KWEL NATURE RESERVE MANAGEMENT PLAN

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Approved by the Trust Fund Board
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PART I - INTRODUCTION

A. LEGAL DESCRIPTION AND OWNERSHIP

This document is a management plan for the Islands Trust Fund's Lasqueti Nature Reserve. The legal description of the property is PID: 023-486-877, Lot 1 and District Lot 111, Section 14, Lasqueti Island, Nanaimo District, Plan VIP 64302. The property is located at the northwest corner of Main Road and Tucker Bay Road on Lasqueti Island, and is approximately 21 hectares (52 acres) in area. The Lasqueti Nature Reserve property was donated to the Islands Trust Fund in 1997 by Amelia Humphries, a former resident of Lasqueti Island. In addition, the Land Conservancy of British Columbia and the Nanaimo and Area Land Stewards Society, will hold a Conservation Covenant on the property.

B. PURPOSE OF THIS REPORT

The purpose of this report is to describe the history, natural features, and ecological conditions and processes of the Lasqueti Nature Reserve, to provide a statement of the goal and objectives for the Reserve, to identify issues that may arise in management of the Reserve, and to recommend a management program designed to realize the goal and objectives.

C. THE ISLANDS TRUST FUND

The Islands Trust Fund is a conservation land trust established to preserve significant natural and cultural areas in the Islands Trust Area. The Islands Trust Fund is governed by a six member Trust Fund Board, which has the following threefold vision for its activities:

- ensuring that portions of the islands remain as natural, undisturbed lands and that important marine areas are also protected for the health and enjoyment of future generations;
- ensuring a mix of habitats is protected to provide for thriving plant, animal, bird, fish and marine life communities;
- ensuring the area's cultural identity is maintained.

The Trust Fund can acquire properties through donation or purchase and uses management plans to provide long-term direction and guidance for the management of properties it owns. The Trust Fund often works closely with local community groups to undertake the management of its nature reserves and sanctuaries.

D. GOAL AND OBJECTIVES FOR THE LASQUETI NATURE RESERVE

The following goal and objectives for the Lasqueti Nature Reserve were derived by a synthesis of statements from the following sources:

- Conservation Proposal submitted to the Islands Trust Fund by Amelia Humphries (donor of the property) in 1997;

- The Vision statement of the Trust Fund Board, adopted by the Board in 1997;
- The first draft Conservation Covenant prepared in July 1998;
- Consultation with members of the Lasqueti Island community; and
- Communication with Islands Trust Fund staff.

Goal

The goal for management of the Reserve is to protect the natural character of the site and provide a place for quiet contemplation and nature appreciation.

Objectives

The objectives for management of the Reserve are:

1. to allow natural ecological processes to function without human interference, except processes such as large-scale wildfire that may cause significant threat to humankind;
2. to protect the natural, scenic, and human restorative values of the site;
3. to ensure that permitted uses will not significantly impair the natural condition of the land or interfere with natural processes on the land; and
4. to allow minimal impact, non-consumptive human use of the Reserve related to contemplation and nature appreciation and nature study.

E. MAPS

Five maps are included with this report, found in Appendix 3. Map 1 shows the location of the property on Lasqueti Island. Maps 2 and 3 provide information on the ecological character of the Reserve. These maps are adapted from maps prepared in 1986 by Donald McLennan as part of an ecological inventory and management plan prepared for the previous owner. Map 2 shows Biogeoclimatic Site Types updated to be consistent with the site classifications currently used by the British Columbia Ministry of Forests (Green and Klinka 1994). Map 3 shows Vegetation Types. The twelve Vegetation Types were defined as part of creating this report; however, the mapping of them was based on McLennan's Stand Map of the Humphries Property (1986). Although there are some minor errors in the location of sites and stands on these maps, they provide a useful general picture of the main ecological characteristics of the Reserve. Map 4 shows the location of some of the special features of the Reserve, as described in Part II, Section F. Map 5 is a reproduction of a legal survey map created in 1996.

PART II - DESCRIPTION AND ECOLOGICAL ANALYSIS OF THE RESERVE

A. PHYSICAL SETTING

Geology, Landforms, and Soils

Geologically, most of Lasqueti Island is derived from Upper Triassic basalts and pillow lavas of the Karmutsen group, about 205 million years old. The underlying landforms of Lasqueti Island are rugged and irregular, dominated by many rocky hills (dome-shaped or oblong ridges) with steep sides and rounded tops. There are many narrow, steep valleys between the rocky hills.

The Gulf (Strait) of Georgia region was covered by glaciers from about 29,000 to about 12,000 years ago. During glaciation, the weight of the ice depressed the land surface, so that Lasqueti Island was below sea level. As the glaciers retreated and the land rebounded, marine and coastal processes eroded loose materials from the higher and steeper parts of the island and laid down finer-textured soil parent materials on many of the lower-lying and more gently sloping areas of the island.

Soils on the sides and tops of the hills vary from bare rock to morainal deposits (mixed material deposited by the glaciers), typically shallow and rapidly drained. Soils are somewhat deeper in the narrow steep valleys, and deepest, with the most water-holding capacity, in the broader lowland valleys and coastal plains. The Lasqueti Nature Reserve has both the rocky and steep landforms with shallow, coarse-textured soils, and the lower and gentler slopes with medium to deep marine soils of medium to fine texture.

Climate

Lasqueti Island lies within the Coastal Douglas-fir biogeoclimatic zone, an area of mild semi-mediterranean climate centred in the southern Strait of Georgia, and encompassing most of the Gulf Islands. The climate of this zone is strongly influenced by the rain shadow of the effect of the Vancouver Island Ranges. In the summer, periods of drought and high temperatures over 4 weeks long are common. Winters are typically rainy and mild. Snow rarely remains on the ground for more than a week, and some winters have no snow. Table 1 provides a summary of climate data from the Merry Island lighthouse, located 21 kilometres east of Lasqueti, which probably has a very similar climate to that of Lasqueti.

In winter the prevailing winds are from the south-east. Winter storms often involve winds up to 30 or 40 knots, which can blow for several days at a time. In summer, warm fair weather is usually associated with steady north-westerly winds, although south-easters can blow in summer too. The Lasqueti Nature Reserve, being located close to the Sabine Channel, is exposed to both northwest and southeast winds that blow along the axis of the Sabine Channel. Lasqueti is somewhat sheltered from the force of cold winter "outflow winds" by the mass of Texada Island to the northeast.

TABLE 1. Summary of climate

(Data for the Merry Island lighthouse station (49°28'N, 123°55'W, 0.8 m a.s.l.; data from Atmospheric Environment Service 1954 to 1990.)

Mean annual precipitation	1028 mm
Mean precipitation of the driest month (August)	38 mm
Mean precipitation of the wettest month (December)	151 mm
Mean precipitation April - September	305 mm
Mean snowfall	33 cm
Mean annual temperature	10.5°C
Mean temperature of the warmest month (August)	17.8°C
Mean temperature of the coldest month (January)	4.3°C
Number of months with mean temperature over 10°C	6
Mean wind speed	18 km/h
Maximum hourly wind speed	100 km/h
Most frequent wind direction	East

Site Types

In ecological terminology, a *site* is defined as an area of land that is relatively uniform in climate, topography, soils, and other critical aspects of the physical environment. Site Types, as shown on Map 2 are portions of the land that have similar physical characteristics, and are thus able to support a certain characteristic community of plants and animals, and to undergo certain characteristic patterns of ecological change. More information about site classification, and about the particular site types that occur on the Lasqueti Nature Reserve, is provided in Appendix 1. As Map 2 illustrates, the Lasqueti Nature Reserve includes a diverse range of sites and hence, supports a wide variety of plants and animals. The pattern of site types on the Reserve can be considered permanent and fixed, although in the very long term (many thousands of years) sites may be altered by processes such as glaciation and weathering of bedrock.

B. HISTORY: TUCKER BAY SCHOOL

Tucker Bay was a centre of activity in the early settlement history of Lasqueti Island[1]. A public dock was built at Tucker Bay in 1913, and it became the main route on and off the island, with the Union Steamships making a regular stop there until 1923. Also in 1913, the first public school on Lasqueti Island was built at the corner of Main Road and Tucker Bay Road, at the south east corner of today's Reserve property. The one-acre square lot (District Lot 111) was apparently divided off from the rest of NW quarter Section 14 and donated for the purpose of a school by the Washburn family, owner of the property at that time. Although the lot was surveyed, it is unclear whether a separate legal parcel was ever created.

[1] Information in this section is derived from *Lasqueti Island: History and Memory* by Elda Mason; and from personal communication from Mrs. Patricia Forbes of Lasqueti Island.

The original school building, made of logs, burnt down the next year in a fire caused by land-clearing associated with building Main Road. (It may be that this was the same fire that burnt nearby forest areas—then freshly logged—and helped create conditions for regeneration of the second-growth Douglas-fir stands now found near the old school site and along Main Road.) After the fire, the school was replaced by a wood frame building with clap-board siding. (See photo 1). School was held in this building until 1917. With the opening of the cannery in False Bay, the centre of population on Lasqueti shifted to the north end, and a new school was built in False Bay. The Tucker Bay school building then was used as a community hall, providing a meeting place for the Farmer's Institute, the Women's Institute, and the Agricultural Association, as well as various community functions.

School classes were resumed at Tucker Bay in 1932, and were held there until 1950, when Charles Williams School (now called False Bay Elementary) was built in False Bay. A school bus service was begun at this time, making it feasible to have one school for the whole island. The Tucker Bay school house continued to be used as community building until it was dismantled in the mid 1960s.

Some time in the 1970s, it was established that District Lot 111 was in fact part of the parent parcel (NW ¼ Sec. 14). By this time, the school building was gone and the new Lasqueti Community Hall was under construction on a nearby parcel of Crown land, so the community had no further need for the lot and District Lot 111 once again became an integral part of the rest of the property. In 1997, the owner, Amelia Humphries, donated the entire parcel, NW ¼ Section 14, to the Islands Trust Fund to maintain as a Sanctuary.

Since the school building was demolished, red alder trees and a few conifers have seeded in naturally. The site shows very little evidence of its former use. In the course of 60 to 100 years, conifers will replace the alders. In the long run, the school site will probably develop a natural character difficult to distinguish from the rest of the Reserve.

C. ECOLOGICAL DESCRIPTION

Original forests

Prior to the arrival of European colonists on the coast of British Columbia, Lasqueti Island was mostly covered with coniferous forests. Some idea of the original forests of this property can be deduced from stumps left after logging, and the occasional veteran trees left behind. More knowledge can be inferred by examining the few remaining stands of undisturbed forest left on the Island. The structure and composition of these stands varies greatly, depending on site factors.

Before logging, Lasqueti's forests were dominated by Douglas-fir on all but the wettest sites, where western redcedar prevailed. Grand fir and western hemlock occurred as shade-tolerant under-story species. Douglas-fir trees over 1.5 metres diameter were common, and many were over 2 metres diameter. On the moister sites there were also very large cedars. On the driest sites, arbutus and Shore pine were co-dominant with Douglas-fir.

These forests were occasionally subject to wildfires, which probably never completely destroyed the stand, since the thick bark and high crowns of the large Douglas-firs gave them excellent resistance to fire. As well, the frequent small wetland areas found throughout the landscape are very resistant to fire. Historically, windthrow was probably as important a factor as fire, as an agent of tree mortality and ecological change in the forest.

History of Logging

Information about logging history can be inferred from evidence found in the present day forest. The parts of the Reserve with gentle terrain, close to Main Road and Tucker Road are now occupied by even-age stands approximately 80 to 85 years old, indicating that these areas were logged around 1910. Charcoal on the stumps of the old trees, and inside the spring-board notches, indicates that the slash was burnt on the site soon after logging. These areas quickly were re-occupied by stands dominated by Douglas-fir. Fire often creates conditions conducive to regeneration of Douglas-fir. However, some areas that were logged at this time regenerated to stands dominated by other conifers: western hemlock, grand fir, and western redcedar.

Some of the areas on steeper ground are now occupied by even-age stands approximately 40 to 45 years old indicate that these areas were logged in the early or mid 1950s. These stands do not appear to have been burnt after logging, and the regenerated stands have considerable diversity of tree species, primarily Douglas-fir, red alder, western hemlock, and grand fir. Most of the portions of the Reserve with dry rocky sites have not been logged. These areas are occupied by stands of fairly small Douglas-fir and Shore pine. Throughout the Reserve, there are individual large old ‘veteran’ trees that were left by the loggers. There are two small stands of ‘big tree’ old forest that were not logged, the larger of the two located near the northwest corner of the Reserve, and the other in a steep narrow draw near the middle of the north boundary of the Reserve. These few large old trees are a reminder of the magnificent stands that formerly occupied much of the Reserve, and that will in time re-develop their former splendor.

D. VEGETATION

Vegetation Types

Twelve distinct Vegetation Types are noted in the Reserve. Each Vegetation Type is unique with respect to the species, age, or height of the dominant trees, or the species of understory plants. Tree ring cores were taken from some of the second growth trees to establish stand ages. Cores were not taken from the larger and older trees, to avoid any risk of injuring them, so the age estimates given for the older stands are only approximate. Each Vegetation Type occurs on a limited range of Site Types. Each Vegetation Type generally has a distinctive disturbance regime, and can be expected, in future, to follow a distinct path of changes, such as growth and succession.

Two of the twelve Vegetation Types are examples of rare plant associations. These are Type # 3 (Old-growth Douglas-fir) and Type # 12 (Sphagnum/sedge/hardhack bog). The British Columbia Conservation Data Centre considers old growth Douglas-fir forests and

undisturbed wetlands in the CDF zone to be extremely rare (Jan Kirkby, personal communication.)

Map 3 shows the different Vegetation Types of the Reserve and illustrates the diverse range of plant communities. The abundance and vigor of different species of plants is strongly affected by the physical environment. As a result, distinctive plant communities are often associated with different sites. However, plant communities are also affected by the particular local history of disturbance, recovery, and succession that have occurred, and may also be affected by interactions with wildlife (e.g., browsing by deer). Because these processes will continue in the future, plant communities are not necessarily permanent, although they may be stable over periods of many centuries. Plant communities are a major factor in determining the wildlife populations of an area, because plants are such a critical element of the habitats for many species. Table 2 provides a summary of these key features of the Vegetation Types, and a list of site types where they mostly occur.

TABLE 2. Vegetation Types

Vegetation Type #	**1**
Dominant Trees Species	Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*), western hemlock (*Tsuga heterophylla*), western redcedar (*Thuja plicata*)
Age & Height Range	Even-age, 80 years. 30 - 40 m
Site Types	04/sandy, 04/slope-skeletal and 06/loamy
Understory Species	Sword fern (*Polystichum munitum*), Dull Oregon-grape (*Mahonia nervosa*), red huckleberry (*Vaccinium parvifolium*), Oregon beaked moss (*Kindbergia oregana*)
Disturbance Regime	This type was regenerated after clear-cut logging. If un-managed, it would probably be susceptible to natural stand-destroying wildfire. However, such events would be infrequent (on average, perhaps every 300 to 600 years). Typically, fires would not kill all trees, but would leave many large old Douglas-fir vets still alive.
Expected Changes	Competition will continue to cause mortality of the smaller and more suppressed trees, leading to a lower density, of larger diameter trees. Some trees will eventually grow to very large sizes. Some gaps may appear due to death of single trees or small groups from causes such as root disease or windthrow. Shade-tolerant understory conifers, particularly cedar, will continue to grow slowly and will gradually occupy a larger portion of the canopy.

Vegetation Type #	**2**
Dominant Trees Species	Douglas-fir(*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*)

Age & Height range	Even-age, 45 years. 25 - 30 m.
Understory Species	Sword fern (*Polystichum munitum*), Dull Oregon-grape (*Mahonia nervosa*)
Site Types	04/sandy, 04/slope-skeletal
Disturbance regime	Similar to # 1.
Expected changes	Similar to # 1, except this stand is not as old, so more mortality due to competition is expected.

Vegetation Type #	**3**
Dominant Trees Species	Douglas-fir (*Pseudotsuga menziesii*)
Age & Height range	Uneven-aged, up to 400 years (?), up to 40 m.
Understory Species	Salal (*Gaultheria shallon*), bracken fern (*Pteridium aquilinum*), step moss (*Hylocomium splendens*)
Site Types	04/sandy, 01/slope-shallow
Disturbance regime	Stand dynamics are dominated by gap dynamics (death of individual trees creating opportunities for suppressed understory trees). This type was historically subject to periodic fires that left some of the large trees standing.
Expected changes	Douglas-fir is tolerant of shade on these sites, and thus will continue to dominate the stand, as the older trees die or blow over from time to time.

Vegetation Type #	**4**
Dominant Trees Species	Douglas-fir (*Pseudotsuga menziesii*)
Age & Height range	Uneven -aged, up to 100 (a few trees up to 250), up to 30 m
Understory Species	Salal (*Gaultheria shallon*), ocean-spray (*Holodiscus discolor*), Step moss (*Hylocomium splendens*)
Site Types	01/shallow
Disturbance regime	Similar to type # 3, except this type was selectively logged in the 1950's, so the larger trees were removed.
Expected changes	Trees will continue to grow, and eventually reach moderate sizes. Douglas-fir is tolerant of shade on these sites, and thus will continue to dominate the stand, as the older trees die or blow over from time to time.

Vegetation Type #	**5**
Dominant Trees Species	Douglas-fir (*Pseudotsuga menziesii*), Shore pine (*Pinus contorta*)
Age & Height range	Even-age 40 years. Up to 20 m.
Understory Species	Salal (*Gaultheria shallon*), evergreen huckleberry (*Vaccinium ovatum*), step moss (*Hylocomium splendens*)
Site Types	01/coarse
Disturbance regime	This vegetation is regenerated after clear-cutting in the 1950s.
Expected changes	Competition will continue to cause mortality of the smaller

	and more suppressed trees, leading to a lower density, of larger diameter trees. Some trees will eventually grow to moderate sizes. Some gaps may appear due to death of single trees or small groups from causes such as root disease or windthrow. Shore pine does not generally live beyond 100 years, whereas Douglas-fir lives much longer, so Douglas-fir will increasingly dominate the stand in the long term.

Vegetation Type #	**6**
Dominant Trees Species	Douglas-fir (*Pseudotsuga menziesii*), Shore pine (*Pinus contorta*)
Age & Height range	Uneven-age 0 - 200 years. Up to 25 m.
Understory Species	Step moss (*Hylocomium splendens*), juniper haircap moss (*Polytrichum juniperinum*), electrified cat's-tail moss (*Rhytidiadelphus triquetris*), salal (*Gaultheria shallon*)
Site Types	01/shallow
Disturbance regime	This vegetation type occurs on areas with shallow soils over bedrock. Because rooting is severely restricted, trees blow over easily. As trees grow taller they become more susceptible to windthrow. Windthrow occurs with single trees or small groups. Mineral soil exposed by windthrow provides a seed-bed for trees and other plants.
Expected changes	Trees will probably continue to grow up and blow over, creating openings for new trees to come up. The species mix will likely remain stable (Douglas-fir and Shore pine) and large trees (over 25 m tall) will be uncommon.

Vegetation Type #	**7**
Dominant Trees Species	Douglas-fir (*Pseudotsuga menziesii*), Shore pine (*Pinus contorta*), arbutus (*Arbutus menziesii*)
Age & Height range	Uneven-aged, up to 150 years. Up to 20 m tall.
Understory Species	Step moss (*Hylocomium splendens*), electrified cat's-tail moss (*Rhytidiadelphus triquetris*), red-stemmed feathermoss *Pleurozium schreberi*)
Site Types	02/rocky
Disturbance regime	Trees on these sites are limited to microsites that have a little more soil or moisture than the rest of the site (e.g., a small crevice in the bedrock). Trees are subject to severe moisture stress, so death of individual trees is the main mode of change.
Expected changes	Individual trees will continue to seed in, grow very slowly, and die of natural stresses, perpetuating a very open stand of fairly small trees. Species mix will likely remain stable,

	except that feral sheep may impair regeneration of arbutus.

Vegetation Type #	**8**
Dominant Trees Species	Douglas-fir (*Pseudotsuga menziesii*)
Age & Height range	Uneven-aged up to 100 (?). Up to 30 m.
Understory Species	Ocean-spray (*Holodiscus discolor*), salal (*Gaultheria shallon*), sword fern (*Polystichum munitum*)
Site Types	04/sandy, 04/slope-skeletal
Disturbance regime	This vegetation type is strongly influenced by the presence of shoestring root disease (*Armillaria ostoyae*) which attacks primarily Douglas-fir, but also grand fir, hemlock, and cedar. The root disease acts slowly and does not always kill all individuals of a susceptible species. Affected trees often are blown over by wind.
Expected changes	This area will likely continue to be very open and dominated by brush species, with occasional conifers seeding in from time to time, but very few of them surviving past 100 years. Deciduous tree species, such as red alder, bigleaf maple, and bitter cherry (*Prunus emarginata*), are likely to become more prevalent.

Vegetation Type #	**9**
Dominant Trees Species	Red alder (*Alnus rubra*), Douglas-fir (*Pseudotsuga menziesii*), (and lesser amounts of western hemlock (*Tsuga heterophylla*), and western redcedar (*Thuja plicata*))
Age & Height range	Even-aged, 45 years. 20 - 25 m.
Understory Species	Sword fern (*Polystichum munitum*), red huckleberry (*Vaccinium parvifolium*), evergreen huckleberry (*Vaccinium ovatum*), step moss (*Hylocomium splendens*), Oregon beaked moss (*Kindbergia oregana*)
Site Types	06/loamy, 04/sandy, 04/slope-skeletal
Disturbance regime	Regenerated after clear-cutting.
Expected changes	Red alder will mostly die off between ages 70 and 100, allowing conifers in the understory (some of which are already present, others may seed in) to grow up into the canopy, resulting in widely-spaced stand dominated by a mix of conifers, which will eventually grow to large sizes.

Vegetation Type #	**10**
Dominant Trees Species	Red alder (*Alnus rubra*), Douglas-fir (*Pseudotsuga menziesii*)
Age & Height range	Even-aged, in small patches from 10 - 30 years, to 20 m.
Understory Species	Grasses
Site Types	04/sandy

Disturbance regime	Established by natural seeding on cleared land (old Tucker Bay School site, old sand pit on Main Road)
Expected changes	The red alder will continue to grow and thin out, and in the long run conifers will take over.

Vegetation Type #	**11**
Dominant Trees Species	No trees
Age & Height range	N.A.
Understory Species	Step moss (*Hylocomium splendens*), electrified cat's-tail moss (*Rhytidiadelphus triquetris*), red-stemmed feathermoss *Pleurozium schreberi*), reindeer lichens (*Cladina* spp.), Wallace's selaginella (*Selaginella wallacei*), and occasional drought-tolerant flowering plants such as meadow death-camas (*Zygadenus venonosus*), and small-flowered blue-eyed Mary (*Collinsia parviflora*)
Site Types	02/rocky, rock outcrops
Disturbance regime	These ecosystems don't appear to be subject to much natural disturbance, although periodic drought probably mediates the balance between the various moss and lichen species.
Expected changes	No significant changes expected, except that browsing by feral sheep may tend to further reduce or eliminate the flowering plants.

Vegetation Type #	**12**
Dominant Trees Species	No trees
Age & Height range	N.A.
Understory Species	Sedges (*Carex* spp.), hardhack (*Spiraea douglasii*), Sphagnum moss (probably *Sphagnum girgensohnii*)
Site Types	10/organic
Disturbance regime	This ecosystem appears to be fairly stable, but may be subject to changes resulting from fluctuation in annual moisture availability.
Expected changes	No significant changes expected.

Understory Plants

Although Vegetation Types are primarily defined in terms of the trees, there is also a great diversity of understory plants that occur in typical patterns on the various sites. Understory plants often serve as indicators of site factors such as the availability of nutrients and moisture. Also, there are many more species of understory plants than trees, so these contribute greatly to the overall diversity of the ecosystems. There are many plant species that usually occur at low densities, even though they are not rare or endangered. Unfortunately, the field work for this report was done in October, when it is difficult to find and identify all the understory plants. However, the Lasqueti Nature

Reserve is known to have occurrences of some interesting species, including orchids such as heart-leafed twayblade (*Listera cordata*) and rattlesnake-plantain (*Goodyera oblongifolia*). Also, there is a good diversity of moss species. It is likely that some of the flowering plants typical of the rocky outcrops, such as meadow death-camas (*Zygadenus venenosus*) and small-flowered Blue-Eyed Mary (*Collinsia parviflora*) are present, albeit with reduced abundance and vigor due to browsing by feral sheep.

E. ECOLOGICAL PROCESSES

One of the management objectives for the Lasqueti Nature Reserve is to allow natural ecological processes to function without human interference. This objective is based on the recognition that change is an inherent quality of forest ecosystems, and that preserving and protecting an ecosystem does not necessarily mean that the ecosystem will remain in its present condition.

There are many ecological processes occurring all the time in a forest ecosystems. Change takes place on many different time scales. For example, some changes occur on daily cycles, such as the feeding and resting cycles of many birds and mammals, while other changes occur on a seasonal cycle, such as the growth and shedding of leaves on deciduous trees, or the arrivals and departures of migratory birds. Many processes, such as feeding, reproduction, or migration, concern primarily individual organisms or species. Other processes involve changes in the overall composition and structure of the ecosystem. Typically, these changes occur over very long time scales. For example, it takes hundreds of years for the development of the structural complexity of an old growth forest. What follows is a brief discussion of three important long-term processes of structural change in the forest ecosystems on the Lasqueti Nature Reserve: disturbance, regeneration, and succession.

Disturbance and Regeneration

Most forest ecosystems are subject to periodic natural disturbances, such as wild-fire or insect epidemics. These natural disturbances alter or destroy the existing forest and they set the stage for regeneration of a new forest. Often there is a somewhat predictable or even cyclic pattern of natural disturbances that repeats over time. This pattern is known as the "natural disturbance regime". Natural disturbances can vary in terms of extent (how large an area is affected); severity (how destructive is the event); and frequency (how often the event is likely to be repeated). There are four main processes of natural disturbance that have occurred, or are still occurring in the Lasqueti Nature Reserve, plus two main forms of human-caused disturbance. These are described in more detail below.

Natural regeneration of plants occurs primarily by seeds from nearby mature plants, disseminated by wind or animals. Other means of natural regeneration include coppicing (stump sprouting) or sprouting from underground roots. Many factors contribute to determining which plants will regenerate at any particular place and time. Obviously, a source of seed is necessary for any plant to regenerate by seeding. Therefore, a natural disturbance such as fire, that is more likely to kill thin-barked trees such as hemlock and cedar, will favor the thicker-barked Douglas-fir, since more Douglas-fir trees will survive to provide seeds to re-colonize the area. Different plants have different requirements for

seed-beds. For example, Douglas-fir is more likely to regenerate on exposed mineral soil, while western hemlock does better on thick accumulations of organic material. Other factors such as temperature, light, and moisture also affect seed germination and growth of seedlings. Animals play important roles in pollination and seed dispersal for many plants. For example, red huckleberry often regenerates on top of stumps, presumably because the seeds are carried there by birds, and left in their droppings

1. Tree mortality due to age.

The death of trees due to age-related stresses usually creates small gaps in the forest canopy as individual trees die. Such gaps are often filled over time either by tree species that grow up from the understory, or by brushy vegetation or ferns, which may inhibit regeneration or growth of trees. Death of single trees generally creates opportunities only for species that can grow in the restricting condition under the forest canopy, such as low levels of sunlight. In an even-aged stand of trees belonging to a relatively short-lived species such as Shore pine, many trees together may die around the same time. This can lead to conditions with more sunlight available in the understory, allowing more light-demanding species to regenerate. Thus Shore pine is often self-replacing on dry sites in the CDF zone.

2. Root disease.

There is one small area affected by Shoestring Root Disease (*Armillaria ostoyae*) on the Lasqueti Nature Reserve. This is a fungal disease that attacks Douglas-fir as well as grand fir, western hemlock, and western redcedar. The disease causes loss of vigor of the tree, and often eventual death. Weakening of the roots can make affected trees more susceptible to windthrow. The disease spreads, very slowly, through root contact. There may also be small areas affected by Laminated Root Rot (*Phellinus weirii*) which is similar to Shoestring Root Disease, but is more selective in attacking primarily Douglas-fir, and it tends to lead to blowdown more than Shoestring root disease.

Areas affected by root disease often have a low density of coniferous trees, many standing dead trees, and vegetation dominated by deciduous trees and shrubs. Thus root diseases can add diversity to a forest ecosystem, and provide patches of habitat that are very valuable for many species of wildlife.

3. Wind.

Wind is a significant agent of disturbance on the Lasqueti Nature Reserve, because of the combination of exposure (areas in topographically raised positions) with very shallow rooting. Wind is usually thought of a “stand-replacing” disturbance, that is, one that occurs at long intervals, killing most of the trees in a stand, and allowing a new even-aged stand to regenerate. However, there are areas on the Lasqueti Nature Reserve where the effect of wind appears to be to topple individual trees, resulting in a stand with many different ages of trees present, with each tree growing in height until its exposure to wind becomes too great.

4. Fire.

Fire is a nearly ubiquitous feature of the coniferous forests of western North America, however it is tremendously variable in terms of its extent, severity, and frequency. In the Coastal Douglas-fir zone, fire can be a stand-replacing disturbance, that occurs at infrequent intervals. However, mature Douglas-fir trees have thick fire-resistant bark that allows them to survive fires of considerable intensity. Thus, Douglas-fir forests in the CDF zone often have several different age classes present, including widely-scattered very large old Douglas-fir trees. Fire often creates soil conditions that are favorable to regeneration of Douglas-fir.

In addition to natural fires, human activities too can cause forest fires. It seems likely that the fire that burned on the Lasqueti Nature Reserve some time around 1913 was caused by land-clearing activities associated with building Main Road. When fire burns through an area previously logged, the large fuel load of dry logging slash can lead to very hot fires.

Unlike the other forms of natural disturbance described here, fire is not likely to continue as an ecological process on the Lasqueti Nature Reserve. The risks of fire are considered unacceptable in an inhabited area such as Lasqueti, and forest fires are vigorously suppressed. In any case, the Lasqueti Nature Reserve is too small an area to permit effective use of fire as tool for ecosystem management. While it is desirable for some portion of a large landscape to be burned from time to time, it would not be particularly desirable for the whole Lasqueti Nature Reserve to be burned at one time. It is possible that very carefully controlled fire might be used on the Lasqueti Nature Reserve at some time in the distant future, but there is no need to consider this possibility at present.

Succession

Succession is the process whereby one biotic community replaces another in an ecosystem. There are three main trajectories of plant succession at work in the Lasqueti Nature Reserve at present.

1. Young red alder to mature forest coniferous forest.

Red alder trees generally live less than 100 years. Many conifers can survive and grow slowly under the shade of alder, in part because of sunlight available in winter, when the alder has no leaves. As a result, alder stands tend to be replaced by stands with more than one species of conifers present, generally rather widely-spaced, and with considerable variation in size. Usually, by the time the last of the red alder has died off, a mature coniferous stand has emerged.

2. Young Douglas-fir to mature or old-growth mixed forest with shade-tolerant conifers.

On moist rich sites, Douglas-fir can form dense even-aged stands following a major disturbance. However, once such stands are established and a closed canopy forms, light levels in the understory are too low for more Douglas-fir to regenerate. In contrast, the more shade-tolerant coniferous species (cedar, grand fir, hemlock, and yew) can regenerate and grow—albeit slowly—in the understory. As a result, these shade-tolerant species tend to replace Douglas-fir over time as Douglas-fir trees die off. However, since Douglas-fir trees can live for many centuries, this process generally results in a mixed

stand that includes very large old Douglas-fir trees as well as other, more shade-tolerant conifers.

3. Young or mature Douglas-fir to old-growth Douglas-fir.
Not all ecosystems undergo a change in the main tree species over time. For example, on the 01 site series, Douglas-fir is sufficiently shade-tolerant that it often is present in all age classes, so the death of a large dominant Douglas-fir creates opportunities for smaller trees of the same species already present in the understory to grow into the vacated space. Therefore, the species composition on sites of this kind may remain stable over long periods of time. However, even when the tree species composition does not change, other changes in the ecosystem can occur over time. In particular, the development of the structural attributes of old growth forests—including large old trees, snags and down logs, and a multi-layered canopy—provide habitat features that allow a very different community of plants and animals to occupy an old-growth Douglas-fir forest than would occur in a younger forest with the same tree species. This principle applies to a wide diversity of organisms. For example, many species of birds depend on large dead or dying trees to excavate their nest cavities, while some species of epiphytic lichens require the very stable conditions of the bark on old-growth trees.

Wildlife and Habitats
The main wildlife mammal species occurring on Lasqueti include Black-tailed Deer, Racoons, Mink, River Otter, Mice, Shrews, and Voles.

Numerous bird species, migratory and resident, are found in the area. Four species of cavity excavators nest in the area: Pileated Woodpecker, Hairy Woodpecker, Downy Woodpecker and Northern Flicker. These species perform a keystone role in the wildlife community, in that the holes they excavate are used by secondary cavity nesters, such as the Western Screech Owl.

The continued presence of these species depends on an ongoing supply of standing dead trees (snags) of sufficient diameter for their use. At present, snags are in adequate supply. Some large Douglas-fir and cedar snags are still present, remaining from the original forest. Other snags are present due to the age-related mortality occurring in the older red alder trees, and age or density-related mortality in the second growth conifer and mixed stands.

The remaining large veteran Douglas-fir and cedar trees are a valuable habitat feature in the forest. Due to the proximity of this forest to shallow tidal waters, these veterans may be selected for nest trees by Ospreys or Bald Eagles. They also serve as perch trees for Ospreys, Bald Eagles, Red-tailed Hawks, and other species. Mature conifer stands are valuable habitat for resident songbirds including Golden-crowned Kinglets and Chestnut-backed Chickadees.

F. SPECIAL FEATURES

Bigleaf Maple.
Bigleaf maple (*Acer macrophyllum*) trees occur at low densities in several of the different Vegetation Types, mostly 1 and 2. There are at least two large “clumps” of Bigleaf

maples, growing close together in a rough circle. These are an interesting feature, although not especially rare or unusual. The following is a description of how these maple clumps probably came to be. Bigleaf maple can reproduce by seeds, or vegetatively by coppicing (sprouting from a stump). The wood of bigleaf maple is brittle, so the trees often break rather than uprooting when subject to extreme winds. When a large maple tree breaks, the stump will often produce sprouts close to the ground, around all sides of the stump. Over time, the stump will die and rot away while the new sprouts grow up into separate trunks. Competition will eliminate many of the new stems, and the final number will usually be between one and half a dozen.

Although this is a fairly common phenomenon, there is a particularly good example of one of these coppiced clumps on the Reserve, having ten stems, measuring between 30 and 60 cm dbh (diameter at breast height) individually. The circumference measured around the entire clump is roughly 10 m. (See Photo __.) The space inside this clump is so large, that one wonders if this clump might be the result of more than one coppicing event—if perhaps the present trees sprouted from a number of trees, these predecessor trees being themselves the products of an earlier coppicing event.

Bigleaf maple supports many species of epiphytic mosses, liverworts, lichens, and even ferns—more than any other local tree species—so its presence is very valuable for maintaining biological diversity.

Pacific Yew.
Pacific Yew is a rather uncommon tree of coastal forests. Because of its relative scarcity, its very slow rate of growth, and its adaptation to the shady conditions in the understory of mature conifer stands, its abundance is likely to be reduced in future by logging and land-clearing. Therefore, yew trees should be considered an important conservation feature of the Reserve.

There are at least six yew trees on the Reserve over 30 cm dbh, and more of smaller diameters. The largest is 107 cm dbh. (See Photo__.) For Lasqueti island, this an above-average density of Yew trees, especially the larger ones.

Mini-bog.
There is a very small area (less than 0.1 ha) of a nutrient-poor bog ecosystem, with the ground cover dominated by sphagnum moss, and a shrub layer of sedges and hardhack (Vegetation Type 12). Spagnum bogs are quite uncommon in the dry climate of the CDF zone, and any wetland in natural undisturbed condition such as this should be considered an important conservation feature. (See Photo __).

Douglas-fir old growth.
There are two small patches (approximately 1 ha total) of old-growth Douglas-fir forest (Vegetation Type 3). The extent of old growth forest in the CDF zone is now reduced to less than 1% of its former extent, so that even very small patches such as these are important conservation features. (See Photo __.)

G. Recreational and Aesthetic Features

Although the main purpose of the Reserve is nature conservation, it is also well suited for low impact use for quiet appreciation of nature. The exposed rock bluffs have fine views out over the Sabine Channel with its many small islets, and Texada Island in the background.(See Photo__.) Because these areas have few trees, they are pleasantly sunny in fair weather. These areas are somewhat sensitive—heavy traffic can damage the mosses and lichens on the rocks—but are sufficiently robust to withstand occasional use. The small patch of old growth forest, with its majestic old trees in a stand with sparse mossy understory is also an exceptional feature for nature appreciation and can withstand low impact human activity such as walking.

PART III - MANAGEMENT PLAN

A. REGIONAL CONTEXT

Of the 14 biogeoclimatic zones of British Columbia, the degree to which natural ecosystem have been altered and destroyed is highest in three zones: the Coastal Douglas-fir zone on the Coast, and the Ponderosa Pine and Bunchgrass zones in the Interior. Approximately half of the CDF zone has been converted to uses such as agriculture and residential development that permanently remove the natural ecosystems (primarily forests, but also wetlands, grasslands, estuaries, etc.). Only about one percent of the original extent of old growth forest on the CDF zone remain uncut. Less than two percent of the CDF zone is in Protected Areas, compared to the provincial governments goal of 12%. Only a few hundred hectares of old growth forest of the CDF zone is in Protected Areas.

The value of small nature Reserves has been hotly debated in the conservation science literature. If the lands around the Lasqueti Nature Reserve were very heavily modified, so that it became an isolated island of natural habitats in a sea of altered land uses, there is little doubt that profound changes in the ecology of the Reserve would result, with possible loss of some species sensitive to disturbance, and introduction of invasive non-native species.

Fortunately however, the Lasqueti Nature Reserve is one component of a system of nature reserves contributing to conservation of the biological diversity of the Coastal Douglas-fir zone. Even a relatively small area such as the Lasqueti Nature Reserve makes an important contribution. In the local vicinity, other areas devoted to conservation include the Lasqueti Ecological Reserve, Jedediah Island Provincial Marine Park, and the South Texada Island Protected Area. It is expected that Paul Island, Jervis Island, and other small Crown islands in the Sabine Channel will also be protected in the future. In addition there are significant areas of Crown Land on Lasqueti Island that could be devoted to conservation, either as Park or Ecological Reserves, or by some other designation such as Old Growth Management Areas. There are also significant areas of private land on Lasqueti Island whose owners are committed to conservation. Of course, there is no long-term assurance that conservation will prevail on these private lands.

B. MANAGEMENT ISSUES

Access

Access to the Lasqueti Nature Reserve is readily available due to its frontage on Main and Tucker Bay Roads. There appears to be no need to either increase or restrict access.

Sign

The main questions relevant to a sign are what should it say and where to locate it. The principal issue is probably to find the right balance between discretion and prominence, that is, to convey the necessary information without undue ostentation. A sign that was

too large or prominent might be considered tasteless or out-of-place, or might attract unwanted attention to the Reserve. Many people on Lasqueti Island are very concerned about unauthorized camping, mainly because of the fire hazard. A sign that was too small or well-hidden might fail to make anyone aware of the Reserve.

Unacceptable Uses

There may be some risk that unacceptable uses will occur on the Lasqueti Nature Reserve in the future, such as camping, mountain biking, excessive recreational hiking, or poaching of wood (e.g., firewood cutting, shake cutting, stealing yew logs). There is no evidence of such uses occurring at present. The strategy to prevent problems from arising should include:

- reliance on the local community to keep an eye on the Reserve, and
- a regular monitoring program.

Boundaries

The boundaries of the Lasqueti Nature Reserve are quite easy to locate. The south and east boundaries follow Main Road and Tucker Bay Roads. At present, the west and north boundaries are marked with flagging tape. The north boundary is located by an iron pin at its east end, another iron pin near the middle of the line, and at the western end there is a brass plaque set in the rock, marking the northwest corner of the Reserve and the intersection of four Sections. The north end of the west boundary is marked by this same brass plaque. The south end of this line seems to be unmarked. It appears that recent ditching work along Main Road may have buried an iron pin, if there was one. However, there is an iron pin on the other side of Main Road, 20 m south of where the pin should be to mark the southwest corner of the Reserve. At this time there is no need to further mark the boundaries.

Uses on Adjoining Parcels

The adjoining parcels of land are mostly forested, with no active land uses occurring along the boundary, so this does not appear to be an issue at present.

Feral Sheep

Sheep were first introduced to Lasqueti over a hundred years ago by the early settlers. Since that time various flocks have been abandoned and there is now a feral population, estimated very roughly at about 500 animals. Their preferred foods are grasses and herbs, but there is inadequate pasture available, so the sheep spend much of their time in the forests browsing shrubs and tree seedlings.

Although the effects of logging are more striking to the eye, the long-term impacts of browsing on the forest are also significant. In some parts of the island the sheep have almost completely eliminated the understory vegetation, even on sites that would normally be covered by dense lush sword fern. Tree regeneration is equally inhibited, especially arbutus, cedar, and Douglas-fir.

The density of sheep populations is unevenly distributed on Lasqueti. Some local areas have very high populations, with high impacts on vegetation resulting. At present, the

sheep populations and their impact on vegetation appear to be fairly minor on the Lasqueti Nature Reserve. Most likely, some species of flowering plants have been reduced in abundance or eliminated altogether by the many decades of sheep browsing on the Reserve, as has occurred in many areas on Lasqueti. (The evidence for this is mostly circumstantial. Some of the smaller islands near Lasqueti, such as Sangster Island and Paul Island, have deer but no sheep. These island have much more abundance and diversity of flowering plants associated with dry rocky habitats, including common camas (*Camassia quamash*), meadow death-camas (*Zygadenus venenosus*), white fawn lily (*Erythronium oregonum*), sea blush (*Plectritis congesta*), and small-flowered blue-eyed Mary (*Collinsia parviflora*). This suggests that sheep are probably responsible for the loss of these and similar plants.) The condition of vegetation on the Reserve, and the impacts of browsing, should be monitored.

The options to reduce the impacts of feral sheep are limited. Fences can work, but are expensive to build and maintain. Many private landowners protect the forest and plants on their properties by programs of hunting the sheep, to keep their numbers down to levels where their impact is not excessive. However, the Islands Trust Fund is not well equipped to implement a program of this kind.

C. General Management Strategy

The overall management strategy for the Lasqueti Nature Reserve is primarily one of passive conservation through protection—allowing natural processes to operate with minimal interference, with the exception of wild fires which should be suppressed. With respect to human use, the strategy is to allow, but not promote, use for low-impact appreciation of nature. At present, there is no need for restorative measures or manipulations of the ecosystem to enhance natural values. It is possible that in the future, some active management may be needed to ensure regeneration of desired wildflowers, and tree species such as Pacific yew and western redcedar, and to address problems of browsing by feral sheep. Short-, mid-, and long-term management programs and strategies are indicated below.

D. Short-term Management Actions

Three active management initiatives are recommended in the short term (first five years):
1. To design and install a sign.
2. To initiate a regular program of annual monitoring.
3. To identify a group of dedicated islanders to check the site more often for inappropriate uses.

Sign

The sign for the Lasqueti Nature Reserve should be fairly modest in size, located unobtrusively, and using colors that blend with the natural environment. The logical location would be at the corner of Tucker Road and Main Road, at the old school site. One member of the Lasqueti community suggested that a sign might be located a short distance back from the road, among the trees, such that it would be visible from the road, but slightly screened.

The content of the sign might include the following information:
- Identification of the Lasqueti Nature Reserve and reference to Islands Trust Fund and to The Land Conservancy and the Nanaimo and Area Land Stewards Society Conservation Covenant
- Acknowledgment of the donor (if she wishes this to appear)
- Purpose of the Lasqueti Nature Reserve
- Request to please respect the Lasqueti Nature Reserve
- Permitted uses (quiet and non-consumptive nature appreciation and study)
- Other uses not permitted
- Map of Lasqueti Nature Reserve showing boundaries
- Contact phone number for the Islands Trust Fund.

Monitoring Program

A site visit for monitoring the condition of the Lasqueti Nature Reserve should occur once a year. It may turn out that less frequent monitoring will be sufficient in the longer

term. The main factors to check in annual monitoring are whether any inappropriate uses are occurring that may compromise the conservation values of the Reserve, to document the flowering plants and the extent to which browsing by feral sheep is affecting vegetation. Particular indicators of excessive browsing are:

- heavy browsing on sword fern,
- damage to seedlings of western redcedar,
- suppression or elimination of flowering plants on the rock outcrops.

Dedicated Islanders

At present, the awareness in the local community of the Reserve and sense of stewardship towards it, are probably sufficient to ensure that any significant damaging activity on the Reserve would soon be noticed. Most likely, a person who knew and cared about the Reserve and who noticed such activities, would either speak directly to the person responsible or notify the Islands Trust Fund, as appropriate. However, it might be a useful safety precaution to actively increase local awareness of the Reserve and cultivate a sense of responsibility for it. A simple inexpensive way to do this would be for the Islands Trust Fund to write a brief thank-you note to each of the local community members who attended the open house session, asking them to keep an eye out for any inappropriate activities, and to pass the word on to others who might be interested and supportive.

If the regular monitoring program discloses a need for greater vigilance, it would be possible to further increase local awareness and commitment. For example, this could be accomplished by hosting a guided nature walk during favorable weather, or involving the school in some form of nature study activity.

E. MID-TERM AND LONG-TERM STRATEGIES

In the mid-term (five to ten years), it might be beneficial to undertake research relating to regeneration of desired tree species that may not regenerate naturally in great abundance, or may be subject to browsing. This might include Pacific yew, western redcedar, and bigleaf maple. The first step would be to determine whether a problem exists (i.e., is the natural regeneration of these species inadequate), and the subsequent steps might include developing and implementing a plan to regenerate these species as required.

In the mid to long-term it may be beneficial to build enclosures (fences) around the most sheep sensitive parts of the Reserve. This has been done at the Ecological Reserve on Lasqueti with immediate results.

In the long-term (ten to twenty-five years) it may prove necessary to develop strategies for impact management from feral sheep, if monitoring indicates that the impact is excessive.

REFERENCES

Green, R.N. and K. Klinka. 1994. A Field Guide To Site Identification And Interpretation For The Vancouver Forest Region. British Columbia Ministry of Forests. Victoria, B.C.

Mason, Elda.1975. Lasqueti Island: History and Memory. Byron Mason, Lantzville, B.C.

APPENDIX 1. BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION

Ecosystem classification, using the B.C. Ministry of Forests (MoF) Biogeoclimatic Ecosystem Classification (BEC) system, provides the basis for ecosystem conservation and management in this plan. The BEC system has three levels: Regional, Local, and Chronological. The Regional and Local levels are used in this plan.

1) Regional level

The regional level of classification is based on regional climate, as inferred from characteristic plant communities and soil/vegetation relationships. A **biogeoclimatic subzone** has a distinct climax (or near-climax) plant association on zonal sites. (A zonal site is one that is neither strongly water-shedding nor water receiving, and thus reflects the influence of the regional climate.)

All of Lasqueti Island falls within the Coastal Douglas-fir moist maritime biogeoclimatic subzone (CDFmm). In this subzone, the climate is strongly affected by the rainshadow effect of Vancouver Island. In the summer, periods of drought over 4 weeks in duration are common. High temperatures and the lack of precipitation combine to cause moisture deficits, which can be pronounced on south-facing slopes, coarse-textured or shallow soils, and upper slopes. The maritime influence moderates seasonal temperature ranges. In the CDFmm, Douglas-fir behaves as a rather shade-tolerant species, forming self-replicating climax stands on zonal sites, and tolerating considerable overtopping by deciduous and coniferous species on fresh to moist sites.

2) Local level

Within an area having a uniform regional climate (such as the CDFmm subzone), local features such as topography, soils, aspect, and slope act together to create an environment with a certain potential to support plants. A forest **site** is defined as an area of the landscape that is relatively uniform in climate, topography, soils, etc., and so has the potential to support a certain characteristic plant community. Biogeoclimatic site classification groups together similar physical environments, but it does so on the basis of their biotic potential.

A **site series** is the group of all sites, within one subzone, that have similar or equivalent physical properties, and the same vegetation potential. For example, all sites in the CDFmm subzone with the potential to develop a climax community dominated by Douglas-fir with an understory of salal and other characteristic species would belong to the **CDFmm/Douglas-fir - Salal** site series. (Since all of Lasqueti is in the CDFmm, this is shortened to **Douglas-fir - Salal** (or **Fd - Salal**) for convenience).

Note that the tree species or understory plant for which the site is named may be absent from the site if the vegetation is not at late seral or climax conditions. For example, sites in the **Western redcedar - grand fir - foamflower** site series are often dominated by red alder originating after logging, while foamflower may be absent due to browsing by feral sheep, or other circumstances.

A **site type** is a finer subdivision of a site series, distinguished according to soil or topographic features that are considered important for management purposes. For example, all sites in the Fd - Salal site series that have shallow soils (soil less than 50 cm deep) belong to the **CDFmm/Douglas-fir - Salal/shallow** site type. For some site series, only one site type was recognised in this mapping project. Table 1 gives definitions of site type adjectives.

Table 1. Definitions of site type adjectives.

Adjective	Definition
rocky	sites that have exposed bedrock on > 25% of the ground surface and rooting depth < 25 cm.
shallow	(sh) soils that are < 50 cm deep
coarse >	(c) loamy soil texture and > 70% coarse fragments or sandy soil texture and 35% coarse fragments.
slope	(sl) slope between 35% and 70% gradient
skeletal	(sk) soils with > 35% coarse fragments by volume
sandy	(s) soils with sandy texture
loamy	(l) soils with loamy texture
organic	(or) sites with organic soil (> 30% organic matter)

3) Edatopic grid

A terrestrial ecosystem is composed of vegetation, animals, micro-organisms, and their physical environment. The physical environment (the site) can be conceptually simplified into three main elements: climate, soil moisture regime, and soil nutrient regime. Within a subzone, climate is relatively uniform. Therefore, the two main variables that describe local differences in forest sites are soil moisture regime and soil nutrient regime.

The relation between these two variables can be drawn on a graph, called an **edatopic grid**, illustrating how soil moisture and nutrient regimes vary among the different site series (Figure 1). Typically, these two soil properties tend to vary together. In other words, dry sites are often poor in nutrients, and moist sites are much richer. For example, the very dry and nutrient poor sites (FdPl - Arbutus) occur much more often than the very dry, nutrient-rich site series (Fd - Oniongrass). Similarly, the slightly dry to fresh, nutrient-poor site series (CwFd - Kindbergia); and the wet, nutrient-poor site series (Pl - Sphagnum) are rather rare.

In addition to the main edatopic grid, a special grid is needed to illustrate the sites affected by a strongly fluctuating water table (also in Figure 1). Because of the pronounced summer drought in the CDF zone, there are very few sites that remain moist or wet throughout the summer. Typically, sites in low-lying flat areas or depressions have a water table that fluctuates strongly with the seasons, being at or near the surface in winter, but dropping or drying up altogether in summer.

4) Topographic sequence

The site series recognised within a subzone cover the range and diversity of ecosystems found in the landscape. These ecosystems usually occur in a somewhat predictable pattern on the landscape. Figure 2 shows a typical topographic sequence on Lasqueti Island.

Figure 1. Edatopic grid showing the site series of the CDFmm subzone (above). The site series used in this report are shaded to show their map colours. A separate grid shows sites affected by a strongly fluctuating water table. (Source: Green and Klinka 1994.)

Figure 2. A cross-section of a hypothetical, typical portion of the landscape of Lasqueti Island, showing the usual topographic locations of some of the more common site types. (Drawn by Doug Hopwood)

APPENDIX 2. DESCRIPTIONS OF SITE SERIES AND TYPES

As described in Appendix 1, Biogeoclimatic Site Classification forms the basis for ecological forest management. The land is classified into Site Types, with each Site Type representing a unique type of physical environment (See Map 2). This Appendix provides a description of each Site Type. Note that these are general descriptions, and may not fully describe each particular area that belongs to a given site type.

Douglas-fir - Shore pine - Arbutus site series (02; FdPl - Arbutus)

This site series has a very dry soil moisture regime, and a very poor to medium (but most commonly poor) soil nutrient regime. The tree canopy is discontinuous because of frequent rock outcrops and patches of very shallow soil. The tree canopy is dominated by Douglas-fir, with Shore pine and arbutus present as minor components. Western redcedar may be present in pockets of deeper soil, but it is not vigorous. Trees seldom reach over 15 metres in height, although some old Douglas-firs may be over a meter in diameter and achieve a certain venerable and gnarled magnificence. Rocky mountain juniper is an occasional species on sunny, exposed sites near the ocean.

The sparse shrub layer may include ocean spray, baldhip rose, and red huckleberry. The moss layer is well developed in places, and includes *Polytrichum juniperinum, Hylocomium splendens, Pleurozium schreberii, and Homalathecium megaptillium.*

In some areas on Lasqueti or the neighbouring islands, a variety of spring wildflowers such as blue-eyed Mary, poison camas, and sea blush are found in the FdPl - Arbutus site series. However, these open spaces are favoured by the feral sheep. When browsing is excessive, the vegetation is kept cropped very close to the ground, and the herb layer is dominated by unpalatable exotic species such as foxglove and mullein. Only one site type was recognised in this site series.

FdPl - Arbutus/rocky site type (02/r)

Description: This site type occurs on hilltops, ridges, upper slopes, and rocky shoreline areas, where soils are shallow and coarse textured, and rock outcrops are common. The B.C. Ministry of Environment Wildlife Branch lists arbutus forests as a habitat of concern that should be conserved. Sites in this series often have very high aesthetic value, but are sensitive to heavy recreational use.

Critical site factors: Shallow soil, rocky terrain, slow growth, regeneration difficulties, conservation value, high aesthetic and recreational values.

Major species: Douglas-fir, Shore pine, arbutus

Douglas-fir - Salal site series
(01; Fd - Salal)

This is the zonal site series. In other words, it is neither a strongly water-receiving nor a water-shedding site, so its climax plant community reflects the effects of the regional climate. It has a moderately dry soil moisture regime and a very poor to medium nutrient regime.

The vegetation on these sites is usually dominated by Douglas-fir as the major tree species with minor amounts of Shore pine, western redcedar, and western hemlock. The understory is dominated by of salal, although it is not always very vigorous. Other common shrubs include red huckleberry, baldhip rose, and sometimes ocean spray. The moss layer is well developed in some areas, and includes *Kindbergia oregana* and *Hylocomium splendens* as the major species, with *Rhytidiadelphus triquetris* and *Pleurozium schreberii* also occurring. Two distinct site types were recognised.

Fd - Salal/shallow site type (01/sh)

Description: This site type occurs on gentle to steep upper and middle slopes. The soils are shallow deposits overlying bedrock (less than 50 cm deep) derived primarily from morainal and colluvial deposits, and are well-drained, with sandy to loamy textures and variable coarse fragment content. The soil moisture regime of this site type is moderately dry, and the soil nutrient regime is poor. On this site type, Douglas-fir behaves as a shade-tolerant tree species, capable of regenerating under the small canopy gap created by the death of a single tree. In the undisturbed condition, Douglas-fir can form uneven-aged stands with many age classes represented, from fire-scarred veterans to young seedlings. Trees may reach heights of 30 metres or more, and some older Douglas-firs may reach diameters over one metre. Tree growth is usually fairly slow, due to the pronounced growing season moisture deficit. Regeneration can be impeded by droughty conditions, especially on south and west aspects, or by excessive browsing. Understory vegetation tends to be patchy and not very vigorous.

Critical site factors: Shallow soils, slow growth, rough terrain, regeneration difficulty, high aesthetic value.

Major species: Douglas-fir

Minor species: Shore pine and arbutus

Fd - Salal/coarse site type (01/c)
Description: This site type occurs on gentle middle slopes, and in narrow valleys between rock outcrops. Soils are well drained and derived from coarse sandy-textured marine deposits with variable coarse fragment content. Douglas-fir is the dominant tree species, although Shore pine, western hemlock and western redcedar may form minor components of stands. Stands on this site type tend to be dense, and even-aged stands of Douglas-fir sometimes occur naturally. Unlike the Fd - Salal/shallow site type, these sites can support vigorous growth of salal.
Critical site factors: Slow growth, salal competition
Major species: Douglas-fir
Minor species: Western redcedar, Shore pine, arbutus.

Douglas-fir - Grand fir - Oregon-grape site series
(04; FdBg - Oregon-grape)

This site series has a moderately dry moisture regime and a rich to very rich nutrient regime. Douglas-fir is usually the dominant tree species, and variable amounts of western redcedar and grand fir are usually present. This site series can include a range of soil and terrain conditions, from steep to very gentle slopes. Two site types were recognised. They have similar vegetation potential.

FdBg - Oregon grape/sandy site type (04/s)

Description: These sites occur on gentle middle to lower slopes. The soils are derived from marine deposits of sandy texture, with a variable coarse fragment content, and sometimes an overlying veneer of colluvial materials. Temporary seepage, or fine-textured marine soils may be present, resulting in high moisture content. In either case, the result is only a short period of moisture deficit in the growing season, and forest productivity is quite high. Common tree species in the original forest included Douglas-fir, with moderate components of western redcedar and grand fir. These sites are often occupied by seral stands of red alder that regenerated after logging, or sometimes mixed alder and conifer stands. Red alder does not attain its most vigorous growth on these sites. Understory vegetation includes shrubs such as salal (usually associated with decaying wood) Oregon-grape, sword fern, and red huckleberry. Herbs such as broad-leaved starflower and sweet-scented bedstraw are sometimes present. The patchy moss layer may include *Kindbergia oregana*, *Plagiomnium insigne*, *Rhizomnium glabrescens*, and *Leucolepis menziesii*.

Critical site factors: Medium to good productivity and growth.

Major species: Douglas-fir, western redcedar. Because of their different light requirements and rooting patterns, mixed stands of Douglas-fir and western redcedar can utilise site resources more than a single-species stand.

Minor species: Grand fir, western hemlock, red alder, bigleaf maple, Pacific yew.

FdBg - Oregon grape/slope skeletal site type (04/sl-sk)

Description: These sites occur on steep slopes at the base of hills and rock outcrops. The soils are derived from colluvial materials (rock fragments that have arrived by gravity from upslope areas) with a coarse texture. These coarse materials overlay finer textured marine soil deposits. These sites receive seepage water from upslope areas, which is detained by the finer textured soil materials below the surface. As a result, these sites may be more productive than their rocky and steep appearance would suggest. Understory vegetation on these sites is usually sparse, but may include Oregon grape, and occasional specimens of sword fern. Common tree species include Douglas-fir, western redcedar and grand fir. These sites favour the growth of some fine large specimens of bigleaf maple.

Critical site factors: Steep slope, regeneration difficulty.

Major species: Douglas-fir, western redcedar.

Minor species: grand fir, bigleaf maple.

Western redcedar - Grand fir - Foamflower site series
(06; CwBg - Foamflower)

This site series has a slightly dry to fresh soil moisture regime, and a rich to very rich soil nutrient regime. The original forest on these sites included very large Douglas-fir and western redcedar trees over 2 metres in diameter, as well as variable amounts of grand fir, western hemlock, and bigleaf maple. Douglas-fir is unlikely to grow well beneath an intact forest canopy on this site series, and probably depended on periodic fire or windstorm disturbances to create good conditions for its regeneration. Western redcedar occurs as a tolerant understory species, and its growth is slow until an opening occurs in the canopy above.

In some cases these sites are now occupied by successional stands of red alder which regenerated after logging. Alder grows well on these sites and can reach large dimensions. Conifer species may occur under the alder canopy. In this case, the conifers rely heavily on photosynthesis in winter when the alders are bare. Conifer growth is slow under an alder canopy. In other cases these sites may regenerate to nearly pure stands of Douglas-fir after logging.

Ordinarily these sites have a vigorous and dense cover of sword fern. The herb layer includes three-leafed foamflower and trailing blackberry. The moss layer is not well developed but may include *Leucolepis menziesii* and *Plagiomnium insigne*. Under extreme browsing pressure the understory can become completely bare. One site type was recognised.

CwBg - Foamflower/loamy site type (06/l)

Description: This site type occurs on gentle lower slopes and undulating or level bottomlands. Soils are derived from stratified marine deposits, with an impermeable clay layer in the lower profile, creating imperfect drainage. Textures in the upper horizon are generally loamy or silty, with few coarse fragments. These sites are very productive for tree growth.

Critical site factors: High productivity, moderate soil compaction hazard, moderate brush competition hazard, high conservation value, potentially high aesthetic value of large diameter trees.

Major species: Western redcedar, Douglas-fir, red alder.

Minor species: Grand fir, western hemlock, bigleaf maple, Pacific yew.

Shore pine - sphagnum site series
(10; Pl - Sphagnum)

This site series is distinguished by a build-up of undecomposed or partially decomposed organic material, often derived from sphagnum moss, but also from other wetland plants. The soil nutrient regime is very poor to poor and the soil moisture regime is wet. Although water is abundantly present, it does not move through the soil on these sites to any great degree. As a result, plants on these sites must depend largely on the nutrients available in rain water, plus what small amounts become available through litterfall and decomposition, animal droppings, etc. The low nutrient input combined with the acidifying properties of sphagnum moss make for an unusual habitat, occupied by a distinctive plant community.

The plant community is dominated by shrub plants such as salal, labrador tea, and swamp laurel. The discontinuous and stunted tree layer consists primarily of Shore pine, with lesser amounts of western hemlock, western redcedar, and very occasionally white pine. The deep, spongy moss layer includes *Sphagnum girgensohnii, Rhytidiadelphus loreus, Hylocomium splendens* and other species. In some cases sundews and bog cranberry may be present. Only one site type was recognised.

Pl - Sphagnum/organic site type (10/or)

Description: This site type occurs in flats or depressions away from the influence of nutrient rich seepage water. The soils consist of deep organic deposits, and the growth of trees is extremely slow. These sites have high aesthetic values, especially in spring when the labrador tea and swamp laurel are in bloom. They also have high conservation value, as the habitat of a number of plant species that are restricted to this kind of site. These ecosystems are sensitive to alterations in water table or water flows. Draining or flooding is likely to lead to a shift to a more common form of plant community.

Critical site factors: saturated soils (will not support machinery), high aesthetic and conservation value, very slow growth, sensitive to hydrologic change.

Major species: Shore pine.

Minor species: western redcedar, western hemlock, western white pine.

APPENDIX 3. MAPS

Lasqueti Nature Reserve
Map 2. Biogeoclimatic Site Types

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Site Types

01/sh	Douglas-fir - Salal / shallow
01/sl-sh	Douglas-fir - Salal / slope - shallow
01/c	Douglas-fir - Salal / coarse
02/r	Douglas-fir - Shore pine - arbutus / rocky
04/s	Douglas-fir - grand fir - Oregon grape / sandy
04/sl-sk	Douglas-fir - grand fir - Oregon grape / slope - skeletal
06/l	Western redcedar - grand fir - foamflower / loamy
10/o	Shore pine - sphagnum / organic

R = rock outcrop

Not to scale (approximate scale 1:5000)

Lasqueti Nature Reserve
Map 3. Vegetation Types

N
⇑

Not to scale (approximate scale 1:5000)

Lasqueti Nature Reserve
Map 4. Special Features

N
⇑

Not to scale (approximate scale 1:5000)