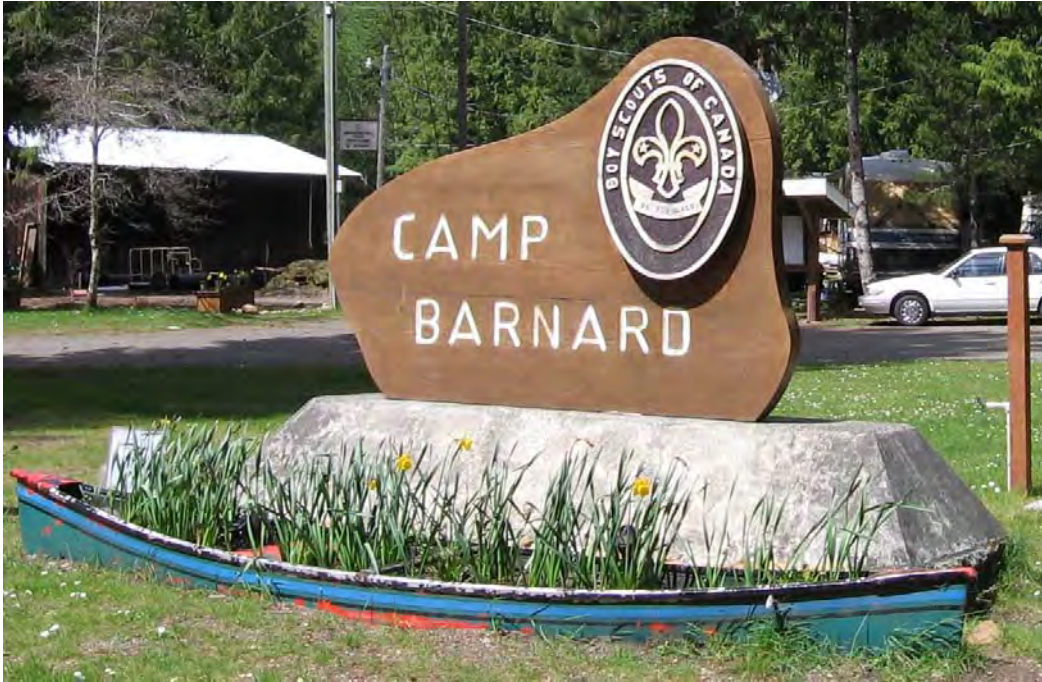


Ecological restoration and education at Camp Barnard, Sooke, British Columbia



*"no one among us wants to be a member of the last generation to pass on
to its children the joy of playing outside in nature. "*

(Richard Louv 2007)

University of Victoria – ER 390
Karen Hogg
July 2011

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Abstract

Camp Barnard is owned by Scouts Canada and managed by the Greater Victoria Area Camp Barnard Camp Committee. This project was conducted to provide the Committee with environmental information that will improve their work as environmental stewards within the context of camp management. Ecosystem mapping, vegetation surveys, and restoration projects (including the removal of invasive plant species and revegetation in a disturbed site) were conducted during 2009-2011. This work will enhance the environmental components of camp – including youth educational programs and ecological values – while being incorporated into current and future camp infrastructure.

Introduction

Camp Barnard is a 251-acre property that is owned by Scouts Canada and was established as a camp in 1954. Located outside of the Greater Victoria area near Sooke, British Columbia, the property is an important asset to the Scouting program as its primary purpose is to provide opportunities to youth for outdoor recreation and education that are not available in an urban setting. Although environmental protection is not the main goal of Camp, an important tenet of the Scouting program is environmental stewardship. Therefore, it is important to incorporate ecological knowledge in management decisions to ensure the continuation of healthy ecosystems and to restore, where able, those areas that are under stress. Whether through protection, conservation or restoration, the work of stewardship will provide important outdoor “classrooms” that many will only experience at camp.

Objectives

To provide the camp managers with baseline ecological information that will aid in informing their management decisions and to provide educational tools to increase youth awareness of the camp’s attributes.

Tangible deliverables:

1. Property map identifying vegetation, sensitive areas
2. Vegetation species list
3. Identification of opportunities for restoration
4. Educational trail guides as geocache challenges
5. On-site restoration projects with youth

Site

History

In February 1954, Camp Barnard was founded with the donation of two parcels of land to the Victoria District Council, Boy Scouts of Canada. The land was formerly owned by Senator George Henry Barnard, a former mayor of Victoria (1904-1905), Member of Parliament (1908-1917) and Senator (1917-1945). Two additional pieces of property were acquired (1971 and 1974) and some land was expropriated to build Butler Main, a logging access road. (Venturers 1998). Over the 60 years of the camp, facilities have been built and replaced or improved. These include cabins, kitchens, washrooms and assorted outbuildings.

Physical description

The property (lat. 48° N 24.733, long. 123°W 45.533) is a 251-acre property west of Sooke, B.C., on the southern end of Vancouver Island, British Columbia. At the centre of the property is Young Lake, a fish-bearing lake that is fed by a creek that flows from the Sooke Hills. DeMamiel Creek flows from the lake into Sooke Harbour. Another creek, part of which flows through the property, feeds into McKenzie Lake which is west of camp. This entire area is within the DeMamiel Creek watershed (Capital Regional District Environmental Services 2009). The north end of the property is bordered by the Sooke Hills (Bluff Mountain in particular).

“Soils of Vancouver Island” (Jungen 1985; Figure 1) illustrates the soils of camp property and surroundings. The two soil types found on the property (Qualicum (Q3/c) and Robertson (RO⁶RL6⁴/fg)) are common in the coastal Douglas-fir subzone of the CWH (Coastal Western Hemlock) zone. They are developed in sandy, gravely fluvial or colluvial deposits. The area around Young Lake is rapidly drained, very gravely to gravely loamy sand with bedrock found at 1.5-2m. Usual soil classification is Duric Dystric Brunisol. At higher elevation (edges of camp property), soils continue to be rapidly draining due to the high gravel content. Bedrock is closer to the surface (50-100cm) and usual soil classification is Orthic Humo-Ferric Podzol.

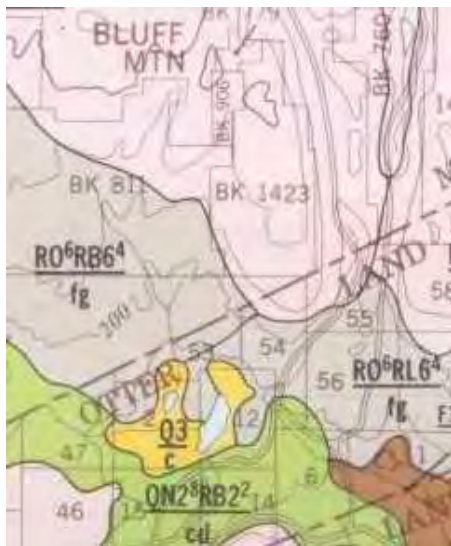


Figure 1. Soils of camp (Jungen 1985).

According to the British Columbia biogeoclimatic zone system, the camp property is located in the Coastal Western Hemlock, very dry, maritime biogeoclimatic zone (CWHxm2) British Columbia (B.C. Ministry of Forests and Range 2008). This zone (Pojar *et al.* 1991) is dominated by Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*) and western redcedar (*Thuja plicata*). Grand fir (*Abies grandis*) and bigleaf maple (*Acer macrophyllum*) are also found in the tree layer with red alder (*Alnus rubra*) common in disturbed areas. Oregon grape (*Mahonia nervosa*) and red huckleberry (*Vaccinium parvifolium*) are the most common shrubs and the moss layer includes Oregon beaked moss (*Kindbergia oregano*), step moss (*Hylocomium splendens*) and Lanky moss (*Rhytidiadelphus loreus*). Within the CWHxm, there are 3 main vegetation associations depending on nutrients and water:

- a. The Douglas-fir – western hemlock – salal association tends to be dry with medium-very poor nutrient status. Soils are coarse and rapidly draining. Mature forest stands have Douglas-fir as the tallest trees with western hemlock and redcedar in the lower stratum.
- b. The redcedar – lady fern association is moist and nutrient-rich in areas that are water-receiving on imperfectly drained lower slopes with sandy to loamy soils. Most of this zone in the province is second growth forest which features Douglas-fir and very large, old cut stumps of redcedar. Vine maple (*Acer circinatum*) and salmonberry (*Rubus spectabilis*) dominate the shrub layer. Commonly found in the herbaceous layer are lady fern (*Athyrium filix-femina*), sweet-scented bedstraw (*Galium triflorum*), swordfern (*Polystichum munitum*) and foamflower (*Tiarella trifoliata*).
- c. The redcedar – sitka spruce – skunkcabbage association is in wet and nutrient medium/rich sites that are water collecting. The dominant tree species are redcedar and western hemlock. Salal (*Gaultheria shallon*), red huckleberry and salmonberry are the main shrubs. Lady fern, skunk cabbage (*Lysichitum americanum*), clasping-leaved twisted-stalk (*Streptopus amplexifolius*) and *T. trifoliata* are also found.

The property is surrounded by other private properties belonging to individuals or forest companies (TimberWest, Western Forest Products). As development (i.e. subdivisions, road construction, logging) continues on these lands, the relatively undisturbed greenspaces at camp become increasingly rare and valuable.

Objective 1. Property map identifying vegetation, sensitive areas

Methods

With the use of Capital Regional District Natural Areas Atlas (Capital Regional District 2011), aerial photos of camp property were used to get an overview of the extent of the property and to provide guidance regarding where to look for different ecosystem types due to topography and dominant vegetation. Subsequent surveys on-site provided more information regarding local ecosystems and their status.

Results

I divided the property into three main zones according to topography, hydrology and vegetation (Figure 2).

- a. mature second growth forest – characterized by mature Douglas-fir and western hemlock trees, old western redcedar stumps. The understory and moss layers are well-developed. Red alder is found in wet pockets of former (30 year old) disturbance.
- b. riparian –characterized by persistent water in lake, ponds, wetlands, and creeks.
- c. rocky bluffs – found at elevation at the north part of the property.

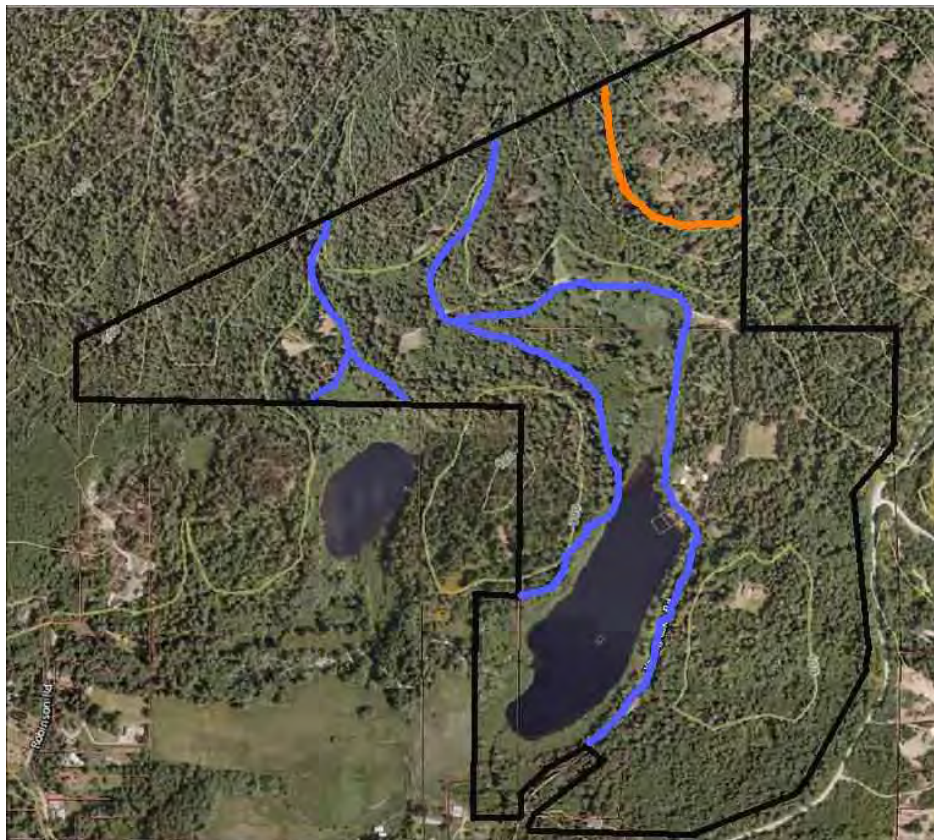


Figure 2. Zones of camp property. Blue lines mark creeks and outline riparian zone; orange line delineates rocky zone; remainder of the property is mature forest zone.

Discussion

At a smaller land scale, I identified three sites that would be vulnerable to change.

- a. Rocky zone. This ecosystem type makes up less than 20% of the landmass of camp. It contains vegetation unique to the drier, shallow soils and open exposure, including Hairy Manzanita (*Arctostaphylos columbiana*), Western saxifrage (*Saxifraga occidentalis*) and small flowered blue-eyed Mary (*Collinsia parviflora*). Because of the shallow soils, the area is susceptible to damage from trampling/compaction/erosion with increased use by hikers. To minimize this, camp has a marked trail system and, in wet areas, short boardwalks.
- b. Riparian zone. Young Lake is fish-bearing (including coho salmon and trout) and the creek that feeds into the lake is a known spawning ground. Young Lake is also the water supply for the camp. Therefore the riparian is of great importance and care must be taken in development to maintain buffer zones around riparian areas so that camp activities (including campsites, cook facilities, etc.) are not impacting health of the water.
- c. West side of Young Lake. This thin strip of property is bounded by the lake to the east, and rocky elevation and property boundary to the west. The largest Douglas-fir trees are found in this area and the cool, moist, shaded conditions are home to plants including false lily-of-the-valley (*Maianthemum dilatatum*) and palmate coltsfoot (*Petasites palmatus*). The only finding of a population of pink fawn lily (*Erythronium revolutum*) was located in this area.

All three zones would be affected by an increase in use (damage to trails, compaction of soil and plants, etc.). Policies at camp are in place (i.e. stay on the trail, waste water management, don't pick wildflowers) that aid in conservation of these areas and illustrate the concern and awareness of Scouts Canada and Camp Committee for the health of the natural areas.

Objective 2. Vegetation species list

Methods

A vegetation species list had been compiled by Dr. Nancy Turner and Abe Lloyd (University of Victoria, September 2007). To expand this list, I visited camp over two years and conducted a series of traverses (or meander searches (Lancaster 2000)) throughout the property on foot. The purpose of multi-visits was to capture species that are seasonal. Plant identification was confirmed through the use of Pojar and MacKinnon (1994) and Klinka *et al.* (1989).

Results

An expanded vegetation list was created (Table 1). 16 tree species were identified, two of which are introduced species (Holly (*Ilex aquilifolium*) and mountain ash (*Sorbus aucuparia*)). 33 shrub species were found and four of these are introduced. 14 introduced species were included in the 54 herbaceous species that were identified. Seven fern species were identified. Other vegetation groups included aquatic flowering plants, fungi, grasses, lichens, and mosses.

Discussion

The majority of the plant surveys were conducted along trail or road systems throughout the camp property to minimize impact and, as some work was done while youth camps were in session, to honour the Camp rule about “staying on the trails”. To produce a more complete species list, less-accessible areas should be surveyed. The lesser known groups (aquatics, fungi, grasses, lichens and mosses) can also be expanded upon.

SHRUBS (continued)

<i>Gaultheria shallon</i>	Salal	Forest***	
<i>Hedera helix*</i>	English ivy	Forest	Hogg
<i>Holodiscus discolor</i>	Oceanspray	Forest**	
<i>Linnaea borealis</i>	Twinflower	Forest**	
<i>Lonicera ciliosa</i>	Orange Honeysuckle	Forest*	
<i>Mahonia nervosa</i>	Dull Oregon-Grape	Forest**	
<i>Oemleria caryocarpus</i>	Indian plum	Forest *	Hogg
<i>Physocarpus capitatus</i>	Pacific Ninebark	Wetland**	
<i>Rhamnus purshiana</i>	Cascara	Forest edges*	
<i>Rosa gymnocarpa</i>	Dwarf or Baldhip Rose	Forest**	
<i>Rosa nutkana</i>	Nootka Rose	Forest edges**	
<i>Rubus discolor*</i>	Himalayan blackberry	Road/field edges*	
<i>Rubus laciniata*</i>	Cut-leaf Blackberry	Field, field edges, road*	
<i>Rubus laxiflorum</i>	Trailing black currant	Forest, wet areas*	
<i>Rubus parviflorus</i>	Thimbleberry	Forest**	Turner&Lloyd
<i>Rubus spectabilis</i>	Salmonberry	Forest, lakeshore**	
<i>Rubus ursinus</i>	Trailing Blackberry	Forest **	
<i>Salix hookeriana</i>	Hooker's Willow	Wetland*	Turner&Lloyd
<i>Salix scouleriana</i>	Scouler's Willow	Forest, lakeshore **	
<i>Salix sp. (grey with velvet twigs)</i>		Wetland	Turner&Lloyd
<i>Sambucus racemosa</i>	Red Elderberry	Forest*	
<i>Spiraea douglasii</i>	Hardhack	Wetland**	
<i>Symphoricarpos albus</i>	Snowberry	Forest edges*	
<i>Symphoricarpos occidentalis</i>	Western Snowberry	Forest edges*	
<i>Vaccinium ovatum</i>	Evergreen Huckleberry	Forest**	
<i>Vaccinium parvifolium</i>	Red Huckleberry	Forest**	

HERBACEOUS FLOWERING PLANTS

<i>Achlys triphylla</i>	Vanilla Leaf	Forest*	
<i>Anaphalis margaritcea</i>	Pearly everlasting	Forest edge*	
<i>Aquilegia formosa</i>	Red Columbine	Forest*	Hogg
<i>Aruncus dioicus</i>	Goatsbeard	Forest edge*	
<i>Bellis perennis*</i>	Perennial daisy	Field*	
<i>Bidens sp.</i>	Beggarticks	Wetland*	Turner&Lloyd

HERBACEOUS FLOWERING PLANTS (continued)

<i>Chimaphila umbellata</i>	Pipsissewa	Forest*	Hogg
<i>Cirsium vulgare*</i>	Scotch thistle	Field*	
<i>Claytonia sibirica</i>	Siberian Miner's Lettuce	Forest edge*	
	Small flowered blue-eyed		
<i>Collinsia parviflora</i>	Mary	Rocky outcrops	Hogg
<i>Corallorhiza sp.</i>	Coralroot	Forest	Hogg
<i>Dicentra formosa</i>	Pacific bleeding heart	Forest	Hogg
<i>Dodecatheon hendersonii</i>	Broad-leaved shooting star	Forest gaps	Hogg
<i>Epilobium angustifolium</i>	Fireweed	Forest edge	
<i>Erythronium oregonum</i>	White fawn lily	Forest	Hogg
<i>Erythronium revolutum</i>	Pink fawn lily	Wet area (bridge area)	Hogg
<i>Fragaria virginiana</i>	Wild strawberry	Forest edge	
<i>Galium triflorum</i>	Sweet-scented bedstraw		Hogg
<i>Geum macrophyllum</i>	Large-Leaved Avens	Forest*	Turner&Lloyd
<i>Goodyera oblongifolia</i>	Rattlesnake plantain	Forest	
<i>Hypochaeris radicata*</i>	Cat's ear dandelion	Field	
<i>Iris sp.*</i>	Iris	Wetland	
<i>Lactuca muralis*</i>	Wall Lettuce	Forest*	
<i>Lapsana communis*</i>	Nipplewort	Field	Hogg
<i>Leucanthemum vulgare*</i>	Oxeye daisy	Field	Hogg
<i>Lycopus uniflorus</i>	Northern Water Horehound	Wetland*	
<i>Lysichitum americanum</i>	Skunk cabbage	Wetland	Hogg
<i>Maianthemum dilatatum</i>	False Lily-Of-The-Valley	Forest, roadside, wet areas*	
<i>Mentha arvensis</i>	Field Mint	Wetland**	
<i>Mimulus gattatus</i>	Yellow monkey flower	Rocky outcrops	Hogg
<i>Mitella breweri</i>	Brewer's mitrewort		Hogg
<i>Myosotis laxa</i>	Forget-Me-Not	lakeshore*	Turner&Lloyd
<i>Osmorhiza chilensis</i>	Mountain sweet cicely		Hogg
<i>Petasites palmatus</i>	Palmate coltsfoot	Forest, wet areas	Hogg
<i>Plantago lanceolata*</i>	English plantain/ribwort	field	
<i>Prunella vulgaris*</i>	Heal-All, Self-heal	Roadside*	Turner&Lloyd
<i>Ranunculus flammula</i>	Water Buttercup	Wetland*	Turner&Lloyd
<i>Ranunculus occidentalis*</i>	Western buttercup		Hogg
<i>Ranunculus repens*</i>	Creeping Buttercup	Roadside*	
<i>Rumex acetosella</i>	Sheep Sorrel	Field*	Turner&Lloyd

HERBACEOUS FLOWERING PLANTS (continued)

<i>Rumex ? Crispus</i>	Curly Dock	lakeshore*	Turner&Lloyd
<i>Saxifraga occidentalis</i>	Western saxifrage	Rocky outcrops	Hogg
<i>Sedum spathulifolium</i>	Broad-leaved stonecrop	Rocky outcrops	Hogg
<i>Senecio sp.*</i>	Tall Groundsel	Forest edge*	
<i>Solidago canadensis</i>	Canada Goldenrod	Field, roadside*	
<i>Taraxacum officinale*</i>	Common dandelion	Field*	
<i>Trientalis latifolia</i>	Broad-leaved starflower	Forest*	
<i>Trifolium repens*</i>	Creeping White Clover	Field*	
<i>Trillium ovatum</i>	Trillium	Forest gaps/edge	Hogg
<i>Urtica dioica</i>	Stinging nettle		Hogg
<i>Veratrum eschscholtzii</i>	False hellebore	Forest*	Hogg
<i>Veronica sp.</i>		Wetland*	Turner&Lloyd
<i>Viola ?sempervirens</i>	Evergreen Violet	Forest*	Turner&Lloyd
<i>Viola orbiculata</i>	round leaved yellow violet	Forest/rocky bluff*	Hogg

FERNS AND FERN RELATIVES

<i>Adiantum pedatum</i>	Maidenhair fern	Forest*	Hogg
<i>Athyrium filix-femina</i>	Lady fern	Forest*	Hogg
<i>Blechnum spicant</i>	Deer fern	Forest*	Hogg
<i>Equisetum arvense</i>	Common Horsetail	Wetland*	
<i>Polypodium glycyrrhiza</i>	Licorice fern	Forest**	
<i>Polystichum munitum</i>	Swordfern	Forest***	
<i>Pteridium aquilinum</i>	Bracken Fern	Forest**	

AQUATIC FLOWERING PLANTS

<i>Carex glauca?</i>		Wetland	Turner&Lloyd
<i>Carex obnupta</i>	Slough Sedge	Wetland***	Turner&Lloyd
<i>Carex sitchensis</i>	Sitka sedge	Wetland**	Hogg
<i>Eleocharis palustris</i>	Creeping Spike-Rush	Wetland*	Turner&Lloyd
<i>Juncus effusus</i>	Common Rush	Wetland**	Turner&Lloyd
<i>Juncus sp.</i>		Wetland*	Turner&Lloyd
<i>Nuphar polysepalum</i>	Yellow Pond Lily	Wetland***	
<i>Nymphaea odorata*</i>	Fragrant Water Lily	Wetland*	Turner&Lloyd
<i>Typha latifolia</i>	Cattail	Wetland***	

FUNGI [very incomplete]

<i>Agaricus agustus</i>	Prince	Forest	Turner&Lloyd
<i>Coprinus sp.</i>	Brittle Inky Cap	Forest	Turner&Lloyd
<i>Coprinus sp.</i>		Forest	Turner&Lloyd
<i>Inocybe sp.</i>		Forest	Turner&Lloyd
<i>Russula</i>	Russula	Forest	Turner&Lloyd
	Gemmed Puffball	Forest	Turner&Lloyd
	Velvet Top	Forest	Turner&Lloyd

GRASSES [very incomplete]

<i>Aira caryophyllea*</i>	Silver Hairgrass	Field**	Turner&Lloyd
<i>Aira praecox*</i>	Early Hairgrass	Field**	Turner&Lloyd
<i>Anthoxanthum odoratum*</i>	Sweet Vernalgrass	Field**	Turner&Lloyd
<i>Dactylis glomerata*</i>	Orchard Grass	Field**	
<i>Phalaris arundinacea*</i>	Reed Canary Grass	Wetland**	
<i>Poa pratensis*</i>	Kentucky Bluegrass	Field***	
<i>Bromus sitchensis</i>	Alaska Brome	Field*	Turner&Lloyd

LICHENS [very incomplete]

<i>Alectoria spp.</i>			Turner&Lloyd
<i>Cetraria sp.</i>		tree trunks*	Turner&Lloyd
<i>Cladina spp.</i>			Turner&Lloyd
<i>Peltigera aphthosa</i>		Forest edge*	Turner&Lloyd
<i>Peltigera sp.</i>			Turner&Lloyd
<i>Stereocaulon sp.</i>		tree trunks*	Turner&Lloyd
<i>Usnea longissima</i>	Methuselah's Beard	Forest*	Turner&Lloyd
<i>Usnea sp.</i>			Turner&Lloyd

MOSSES [very incomplete]

<i>Climacium dendroides</i>	Tree moss	Forest*	Hogg
<i>Hylocomium splendens</i>	Stair Step Moss	Forest**	
<i>Rhytidiadelphus loreus</i>	Electrified cat's tail	Forest**	Hogg
<i>Dicranum fuscescens</i>	Dusky Fork Moss	Forest**	Turner&Lloyd
<i>Dicranum scoparium</i>	Broom Moss	Forest**	Turner&Lloyd
<i>Kindbergia oregana</i>	Oregon Beaked Moss	Forest**	
<i>Polytrichum juniperinum</i>	Juniper Moss	Forest*	Turner&Lloyd
<i>Racomitrium canescens</i>	Roadside Rock Moss	Forest*	Turner&Lloyd
<i>Rhytidiadelphus triquetrus</i>	Goose-Necked Moss	Forest***	Turner&Lloyd
<i>Timmia austriaca</i>	False polytrichum	Forest*	Hogg

Objective 3. Identification of opportunities for restoration

A. Invasive species

An “invasive plant” is generally defined as “...any invasive alien plant species that has the potential to pose undesirable or detrimental impacts on humans, animals or ecosystems.” (IPCBC 2011). I have noted three areas on camp property where there is the greatest population of invasive (and highly prolific) species.

- a. Slope
- b. Pond
- c. Marshy

Slope



Figure 3. Area identified as “slope” for restoration.

The soil in this south-facing slope (N 48° 24.640 W 123° 45.836; an area of 1800m²) is fluvial outwash made of loose gravels and characterized by quick drainage. This slope will become unstable and slump if the current vegetation (Himalayan blackberry (*Rubus discolor*) and Scotch broom (*Cytisus scoparius*)) and their anchoring roots are completely removed. This slope is bordered by mature Douglas-fir forest with alder along the upper edges.

While the current plants are serving a useful purpose (holding the slope in place) they are a seed source for future spreading of the species plus they are prohibitive to the establishment of native vegetation on the slope.

Recommendations for restoration:

In late fall when conditions are cool and wet, clear smaller areas (~ 1m² every 3-4m) of the blackberry and broom by cutting to ground level. Cutting will minimize soil disturbance which can lead to erosion and germination of broom seed in the substantial seedbank. Healthy, woody stakes (minimum length of 1.5 metre long) cut from surrounding willow and alder should be stripped of branches and leaves (but not buds) and soaked in water for 2-3 hours (or overnight) and then “planted” (insert vertically, up to ¾ of the length of the stake) in the clearings. It is important to collect this material after the vegetation has gone dormant so the stake will have adequate stored energy reserves for sprouting in spring. These will root during the winter and sprout in spring (“live staking” as per Polster (1999) and Urban Creeks Council (2002)). The taller stakes will be above the height of the surrounding invasive species and be able to access light – something that seedlings under a canopy of thick vegetation would be unable to do.

Other benefits of using the local trees as a planting source are the use of local genetic material suited to the site which is also free. Because the work will be done in the wetter part of the year, there will not be a need to water the planting stock. As the alder and willow grow, they will begin to outshade the broom and blackberry (both sun-loving species) and these undesired plants will eventually die out.

The ditch at the base of the slope is currently filled with hardhack (*Spirea douglasii*). This native species is very efficient at erosion control due to its thick rooting system which slows water flow. Its flowers and seed are also food sources for birds. Care should be taken to minimize damage to these plants.

Pond



Figure 4. Pond with reed canary grass filling in at perimeter.

Reed canary grass (aka canary reed grass, *Phalaris arundinacea*), used in agriculture for its value as a forage crop and in restoration because of its ability to grow quickly and to prevent soil erosion, is acknowledged as an invasive species in British Columbia. Its great impact is on wetlands where it fills in water bodies and dominates the vegetation thereby altering hydrology, vegetation communities and wildlife habitat. At this pond site (N 48° 24.600 W 123° 45.800; an area of 1350m²), reed canary grass will eventually fill in the area completely and, over time, the pond will fill in with willow, shrubs and trees and the open water will be gone. Currently, this pond is known habitat for Pacific chorus frog (*Pseudacris regilla*), provides habitat and food for birds, and is home to aquatic plants including water lily (*Nuphar polysepalum*). It may be in use by other riparian species as well, such as salamanders, turtles and other frog species.

Recommendations for restoration:

Some management strategies include excavating, mowing, burning, mulching, shading, herbicide (Anteau 2004). Due to location (fish-bearing waterway next to dry forest), herbicide and burning would not be recommended. Unless able to excavate all plants and their complete rhizome systems, this process will result in the production of more plants as they are able to regenerate prolifically from rhizome segments. Instead, I recommend a combination of mowing and mulching. While this is much more labour intensive, there is less collective damage to the system. Mowing the grasses but leaving the cuttings as mulch will provide a deep shade that is not favourable for the sprouting of the rhizomes/seeds of the reed canary grass. Regular mowing also weakens the nutrient reserves of the current plants plus lessens the amount of seed produced. After a year of layering with dense mulch, the area can be planted with native vegetation which will also aid in shading out the invading grasses. As with the “slope” area, the use of “live staking” (Kim *et al* 2006; Polster 1999) can be employed using willows (*Salix spp.*) found in the area.

Marshy area

This area (N 48° 24.616 W 123° 45.850; an area of 950m²) is adjacent to the pond described previously. As part of the riparian area, it experiences flooding in winter and remains wet in summer months. In May 2010 the area was covered in a mixture of orchard grass (*Dactylis glomerata*), reed canary grass, thistle (*Cirsium vulgare*) and horsetail (*Equisetum arvense*).



Figure 5. Marshy area: after mowing of grasses and planting of western redcedar to control reed canary grass, orchard grass and thistle (April 2011).

Methods used for for restoration:

The area was mowed in the summer of 2010. In November 2010, 30 western redcedar boughs (up to 1 m in length) were collected from surrounding trees and directly planted into the soil (“live staking”). In April 2011, 2-year seedling stock western redcedar were planted to fill in the area.

Discussion:

Redcedar was chosen for planting as it is already on site plus it can withstand seasonal moist soil conditions. As they grow, the trees will shade out grasses and thistle over time. To aid in their growth, the grass will be mowed throughout the summers until the trees are above the height of the competing vegetation.

Of the 30 western redcedar boughs planted in fall 2010, 12 were firmly rooted as of May 2011. Rooting success will continue to be monitored. In the future, this method can be implemented for filling in gaps where there has been tree mortality.

Note: there are other plant species that are potential problems at camp and should be removed as found. These include English ivy (*Hedera helix*), holly and (to be confirmed) yellow-flagged iris (*Iris pseudacorus*). Ivy and holly are shade-tolerant, and therefore able to do well in forested areas, and difficult to remove once established. It is much more efficient to remove them by pulling, cutting, and disposing with care before the populations grow in size (Saanich Environmental Services 2009a). Iris is an invader of wetlands and, once established, is able to spread quickly (Saanich Environmental Services 2009b). Removal is also challenging as it is able to regenerate from small bits of rhizome left after pulling, therefore this species also requires care in removal.

B. Lakeside campsite

This is a small (approximately 120 m²) area on the west side of the lake that is used for small-group camping. It is under a canopy of Douglas-fir and there is minimal shrub layer due to compaction. There is currently discussion by camp committee on whether to maintain it as a campsite or to decommission it and restore the area to forest. The purpose of this work was to establish what would be required for restoration if the latter option is chosen.

Methods



Figure 6. Penetrometer transect at Lakeside campsite.

Three linear transects were laid out parallel to the lake edge (Appendix II) on March 20, 2010. Due to the oval shape of the site, transect 1 (closest to forest edge) was 20m long, transect 2 was 16m long and transect 3 (closest to lakeshore) was 4m long. Penetrometer readings were taken at 2m intervals along each transect using a Soil Assessment Cone Penetrometer A2451 (Leonard Farnell & Co. Ltd., North Mymms, Hatfield, Herts, England). Three locations off-trail were chosen as “undisturbed” sites and measured for comparison. Compaction was measured in Cone Index and recorded as the rod was slowly pushed into the soil (at every inch, from 1” to 10” soil depth – converted to cm for analysis and discussion).

Cone Index (CI) was converted to kPa using the formulas:

$$N = CI/5 * 11.12 \quad (\text{formula from penetrometer})$$
$$kPa = ((N/0.000129m^2)/1000) \quad (\text{where } 0.000129m^2 = \text{basal area of penetrometer cone})$$

Results

The upper 10cm of the soil profile was significantly compacted as compared to the undisturbed soils (Figure 7). Average compaction levels were not above 1500 kPa. Of the 230 measurements (23 transects at 10 depths), only 8 were greater than 2000 kPa.

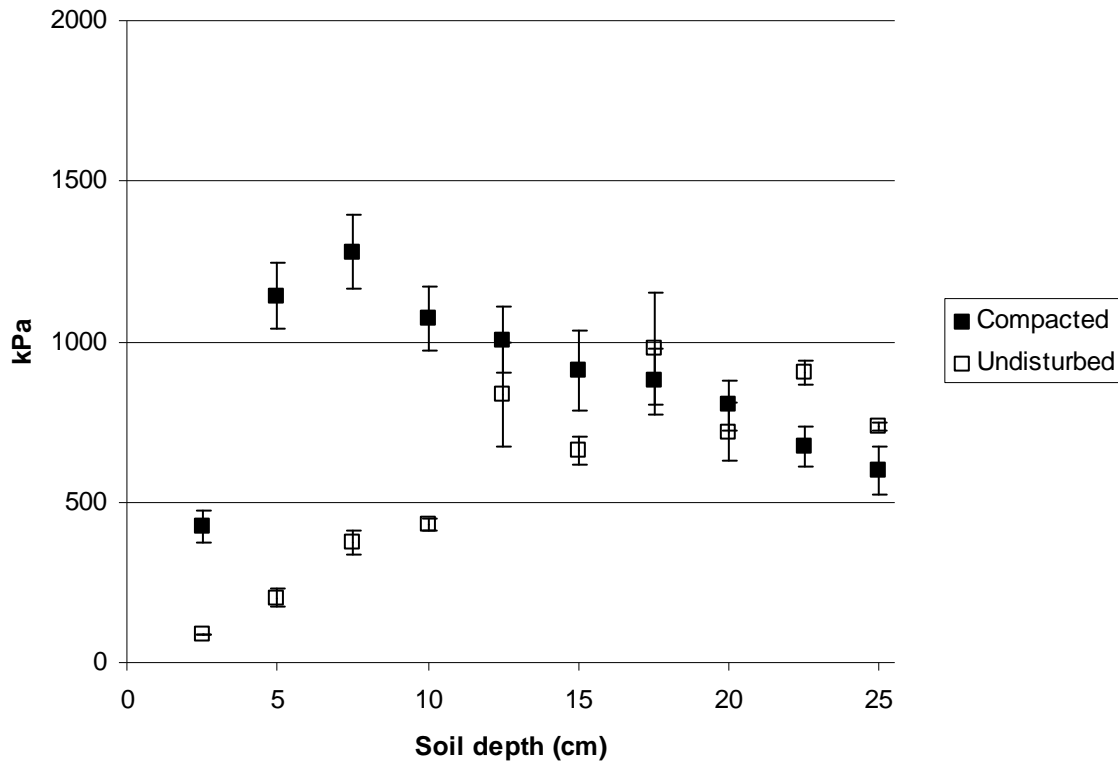


Figure 7. Average soil compaction (kPa) by depth at Lakeside campsite. Bars show standard error.

Discussion

Compaction at the Lakeside site has affected the ability of plants to thrive or become established in the three years of non-use. The apparent difference in compaction between compacted and undisturbed soils is in the vital germination/rooting zone for plants (0-10cm). Studies have shown that compaction levels greater than 2000 kPa can have serious negative impacts on tree growth (Miller *et al.* 2004). The results of this study indicate that, if plants are able to become established, soil compaction will not be a major hindrance to their survival.

Recommendation for restoration:

If the committee chooses to permanently deactivate this camping site, some soil preparation to loosen the upper 10cm would improve the success of a planting project. The use of shade-tolerant species is recommended (i.e. salal, Oregon grape) as the area is under dense canopy and does not get direct sunlight. The area would also need to be cordoned off during restoration to restrict human access (and associated trampling).

Objective 4. Educational trail guides

Methods

With the use of GPS (Garmin GPSmap 76CSx) and knowledge of camp's special attributes, five mini geocache tours have been designed for use by small groups to learn more about the camp property and its nature values and challenges.

Results

Five themes were chosen and points chosen (and GPS coordinates recorded) to illustrate the topic. The themes include:

- a. native plants and their uses
 - includes berries and other food, trees for building, medicines
 - discuss Traditional Ecological Knowledge, importance of natural systems and native species
- b. invasive species
 - includes vegetation and wildlife
 - discuss impacts of invasive species; importance of their control; role of humans (including are we introduced or not?)
- c. who lives at camp
 - plants, birds, and animals
 - discuss habitat (what makes a habitat and what is required by different organisms)
- d. types of ecosystems
 - riparian, forests, and rocky bluffs
 - discuss how are they different and what makes them different
- e. where is the water
 - follow the flow of water as it comes to camp, goes through the lake, is used by different groups (i.e. plants, fish, and people), and leaves for the ocean
 - discuss how water is important and what it is impacted by

Discussion

There are advantages to the use of GPS geocaching as an education tool. There is less environmental impact (no permanent signs to purchase, install and maintain), Teaching can be adjusted to the appropriate level for the group depending on age range, group size, and time availability. The themes are meant to be a starting point for leaders and outcomes will vary depending on group and leader knowledge and interest. There is also latitude for expanded group discussion about the topics and chosen points during the activity.

For many groups, this activity will give them the opportunity to see more of the camp property and find out what resources are available.

Other potential projects that would expand on the educational portion of camp include:

- a. prepare and conduct wildlife surveys
 - birdwatching
 - salamander surveys

- b. wildlife habitat projects
 - adding woody debris to DeMamiel Creek as it enters Young Lake for turtle sunning spots
 - build and install bat and bird houses
 - repair current Nature trail (clear trail, repair signage)
refer to Appendix I for location
- c. incorporate “Project WILD” (WildBC 2008) and “Project WET” (Canadian Water Resources Association 2009) into geocache activities

Objective 5. On-site restoration projects with youth

A. Broom pull with 1st Arbutus Venturer Company (May 2009)

Scotch broom is prolific on southern Vancouver Island and Camp Barnard is not immune to its invasion. Although much of the property is forested, broom is found along roads, trails and forest edges. An area of older broom plants (often greater than 1.5m tall with stem diameter of up to 10cm) was chosen for removal by 1st Arbutus Venturer Company.

Methods

On May 9, 2009 12 youth cut, pulled, removed and burned broom plants from a 1200m² area in a seven-hour period. (Figure 8a and 8b). The work was done in spring to avoid spreading of new seed, to take advantage of moister soil conditions that would make pulling of smaller plants more efficient and effective, and to allow for the burning of the material as removed off site. Also, blossom production in plants requires a lot of energy and is when the plant has its lowest levels of food reserves. By removing above-ground portions of the plants at this time, the root system is weakened and resprouting will be less vigourous.



Figure 8a. Broom removal



Figure 8b. Burning of part of biomass removed from site.

Results

As of May 2011, there has been regeneration of the seedbank and larger plants have been replaced by many small seedlings.

Discussion

The elimination of broom from camp property will continue to be a constant project as there is a large seed-bank, and more seed produced by plants on-site and those on surrounding properties. As the older and larger plants (and biggest seed sources) are removed, the work of pulling seedlings will be more manageable. All groups at camp are aware of the broom issue and are encouraged to remove it (especially the smaller plants) as they use the property and it is not uncommon to see hiking groups pulling plants as they move along. More organized pulls with equipment (pullers, saws) and older youth will be needed to continue the removal of the bigger plants.

B. Transplanting in disturbed areas

Methods

Transplanting appropriate plants from the property to areas where there has been disturbance. The reasons may be include aesthetics or to repair an area with native vegetation (and to preclude the establishment of unwanted plant species).

Results and Discussion:

Lodges:

After the construction of access ramps at the Lodges, swordfern (*Polystichum munitum*) was dug from the forested areas where it was overgrowing trails, and transplanted. This work was done in November 2010 (Figure 9) and as of April 2011, there was 80% survival.

Swordfern was chosen because it is tall enough to create a walking barrier without disrupting view lines (unlike oceanspray (*Holodiscus discolor*)). No poisonous berries are produced by this plant – a concern for groups with small, enthusiastic children. It is also a robust species that is able to grow in many different conditions, including drier sites. The plants will be watered through out the 2011 growing season and the area has been cordoned off to minimize trampling. Dead plants will be replaced in November 2011 as winter planting allows for the plants to root in cooler and wetter conditions. Other species that can be added to this border include Oregon-grape (*Mahonia nervosa*) and kinnickinnick (*Arctostaphylos uva-ursi*) which grow on the property, are transplantable to areas that are open/dry/nutrient medium-poor (GOERTS 2011).



Figure 9. Swordfern planting at lodge.

Septic field:

A forested area was cleared in during the installation of a septic field by Mor Kitchen (Appendix I). After construction (April 2011), the soil was replaced and the 15m x 15m site marked off as a restoration area (Figure 10a). The restoration of this area was adopted by the 1st Arbutus, 9th Juan de Fuca, and 14th Juan de Fuca Scout troops as part of their badge work. On May 22, 2011 the site was planted with transplanted vegetation collected from the surrounding forest area. For this Douglas-fir and western hemlock site, these plants included salal, Oregon-grape, swordfern and huckleberry (*Vaccinium ovatum*).



Figure 10a. Septic field area before restoration.

The area remains marked off with signage, flagging tape and a rock border (Figure 10b). Plantings will be monitored throughout the growing season and watered if necessary.



Figure 10b.

This project was a good learning experience for the Scout troop who learned about disturbance, the value of restoration, and what needs to be considered for the success of the project (i.e. use of appropriate species, protection of area from people). It will also be an illustration of what can be done for all who will see the work and how it changes over time.



Inspection of work by the Scout who led the project.

SUMMARY

The main challenge in this project was of balance. Camp Barnard Camp Committee does not want to “pave paradise and put up a parking lot” but, in order to be financially viable, some “paradise” will need to be “parking lot”. Because of this work, there are now more resources available to the managers as they make these decisions, including maps and a vegetation species list. As of May 2011, this is of greater significance as Camp Barnard was awarded the B.C. Provincial Scout Jamboree for 2015 during which up to 6000 people will be living on the property for one week. Preparations have started and the greater appreciation of environmental impact, restoration, and long-term consequences make the planning team able to make more informed decisions. Scouting youth have been introduced to the idea and work of restoration. They have gained a deeper connection to their Camp and have more knowledge of their natural world. As this type of work continues, and with the use of focussed educational tools, more youth will be exposed to the natural world in the camping seasons to come.

The author Richard Louv is known for his work on what is known as “nature deficit disorder”. The concept is that there are serious effects on children as they spend less time in the outdoors which include:

“threats to their independent judgment and value of place, to their ability to feel awe and wonder, to their sense of stewardship for the Earth—and, most immediately, threats to their psychological and physical health.” (Louv 2007)

Camp Barnard is a relatively undisturbed natural area that provides invaluable outdoor experiences to youth and can become a greater tool in environmental education. It may be that by making natural areas such as this camp accessible (and viable) while maintaining its environmental integrity through preservation or restoration, we are creating an incredible legacy for the future.

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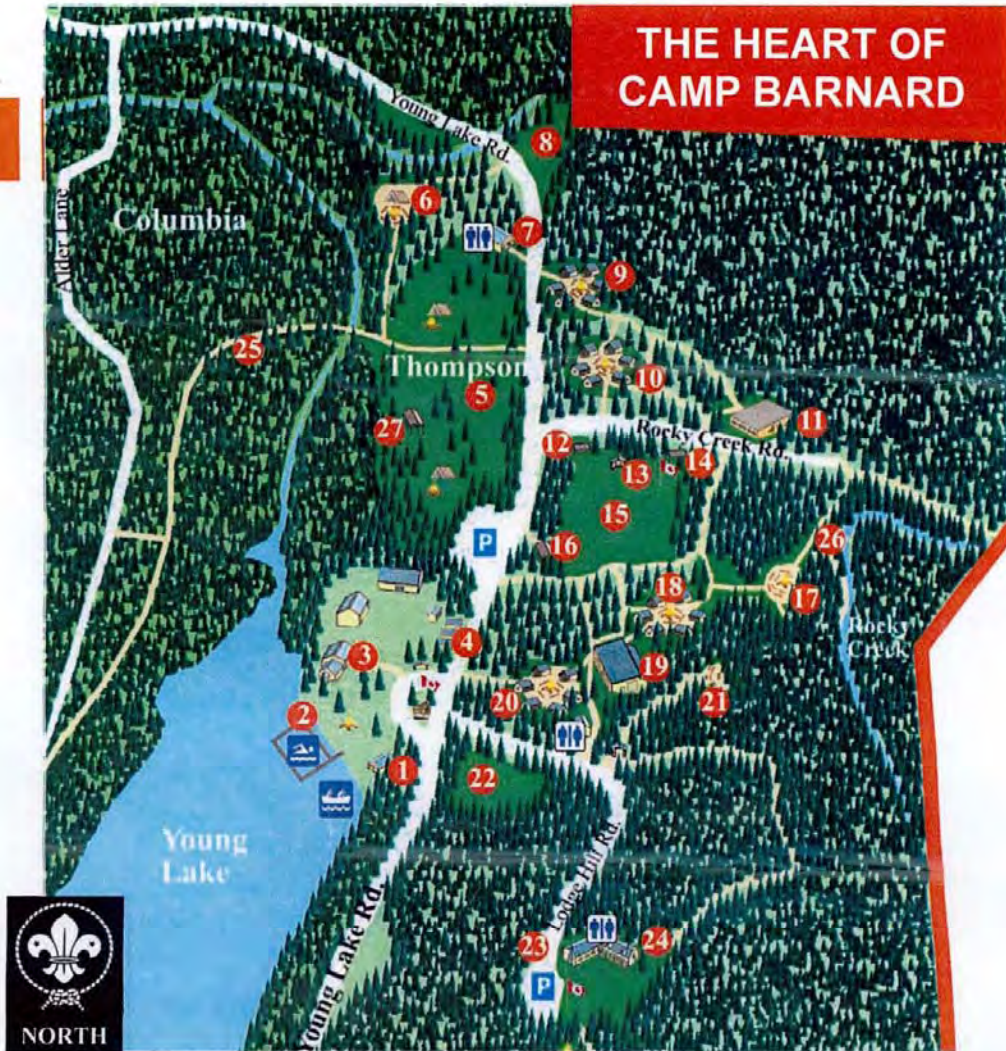
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APPENDIX I – Facilities at Camp Barnard



- | | | |
|--|------------------------|------------------------|
| 1. Boat House | 10. Rama Circle | 20. Kaa Circle |
| 2. Swim Area | 11. Mor Kitchen | 21. Chapel |
| 3. Camp Ranger's Office | 12. West Field Shelter | 22. Lower Forty |
| 4. Registration, Recycling, & Wood Sheds | 13. Gone Home Board | 23. McPherson Lodge |
| 5. Thompson Field | 14. East Field Shelter | 24. Totem Lodge |
| 6. Creekside | 15. Playing Field | 25. Lakeside Trail |
| 7. Thompson Field Washroom | 16. Mowgli's Den | 26. Nature Trail |
| 8. Mt. Bluff Trail Head | 17. Amphitheatre | 27. Akela's Cook Shack |
| 9. Mang Circle | 18. Sona Circle | |
| | 19. Keego Kitchen | |

Be Prepared

APPENDIX II – Penetrometer data

Penetrometer data at Lakeside (March 20, 2010)

3 transects
 points measured at 2m intervals

Calculation

$$N = (\text{dial measurement}/5) * 11.12$$

$$\text{cone area} = 129 \text{ mm}^2 (=0.000129 \text{ m}^2)$$

$$\text{kPa} = (N/0.000129 \text{ m}^2) / 1000$$

point #	11	10	9	8	7	6	5	4	3	2	1
		29	28	27	26	25	24	23	22	21	
				33	32	31					

Penetrometer raw measurements (CI scale-small cone)

Point	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"
1	25	65	68	70	45	10	25	30	30	30
2	70	95	80	60	30	25	27	27	27	30
3	7	30	65	100	85	70	40	35	35	15
4	15	50	140	40	60	25	20	5	20	15
5	20	110	110	105	60	45	50	50	60	45
6	30	80	100	rock						
7	10	45	45	35	25	45	45	50	55	70
8	10	30	40	25	40	20	40	60	35	5
9	15	85	100	110	140	120	65	75	60	60
10	25	125	125	80	70	60	55	50	35	25
11	10	25	35	65	90	70	75	50	30	40
21	35	80	85	40	85	110	rock			
22	25	65	65	40	35	45	80	90	rock	
23	45	125	130	80	60	80	90	40	60	20
24	20	75	70	30	35	110	120	rock		
25	30	45	50	55	60	rock				
26	25	70	45	45	40	15	25	rock		
27	30	60	40	40	30	10	30	40	35	50
28	30	65	65	35	40	45	30	40	5	10
29	10	40	45	100	75	75	30	50	40	40
31	25	40	45	60	50	45	35	40	45	40
32	25	60	100	90	80	30	65	70	45	45
33	30	60	60	65	50	55	70	35	45	50

Undisturbed points

A	5	5	10	20	15	25	15	30	rock	
B	5	10	25	30	100	50	110	70	45	40
C	5	20	30	25	30	40	45	25	60	45

Conversion to kPa

Point	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"
1	431.0	1120.6	1172.3	1206.8	775.8	172.4	431.0	517.2	517.2	517.2
2	1206.8	1637.8	1379.2	1034.4	517.2	431.0	465.5	465.5	465.5	517.2
3	120.7	517.2	1120.6	1724.0	1465.4	1206.8	689.6	603.4	603.4	258.6
4	258.6	862.0	2413.6	689.6	1034.4	431.0	344.8	86.2	344.8	258.6
5	344.8	1896.4	1896.4	1810.2	1034.4	775.8	862.0	862.0	1034.4	775.8
6	517.2	1379.2	1724.0	.	.	.	.	.	.	.
7	172.4	775.8	775.8	603.4	431.0	775.8	775.8	862.0	948.2	1206.8
8	172.4	517.2	689.6	431.0	689.6	344.8	689.6	1034.4	603.4	86.2
9	258.6	1465.4	1724.0	1896.4	2413.6	2068.8	1120.6	1293.0	1034.4	1034.4
10	431.0	2155.0	2155.0	1379.2	1206.8	1034.4	948.2	862.0	603.4	431.0
11	172.4	431.0	603.4	1120.6	1551.6	1206.8	1293.0	862.0	517.2	689.6
21	603.4	1379.2	1465.4	689.6	1465.4	1896.4	.	.	.	.
22	431.0	1120.6	1120.6	689.6	603.4	775.8	1379.2	1551.6	.	.
23	775.8	2155.0	2241.2	1379.2	1034.4	1379.2	1551.6	689.6	1034.4	344.8
24	344.8	1293.0	1206.8	517.2	603.4	1896.4	2068.8	.	.	.
25	517.2	775.8	862.0	948.2	1034.4	.	.	.	.	.
26	431.0	1206.8	775.8	775.8	689.6	258.6	431.0	.	.	.
27	517.2	1034.4	689.6	689.6	517.2	172.4	517.2	689.6	603.4	862.0
28	517.2	1120.6	1120.6	603.4	689.6	775.8	517.2	689.6	86.2	172.4
29	172.4	689.6	775.8	1724.0	1293.0	1293.0	517.2	862.0	689.6	689.6
31	431.0	689.6	775.8	1034.4	862.0	775.8	603.4	689.6	775.8	689.6
32	431.0	1034.4	1724.0	1551.6	1379.2	517.2	1120.6	1206.8	775.8	775.8
33	517.2	1034.4	1034.4	1120.6	862.0	948.2	1206.8	603.4	775.8	862.0

Undisturbed points

A	86.2	86.2	172.4	344.8	258.6	431.0	258.6	517.2	.	.
B	86.2	172.4	431.0	517.2	1724.0	862.0	1896.4	1206.8	775.8	689.6
C	86.2	344.8	517.2	431.0	517.2	689.6	775.8	431.0	1034.4	775.8

APPENDIX III –

Online resources for vegetation and wildlife at Camp Barnard

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APPENDIX IV - Geocache themes (and coordinates):

Native plants and their uses

Douglas-fir stump (count the rings!)

N 48° 24.476 W 123° 45.523

Amphitheatre

N 48° 24.497 W 123° 45.500

Nature trail at creek level

N 48° 24.439 W 123° 45.472

Invasive species

Scotch broom edges in amphitheatre

N 48° 24.497 W 123° 45.500

Reed canary grass wetland

N 48° 24.616 W 123° 45.722

People cub condos

N 48° 24.549 W 123° 45.612

Himalayan blackberry side slope

N 48° 24.640 W 123° 45.836

Who lives here

Salmon bridge back bridge

N 48° 24.612 W 123° 46.087

Big old Douglas-fir trail back of Columbia

N 48° 24.508 W 123° 45.794

Shorebirds dock

N 48° 24.416 W 123° 45.731

Frog pond wetland

N 48° 24.616 W 123° 45.722

Ecosystem types – and what lives in them

Forest trails

N 48° 24.508 W 123° 45.794

Lake

N 48° 24.416 W 123° 45.731

Mountain entrance to Mt. Bluff

N 48° 24.600 W 123° 45.632

Stream

N 48° 24.576 W 123° 46.200

Wetlands

N 48° 24.616 W 123° 45.722

Where does the water come from? go?

Stream	salmon stream	
	N 48° 24.576	W 123° 46.200
Kitchens		
	N 48° 24. 429	W 123° 45.604
Water pipe		
	N 48° 24.507	W 123° 45.632
Pullout on main road		
	N 48° 24.309	W 123° 45.782
Fish weir		
	N 48° 24.104	W 123° 45.929