COSEWIC
Assessment and Status Report

on the

Coast Microseris
Microseris bigelovii

in Canada

ENDANGERED
2006

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

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Coast microseris — Illustration of *Microseris bigelovii* by Elizabeth J. Stephens (Douglas *et al*. 1998, with permission).

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COSEWIC
Assessment Summary

Assessment Summary – April 2006

Common name
Coast microseris

Scientific name
Microseris bigelovii

Status
Endangered

Reason for designation
A small annual herb present in a few fragmented sites within a narrow coastal fringe on southeast Vancouver Island in a densely inhabited urbanized region. Development, recreational activities, site management practices and competition from invasive alien plants continue to impact the species.

Occurrence
British Columbia

Status history
Designated Endangered in April 2006. Assessment based on a new status report.

COSEWIC
Executive Summary

Coast Microseris
Microseris bigelovii

Species information

Coast microseris (*Microseris bigelovii*) is a small stemless herb of the aster family with narrow, entire to deeply lobed basal leaves and a leafless flowering stalk bearing a single yellow flower head. Its fruits (achenes) are crowned by five distinctively shaped scales, each terminating in a long, hair-like bristle.

Distribution

The species ranges from Vancouver Island south along the coast to California. In Canada, *M. bigelovii* is restricted to southeast Vancouver Island and the adjacent Gulf Islands. The nearest extant population outside Canada occurs in Yachats, Oregon, about 450 km to the south.

Habitat

In Canada, coast microseris occurs on open rock bluffs and in rock-bound vernal seeps within 100 metres of the ocean. The sites are moist in autumn, winter and spring but dry during the summer.

Biology

The species is a self-pollinated annual that flowers and fruits in late spring. Seeds appear to have no dormancy mechanisms. Canadian populations possess a number of genetic traits that suggest they are derived from a single founder.

Population sizes and trends

Coast microseris is found in only six sites in Canada. All six sites are small with populations varying in size from 100 to 2,500 plants per site for an aggregate total of 5,500 to 6,500 individuals. It has become extirpated from at least four, and perhaps as many as six, historic locations in Canada.

Limiting factors and threats

Habitat loss and degradation presents the primary threat in Canada. An estimated 95% of the potential habitat has been lost over the past century due to urban and industrial development along with fire suppression and invasion by exotic herbs and shrubs. The species is restricted to the sub-Mediterranean climate of southeast Vancouver Island, and even there it only occurs in the ameliorated climate of shoreline locales, which experience fewer frosts and receive more moisture in the form of fog.

Special significance of the species

The Canadian populations are of scientific interest because they are highly disjunct from the species' main range, and because they are genetically distinct from plants in the main range of the species.

Existing protection or other status designations

Coast microseris is not protected by any endangered species legislation. Only one population occurs in a protected area. It has a global rank of G4 – apparently secure.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5th 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2006)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Coast Microseris

Microseris bigelovii

in Canada

2006

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SPECIES INFORMATION

Name and classification

Scientific name*:* *Microseris bigelovii* (A. Gray) Schultz-Bip.
Synonym: none
Common names: coast microseris, coastal silverpuffs, microséris de Bigelow
Family: Asteraceae (aster family)
Major plant group: Eudicot flowering plant

Microseris bigelovii is a clearly defined taxon that presents no classification problems.

Description

Microseris bigelovii is a taprooted annual with erect to ascending leafless flower stalks (scapes) 4-35 cm tall (Figure 1). The leaves are all basal, 3-25 cm long, and linear to narrowly spoon-shaped (oblanceolate), entire or coarsely pinnately cut with slender or broad tapering lobes or teeth. The leaves exude a milky juice when broken.

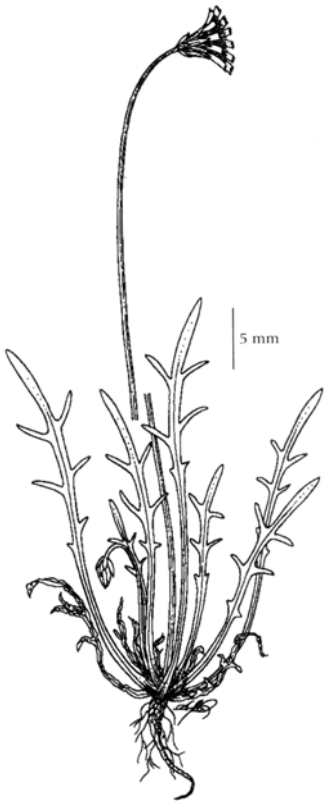

Figure 1. Illustration of *Microseris bigelovii* (artwork by Elizabeth J. Stephens, Douglas *et al*. 1998, with permission).

The solitary, terminal heads are nodding until mature. They are composed of yellow to yellow-orange strap-shaped flowers. The flowers are enclosed within a 6-15 mm tall involucre of broadly lanceolate bracts, often reddish on the outer surface and long black-hairy within. The fruits are brown to bronze, sometimes darkly spotted achenes. The achenes are 2.5-6 mm long and abruptly tapered at the base; they are crowned by a pappus of five hairless or short-hairy scales, each terminating in a long, hair-like bristle arising from the pointed scale (Douglas *et al*. 1998). There are no similar species within its extent of occurrence which might be mistaken for Coast Microseris.

Genetic description

Microseris bigelovii has a chromosome count of 2n=18 (Chambers 1993). Heusden and Bachmann (1992) examined genetic characteristics of material grown from seed collected at Saxe Point and Cattle Point. They found the plants at both of these sites had a chloroplast mutation only known from one other population (from San Mateo County, south of San Francisco). Grown in a greenhouse, plants derived from British Columbia populations flowered almost two months later than those from the southern-most California populations and possessed distinctive leaf morphologies (Bachmann *et al*. 1987).

DISTRIBUTION

Global range

Microseris bigelovii ranges from Vancouver Island south along the coast to California (Hitchcock *et al*. 1955; see Figure 2). The nearest United States record was from San Juan County in North Puget Sound. The species disappeared from San Juan County, where it formerly occurred at a number of locations, mostly on San Juan Island. The most recent San Juan County report was made in the mid-1980s (Atkinson and Sharpe 1993). It has not been found elsewhere in Washington State, where it is now listed as extirpated (Florence Caplow pers. comm. 2003). The nearest United States records are from Yachats, Oregon about 450 km south of the nearest Canadian populations. *M. bigelovii* has been extirpated from mainland Oregon, apparently as a result of competition from introduced weeds. It persists on some offshore islands, where bird guano appears to limit growth by weedy competitors (K. Chambers, pers. comm. 2004).

Canadian range

In Canada, *Microseris bigelovii* is restricted to southwestern British Columbia from Hornby Island to Victoria and vicinity (Figure 3). It occupies a coastal strip, no more than 50 metres wide, along southeast Vancouver Island. The extent of occurrence of this strip was estimated to cover approximately 20 km^2 (using GIS tools to calculate the length of the shoreline between Comox and Rocky Point).

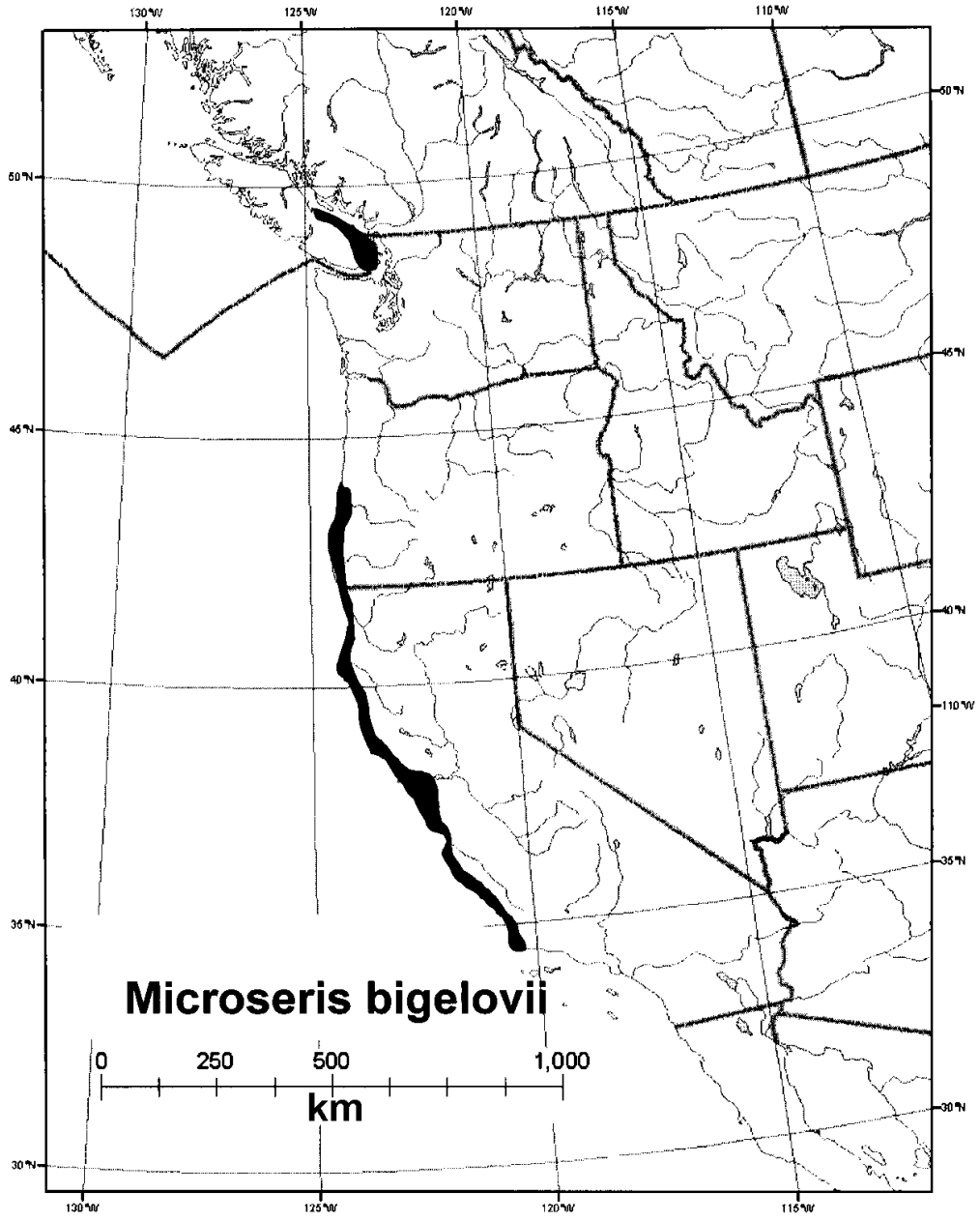

Figure 2. Global distribution of *Microseris bigelovii*. Oregon populations are now extirpated except on 'bird islands'.

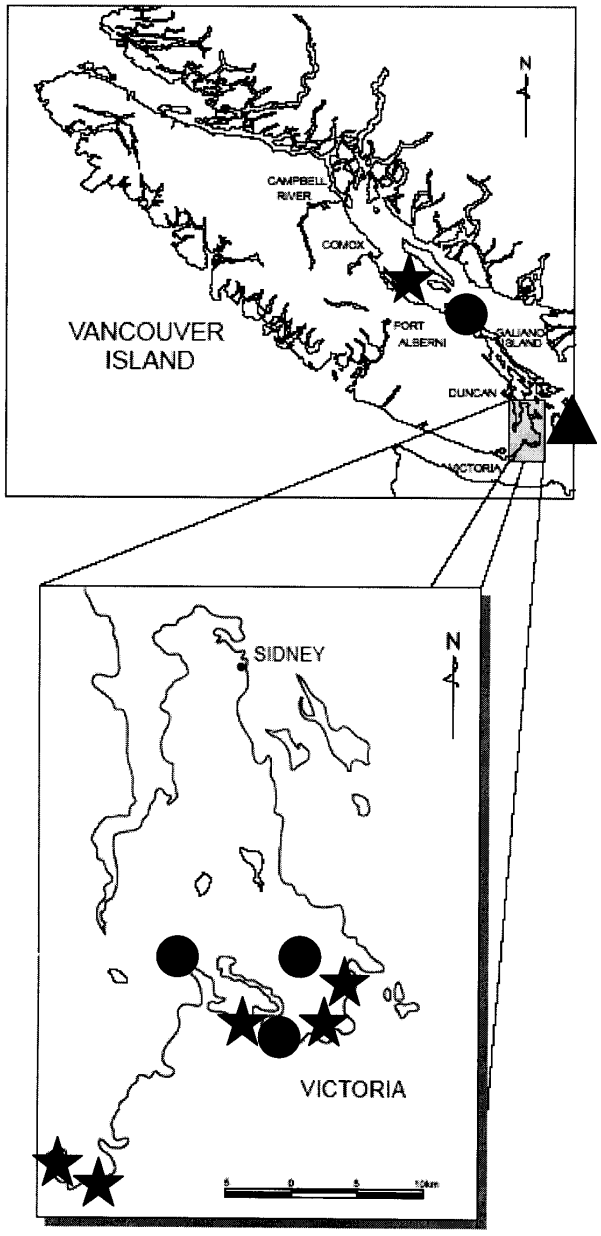

Figure 3. Distribution of extant and extirpated populations of *Microseris bigelovii* in Canada and adjacent area in Washington State. Solid stars indicate one or more extant populations, large solid dots indicate extirpated Canadian populations, and the triangle represents a group of extirpated US populations.

The Canadian populations tend to be widely separated. The northern population is approximately 150 km from its nearest neighbour. The other populations are all separated by at least 2, and up to 8 km. The Canadian populations tend to occupy quite small areas (Table 1) and have a total area of occupancy approximating 3,000 m^2.

Table 1. *Microseris bigelovii* population data.			
Population	**Last Observation**	**Population Extent (total area of occupancy)**	**Number of Individuals**
Hornby Island	June 2002	2 subpopulations (500 m^2)	2,000 – 2,500
Oak Bay 1[1]	June 2004	1 population (2,000 m^2)	1,500 – 2,000
Oak Bay 2	June 2004	1 subpopulation (100 m^2)	~ 190 plants
Esquimalt	June 2004	3 subpopulations (150 m^2)	~ 530 plants
Rocky Point 1	July 2004	1 population (150 m^2)	100-500 plants
Rocky Point 2	June 2004	2 subpopulations (135 m^2)	east subpop: ~1,000 plants
			south subpop: ~ 250 plants
Thetis Lake	May 3, 2003	not found	extirpated?
	May 1, 1953	unknown	unknown
Mount Tolmie	June 5, 2002	not found	presumed extirpated
	May 10, 1875	unknown	unknown
Beacon Hill Park	June 9, 2002	not found	presumed extirpated
	May 24, 1947	unknown	unknown
Dallas Road	June 9, 2002	not found	presumed extirpated
	May 26, 1910	unknown	unknown
Gonzales Hill	June 2, 2002	not found	presumed extirpated
	May 11, 1923	unknown	unknown
Wellington[2]	May 1916	unknown	unknown

Four lines of evidence suggest it is a native element of the Canadian flora. The first line of evidence relates to the presence of many other disjunct species with similar distributions. The sub-Mediterranean climate of Victoria and the Georgia Basin (including San Juan County, Washington State) is anomalous along the Pacific Northwest coast and may account for the pattern of disjunct distributions of many "semi-desert species" (e.g. *Allium amplectens, Crassula connata, Clarkia purpurea* ssp. *quadrivulnera, Dryopteris arguta, Isoetes nuttallii, Juncus kelloggii, Minuartia pusilla, Lupinus densiflorus, Montia howellii, Ranunculus californicus, Trifolium depauperatum, Triphysaria versicolor* and *Woodwardia fimbriata*) as noted by Hitchcock *et al*. (1961 p. 321).

Secondly, *Microseris bigelovii* is locally abundant and broadly (if thinly) distributed in southeast Vancouver Island and, formerly, on San Juan island, despite the poor

[1]Uplands Park subpopulation has been extirpated but one other subpopulation persists at Oak Bay 1
[2]location too vague to map, extensive surveys in area have failed to discover populations, likely extirpated

dispersal abilities of its seeds. It sometimes occurs on very remote sites that are rarely if ever visited by people. This pattern of distribution suggests a relictual origin rather than recent immigration.

Thirdly, it was collected in Victoria as far back as in 1875 (Macoun coll. no. #14986 at CAN acc. no. 111,350), early in the European settlement of Vancouver Island and at the very beginning of botanical studies in the area. In conclusion there is little evidence to suggest it is an introduced taxon.

Fourthly, there are significant genetic differences between B.C. plants and most populations in the United States (see genetic description) which may reflect the fact that Canadian *M. bigelovii* populations have been isolated from other populations long enough for genetic and morphological differences to evolve.

There have been either 11 or 12 reported populations of *Microseris bigelovii* (depending on whether the 1947 Beacon Hill Park and 1910 Dallas Road collections came from a common population) in Canada (Table 1). Considering the degree of habitat fragmentation, the limited dispersal ability of the species and its diminutive stature, it seems reasonable to conclude that recently discovered populations were probably previously overlooked. Since there are now only six extant populations, it appears there has been a long-term decline in the number of populations. There is no reliable evidence on changes in the number of populations over the past decade.

HABITAT

Habitat requirements

In Canada, *Microseris bigelovii* is restricted to a small area of southeastern Vancouver Island. This area, which is highly correlated with the distribution of Garry oak, has mild winters and dry, cool summers.

Winters are mild as a result of relatively warm, low pressure areas which dominate coastal areas. The Coast Mountains impede the westward movement of cold high pressure systems. Winter temperatures along the coast are moderated by proximity to the ocean, which is dominated by mild waters of the California Current all year long.

January, the coldest month, has a daily mean temperature of 4.6^{o} C and a mean daily minimum of 2.5^{o} C[3]. Mild winter temperatures characterize the southeast coast of Vancouver Island. Southeast Vancouver Island also has drier winters than elsewhere in south coastal British Columbia. It lies in the rain-shadow of the Vancouver Island and Olympic Mountains, which intercept moisture from the prevailing systems that move in

[3]All figures are 1898-1988 climatic normals for Victoria Gonzales Heights, a coastal station 69 m above sea level and close to many maritime meadows that contain species at risk. Actual climatic regimes of many maritime meadows are even milder because they are closer to the ocean and at lower elevations. Source: Climatic Normals (Environment Canada); web site accessed Sept. 2003: http://www.msc-smc.ec.gc.ca/climate/climate_normals_1990/show_normals_e.cfm?station_id=258&prov=BC

from the Pacific. December, which is also the wettest month, receives an average of 108 mm of precipitation (but very little snow).

Summers are cool and dry. A large semi-permanent high pressure area extends over the northeastern Pacific, dominating the general circulation in western Canada. The Olympic and Vancouver Island Mountains continue to intercept much of the moisture from systems moving into the region. May, June, July and August each bring less than 25 mm of mean monthly precipitation and pronounced moisture deficits develop. Temperatures are greatly mediated by proximity to the ocean and daily maximum temperatures often increase by several degrees as one moves inland on a warm summer day.

The combination of mild, relatively clear winters and dry clear summers, along with a southern location, determine that southeast Vancouver Island has the greatest annual amounts of sunshine in British Columbia. The scarcity of snow and rarity of hard frosts allow vegetation to remain green throughout the winter. Strong moisture deficits turn the meadows brown in mid-summer.

Edaphic factors strongly limit the distribution of *Microseris bigelovii* within southeastern Vancouver Island and the adjacent Gulf Islands. The low-elevation band of coastal environments is narrow and quickly gives way to uplands that lack the necessary mesoclimatic conditions. Broken terrain over much of the lowland band creates many cool north- and east-facing slopes where forest plants have a comparative advantage. Well-to moderately well-drained soils favour forests; consequently, potential habitat is quite patchy due to natural causes. This natural level of patchiness is exacerbated by the extensive human development in the area (see below).

In Canada, *Microseris bigelovii* is restricted to open sites without tall vegetation. These areas remain open because of wind exposure along shore, summer drought stress in thin soils, or winter seepage that waterlogs soils preventing taller vegetation from dominating. *Microseris bigelovii* is restricted to areas within 50 m of the coast where frequent coastal fogs occur in the autumn and winter and the ocean buffers against deep frosts in the winter.

Some populations occur on rock-ledge sites and have a significant cover of 'shrubby' fruticose lichens – primarily *Cladina portentosa*. Associated species often include *Selaginella wallacei, *Gnaphalium purpureum*[4]*, Grindelia integrifolia, *Hypochaeris radicata, *H. glabra, Lotus micranthus, *Rumex acetosella, *Teesdalia nudicaulis, Triteleia hyacinthina, Brodiaea coronaria, Danthonia californica, Elymus glaucus, Festuca rubra, *Holcus lanatus, *Vulpia bromoides, Polytrichum piliferum, Racomitrium lanuginosum,* and *R. elongatum*. *Cytisus scoparius* may also root in rock fractures but is rarely tall or thick.

Other populations occur on the margins of shallow, winter-wet depressions which have little or no *Cladina*, but are covered with low plants including *Aphanes microcarpa,*

[4]asterisks indicate introduced species

*Cerastium arvense, *Gnaphalium purpureum, *Hypochaeris glabra, *H. radicata, Plagiobothrys scouleri, Plantago elongata, Trifolium spp., Triphysaria pusilla, *Aira praecox, Brodiaea coronaria, *Poa annua, Triteleia hyacinthina* and **Vulpia bromoides*.

Habitat trends

The amount of potential habitat has declined greatly over the past century as coastal areas in southeast Vancouver Island have been developed for residential and recreational use.

Most large areas of suitable habitat have been surveyed for *Microseris bigelovii* but it is not practical to survey all of the small fragments of suitable habitat. Trends in suitable habitat for *Microseris bigelovii* may be indirectly estimated according to the following indicators.

Microseris bigelovii typically occurs within a matrix of Garry oak ecosystems, so the decline of these ecosystems provides an indirect measure of the loss of habitat for *M. bigelovii*. Overall, Garry oak systems have, over the past century, been reduced to less than 5% of their original extent in the Victoria area (Lea 2002). Garry oak ecosystems persist largely as isolated communities that are heavily fragmented and lack connections that would allow substantial genetic interchange. *Microseris bigelovii* prefers shoreline situations, which are also sought after for residential development, while Garry oak ecosystems are more broadly distributed, so the actual decline in suitable habitat is probably even higher.

Much of the remaining habitat suitable for *Microseris bigelovii* has been heavily altered due to invasion by alien weeds including several grasses (*Agrostis capillaris*, *Aira caryophyllea*, *A. praecox*, *Anthoxanthum odoratum*, *Bromus hordeaceus*, *Cynosurus echinatus*, *Dactylis glomerata*, *Hordeum* spp., *Lolium perenne*, *Poa annua*, *P. bulbosa*, *Vulpia bromoides*) and forbs (*Bellis perennis*, *Cerastium semidecandrum*, *Geranium molle*, *G. pusillum*, *Hypochaeris glabra*, *H. radicata*, *Plantago lanceolata*, *Rumex acetosella*, *Silene gallica*, *Stellaria media*, *Trifolium dubium*, *T. subterraneum*, *Vicia lathyroides*).

The distribution of *Microseris bigelovii* in Canada lies at the heart of one of North America's fastest growing regions. The Victoria Metropolitan Area includes all but one of the extant populations of *M. bigelovii* and all but one of the apparently extirpated populations. The population of metropolitan Victoria has increased from approximately 180,000 in 1966 to 318,000 in 1996 and is projected to increase to more than 400,000 by 2026. The Capital Regional Plan adopted in 1959 led to expansion into rural areas surrounding Victoria over the past 44 years and this pattern of expansion may continue in order to accommodate population increases (Capital Regional District Regional Growth Strategy 2003a). During past the 18 years, average prices for single family residences in Metropolitan Victoria have increased 330% from $94,000 to $313,000, reflecting the pent-up demand for property (Capital Regional District Regional Growth Strategy 2003b). The most expensive and sought-after properties are ocean frontage, the favoured habitat of *M. bigelovii*.

Several historic populations (Beacon Hill, Thetis Lake, Mount Tolmie, Uplands Park subpopulation, and Gonzales Hill) in the Victoria area have apparently disappeared as a result of habitat loss or degradation and the same trend holds in adjacent San Juan County (Washington State) where the species has been extirpated.

Habitat protection/ownership

Only the Hornby Island population occurs in a protected area. British Columbia's Parks and Protected Areas do not have a management plan with specific protection for *Microseris bigelovii*, although under the *Parks Act* it cannot be collected in Provincial Parks or Protected Areas.

One of the populations is on private land designated as a National Historic Site and managed with guidance from Parks Canada. Two populations occur in municipal parks where they are protected from residential development but subject to very high levels of recreation use. Neither municipality has plans or programs designed to manage for species at risk. The two Rocky Point populations occur on Department of National Defence (DND) property managed by CFB Esquimalt. The Department of National Defence does not have any management plans in place for *M. bigelovii*, although their regular operations make little use of the areas where Rocky Point population #2 occurs.

Four populations (Thetis Lake, Mount Tolmie, Beacon Hill/Dallas Road and Gonzales Hill) have been extirpated despite occurring on municipal or regional park lands.

None of the sites where it occurs have weed or vegetation management plans to protect the habitat of *Microseris bigelovii* from alien invasives or succession.

BIOLOGY

There is very little published information relevant to reproduction and dispersal, germination, seedling ecology, survivorship, herbivory or physiology of *Microseris bigelovii* in Canada. The following notes are based primarily on observations and experiments conducted by the first author of this status report.

General

Microseris bigelovii may be an annual or a winter annual, apparently depending on whether the soil becomes suitably moist before the onset of cool winter weather. It has a generation time (germination to death) of 8-10 months.

Reproduction and dispersal

Microseris bigelovii shows a high degree of self-pollination, with occasional low-level outcrossing (K. Chambers, pers. comm. 2003). It blooms in May or June and produces seed in June. Many populations in the United States occur on or near bird

nesting colonies. The bristle-tipped pappus scales may tend to catch on bird feathers. The highly disjunct distribution of the plant throughout the west coast of North America may be attributable to bird dispersal. Most seeds, however, are likely dispersed over short distances by wind and gravity. The pappus scales diverge from the crown of the achene in an open fashion that likely allows wind to puff and tumble the light achenes over short to moderate distances.

Germination

Seeds germinate readily when watered, and do not appear to have any dormancy mechanism. Over 90% of seeds collected from Church Point in 2002 germinated within 2 weeks of being planted.

Seedling ecology

Where *Microseris bigelovii* grows amongst clumps of *Cladina portentosa*, its seeds tend to germinate in the autumn. This fall germination may be due to the lichen absorbing moisture from nocturnal fog and retaining this moisture throughout the day. This additional moisture is then available for germination. The seedlings may grow quickly before the onset of cooler winter weather, and then persist until warmer temperatures return in the spring. Plants that do not grow in *Cladina* appear to defer germination until late winter or spring.

Survival

Survivorship curves have not been developed for *Microseris bigelovii*, nor has anything been reported that would assist in determining recruitment or conservation concerns.

Herbivory

No herbivory was observed in any of the populations, even though several occurred in areas with evidence of moderate grazing by black-tailed deer and rabbits.

Physiology

Microseris bigelovii appears to tolerate dry sandy soils and may require frequent coastal fogs to protect it from desiccation. It also tolerates high nitrogen/fertility levels that occur where it grows amid guano. The species may be outcompeted on less adverse sites.

POPULATION SIZES AND TRENDS

Search effort

Suitable sites have been surveyed repeatedly since the early 1980s in a series of projects designed to document the distribution of rare plants in open meadows in southeast Vancouver Island and the Gulf Islands. The principal investigators included Adolf and Oldriska Ceska, Matt Fairbarns, Hans Roemer, Jenifer Penny, Chris Brayshaw, Harvey Janszen, Frank Lomer and George Douglas, all of whom are familiar with the species.

Over 1,000 ha of suitable habitat in over 80 sites have been investigated and much of it has been surveyed more than once during this period. During the past decade alone, over 500 person-days have been spent searching for rare species in suitable habitats.

While *Microseris bigelovii* is a small plant easily overlooked during casual botanical inventories, this status report was only prepared after a directed survey by botanists familiar with the species. This survey effort includes three annual searches specifically for it (approximately 14 person-days in 2002, 8 person-days in 2003 and 4 person-days in 2004). Despite the concentrated effort, only two new populations and four previously reported populations were documented. All three years appear to have been suitable years for surveying *M. bigelovii*, based on the number and vigour of plants at known, extant populations. These efforts included unsuccessful surveys of the many sites that had other rare plants that have been associated with *M. bigelovii* (Figure 4).

Abundance

Records from 2002, 2003 and 2004 indicate there were between 5,000 and 7,000 individuals in Canada. Flowering is asynchronous and the flowers are short-lived. It is impossible to determine what proportion of these individuals actually flowered rather than perishing in the summer drought before they had a chance to reproduce (a common problem in inventorying this and other annual species).

The number of populations and subpopulations, defined by the rate of genetic interchange via seed movement and pollen exchange, is difficult to establish. Seed dispersal between patches is probably restricted to fairly short distances. The species relies primarily upon self-pollination but out-crossing occurs and it is not clear how frequently pollen is exchanged and over what distances (Chambers 1955).

Table 1 presumes that two occurrences at Hornby Island function as subpopulations (exchanging genetic material more than once in an average year) rather than separate populations. Several patches of *Microseris bigelovii* are known from Oak Bay #1 and they appear to constitute subpopulations of a single population. The Oak Bay #2 population consists of a single discrete population. Three occurrences at Esquimalt are best considered subpopulations belonging to a common population.

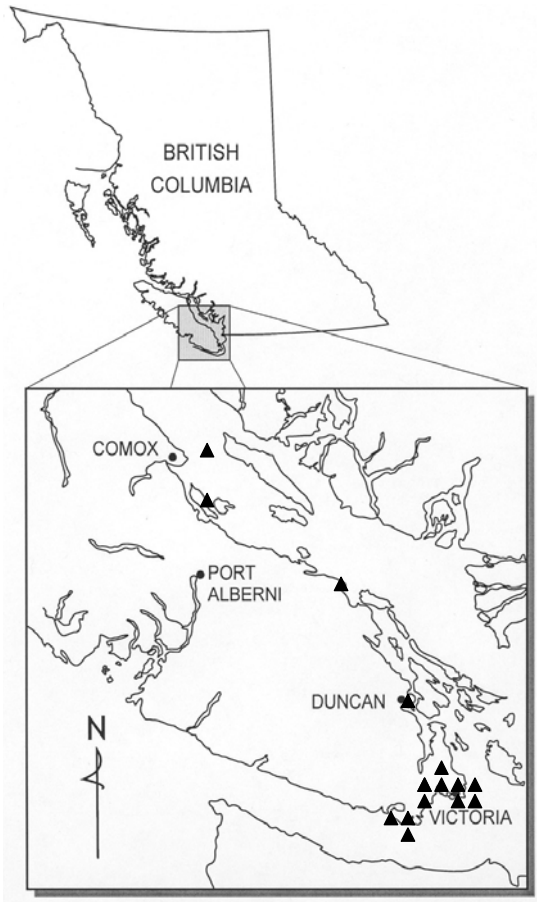

Figure 4. Negative search results. Solid triangles indicate one or more sites surveyed without success.

The report of *Microseris bigelovii* from Thetis Lake may be erroneous. It appears to be based on a herbarium specimen (V 10117) that has two place names on its label. One place name corresponds to Oak Bay population 1, while the other is Thetis Lake. It may be that the collector visited both locations in one day and was not able to determine which species were collected in which location. Thetis Lake is an unusual location for *M. bigelovii* because it lacks seashore habitats.

The plants at Rocky Point #1 are confined to a small area and almost certainly function as a single population. The two patches at Rocky Point #2 are treated as subpopulations but further analysis may show that they are actually different populations. Certainly, they are well separated and the intervening terrain is likely inimical to both seed and pollen dispersal. Nevertheless, they are only about 400 m apart and the BC Conservation Data Centre, by convention, treats them as a single population[5].

[5]By convention, the BC Conservation Data Centre treats observations less than 1 km apart as part of a common “occurrence” (population).

Fluctuations and trends

There is no reliable information on past population sizes so fluctuations and trends in the size of extant populations cannot be determined. This species, like many other annuals (Harper 1977), may experience significant natural fluctuations in population sizes.

Rescue effect

Microseris bigelovii is extirpated in Washington State and there is negligible opportunity for unassisted genetic exchange (seed or pollen) with US populations in Oregon or California. Genetic evidence and greenhouse studies (see above) suggest that populations in Oregon and California may be poorly adapted to conditions in British Columbia. These differences may restrict the potential for successful re-introductions should Canadian populations be lost.

LIMITING FACTORS AND THREATS

Habitat loss

The loss of habitat is likely to continue into the future. The distribution of *Microseris bigelovii* in Canada lies at the heart of one of North America's fastest growing regions. The Victoria Metropolitan Area includes five of the six extant populations of *M. bigelovii* and four of the five apparently extirpated populations.

Threat associated with recreational activities

One major threat to remaining populations of *Microseris bigelovii* comes from recreational use and outdoor recreation development. The populations at Hornby Island, Oak Bay #1, Oak Bay #2 and Esquimalt all occur in popular walking areas. Light foot traffic likely favours *M. bigelovii* by discouraging the growth of competitive species. The plants were not observed directly on footpaths so it appears that heavy trampling threatens the species. Picnickers were observed lunching on a blanket placed directly over a major portion of the population at Oak Bay #2 during seed maturation in 2004. Recreational use is likely to increase in all of these locations as the number of people in southeast Vancouver Island increases (see above). Recreational use also poses an indirect threat as new structures such as park benches and interpretive displays are developed. Several park benches have already been established on or adjacent to subpopulations of *M. bigelovii* at Oak Bay #1 and Esquimalt, as well as near populations of other rare plants (including *Triphysaria versicolor, Limnanthes macounii* and *Callitriche marginata*) elsewhere in the Victoria area. Species that favour small, level areas such as *M. bigelovii* are at greatest risk because these are the easiest areas to build benches and kiosks and are much less extensive than the rugged rock outcrops that typify many coastal parks on southeast Vancouver Island.

Threat associated with altered fire regimes

Pre-European fire regimes in the dry coastal belt of southeast Vancouver Island are probably more complex than is generally reported. There is no doubt that First Nations in the area used fire extensively to stimulate the growth of food species (Turner and Bell 1971) – particularly camas bulbs, which provided a storable form of starch. Fire may also have been used to improve forage for game species (elk and deer).

Frequent low-intensity burns killed young red alder and Douglas-fir and checked the growth of trembling aspen and most shrub species – notably *Symphoricarpos albus* and *Rosa nutkana*. The resulting increase in light levels and decrease in competition favours the growth of low herbaceous plants such as *Microseris bigelovii*. Even the composition of the herb layer is altered, since many highly competitive plants decrease under a regime of frequent burning.

First Nations fire management practices also played a significant role in the development (and therefore fertility) of soils. The organic component of the upper mineral horizon was not greatly reduced by low-intensity fires because it accumulated below the surface through the *in situ* decomposition of root material. In contrast, the surface organic materials did burn, rather than accumulate, releasing nutrients. Since the main inputs of organic matter came from herbs rather than coniferous trees, the upper mineral horizon also had a relatively neutral reaction in sharp contrast to the acidic nature of soils under Douglas-fir forests (Broersma 1973). As well, the frequent fires provided a continuous supply of 'safe sites' where the small seeds of *Microseris bigelovii* may have been able to germinate and grow without the stifling influences of litter and surface organic horizons.

First Nations' burning has ended and all fires are now suppressed throughout the range of *Microseris bigelovii*. In the absence of burning, the supply of suitable habitats has likely diminished.

Threat associated with livestock grazing

In some respects, livestock grazing during the early 20th century may have offset the impacts of altered fire regimes. They convert recalcitrant foliage litter into labile (more easily decomposed) forms (primarily dung), releasing nutrients in a form available to plant growth. The persistence of *Microseris bigelovii* at many sites (e.g. Uplands Park) until the late 20th century may have been partly related to the lingering effects of livestock activity earlier in the century.

More significantly, livestock grazing also played a major role in the establishment and eventual dominance of exotic forage species, which have pre-empted sites where *Microseris bigelovii* may have formerly flourished.

Threat associated with invasive alien plants

Invasive plants pose the most striking threat in most open habitats in southwestern British Columbia. Extant populations of *Microseris bigelovii* were seen growing in a matrix dominated by many invasive alien shrubs, grasses and herbs.

Invasive species threaten *Microseris bigelovii* in many ways. Some species (e.g. *Trifolium subterraneum*, *T. dubium*, *Silene gallica*) are capable of growing in the drought-stressed environments where *M. bigelovii* occurs and present a direct threat. Such alien species may out-compete it for moisture (particularly in the late spring and early summer) and nutrients. The most serious threat posed by alien annual species is their ability to pre-empt 'safe sites' – recent soil disturbances which would be favoured by *M. bigelovii* were it not for the ubiquity of annual invasives. Perennial aliens may have established permanent cover in sites that formerly provided a constant supply of bare mineral soil. Taller plants may not be able to survive in the drought-stressed microhabitats where *M. bigelovii* grows, but in finely grained mosaics they may occupy adjacent habitat and shade it out.

SPECIAL SIGNIFICANCE OF THE SPECIES

Canadian populations of *Microseris bigelovii* are of scientific interest because its distribution suggests that it is a relict from the Hypsithermal Interval of warm, dry climate 4,000-6,000 years b.p. British Columbia populations are highly disjunct from its distributional centre in California. Although no Aboriginal uses have been found in the literature for *M. bigelovii*, the root of another species, *M. nutans*, found in British Columbia but primarily southwards in Montana, Utah, Colorado and California, is known to have been used as a food in Montana (Native American Ethnobotany, web site accessed Dec. 2004).

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Microseris bigelovii is not covered under the Convention on International Trade in Endangered Species (CITES), the Endangered Species Act (USA) or the IUCN Red Data Book. NatureServe globally ranks it as G4: apparently secure.

The Washington State Natural Heritage Program ranks it as SX (extirpated) in their state. The Oregon Natural Heritage Information Centre ranks the species as S2 (imperiled). It appears to be secure in California.

In British Columbia, it is currently ranked as S1 (critically imperiled). It does not occur elsewhere in Canada. The British Columbia Conservation Data Centre also places it on the provincial red list of species that are provincially threatened or endangered. British Columbia does not provide any legal protection for *M. bigelovii*.

There is negligible possibility of immigration from extra-territorial populations because the closest locations are several hundred kilometres away in Oregon and the species lacks effective adaptations for substantial rates of long-term dispersal.

TECHNICAL SUMMARY

Microseris bigelovii
coast microseris microséris de Bigelow
Range of Occurrence in Canada: British Columbia

Extent and Area Information	
• Extent of occurrence (EO)(km²) (Coastal strip 400 km long with maximum inland occurrence of 50 m from shore)	about 20 km^2
• Specify trend in EO	stable
• Are there extreme fluctuations in EO?	no
• Area of occupancy (AO) (km²) (actual area of habitats occupied)	<<1km^2 (<1 hectare)
• Specify trend in AO	long-term decline, short-term stable
• Are there extreme fluctuations in AO?	no
• Number of known or inferred current locations	6
• Specify trend in #	long-term decline, short-term stable
• Are there extreme fluctuations in number of locations?	no
• Specify trend in area, extent or quality of habitat	declining in both area and quality
Population Information	
• Generation time (average age of parents in the population)	8-10 months
• Number of mature individuals	5,500-6,500
• Total population trend:	long-term decline; short-term stable
• % decline over the last/next 10 years or 3 generations.	no reliable information
• Are there extreme fluctuations in number of mature individuals?	possibly
• Is the total population severely fragmented?	yes, most populations unlikely to have any exchange even over longer periods
• Specify trend in number of populations	declining (over half the known populations have disappeared in the past 130 years)
• Are there extreme fluctuations in number of populations?	no
Hornby Island 2,000 – 2,500 Oak Bay #1 1,500 – 2,000 Oak Bay #2 190 Esquimalt 530 Rocky Point #1 50 Rocky Point #2 1,250	
Threats (actual or imminent threats to populations or habitats)	
Existing threats: recreational use, park facility development, invasive species, loss of potential habitat Potential threats: marine pollution	
Rescue Effect (immigration from an outside source)	none
• Status of outside population(s)? **USA**: extirpated in WA, imperiled in Oregon	
• Is immigration known or possible?	unknown and not likely
• Would immigrants be adapted to survive in Canada?	uncertain

• Is there sufficient habitat for immigrants in Canada?	very limited
• Is rescue from outside populations likely?	no
Quantitative Analysis [provide details on calculation, source(s) of data, models, etc]	none possible
Current Status COSEWIC: Endangered, 2006	

Status and Reasons for Designation

Status: Endangered	**Alpha-numeric code**: B1ab (ii, iii) + 2ab (ii, iii)

Reasons for Designation:
A small annual herb present in a few fragmented sites within a narrow coastal fringe on southeast Vancouver Island in a densely inhabited urbanized region. Development, recreational activities, site management practices and competition from invasive alien plants continue to impact the species.

Applicability of Criteria

Criterion A: (Declining Total Population): n/a

Criterion B: (Small Distribution, and Decline or Fluctuation): Meets Endangered B1ab (ii, iii) + 2ab (ii, iii) based on extent of occurrence and area of occupancy much below critical criterion values, present at only 6 highly fragmented sites and continuing decline inferred in area of occupancy and quality of habitat due to the spread of exotic shrubs and herbs; no specific data are available on extreme fluctuations of this annual plant.

Criterion C: (Small Total Population Size and Decline): n/a Population size estimated at 5,500-6,500 but the degree of population decline has not been clearly identified and some populations consist of >1,000 plants.

Criterion D: (Very Small Population or Restricted Distribution): Meets Threatened D2 due to the small area of occupancy and the presence of ongoing impacts from the spread of exotic plants and site management practices.

Criterion E: (Quantitative Analysis): n/a No analysis available.

ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED

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Authorities Contacted

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Vrilakas, Susan. Botany Data manager. Oregon Natural History Information Center.

INFORMATION SOURCES

Atkinson, S. and F. Sharpe. 1993. Wild Plants of the San Juan Islands (2nd edition). The Mountaineers, Seattle. 191 pp.
Bachmann, K., Heusden, A.W. van, Chambers, K.L. and H.J. Price. 1987. Genetic variation for the onset of flowering in *Microseris bigelovii* (Asteraceae: Lactuceae). Beitr. Biol. Pflanzen 62: 23-41.
Broersma, K. 1973. Dark soils of the Victoria area, British Columbia. M.Sc. Thesis. Department of Soil Science, University of British Columbia. Vancouver. 110 pp.
Capital Regional District Regional Growth Strategy 2003a. A citizen's guide to growth strategy options for the Capital Region. http://www.crd.bc.ca/regplan/RGS/Choices/pdf/guide.pdf
Capital Regional District Regional Growth Strategy 2003b. Real Estate - Historical Average MLS Residential Prices, 1985 - Present, Victoria Metropolitan Area. http://www.crd.bc.ca/regplan/RIS/Facts/RealEst/reshist.htm

Caplow, F. pers. comm. 2003. *E-mail correspondence to M. Fairbarns*. October 2003. Rare Plant Botanist. Washington Natural Heritage Center. Olympia, WA.
Chambers, K.L. pers. comm. 2003. *Telephone conversation with M. Fairbarns*. October 2003. Professor Emeritus. Oregon State University Herbarium. Eugene, OR.
Chambers, K.L. pers. comm. 2004. *E-mail correspondence to M. Fairbarns*. August 2004. Professor Emeritus. Oregon State University Herbarium. Eugene, OR.
Chambers, K.L. 1993. *Microseris* pp. 316-319 *In* Hickman, J.C. (ed.) The Jepson Manual: Higher Plants of California. University of California Press. Berkeley. 1400 pp.
Douglas, G. W., G.B. Straley, D. Meidinger & J. Pojar. 1998. Illustrated Flora of British Columbia. Volume 1: Dicotyledons (Aceraceae through Asteraceae). B.C. Ministry of Environment, Lands & Parks, B.C. Ministry of Forests, Victoria, B.C.
Harper, J.L. 1975. Population biology of plants. Chapter 18: Annuals and Biennials pp. 515-547. Academic Press. London.
Heusden, A.W. van and K. Bachmann. Genotype relationships in *Microseris bigelovii* (Asteraceae: Lactuceae) amplified from arbitrary primers. Botanica Acta 105: 331-336.
Hitchcock, C.L. and A. Cronquist. 1973. Flora of the Pacific Northwest. Univ. Washington Press. Seattle, Washington.
Hitchcock, C.L., A. Cronquist, M. Ownbey and J.W. Thompson. 1955. Vascular Plants of the Pacific Northwest. Part 5: Compositae. University of Washington Press, Seattle.
Hitchcock, C.L., A. Cronquist, M. Ownbey and J.W. Thompson. 1961. Vascular Plants of the Pacific Northwest. Part 3: Saxifragaceae to Ericaceae. University of Washington Press, Seattle.
Lea, Ted. 2002. Historical Garry Oak Ecosystems of Greater Victoria and Saanich Peninsula. 1:20,000 Map. Terrestrial Information Branch, B.C. Ministry of Sustainable Resource Management. Victoria, B.C.
Native American Ethnobotany: http://herb.umd.umich.edu/; web site accessed Dec. 2004.
Pacific Marine Heritage Legacy (PMHL). 1996. A proposal for the protection of the Ballenas and Winchelsea Islands under the Pacific Marine Heritage Legacy (a partnership between the Canadian Wildlife Service, Environment Canada, the Department of National Defence, and the Nature Conservancy of Canada).
Peck, M.E. 1941. A manual of the higher pants of Oregon. Binfords and Mort. Portland, Oregon. 866 pp.
Turner, N.C. and M.A.M. Bell. 1971. The ethnobotany of the coast Salish Indians of Vancouver Island. Economic Botany 25:63-39.

SUPPLEMENTAL LITERATURE

A number of papers touching on *Microseris bigelovii* were not used in this status report so they are not referenced in the Information Sources section. Some of these papers will be of interest to others studying this species so they are listed below.

Bachmann, K. 1992. Phenotypic similarity and genetic relationships among populations of *Microseris bigelovii*. Bot. Acta. 337-342.
Bachmann, K. and K.L. Chambers. 1978. Pappus part number in annual species of Microseris (Compositae, Cichorieae). Plant Syst. Evol. 129: 119-134.
Bachmann, K. and K.L. Chambers. 1981. Genes regulating the appearance of two kinds of fruit in *Microseris* strain B87 (Asteraceae: Compositae). Experientia 37: 29-31.
Bachmann, K. and K.L. Chambers. 1990. Genetic variation for the timing and site of trichomes on the leaves of *Microseris bigelovii* (Asteraceae: Lactuceae). Biol. Zentralb. 109: 151-158.
Bachmann, K. and K.L. Chambers. 1990. Heritable variation for heterocarpy in *Microseris bigelovii* (Asteraceae-Lactuceae). Beitr. Biol. Pflanzen 65: 123-146.
Bachmann, K. and K.L. Chambers. 1996. Mapping genes for phenotypic variation in *Microseris* (Lactuceae) with molecular markers. Pp. 23-43 In P.D.S. Caligari and D.J.N. Hind (eds.). Compositae: Biology and utilization. Proceedings of the International Compositae Conference. Kew. 1994
Bachmann, K., K.L. Chambers and H.J. Price. 1981. Genetic determination of pappus part numbers in the annual hybrid *Microseris* B87 (Asteraceae – Lactuceae). Plant Syst. Evol. 138: 235-246.
Bachmann, K., K.L. Chambers and H.J. Price. 1984. A second marker enzyme in the genetics of pappus part numbers in *Microseris* hybrid B87 (Asteraceae, Lactuceae). Plant Syst. Evol. 145: 243-258.
Bachmann, K., K.L. Chambers and H.J. Price. 1984. Differential geographic distribution of spatulate and pointed leaf shapes in *Microseris bigelovii* (Asteraceae, Lactuceae). Beitr. Biol. Pflanzen 59: 5-14.
Bachmann, K., K.L. Chambers and H.J. Price. 1984. Genetic components of heterocarpy in *Microseris* hybrid B87 (Asteraceae, Lactuceae). Plant Syst. Evol. 148: 149-164.
Bachmann, K., K.L. Chambers, H.J. Price and A. Konig. 1982. Four additive genes determining pappus part numbers in *Microseris* annual hybrid C34 (Asteraceae/Lactuceae). Plant Syst. Evol. 141: 123-141.
Bachmann, K., K.L. Chambers, H.J. Price and A. Konig. 1982. Spatulate leaves: a marker gene for the evolution of *Microseris bigelovii* (Asteraceae – Lactuceae). Beitr. Biol. Pflanzen 57: 167-179.
Bachmann, K. and E. Hombergen. 1997. From phenotype via QTL to virtual phenotype in *Microseris* (Asteraceae): predictions from multilocus marker genotypes. New Phytol. 137: 9-18.
Bachmann, K. A.W. Van Heusden, K.L. Chambers and H.J. Price. 1985. Duplications of additively acting genes in the evolution of a plant (*Microseris pygmaea*). Experientia 41: 1348-
Bachmann, K., A.W. Van Heusden, K.L. Chambers and H.J. Price. 1987. A second gene determining spatulate leaf tips in *Microsteris bigelovii* (Asteraceae-Lactuceae). Beitr. Biol. Pflanzen 62: 97-106.
Battjes, J., K.L. Chambers and K. Bachmann. 1997. Evolution of microsporangium numbers in *Microseris* (Asteraceae: Lactuceae). Amer. J. Botany 81: 641-647.

Chambers, K.L. 1955. A biosystematic study of the annual species of *Microseris*. Contributions from the Dudley Herbarium 4: 207-312. Natural History Museum of Stanford University. Stanford, California.
Chambers, K.L. 1963. Amphitropical species pairs in Microseris and Agoseris (Compositae: Cichorieae). Quarterly Review of Biology 38: 124-140.
Heusden, A.W. van and K. Bachmann. 1992. Nuclear DNA polymorphisms among strains of *Microseris bigelovii* (Asteraceae: Lactuceae) amplified from arbitrary primers. Bot. Acta 105: 331-336.
Heusden, A.W. van, K. Bachmann and K.L. Chambers. 1989. Variation in time and place of trichome appearance in *Microseris* hybrid J05 (*M. pygmaea* x *M. bigelovii*, Asteraceae). Biol. Zentralb. 108: 153-161.
Price, H.J., K.L. Chambers and K. Bachmann. 1981. Genome size variation in diploid *Microseris bigelovii* (Asteraceae). Bot. Gaz. 142:156-159.
Price, H.J., K.L. Chambers, K. Bachmann and J. Riggs. 1985. Inheritance of nuclear 2C DNA content in a cross between *Microseris douglasii* and *M. bigelovii* (Asteraceae). Biol. Zentralb. 104: 269-276.
Price, H.J., K.L. Chambers, K. Bachmann and J. Riggs. 1985. Inheritance of nuclear 2C DNA content in intraspecific and interspecific hybrids of *Microseris* (Asteraceae). Amer. J. Bot. 70: 1133-1138.
Vlot, E.C., W.H.J. Van Houten, S. Mauthe and K. Bachmann. 1992. Genetic and non-genetic factors influencing deviations from five pappus parts in a hybrid between *Microseris douglasii* and *M. bigelovii* (Asteraceae: Lactuceae). Int. J. Plant Sci. 153: 89-97.
Zentgraf, J., K. Bachmann, K.L. Chambers and H.J. Price. 1984. Single-gene heterozygotes derived from polygenic pappus part system of *Microseris* hybrid C34 (Asteraceae – Lactuceae). Plant Syst. Evol. 147: 205-226.
Zentgraf, J., K. Bachmann, K.L. Chambers and H.J. Price. 1985. Modifiers of heterocarpy determine capitulum size in *Microseris* hybrid D14 (Asteraceae – Lactuceae). Plant Syst. Evol. 151: 103-119.

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Adolf Ceska, Pro.Biol. (=M.Sc.) Charles University in Prague, Ph.D. (Victoria), botanist and plant ecologist, recently semi-retired and freelance consultant, former Visiting Assistant Professor, University of Victoria, Curator of Botany in the Royal British

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Oldriska Ceska, Pro.Biol. (=M.Sc.) Charles University in Prague. Oldriska Ceska is a tireless field botanist with extensive experience throughout the Pacific Northwest. Mrs. Ceska has over 35 years experience in ecological research, mycology, and botany, with special emphasis on rare plant inventory and surveys. As a chemotaxonomist she developed techniques for chemical identifications of water milfoils and discovered the as yet undescribed chemical compound coriandrin from cilantro. She has participated in numerous floristic and vegetation studies throughout British Columbia, focusing on cryptogams, fungi, and taxonomically difficult plants. She has taken part in many professional field trips throughout the Pacific Northwest in Washington, Oregon, and northern California. She has authored or co-authored over 50 papers, many of them in reviewed scientific journals.

COLLECTIONS EXAMINED

The following collections were consulted:

- Royal BC Museum herbarium (V)
- University of Victoria herbarium (UVIC)
- University of British Columbia Herbarium (UBC)