Sand Dune Ecosystems on Savary Island, B.C.
with particular reference to D.L. 1375

Prepared for the Savary Island Land Trust

by:

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Site Name: Savary Island, District Lot 1375

Site Location: NTS Map 92F/15
CHS Chart 3513
Lat. 49º 57'
Long. 124º 47’- 124º 49’

Site Visit Dates: March 11 – 12, 2000

Access: Access is via Lund Water Taxi from Lund to the Keefer Bay Government Dock on the north-east side of the island.

Background Data

Savary Island is located at the northern end of the Strait of Georgia, between 49º 56’ and 49º 57’ north latitude, and 124º 45’ and 124º 52’ west longitude (Figure 1). Savary Island is oriented east – west in the Strait, and is approximately 7.6 km in length, with a width ranging between 0.3 km and 1.5 km. Total area of the island is 450 hectares (1,111 acres). No permanent streams or rivers occur on the island.

Biogeoclimatic Unit

All of Savary Island lies within the Coastal Douglas-fir Zone, which because of its position in the rainshadow of Vancouver Island, has warm, dry summers and mild, wet winters (Green & Klinka 1994). The climate of Savary Island is typical of most of the Gulf Islands, with the greatest frequency and volume of precipitation occurring between October and January. Total annual precipitation averages around 1200 mm or less.

Throughout Savary Island, forests are dominated by Pseudotsuga menziesii (Douglas-fir) and Thuja plicata (western redcedar) on zonal sites. Abies grandis (Grand fir) regeneration was noted in many understorey areas where the soils are richer, while Acer macrophyllum (big-leaf maple) and western redcedar is more common on fresh soils. Arbutus menziesii is indicative of drier exposed coastal sites where many large trees were noted. Taxus brevifolia (Western yew) is found throughout the island in the forest understorey, and several very large trees were noted along the main road. Tsuga heterophylla (Western hemlock) is on Savary Island, although it is restricted to a few moist sites where it forms a minor component of the sub-canopy layer.

Understorey shrubs include salal (Gaultheria shallon), oregon grape (Mahonia spp.), oceanspray (Holodiscus discolor), baldhip rose (Rosa gymnocarpa), salmonberry (Rubus spectabilis), trailing blackberry (Rubus ursinus), snowberry (Symphoricarpos albus), red huckleberry (Vaccinium parvifolium), and evergreen huckleberry (Vaccinium ovatum). Herbs are diverse and are listed by broad forest type in Geall (1996).
Figure 1. Location of Savary Island in the Strait of Georgia
Major Geographic Features

Savary Island consists of two high plateaus at its eastern and western ends, which are joined by a lower saddle at mid-island. This saddle consists of a sand plain and dune field located between Beacon Point and Whalebone Point. Near Garnet Point in the east, elevations reach 50 metres a.s.l., and a similar elevation is found on the western side of the island, about mid-way between DL 1375 and Indian Point.

**Indian Point**

The western end of the island is known as Indian Point, which is a sand spit of about 15 hectares extending about 0.5 km from the western plateau (Bornhold et al. 1996). The mostly vegetated spit has formed from the reworking and slow accretion of Quadra Sands eroding from the 50 m high bluffs along the southern shore. Beach sand sediments are transported westward into Manson Passage (between Savary Island and Hernando Island) by longshore currents, some of which are accreted onto Indian Point. Indian Point was not visited during the March 11-12 visit. Historical records suggest that the beaches and herb-rich dune meadows in the area are of botanical interest and should be examined for species such as *Abronia* spp., *Amsinckia spectabilis*, and *Camissonia contorta*. The grasses of Savary Island have been very overlooked to date, and further fieldwork may turn up species such as *Agrostis pallens*, *Poa confinis*, and *Vulpia microstachys*.

**Green’s Point**

The eastern end of Savary Island is known locally as “Green’s Point”, but is charted as Mace Point. The only outcropping bedrock on Savary Island is located at Green’s Point, where it forms a 3.6 hectares (9 acre) windswept coastal bluff headland supporting a diversity of plant species. The bedrock is described as a granodiorite (tonalite) with exposed late basaltic dykes. Vernal pools and seepages were noted on March 12, 2000.

A small stand (~ 5 plants, 2 to 3 metres in height) of Garry Oak (*Quercus garryana*) was located on a north-facing ledge of Green’s Point on March 12, 2000. Visible plants occurring with the oaks were *Holodiscus discolor*, *Symphoricarpos albus*, *Ribes sanguineum*, *Gaultheria shallon*, *Mahonia nervosa*, *Pteridium aquilinum* and *Sanicula crassicaulis*. The overstorey above the ledge consists of an older *Pseudotsuga menziesii* – *Arbutus menziesii* forest. This population appears to be a northern range extension for *Quercus garryana*.

![Photo 1. *Quercus garryana* at Green’s Point.](image_url)
**Middle of Island/DL 1375**

Between the eastern and western extremities of Savary Island are a series of forested dune ridges and sand dune ecosystems of varying ages. With the exception of DL 1375 in the centre of the island, this area has been subdivided into many small lots and the dune profiles found outside DL 1375 have long been disturbed by cottage development. Most of the dunes and dune meadows have been preserved since first being documented in the late 1800’s to early 1900’s by a local botanist and naturalist, R.S. Sherman. A draft manuscript (c.1931) prepared by Sherman provides a historical reference point for understanding the ecology of Savary Island, and summarises his findings based on visits to the island beginning in 1892.

Where the sands are more active on the south shore, a pioneer community of plant species that tolerates sand burial has been noted. Principle species documented over the years include *Carex macrocephala*, *Poa douglasii* ssp. *macrantha*, *Calystegia soldanella*, *Grindelia integrifolia* and *Lathyrus littoralis*. Several of these species are restricted to relatively few sites in coastal British Columbia because of their specific habitat requirements.

Of botanical interest is the dune meadow communities that have become established where the southern shoreline has stabilised on gentle slopes. Several of these generally undisturbed meadows occur on DL 1375, and others are found further west towards Indian Point.

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*Photo 2. Dune Meadows on DL 1375. Note the first and youngest dune ridge with the Shore Pine – Salal Forest on the left.*
Straley et al. (1985) report herbarium records from Savary Island for the following species:

- **Allotropa virgata** (Candystick)
- **Boschniaka hookeri** (Vancouver groundcone)
- **Carex macrocephala** (Big-headed sedge)
- **Claytonia spathulata** (Pale spring beauty)
- **Lotus micranthus** (Small-flowered bird’s-foot trefoil)
- **Lupinus bicolor** (Bi-coloured lupine)

**Lupinus littoralis** (Chinook lupine)

**Trifolium bifidum** (Pinhole clover)

**Trifolium microcephalum** (Small-headed clover)

**Trifolium oliganthum** (Few-flowered clover)

**Trifolium tridentatum** (Tomcat clover)

**Trifolium variegatum** (White-tipped clover)

A search of the UBC Herbarium turned up the following records from Savary Island:

**Convolvulus (Calystegia) soldanella**
Savary Island, 1912, 1920 (“sandy bluff, south side”)

**Carex macrocephala**
Savary Island, 1912

**Lupinus littoralis**
Savary Island, 1913, 1913

**Lathyrus japonicus**
Savary, 1911, 1913

**Ambrosia chamissonis**
Savary, 1913

**Trifolium microcephalum**
no UBC records

**Trifolium oliganthum**
Savary, 1913, 1914, 1914, 1914

**Trifolium bifidum**
no UBC records

**Lotus micranthus**
Savary, 1914

**Allotropa virgata**
Savary, 1914, 1918

**Orobanche californica**
Savary, 1937

**Boschniaka hookeri**
Savary, 1919

Some of these species are well-known and recorded from Savary Island today, while others will require re-location. A search of other herbaria will likely reveal further records for those species known, but not in the UBC collection. In addition to the above lists, a number of other less common species are recorded from Savary Island. Geall (1996) has synthesised the records of various local field naturalists and notes the following species from the dunes and dune meadows:

**Achillea millefolium** (Yarrow)

**Grindelia integrifolia** (Gumweed)

**Allium acuminatum** (Hooker’s onion)

**Lomatium nudicaule** (Indian consumption plant)

**Allium cernuum** (Nodding onion)

**Lotus micranthus** (Small-flowered lotus)

**Anaphilis margaritaceae** (Pearly everlasting)

**Lupinus bicolor** (Bi-coloured lupine)

**Aster subspicatus** (Douglas’ aster)

**Lupinus littoralis** (Chinook lupine)

**Boschniaka hookeri** (Poque)

**Microsteris gracilis** (Pink microsteris)

**Brodiaea coronaria** (Harvest brodiaea)

**Orobanche californica** (California broomrape)

**Brodiaea hyacinthine** (Fool’s onion)

**Orobanche fasciculate** (Clustered broomrape)

**Calystegia soldanella** (Beach morning glory)

**Plectritis congesta** (Sea blush)

**Collinsia parviflora** (Blue-eyed mary)

**Pteridium aquilinum** (Bracken)

**Dodecatheon hendersonii** (Broad-leaved shooting-star)

**Ranunculus occidentalis** (Western buttercup)

**Epilobium angustifolium** (Fireweed)

**Sisyrinchium littorale** (Shore blue-eyed grass)

**Eriophyllum lanatum** (Oregon sunshine)

**Solidago canadensis** (Canada goldenrod)

**Fragaria chiloensis** (Coastal strawberry)

**Viola adunca** (Early blue violet)

**Fritillaria lanceolata** (Chocolate lily)

**Zygadenus venenosus** (Death camas)
Site Description

DL 1375, and several adjoining smaller parcels (“the property”) comprise an undeveloped 137 hectare (339 acres) property occupying the central portion of Savary Island, between Whalebone Point Bay and Beacon Point (Figure 2). In overall area, the property covers one third of the land base of Savary Island. The property extends from the southern shore through to the northern shore of the island, with an average width of approximately 0.75 km. The highest point is approximately 30.0 metres a.s.l. The main cross-island road bisects the property, following the contours between dune ridges. This road is not surfaced and is only occasionally graded. A recently closed gravel airstrip is located on the sand plain in the north-east-quadrant of the property, and is aligned along a NW-SE axis between Whalebone Point and Second Point. Broom (*Cytisus scoparius*) has invaded the cleared spaces around the airstrip. A few hiking trails provide access to the interior dunes and beaches.

Geology and Geomorphology

The property contains intact examples of the landforms and surficial geology that display the history of the late-Quaternary Period to approximately 30,000 years before present (BP). The oldest Quaternary glacio-fluvial sediments are buried below sea level, and consist of deposits of the Cowichan Head Formation that overlay glacial-marine sediments of Semiahmoo Drifts (Clague 1977). These layers of plant-bearing silt, sand and gravel were deposited during the retreat of the Semiahmoo Glaciation in a period known as the Olympia Non-Glacial Interval, which began around 60,000 BP and lasted until 25,000 BP (Figure 3). Bedding this oldest deposit is a clay layer pre-dating 60,000 BP.

Quadra Sands were deposited as outwash in front of the advancing glaciers of the Fraser Glaciation, between 26,000 and 29,000 BP. At that time, the Strait of Georgia was an extensive floodplain. The sands are composed of grains of plagioclase, quartz and hornblende, with origins in the mainland Coast Range. Other sediments include silts and clays that occur in the lower horizons. The maximum exposed thickness of Quadra Sands has been found to be 75 metres. On DL 1375, a distinct clay layer is found within the Quadra Sands at depths 10 to 15 metres below the soil surface. This impermeable layer traps groundwater that is used as a water supply on the island, and on DL 1375, form an important aquifer for the island. The clay layer is visible along exposed shoreline cliff faces, and in places groundwater can be seen seeping over the top. Within the Quadra Sands, a piece of buried tree has been recently exposed in the sediments about halfway down the cliff on the north side of the island (Photo 3).

The Fraser Glaciation began about 25,000 BP and lasted until the glaciers retreated for a final time between 13,000 and 11,000 years ago. As the ice melted, rock debris and sediments dropped out as a discontinuous and variable-depth layer of till (Vashon Drift) the island. Vashon Drift consists of silty clay with variable amounts of gravel, cobbles and boulders. Bornhold *et al.* (1996) note that most of the boulders and gravel found on the beaches are derived from eroding layers of Vashon Drift. The Vashon Drift layer is quite extensive through DL 1375, with the greatest depths occurring under the dunes on the western side of the property.

Over the past 10,000 years, aeolian activity around Savary Island has resulted in the formation of sand dunes that now overly the Vashon Drift layer in DL 1375. Sand dunes form only when there is a supply of sand to be blown onshore, and steady onshore winds to blow it. Shallow beaches of fine sands, exposed by a large tidal range that gives time for the sand to dry out and become airborne, are ideal.

Dune formation occurs through a process known as saltation, where wind turbulence picks up particles and skips or bounces them to a new location in the prevailing direction. Saltation results in more and more sand grains being moved inland. As well as saltation, a process known as surface creep also moves sand inland. Surface creep occurs when a descending grain strikes a larger grain. The larger grain is too big to bounce into the air, and instead creeps forward on the ground. Less sand moves inland with surface creep than with saltation, but the process of particle sorting occurs as the sand moves. Small grains go further and more quickly downwind, while the larger grains travel shorter distances at a slower rate.
Figure 2. Location of D.L. 1375 and Subdivision Pattern on Savary Island
Figure 3. Pleistocene Deposits That Form Savary Island.

Photo 3. Quadra Sands on the north shore cliff showing exposed buried tree and sediment strata.
Given wind and a sand supply, sand will move inland. Dunes however, only form if something then gets in the way of this movement and creates a barrier upon which sand will accumulate to the height of the barrier. The formation of large, permanent dunes requires the addition of vegetation. Vegetation forms an obstruction that keeps on growing, being buried, re-establishing, and ultimately stabilizing the dune.

As new dune ridges form, the older ridges change due to the influence of the wind. Wind speed is high on the windward side, and lower on the leeward side of a dune ridge. Wind speed is then high again in the trough between two ridges. The results of this activity are:

1. As the dune grows, wind speed at the dune crest increases. Eventually the dune can grow no higher because the wind speed is high enough to prevent further sand deposition. The dune then stabilises and reaches its angle-of-repose.

2. Sand is taken from the windward side of the dune and deposited on the leeward side. Over time the whole dune is rolled over and moves inland until obstructed by a new barrier.

3. The wind scourates the sand between the dune ridges and forms a trough. Scouring lasts until damp sand is reached near the water table. The damper areas are known as dune slacks, and become vegetated with moisture seeking plants (Photo 4.)

4. Environmental conditions that arise from dune creation have a major influence on plant species distribution at the micro-site level.

Typically, coastal dunes lie transverse to the direction of prevailing winds. On DL 1375, the dunes trend NW-SE, in parallel alignment with the dominant wind direction (Figure 4). This suggests that sometime over the past 10,000 years the prevailing wind direction changed from the south-west to the south-east.

This anomaly is interesting, and worth further research and exploration by a Quaternary geology research specialist. During a telephone discussion (29 March 2000) with Dr. John Clague of the Department of Earth Sciences, Simon Fraser University we explored several hypotheses for the dune alignment, and he will give the problem more attention if loaned a set of air photos and maps.

Photo 4. Dune Slack behind first dune ridge. DL 1375.
Figure 4. Contour Map of DL 1375 Showing Major Dune Series.
**Ecology**

Several outstanding natural (earth and life science) features are found on DL 1375, which are ecologically unique in the Strait of Georgia, and possibly the Province. In most dune ecosystems, succession is traced geographically, through time and space. For example, the youngest stages occur on the shore and the oldest are found furthest away. The property provides one of the best examples of the geography of coastal dune ecosystems in Canada. Along with the dunes is a unique, complete, and therefore very rare, plant successional sequence: beach, beach strand, foredune, dune meadow, young dune forest and older forest.

The dune system sequence is best observed by traversing the property from south to north (See Figure 5). At the back of the open beach, seaweed and debris has accumulated along the strand, which supports the two halophytic species, *Cakile edentula* and *Atriplex patula*. Behind the strand, a narrow foredune has formed and is being stabilized by dune building species such as *Elymus* (*Leymus*) *mollis*, *Poa douglasii* ssp. *macrantha*, *Calystegia soldanella*, *Ambrosia chamissonis*, and *Lathyrus japonicus*.

Where the shoreline slopes gently to the beach, the first dune ridge forms open dune meadow communities in several places. Previous inventory work (beginning with R.S. Sherman in the early 1900’s; Geall 1996) has resulted in the documentation of a rich assemblage of herbaceous species and grasses. No flowering plants were recorded during the March 11 – 12, 2000 site visit, but various members of the *Liliaceae* and other species were beginning to emerge through the grass and moss layers. Behind the Beacon Point meadows, shifting sands have buried an older forest. The tops of several large Douglas-fir trees are still alive, and are exposed near the highest elevation of the dune ridge.

The oldest dunes form an inland forested parallel ridge and trough ecosystem complex. The ridge and trough complex supports a unique Shore Pine – Salal forest community (*Pinus contorta* var. *contorta* – *Gaultheria shallon*) on the ridges (Photo 5). A mature Douglas-fir - Salal – Evergreen huckleberry community is found in the troughs (*Pseudotsuga menziesii* - *Gaultheria shallon* – *Vaccinium ovatum*) and on the older dune ridges. Further research is required to determine whether the ridge community is a late successional stage that will eventually be replaced by a Douglas-fir – Salal forest (*Pseudotsuga menziesii* – *Gaultheria shallon*).

![Figure 5. Dune Succession Sequence.](image-url)
Photo 5. Shore Pine – Salal Forest on Young Dune Ridge
Comments and Recommendations

Comparative Sites:

1. A similar ridge and trough ecosystem is found in Ontario at Point Pelee National Park, but prior to park acquisition was subjected to several hundred years of disturbance including road and trail construction, farming, and cottage development (Dunster 1990, 1992). It is now reduced to only a few intact hectares. DL 1375 is relatively undisturbed in comparison, with just a few informal trails and the one main road. The low year-round population (60 residents) and lack of good protected moorage on the island has helped minimise casual visitors that might not be aware of the fragility of the dunes.

2. The dune vegetation on DL 1375 is similar to that found much further south on the Oregon coast at the Sand Lake Dune System near Cape Lookout, between 45º 15’ and 45º 20’ (Franklin & Dyrness 1987; Wiedemann 1990). There, the successional pathway on stabilised dry to moist sandy soils leads from a grass/herb meadow dominated by Festuca rubra – Lupinus littoralis, to a shrub stage of Gaultheria shallon – Vaccinium ovatum. The shrub community is then replaced by a seral forest of Pinus contorta – Rhododendron macrophyllum that is eventually succeeded by a terminal forest of Pseudotsuga menziesii – Tsuga heterophylla – Rhododendron macrophyllum.

3. Within the SEI Study Area for Southern Vancouver Island and Adjacent Gulf Islands, there are no comparable sites to those found on DL 1375. Within the 4,121 km² SEI Study Area, less than 50 hectares of dune ecosystems were mapped, and most of these dunes consisted of young and developing foredunes. A full sequence of dune succession occurs on DL1375. Given the unprotected status of the property, it is extraordinary that these ecosystems have survived relatively intact up to this point in time.

Given the above three points, protection of this property as an ecological reserve or nature reserve would be the most appropriate conservation tool to ensure that the values and features discussed above and below are preserved.

Values and Features In Need of Protection:

1. **Earth Science Features:** Sand Dunes.

The fragile nature of the dunes and their associated plant communities dictates the desirability for maximum conservation protection. The sands are highly erodable, and are most sensitive to disturbance.

2. **Life Science Features:** Sand Dune Ecosystems.

DL 1375 contains the full representation of dune succession vegetation found on Savary Island, including excellent examples of the most rare dry forest plant associations that occur in the Coastal Douglas-fir BEC Zone.

3. **Rare Plant Species Habitat:**

Many rare dune plant species are known from Savary Island and DL 1375. The specific locations, population sizes and/or critical habitats of these rare species have not yet been fully mapped at a large scale, for site-specific management and planning purposes. Prior to any further work, whether for conservation or development, detailed mapping is required to ensure rare plants and their habitats are given maximum protection.
4. Rare Plant Associations:

Because there are so few dune ecosystems in coastal British Columbia, the plant associations found on them are generally considered to be rare, or red-listed. The Pinus contorta var. contorta – Gaultheria shallon (Shore Pine – Salal) plant association is unique to the Georgia Depression Ecoprovince, as is the Carex macrocephala – Poa douglasii ssp. macrantha (Big-headed sedge – Seashore bluegrass) plant association. The dune meadow plant associations have not yet been classified, but again are rare and vulnerable to disturbance.

5. Rare Invertebrates:

The open dune meadows and forested dune ridges are known to contain several plant species that are larval food plants for several rare butterfly species listed below. The presence, locations and/or critical habitats of these and other invertebrates are not yet determined. An invertebrate survey should be undertaken while the adult butterflies are known to be in flight to determine if they are present in DL 1375. Museum collections should be checked to identify other insect records for Savary Island, and fieldwork should be undertaken to re-locate and verify these species. R.S. Sherman, for example, is known to have collected Diptera specimens prior to 1931.

*Euphydryas editha taylori*  The Edith’s Checkerspot butterfly is found in open meadow habitat on Hornby Island. Adults are on the wing in April and May (Layberry *et al.* 1998). The larval food plant is Plantago spp. and an early nectar source is spring-gold (Crocidium multicaule). Alternate larval food plants are the paintbrush (Castilleja spp.), of which C. miniata is found on the cliffs and arbutus woodlands in DL 1375. Red-listed.

*Incisalia mossii mossii*  The Moss’ Elfin butterfly is usually found very close to its larval food - Sedum spp., and has a flight season from March to June (Layberry *et al.* 1998). Blue-listed.

*Icaricia icarioides blackmorei*  The Icarioides Blue butterfly is found in open clearings from mid-June to early September, where the larval food plant, Lupinus spp., is prevalent (Layberry *et al.* 1998). Two Lupinus spp. are found on DL 1375, L. bicolor and L. littoralis. Layberry et al. (1998) note that hairy lupines are preferred to less hairy species. Both species found on the property are hairy. Red-listed.

*Colias occidentalis*  The Western Sulphur butterfly is found in dry open Douglas-fir forests from late-May to early June. Larval food plants are legumes such as Vicia spp., Lathyrus spp., and Lupinus spp. (Layberry *et al.* 1998). Blue-listed.

**Conservation Options**

The fragility of dune ecosystems is well documented in the literature, as are the environmental disasters that occur when dunes are altered by construction and development, vegetation removal, trampling and excessive recreational usage.

A dune system is threatened when the supply of windblown (aeolian) sand is reduced or altered, when storm winds blow away the surface sand, when storm waves undercut the shoreline, and when vegetation is destroyed by trampling and other uses. The loss of vegetation from dunes leads to instability, erosion, blowouts, and property loss. The dunes of DL 1375 must be carefully conserved and managed to prevent such damage from happening in the future due to human misuse.

As more and more people are attracted to coastal areas such as Savary Island, the sand dunes will come under increasing pressure for development and recreational uses. However, the cost of development may well introduce hazards both on the property and elsewhere on the island (Bornhold *et al.* 1996). Because of its ecological sensitivity to disturbance, the property should be preserved primarily because of the vital
habitat it provides for a number of plant and animal species found only in sand dune environments. Additional values that favour the case for preservation include the high scientific research potential for the property, protection of hazard lands from development, and protection of an important drinking water aquifer.

Should acquisition by a conservation agency not be forthcoming, development should be restricted to the interior of DL 1375, in and around the airstrip site. In this area, the least amount of damage to the dunes will occur, providing conservation covenants are placed on the entire property to ensure that it is protected in perpetuity from destructive activities and land development practices.

Acknowledgements

My visit to Savary Island was at the invitation of the Savary Island Land Trust, who made arrangements for getting to and around the island, provided overnight accommodation, provided background documentation, and contributed important local knowledge about the island and its natural and cultural history. Thanks are also due to Karen Golinski and Nick Page for their help in checking records at the UBC Herbarium.
References


