COSEWIC
Assessment and Status Report

on the

Silky Beach Pea
Lathyrus littoralis

in Canada

THREATENED
2013

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Silky Beach Pea — Photo by Matt Fairbarns, with permission.

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COSEWIC
Assessment Summary

Assessment Summary – May 2013

Common name
Silky Beach Pea

Scientific name
Lathyrus littoralis

Status
Threatened

Reason for designation
This plant of coastal dunes, which has much of its global range in Canada, is threatened because of competition with invasive alien plants, off-road vehicles, trampling, herbivory, and a decline in suitable habitat associated with more extreme and frequent storm surges due to climate change. The species' restricted distribution, the very small number of individuals, and the small number of subpopulations make the species at risk.

Occurrence
British Columbia

Status history
Designated Threatened in May 2013.

COSEWIC
Executive Summary

Silky Beach Pea
Lathyrus littoralis

Wildlife Species Description and Significance

Silky Beach Pea (*Lathyrus littoralis*) is a rhizomatous perennial herb that grows 10-60 cm tall. It has branched and densely grey-silky shoots bearing alternate and pinnately compound leaves with 4-8 leaflets and no tendrils. The pea-type flowers have smaller white lower and side petals but the larger upper petals are pink, red or purple. The pods are about 3 cm long and 1 cm wide, grey-silky, and contain 1-5 seeds.

Distribution

Silky Beach Pea occurs in coastal regions from central California to British Columbia. In Canada, Silky Beach Pea is restricted to Vancouver Island, nearby islands, and Haida Gwaii. The Canadian populations occupy about 40% of the global range of the species.

Habitat

Silky Beach Pea is restricted to rapidly-drained dunes, sand plains and sandy beaches along Pacific Ocean shores. It does not tolerate shading and only occurs in open areas dominated by low grasses and forbs with little or no cover of native trees or shrubs. Since 1930, there has been a 50-90% decline in the areal extent of the sparsely-vegetated habitats favoured by the Silky Beach Pea.

Biology

Silky Beach Pea reproduces by seeds and by rhizomes. Most seeds are shed in the immediate vicinity of the parent plant, but rhizome fragments may be dislodged by winter storms and carried to new beaches along ocean currents. Long-distance transport very rarely results in the establishment of new populations. Plants growing on exposed beaches tend to be killed by winter storm surges. However, rhizome fragments may be occasionally carried into backshore areas above the reach of all but the most violent storms, where they may establish stable populations. As with many species in the pea family, Silky Beach Pea plants form a symbiotic relationship with bacteria; this facilitates nitrogen uptake in the otherwise nitrogen-poor sandy habitat environment where the species occurs. Silky Beach Pea plants produce chemicals that discourage most, but not all, invertebrate herbivory. Silky Beach Pea may be heavily grazed by deer.

Population Sizes and Trends

The most recent estimation of the size of the Canadian population, derived from detailed surveys (2009-2011), is between 325 and 956 mature individuals.

Threats and Limiting Factors

Invasive alien grass species (primarily European Beachgrass) pose the greatest threat to Silky Beach Pea. Several populations of Silky Beach Pea are threatened by off-road vehicle use and/or trampling by hikers. Silky Beach Pea is threatened by habitat loss as the result of storm surges associated with climate change. In areas where deer have been introduced, or occur in high numbers as the result of human actions, Silky Beach Pea is also threatened by herbivory.

Protection, Status, and Ranks

At the time of assessment in April 2013, Silky Beach Pea was not protected by federal or provincial species at risk legislation. All or much of each of the six extant populations occurs in National Park Reserves, Provincial Parks, Provincial Ecological Reserves or Municipal Parks, which affords some measure of protection under general provisions affecting native plants. Silky Beach Pea has a NatureServe global rank of G3G4 (vulnerable to apparently secure, last reviewed 2013), a national rank of N2 (imperilled) in Canada, and is ranked as S2 (imperilled) in British Columbia. It has a General Status Rank of 2 (may be at risk). The national rank is not yet assessed (NNR) for the United States or in Oregon and Washington. In California it is ranked as S3S4 (vulnerable to apparently secure).

TECHNICAL SUMMARY

Lathyrus littoralis
Silky Beach Pea Gesse littorale
Range of occurrence in Canada: British Columbia

Demographic Information

Generation time (average age at which vegetatively produced individuals are capable of independent existence) *The generation time presented in this table reflects a conservative estimate of the average age of parent plants of the clones.*	>10 years
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals? *Decline inferred from decline in area of habitat, degree of damage by off-road vehicles and trampling at some sites, and the pervasiveness of the invasive alien species*.	Yes, inferred
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations].	unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	unknown
Are the causes of the decline clearly reversible and understood and ceased?	no
Are there extreme fluctuations in number of mature individuals?	unknown

Extent and Occupancy Information

Estimated extent of occurrence *EO is <100 km² if the unsuitable habitat is removed as most of the area is ocean*.	61,400 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value).	24 km²
Is the total population severely fragmented?	no
Number of locations∗	6
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	no
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy? *Observed loss of apparently permanent populations reported from Savary Island, Radar Beach, Stubbs Island, and Ahous Bay could be projected to continue*.	yes
Is there an [observed, inferred, or projected] continuing decline in number of populations? *See above*.	yes
Is there an [observed, inferred, or projected] continuing decline in number of locations*? *See above.*	yes
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat? *Observed and projected continuing decline in extent and quality of habitat.*	yes
Are there extreme fluctuations in number of populations?	no

∗ See Definitions and Abbreviations on COSEWIC website and IUCN 2011 for more information on this term.

Are there extreme fluctuations in number of locations∗?	no
Are there extreme fluctuations in extent of occurrence?	no
Are there extreme fluctuations in index of area of occupancy?	no

Number of Mature Individuals (in each population)

Population	N Mature Individuals
Saanich Spit	49-200
Wickaninnish Dunes	88-291
Schooner Cove	23-60
Tlell	80-200
Oeanda River	5
Rose Spit	80-200
Total (total shoots, most of which are non-flowering)	325-956

Quantitative Analysis

Probability of extinction in the wild is unknown.	not available

Threats (actual or imminent, to populations or habitats)

Invasive alien plants, off-road vehicles, trampling, decline in suitable habitat as the result of more extreme and frequent storm surges due to climate change, and herbivory.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? Vulnerable to Apparently Secure (G3G4; last reviewed in 2013), not ranked in the USA or in Washington or Oregon. California has a rank of S3S4.	
Is immigration known or possible? *Prevailing ocean currents (i.e., from the direction from which immigrants would originate) suggest that immigration, though possible, is probably a very rare event*.	yes
Would immigrants be adapted to survive in Canada?	probably
Is there sufficient habitat for immigrants in Canada? *While suitable habitat still exists*, *it is very rare.*	yes
Is rescue from outside populations likely? *Although rescue is possible, it is unlikely to occur frequently*.	no

Status History

COSEWIC: Designated Threatened in May 2013.

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Threatened	B2ab(ii,iii,iv,); C2a(i); D1

Reasons for designation:

This plant of coastal dunes, which has much of its global range in Canada, is threatened because of competition with invasive alien plants, off-road vehicles, trampling, herbivory, and a decline in suitable habitat associated with more extreme and frequent storm surges due to climate change. The species' restricted distribution, the very small number of individuals, and the small number of subpopulations make the species at risk.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not met. Data not available to determine extent of declines.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Threatened B2ab(ii,iii,iv). EO exceeds thresholds for B1 (61,400km²). The index of area of occupancy is below the threshold for Endangered (24 km²); however, there are 6 locations, therefore exceeding the threshold for Endangered. The species is experiencing declines in habitat, and most of the subpopulations are small and may be subject to extirpation resulting in a decrease in the IAO.
Criterion C (Small and Declining Number of Mature Individuals): Meets Threatened C2a(i) as there is an inferred continuing decline and no population is known to contain >1000 individuals. Comes close to meeting Endangered using the same criteria; however, one population probably exceeds the threshold of >250 individuals.
Criterion D (Very Small or Restricted Total Population): Meets Threatened D1 as the total population is <1000. Comes close to meeting Threatened D2 with 6 locations and an IAO of 24 km²; however, it is unlikely that a single threatening event could rapidly affect all populations simultaneously.
Criterion E (Quantitative Analysis): Not done.

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 5, 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
(2013)

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 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.

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Lathyrus littoralis

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2013

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific Name: *Lathyrus littoralis* (Nutt.) Endl.

Synonyms: *Astrophia littoralis* Nutt., *Orobus littoralis* (Torr. & A. Gray) A. Gray

Common English Names: Silky Beach Pea, Grey Beach Peavine, Gray Beach Pea, Dune Sweet Pea, Silky Beach Vetchling, Silvery Beach Peavine, Strand Sweet Pea

Common French Name: Gesse littorale

Family Name: Fabaceae (Pea Family)

Silky Beach Pea is a well-established taxon with no described subspecies or varieties and no taxonomic complications.

Morphological Description

Silky Beach Pea (Figure 1) is a perennial herb with a wide-spreading underground stem that gives rise to annual shoots. Mature shoots are densely grey-silky, 10-60 cm tall and branched. The leaves are alternate and pinnately compound with 4-8 leaflets. Unlike many related species, the leaves do not end in tendrils so Silky Beach Pea is not a climbing vine. The lower and side petals of its pea-type flowers are white but the large upper petals are pink, red or purple. The pods are about 3 cm long and 1 cm wide, grey-silky, and contain 1-5 seeds (Douglas *et al.* 1999).

Figure 1. Silky Beach Pea in flower and fruit. Photos by Matt Fairbarns, with permission.

Silky Beach Pea is the only species of *Lathyrus* in Canada that is densely hairy and lacks tendrils on its leaves.

Population Spatial Structure and Variability

The Canadian populations on Vancouver Island and Haida Gwaii are separated by over 700 km of open ocean. This distance may have created genetic structure or strong demographic isolation within the Canadian part of the range of Silky Beach Pea, as well as between Canadian populations and those outside Canada. Morphological and genetic variability has not been investigated in Canadian populations, and there are no known genetic studies of this plant.

Designatable Units

The Canadian populations belong to a single designatable unit because they belong to a single taxon and they all occur within a single COSEWIC Ecological Area (Pacific). Currently there are no data on morphological or genetic differentiation between Vancouver Island and Haida Gwaii populations that would warrant their separation into two DUs.

Special Significance

The separation distance of over 700 km between Canadian populations of Silky Beach Pea on Vancouver Island and Haida Gwaii is of ecological and biogeographic significance and may have led to genetic differentiation among populations. Although rare in British Columbia, this is a salt-tolerant species that has been used in revegetating shoreline areas in the U.S. (Pickart 1988).

There are no reported cultural uses of Silky Beach Pea (Moerman n.d.).

DISTRIBUTION

Global Range

Silky Beach Pea occurs from central California to British Columbia (Hitchcock and Cronquist 1973; Isely 1993; Douglas *et al.* 1999) (Figure 2). Apart from an unsubstantiated report from north central California (CalFlora 2011), it is primarily a coastal species. Approximately 40% of the global range lies within Canada.

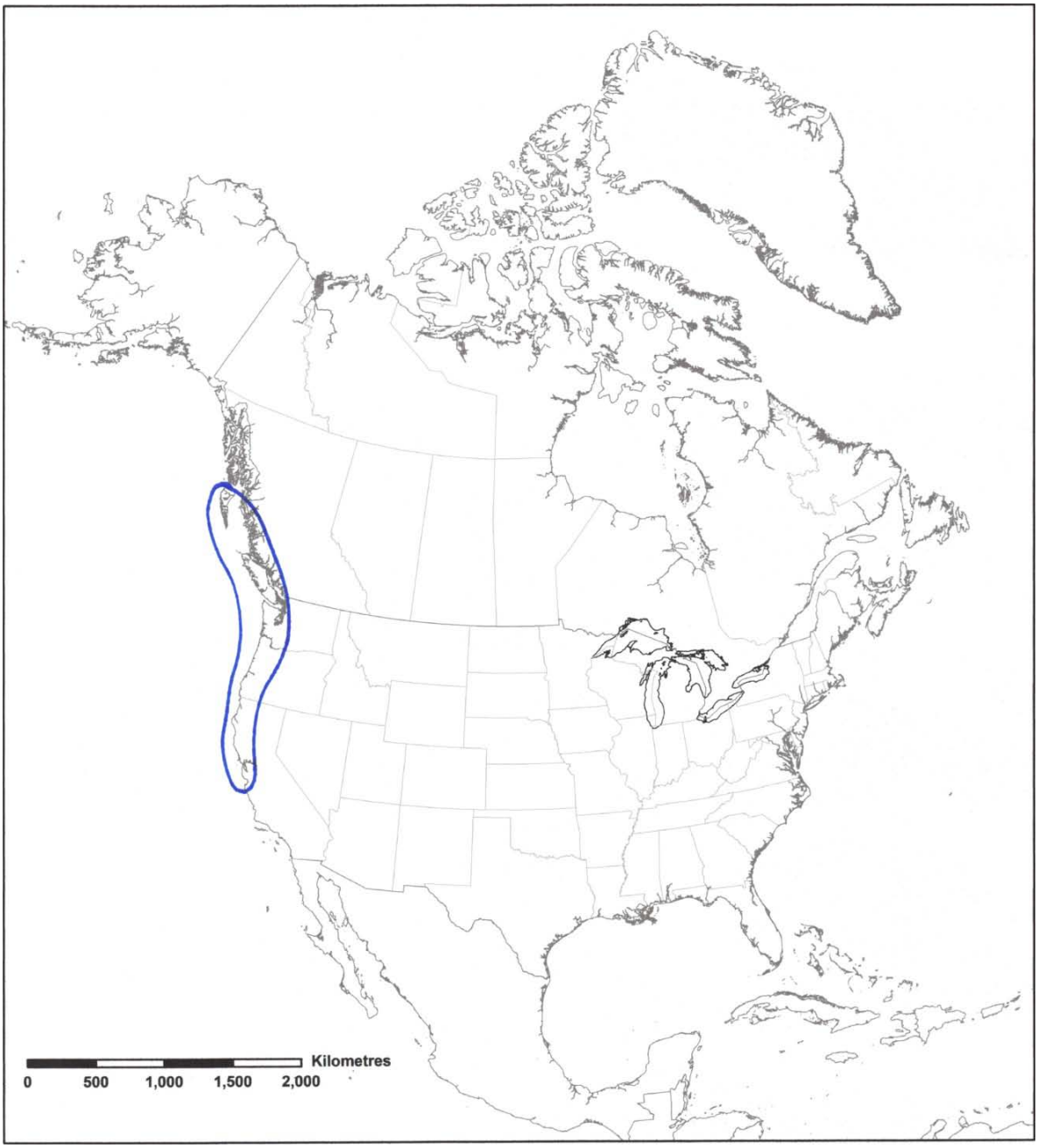

Figure 2. Global distribution of Silky Beach Pea.

Canadian Range

In Canada, Silky Beach Pea is restricted to six localities along shorelines from southern Vancouver Island to the northern part of Haida Gwaii (the Queen Charlotte Islands) (Figure 3) within the Coastal Douglas-fir and Coastal Western Hemlock Biogeoclimatic zones (Douglas *et al.* 1999).

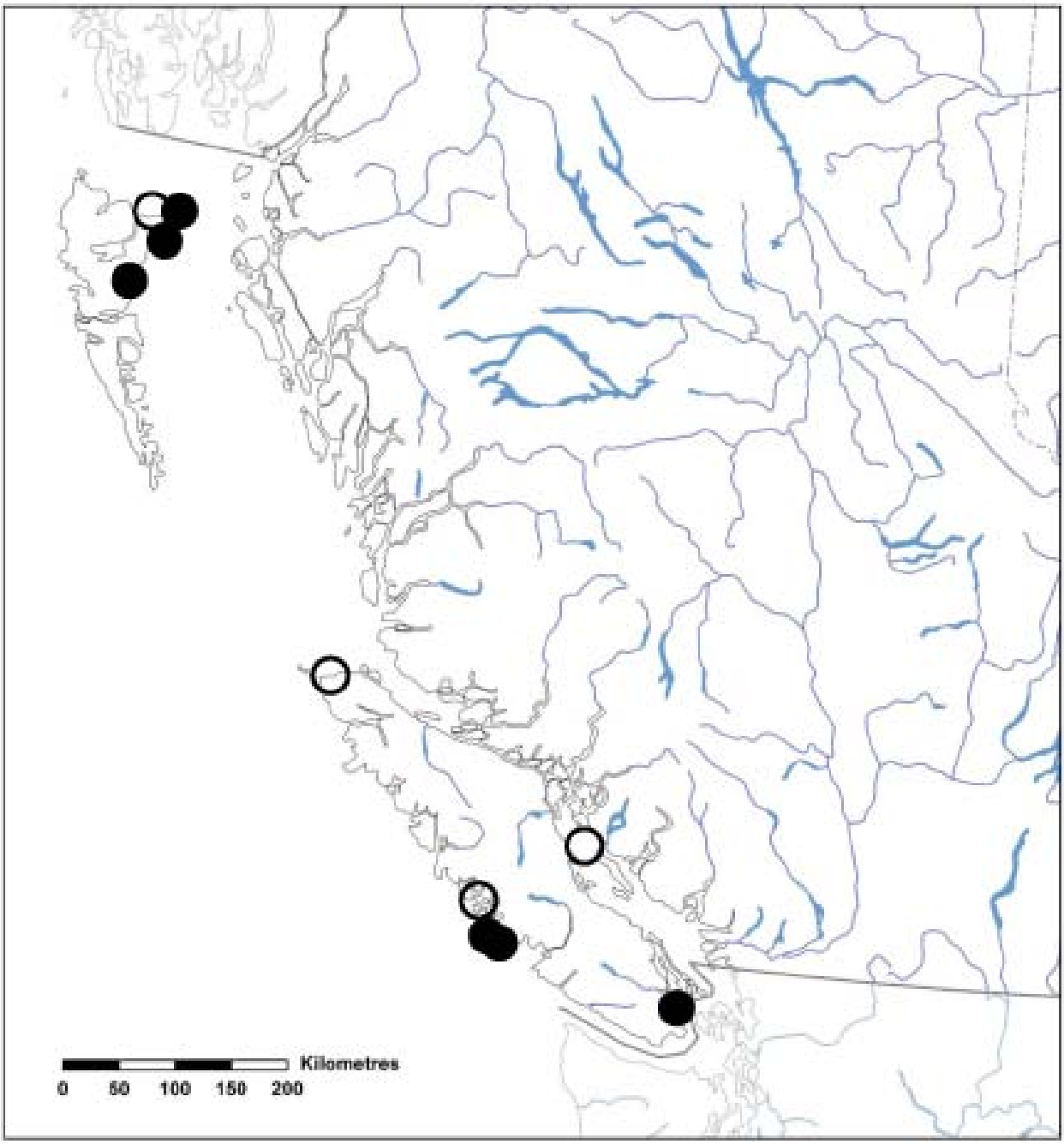

Figure 3. Canadian distribution of Silky Beach Pea. Solid circles show extant populations. Hollow circles show transient populations or long-established populations that no longer exist. Several of the hollow circles indicate the former sites of multiple populations.

Nineteen populations of Silky Beach Pea have been reported in Canada, but site descriptions for two of these populations (Ucluelet and Clayoquot) are vague and may refer to more specific areas of known occurrence such as Wickaninnish Dunes and Ahous Bay, respectively (Table 1). Silky Beach Pea has been reported from 11 of these sites where it now appears to be extirpated, or possibly the populations were only transient. Populations are described as transient when they occur within the reach of the winter storm tides, when they consist of only one or a few individuals, and where they were/are only observed once. The Stubbs Island and Savary Island populations appear to have been extirpated while the Florencia Bay, Sandhill Creek, Radar Beach, Guise Bay, Kliki Creek, Sangan River and Tow Hill populations were more likely to have been transient, likely derived from rhizome fragments from large nearby populations. It is difficult to infer whether the populations lost from Sidney Island and Ahous Bay were transient or once well-established.

Table 1. Population and locality data.

Population	Year	Observer	Abundance # mature individuals
Gulf Islands			
Savary Island (apparently extirpated)	2000	Roemer	not noted
	2010	Fairbarns	failed to find
Sidney Island (apparently extirpated)	1975	Long	not noted
	2008	Fairbarns	0*
	2011	Fairbarns	0
Southeast Vancouver Island			
Saanich Spit (extant)	1924	Newcombe	not noted
	1940	Eastham	not noted
	1950	Hardy	not noted
	1951	Hardy	not noted
	1953	Melburn	not noted
	1967	Harrison	not noted
	1971	Beebe	not noted
	1973	Harrison	not noted
	1976	Ceska and Ceska	not noted
	2003	Page	not noted
	2007	Fairbarns	100-200
	2009	Page	< 100
	2010	Fairbarns and Oldham	49-52
	2011	Costanzo	100-200
Western Vancouver Island			
Ucluelet (apparently extirpated)	1909	Macoun	not noted
	1960	Szczawinski	not noted
Florencia Bay (apparently extirpated)	1916	Henry	not noted
	2001	Page	failed to find
	2006	Fairbarns	0*
	2010	Fairbarns	failed to find
Wickanninish Dunes (extant)	1957	Szczawinski	not noted
	1960	Szczawinski	not noted
	1970	Pavlick	not noted
	1971	Harcombe and Willis	not noted
	1974	Clements	not noted
	2006	Fairbarns	260-280
	2010	Bellefleur and Collyer	88-291

Population	Year	Observer	Abundance # mature individuals
Sandhill Creek (apparently extirpated)	1969	Soper	not noted
	2006	Fairbarns	failed to find
	2007	Fairbarns	failed to find
	2011	Darke	failed to find
Schooner Cove (extant)	2001	Page	23
	2010	Fairbarns	30-60
Radar Beach (apparently extirpated)	2001	Page	scattered
	2006	Fairbarns	failed to find
	2011	Darke	failed to find
Clayoquot (status uncertain, locality imprecise)	1924	Anderson	not noted
	1929	Anderson	not noted
Stubbs Island (apparently extirpated)	1960	Guiguet	not noted
	2008	Fairbarns	failed to find
Ahous Bay, Vargas Island (apparently extirpated)	1896	Anderson	not noted
	2001	Page	0*
	2006	Fairbarns	failed to find
	2009	Fairbarns	failed to find
	2010	Fairbarns	failed to find
Guise Bay, Cape Scott (apparently extirpated)	2001	Page	0*
Haida Gwaii (Queen Charlotte Islands)			
Tlell (extant)	1925	Newcombe	not noted
	1964	Calder and Taylor	not noted
	2009	Wijdeven	160-200
	2011	Wijdeven	c. 80-100
Oeanda River (extant)	1964	Calder and Taylor	not noted
	2009	Wijdeven	5
Rose Spit (extant)	2011	Wijdeven	80-200
Tow Hill (apparently extirpated)	1974	Beil	not noted
	2011	Wijdeven	failed to find
Kliki Creek (apparently extirpated)	1964	Calder and Taylor	few, scattered
	2011	Wijdeven	failed to find
Sangan River (apparently extirpated)	n.d.	anonymous record	not noted
	2011	Wijdeven	failed to find

**< 10 non-flowering shoots, all below the storm tide line and therefore likely transient*

Extent of Occurrence and Index of Area of Occupancy

The current Canadian extent of occurrence (EO) of Silky Beach Pea was calculated to be 61,400 km^2. This was determined from a minimum convex polygon that almost entirely consists of ocean or inland areas that constitute “obviously unsuitable habitat”. The extent of sand dunes within the polygon, which constitutes the only plausibly suitable habitat, is difficult to quantify but is certainly less than 100 km^2.

Each of the six established populations is at least 2 km from the others and is largely contained within a single 2 km x 2 km cell[1] so the index of area of occupancy (IAO) is 24 km^2 using a 2 km x 2 km grid. The biological area of occupancy is <10 ha.

Severe Fragmentation

The four largest Canadian populations of Silky Beach Pea (containing > 50% of the Canadian population) are isolated from one another by distances > 50 km (several times greater than the long-term average dispersal distance) and are therefore considered relatively isolated. These four populations are each estimated to contain at least 49 mature individuals in unfavourable years. If such population sizes are considered large enough to remain viable, then the Canadian population is not severely fragmented according to standards established by COSEWIC.

Search Effort

Silky Beach Pea is strikingly easy to detect when in flower and relatively easy to find even when in vegetative form, because its form and distinctive grey foliage stand out in the sparse dune and sand plain vegetation where it occurs. Suitable sites have been surveyed repeatedly since the early 1990s in a series of projects designed to document the distribution of rare plants in sand dunes and sand plains of Vancouver Island, Haida Gwaii and the Gulf Islands (Figure 4). The principal investigators included Adolf and Oldriska Ceska, Matt Fairbarns, Nick Page, Hans Roemer, James Miskelly, Berry Wijdeven, Jenifer Penny, Frank Lomer, Ian Darke and George Douglas, all of whom are/were familiar with the plant. During the past decade alone, over 150 person-days have been spent searching for rare plant species in sand dune habitats within the Canadian range of Silky Beach Pea. As well, Calder and Taylor (1968) reported on detailed botanical surveys carried out throughout Haida Gwaii in the 1950s and 1960s.

[1] Some populations may disperse rhizome fragments that establish new but apparently transient subpopulations over a distance of > 2 km.

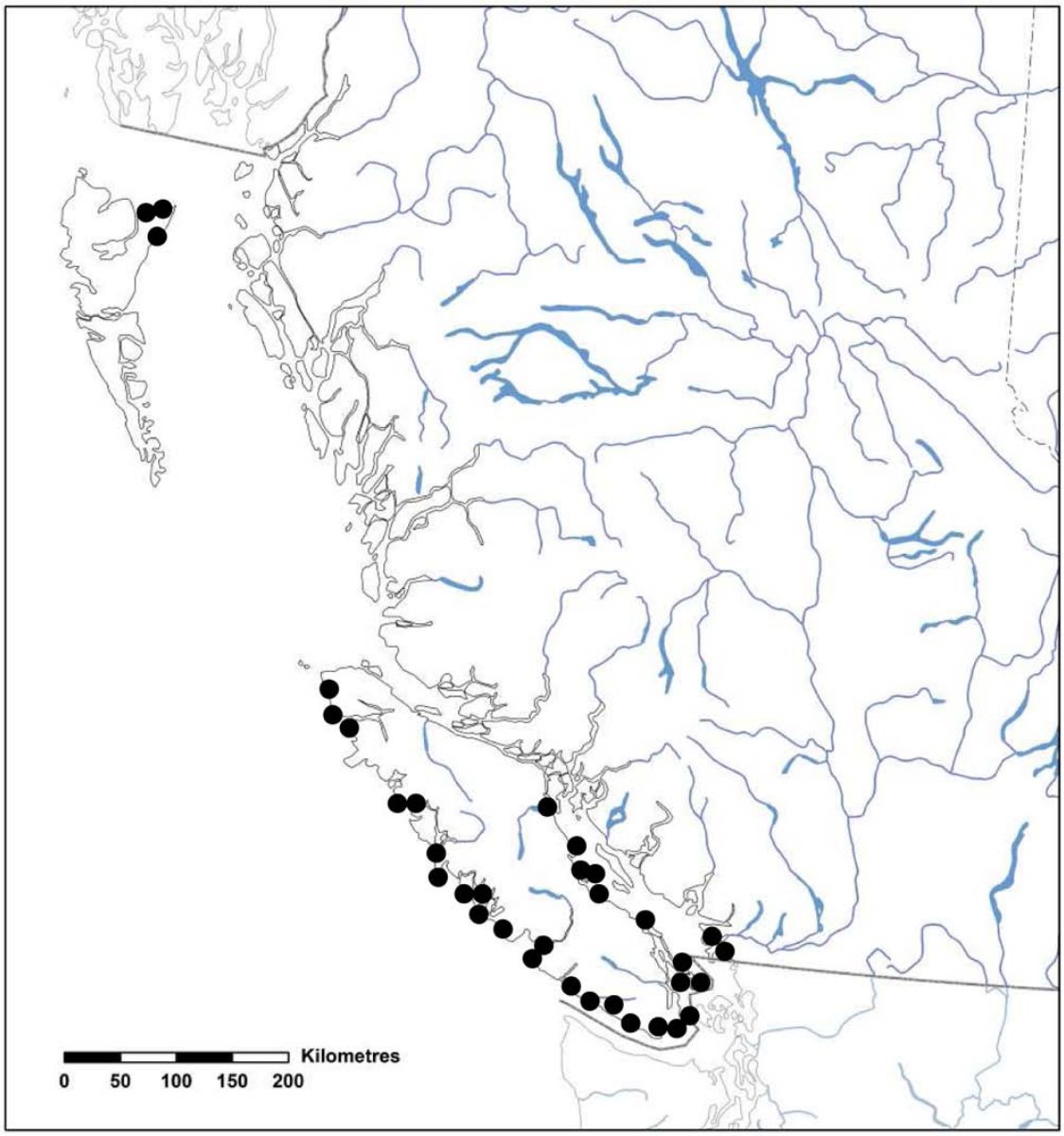

Figure 4. Negative search results. Circles indicate dune and backshore areas where Silky Beach Pea was not found. Some of the circles indicate multiple areas, owing to the scale of the map.

HABITAT

Habitat Requirements

Silky Beach Pea is restricted to rapidly drained dunes, sand plains and sandy beaches along the shores of the Pacific Ocean (Hitchcock and Cronquist 1973; Isely 1993; Douglas *et al*. 1999). Within its Canadian range, winters are mild and hard frosts are rare.

Silky Beach Pea is intolerant of shading and the Canadian populations occur in open areas dominated by low grasses and forbs with little or no cover of native trees or shrubs (Fairbarns pers. obs). Page (2003) provides a useful classification of sand beach and dune ecosystems in coastal British Columbia. Fieldwork conducted for the purposes of this status report revealed that Silky Beach Pea occurs in two of the seven plant associations defined by Page: the Dune Bluegrass (*Poa macrantha*) Sparse Vegetation type and the Pacific Wormwood (*Artemisia campestris*) – Red Fescue (*Festuca rubra s.l.*) / Grey Rock Moss (*Racomitrium canescens*) Herbaceous Vegetation type.

Habitat Trends

A survey of managers, stewards, and biologists (Page *et al.* 2011) identified seven main threats to sand dune habitats (Figure 5) in coastal British Columbia:

1. invasive alien plants;
2. disruption to coastal sediment transport;
3. recreational activities;
4. coastal development;
5. climate change;
6. invasive introduced animals;
7. atmospheric nitrogen deposition.

Figure 5. Degraded habitat of Silky Beach Pea. Invasive shrubs such as Scotch Broom (background), trampling by hikers, and vehicle ruts have degraded many sites (Photo by M. Fairbarns, with permission).

Page *et al.* (2011) examined land cover change at six representative coastal sand ecosystems in B.C., using historical air photos They found a 50-90% decline in the areal extent of sparsely vegetated habitats (such as those favoured by Silky Beach Pea) since 1930. They surmised similar rates of decline for species and ecological communities at risk associated with such habitats.

BIOLOGY

Relatively little has been written about the biology of Silky Beach Pea. Except where otherwise specified, the information presented in the following section is based on unpublished notes made by M. Fairbarns between 2003 and 2010, in the course of field investigations of sand dune plants of coastal BC.

Life Cycle and Reproduction

The flowers of Silky Beach Pea may be pollinated by many species of bees (Gordon 2003; Nyoka 2004; Monroe 2010). Pollination tends to occur in May or June and seeds ripen in June or July. X-ray images revealed that approximately 95% of seeds collected from a subsample of Silky Beach Pea plants growing at Saanich Spit in 2004 had intact embryos and abundant endosperm (Figure 6). No information could be found on how long seeds of Silky Beach Pea may be banked in the soil but they can probably remain viable for many years, as has been noted for closely related species with hard seed coats (Burton and Burton 2003).

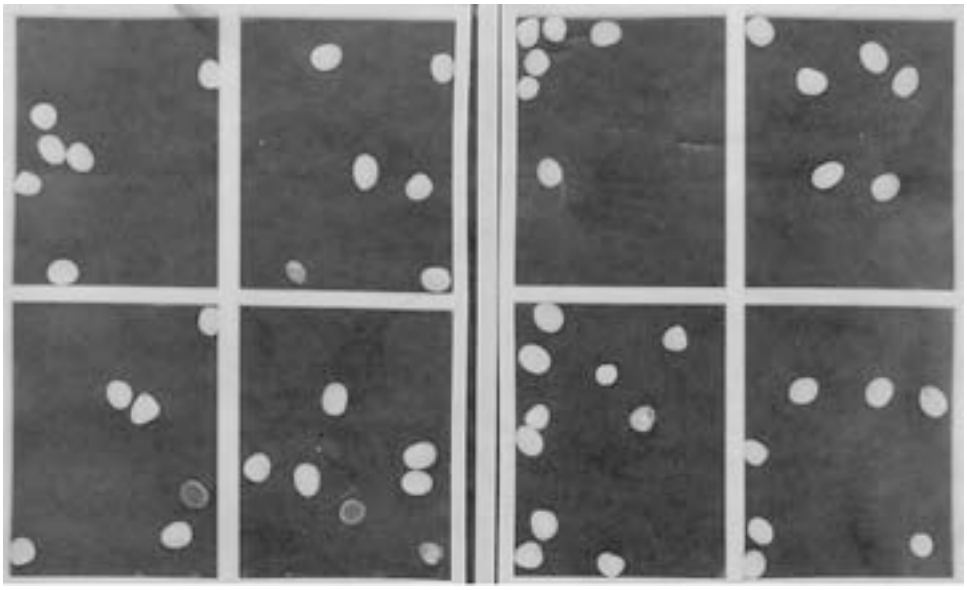

Figure 6. X-ray image of seeds of Silky Beach Pea. Images prepared by Robb Bennett and Matt Fairbarns. Seeds with bright white interiors have well-developed embryos and endosperm. Seeds with dark interiors are not viable.

Although Silky Beach Pea populations may increase through reproduction by seed, most shoots appear to be derived from rhizome expansion rather than seed germination.

The concept of “mature individual” is primarily a morphological consideration, and is essential in the determination of a species’ status because of “the effects of threats and demographic stochasticity to a small population” (IUCN 2011). The clonal nature of species such as Silky Beach Pea creates ambiguity regarding the definition of a mature individual.

IUCN (2011) provides the following guidance in determining what constitutes a mature individual in a species which shows modular growth, such as a rhizomatous plant.

“As a general rule, the ramet, (i.e., the smallest entity capable of both independent survival and [sexual or asexual] reproduction) should be considered a ‘mature individual’.” This approach presents a problem because a rhizomatous plant could be divided into increasingly small pieces until one is left with a single rooted shoot which is conceptually capable of independent survival. All rooted shoots are likely to survive such a process. The IUCN guidelines clearly state that “mature individuals that will never produce new recruits should not be counted”.

“In those cases where the organism appears in well-distinguishable units, each such unit would be counted as one mature individual. Examples may be a bryophyte tuft … or a lichen thallus”. This appears to contradict the previous instruction because individual shoots of a bryophyte tuft, and fragments of a lichen thallus, may be capable of independent survival and reproduction.

The IUCN (2011) guidelines provide examples of how to delineate mature individuals but there is no example given for rhizomatous plants. As a result, one must follow the general advice provided by IUCN (2011) “it is important to identify entities that are comparable in extinction proneness to discrete mature individuals of animals and other organisms”.

The rhizomes of many herbaceous plants produce both suppressed buds and buds from which arise annual shoots. The suppressed buds are more analogous to seeds than to mature individuals of non-clonal plants and therefore are not comparable in extinction proneness to mature individuals of non-clonal plants.

In contrast, if a bud produces an annual shoot that goes on to flower, and if the shoot is physically well separated from other flowering shoots produced by the same rhizome system, its extinction proneness is roughly analogous to that of a mature individual of a non-clonal species. Treating each flowering shoot as analogous to a mature individual of a non-clonal species will lead to an overestimate of effective population size and therefore the ability of a population to adapt to risk factors such as climate change and habitat alteration: see Tepedino 2012 for a fuller discussion. It is also possible for pathogens and toxins to be transmitted between flowering shoots through rhizomal connections (c.f. Parker 1987), increasing extinction risk.

Clumped annual shoots that are connected by short rhizomes, are functionally equivalent to clumps of bunchgrass or tufts of sedge and analogous to bryophyte tufts. The entire clump is comparable in extinction proneness to mature plants of a non-clonal species. Thus, even though it is true that most of the shoots within a tuft of grass may die yet the tuft survive, the entire tuft should be treated as a single mature individual. It remains a challenge determining what the threshold length should be used when determining whether or not annual shoots are separated by "long" rhizomes. Few non-clonal species of *Lathyrus* form individuals more than 1 m in diameter, so for the purposes of this report, shoots or clumps of shoots separated by over 1 m (where such information is available) are treated as separate individuals.

In cases where Silky Beach Pea forms large, fairly continuous patches rather than discrete isolated clumps of relatively few shoots, or where the number of discrete clumps has not been recorded, this report defines the term "mature individual" as a group of 25 flowering/non-flowering shoots. This proportion is based on an experiment by Pickard (1990) which found that only one in 25 rooted shoots survived when transplanted into suitable habitat. It is a conservative estimate and future investigations may suggest a higher proportion of shoots be counted as mature individuals; however, IUCN (2011) explicitly encourages the use of "plausible lower bounds[2], rather than best estimates, in determining the quantities used in the criteria".

The longevity of individuals plays an important role in assessing the status of many species under ranking criteria A, C1 and E. COSEWIC (2011) defines generation time as the average age of parents of a cohort (i.e., newborn individuals in the population). Generation time, therefore, can only be calculated after the term "individual" has been defined.

[2] I.e., in situations where the spread of plausible values (after excluding extreme or unlikely values) qualifies a taxon for two or more categories of threat, the precautionary approach would recommend that the taxon be listed under the higher (more threatened) category.

As previously noted, most individuals are produced from vegetative reproduction (rhizome expansion) rather than by sexual reproduction (seed germination, growth and maturation). As a result, the estimation of generation time is little affected by considerations of sexual reproduction. Regardless, it is worth noting that the process of sexual reproduction, calculated from when a seed is produced by a parent plant to when the plant finally becomes large enough to produce new individuals through sexual or asexual reproduction, is likely more than 10 years (factoring in the length of time the seed was banked in the soil).

Because the term “mature individual” has been defined as a clump of shoots (where discrete clumps are found) or 25 shoots (where there are large, continuous patches or the number of clumps has not been recorded), generation time is defined in this respect. There is no information on the average age of discrete clumps, or the average time it takes for a single shoot to give rise to a group of 25 annual shoots. Nevertheless, considering the species’ rhizomatous habit and the fact that patches of Silky Beach Pea tend to occur in the same places year after year, it is reasonable to conclude that the generation time for “individuals” derived from rhizomatous growth is at least one decade and perhaps much longer.

Physiology and Adaptability

As with many members of the pea family, Silky Beach Pea forms a symbiotic relationship with fast-growing soil bacteria (*Rhizobium* and related genera). These soil bacteria form nodules on the host roots where they fix nitrogen and thereby aid significantly in plant nutrition (Holton 1980). Such legume species tend to grow most vigorously if they have functioning nodules of nitrogen (N)-fixing bacteria. The soil is the natural habitat of N-fixing bacteria, but soil at many sites may not have either the proper kind of nodule-forming bacteria or enough of them (Adjei *et al.* 2006). Because coastal sand dunes are a nitrogen-poor environment (Kachi and Hirose 1983; Holton *et al.* 1991), nitrogen-fixation by nodules on Silky Beach Pea may provide a great competitive advantage.

The long rhizomes of Silky Beach Pea (Figure 7) allow it to adapt to annual patterns of erosion and deposition in sand dune environments. The shoots die back as the summer drought progresses, but it may sometimes resprout from the root crown with the arrival of autumn rains.

Figure 7. Partially excavated plants showing long rhizomes. (photo by M. Fairbarns, with permission).

Dispersal and Migration

The capsules of Silky Beach Pea dehisce in mid-summer, releasing small, sub-spherical, dense seeds. The seeds lack appendages to assist in dispersal and can often be found in abundance at the base of the parent shoot. Some seeds may be dispersed through the gut of small mammals; for instance, North American Deermice (*Peromyscus maniculatus*) are known to feed preferentially on the seeds of Silky Beach Pea (Pitts and Barbour 1979). Chemical scarification using sulphuric acid, which may mimic the effects of passage through an animal gut, is shown to greatly increase germination rates (Lemmon *et al.* 1943).

Rhizome fragments are most likely to be dislodged from parent populations during violent storms, which are most common during the winter months. The majority of small populations of Silky Beach Pea occur on beach areas below the storm tide line. Such habitat is more likely to be colonized by drifting rhizome fragments than by animal-dispersed seeds. Such small occurrences tend to be transient. For instance, Fairbarns failed to detect Silky Beach Pea during detailed surveys of rare beach plants on Sidney Island in 2005. In 2008, however, he discovered a compact patch of nine non-flowering shoots on an area of sandy beach that is over-washed by winter storm tides. It seems unlikely this patch was overlooked in the 2005 surveys, because a subpopulation of Yellow Sand-verbena (*Abronia latifolia*) less than 5 metres away had been mapped and counted at the time. Repeat visits in 2009 and 2010 failed to rediscover Silky Beach Pea at the site. It seems likely that the plants observed in 2005 had grown from a rhizome fragment derived from the Saanich Spit population, about 7 km away. Dispersal by long-shore currents carrying rhizome fragments also appears to explain the occurrence of small patches of Silky Beach Pea along beaches north of the main Oeanda River population (that area of coastline is characterized by strong north-trending long shore currents). Similarly, Page (pers. comm. 2011) concluded that small patches of Silky Beach Pea discovered on the beaches of Ahous Bay and Guise Bay were transient, because their habitats were regularly swept by winter storm tides. Most transient populations of Silky Beach Pea presumably fail to become established above the high tide line before being washed away.

Interspecific Interactions

Silky Beach Pea produces chemicals that may discourage invertebrate herbivory (Boyd 1991). Nevertheless, Ranchman's Tiger Moth, *Platyprepia virginalis*, has been found to feed preferentially upon Silky Beach Pea (Boyd 1991; Schmidt and Opler 2008). Deer may also feed heavily on Silky Beach Pea (see **Herbivory**).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Sampling methods and estimation of number of mature individuals were conducted as follows:

1. Wickaninnish Dunes

    a. 2006: 6,500-7,000 shoots. Estimated number of mature individuals (calculated by dividing the total number of shoots by 25) = 260-280.

b. 2010: the number of Silky Beach Pea shoots (flowering or non-flowering) occurring in dense patches was estimated by multiplying the area of the patch by the percent cover of Silky Beach Pea and dividing the value reflective of the average number of shoots per m^2 where the plants had 100% cover. Bellefleur (pers. comm. 2011) estimated the divisor to be 6.66 while Collyer (pers. comm. 2010) estimated the divisor to be 30. Accordingly, Bellefleur came up with an estimate of 6,568 shoots in the dense patches while Collyer provided an estimate of 1,487 shoots (based on the same patch data). Because the number of clumps in the dense patches was not counted, the estimated number of mature individuals calculated by dividing the total number of shoots by 25 (as explained above) = 59-262 in the dense patches; a further 29 clumps outside of the dense patches; total mature individuals = 88-291.
c. 2011: numbers much lower than in 2010 (Bellefleur pers. comm. 2011)

2. Rose Spit

    a. 2011, 2,000-5,000 flowering and non-flowering shoots, number of discrete clumps not recorded (Wijdeven pers. comm. 2011). Estimated number of mature individuals (calculated by dividing the total number of shoots by 25) = 80-200.

3. Tlell

    a. 2009, 4,000 – 5,000 flowering and non-flowering shoots, number of discrete clumps not recorded (Wijdeven 2009). Estimated number of mature individuals (calculated by dividing the total number of shoots by 25) = 160-200.
    b. 2011, only about ½ the number observed in 2009 = 80-100 (Wijdeven 2011).

4. Oeanda River

    a. 2009: 5 clumps (with a collective total of 58-108 shoots) (Wijdeven 2009).

5. Saanich Spit

    a. 2005, 2006: survey incomplete
    b. 2007: 100-200 clumps (Fairbarns)
    c. 2009: fewer than 100 clumps (Page)
    d. 2010: 1,250-1,300 shoots, number of clumps not counted (Fairbarns and Oldham). Estimated number of mature individuals (calculated by dividing the total number of shoots by 25) = 49-52
    e. 2011: 100-200 clumps (Costanzo)

6. Schooner Cove

    a. 2001: 23 clumps (Page 2011)
    b. 2006: survey incomplete
    c. 2010: 30-60 clumps (Fairbarns)

Abundance

The Canadian population of Silky Beach Pea is estimated as 325-956 mature individuals, the lower value representing the sum of lowest population estimates (2001-2011) and the upper value representing the sum of the highest population estimates over the same period (after excluding extirpated and transient populations) (Table 1).

Fluctuations and Trends

Populations at several sites appear to be transient (Table 1). There is not a sufficient record to determine trends in the persistent populations and there is no evidence of fluctuations of an order of magnitude in the persisting populations.

Rescue Effect

The nearest populations of Silky Beach Pea in the USA are 25 km south of those in B.C. on Waldron Island. Strong, year-round, northward-flowing currents are particularly well defined over the inner continental shelves of Vancouver Island (Thomson *et al.* 1989). This may allow for the occasional dispersal of propagules from source populations in Oregon and Washington north to recipient sites on Vancouver Island and northwards. The chances of rhizome fragments landing on suitable sites is, however, very low; potential recipient sites (coastal sand ecosystems) only occupy 245 ha along the west coast of Vancouver Island, where rescue is most likely to occur (Page *et al.* 2011). It thus appears that the potential for a rescue effect from outside Canada is negligible.

THREATS AND LIMITING FACTORS

Silky Beach Pea is threatened by five main factors: invasive alien plant species, off-road vehicle use, trampling, increased storm surges as a result of climate change, and herbivory. The scope, severity and timing of these threats are presented in Table 2.

Table 2. Summary matrix of main threats facing Silky Beach Pea[3]

Threat	Scope	Severity[4]	Timing
Invasive alien plants	Pervasive (threatens >70% of the Canadian population)	Serious (likely to seriously degrade the affected habitat)	High (threat is ongoing)
Off-road vehicles	Large (threatens 31-70% of the Canadian population)	Moderate (likely to moderately degrade the affected habitat)	High (threat is ongoing)
Trampling	Pervasive (threatens >70% of the Canadian population)	Slight (likely to only slightly degrade the affected populations)	High (threat is ongoing)
Storm surges	Pervasive (threatens >70% of the Canadian population)	Slight (likely to only slightly reduce the affected habitat)	High (threat is ongoing)
Herbivory	Large (threatens 31-70% of the Canadian population)	Slight (likely to only slightly reduce the affected populations)	High (threat is ongoing)

Invasive Alien Plants

Invasive alien plant species present the highest threat to the persistence of Silky Beach Pea in Canada, primarily European Beachgrass (*Ammophila arenaria*) and American Beachgrass (*A. breviligulata*). Both were introduced to the west coast of North America to help stabilize shorelines (Buell *et al.* 1995). The Pacific coast populations of European Beachgrass are derived from plants introduced from Australia in 1868 to stabilize sand dunes near San Francisco (Wiedemann 1998). American Beachgrass was first introduced on the Clatsop Peninsula in northern Oregon in 1935 and has spread northward since (Seabloom and Wiedemann 1994), although it was not reported in British Columbia until 2001 (Page 2001).

Both European and American Beachgrass reproduce strongly by vegetative means (Huiskes 1979; Maun 1984; Seabloom and Wiedemann 1994) and are well-adapted to long-distance dispersal as rhizome fragments floating along in coastal currents (Wallen 1980; Baye 1990; Seabloom and Wiedemann 1994). Almost 10% of the buds on rhizome fragments remain viable after 13 days submergence in seawater (Aptekar and Rejmánek 2000).

[3] Threats evaluated over the next 10 years
[4] Severity is difficult to estimate given the limited data available and should be treated with caution. Estimates of severity provided in Table 2 may be low.

European Beachgrass and American Beachgrass have rapidly colonized beaches along the west coast of British Columbia. They are more vigorous and have broader habitat tolerances than Silky Beach Pea, which may explain why they are more successful colonizers. Because of their superior sand-binding abilities, non-native beachgrasses accumulate sand more rapidly than their native counterpart, Dune Wildrye (*Leymus mollis*). As a result the invasive alien beachgrasses create higher, steeper foredunes and decrease sand flow to interior dunes. The solid front presented by expanding patches of invasive alien beachgrasses leads to the creation of near-monocultures that displace entire native plant communities, while inland areas where the sand supply has been choked off experience a shift from dynamic dune ecosystems to stabilized plant communities (Wiedemann and Pickart 1996).

Kuromoto (1965) described European Beachgrass-dominated plant communities as relatively rare in the area of the Wickaninnish Dunes, but Page (2003) noted that the species has become quite common there and in many other sites along the outer coast of Vancouver Island. European Beachgrass is also abundant at Saanich Spit and Schooner Cove and has been present at Tlell at least since 1970 (Wijdeven pers. comm. 2011). In consequence, at Canadian dunes sites that have been invaded by exotic beach grasses there has been a major loss of suitable habitat for Silky Beach Pea both on the foredunes and among the interior dunes.

Based upon the rapid spread of European Beachgrass and its success in forming monocultures where it becomes established along the west coast of British Columbia, it appears likely that European Beachgrass may form dense near-monocultures throughout the Canadian range of Silky Beach Pea over the next 10-30 years. It is less clear whether American Beachgrass will be able to dominate sand habitats in the northern portion of the Canadian range of Silky Beach Pea (where it has not yet been reported), although it already poses a serious threat along the west coast of Vancouver Island (Fairbarns pers. obs. 2006-2010).

Off-road Vehicles

Off-road vehicles (trucks and ATVs) are legally permitted on the North Beach and East Beach of Graham Island (Haida Gwaii) including portions of Naikoon Provincial Park. This impacts transient/extirpated populations at Tow Hill, Kliki Creek, Sangan River, and Oeanda River. Off-road vehicle use, however, is discouraged in dune areas through the use of signage and periodic monitoring. The Tlell population, which occurs adjacent to the Misty Meadows campground of Naikoon Provincial Park, is subject to ATV use (Wijdeven 2010).

Vehicle traffic is allowed in the vicinity of Saanich Spit and the area is greatly affected by tire ruts. The road leading to the northern site at Saanich Spit was gated in 2008, which has reduced, though not eliminated, vehicle damage to the sand dune habitat where Silky Beach Pea occurs.

Heavy-duty equipment is being used to excavate soil and thereby remove weedy grasses from the dunes at Wickaninnish. A small number (<20) of shoots of Silky Beach Pea were removed in the process (Bellefleur pers. comm. 2011).

Trampling

Populations of Silky Beach Pea at Rose Spit, Oeanda River, Tlell, Schooner Cove, Wickaninnish Dunes, Saanich Spit and Savary Island (now presumed extirpated) are subject to various levels of trampling by hikers. The impacts are probably most severe at Tlell, Saanich Spit, and Savary Island, all of which receive moderate to heavy visitor use. The Rose Spit and Wickaninnish Dunes populations receive intermediate levels of trampling, while impacts are light at Schooner Cove and Oeanda River due to infrequent visitation.

Storm Surges

Storm surges are temporary increases in sea level, above the level of the tide, caused by strong winds. Climate change is anticipated to cause increased storm frequency and intensity, and higher sea levels, which will exacerbate storm surges (Houghton *et al.* 1996; Lowe and Gregory 2005).

Winter storm surges wash up to, and occasionally overtop, natural sand berms, which tend to mark the transition from beach to upland habitats. Such storm surges may erode, transport and redeposit large amounts of sand and may be expected to uproot any Silky Beach Pea plants occurring below the berm. When the storm surges succeed in overriding the berms this may transport rhizome fragments into stable areas above the normal reach of storm tides but such events are infrequent. It is believed that such events may lead to the establishment of persistent populations above the storm tide line. This is reflected in the fact that at most sites where Silky Beach Pea has been found on beaches, it does not occur above the berm. Winter storm surges also move vast amounts of woody debris across beaches (Heathfield and Walker 2011). The woody debris scours the beaches, further lessening the likelihood those Silky Beach Pea plants growing on beaches will survive over winter. Violent storm surges, of the sort which may carry rhizome fragments above the berm, also tend to carry large amounts of wood into the same depositional sites, which reduces the likelihood that Silky Beach Pea can become established above the berm (Fairbarns pers. obs. 2006-2011). Figure 8, for example, shows an area of beach and backshore that had been virtually free of driftwood the previous summer but was overridden by materials deposited in winter storm surges.

Figure 8. Wood carried above the beach berm by winter storm surges. Note that the majority of the stems have saw-cut ends, which increases their scouring ability as they become “rolling pins” in winter storm events (photo by M. Fairbarns, with permission).

Large woody debris, in combination with vegetation colonization, promotes dune stabilization (Heathfield and Walker 2011). This leads to a loss of open sand habitats where Silky Beach Pea can persist.

Sea Level Rise

Sea level rises are anticipated in response to continued global climate change, as a result of the melting of continental glaciers and ice caps (Miller and Douglas 2004) and the temperature- and salinity-driven expansion of waters in the upper ocean. Sea level rises will vary regionally in response to local effects, including tidal patterns, weather patterns and geological factors such as post-glacial rebound, tectonic processes and river delta subsidence. Extreme weather events such as storm surges will intensify the effects of rising sea levels, particularly in areas where coastal erosion is already an issue (Bornhold 2008).

BC Parks has mapped the vulnerability of coastal environments to sea level rising according to five categories (very high, high, medium, low and very low). The vulnerability of sites where Silky Beach Pea occurs varies considerably, for example, ranking as very high (at Sidney Spit), high to very high (at Tlell), high (at Wickaninnish Beach) or medium (at Schooner Cove) (Woods pers. comm. 2012).

Herbivory

Sitka Deer (*Odocoileus hemionas sitkensis*) were introduced to Haida Gwaii in the late 1800s and have become over-abundant throughout the much of the archipelago (Carl and Guiguet 1972). Deer-browsing has led to a dramatic decline in the cover and abundance of most plants (Gaston *et al*. 2006), to the point where forest understories may be reduced to a simple cover of bryophytes (Daufresne and Martin 1997). Calder and Taylor (1968) observed that on Haida Gwaii, Silky Beach Pea was heavily browsed by deer and rarely flowered or developed seed pods. Sidney Island has a large population of non-native Fallow Deer (*Dama dama*) that have greatly reduced plant cover and biomass (Moody *et al.* 1994). Heavy grazing there may have reduced or eliminated populations of Silky Beach Pea, which formerly occurred on the island. Silky Beach Pea was seen by park naturalists in the 1980s to be heavily grazed by Fallow Deer on Sidney Spit (D. Fraser pers. comm. 2013).

Although Ranchman's Tiger Moth (native to North America) uses Silky Beach Pea as a larval food plant, its populations may be sustained at unnaturally high levels due to the abundance of European Searocket (*Cakile maritima*) (Boyd 1991). The later introduced species is abundant on sandy coastal beaches in BC. This may cause higher levels of herbivory on Silky Beach Pea than might be expected in the absence of European Searocket.

Defining Location

Six well-established populations were observed during the 2011 survey. The Saanich Spit population consists of two subpopulations each facing the same suite of threats, and therefore comprise a single location. The same is true for the Wickaninnish Dunes, Schooner Cove, and Tlell populations. There is no immediate observable threat that could plausibly affect most or all of the individuals in the Rose Spit population. The Oeanda River population includes individuals growing on the beach, where they may be subject to storm tides and vehicular traffic, as well as individuals growing above the storm tide line, where there are no serious plausible threats. As a result, there appear to be six locations in Canada.

PROTECTION, STATUS, AND RANKS

Legal Protection and Status

At the time of assessment in April 2013, none of the populations was protected under the

federal *Species at Risk Act* or provincial species at risk legislation (B.C. Conservation Data Centre 2011). The populations at Schooner Cove, Wickaninnish Dunes, and the apparently transient populations reported from Florencia Bay, Sandhills Creek, and Radar Beaches all occur/occurred within Pacific Rim National Park Reserve and are therefore afforded some measure of protection under general provisions of the *National Parks Act*. The apparently transient population at Sidney Spit occurred within Gulf Islands National Park reserve and was afforded similar protection. The populations at Tlell, Rose Spit and Oeanda River and the apparently transient populations reported from Kliki Creek and Sangan River all occur/occurred within Naikoon-Agate Beach and Misty Meadows Provincial Park. The apparently transient populations at Guise Bay and Tow Hill occurred in Cape Scott Provincial Park and Tow Hill Ecological Reserve respectively. The population which appears to have been extirpated from Ahous Bay occurred in an area now within Vargas Island Provincial Park. Populations in BC provincial parks and ecological reserves are therefore afforded some protection under the general provisions of the *BC Parks Act*. A portion of the population on Saanich Spit occurs within Cordova Spit Municipal Park (Municipality of Central Saanich).

Non-Legal Status and Ranks

Silky Beach Pea has recently had its global status reviewed by NatureServe as G3G4 (globally vulnerable to apparently secure) (Francis pers. comm. 2013). In Canada it has been assessed nationally as N2 (imperilled), and S2 (imperilled) in British Columbia (NatureServe 2010). It is a priority 2 species under the BC Conservation Framework (Goal 3: maintain the diversity of native species and ecosystems) and is included on the British Columbia Red List, which consists of species assessed as endangered, threatened or extirpated based on available information. Inclusion on the Red List does not confer any legal protection (B.C. Conservation Data Centre 2011). Silky Beach Pea occurs in Washington, Oregon and California. Washington and Oregon are reviewing their conservation ranks as the species is currently not ranked in those jurisdictions. California has provided a provisional state rank of S3S4 (vulnerable to apparently secure) (Lazar pers. comm. 2012). It has been ranked N3N4 (vulnerable to apparently secure) nationally in the USA (Francis, pers. comm. 2013).

Silky Beach Pea has a General Status Canada Rank of 2 (May Be at Risk) (Canadian Endangered Species Conservation Council 2011).

Habitat Protection and Ownership

The population reported from Savary Island appears to have occurred on private land, although in the absence of precise information on its occurrence, this cannot be confirmed. The population which appears to have been extirpated from Stubbs Island was on private land. Although the last reported site for the population at Ahous Bay was on lands now within a provincial park, the population may have once extended onto an Indian Reserve. A portion of the population at Saanich Spit occurs on an Indian Reserve.

The rest of the extant extirpated and transient populations occur on National Park Reserve land, and on BC Provincial Parks or Ecological Reserves (see **Legal Protection and Status**).

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Authorities Consulted

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INFORMATION SOURCES

Adjei, M.B., K.H. Quesenberry, and C.C. Chambliss. 2006 Nitrogen fixation and inoculation of forage legumes, Florida Cooperative Extension Service, Agronomy Department. Publication #SS-AGR-56.

Aptekar, R., and M. Rejmánek. 2000. The effect of sea-water submergence on rhizome bud viability of the introduced *Ammophila arenaria* and the native *Leymus mollis* in California. Journal of Coastal Conservation 6:107-111.

Baye, P.R. 1990. Comparative growth responses and population ecology of European and American beachgrass (*Ammophila* spp.) in relation to sand accretion and salinity. Ph.D. dissertation. University of Western Ontario, London, Ontario, Canada.

B.C. Conservation Data Centre. 2011. BC Species and Ecosystems Explorer. B.C. Ministry of Environ. Victoria, B.C. Website: http://a100.gov.bc.ca/pub/eswp/ [accessed Feb 16, 2011].

Bellefleur, D. pers. comm. 2011. *Telephone conversation to M. Fairbarns*. October 17, 2011. Dune Restoration Biologist, Project Manager Pacific Rim National Park Reserve of Canada.

Bornhold, B.D. 2008. Projected sea level changes for British Columbia in the 21st century. BC Ministry of Environment. 12 pp.

Boyd, R.S. 1991. Larval feeding preferences of *Platyprepia guttata* Boisduval (Arctiidae) from beach habitat at Point Reyes National Seashore, California. Journal of the Lepidopterist Society 45:105-111. Website: http://peabody.research.yale.edu/jls/pdfs/1990s/1991/1991-45(2)105-Boyd.pdf [accessed: February 8, 2011].

Buell, A.C., A.J. Pickart, and J.D. Stuart. 1995. Introduction history and invasion patterns of *Ammophila arenaria* on the north coast of California. Conservation Biology 9:1587-1593.

Burton, C.M., and P.J. Burton. 2003. A Manual for Growing and Using Seed From Herbaceous Plants Native to the Interior of Northern British Columbia. Symbios Research & Restoration, Smithers, B.C. 168 p.

Calder, J.A., and R.L. Taylor. 1968. Flora of the Queen Charlotte Islands. 2 vols. Queens Printer. Ottawa.

Calflora: Information on California plants for education, research and conservation, based on data contributed by dozens of public and private institutions and individuals, including the Consortium of Calif. Herbaria. [web application]. 2011. Berkeley, California: The Calflora Database [a non-profit organization]. Website: http://www.calflora.org/ [accessed: Feb 11, 2011).

Canadian Endangered Species Conservation Council. 2011. Wild Species 2010: The General Status of Species in Canada. Website: http://www.wildspecies.ca/home.cfm?lang=e [accessed: October 10, 2012].

Carl, G.C., and C.J. Guiguet. 1972. Alien animals in British Columbia. B.C. Prov. Mus., Victoria, BC. Handbook 14. 103 pp.

Collyer, M. pers. comm. 2010. *E-mail correspondence with M. Fairbarns via Danielle Bellefleur*. Parks Canada Agency. December 22, 2010.

COSEWIC 2011. Status report definitions and abbreviations. http://www.cosewic.gc.ca/eng/sct2/sct2_6_e.cfm [accessed: October 10, 2012).

Daufresne, T., and J.L. Martin. 1997. Changes in vegetation structure and diversity as a result of browsing by a large herbivore: The impact of introduced black tail deer in the primary forest of Haida Gwaii, British Columbia. Laskeek Bay Res. 7:2–26. Website: http://www.laskeekbay.org/docs/reports/old/Laskeek_Bay_Research_1996.pdf [accessed: February 11, 2011].

Douglas, G.W., D. Meidinger, and J. Pojar, eds. 1999. Illustrated Flora of British Columbia. Volume 3: Dicotyledons (Diapensiaceae through Onagraceae). B.C. Ministry of Environment, Lands & Parks and B.C. Ministry of Forests, Victoria. 423 pp.

Francis, A. pers. comm. 2013. *Email correspondence with B. Bennett. 20 February 2013*. Lead Botanist, NatureServe, Arlington, VA, USA.

Fraser, D.F. pers. comm. 2013. *Email correspondence with B. Bennett*. February 2013. Endangered Species Specialist, Ecosystem Branch, Conservation Planning Section. Ministry of Environment, Government of British Columbia.

Gaston, A.J., S.A. Stockton, and J.L. Smith. 2006. Species-area relationships and the impact of deer-browse in the complex phytogeography of the Haida Gwaii archipelago (Queen Charlotte Islands), British Columbia. Ecoscience 13(4): 511-522.

Gordon, D.M. 2003. Life history and nest biology of the mason bee *Osmia (Acanthosmioides) integra cresson* in coastal dunes (Hymenoptera: Megachilidae). The Pan-Pacific Entomologist 79: 45-53.

Heathfield, D.K. and I.J. Walker. 2011. Analysis of coastal dune dynamics, shoreline position, and large woody debris at Wickaninnish Bay, Pacific Rim National Park, British Columbia. Canadian Journal of Earth Sciences 48: 1185-1198.

Hitchcock, C.L., and A. Cronquist. 1973. Flora of the Pacific Northwest: An Illustrated Manual. University of Washington Press. 730 pp.

Holton, B., Jr. 1980. Some aspects of the nitrogen cycle in a northern Californian coastal dune-beach ecosystem, with emphasis on *Cakile maritima*. Journal Dissertation Abstracts International, B 1980 Vol. 41(3):805.

Holton, B., M.G. Barbour, and S.N. Martens. 1991. Some aspects of the nitrogen cycle in a California strand ecosystem. Madroño 38:170-184.

Houghton, J.T., *et al.*, eds., 1996. Climate Change 1995--the Science of Climate Change, Cambridge University Press, Cambridge, U.K., Chap. 7, Changes in Sea Level, pp. 359-405.

Huiskes, A.H.L. 1979. Biological flora of the British Isles: *Ammophila arenaria* (L.) Link. J. Ecology 67:363-382.

Isely, D. 1993. *Lathyrus*. pp. 610-614 In Hickman, J.C. (ed.) The Jepson Manual: Higher Plants of California. University of California Press. Berkeley. 1400 pp.

IUCN Standards and Petitions Subcommittee. 2011. Guidelines for Using the IUCN Red List Categories and Criteria. Version 9.0. Prepared by the Standards and Petitions Subcommittee. Downloadable from http://www.iucnredlist.org/documents/RedListGuidelines.pdf. [accessed: October 30, 2012].

Kachi, N., and T. Hirose. 1983. Limiting nutrients for plant growth in coastal sand dune soils. Ecology 71:937-944.

Kuramoto, R.T. 1965. Plant Associations and Succession in the Vegetation of the Sand Dunes of Long Beach, Vancouver Island. M.Sc. thesis, Department of Botany, University of British Columbia. 88 pp.

Lazar, K. pers. comm. 2013. *Email correspondence with B. Bennett. 20 February 2013*. Lead Botanist, California Natural Diversity Database, Department of Fish and Wildlife. Sacramento, CA, USA.

Lemmon, P.E., R.L. Brown, and W.E. Chapin. 1943. Sulfuric acid seed treatment of beach pea, *Lathyrus maritimus*, and silvery pea, *L. littoralis*, to increase germination, seedling establishment, and field stands. Journal of the American Society of Agronomy 35:177-191.

Lomer, F. pers. comm. 2009. *E-mail to M. Fairbarns. April 2009*. Research Associate, UBC Herbarium, University of British Columbia, Vancouver, BC.

Lowe, J.A. and J.M. Gregory. 2005. The effects of climate change on storm surges around the United Kingdom. Phil. Trans. R. Soc. A 363: 1313-1328.

Maun, M.A., 1984. Colonizing ability of *Ammophila breviligulata* through vegetative regeneration. J. Ecol. 72: 565-574.

Miller, L., and B.C. Douglas. 2004. Mass and volume contributions to twentieth-century global sea level rise. Nature 428: 406-409.

Moody, A., B. Burtin, and R. Moody. 1994. An investigation into the ecology of fallow deer of Sidney Spit Provincial Park. British Columbia Parks, Ministry of Environment Lands and Parks, Occasional Paper 1.

Moerman D. n.d. Native American Ethnobotany. A Database of Foods, Drugs, Dyes and Fibers of Native American Peoples, Derived from Plants. Website: http://herb.umd.umich.edu/ [accessed: November 18, 2009].

Monroe, J.V. 2010. Effects of resource availability on foraging trip duration in the silver bee, *Habropoda miserabilis*. Unpublished M.Sc. thesis. Humboldt State University. 42 pp. Website: http://humboldt-dspace.calstate.edu/xmlui/bitstream/handle/2148/593/Monroe_thesis.pdf?sequence=3 [accessed: February 10, 2011].

NatureServe. 2010. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Website: http://www.natureserve.org/explorer [accessed: February 16, 2011].

Nyoka, S.E. 2004. A Pictorial Guide to Bees of the Humboldt Bay Dunes, Humboldt Bay National Wildlife Refuge. Website: http://www.fws.gov/humboldtbay/beeguide/bumblebees_more.html [accessed February 16, 2011].

Page, N. 2001. *Ammophila breviligulata* (Poaceae) new to British Columbia. Botanical Electronic Newsletter No. 276. November 15, 2001. Website: http://www.ou.edu/cas/botany-micro/ben/ben276.html [accessed November 16, 2006].

Page, N. pers. comm. 2011. *Telephone conversation to M. Fairbarns*. March 10, 2009. Botanist, Raincoast Applied Ecology.

Page, N., P. Lilley, I.J. Walker and R.G. Vennesland. 2011. Status report on coastal sand ecosystems in British Columbia. Report prepared for the Coastal Sand Ecosystems Recovery Team. vii + 83 pp.

Page, N.A. 2003. Community and regional scale patterns of native and exotic plant species in sand beaches of Vancouver Island, British Columbia. Unpublished M.Sc. thesis in the Institute of Resources, Environment, and Sustainability, University of British Columbia. 79 pp.

Parker, M.A., 1987. Pathogen impact on sexual vs. asexual reproduction success in Arisaema triphyllum. Am. J. Botany 74: 1758-1763.

Pickart, A. 1988. Dune revegetation at Buhne Point. Fremontia 16(3):3-5.

Pickart, A.J. 1990. Dune revegetation at Buhne Point, King Salmon, California. In Environmental Restoration: Science and strategies for restoring the earth. J.J. Berger (ed.). Island Press. 412 pp.

Pickart, A.J. pers. comm. 2012. E-mail correspondence with M. Fairbarns. September 12, 2012.

Pitts, W.D. 1976. Plant/animal interaction in the beach and dunes of Point Reyes. Ph.D. Dissertation. University of California, Davis. 260 pp.

Pitts, W.D., and M.G. Barbour. 1979. The microdistribution and feeding preferences of *Peromyscus maniculatus* in the strand at Point Reyes National Seashore, California. American Midland Naturalist101: 38-48.

Schmidt, B.C., and P.A. Opler. 2008. Revised checklist of the tiger moths of the Continental United States. Zootaxa 1677: 1-23.

Seabloom, E.W., and A.M. Wiedemann. 1994. Distribution and effects of *Ammophila breviligulata* Fern. (American beachgrass) on the foredunes of the Washington coast. Journal of Coastal Research 10: 178-188.

Tepedino, V.J. 2012. Overestimating populations sizes of rare clonal plants. Conservation Biology 26(5): 945-947.

Thomson, R.E., Hickey, B.M., and LeBlond, P.H. 1989. The Vancouver Island coastal current: Fisheries barrier and conduit. In Effects of ocean variability on recruitment and an evaluation of parameters used in stock assessment models, Vol. 108. Edited by R.J. Beamish and G.A. McFarlane. Can. Spec. Publ. Fish. Aquat. Sci. pp. 265-296.

Wallen, B. 1980. Changes in structure and function of *Ammophila* during primary succession. Oikos 34:227-238.

Wiedemann, A. 1998. *Ammophila arenaria* (L.) Link (European Beachgrass, Marram Grass) on the northwest coast of North America. Botanical Electronic Newsletter No. 183. February 12, 1998.Website: http://www.ou.edu/cas/botany-micro/ben/ben183.html [accessed November 16, 2006].

Wiedemann, A. M., and A. Pickart. 1996. The *Ammophila* problem on the northwest coast of North America. Landscape and Urban Planning 34:287-299.

Wijdeven, B. 2010. Survey of Selected Haida Gwaii East Coast Dune Locations. Unpublished report to the Ecosystem Section, B.C. Ministry of Environment, Queen Charlotte City.

Wijdeven, B. pers. comm. 2011. *Telephone conversation to M. Fairbarns*. September, 2011. Species at Risk Biologist, B.C. Ministry of Environment, Queen Charlotte City.

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COLLECTIONS EXAMINED

The following collections were consulted:

- Royal BC Museum Herbarium (V)
- University of Victoria Herbarium (UVIC)
- University of British Columbia Herbarium (UBC)
- University of Washington Herbarium (WTU)
- Canadian Museum of Nature National Herbarium of Canada (CAN)