ER 331
Urban Restoration and Sustainable Agriculture

Ecological Restoration on Certified Organic Farm

Pender Island, B.C

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Section 1 Introduction

1.1 Purpose of the Report & Document Organization

This report was written with the aim of describing a process of the restoration project in Pender Island, British Columbia. This report begins with Section 1 which describes the rational of this project while briefly introducing the ecological characteristics of the study area located within and around a certified organic farm on Pender. Then, the methods used are explained in Section 2. After summarizing the result of the site inspection in Section 3, the inventory results are analyzed to develop a restoration plan in Section 4, which include goals, objectives, and strategies for exotic plant species management and introduction of native plant species. In the future, Section 5 will provide information on how this plan has been implemented, and Section 6 will give a discussion on what further steps should be taken to achieve the objectives described in Section 4.

1.2 Study Area

The study area, which includes the restoration sites, the organic farm, and the reference sites, is located on the south side of Port Washington Rd on the North Pender Island (Figure 1). The North Pender is within the CDFmm (Coastal Douglas-fir moist maritime) biogeoclimatic zone which lies in the rain shadow of the Vancouver Island and Olympic mountains, at elevations below 150m above sea level (Nuszdorfer et al.1991).This zone is a unique ecosystem with high biodiversity values (Ward et al. 1998), representing only 0.3% of the total land area of B.C (Island Trust. 2007). It has warm, dry summers and mild, wet winters. On Pender, rainfall occurs mainly from October to April including a few days' snowfall. In 2007, the annual precipitation was 1030 mm (Pender Post. 2008).

Because of its attractive landscapes and mild climate, the natural ecosystems of North Pender have been disturbed by clearing for agriculture and human settlement. It is only in relatively undisturbed areas that we can see traces of old-growth trees such as Western redcedar (Thuja plicata). Today, the forest ecosystem is dominated by Douglas-fir (Pseudotsuga menziesii), with occurrences of Arbutus (Arbutus menziesii) on the sunny locations of upland forests along Port Washington Rd. Grand fir (Abies grandis) and Red alders (Alnus rubra) trees are observed at lower, moist sites, and Bigleaf maple (Acer macrophyllum) grows at relatively disturbed sites along the road sides. Garry oak (Quercus garryana) tree is rare but can be observed on dry, rocky cliffs or woodland such as the George Hill CRD Park.

In the forest understorey, the most common native plants are Salal (Gaultheria shallon), Oregon Grape (Mahonia nervosa) and Sword Fern (Polystichum munitum). Salmonberry (Rubus spectabilis), Nootka Rose (Rosa gymnocarpa), Ocean Spray (Holodiscus discolor), and Vanilla Leaf (Achlys triphylla) are also abundant in this area.

1.3 Rationale : Continual Fragmentation of Natural Ecosystems & Extirpation of Native Plant Species

North Pender Island continues to experience urban development due to human population pressure. The population of the North Pender has increased from 1020 in 1981 to 1776 in 2001 (Island Trust. 2004). Then, the permanent population has become 1996 in 2006, which is 12.4% of the population change (Island Tides.2007). As human population increases, lots are subject to further subdivision and rural development, and consequently natural ecosystems have been fragmented on many areas of the Island. Today, over two-third of the land area is designated for residential or agricultural use and only 15% has protected status. As a result, around three quarters of the island's land area is now classified as having been modified by human disturbance, with many of the remaining areas threatened by further fragmentation (Island Trust. 2007).

The land fragmentations will result in the degradation of natural ecosystems which provide specialized habitat and potential dispersal or colonization site for native species. Besides, the fragmentation changes the microenvironment at the fragment edge (Primack.2002), and altered light, temperature, wind, and humidity condition may create ideal "habitat" for invasive, exotic species which will displace native species through competition for resources.

In fact, at the restoration project site, non-native, exotic plant species with high dispersal abilities such as Himalayan Black Berry (Rubus discolor) and Leatherleaf Daphne (Daphne laureola) have become dominant species. Apparently they are out-competing the native vegetation and overshadowing native plant species such as Oregon grape (Mahonia nervosa and repens), Sword fern (Polystichum munitum) and Western Trillium (Trillium ovatum).

If exotic species were allowed to spread into the understorey communities of the forests on the Island, there will be a high risk of reducing the diversity of native species, both fauna and flora, due to habitat loss and altered compositions and functions of the ecosystems.

In order to protect the integrity of the native plant communities which are a vital component of natural ecosystems because they provide various ecological services to all living organisms on Pender, non-native exotic species have to be managed, and species composition and functioning of native plant communities should be restored through effective restoration planning and implementation by private landowners or land managers.

Section 2 Methods for the Site Inspection

2.1 Record with Study Site Map

In order to develop a plan for where to focus my restoration efforts, a pictorial overview of vegetation in and around the restoration site was drawn on a map based on my field observation. The dominant plant species, both native and non-native, were recorded and marked on the base map (Figure 2), which also includes boundaries and other resources such as farm crops.
A code name for each species, which consists of the first letters of the common name, was used for the base map. Tree Species Codes in Appendix

7.1 of the Field Manual for Describing Terrestrial Ecosystems (1998) were also used for marking tree species on the map.

The second site mapping was conducted using a compass and a tape measure in order to record the important permanent locations such as the restoration sites (plot 1-3), camera points for photo-point monitoring (A-D), and soil pits (A & B) (Figure 3). First, I measured the compass bearing from POC (Point of Center) 1 to POC 2, and POC 3 to POC 4, the both of which were S180º (magnetic azimuth: declination: 18º 25' as of June 14, 2005). POC 1-4 are marked by wood stakes which indicates the four corner boundaries of this property (Lot 1, Plan 22558, Section 23, Pender Island, Cowichan District). The distance between POC 1 and POC2 was 91.39m, and between POC 3 and POC 4 was 91.45m. The bearing from POC 1 toward POC 3 was S110 ºE and the distance was 44.52m. From POC 2 toward POC 4 was S110 ºE, with the distance being 44.47m.

In order to study the characteristics of plant communities in the study site, five sample plots were established: The three plots, which are the restoration project site - plot 1, 2 and 3, are found within the property of the organic farm. Plot 4, which is the reference site, is located within Ms.McMahon's property and around 45m from the south end of plot 1 and plot 2 (Figure 1). Plot 5 is located in the forest stand of Mr.Morrison's property, which is around 220m toward S280 ° W from the organic farm.

Each plot was laid out to become the equal size (20m by 20m square).
For example, in order to set up plot 1, I transected the border line (POC 1-POC 2) from POC 2 toward N 0° and stopped at the point of 20 m. From this

point, I traveled 20m on a bearing of E 90°, and then adjusted the compass to go on a bearing S 90°. By repeating this measuring until I came back to the staring point, I could establish a plot perimeter which is a 20m by 20m square. Plot 2, 3, 4, and 5 were established in the same way as this measuring method.

The location of each plot was determined in a subjective manner using an on-site, visual observation. The plant community of each plot was identified with a consideration that each plot is relatively homogeneous in terms of site characteristics such as slope, aspect, elevation, soil moisture content, vegetation cover, and so on. In other words, each plot covers a representative stand of the forest vegetations.

2.2 Monitoring by Photopoint Photographs

In order to monitor representative views of the restoration site, photopoint photographs have been recorded since 2003. Photopoint photographs are standardized pictures of target resources of management concern. I selected the monitoring sites at the forest edges of plot 1, 2, and 3 because the most of the exotic, invasive plants have been proliferating in those areas. It is expected that a visual comparison of invasive and native plants species will be provided by this monitoring method over years.

Pictures have been taken at close to the same date (May 3rd) from one year to the next. A camera with a 35mm lens was used. Pictures were taken from the four permanent photo points (camera position A-E) towards the seven permanent focal points F1-F7. The camera height was set at 1.5m, and 1.5m garden stakes were used to mark the focal points for the camera so that precise replication of the photopint can be achieved each year. Some close-up photos have also been taken as field observation dictated. The direction of the photo is shown with an arrow on the site map (Figure 3).

The following are the distance and direction from the permanent photo points to the focal points:

- From the photo point A to the focal point 1 (the north-east side of the forest edge in plot 1): (15m / S156ºE)

- From the photo point A to the focal point 2 (the north-west side of the forest edge in plot 2): (10.9m / S222ºW)

- From the photo point B to the focal point 3 (a center area of plot 2): (3.53m / S224ºW)

- From the photo point B to the focal point 4 (a new monitoring site in plot 2: habitat for Western Trillium) : (8.5m / S 243º W)

- From the photo point C to the focal point 5 (the east side of the forest edge in plot 1): (4.5 m / N 30ºE)

- From photo point D to the focal point 6 (the south edge of the forest in plot 1 and plot 2, where various kinds of introduced species have become dominant): (8.5m / N 280ºW)

- From the photo point E to the focal point 7 (a new monitoring site in plot 3): (11m / S 116º E)

2.3 Site Description by GIF

I conducted the ground inspection using Ground Inspection Form (GIF) of the Field Manual for Describing Terrestrial Ecosystems (Ministry of Environment, Lands and Parks, and Ministry of Forest. 1998) in order to characterize certain features of the study site and confirm the presence of ecosystem. This manual describes the coding standards for the data attributes on GIF. The ground inspection was conducted on April 22, 2005 for plot 1 and 2 ,May 22, 2005 for plot 5, May 22, 2007 for plot 3, and May 24, 2007 for plot 4 (Figure 4-8).

2.4 Vegetation Survey for Understorey Shrubs and Herbs

2.4.1 Ecological Site Description by Supplementary Vegetation Survey

For the purpose of supporting the data resulted from the vegetation sampling by the Ground Inspection Form, an additional vegetation survey was conducted such as;

- Tree Density: Count the number of trees in plot 1-5 to calculate the relative tree density in each plot:

Relative density of tree species A= the number of tree species A in a sample plot / the number of all trees sampled in the same plot.

* Note: The data for saplings (less than 1.3m but more than 20cm in height) was separately collected from the data for trees (more than 1.3m in height).

➢ Size of Tree (Tree Height and Basal Area)

To interpret the structural features of the forest stand in the study site, the tree height and the basal area for each tree species were calculated;

In each sample plot, the height of 3 main canopy trees was measured.
A clinometer was used to measure the angle to the top of the tree from a known distance from that tree.

- Tree Height = Horizontal distance multiplied by Tangent of the angle + Eye height (1.5m)

- Measure the mean basal area of each tree species in each plot = 22/7 (the ratio of the circumference of a circle to its diameter) multiplied by {the mean dbh(diameter at breast height) / 2} ^{2}

2.4.2 Estimate the Coverage of Understory Plants by Line Intercept Method

In order to describe the species composition in the understorey of plot 1-5, the Line Intercept Method was used. This method enables us to estimate the plant cover (%), which is the proportion of the ground occupied by perpendicular projection of aerial plant parts. The specific purpose of this survey is to compare the abundance of non-native and native plant species in the restoration site (plot 1, 2 and 3) and the reference site (plot 4 and 5).

In order to measure the cover of all the plants, by species, I kept a running tally of different species projecting over (or under) the line as I went on each line which transverses the sample plot 1-5 at each 5m intervals.
Then, I calculated the total length (cm) of the line covered by each species in order to estimate the proportion of the vegetation cover (%) in each plot.

Because the number of multiple flowering stems and rhizomatous plant, which spread from creeping underground roots and often represent a single plant, may not reflect the number of individual plants, the plant density (the number of plants per unit of ground surface) was not measured.

2.4.3 Description of the Soil at the Restoration Site

In order to get more specific information on the physical features associated with the soil before selecting native species which will be planted at the restoration project site, the soil pit was excavated up to 50 cm in depth using garden tools, leaving the face and sides around the ground surface undisturbed. The location of the pits A, B, and C was selected at a core area of plot 1, 2, and 3, where the plant community was rather homogeneous with respect to vegetation cover and soil moisture. While excavating, I observed:

- Organic horizon depths and fabric
- Mineral horizon depths, colours, structure, and texture changes
- Percentage of coarse fragments
- Rooting abundance, depth, and restrictions
- Mottling, water seepage, or water table.
- Fauna (earthworms, beetles, termites, and so on)

Then I recorded what I have observed (Figure 9-11) referring to the Soil Description Form of the Field Manual for Describing Terrestrial Ecosystems (B.C. Ministry of Environment, Lands, and Parks 1998).

Section 3 Results and Site Descriptions (Plot 1-5)

3.1: Ground Inspection in plot 1 based on the Ground Inspection Form (GIF) of the Field Manual for Describing Terrestrial Ecosystems

Plot 1 (20m by 20m) is located at the toe of a valley which extends along Port Washington Road. Part of the forest in this area have been cleared and developed for residential or agricultural purposes. The forest floor had significantly been disturbed by poultry grazing from 2002 to 2003 (photo - 1).

The crown closure was 80% and as Table 1 shows, the tree stratum consisted of two tree species native to this region; Grand fir (Abies grandis) and Red alder (Alnus rubra). These trees were around 18-19m in height (Table 2).Western redcedar (Thuja plicata) and Holly was also observed.

Successional status was MS (Maturing Seral) because mid-seral stands of Red alder and Grand-fir trees have gone through an initial natural thinning due to species interactions. Besides, one age class of Grand fir and Red alder was observed in the overstorey, with regeneration of a shade tolerant Grand fir tree being present in the understorey. Structural stage was 5 (Young Forest) because self-thinning was evident and the forest canopy has begun differentiation into distinct layers of overstorey, intermediate, and suppressed.

As the picture of photopoint monitoring in 2006 shows, the understorey community has been dominated by invasive exotic species such as Daphne (Daphne laureola) (photo - 2). The result of measuring the understory plant cover (%) in plot 1 (20m by 20m) by Line Intercept Method (Table 4) also indicates that the close to 60 % of the ground surface in plot 1 was covered by Himalayan Blackberry and Daphne. On the other hand, native plant species such as Salmonberry (Rubus spectabilis), Nootka Rose (Rosa nutkana) and dull Oregon-grape (Mahonia nervosa) cover less than 20 % of the ground surface in plot 1.

High percentage cover of Himalayan Blackberry and Daphne indicates that continuous disturbance by past human activities in and around the forest might have caused the forest fragmentation by which the forest edges experienced micro-climate changes such as light level, wind speed, and air and soil temperature. This edge effect would have provided a mechanism for introducing new exotic plant species into the forest as the forest has been disturbed. In fact, Himalayan Blackberry over-shading the saplings of Grand-fir trees was observed and as Table 1 shows, 9 withered saplings of Grand-fir were found in plot 1 possibly due to the lack of the sunlight.

In the herb layer, six plant species were recorded, such as Trailing Blackberry (Rubus ursinus), Scouring Rush (Equisetum hyemale), Field Horsetail (Equisetum arvense), Sword Fern (Polystichum munitum), Bracken Fern (Pteridium aquilinum), and Sedge (Carex). Exotic species were also present such as Creeping Buttercup (Ranunculus repens), Orchard Grass (Dactylis glomerata), Common Dandelion (Taraxacum officinale), Bull thistle (Cirsium vulgare) and Canada Thistle (Cirsium arvense).

Soil moisture regime (SMR) was 6 (Hygric) because; (1) the slope of this plot is less than 5% and receives additional water from upper slopes of the valley. (2) the soil has fine particles and the coarse fragment (> 2mm) was estimated to be less than 20% in the rooting zone of the soil profile.
(3) drainage was imperfect and water was being removed slowly enough to keep soil wet for a significant part of growing season. (4) seepage was present at 40 cm deep (Figure 9).

Soil nutrient regime (SNR) was Eutrophic(very rich) because; (1) Humus Form was Mull. (2) F (partially decomposed organic material) horizon was loose and friable. (3) F and H (well decomposed organic material) were less than 2 cm. (3) more than 20cm of the dark colored Ah layer (a mineral A horizon enriched with humified organic matter) was observed. (4) the soil in the Ah layer was granular and earthworms were present.

As a result of SMR and SNR, site series of biogeoclimatic zone became CDF mm 06 (Cw-Bg Foamflower).

Table 1: Relative Density of Tree and Saplings (%) in Plot 1

Number of tree species / 400 m²	4
Number of trees / 400 m²	38 (Bg-18, Dr-18, Cw-1, H-1)
Number of understory saplings/ 400 m²	58(Bg-51, H-4, Dr-2, Cw -1)
Number of withered saplings / 400 m²	9 (Bg-9)
Relative Density of Tree Layer (%) in Plot 1	
Grand fir	47.4
Red alder	47.4
Western redcedar	2.6
Holly	2.6
Relative Density of Saplings (%) in Plot 1	
Grand fir	87.9
Holly	6.9
Red alder	3.4
Western redcedar	1.7

Table 2: Tree Height

Plot 1	Distance (m)	Angle (degree)	Tangent of angle	Tree Height (m)
Red alder	14.4	50	1.191	18.8
Grand fir	24.8	32	0.64	17.5
Red cedar	21.6	35	0.70	16.7

- **Eye height = 1.5m**

Table 3: Mean Basal Area of Each Tree Species

Plot 1	Mean Dbh (m) / tree species	Mean basal area (m^2) / tree
Red alder	0.23	0.042
Grand fir	0.17	0.023
Red cedar	1.02	0.817
Douglas-fir	*	*
Bigleaf		

maple	*	*
Holly	0.041	0.0013

Table 4: Understory Plant Cover (%) in Plot 1 (20m by 20m) by Line Intercept Method

Plant species	**Scientific name**	**Cover (%)**
Native Species		
Salmonberry	Rubus spectabilis	6.1 %
Trailing Blackberry	Rubus ursinus	5.2
Sedge	Carex	5.2
Dull Oregon Grape	Mahonia nervosa	1.3
Nootka Rose	Rosa nutkana	0.2
	Total	**18.0 %**
Non-Native Species	**Scientific name**	**Cover (%)**
Himalayan Blackberry	Rubus discolor	33.3 %
Daphne	Daphne laureola	24.5
Holly (saplings)	Ilex aquifolium	3.3
Common Dandelion	Taraxacum officinale	1.2
	Total	**62.3%**

*** Tree Species Codes:** Dr: Red Alder, Bg: Grand fir, Fd: Douglas-fir, Cw: Western redcedar, Mb: Bigleaf maple, H: Holly

* The tree includes all woody plants greater than 1.3m tall.

3.2 Ground Inspection in Plot 2 based on the Ground Inspection Form (GIF) of the Field Manual for Describing Terrestrial Ecosystems

Plot 2 (20m by 20m) is adjacent to Plot 1 and located in the same fragmented forest stand. The crown closure was 85% and, as Table 5 shows, the tree layer was dominated by Grand fir (Abies grandis) and Red alder (Alnus rubra). One Douglas-fir (Pseudotsuga menziesii), which was 30m in height (Table 6), was observed.

Successional status was MS (Maturing Seral) because mid-seral stands of Red alder and Grand-fir trees have gone through an initial natural thinning due to species interactions, and one age class of Grand fir and Red alder was observed in the overstorey. Regeneration of a shade tolerant Grand fir tree was also recorded in the understorey (Table 5). Structural stage was 5 (Young Forest) because self-thinning was evident and the forest canopy has begun differentiation into distinct layers of overstorey, intermediate, and suppressed.

As the pictures of photopoint monitoring in 2006 shows, the understorey community has been dominated by invasive, exotic species such as Daphne (Daphne laureola) and Himalayan Blackberry (Rubus discolor) (photo 3 and

4). The result of measuring the understory plant cover (%) in plot 2 (20m by 20m) by Line Intercept Method (Table 8) also indicates that more than 40 % of the ground surface in plot 2 was covered by Himalayan Blackberry and Daphne. This invasive plant might have adverse effects on the native flora of forest, such as obstructing the sunlight, competing for a space and nutrition, or potential for allelopathic effect which suppresses native plant growth and dispersals.

On the other hand, native plant species, such as Trailing Blackberry (Rubus ursinus), Salmonberry (Rubus spectabilis), and Nootka Rose (Rosa nutkana), cover around one-quarter of the ground surface in plot 2 (Table 8).

In the herb layer, plant species recorded were Field Horsetail (Equisetum arvense), Sword Fern (Polystichum munitum), and Lady Fern (Athyrium filix-femina.). Exotics such as Creeping Buttercup (Ranunculus repens), Orchard Grass (Dactylis glomerata), Common Dandelion (Taraxacum officinale), and Bull thistle (Cirsium vulgare) were also present.
Besides, Western Trillium (Trillium ovatum), which is considered one of rare species on this island, was observed at a basal area of a Grand fir tree (photo-5). However, as the photo-6 shows, the habitat for Western Trillium and Oregon grape has been dominated by invasive, exotic species such as Daphne.

Soil moisture regime (SMR) was 5 (Subhygric) because; (1) the slope of this plot is less than 5% and receives additional water from upper slopes of the valley. (2) the soil has fine particles and the coarse fragment (> 2mm) was estimated to be less than 20% in the rooting zone of the soil profile.

(3) drainage was imperfect and water was being removed slowly enough to keep soil wet for a significant part of growing season. (4) mottles were observed at the depth of between 20cm and 35cm. (5) seepage was present at 40cm deep (Figure 10).

Soil nutrient regime (SNR) was Eutrophic(very rich) because; (1) Humus Form was Mull. (2) F (partially decomposed organic material) horizon was loose and friable. (3) F and H (well decomposed organic material) were less than 2 cm. (3) more than 20cm of the dark colored Ah layer (a mineral A horizon enriched with humified organic matter) was observed. (4) the soil in the Ah layer was granular and earthworms were present.

As a result of SMR-SNR inspection, site series became CDF mm 06 (Cw-Bg Foamflower).

Table 5: Relative Density of Tree and Saplings (%) in Plot 2

Results from the Supplementary Vegetation Survey (Section 2: 2.1-(5))

Number of tree species / 400 m²	3
Number of trees / 400 m²	19 (Bg-11,Dr-7, Fd-1)
Number of understory saplings/ 400 m²	49(Bg-30, Dr-2, H-17)
Number of withered saplings / 400 m²	0
Relative Density of Tree Layer (%) in Plot 2	
Grand fir	57,9
Alder	36.8
Douglas-fir	5,3
Relative Density of Saplings (%) in Plot 2	
Grand-fir	61,2
Alder	4,1
Holly (non-native species)	34,7

* **Tree Species Codes:** Dr: Red Alder, Bg: Grand fir, Fd: Douglas-fir, Cw: Western redcedar, Mb: Bigleaf maple, H: Holly

* The tree includes all woody plants greater than 1.3m tall.

Table 6: Tree Height

Plot 2	Distance (m)	Angle (degree)	Tangent of angle	Tree Height (m)
Red alder	22.0	45	1.0	23.6
Grand fir	17.5	35	0.70	13.9
Douglas-fir	13.3	65	2.145	30.1

* Eye Height = 1.5m

Table 7: Mean Basal Area of Each Tree Species

Plot 2	Mean Dbh (m) / tree species	Mean basal area (m^2) / tree
Red alder	0.36	0.102
Grand fir	0.16	0.020
Red cedar	*	*
Douglas-fir	0.48	0.181
Bigleaf maple	*	*
Holly	*	*

Table 8: Understory Plant Cover (%) in Plot 2 (20m by 20m) by Line Intercept Method

Plant species	**Scientific name**	**Cover (%)**
Native Species		
Trailing Blackberry	Rubus ursinus	13.7 %
Salmonberry	Rubus spectabilis	6.3
Wild Strawberry	Fragaria virginiana	3.2
Sword Fern	Polystichum munitum	1.7
Nootka Rose	Rosa nutkana	0.3
	Total	**25.2 %**
Non-Native Species	**Scientific name**	**Cover (%)**
Himalayan Blackberry	Rubus discolor	22.2 %
Daphne	Daphne laureola	20.8
Creeping Buttercup	Ranunculus repens	3.7
Orchard Grass	Dactylis glomerata	2.2
Common Dandelion	Taraxacum officinale	0.5
	Total	**49.4 %**

3.3 Ground Inspection in Plot 3 based on the Ground Inspection Form (GIF) of the Field Manual for Describing Terrestrial Ecosystems

Plot 3 (20m by 20m) is located at the middle slope of the valley which extends along Port Washington Rd. Elevation is less than 50m. The crown closure was 60 % and as Table 9 shows, the tree stratum consisted of three tree species; Bigleaf maple(Acer macrophyllum), Douglas-fir (Pseudotsuga menziesii), and Grand fir (Abies grandis).

Successional status was MS (Maturing Seral) because mid-seral stands of Grand-fir trees have gone through an initial natural thinning due to species interactions, and one age class of Douglas-fir was observed in the overstorey. Regeneration of a shade tolerant Douglas-fir, Grand fir, and Bigleaf Maple was also recorded in the understorey (Table 9). Structural stage was 5 (Young Forest) because self-thinning was evident and the forest canopy has begun differentiation into distinct layers of overstorey, intermediate, and suppressed.

As the picture of photo monitoring in 2006 shows, the understorey community has been dominated by invasive grass species such as Orchard Grass (Dactylis glomerata) and Meadow Fescue (Festuca pratensis) (Photo - 7). The result of measuring the understory plant cover (%) in plot 3 (20m by 20m) by Line Intercept Method (Table 12) also shows, more than 60 % of the ground surface in plot 3 was covered by introduced species, such as those exotic grass species, Daphne and Common Dandelion. On the other hand, native plant species such as Trailing Blackberry, Bracken Fern, and

Pacific Sanicle (Sanicula crassicaulis) covers less than 10 % of the ground surface in plot 3.

In the herb layer, plant species observed were Dull Oregon Grape (Mahonia nervosa), Sword Fern (Polystichum munitum), Wild Strawberry (Fragaria virginiana), Hairy Honeysuckle (Lonicera hispidula), and Western Buttercup (Ranunculus occidentalis). The small number of introduced species such as Common Vetch (Vicia sativa) and Scotch Bloom (Cytisus scoparius) was also recorded.

Soil moisture regime (SMR) was 4 (Mesic) because; (1) this plot is located at the middle slope. (2) water table, seepage, or mottles were not present (3) water is removed readily in relation to supply and water is available for moderately short periods following precipitation (4) particle size is not fine

Soil nutrient regime (SNR) was Mesotrophic (medium) because; (1) Humus Form was Moder. (2) Ah horizon is less than 5cm (3) Soil was light colored and particle size is not fine

As a result of SMR-SNR inspection, site series has become CDF mm 01(Fd - Salal).

Table 9: Measurement of Tree Density in Plot 3

Results from the Supplementary Vegetation Survey (Section 2: 2.1-(5)):

Number of tree species / 400 m²	3
Number of trees / 400 m²	15 (Mb-10, Fd-3, Bg-2)
Number of understory saplings/ 400 m²	27 (Fd-10, Mb-9, Bg-8)
Number of withered saplings / 400 m²	0
Relative Density of Tree Layer (%) in Plot 3	
Bigleaf maple	66.7
Douglas-fir	20.0
Grand fir	13.3
Relative Density of Saplings (%) in Plot 1	
Douglas-fir	37.0
Bigleaf maple	33.3
Grand fir	29.6

* **Tree Species Codes:** Dr: Red Alder, Bg: Grand fir, Fd: Douglas-fir, Cw: Western redcedar, Mb: Bigleaf maple, H: Holly

* The tree includes all woody plants greater than 1.3m tall.

Table 10: Tree Height

Plot 3	Distance (m)	Angle (degree)	Tangent of angle	Tree Height (m)
Douglas-fir	7.0	55	1.428	11.5
Douglas-fir	15.0	65	2.145	33.7
Douglas-fir	23.0	55	1.428	34.3

* Eye Height = 1.5m

Table 11: Mean Basal Area of Each Tree Species

Plot 3	Mean Dbh (m) / tree species	Mean basal area (m^2) / tree
Red alder	*	*
Grand fir	**0.01**	**0.0001**
Red cedar	*	*
Douglas-fir	**0.55**	**0.238**

Bigleaf maple	**0.21**	**0.035**
Holly	*	*

Table 12: Understory Plant Cover (%) in Plot 3 (20m by 20m) by Line Intercept Method

Plant species	**Scientific name**	**Cover (%)**
Native Species		
Trailing Blackberry	Rubus ursinus	5.0
Bracken Fern	Pteridium aquilinum	2.3
Pacific Sanicle	Sanicula crassicaulis	0.7
	Total	**8.0 %**
Non-Native Species	**Scientific name**	**Cover (%)**
Grass (Orchard)	Dactylis glomerata	52.3
Grass (Fescue)	Festuca	8.3
Daphne	Daphne laureola	2.0
Common Dandelion	Taraxacum officinale	1.8
	Total	**64.4 %**

3.4 Ground Inspection in Plot 4 based on the Ground Inspection Form (GIF) of the Field Manual for Describing Terrestrial Ecosystems

Plot 4 (20m by 20m) is located at the toe of the valley where Plot 1 and Plot 2 are situated. The crown closure was 50 % and under the canopy layer of mature Douglas-fir trees, the second layers were composed of four tree species; Red alder (Alnus rubra), Western redcedar (Thuja plicata), Grand fir (Abies grandis), and Bigleaf maple(Acer macrophyllum).

Successional status was MC (Maturing Climax) because: (1) the forest stand is composed of the species (Douglas-fir) which is expected to be present in the climax stand; (2) the stand has undergone natural thinning; (3) gaps have been created in the stand; (4) a better-developed understorey; (5) a structure similar to that expected at climax has developed.

Structural stage was 6 (Mature Forest) because Douglas-fir tree established after the last disturbance have matured and a second cycle of shade tolerant trees such as Western red cedar and Grand fir have established.

As the result of measuring the understory plant cover (%) in plot 4 (20m by 20m) by Line Intercept Method (Table 16) shows, close to 60 % of the ground surface in plot 4 was covered by native shrubs and herbaceous species, such as Salmonberry (Rubus spectabilis), Trailing Blackberry (Rubus ursinus), Vanila Leaf (Achlys triphylla), Lady Fern (Athyrium filix-femina.), and Sword Fern (Polystichum munitum) (Photo – 8 and 9).
Giant Horsetail (Equisetum telmatiea), Pacific Water Parsley (Oenanthe sarmentosa), Pacific Sanicle(Sanicula crassicaulis), Bracken Fern (Pteridium

aquilinum), Skunk Cabbage (Lysichiton americanum), and Stinging Nettle (Urtica dioica) were also recorded. On the other hand, non-native plant species such as Daphne (Daphne laureola), Bull thistle (Cirsium vulgare), and Creeping Buttercup (Ranunculus repens) cover around 6 % of the ground surface in plot 4.

Soil moisture regime (SMR) was 6 (Hygric) because;(1) the slope of this plot is less than 5% and receives additional water from upper slopes of the valley. (2) the soil has fine particles and the coarse fragment (> 2mm) was estimated to be less than 20% in the rooting zone of the soil profile.
(3) drainage was imperfect and water was being removed slowly enough to keep soil wet for a significant part of growing season.

Soil nutrient regime (SNR) was Permesotrophic (Rich) because; (1) Humus Form was Mull. (2) Soil was dark colored and Ah horizon was present.

As a result of SMR-SNR inspection, site series became CDF mm 06(CwBg-Foamfloer).

Table 13: Relative Density of Tree and Saplings (%) in Plot 4

Number of tree species / 400 m²	5
Number of trees / 400 m²	12 (Fd-4, Dr-3, Bg-2, , Cw-2, Mb-1)
Number of understory saplings/ 400 m²	Cw-1
Number of withered saplings / 400 m²	0
Relative Density of Tree Layer (%) in Plot 1	
Douglas-fir	33.3
Red alder	25.0
Western red cedar	16.7
Grand fir	16.7
Bigleaf maple	8.3
Relative Density of Saplings (%) in Plot 4	
* only one cedar sapling was observed	*

* **Tree Species Codes:** Dr: Red Alder, Bg: Grand fir, Fd: Douglas-fir, Cw: Western red cedar, Mb: Bigleaf maple, H: Holly

* The tree includes all woody plants greater than 1.3m tall.

Table 14: Tree Height

Plot 4	Distance (m)	Angle (degree)	Tangent of angle	Tree Height (m)
Douglas-fir	10.0	62	1.881	20.3
Douglas-fir	10.0	80	5.671	58.2
Red cedar	10.0	58	1.600	17.5

* Eye Height = 1.5m

Table 15: Mean Basal Area of Each Tree Species

Plot 4	Mean Dbh (m) / tree species	Mean basal area (m^2) / tree
Red alder	0.19	0.028
Grand fir	0.05	0.002
Red cedar	0.33	0.086
Douglas-fir	0.54	0.230
Bigleaf		

maple	0.25	0.050
Holly	*	*

Table 16: Understory Plant Cover (%) in Plot 4 (20m by 20m) by Line Intercept Method

Plant species	**Scientific name**	**Cover (%)**
Native Species		
Salmonberry	Rubus spectabilis	25.5%
Trailing Blackberry	Rubus ursinus	18.3
Vanila Leaf	Achlys triphylla	4.2
Lady Fern	Athyrium filix-femina	3.8
Sword Fern	Polystichum munitum	3.0
Giant Horsetail	Equisetum telmatiea	1.7
Pacific Water-Parsley	Oenanthe sarmentosa	1.7
Pacific Sanicle	Sanicula crassicaulis	0.3
Bracken Fern	Pteridium aquilinum	0.3
	Total	**58.8 %**
Non-Native Species	**Scientific name**	**Cover (%)**
Holly (saplings)	Ilex aquifolium	3.7 %
Daphne	Daphne laureola	1.8

Bull Thistle	Cirsium vulgare	0.6
	Total	**6.1 %**

3.5 Ground Inspection in Plot 5 based on the Ground Inspection Form (GIF) of the Field Manual for Describing Terrestrial Ecosystems

Plot 5 (20m by 20m) is situated within a property on which the land owner put Conservation Covenant. Conservation Covenant is a legal agreement that allows landowners to permanently protect certain natural values of the land (The Land Trust Alliance of BC. 2006). An expertise from Pender Island Conservancy Association observed fifty-four native plants species within this covenant area (Appendix 1), though this site had experienced some disturbances by agricultural activities during early 1900's.

The crown closure was 70 % and as Table 17 shows, the tree stratum consisted of four species; Red alder (Alnus rubra), Bigleaf maple(Acer macrophyllum), Douglas-fir (Pseudotsuga menziesii), and Western redcedar (Thuja plicata).

Successional status was MC (Maturing Climax) because: (1) the forest stand is composed of species (Douglas-fir and Western red cedar) which are expected to be present in the climax stand; (2) the stand has undergone natural thinning; (3) gaps have been created in the stand; (4) a better-developed understorey; (5) a structure similar to that expected at climax has developed. Structural stage was 6 (Mature Forest) because Douglas-fir tree established after the last disturbance have matured and a second cycle of shade tolerant trees such as Western red cedar has established.

The understory was well developed (photo -10). As the result of measuring the understory plant cover (%) in plot 5 (20m by 20m) by Line Intercept Method (Table 20) shows, close to 90 % of the ground surface in plot 5 was covered by native species, such as Sword Fern (Polystichum munitum), Salal (Gaultheria shallon), Trailing Blackberry (Rubus ursinus), Vanila Leaf (Achlys triphylla), and Dull Oregon Grape (Mahonia nervosa). Salmonberry (Rubus spectabilis) and Ocean Spray (Holodiscus discolor) were also observed.

Soil moisture regime (SMR) was 3 (Submesic) because; (1) water table or mottles were not present (2) water is removed readily in relation to supply and water is available for moderately short periods following precipitation (3) particle size is coarse

Soil nutrient regime (SNR) was Mesotrophic (medium) because; (1) Humus Form was Mor. (2) A horizon was absent (3) particle size was coarse

As a result of SMR-SNR inspection, site series became CDF mm 01(Fd - Salal).

Table 17: Relative Density of Tree and Saplings (%) in Plot 5

Number of tree species / 400 m²	4
Number of trees / 400 m²	21 (Dr-9, Mb-6, Fd-4, Cw-2)
Number of understory saplings/ 400 m²	3 (Cw-3)
Number of withered saplings / 400 m²	0
Relative Density of Tree Layer (%) in Plot 5	
Red alder	42.9
Bigleaf maple	28.6
Douglas-fir	19.0
Western redcedar	9.5
Relative Density of Saplings (%) in Plot 5	
* 3 cedar saplings were observed	*

*** Tree**

Species Codes: Dr: Red Alder, Bg: Grand fir, Fd: Douglas-fir, Cw: Western redcedar, Mb: Bigleaf maple, H: Holly

* The tree includes all woody plants greater than 1.3m tall.

Table 18: Tree Height

Plot 5	Distance (m)	Angle (degree)	Tangent of angle	Tree Height (m)
Douglas-fir	220.0	10	0.176	40.2
Douglas-fir	220.0	8	0.141	32.5
Douglas-fir	220.0	5	0.087	20.6

* Eye Height = 1.5m

Table 19: Mean Basal Area of Each Tree Species

Plot 5	Mean Dbh (m) / tree species	Mean basal area (m^2) / tree
Red alder	0.27	0.057
Grand fir	*	*
Red cedar	0.31	0.075
Douglas-fir	0.60	0.283

Bigleaf maple	0.31	0.075
Holly	*	*

Table 20: Understory Plant Cover (%) in Plot 5 (20m by 20m) by Line Intercept Method

Plant species	**Scientific name**	**Cover (%)**
Native Species		
Sword Fern	Polystichum munitum	52.2 %
Salal	Gaultheria shallon	17.3
Trailing Blackberry	Rubus ursinus	6.7
Vanilla Leaf	Achlys triphylla	4.8
Moss	* (not identified)	5.5
Dull Oregon Grape	Mahonia nervosa	2.3
Sedge	Carex	0.2
	Total	**89.0 %**
Non-Native Species	**Scientific name**	**Cover (%)**
Grass	* (not identified)	1.3

	Total	**1.3 %**

Section 4 Restoration Strategy

Referring to “Principles and Guidelines for Ecological Restoration in Canada’s Protected Natural Areas (Parks Canada. 2008)” and “Evaluation Sourcebook: Measures of Progress for Ecosystem & Community-Based Projects (Ecosystem Management Initiative. 2006)”, the framework for restoration strategies and implementation plans has been developed.

The following are the framework which consists of seven steps;

Step 1: Identify Values of the Restoration Site

Step 2: Identify Restoration Filters and Define Problem

Step 3: Set Restoration Goals

Step 4: Set Restoration Objectives & Develop Detailed Restoration Strategic Plans

Step 5: Implement field trials and detailed restoration plan (*to be developed in ER390)

Step 6: Develop an assessment framework (*to be developed in ER390)

Step 7: Create an action plan if necessary (*to be developed in ER390)

4.1 Step 1: Identify Values of the Restoration Site

4.1.1. Ecological Value

As is stated in Ground Inspection in Plot 2(Section 3.2), a rare, indicator native plant species, Western Trillium, grows in the restoration site. According to a local expertise of Conservancy Association, only a few habitats of the species have been reported on Pender so far. Other native plant species, such as Dull Oregon Grape, Nootka Rose, Pacific Sanicle, and Saskatoon berry are also present in the site. Some wildlife species use this site for perching or hunting, such as Bald Eagle, Great Blue Heron, Barred Owl, Red-Tailed Hawk, Turkey Vulture and Pileated Woodpecker.
As Butterfly Observation (Appendix 2 * to be developed in ER390) shows, twenty species of butterflies have been recorded since 2001.

4.1.2. Socio-cultural Value

The restoration project site (plot 1-3) is located right beside the certified organic farm which occasionally receives farm visitors. The restoration project site (plot 1-3) will be able to offer good learning tools for visitors, who may consider stewardship to be one of the most important components of farming or gardening practices. By encouraging native plants to thrive on agro-ecosystems farmers or general public will be able to know how they can contribute to maintaining diversity and function of the local ecosystems.

4.2 Step 2: Define Priority Issue

4.2.1 Impact of the introduced exotic plant species

The terms invasive, non-native, and exotic are used to describe species that have been introduced into British Columbia (BC Ministry of Agriculture, Food, and Fisheries. 2002). Exotic species are species that occur outside their natural ranges because of human activity such as horticulture and agriculture. When human activity modifies natural environmental conditions, exotics may be able to take advantage of disturbed conditions (Primack. 2002) and colonise ecosystems because of their competitive abilities or adaptations to disturbed sites (McPhee et al. 2000). Today, the spread of invasive exotic plant species are considered one of the most serious issues in native plant communities of British Columbia because these exotic species adversely affect ecological processes in our region. According to Invasive Plant Council of British Columbia, invasive species are the second biggest threat to species at risk in BC after habitat loss. Besides, in agriculture, invasive plants reduce yields and crop quality, thereby affecting the economic value of agriculture produce.

The main concern of exotic species is that the interactions between native species in a local ecosystem are altered or destroyed by the introduced species (Leanna and Lucas.2002) because they are originally not part of the ecosystem. As a result, the rate and scale of establishment of exotics in new habitat increase. Especially, exotic species with weed-like characteristics such as English Ivy, Gorse, Orchard grass, and Scotch broom can displace native plants establishing quickly in an area and reproducing rapidly. Reduction of native plant community leads to decrease in food and habitat for wildlife (Canadian Parks and Wildness Society-BC Chapter. 2005). Primack (2002), referring to Mack (2000) and Toft (2001), also states that when invasive species increase in abundance and dominate a community at the expense of native species, the diversity of native plant and wildlife species that feed on them show a corresponding decline. Moreover, according to Flynn (1999), the understorey plants of Coastal Douglas-fir Ecosystems are in danger of being overshadowed by invasive, non-native plant species, which affect natural successional processes by interfering with the regeneration of the forests.

4.2.2. Triggers for Restoration

As the results of ground inspection in Section 3 show, the fragmented forest where the restoration project site (Plot 1-3) is situated is vulnerable to the exotic species because this site has been disturbed by the past human activities and it has been fragmented to be a small patch of island-like ecosystem. For example, in plot 1 and plot 2, Daphne and Himalayan Blackberry have spread into the forest and formed dense thickets, over-shading the saplings of grand fir and native plant species such as Oregon grape and Western Trillium. In Plot 3, the dominant exotic grass species, Orchard grass, are out-competing seedlings of native trees, shrubs, and herbaceous species.

Unless appropriate management measures are taken, the understorey plant community (plot 1-3) will have been dominated by exotic species, significantly reducing the diversity of native plant communities. One of undesired ramifications is that the forest becomes a seed bank for non-native vegetations, which will cause further dispersal of more exotic species into the surrounding ecosystems on the island.

4.3 Step 3: Develop Restoration Project Goals

The primary goal of this restoration project is to enhance the diversity of native plant species in the fragmented forest (the restoration project site) because its understorey vegetation has been dominated by only a few kinds of exotic, introduced plant species.

Through the management of invasive exotic plants, preserving the existing native plant species to assist natural successional processes is a priority in the processes of the restoration project.

For the purpose of restoring native species composition which is suitable for the biogeoclimatic zone of the restoration project site, replanting with native plants is also a vital component of the project. Special care will also be given to Western Trillium in order to enhance public awareness of protecting the rare species of concern on the island.

The size of the restoration area is less than one acre of a small forest adjacent to certified organic farm. However, it is anticipated that this project will provide an educational opportunity for local private land owners to launch a backyard restoration initiative to protect remnants of ecosystem characteristic on the island.

The following are the summary of Restoration Project Goals;

- Restoration Project Goal 1: Through the management of invasive exotic plants, preserve existing native plant species to assist natural successional processes in the restoration project site (plot 1-3)

- Restoration Project Goal 2: Restore the species composition of native plants suitable for the biogeoclimatic zone of the study area.

- Restoration Project Goal 3: Enhance public awareness of restoring native plant communities on private lands of Pender Island.

4.4 Step 4 Develop Detailed Restoration Strategic Plans

In order to achieve the restoration goal 1-3 established in Step 3(4.3), strategic restoration plans have been developed.

4.4.1 Restoration Goal 1: Through the management of invasive exotic plants, preserve existing native plant species to assist natural successional processes in the restoration project site (plot 1-3)

4.4.1.1 Set Target Exotic Species

As the Results and Site Descriptions in Section 3 indicate, Himalayan Blackberry, Daphne, and Orchard Grass have become dominant exotic species of concern because they now cover from 50 to 60 % of the understorey on the restoration sites. Canada thistle, Bull thistle, and English Holly also have a great potential to spread out from the disturbed open space into the surrounding areas due to their high dispersal ability, (photos *to be developed in ER390).

Referring to E-Flora BC and other sources, the ecology of the target exotic species was compiled in order to develop effective management strategies (Table 21)

Table 21: Ecology of Target Exotic Species

Species	Habitat	Life Cycle Stages	Reproduction	Dispersal
Himalayan Blackberry (Rubus discolour)	Disturbed sites with mesic soils, streamside areas infertile soil types, a wide range of soi PH and textures (introduced from Asia)	Flowering occurs from June to July, seeds mature from August to September	Fruit ripens one or two months after flowering and seed is dispersed approximately one month after that.	Berry-eating birds spread seeds or from roots ,canes and stem fragments
Leatherleaf Daphne (Daphne laureola)	Mesic forests and waste area Full shade – semi-shade (introduced from Eurasia)	Evergreen shrub, Seeds mature from June to September	Drupes (egg-shaped, black: 8-11mm) which are poisonous	Unintentional dispersal by birds which can eat the seeds and spread them
Orchard Grass	Mesic meadows,	Starts growth early in	Tufted perennial with	By seeds

(Dactylis glomerata)	disturbed sites and pastures (introduced from Eurasia)	March and flowers in May-June	short rhizomes	
Canada Thistle (Cirsium arvense (L.) Scop	Disturbed areas Best adapted to rich, heavy loam, clay loam, and sandy loam soil	Flowering occurs from June to October, seeds mature from July to October	By seed and vegetatively through horizontal roots. Seeds germinate in mid-spring. Dicecious plant with low seed viability	Primarily by wind May produce 1,000 – 1,500 seeds per flowering shoot
Bull Thistle (Cirsium vulgare (Savi) Tenore	Grow in dry to moist habitats: roadside, cultivated fields, pasture, and logged forestland	Biennial, forming a rosette in the first year and bolting in the second year	Highly viable seeds, which germinate in spring and autumn	Seeds with pappus can be windblown for long distance

English Holly (Ilex aquifolium)	Grow under a forest canopy and out-competes native vegetation for light, nutrients, and water.	Evergreen tree up to 15m Small and white flowers.	Red berries (poisonous) on female trees in winter.	Spread through suckering from the roots, sprouting where branches touch on the ground, or by birds that eat its berries

4.4.1.2 Set Priority Management Objectives

Objective 1: Immediately, protect habitat for Western Trillium in plot 2.

Objective 2: Over the next two years, prevent new infestations of exotic plants within and around the restoration project site.

Objective 3: Over the next two years, reduce the abundance of Himalayan Blackberry, Daphne, and other exotic species by 80% at the restoration project site.

4.4.1.3 Develop suitable management strategic plans.

Objective 1: Protect habitat for Western Trillium in plot 2.

Strategic Plan 1: Immediately install a fence to restrict the access of grazing animals such as deer and poultry into the restoration project site.

Strategic Plan 2: Remove any invasive exotic plant species already growing in the proximity of the Western Trillium.

Objective 2: Over the next two years, prevent new infestations of exotic plants within and around the restoration project site.

Strategic Plan 1: Within one year of their discovery, remove any new, small, or satellite exotic species prior to seed production.

Strategic Plan 2: Seasonally, monitor the restoration site and its surrounding area to check a new exotic plant infestation.

Strategic Plan 3: Avoid the use of external inputs for agricultural purposes, which are potential sources of exotic plants' seeds such as purchased soils, manure, or compost.

Strategic Plan 4: Reseed or plant native species immediately after the soil is disturbed for the removal of exotic species. Otherwise, spread mulch on the disturbed site using logs or tree branches.

Strategic Plan 5: Work with the neighboring land owners to prevent exotic plants from spreading on the property lines.

Objective 3: Over the next two years, reduce the abundance of Himalayan Blackberry, Daphne, and other exotic species by 80% at the restoration project sites.

Strategic Plans for Himalayan Blackberry

1. Remove satellite patches as the highest priority to prevent further spread of blackberry.

2. Cut the canes as close to the ground as possible before its seed production in August.

3. In the winter, when most native plant species are dormant, dig out the roots if possible.

4. Contain large patches by working on the edges around them. Then move into the center areas to reduce the abundance.

5. After applying those control methods, plant native species and monitor the treated area.

Strategic Plans for Daphne

1. Focus on removal of individual mature plants in a new area before the plants go to seeds in order to prevent further spread of Daphne.

2. In the summer when plant energy reserve is low, cut below the lowest point of the stem where leaves occur and repeat this treatment the following year.

3. Before the early summer when the soil is still moist, pull mature plants and young shrubs using a weed wrench.

4. Remove underground roots with minimal soil disturbance.

5. After the removal of the large invasion, treat the initial pulse of Daphne germination as soon as possible.

6. Seed or plant with native species right after the treatment of the small infestations.

Strategic Plans for Orchard Grass

1. In order to prevent the further spread of Orchard Grass, contain the satellite patches starting with the periphery, and then move toward the centre.

2. Cut the plant just below ground level, using a hoe or a sickle.

3. Repeat the treatment until late summer when the plant sets seeds.

4. After the treatment, re-seed or plant with native species. Otherwise, mulch with logs, tree branches, or leaves.

Strategic Plans for Canada thistle and Bull thistle

1. Cut topgrowth or taproot just below the root crown with a hoe or a sickle before seed formation.

2. Repeat applications of the treatment aimed at depleting food reserves in the roots.

3. Remove new seedlings before they form a well-developed root system.

4. Minimize the soil disturbance during the treatment and after that, establish stands of perennial native plants.

Strategic Plans for Holly

1. Pull young Holly plants before producing berries

2. Remove mature trees and saplings by cutting them below the root crown.

3. Repeat visiting the site regularly and monitor the cut stumps of each species for signs of re-sprouting.

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4.4.2 Restoration Project Goal 2: Restore the species composition of native plants suitable for the biogeoclimatic zone of the study area.

Objective: Over the next three years, increase the diversity and abundance of native plant species at the restoration project site.

Strategic Plan 1: Remove or prune back invasive exotic plants to prevent them from over-shading or crowding-out the existing native species including saplings of tree species such as Grand fir and Red alder (see 4.4.3 for details).

Strategic Plan 2: Identify reference ecosystems as a model and mimic their successional processes using functional species which play an essential role as keystone species.

Strategic Plan 3: Take biological, climatic, and geological attributes of the restoration site into consideration when designing the composition of native plant communities at the restoration project site.

Strategic Plan 4: Introduce a few individual plants of as many of the native species as possible to create self-reproductive patches of the native plant community.

Strategic Plan 5: In order to increase self-sustaining capability and resilience in response to biotic or abiotic stresses, save the genetic diversity of local native species on the island using plant propagation techniques or through a local plant salvage program.

Strategic Plan 6: Implement field trials to compare the effectiveness of the strategies and develop action plans after monitoring and evaluation have been done. For example, designate Strategic Plan 2 to plot 1, and implement Strategic Plan 3 and 4 in plot 2.

Strategic Plan 7: Plant during the rainy season (October to March) to reduce the stress and encourage root elongation.

4.4.3 Restoration Project Goal 3: Enhance public awareness of restoring native plant communities on private lands of Pender Island.

Objective: Over the next three years, increase the number of local resident who initiate a small-scale backyard restoration project.

Strategic Plan 1. Return biologically, socially, and culturally valuable native species to the restoration project site, such as those used for pollinations, foods, tools, and rituals.

Strategic Plan 2. Offer an educational opportunity for local land owners by opening the restoration project site to the public and share ideas in progress.

Strategic Plan 3. Engage local people in hands-on experience of the restoration work and stewardship of the restoration project site.

Strategic Plan 4. Work with a local conservancy association and plan a local event aimed at raising public awareness of small-scale restoration initiative on private lands of Pender.

Note: Section 5 (Step 5: Implement field trials and detailed restoration plan), Section 6 (Step 6: Develop an assessment framework), and Section 7(Step 7: Create an action plan if necessary) will be developed in ER390 Project.

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