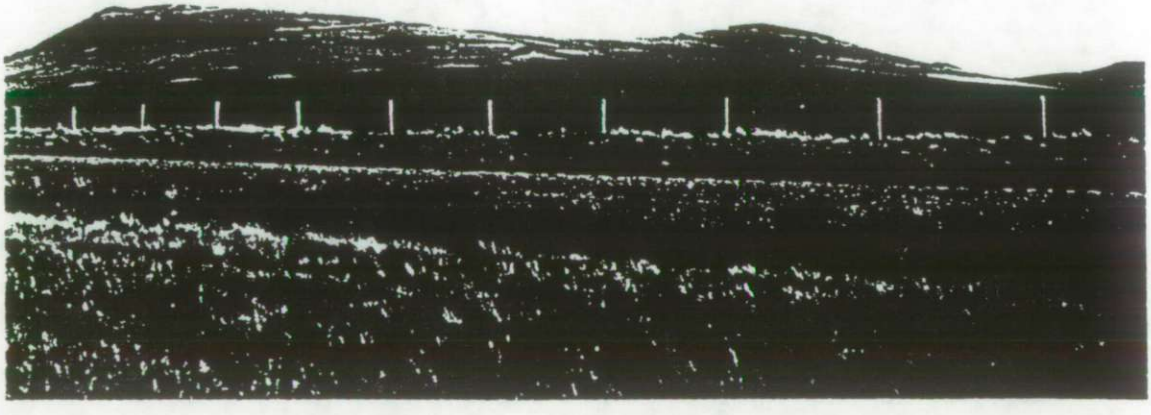


Figure 8: Cultivation practices in the Rock Glen area (Lisieux), Sask. showing loss of hilltop habitat.

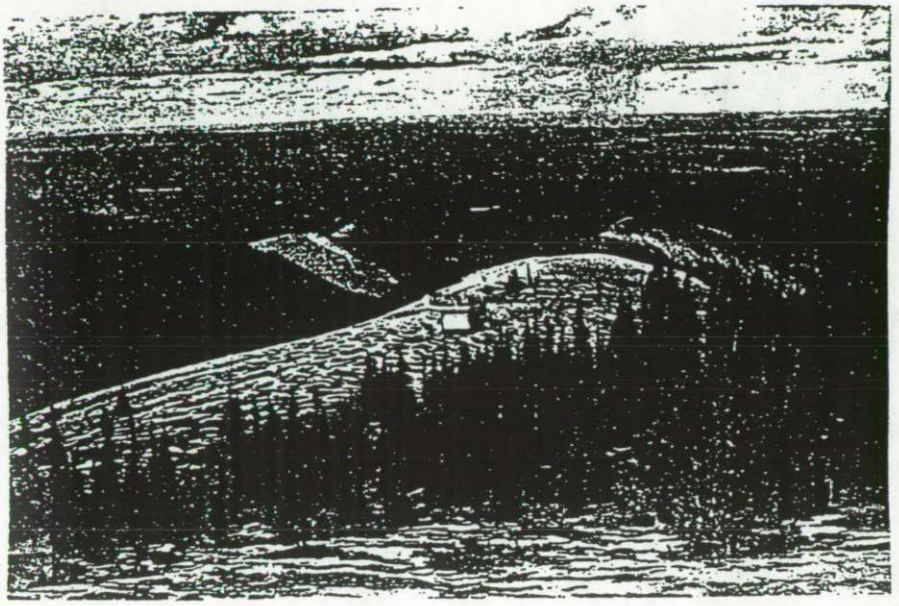


Figure 9: Site 4A: Ram Mountain, Alberta. Yellow marks the Dwarf fleabane location. (Johnson 1975)

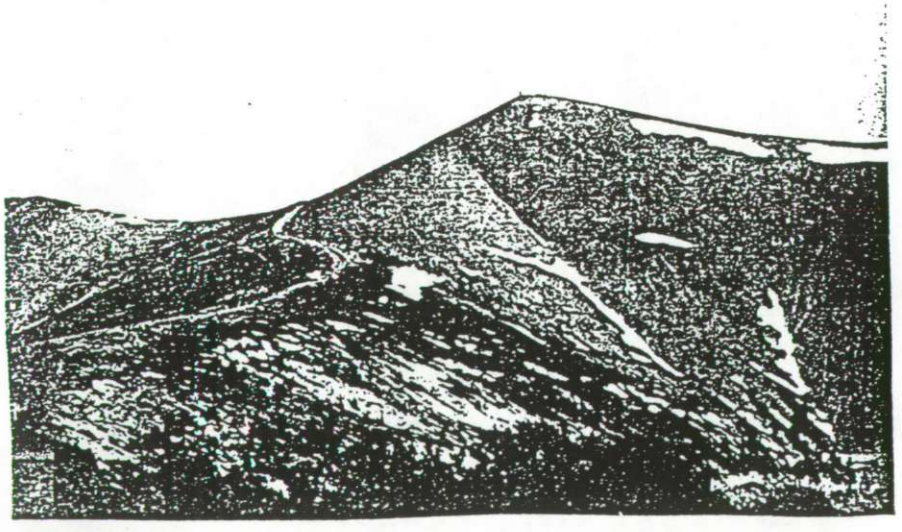
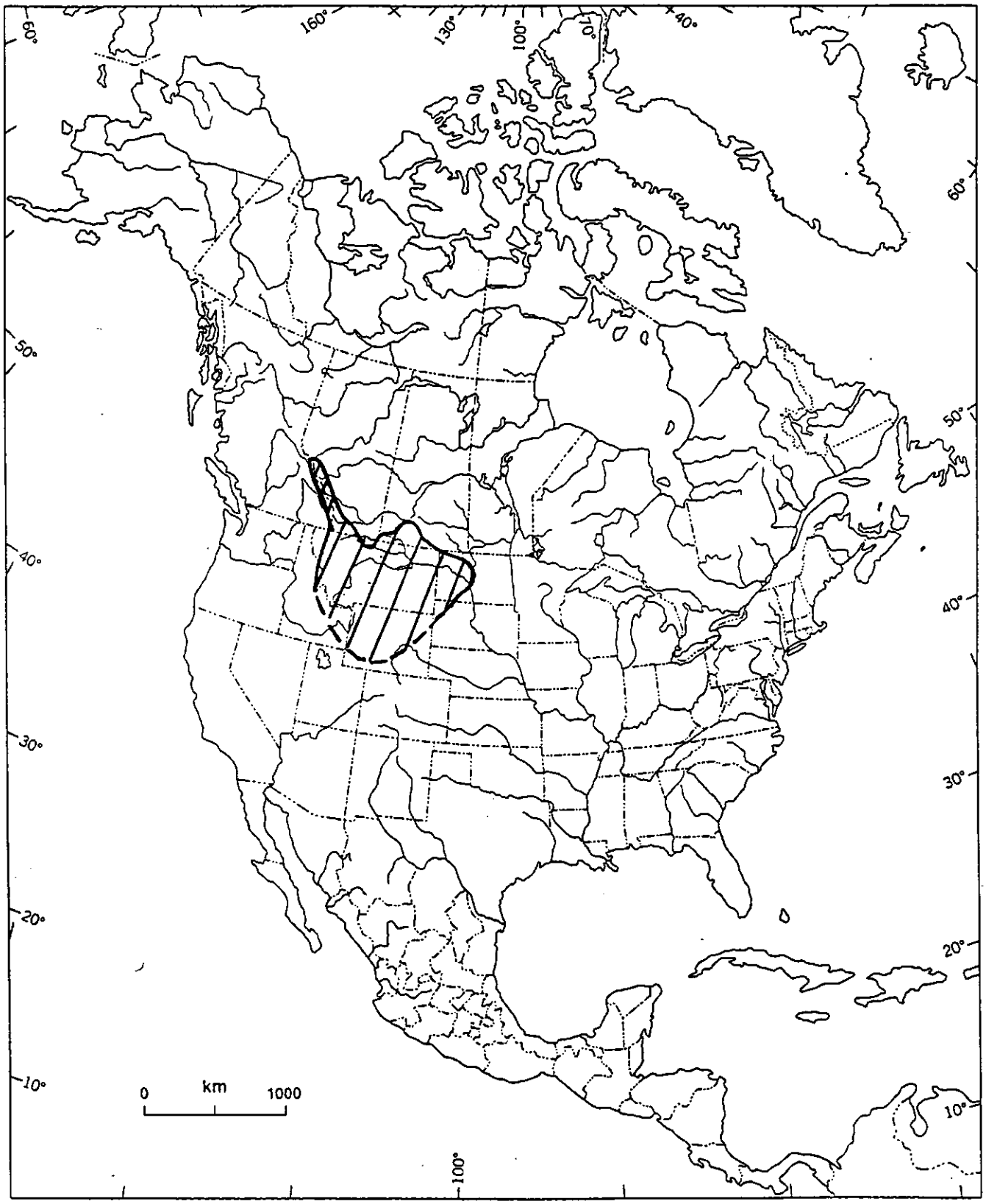
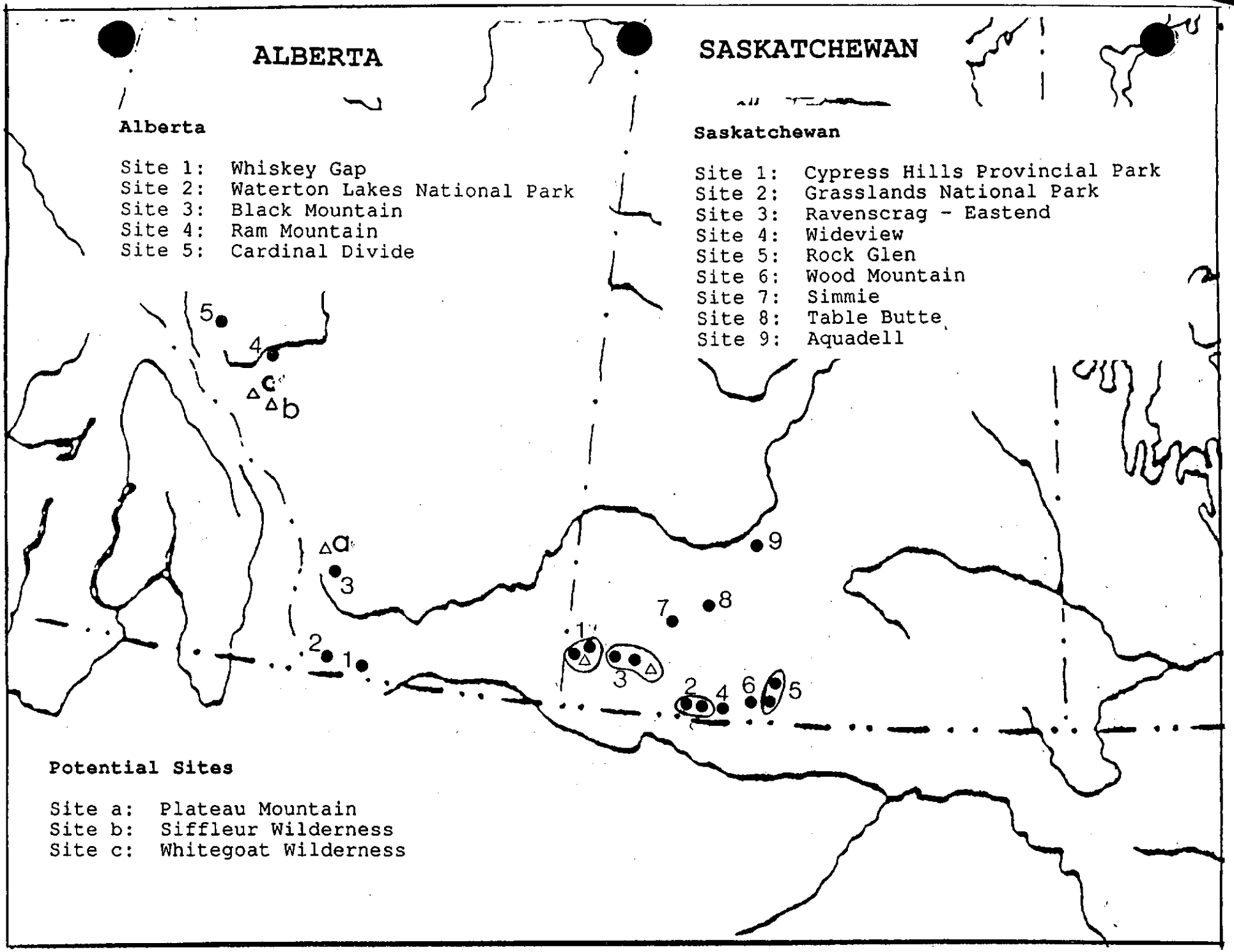


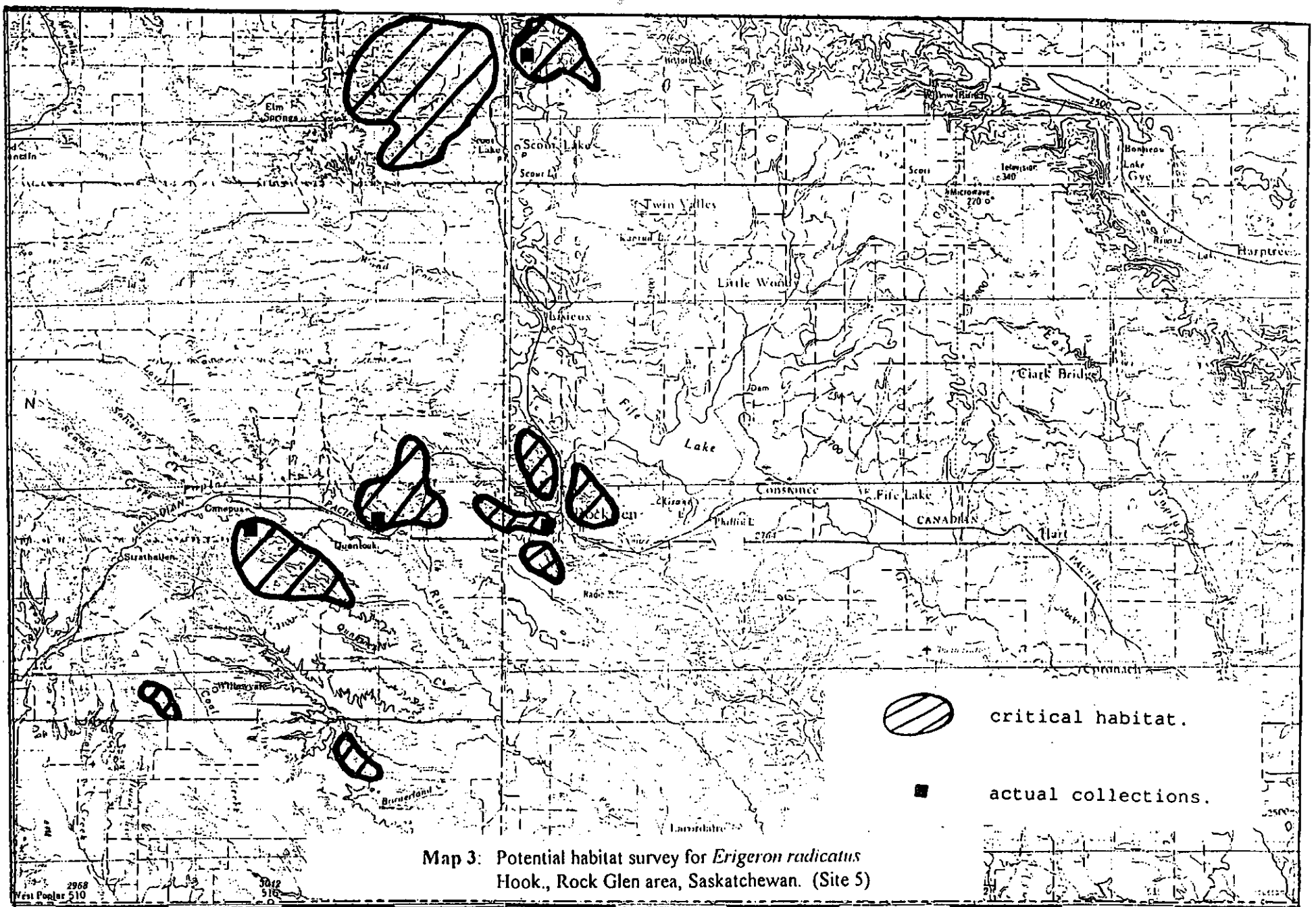
Figure 10: Site 4B: Ram Mountain, Alberta. Yellow marks the Dwarf fleabane location. (Johnson 1975)



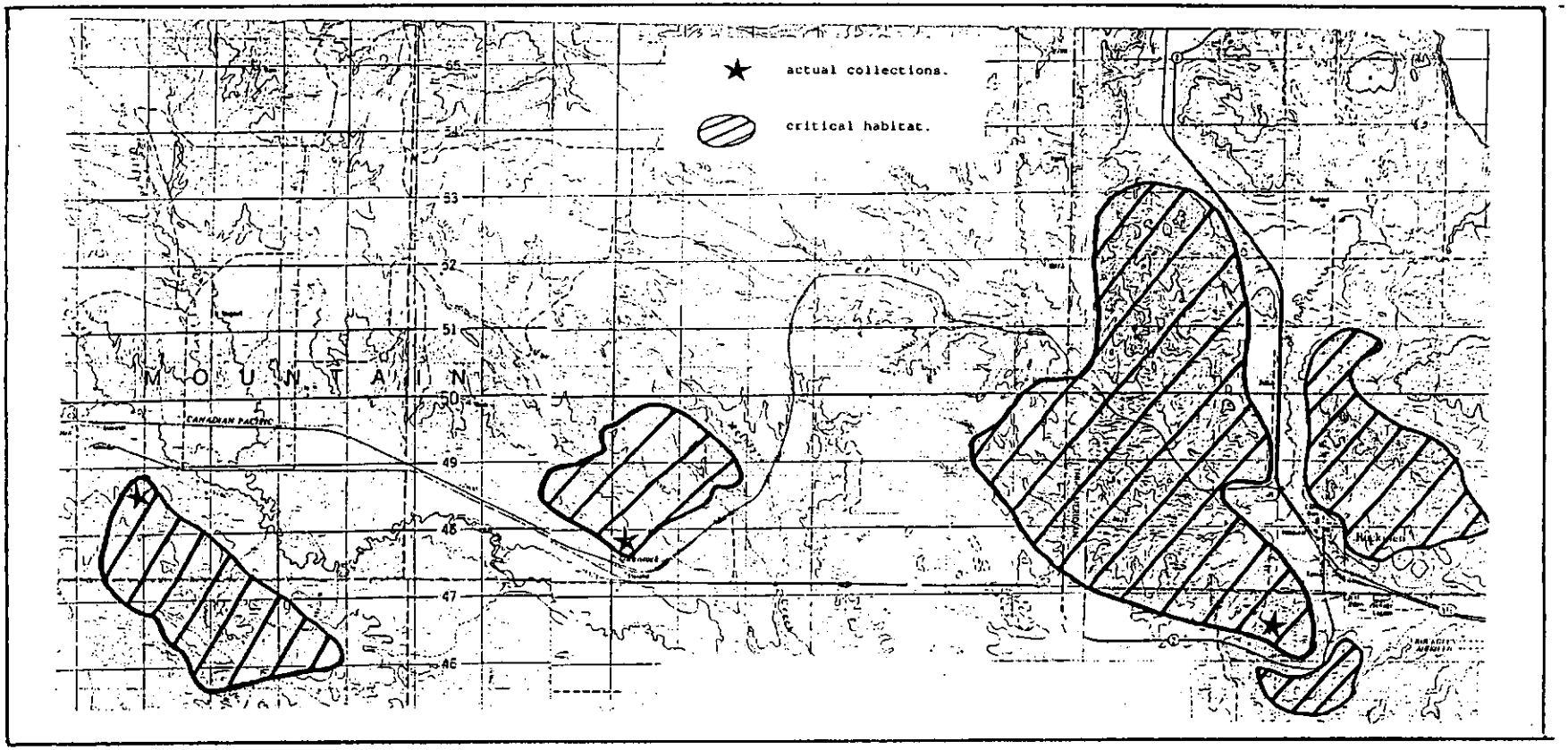
Map 1: Distribution of *Erigeron radicatus* Hook.



Map 2: Distribution of *Erigeron radicatus* Hook. in Canada.



Map 3: Potential habitat survey for *Erigeron radicatus* Hook., Rock Glen area, Saskatchewan. (Site 5)



Map 4: Critical habitat of *Erigeron radicatus* Hook., Rock Glen area, Saskatchewan. (Site 5)

Map 5: Critical habitat and potential habitat survey for *Erigeron radicatus* Hook., Ravenscrag - Eastend, Saskatchewan. **(Site 3)**