

Conservation Evaluation of the Seaside Birds-foot Trefoil, *Lotus formosissimus*, in Canada*

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In Canada, Seaside Birds-foot Trefoil, *Lotus formosissimus*, is restricted to the Victoria area on southeastern Vancouver Island and two adjacent islands. Populations at five sites are extant and have been recently inventoried, whereas populations at two or more sites in Victoria are extirpated. Existing populations represent the northern range limits of *L. formosissimus*. Although known populations are protected to a certain extent from direct habitat destruction, introduced herbaceous species may pose a serious threat to the continued existence of most populations and may prevent the establishment of *L. formosissimus* at other sites. Fire suppression, grazing, encroachment and low survivorship are also limiting factors.

Key Words: Seaside Birds-foot Trefoil, *Lotus formosissimus*, endangered, distribution, population size, British Columbia.

Seaside Birds-foot Trefoil, *Lotus formosissimus* Greene, is a member of a genus of about 200 species occurring throughout the world, primarily in temperate zones. It is one of nine species occurring in British Columbia and Canada, four of which have been introduced from the Old World (Pojar 1999; Scoggan 1978).

Lotus formosissimus is a sprawling or ascending, multi-stemmed perennial that grows from a short root-stock and thick taproot to 20-50 cm tall (Figure 1; Pojar 1999). It has compound, pinnate leaves 4-8 cm long with 3 to 7, ovate to obovate leaflets. The three to five yellow and pink pealike flowers are 10-15 mm long and arranged in umbels. The umbels are borne on axillary peduncles 2-6.5 cm long and are usually subtended by trifoliate bracts. The wings of the flowers are pinkish to purplish tinged, the keel is purple tipped, and the banner is yellow and 11-15 mm long. The wings and clawed keel exceed the calyx considerably. Pods are 27-36 mm long by 1.5-2 mm wide and enclose 7 to 15, dark brown to black seeds. *Lotus formosissimus* is distinguished from other *Lotus* species by its perennial habit, membranous stipules, trifoliate bracts (sometimes unifoliate), and pink and yellow flowers (Ryan and Douglas 1994*, 1996*). Bog Bird's-foot Trefoil (*L. pinnatus*) also has yellow but never pink corollas.

Distribution

Lotus formosissimus is restricted to the west coast of North America, from southeastern Vancouver Island to central California (Isely 1993; Pojar 1999). In Canada, it is restricted to southeastern Vancouver Island



FIGURE 1. Illustration of *Lotus formosissimus*. (Line drawing from Pojar 1999).

and nearby islands (Figure 2; Dunn and Gillet 1966; Pojar 1999; Douglas et al. 2002a, 2002b).

*The original field work for *Lotus formosissimus* was funded by the British Columbia Conservation Data Centre. The results appear in the British Columbia Conservation Data Centre database and a rare plant manual (Douglas et al. 2002a). This information formed the basis for a Committee on the Status of Endangered Wildlife in Canada status report (Douglas and Ryan 1996*) and the subsequent assessment of *Endangered*. This paper includes more recent information that did not appear in the original status report.

TABLE 1. Populations of *Lotus formosissimus* in Canada (in Victoria and west of Victoria at Department of National Defense – Rocky Point).

Collection Site	Last Observation	Collector	Population Status (number/area)
Oak Bay, Victoria	1896	Anderson	Extirpated
Foul Bay, Victoria	1912	Henry	Extirpated
William Head, W of Victoria	2002	Fairbarns	19/8 m ²
Bentinck Island, Rocky Point	2004	Fairbarns	278/110 m ²
Rocky Point, E side	2005	Fairbarns	36-53/75.5 m ²
Rocky Point, Church Point	2004	Fairbarns	209-327/137 m ²
Trial Island, Victoria	2004	Fairbarns	383/5000 m ²

Habitat

Lotus formosissimus grows in various coastal meadow and woodland habitats, ranging from open exposed grass-dominated meadows to exposed steep rocky sites inhabited by Garry Oak (*Quercus garryana*), to shaded Garry Oak-Brome (*Quercus garryana*-*Bromus*) forests. Associated species, which typically occur in the understory of *Quercus garryana* stands, include Lance-leaved Stonecrop (*Sedum spathifolium*), Sea Blush (*Plectritis congesta*), Nodding Onion (*Allium cernuum*), Menzies Larkspur (*Delphinium menziesii*), Orchard Grass (*Dactylis glomerata*), Sweet Vernalgrass (*Anthoxanthum odoratum*), Hairy Cat's-ear (*Hypochaeris radicata*), Common Velvet-grass (*Holcus lanatus*), Early Hairgrass (*Aira praecox*), Ribwort Plantain (*Plantago lanceolata*), and several species of brome (*Bromus*). *Lotus formosissimus* also occurs in vernal seeps. It is suspected that *L. formosissimus* is a poor competitor with a number of perennial grasses because it is absent in a number of grass-dominated micro-sites that are otherwise apparently suitable habitats.

Biology

Little is known regarding the biology of *Lotus formosissimus*. It appears that *L. formosissimus* shoots emerge in 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 begin, followed soon thereafter by die-back of the stems to the rootstock, which is located several centimetres below the soil surface. In his demographic studies of *Lotus formosissimus*, M. Fairbarns (personal communication) discovered, based on ex situ experiments, that seeds may remain in the seed bank for at least two years. He postulated that this was a likely explanation for his in situ observations of higher numbers of seedlings than numbers of seeds set in the previous year.

Flowers likely require cross-pollination to set viable seed although pollinators have not yet been identified (Zandstra and Grant 1968). Seeds are believed to be easy to germinate (Hitchcock et al. 1961) but like other members of Fabaceae, they may have a hard seed coat, delaying the germination of 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*, like other legumes, is associated with nitrogen-fixing *Rhizobium* that provides the plants with an independent source of nitrogen from that in the soil.

Population Attributes

Lotus formosissimus has been collected at seven sites in Canada on southern Vancouver Island or adjacent islands (Table 1, Figure 2). Populations at two of these sites are considered extirpated. Other older collections not listed in Table 1 may or may not represent different locations (e.g., Victoria, and Oak Bay, Victoria). The population on Trial Island has been known since the 1950s and surveyors reported 28 plants in 1994 and 380 plants in 2004. Likewise, the population at Rocky Point has also been observed for over 20 years and was represented by 165 plants in 1993 and 245-380 plants in 2005. The increase, however, is likely attributable to different observers and different sampling methods. It is very unlikely that the populations are actually increasing significantly. The remaining sites have not been monitored for any length of time and thus, no information is available on population trends.

Provincial, National and Global Ranks

The British Columbia Conservation Data Centre has ranked this species as S1 and placed it on the Ministry of Environment Red list. This is the most critical category for imperiled rare native vascular plants in the province. A rank of S1 is considered "critically imperiled because of extreme rarity (five or fewer occurrences or very few remaining individuals) or because of some factors making it especially vulnerable to extirpation or extinction". *Lotus formosissimus* is on the Canadian *Species At Risk Act* legal list (COSEWIC 2000*) and globally, it is G5 or common and secure in its range (NatureServe Explorer 2006*).

Threats and Protection

In the past, the most direct threat to *Lotus formosissimus* was that of habitat destruction. Grass-dominated meadows, often associated with *Quercus garryana*-*Bromus* stands, commonly occurred on gentle slopes on the southeastern side of Vancouver Island and some of the Gulf Islands prior to European colonization. Since colonization, both types of vegetation have been subjected to extensive agricultural and res-

idential development and have been essentially eliminated outside parks or ecological reserves. Direct habitat destruction, however, is no longer the most important threat. It is the loss of suitable sites outside the current occupied area of *L. formosissimus* that severely limits the potential for this species to spread into new areas and therefore, threatens its long-term survival in Canada.

Less direct factors which threaten known populations include the introduction of aggressive European species. These species have resulted in substantial changes to the grass-dominated meadows associated with *Quercus garryana* and the rocky xeric sites in the Victoria area. One of the most devastating species is Scotch Broom (*Cytisus scoparius*). This species has become a dominant shrub on xeric, exposed sites throughout much of southeastern Vancouver Island and the Gulf Islands and either competes with native plants such as *L. formosissimus* for resources or prevents the establishment of their seedlings.

Furthermore, the suppression of natural and unnatural periodic fires may have resulted in changes to the vegetation of many sites where this species would be expected to occur. In the past, aboriginal peoples probably set fire to many of these sites to maintain them as an important habitat for food plants and wildlife (Roemer 1972). During the past century these sites have experienced little disturbance resulting in increased domination of some sites by trees and shrubs, especially introductions, that effectively eliminate many herbaceous species.

Another limiting factor is grazing. M. Fairbarns (personal communication) observed that grazing prior to seed set had greatly limited seed production and caused reduced vigour among established plants on Bentinck Island.

Finally, demographic constraints also play a role in the viability of populations. Fairbarns (personal communication) found low rates of juvenile survivorship and low levels of seed production. He found that they were related primarily to summer drought and grazing.

All extant populations of *L. formosissimus* in British Columbia are protected from heavy recreational pressure and disturbance caused by the general public. Although these sites contain a large number of introduced species, the latter were not nearly as abundant at Rocky Point, Bentinck Island, and Trial Island as they are at other public sites. It is very likely that restricted public access and lack of disturbance are the primary reasons for the continued existence of *L. formosissimus* at these sites.

The populations at Rocky Point and Bentinck Island are owned by the Department of National Defense. 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 *L. formosissimus* occurs. Bentinck Island is used by DND to detonate unused ammunition, but such activities do not coincide with

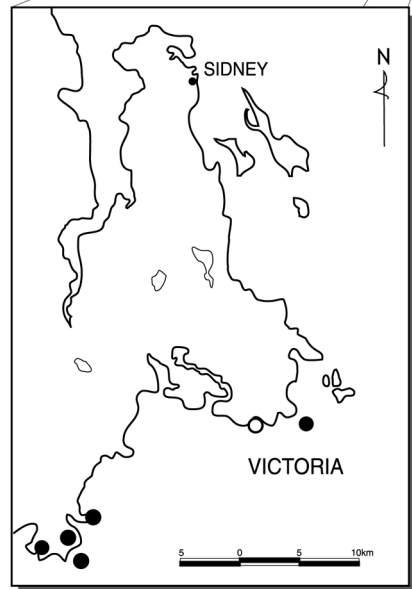
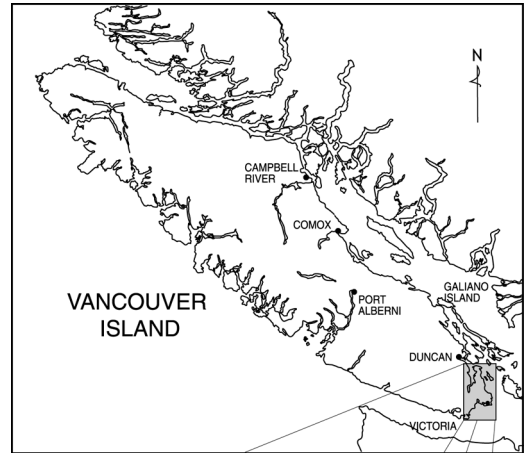


FIGURE 2. The status and location of *Lotus formosissimus* sites in British Columbia. ● – recently confirmed sites, ○ – extirpated site.

locations of *L. formosissimus* on the island. These populations are also protected by the Canadian *Species at Risk Act* by their occurrence on land under federal jurisdiction and therefore, are not likely to be directly harmed. The Canadian Forest Service is also involved in a number of projects with the goal of managing appropriately for species at risk on federal lands, including Scotch Broom removal from sites.

The *Lotus formosissimus* population in Trial Island Ecological Reserve is also provided with a high degree of protection. Despite its proximity to Victoria, it has

very limited public access because it is only accessible by boat, thus preventing excessive disturbance.

A recovery strategy (which treats *Lotus formosissimus* in addition to several other species-at-risk) has been proposed (Parks Canada Agency 2005*). The recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. Detailed planning is done at the action plan stage. In the absence of an action plan, no attempts have been made to introduce *L. formosissimus* to suitable habitats or to increase the number of individuals at current locations. However, Scotch Broom removal at the Bentinck Island site has revealed additional *Lotus* plants (M. Fairbarns, personal communication). The site now offers improved conditions for growth and reproduction.

Evaluation of Status

The British Columbia Conservation Data Centre considers *Lotus formosissimus* to be endangered in Canada (Douglas et al. 2002a). The Committee on the Status of Endangered Wildlife in Canada has also assigned this species to the Endangered category (COSEWIC 2000*). Between 925 and 1060 plants are known from five sites on southeastern Vancouver Island and adjacent islands. The long-term survival of this species in Canada is dubious as a result of a number of limiting factors: shading by aggressive introduced species, poor survivorship, grazing, fire suppression and encroachment. Even though known populations are protected from excessive disturbance on federal lands and in the ecological reserve, the loss of suitable habitats at other sites severely limits the potential of this species to become established at new sites.

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