

COSEWIC
Assessment and Status Report

on the

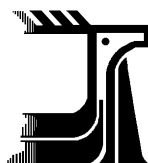
Seaside Birds-foot Lotus
Lotus formosissimus

in Canada



ENDANGERED
2000

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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Seaside birds-foot lotus — from *Rare native vascular plants* of British Columbia, 1998.

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COSEWIC Assessment Summary

Assessment summary – May 2000

Common name

Seaside birds-foot lotus

Scientific name

Lotus formosissimus

Status

Endangered

Reason for designation

Few remaining populations and the area of occupancy are declining because of competition from invasive alien plants and rabbits.

Occurrence

British Columbia

Status history

Designated Endangered in April 1996. Status re-examined and confirmed in May 2000. May 2000 assessment based on new quantitative criteria applied to information from the existing 1996 status report.



COSEWIC
Executive Summary

Seaside Birds-foot lotus
Lotus formosissimus

Description

Lotus formosissimus (seaside birds-foot lotus) is a sprawling, multi-stemmed perennial herb, 20-50 cm long, with compound, pinnate leaves. The pink and yellow pealike flowers are arranged in umbels subtended by a trifoliate bract. It is distinguished from other *Lotus* species by its perennial habit, membranous stipules, trifoliate bracts, and pink and yellow flowers.

Distribution

Lotus formosissimus is restricted to the west coast of North America, from southeastern Vancouver Island, south on the west side of the Cascade Mountains from Washington to Oregon and west of the Sierra Nevada Mountains to Monterey County, California.

Population Size and Trends

In Canada, only five *Lotus formosissimus* sites are known. Of these, populations at two sites have been recently confirmed, populations at two other sites are likely extirpated, and the population at a fifth site is likely extant but could not be relocated. The total number of plants in Canada is less than two hundred. No populations have been monitored thus it is not possible to determine previous sizes of known populations.

Habitat

Lotus formosissimus is known to occur in xeric habitats on southeastern Vancouver Island and adjacent islands. It ranges from open and exposed grass-dominated meadows, to exposed steep rocky sites inhabited by *Quercus garryana*, to shaded *Quercus garryana*-*Bromus* forests. Associated species include *Sedum spathifolium*, *Plectritis congesta*, *Allium cernuum*, *Delphinium menziesii*, *Dactylis glomerata*, *Anthoxanthum odoratum*, *Hypochoeris radicata*, *Holcus lanatus*, *Aira praecox*, *Plantago lanceolata*, and several species of *Bromus*.

General Biology

Little is known regarding the biology of *Lotus formosissimus*. Flowers likely require cross-pollination to set viable seed although pollinators have not yet been identified. Seeds are believed to be easy to germinate but may have a hard seed coat thus delaying the germination of some seeds for several months or years. Mature plants may be long-lived and recruitment from germinating seeds is likely a rare event. It is believed that *L. formosissimus* is associated with nitrogen-fixing *Rhizobium* thus providing the plants with an independent source of nitrogen from that in the soil. It is suspected that *Lotus formosissimus* is a poor competitor with a number of perennial grasses because it was absent in a number of microsites dominated by grasses that were otherwise suitable habitats.

Limiting Factors

In the past, the most direct threat to *Lotus formosissimus* was habitat destruction by agricultural and residential developments. At the present time, habitat destruction does not threaten known populations but the loss of suitable habitats at other sites severely limits the potential to introduce this species into new areas and further threatens the longterm survival of this species in Canada. Less direct factors which threaten known populations include the introduction of aggressive European species such as *Cytisus scoparius* which may either compete with *Lotus formosissimus* for resources or prevent the establishment of seedlings. Furthermore, fire suppression appears to have resulted in changes to the vegetation of many sites where this species would be expected to occur including the increased domination of some sites by trees and shrubs which effectively eliminate many herbaceous species. The single trait shared by all *Lotus formosissimus* sites is a lack of disturbance of the vegetation by the general public.

Protection

The two known *Lotus formosissimus* sites are protected on public land. One site is located in an ecological reserve on a small island and the other site is located on the southernmost point of Vancouver Island on property leased by the Department of National Defence. Public access is prohibited at both sites. No attempts have been made to either rehabilitate or introduce this species into new habitats.



COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

- * 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.

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.



Environment Canada	Environnement Canada
Canadian Wildlife Service	Service canadien de la faune

Canada

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

COSEWIC Status Report
on the
Seaside Birds-foot lotus
Lotus formosissimus
in Canada

Michael Ryan¹
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1996

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SPECIES INFORMATION

Classification and Nomenclature

Scientific name: *Lotus formosissimus* Greene

Bibliographic citation: Pittonia 2: 147, 1890.

Pertinent synonyms: *Hosackia gracilis* Benth.
Lotus gracilis Frye & Rigg (non *L. gracilis* Salisb.)

Common names: Seaside birds-foot lotus
Seaside birds-foot trefoil
Seaside lotus
Coast Hosackia

Family name: Fabaceae

Major plant group: Angiosperm

History of taxon

Lotus formosissimus is one of about 200 species of *Lotus* found throughout the world with most occurring in temperate zones. About 60 species are endemic to North America and likely originated in the southwestern United States. Only five species range as far north as Canada of which four are restricted to British Columbia. Another four species have been introduced from the Old World (Zandstra and Grant 1968).

Bentham originally described *L. formosissimus* as *Hosackia gracilis*. However, examination of Old and New World species by Ottley (1923) and later, by Callen (1959), led them to place these species in the genus *Lotus* since there were no definitive characters that could be used to separate North American and Old World species.

Zandstra and Grant (1968) examined the biosystematics of native and introduced *Lotus* species in Canada. They reported that although polyploidy was a common characteristic of Old World species, none of the North American species examined exhibited the same trait. North American species have a base chromosome number of 6 or 7. Of the species native to Canada, *L. formosissimus* and *L. pinnatus* Hook. were the most closely related species based on morphological, habitat, and cytological characteristics. They differed from other native Canadian species in that both were perennial outcrossers with large-flowered umbels on long peduncles; the other three species were self-fertile annuals with small flowers. Zandstra and Grant (1968) believed *L. formosissimus* and *L. pinnatus* were more primitive than the annual species. A chemotaxonomic investigation using thin-layer chromatography further supported the general nomenclatural relationships among Canadian *Lotus* species with *L. formosissimus* and *L. pinnatus* exhibiting the greatest degree of similarity (Grant and Zandstra 1968).

Description

Taxonomic Description

Lotus formosissimus

[Description from Hitchcock and Cronquist (1961) and Zandstra and Grant (1968)]

General: Perennial, with a thick taproot and short rootstock.

Stems: Stems 20-50 cm long, sprawling to ascending, branching from the base.

Leaves: Petiolate, 4-8 cm long, 3-7 foliate, the leaflets ovate to obovate, the central leaflet 10-20 mm long, 5-10 mm broad; stipules membranous, rounded to acuminate, 3-10 (15) mm long, flowering stems with a usually 3 (1-5 or 7) - foliate bract at the tip.

Flowers: Inflorescence headlike, 3-5 flowered, produced on axillary peduncles 2-6.5 cm long; flowers pealike, 10-15 mm long; banner yellow 11-15 mm long, wings and keel with claw considerably exceeding the calyx, the wings pinkish- to purplish-tinged, keel purple-tipped,

Fruits: Pods 27-36 mm long, 1.5-2 mm broad; seeds 7-15, dark brown to black, mottled with olive.

Illustrations

- 1) see Fig. 2, p. 564, in Zandstra and Grant (1968).
- 2) see Plate 66, Fig. 7-13, p. 251 in Ottley (1923).
- 3) see p. 295 in Hitchcock and Cronquist (1961).
- 4) see *Hosackia gracilis* Benth., Fig. 2715, p. 544, in Abrams (1944).

Diagnostic Features

Of the ten *Lotus* species known from Canada, nine occur in British Columbia (Scoggan 1978-1979). Seven species (*Lotus corniculatus* L., *L. denticulatus* (Drew) Greene, *L. micranthus* Benth., *L. nevadensis* (S. Wats.) Greene, *L. pedunculatus* Cav., *L. purshianus* (Benth.) Clem. & Clem., *L. tenuis* Waldst. & Kit.) are distinguished from *L. formosissimus* by having reduced stipules represented by blackish glands. The eighth species *L. pinnatus* is very similar to *L. formosissimus* except the petals of the former species are yellow and white whereas those of *L. formosissimus* are yellow and pink. Likewise, *L. pinnatus* lacks the foliar bract that is often present in *L. formosissimus* (see Douglas 1990, Hitchcock and Cronquist 1961). Zandstra and Grant (1968) reported that *L. formosissimus* seeds were about half the size of *L. pinnatus* seeds.

In the field, there are several species that superficially resemble *L. formosissimus*, thus making it difficult to locate specimens. *Vicia* species are often present in similar habitats that, at first glance, resemble *L. formosissimus* by their sprawling stems and similar leaf arrangement. However, on closer examination, the leaves of *Vicia* species are smaller in size and the terminal leaflet is represented by a tendril. Likewise, *Lotus micranthus* and *L. purshianus* are sometimes present in similar habitats but are often smaller in size and lack the membranous stipules present on *L. formosissimus*. When not in flower, it is difficult to distinguish *L. formosissimus* from *L. pinnatus*. Although, the flowers of *L. formosissimus* are usually subtended by a trifoliate bract, specimens examined in the field sometimes lacked a bract or only a unifoliate bract was present. These bracts appear to be fragile and are easily broken off, thus giving the false impression that the plant is *L. pinnatus*. At present, *Lotus pinnatus* is known only from the Nanaimo area on Vancouver Island.

DISTRIBUTION

Lotus formosissimus occurs along the west coast of North America west of the Cascade Mountains from southern British Columbia to Oregon and west of the Sierra Nevada Mountains to Monterey Co. in California (Fig. 1). In Canada, it is restricted to the Victoria area on southeastern Vancouver Island and nearby islands. The nearest U.S. population of *L. formosissimus* appears to be in the southern part of the Olympic Peninsula, WA (Buckingham and Tisch 1979, Hitchcock and Cronquist 1961).

CLIMATE

The climate of the southeastern side of the island is characterized by mild wet winters and warm dry summers in which the bulk of the rainfall (95%) occurs during the winter months. Annual rainfall is particularly low in the southeastern corner of Victoria. This area receives about one-third of the rainfall to that west of Victoria (Fig. 2).

HABITAT

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

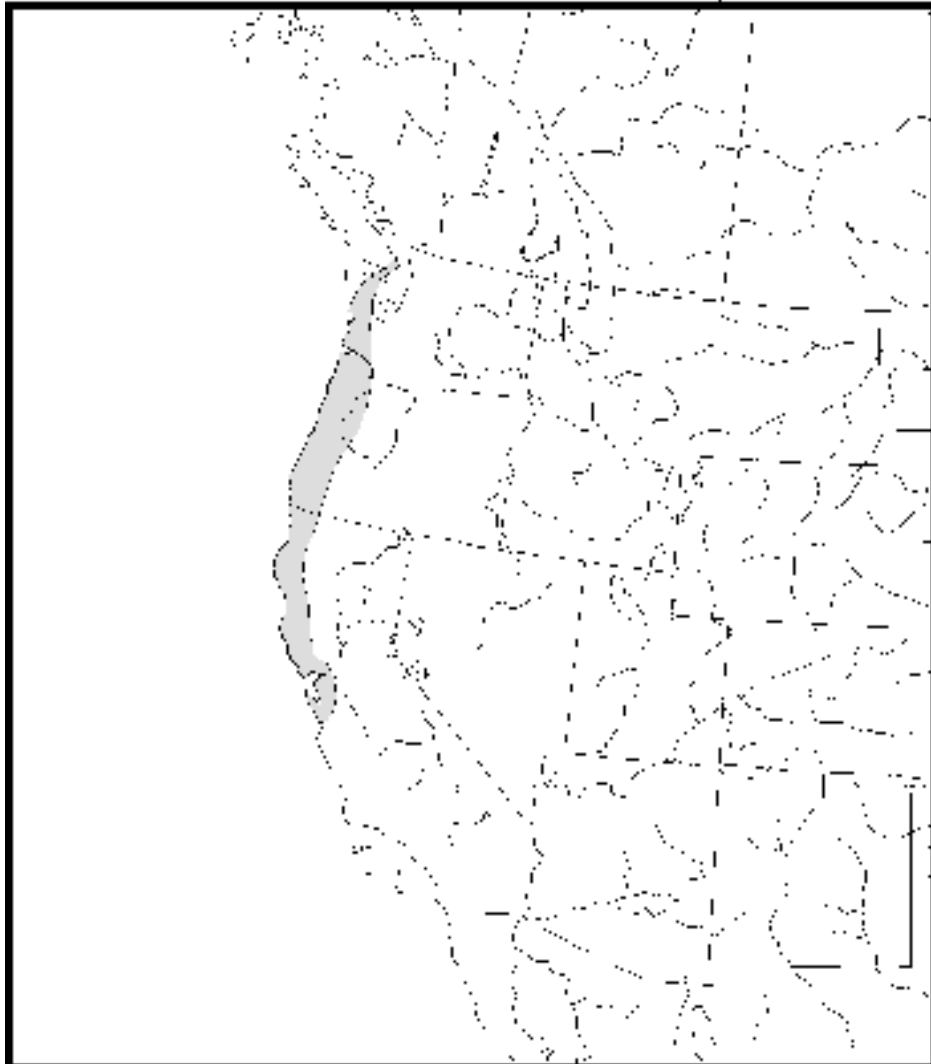


Figure 1. The range of *Lotus formosissimus*

Lotus formosissimus has been found in various habitats within *Quercus garryana* communities, or in grass-dominated meadows composed of species that typically occur in the understorey of *Quercus garryana* stands. Soils, whether shallow or deep, tend to retain moisture for longer periods following rain than the surrounding areas. These habitats do, however, experience drought conditions, particularly during the summer months.

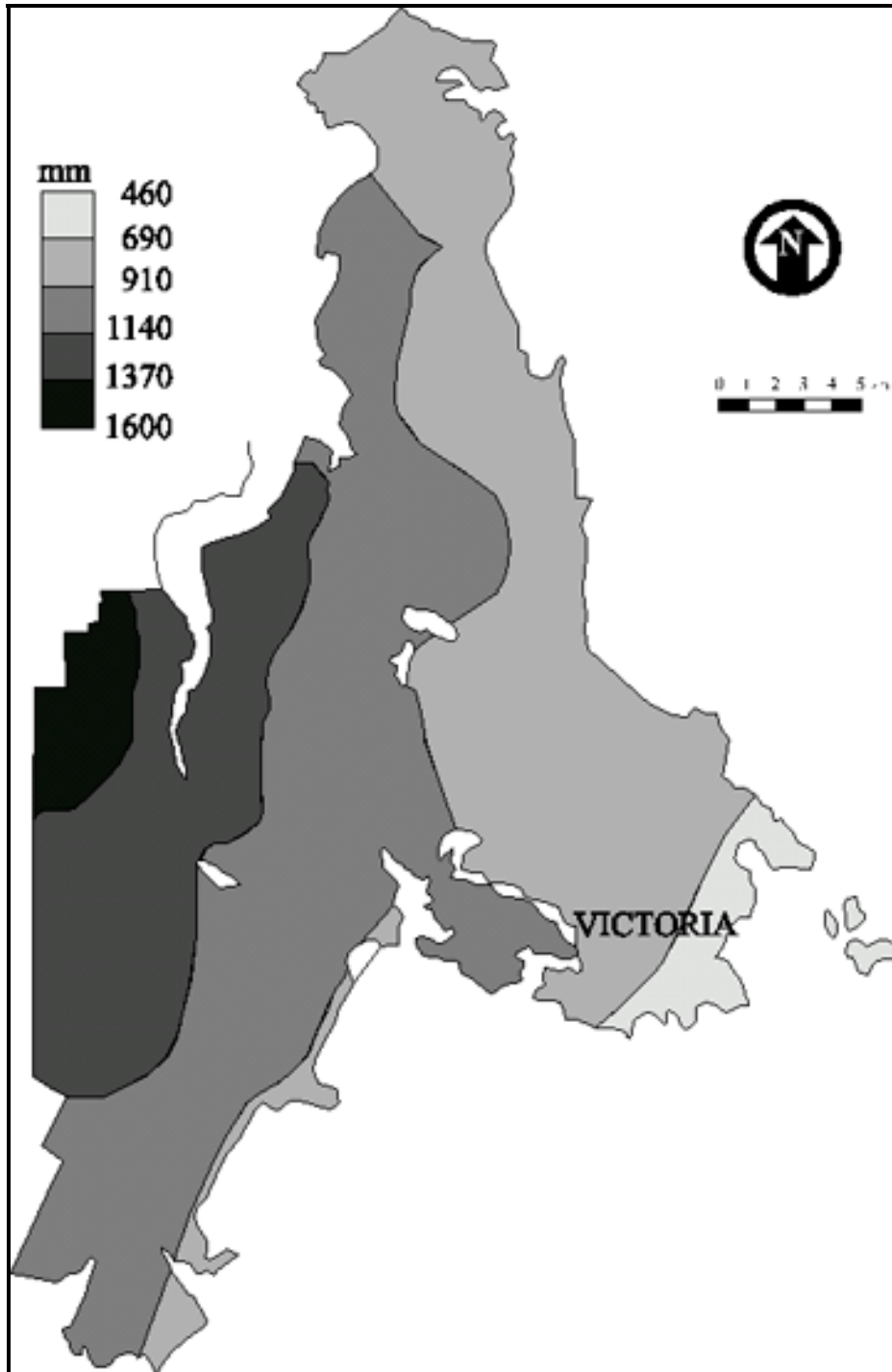


Figure 2. Average annual rainfall in the Victoria region. Redrawn from McMinn *et al.* (1976)

POPULATION SIZE AND TRENDS

Lotus formosissimus has been collected at five sites in BC (Table 1, Fig. 3). All populations have been found in the Victoria area on Vancouver Island and nearby

islands. Of the five known locations, only two sites could be verified during this study. The population at a third site could not be relocated in 1993 but it is likely *L. formosissimus* remains extant at this site. The remaining two sites have been extensively disturbed and it is unlikely that these populations currently exist.

Table 1. *Lotus formosissimus* sites in Canada

Collection Site	Last Observation	Collector	Population (no./area)
Foul Bay (Victoria)	1912	Macoun	
William Head (Victoria)	1953	Hardy	
Bentinck Island (Victoria)	1977?	Ceska	
Trial Island (Victoria)	1992	Douglas	28/30 m ²
Rocky Point (Victoria)	1993	Ryan	165/125 m ²

Recently verified populations

Rocky Point (Victoria)

Lotus formosissimus was recently discovered (1993) at three sites on the eastern side of Rocky Point. About 40 plants were located in a small grass-dominated gully in a 10 m² area along the edge of a cliff adjacent to the shoreline in *Quercus garryana*-*Holodiscus discolor* vegetation. The southeast slope was gentle to moderate and although the site was open and exposed, it was partially sheltered from saltspray and offshore winds by an adjacent cliff face. The substrate was primarily composed of a shallow layer of humus (2-5 cm) overlying bedrock although some plants appeared to be rooted in deeper crevices. Associated species included the introduced species *Hypochoeris radicata*, *Holcus lanatus*, *Aira praecox*, and *A. caryophyllea*, the native species *Sedum spathifolium*, *Achillea millefolium*, *Danthonia californica*, *Piperia elegans*, and the lichen, *Cladina* sp.

A second group of plants was located farther inland (about 20 m from the ocean) in the same type of vegetation between two rock outcrops, forming a 1-2 m deep gully with a northwest aspect. There appeared to be approximately 50 to 100 plants within a 15 m² area. *Lotus formosissimus* contributed about 25% to the total cover of herbs in the gully. While the site lacked a forest canopy, it was partially shaded by *Quercus garryana* to the west. Soils were very shallow and consisted of a dark brown layer of humus and mineral soil (10 cm deep) overlying bedrock. Associated species included the introduced species *Vicia hirsuta* and *Plantago lanceolata*, and the native species *Mimulus guttatus* and *Plectritis congesta*. Species present on adjacent rock outcrops included *Holcus lanatus*, *Hypochoeris radicata*, the moss *Dicranum scoparium* and the lichen *Cladina* sp.

A third population was located even farther inland, in a *Quercus garryana*-*Bromus* forest that bordered a mixture of *Pseudotsuga menziesii* forest with *Holodiscus discolor* and rocky knolls. About 50 plants are located in a 100 m² area. The plants were shaded by an open stand of *Quercus garryana* on level, moist, deep soils. The

understorey vegetation was dominated by a mixture of grasses and herbs including the introduced species *Plantago lanceolata*, *Vicia hirsuta*, and *Holcus lanatus* and the native species *Elymus glaucus*.

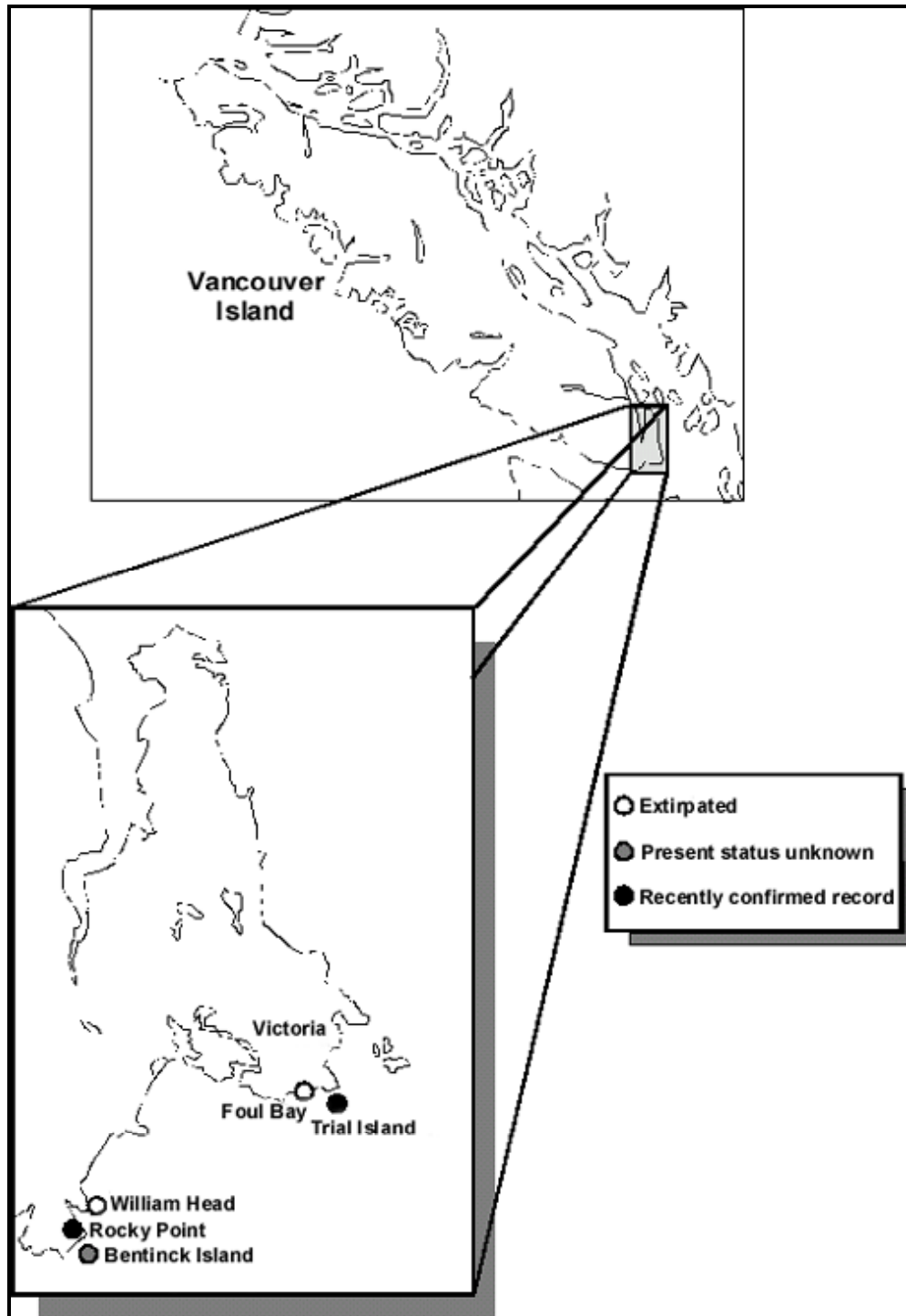


Figure 3. The status and location of *Lotus formosissimus* sites in Canada.

Trial Island (Victoria)

Lotus formosissimus was found in a meadow on Trial Island, located off the Victoria waterfront. Twenty-eight plants were observed in 1992 growing in two populations of 20 m² and 10 m². The populations were located in a site that was relatively sheltered except during extremely stormy weather at which time they received varying amounts of saltspray. Soils at the site were shallow, usually less than 20 cm. The meadow vegetation had numerous co-dominant forbs and grasses similar to those found in *Quercus garryana* stands and included *Camassia quamash*, *Ranunculus occidentalis*, *Plantago lanceolata*, *Taraxacum officinale*, *Danthonia spicata*, *Achillea millefolium*, and *Allium cernuum*.

Status Unknown

Bentinck Island (Victoria)

Bentinck Island is dominated by *Pseudotsuga menziesii* with *Pinus contorta* var. *contorta*, and to a lesser extent, *Quercus garryana*, occurring along the shoreline where shallow soils and exposed rocky knolls are common. *Lotus formosissimus* has been observed in the past on Bentinck Island (A. Ceska, pers. comm.) but a recent survey (1993) failed to relocate this species (it is easily overlooked, particularly when not in flower). It is likely this population is extant but this will have to be confirmed by future surveys.

Extinct Populations

Foul Bay (Victoria)

Lotus formosissimus was collected in 1912 from the Foul Bay area. At the present time this area is dominated by family residences and very little of the existing vegetation remains, particularly along the shoreline where almost all of the native vegetation has been replaced by retaining walls or introduced species. Given the extent to which this area has been altered and the length of time since *L. formosissimus* was last observed, it is very improbable that this species is extant in this area.

William Head (Victoria)

Lotus formosissimus was collected at this site in 1953. Almost all of the natural vegetation has been eliminated and all of William Head is now occupied by a correctional facility. It is very unlikely that *L. formosissimus* is extant at this site.

GENERAL BIOLOGY

Little is known regarding the biology and ecology of *Lotus formosissimus*. It probably shares several traits that are characteristic of other *Lotus* species and other members of the Fabaceae.

It appears that *L. formosissimus* shoots emerge from the perennating short rootstock in the spring followed by flowering between May and the end of June when moist soil conditions and warm temperatures are prevalent in *Quercus garryana* stands and meadows. By July, when drought conditions are prevalent, seed maturation and dispersal has begun, followed soon thereafter, by dieback of the stems to the rootstock, located several centimetres below the soil surface. However, the specific timing of events may depend on local habitat conditions. For example, on August 8, 1993, plants located in the shaded *Quercus garryana*-*Bromus* forest at Rocky Point had set seed but the stems and leaves were still green and healthy and had not died back to the rootstock. Alternatively, at the beginning of July, plants located in the drier *Quercus garryana*-*Holodiscus discolor* vegetation had set seed and were already beginning to die back to the rootstocks. It is likely that the shaded, damp conditions at the former site extended the length of time in which the plants were able to remain physiologically active.

Zandstra and Grant (1968) suggested that *Lotus formosissimus* depended on cross-pollination to produce viable seeds, unlike self-fertile annual species. The insects responsible for cross-pollination in *L. formosissimus* have not been reported in the literature although it is possible that bees are the primary pollinators as they are for another perennial species, *L. corniculatus*. Morse (1956) reported that 12 to 25 visits by bees to each flower of *L. corniculatus* were required for maximum seed set.

Young and Young (1986) found that seeds of many North American *Lotus* species usually had multiple forms of complex dormancy and required pretreatment, including hot water, to induce germination. Like other members of the Fabaceae, it is possible that the seeds of *Lotus formosissimus* have a hard seed coat so that some seeds will germinate in the spring following dispersal the previous autumn but other seeds will remain dormant in the soil. The specific germination requirements of *L. formosissimus* have not been reported in the literature although Hitchcock and Cronquist (1961) reported that the three perennial species, *Lotus formosissimus*, *L. pinnatus*, and *L. crassifolius* were easily grown from seeds; they made no mention of pre-treatment requirements. Similarly, Zandstra and Grant (1968) reported that they grew *L. formosissimus* from seeds to provide live material for their investigations although the cultivation methods used were not described.

Lotus formosissimus is a perennial species and, like other legumes, it is probably associated with nitrogen-fixing bacteria. Furthermore, preliminary field observations suggest it does not appear to be a strong competitor with grasses; it was absent in nearby habitats that appeared to be suitable sites except for the thick turf formed by introduced grasses. However further investigations of the habitat requirements and competitive abilities of *L. formosissimus* will have to be made to determine why this species is so rare and has a limited range in comparison to other more successful and widespread species of *Lotus* including *L. corniculatus*. Furthermore, the average life span and rate of seedling recruitment of *L. formosissimus* have yet to be investigated.

LIMITING FACTORS

Specific Threats

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

At this time, pressures to develop unprotected *Quercus garryana* stands and meadows for the expansion of the urban infrastructure of Victoria, and other population centres on Vancouver Island, are intense. Currently a number of *Quercus garryana* stands are threatened or are in the process of being destroyed as a result of residential development and the expansion of services associated with it. Loss of these habitats severely limits the availability of suitable sites for the establishment of *Lotus formosissimus*.

Historically, *Quercus garryana* communities and grass-dominated meadows have always been heavily influenced by human activity. Aboriginal peoples set fire to these stands to maintain them as an important habitat for wildlife and for harvesting *Camassia*, a member of the Liliaceae whose bulbs were an important source of starch in the diet of aboriginal people (Roemer 1972, Turner and Bell 1971). Roemer (1972) believed that without human interference some of these stands would have eventually been replaced by *Pseudotsuga menziesii* forests.

The suppression of fire within the past century may have contributed to the demise of *Lotus formosissimus* populations. All of the sites in which *L. formosissimus* has been collected were likely maintained in the past as a result of periodic episodes of fire. This would have destroyed much of the competing vegetation resulting in newly-created

habitats where *L. formosissimus* might have become established. However, since that time, these sites have experienced little disturbance, resulting in the invasion and expansion of other species at these sites including the shrubs *Symphoricarpos albus* and *Cytisus scoparius*.

The introduction of European species has resulted in substantial changes not only to the grass-dominated meadows associated with *Quercus garryana* but also the rocky xeric sites in the Victoria area where *Lotus formosissimus* has been collected in the past. One of the most troublesome species is *Cytisus scoparius* which has become a dominant species on xeric, exposed sites throughout much of eastern Vancouver Island and the Gulf Islands.

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

A threat to populations located at Rocky Point is herbivory (probably by cows, deer and/or rabbits which are abundant in the area). Many *L. formosissimus* stems were browsed to within 10 cm of the ground which may have serious consequences in terms of growth and reproductive output. Furthermore, browsing might reduce the ability of these plants to compete with other herbaceous species.

Lastly, the single trait shared by all known *L. formosissimus* sites was their restricted access to the general public. As a result, these sites did not show the same degree of site degradation from trampling to that observed in almost all other *Quercus garryana* stands and meadows in the Victoria area, particularly those located in public parks. Although the vegetation at *Lotus formosissimus* sites still contained a large number of introduced species, which typically respond favourably to disturbance and are usually dominant species, they were not nearly as abundant at Rocky Point, Bentinck Island, and Trial Island as they are at other sites. This included the species *Cytisus scoparius*, *Ulex europaeus*, *Rubus discolor*, and *Dactylis glomerata*. These species not only typically occur in *Quercus garryana* stands but also occur in disturbed habitats. It is very likely that restricted public access is the primary reason for the continued existence of *Lotus formosissimus* at these sites.

Changes in Populations

In British Columbia populations of *Lotus formosissimus* have not been monitored over time thus it is not possible to identify population changes. Whether or not existing populations of *L. formosissimus* are remnants of a more contiguous distribution along the southeastern portion of Vancouver Island is not known given that the only known populations are from the Victoria area. It is likely, given the extent to which *Quercus garryana* stands and meadows have been altered or destroyed in BC, that the size and number of *Lotus formosissimus* populations has declined over the past 100 years.

PROTECTION

Regulatory Measures

There is no specific legislation for the protection of rare and endangered vascular plants in British Columbia. However, existing populations of *L. formosissimus* are protected to a certain extent by their location on public property.

Bentinck Island and Rocky Point (Victoria)

These populations are located on land controlled by the Department of National Defense. Public access is prohibited and although a portion of the property has been extensively altered, much of it remains undisturbed. *Quercus garryana* vegetation is most abundant on the east side of Rocky Point and represents one of the few areas in which the vegetation has not been extensively disturbed by trampling. This is particularly evident on the rocky knolls that extend along the eastern shoreline and that support a diverse and large cover of lichens and, to a lesser extent, mosses. Similar habitats in more accessible areas in the Victoria area have been degraded and are largely bare of lichens and mosses because of their sensitivity to trampling.

The Department of National Defence is aware of the location of rare species at Rocky Point and there are no plans to develop those areas in which *Lotus formosissimus* is located. Although, legally, these populations do not have the same degree of protection as they would in public parks, the lack of public access to Rocky Point is likely more important to the continued existence of these populations than the legal protection provided by their occurrence in public parks.

Trial Island (Victoria)

This population is located in the Trial Island Ecological Reserve which provides these plants with the greatest degree of legal protection currently available in BC. Furthermore, Trial Island, despite its proximity to Victoria, has very limited public access because it is only accessible by boat and permits are required by the Ecological Reserves Program before access is allowed.

Rehabilitation Efforts

No attempts have been made to introduce *Lotus formosissimus* to suitable habitats or to increase the number of individuals at current locations. Hitchcock and Cronquist (1961) reported that it was easily transplanted and grown from seed. Until the ecology of *L. formosissimus* is known it is not possible to provide suggestions on the management of this species.

Some introduced grass species which now dominate the understorey vegetation in many *Quercus garryana* stands and meadows may pose a threat to *Lotus formosissimus* either through direct competition for resources or indirectly by preventing the germination and establishment of seedlings. Unfortunately, the control of most grass species is likely to be difficult, given their ability to resprout from the dense network of roots located in the soil. Furthermore, many species are likely to reappear after any form of soil disturbance from buried viable seeds.

Fire, as it was historically used by the aboriginal peoples of BC, may have favoured the habitats in which *L. formosissimus* occurred by reducing the dense cover of competitive shrubs and trees and maintaining a herb-rich understorey in *Quercus garryana* stands. At the present time, fire does not appear to be a viable management option for a number of reasons:

- 1) Most *Q. garryana* stands are in parks or near residential areas where burning is not likely to be permitted.
- 2) The impact of burning sites inhabited by *Lotus formosissimus* is not known. Unfortunately, because this species is known from so few locations, it would be unwise to attempt such a drastic form of management without a better understanding of its ecology.
- 3) Most *Quercus garryana* stands have not been burned in many years which has resulted in the excessive buildup of woody fuels in the understorey. To burn these stands now would likely result in fires that are so intense that they would likely kill many species.
- 4) Burning is likely to encourage the germination and spread of many species that have been introduced over the past 100 years, particularly species whose seeds remain viable in the soil for long periods of time such as *Cytisus scoparius*.

ASSESSMENT OF STATUS

Comments on Status

Globally, *Lotus formosissimus* is ranked as a G5 species by the BC Conservation Data Centre (BC Ministry of Environment, Lands, Parks). This ranking indicates that, on

a global scale, it is considered to be "common to very common; demonstrably secure and essentially ineradicable under present conditions".

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

Status Recommendation

Lotus formosissimus should be ranked as an endangered species for the following reasons:

- 1) The number of known *L. formosissimus* sites in Canada number fewer than five and all recently verified sites contain less than 200 individuals.
- 2) The types of vegetation in which *L. formosissimus* occurs appears to be undergoing changes in structure and composition resulting from the introduction of European species and the suppression of fire. Either or both factors are likely to have had, and will continue to have, negative impacts on the ability of *L. formosissimus* to become established at new sites.

Prognosis

The prognosis for this species is not good. Although recently verified populations are protected on public land, it is possible that some of these populations may disappear without some form of management. Some assurance would be provided if the stands in which *Lotus formosissimus* occur could be considered stable natural ecosystems. However, with the introduction and domination of these stands by many non-native species and the suppression of fire, it is apparent that the composition and structure of the vegetation are changing in some stands and it is difficult to predict what impact these changes will have on the success or failure of *L. formosissimus* populations. There are no existing *Quercus garryana* stands or meadows in which introduced species are not a significant component of the vegetation thus there is no basis by which to compare existing stands with those that were present before Europeans settled on the west coast of British Columbia.

The management of *Lotus formosissimus* is hampered because very little is known regarding the ecology of this species. In particular, demographic information is lacking and it remains unclear as to which factors influence the establishment, growth and decline of populations.

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