Investigating Plant Ecology in the Pacific Northwest

Vancouver Community College Science Department
Robyn Wood, Hilary Brown, Cherri McGarvie, Michael Robinson

Objectives

The main objectives of these field trips are to teach students:

- **How to effectively observe and describe ecosystems (through field notes)**
- **Plant identification skills**
- **How to measure abiotic factors such as light and soil pH**
- **How to gather data on plant distribution**
- **Ecological concepts such as succession**

Introduction

Grade 11 biology adult education students at Vancouver Community College participate in a series of instructive field trips to diverse coastal temperate rainforest habitats. The students discover and compare vegetation diversity as well as analyze and interpret relationships between abiotic characteristics and distribution of plant life.

Vancouver is on the south-west coast of British Columbia, Canada. With a climate of mild wet winters and warm dry summers, plant growth in the coastal region is possible 265 days/year. Abiotic factors and dominant conifer forest define the local **biome** as primarily **Coastal Temperate Rainforest**, which is characterized by annual precipitation over 1400 mm and mean temperature between 4-12º C (1). These forests sustain the highest levels of biomass of any terrestrial ecosystem (6).

Figure 1. The Greater Vancouver Area of British Columbia Showing Biogeoclimatic Zones and Field Trip Locations (4)

British Columbia holds one quarter of the remaining coastal temperate rainforest in the world, and has the largest intact tract left on earth (6).

British Columbia forests are divided into 14 **biogeoclimatic zones,** which classify areas of the province based on dominant vegetation, climate and local geology (2). **The Coastal Western Hemlock (CWH) zone** covers most of the Vancouver region, with the drier **Coastal Douglas Fir (CDF) zone** in small strips in several coastal locations and the **Mountain Hemlock (MH) zone** covering higher elevations (Fig 1).

Students are led through a series of three field trips to Pacific Spirit Park, Lighthouse Park and Richmond Nature Park. On these trips measurements of temperature, soil pH, and light are collected and discussed in terms of their significance to plant distribution and abundance. The students apply observations and data they collected to their understanding of **ecosystem cycles, growth rates, plant reproduction, classification and evolution, and the impact of humans.**

Figure 2. Many primitive plants abound in the Coastal Temperate Rainforest. Various ferns, mosses and horse tails enjoy the shade and moisture of the forest understory.

Pacific Spirit Park

A Coastal Western Hemlock Zone Forest

Pacific Spirit Park is a 770 hectare green belt within the city of Vancouver. A history of logging and fires has resulted in homogenous second growth stands of Western Hemlock and Douglas Fir, interspersed with small pockets of old growth forest and other areas in earlier stages of succession (2).

Figure 3. Vestiges of the first stage of succession are open meadows containing Fireweed (*Epilobium angustifolium*) and other herbaceous species. In later stages, the nitrogen-fixing shrub Salal (*Gaultheria shallon*) moves in, along with Salmonberry (*Rubus spectabilis*), Thimbleberry (*Rubus parviflorus*), and other deer-inviting shrubs.

Figure 4. Succession in action. A man-made clearing creates opportunity for the fast growing Red Alder (*Alnus rubra*) to dominate the fringes before giving way to the large conifers.

On this field trip, students are introduced to field note taking and observational skills through investigation of four sites:
Site 1: A mixed second growth forest,
Site 2: An older coniferous forest with low canopy light penetration
Site 3:A barren rocky meadow,
Site 4: A man-made clearing

At site #1 students first practice observation and note taking by sitting silently for 20 minutes and recording observations of their surroundings.
Next students work in teams to create their own **nature trails.** Students are instructed to make a transect with a 10 meter rope on the forest floor and tie flagging tape at positions featuring interesting plants, animals, or other items. They then exchange information with another team. This activity allows students to closely observe the diversity that can be found on the forest floor.

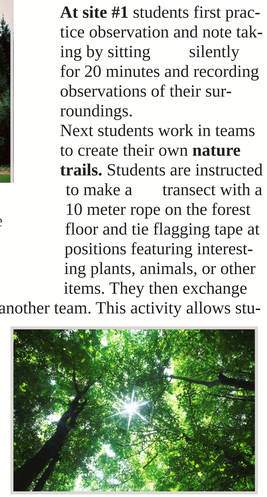

Figure 5. Light penetration of the canopy is one abiotic factor influencing plant growth in the understory.

Next, students form a 10 m x 10 m test plot on the forest floor. Using a **light meter,** intensity of sunlight penetration through the forest canopy is measured. Then, percent vegetative ground cover is estimated, and species present are noted. This procedure is repeated at each additional test area **(sites 2, 3, 4)** and the students then determine whether correlations can be drawn between the amount of available light and the presence/abundance/type of understory vegetation

At **sites 3 and 4**, succession is observed and discussed. In these sites, the forest canopy has been opened, clearing the way for growth of shade intolerant species, such as would be observed after a disturbance such as fire or logging (see fig. 3).

Figure 6. Both living and dead conifer trees provide a nutritious substrate for many other organisms. Epiphytic moss grows on the trunk of the small conifer on the right.

Figure 7. Deciduous Red Alder dominates in early succession. Presently, most areas of the park feature a climax Coastal Western Hemlock forest which includes a mixture of Western Hemlock (*Tsuga heterophylla*) Western Red Cedar (*Thuja plicata*) and Douglas Fir. Big Leaf Maple (*Acer macrophyllum*) can also be found, along with smaller understory species such as vine maple (*Acer circinatum*)

Lighthouse Park

Transition from a Coastal Western Hemlock Zone Forest to Coastal Douglas Fir Forest

This location is a 75 hectare park in West Vancouver. It represents one of the few natural sites in Canada featuring a transition from moister Coastal Western Hemlock (CWH) zone to the drier Coastal Douglas Fir (CDF) zone (5). It contains sections of old growth forest with stands of Douglas Fir and Western Redcedar that are more than 500 years old (3).

Figure 8. Typical Coastal Western Hemlock Zone Understory Layer.
Right: Salmonberry and ferns growing from a stump.
Left: Pacific Bleeding Heart (*Dicentra Formosa*)

The great diversity of plants found at Lighthouse park (over 250 species) along with the unique ecology make it an ideal location to teach students about plant identification and plant ecology (7).

On this field trip students are introduced to plant identification techniques and other aspects of plant ecology. They are also shown comparisons of the CWH and CDF forest, and they investigate various aspects of an old growth forest.

This trip starts in the parking lot area which falls within the Coastal Western Hemlock forest zone. At this site, students are led through a plant comparison activity which teaches them to closely observe plant features. They then work in teams to practice identifying plant species using plant guides. Information is shared among all groups.

Next, along Juniper Loop Trail, the students embark upon a wildlife scavenger hunt. They investigate a section of old growth forest for trees and other features that are valuable habitat for wildlife.

Moving down the Shore Pine trail, a transition between the upper level CWH zone and a drier CDF zone is observed.

Figure 9. Lichen and Moss growing on Conifer Bark. These plants can also be seen in the park growing on bare rock, allowing discussion of early colonizers and succession.

About midway along the trail, the group stops to examine a bare rock face covered with early colonizers such as lichen and moss. Here, the concept of succession and microclimates is discussed. Also discussed, is the role of slope and soil type in determining soil moisture.

The next destination is Shore Pine Point. This is a rocky outcrop on the ocean featuring a nice diversity of drier subzone species, many typical of the CDF.

The trip is completed with a review of the major plant species in the "Songbird Meadow" area.

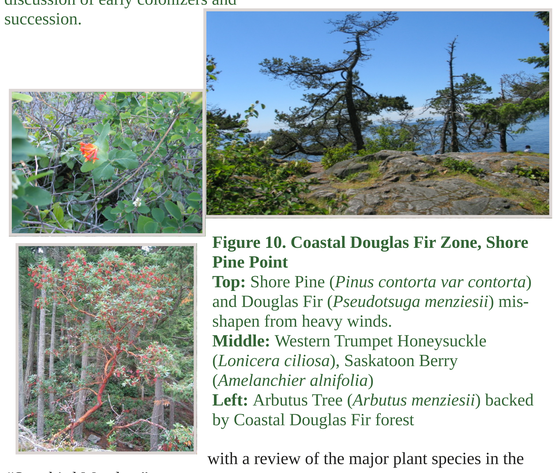

Figure 10. Coastal Douglas Fir Zone, Shore Pine Point
Top: Shore Pine (*Pinus contorta var contorta*) and Douglas Fir (*Pseudotsuga menziesii*) misshapen from heavy winds.
Middle: Western Trumpet Honeysuckle (*Lonicera ciliosa*), Saskatoon Berry (*Amelanchier alnifolia*)
Left: Arbutus Tree (*Arbutus menziesii*) backed by Coastal Douglas Fir forest

Richmond Nature Park

A Bog Ecosystem

The Richmond Nature Park has a bog ecology. The survival of plants in this bog require that they tolerate a high water table, low levels of soil nutrients and low soil pH. On this trip we introduce students to bog ecology and introduce them to a number of specialized bog plants that are well adapted to these conditions.

Figure 11. Hummocks of wet **sphagnum** moss grow on the surface of this bog.

Figure 12. Bog cranberry (*Oxycoccus oxycoccos)*
First Nations people used cranberries to fight scurvy because they were a great source of vitamin C (8).

Figure 13. Bog blueberry (*Vaccinium uliginosum)*

Struggles to compete with domestic blueberries that have invaded the bog from local farms.

Figure 14. Cloudberry *(Rubus chamaemorus)*

An arctic remnant which was a staple food for the first nations. Has a baked apple taste (8).

Figure 15. Sundew (*Drosera rotundifolia*)

A tiny carnivorous plant which compensates for lack of soil nutrients by ingesting insects (8).

Figure 16. Labrador Tea (*Ledum groenlandicum*)
Leaves have rolled edges and fuzzy brown hair underneath. These are adaptations allowing the plant to retain moisture. The leaves of this plant can be used to make a tea with many medicinal uses (8).

Figure 17. Hummock Sampling

In addition to observing bog plants, students test the **pH** of the soil in the bog and surrounding forests using pH indicator. They also work on a **hummock sampling** activity using a grid system that looks like a rope-ladder. Students record the dominant plant species found in each vertical section of the hummock. This allows them to observe succession.

References Cited

1) Alaback, P.B. 1991: *Comparative ecology of temperate rainforests of the Americas along analogous climatic gradients.* Rev. Chil. Hist. Nat. 64: 399–412.
2) Ballin Peter, 2004. Biology 061/071 Course Manual. Vancouver Community College. VCC Press. Vancouver, Canada
3) Catherine Berris Associates Inc. Lighthouse Park Management Plan. June 2004
4) Coastal Resource Mapping Ltd.2007.Chilliwack Forest District Version 6 BEC map, created for BC Forest Service. http://www.for.gov.bc.ca/rco/research/eco/bec_web/docs/pdfs/DCK.pdf. Accessed May 28th, 2009.
5) Coates, B. and Mondor, C. 1978. An Assessment of the National Significance of Lighthouse Park. National Parks Branch, Parks System Planning.
6) David Suzuki Foundation. 2009. Temperate Rainforests. http://www.davidsuzuki.org/Forests/Forests_101/Temperate_Forests.asp. Accessed May 27th, 2009.
7) District of West Vancouver Parks Department. 2003. Lighthouse Park Phase 1 Background Document
8) Pojar, J. and Mackinnon, A. 1994. Plants of Coastal British Columbia. Lone Pine Publishing, Vancouver, B.C. Richmond Nature Park, Richmond BC

Acknowledgements

Thank you to Peter Ballin and Maria Morlin for many of the plant images
Jane Huang , Maria Morlin and Gordon McIntyre for editing and advice