

Virgin Douglas Fir Forest on Saturna Island, British Columbia

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A survey of the Saturna Island Ecological Reserve provided a description of its virgin Douglas Fir (*Pseudotsuga menziesii*) forest. The vegetation was quantitatively analyzed with respect to structure and composition. The tree stratum dominated the structure of this reserve, followed secondarily by the low-shrub and bryophyte strata. *Pseudotsuga menziesii* was the most important tree species with *Tsuga heterophylla* (Western Hemlock) and *Thuja plicata* (Western Red Cedar) probably limited by low precipitation and soil texture. *Gaultheria shallon* (Salal) was the dominant understory species with *Eurhynchium oregonum* and *Hylacomium splendens* dominating the bryophyte stratum.

Key Words: British Columbia, coniferous forests, ecological reserve, forest structure, old-growth forests, *Pseudotsuga menziesii*.

87.5 cm

Ecological reserves have been established in British Columbia primarily for scientific research and related educational purposes pertaining to our natural environment (Krajina 1973). Included within this proclamation (Ecological Reserves Act 1971) is the conservation of natural communities over a long period of time to prevent their alteration by man. The preservation of rare or endangered native plants and animals in their natural habitat is of paramount importance in this concept of conservation.

The selection of reserves has been based largely on the previous ecological classification of the province into biogeoclimatic zones. Saturna Island and its ecological reserve, composed of virgin coastal Douglas Fir forest, are located in the dry subzone of the Coastal Douglas Fir (CDF) zone (Krajina 1965, 1969). An IBP (International Biological Programme) survey of the area was completed in 1968 by T.M.C. Taylor and T.C. Brayshaw (summary sheet of Region 1, Area 4 in La Roi et al. 1976).

The objective of this study was to provide a detailed ecological description of the virgin Douglas Fir forest on this reserve. This type of description is essential to the understanding and management of ecological reserves.

Study Area

Saturna Island, comprising approximately 28 km², is the most southern Canadian island of

the Gulf Islands in the Strait of Georgia. It lies between 48°46'–48°49'N and 123°2'–123°13'W. The Saturna Island Ecological Reserve is composed of two quartersections and encompasses 1.3 km². It has a range of elevation of from 150 to 320 m. Figure 1 shows the interior of this Douglas Fir forest.

Weather data for this region are lacking. The study area is characterized by mild temperatures with prolonged cloudy periods, especially in winter, and a small range of temperature seasonally. Fairly wet but mild winters and warm dry summers are prevalent with a long frost-free season. Annual total precipitation is less than 90 cm because of the rain shadow effect of the Olympic Mountains and higher elevations on Vancouver Island.

Methods

Vegetation sampling was done during July and August 1972. The vegetation was analyzed by strata. The tree, shrub, and high-herb strata were sampled (restricted random sampling scheme) by 21 plots, 10 × 20 m each. The low-herb-dwarf-shrub stratum and bryophyte-lichen stratum were sampled by 210 subplots, each 1 × 1 m; 10 were placed systematically within each large plot.

Data were obtained for diameters of all trees over 10 cm dbh (diameter at breast height) in the plots by species; heights of representative trees in plots using a Blume-Leiss altimeter; density of

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FIGURE 1. Interior of stand of trees representative of the virgin Douglas Fir forest on the Saturna Island Ecological Reserve.

tree saplings (individuals < 10 cm dbh) by species; density of tree seedlings in subplots by species; percent cover estimates for all plant species in their respective plots and subplots using the coverage scale of Daubenmire (1959, 1968). A complete plant species list for the Saturna Island Ecological Reserve is available from Depository of Unpublished Data, CISTI, National Research Council of Canada, Ottawa, Canada K1A 0S2. Vascular plant nomenclature follows Hitchcock and Cronquist (1973), that of bryophytes follows Lawton (1971) and Stotler and Crandall-Stotler (1977), and that of lichens follows Hale and Culbertson (1970).

Results

Importance values, absolute measurements, and diameter size classes for the tree stratum are presented in Table 1. The importance value is a summation of percentages of relative density + relative basal area + relative frequency (after Curtis and McIntosh 1951; Bray and Curtis

1957; Curtis 1959). *Pseudotsuga menziesii* has the highest importance value at 190 and the most consistent distribution of size classes throughout the stand. The average percent cover values for trees and saplings are presented in Figure 2. Douglas Fir trees are located on every plot and exhibit consistently high cover values throughout the reserve. This dominant species has a mean cover value of 52%. Unfortunately, it was not possible to obtain core samples from the protected trees on this reserve (regulations prohibit any disturbance of vegetation on ecological reserves), and hence there are no estimates of stand age. Average percent cover values for the three species in the low-shrub stratum and the two fern species in the high-herb stratum are in Figure 2. *Gaultheria shallon* (Salal) is distributed throughout most of the reserve and completely dominates the low-shrub layer. The average percent cover values for the most dominant species in the low-herb - dwarf-shrub and bryophyte strata are presented in

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TABLE 1. Importance values, absolute measurements, and diameter size classes for tree species in the Saturna Island Ecological Reserve, based on measurements in 21 plots, 10 x 20 m each

Species	Importance value* (0-100)	Absolute density (ha ⁻¹)	Absolute basal area (m ² ha ⁻¹)	Absolute frequency (%)	Seedlings	<10 cm dbh	10 cm dbh size class distribution (cm)						Max. ht (cm)	
							10	15	20	30	41	51		61
<i>Pseudotsuga menziesii</i>	189.8	619	39.3	100	3,100	469	162	101	157	101	64	21	5	43.1
<i>Tsuga heterophylla</i>	63.5	154	8.7	62	6,600	429	38	40	33	21	17	5	0	35.1
<i>Thuja plicata</i>	46.7	123	6.6	43	900	174	50	19	38	2	7	5	2	44.2
Total all species	300.0	896	54.6	205	10,600	1272	250	169	228	123	88	31	7	

*Importance value = Relative density + relative basal area + relative frequency (after Curtis and McIntosh 1951, Bray and Curtis 1957, Curtis 1959)

Figure 3. *Eurhynchium oregonum* completely dominates the bryophyte layer with a mean coverage of 23%. *Hylocomium splendens* is the second most important species with a mean coverage of 5%.

Discussion

Pseudotsuga menziesii is the dominant tree species, constituting the uppermost layer of the forest canopy. This species is suitably adapted to all possible moisture and nutrient levels controlled by the soil and topography on this reserve. The highest productivity of the species

in this dry subzone of the CDF zone is a site ^{low yield?} index of 45 to 48 m at 100 yr. Trees near the base of the slope on this reserve will probably attain this size class at 100 yr. Because this dry subzone is the least productive forest area of all the coastal parts of the mesothermal climatic region in British Columbia (Krajina 1969), *Pseudotsuga menziesii* does not achieve the growth reached by this species in more favorable regions.

Tsuga heterophylla (Western Hemlock) is in low abundance and, in general, trees of this species are smaller than those of *Pseudotsuga*

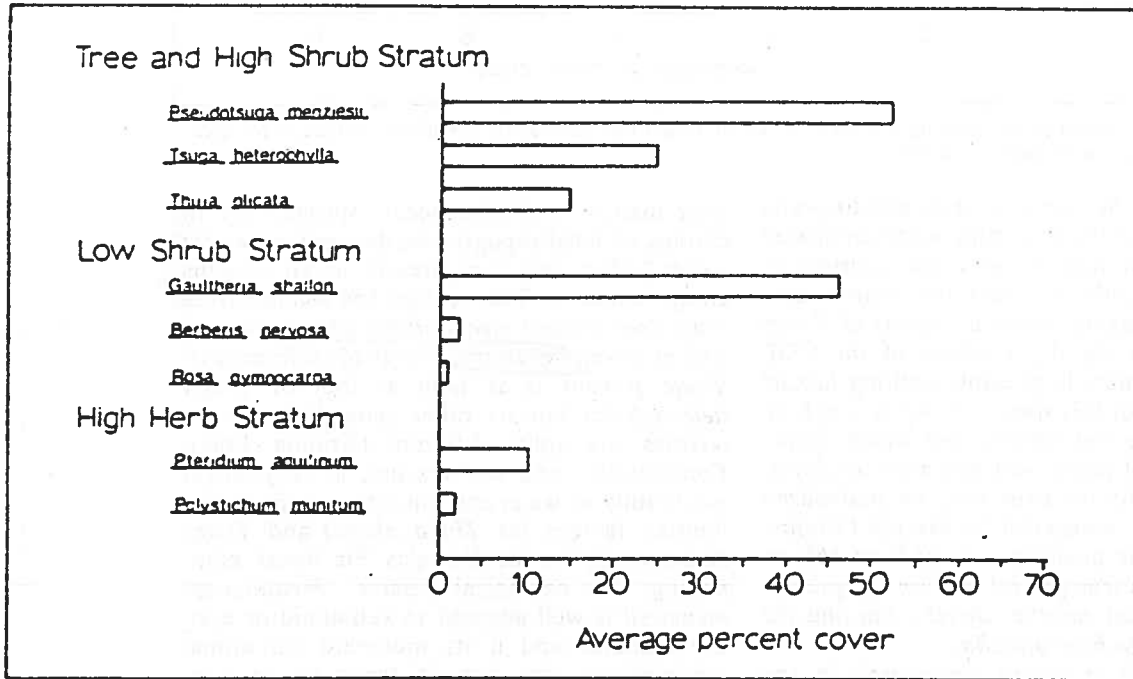


FIGURE 2. Average percent cover values for tree, low-shrub, and high-herb strata in the Saturna Island Ecological Reserve, based on estimates in plots and subplots.

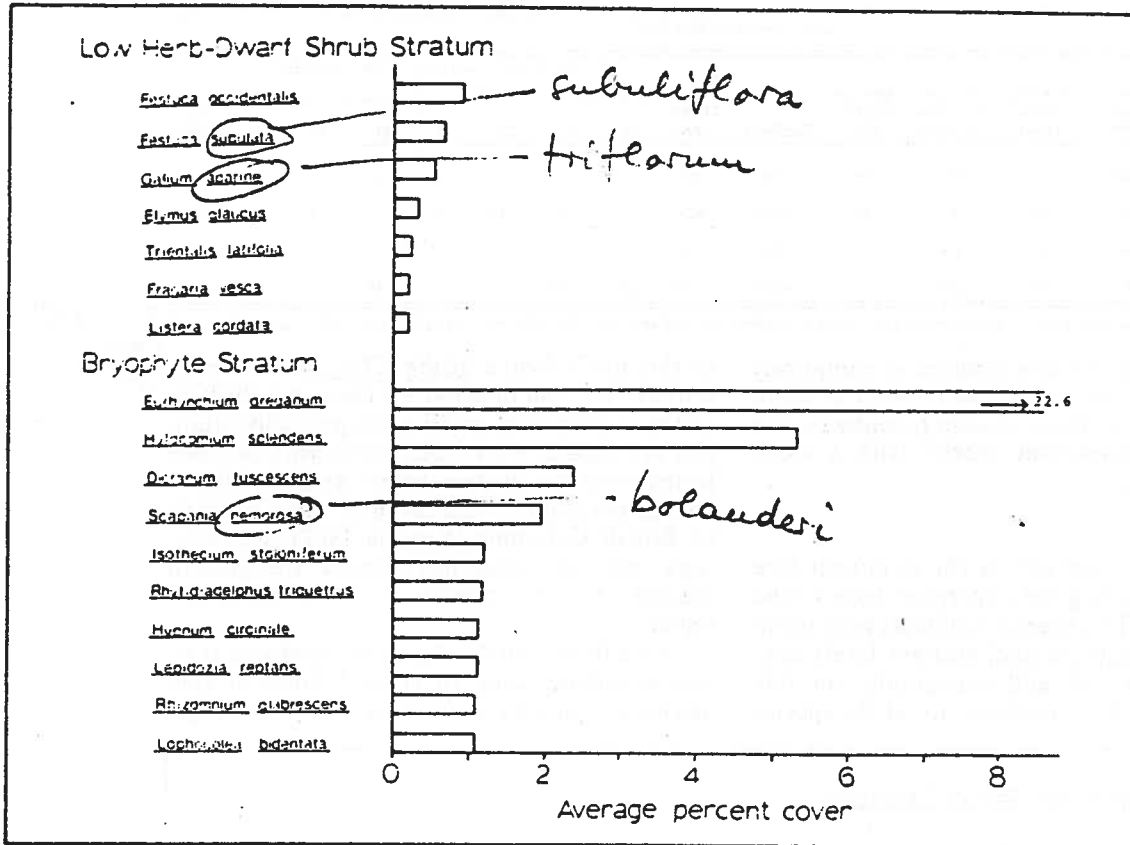


FIGURE 3. Average percent cover values for low-herb dwarf-shrub and bryophyte strata in the Saturna Island Ecological Reserve, based on estimates in subplots.

menziesii. Most Western Hemlock seedlings and saplings are growing on rotting wood compared with the soil or litter habitat characteristic of Douglas Fir seedlings. This low density and growth on decaying wood is typical of *Tsuga heterophylla* in the dry subzone of the CDF zone, which generally presents limiting factors for the growth of this species. It has a very high shade tolerance and prefers soils which supply low amounts of fairly well balanced nutrients, and these conditions exist only on podzolized soils frequently moistened by rainfall (Krajina 1969). Adequate precipitation (at least 165 cm annually) and a true podzol soil are not present on the ecological reserve, thereby limiting the success of *Tsuga heterophylla*.

Thuja plicata is found downslope in the northern half of the reserve in association with *Tsuga heterophylla* and the dominant *Pseudotsuga menziesii*.

It also occurs sporadically in clumps in local topographic depressions where some surface water is present in all seasons except summer. This species has smaller trees than *Pseudotsuga menziesii* but does grow very well at lower elevations. The shade tolerance of *Thuja plicata* is as high as that of *Tsuga heterophylla* but its other ecological characteristics are quite different (Krajina 1969). Precipitation and soil texture, as they affect availability of water and nutrients, are probably limiting factors for *Thuja plicata* and *Tsuga heterophylla* in the Douglas Fir forest comprising this ecological reserve. *Pseudotsuga menziesii* is well adapted to subhumid or even dry climates and if its moderate nutritional requirements are met, it tends to be very successful in both dominance and abundance, relative to other species in this study area.

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The associations of the Coastal Douglas Fir zone have been studied and described by Mueller-Dombois (1959) with reference to the Nanaimo Lakes region and adjacent valleys. But there have been no plant community studies on this biogeoclimatic zone on the Gulf Islands.

Three of the seven recognized associations of the Coastal Douglas Fir zone (dry subzone) are present on this ecological reserve. The Salal, moss, and Sword Fern (*Polystichum munitum*) associations are all represented. The Salal association (ca. 65% relative area) is most widespread and occurs with all three tree species. Herbs and bryophytes are suppressed owing to the presence of *Gaultheria shallon*. The moss association (ca. 25% relative area) alternates with Salal in a patchy distribution throughout the reserve. *Eurhynchium oregonum* and *Hylacomium splendens* best represent this community in their appearance as mats on the forest floor.

The Sword Fern association (ca. 10% relative area) is probably best represented on this reserve at lower elevations. Here *Pseudotsuga menziesii* achieves its best growth in both height and diameter. *Thuja plicata* also follows this trend but is still the subdominant species. *Polystichum munitum* is not abundant in the forest but exhibits its highest cover value in this part of the reserve.

A brief discussion of the probable history and future successional status of this forest is of importance to the understanding and management of this ecological reserve. There are a few isolated individuals of *Pseudotsuga menziesii* scattered throughout the forest, which are much larger and older than the majority of trees. Most of these trees, dead and alive, show evidence of fire damage. Also, traces of burnt logs and wood are distributed over the reserve. Therefore, at least part of the area has experienced past fire, which probably affected the growth of trees in the present-day forest. It is possible that the very large trees that survived the fire provided a seed source for regrowth of the Douglas Fir forest. Logging in the past is evident on the extreme eastern part of the reserve but is definitely absent from all other areas.

The future forest will continue to be dominated by *Pseudotsuga menziesii*. Its seedlings are the most evenly distributed of all species and

exhibit shade tolerance on all available habitats. The high density of seedlings and saplings of *Tsuga heterophylla* and *Thuja plicata* is due to clumping in restricted habitats, which contrasts with the widespread occurrence of *Pseudotsuga menziesii*. Both these species will remain restricted to specific sites in correlation with water and nutrient requirements.

In the understory, the pattern of Salal, mosses, and open areas should continue to predominate, with suppressed herb and reduced shrub layers due to the shade cast by *Gaultheria shallon*. It is possible that Salal may expand and shade out regions of the moss association if soil moisture and topographic variation do not continue to support this Salal-moss distribution.

Finally, the browsing of vegetation by Columbian Black-tailed Deer (*Odocoileus hemionus columbianus*) may become important if the population density of these animals increases. My sightings of deer during fieldwork indicated that these animals were very abundant throughout the reserve and on Saturna Island in general. The understory species, *Gaultheria shallon*, *Rosa gymnocarpa*, *Pteridium aquilinum*, and *Polystichum munitum* exhibited some degree of damage from browsing. Effects on tree seedlings were not noticeable, but according to J. Revel (1963 unpublished report, Faculty of Forestry, University of British Columbia) and Cowan and Guiget (1970), this species of deer prefers seedlings of Western Red Cedar and Douglas Fir. Western Hemlock is usually exempt from browsing. Therefore, the future successional status of this forest could be controlled by the effects of seedling browsing as well as the ecological tolerances already discussed for the three tree species. In addition, deer trails on some downslope regions of the reserve have disturbed the ground cover of mosses exposed to the passage of these animals.

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NO

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Salal!

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