Biological Inventory of Blaauw ECO Forest – NWD Plan 1560 (Township of Langley):

Including vertebrates, vascular plants, select non-vascular plants, and select invertebrates

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Abstract

Preserving the earth's remaining biodiversity is a major conservation concern. Especially in areas where urban development threatens to take over prime species habitat, protecting green spaces can be an effective method for conserving local biodiversity. Establishing biological inventories of these green species can be crucial for the appropriate management of them and for the conservation of the species which use them. This particular study focused on a recently preserved forest plot, just 25 acres in size, which is now known as the Blaauw ECO Forest. The Blaauw ECO Forest was acquired by Trinity Western University in 2013 to serve as an ecological preserve where students and staff can conduct ecological research and conservation work. After ten months of research and over 100 hours of onsite observations, over 250 species of flora and fauna have been documented inhabiting or using the forest (e.g. as a breeding site). Throughout the duration of this study, several large mammals such as coyotes (*Canis latrans)*, mule deer (*Odocoileus hemionus*), and black bears (*Ursus americanus*) have been documented using the forest which highlights the forest's use as patch habitat. Several provincially blue-listed species have also been seen in the forest, the Pacific Sideband snail (*Monadenia fidelis*) and Northern Red-legged Frog (*Rana aurora*) in particular, and these species may testify to the forest's rich ecology. The Blaauw ECO Forest has many different ecological communities and microhabitats which allow it to support a vast diversity of life. However, invasive species and other negative ecological disturbances present in the area pose a serious risk to the ecological integrity of the forest and surrounding region. Future conservation work on the property is imperative for the preservation of this local biodiversity sanctuary.

Table of Contents

1.) Introduction

Biological inventories are indispensable in the fields of conservation and ecological restoration (Balvanera et al. 1994). They are fundamental to the studies of biological diversity and aiding land management and conservation efforts (Balvanera et al. 1994). Bio-inventories are particularly important for establishing conservation strategies for endangered species (Franklin 1993). Some projects aiming to conserve endangered species fail, but this is frequently because such projects limit their research to a specific population of a single species (Franklin 1993). Indeed, a much broader ecosystem approach is imperative for understanding the ecological relationships these species engage in within their niche (Franklin 1993). Acknowledging these relationships and the biodiversity within the ecosystem greatly increases the success of species conservation (Franklin 1993). However, the importance of biodiversity for ecosystem productivity is a relationship which is often overlooked, even though research supports this positive correlation (Kaiser 2000). The study of the importance of biodiversity has even caused divisions among biologists who question its worth and ability to be accurately tested (Kaiser 2000). Regardless of such claims, there is a large body of supporting evidence that preserving biodiversity is of critical importance, not only to ecosystem health but for human benefit as well (Kaiser 2000).

Studying the biodiversity of a region can be a task that requires a large investment of time and resources, but such studies can serve to satisfy many different research objectives simultaneously. Assembling comprehensive biological inventories is a major way in which ecologists can ascertain the richness of species and learn about the interrelatedness of biological communities (McCarter et al. 2001). In fact, biological inventories serve as a precursor to assessing the overall biodiversity of a region (Vanclay 1998). One of the largest biological inventory studies ever completed was in the Great Smoky Mountains National Park (Sharkey 2001). This research both benefitted the general public and provided scientific advancements (Sharkey 2001). The inventory led to discoveries within taxa that were not well studied, and helped establish an example for biodiversity assessment that could be used for quantifying large scale diversity (Sharkey 2001). This data is also useful for the park's future considerations in conservation work and future management (Sharkey 2001).

Biological inventories also help enforce the need for biodiversity preservation (Tilman and Downing 1996). Preserving biological diversity has proven to be important for landscape restoration in repairing landscapes which have suffered from negative ecological disturbance, for example, the restoration of native grasslands in Minnesota (Tilman and Downing 1996). Greater biodiversity is also crucial in maintaining the stability of an ecosystem, meaning that diverse ecosystems are more resilient to negative disturbances such as droughts (Tilman and Downing 1996). Biodiversity studies have helped inform landscape management efforts throughout Australia as well, particularly in subtropical woodlands and agricultural areas facing degradation (Hugget 2005). Such studies have shown that high biodiversity ensures not only more resilient ecosystems, but also a greater productivity within the ecosystem (Tilman and Downing 1996, Gamfeldt et al. 2008). This means that a greater diversity of species within an ecosystem can offer a greater array of ecosystem services and functions such as nutrient recycling (Gamfeldt et al. 2008). All of these observations, which may originally stem from a species inventory, can inform decisions over land use and resource management – affirming biological inventories to be an essential part of conservation biology (McCarter et al. 2001).

Bio-inventory studies are of particular importance in regions which are facing high pressures for industrial or agricultural development such as the Fraser Valley of British Columbia (Anonymous 2004). The Fraser Valley is a regional district of southwestern British Columbia which straddles the border with the U.S. This region currently houses 230, 000 people, but 90% of this population resides on less than 1% of the district's total land base (Anonymous 2004). The Fraser Valley Regional District is also estimated to double its population in as little as 20 years (Anonymous 2004). The immense pressure for development to accommodate this population increase places a huge stress on fragile micropopulations of threatened species (Pearson and Healey 2012). Not only is the Fraser Valley developing at a rapid rate but it is also home to threatened and endangered species that are already impacted by habitat loss and fragmentation (Anonymous 2004, Pearson and Healey 2012). Much of southern British Columbia faces this predicament of vast development pressure outweighing habitat preservation (Pearson and Healey 2012). However, even the small forest communities which remain in these regions can offer refuge for at-risk species. The Blaauw ECO Forest is one of these communities. In September 2013 there was a generous donation of $2.5 million dollars to Trinity Western University to buy a 25 acre plot of mature second-growth forest from the Langley Township (Ferguson 2013). The donation was made by a local family wishing to honour the memory of a lost loved one who spent many hours enjoying the forest's treasures. Now under the ownership and management of Trinity Western University, with input on management provided by partnering organisations, the property is destined to be used for environmental research and to serve as an ecological land reserve (Clements 2013, pers. Comm.).

1.1) Previous Research

Although a 25 acre plot of land may seem small, the mature forest community which exists there harbours a wealth of wildlife. A previous biological inventory completed in 2012 revealed a rich community of plants and animals on the property (Henderson and Ryder 2012). Although this study was preliminary, it did highlight that at-risk species might be using the property (Henderson and Ryder 2012). This report documented distinct biogeoclimatic zones on this property which are provincially recognized as threatened ecosystems (Henderson and Ryder 2012). Previous environmental assessments of the forest completed in 1999 and 2000 yielded similar results (Henderson 1999, Henderson 2000). The value of preserving this small forested property should not be underestimated. It is crucial that an accurate biological inventory covering as many taxa as possible is established for this property to help aid in its conservation.

1.2) Why Is This Study Important?

The Fraser Valley is one of top five biodiversity hotspots within British Columbia (Cox 2010). British Columbia is also the most biodiverse province in Canada but the province with the most at risk species (Anonymous 2008, Cox 2010). In order for British Columbia to maintain its biological richness and prevent impending species extinctions, remaining forests and undeveloped land must be preserved (Pearson and Healey 2012). A small 25 acre parcel can serve as a biological corridor which allows larger species such as bobcats, deer, or coyotes to pass through (Beier and Ross 2008, Albano et al. 2012). Small islands of forest like that of Blaauw ECO Forest are dotted throughout the Fraser Valley, and these islands provide crucial habitat which wildlife can use as corridors to connect variably-sized habitat patches together (Beier and Ross 2008, Albano et al. 2012). Preserving biological corridors is valuable for the conservation of species which rely on large expanses of habitat for their survival (Beier and Ross 2008, Albano et al. 2012).

This study aims to reinforce the importance of the Blaauw ECO Forest and complement existing evidence (Henderson and Ryder 2012) suggesting that this land possesses ecological integrity and needs protection. A preliminary bio-inventory of the Blaauw ECO Forest is necessary to help inform the future management objectives of the property and help direct future research regarding the forest and its ecology.

1.3) Study Site

This research was conducted on the 25 acre land parcel now known as the Blaauw ECO Forest. In the past this property has been locally referred to as McLellan Forest East and Grey Pit. The property sits less than 1km south of the Fraser River (within its floodplain) in a north-eastern Langley region known as Glen Valley. The forest is dominated by large Big-leaf Maples *(Acer macrophyllum)*, Western Hemlocks *(Tsuga heterophylla)*, and Red Cedars *(Thuja plicata)*. This forest has many unique microhabitats and ecological communities such as various wetlands and mixed forests which can foster a greater richness of plant and animal species (Henderson and Ryder 2012).

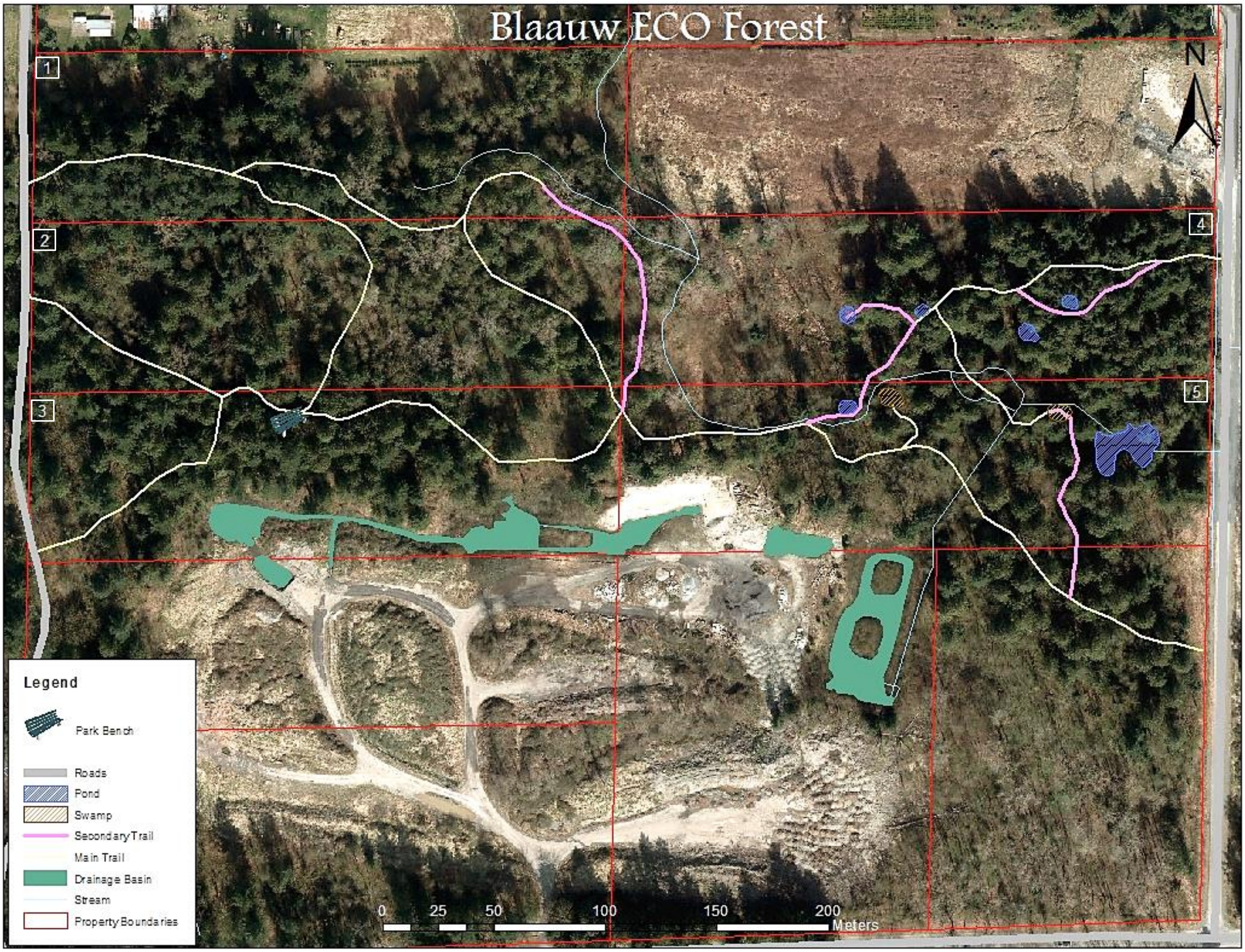

Figure 1: Blaauw ECO Forest in Glen Valley, British Columbia and some of the forest's distinct spatial features. The five 5-acre parcels which makeup TWU's property are numbered 1-5. (Basemap and sources: Open Data Catalog, Township of Langley, 2014)

2.) Methods

The objective of this study was to compile a biological inventory for the Blaauw ECO Forest covering as many taxa as possible within the given expertise and time constraints of the researcher(s). Field data and observations collected from June 2013 to April 2014 have been homogenized with historical records from three previous studies done on the property to create one bio-inventory of the forest. The field methodologies used for the data collection were similar between some taxa (e.g. birds, amphibians, and reptiles) but also unique for others (e.g. mammals). Therefore the following methods section has been divided accordingly.

2.1) General Field Methods

The methodology for documenting many of these taxa of plants and animals was to stay on pre-existing trails established on the property and cover every accessible region of forest, especially areas with unique features (Henderson and Ryder 2012). This was important so that only minimal disturbance was done to the forest community while collecting field data. At least 2-3 hours per week were spent in the field, and the forest was visited at different times of day (morning, afternoon, night) to increase chances of sighting species only active during such times. This allowed the researcher(s) to see shifts in the biological communities not only through different times of day, but also throughout seasonal shifts. There are some transitions in plant communities throughout the park as identified by Henderson and Ryder (2012), so it was crucial that the researcher(s) explored all of these different ecological zones and plant communities on the property during each visit. All of the communities, including mixed forest stands, wetlands, and dry coniferous regions, were covered relatively equally to aid the accuracy of inventory data.

2.2) Birds, Amphibians, and Reptiles

By following the previously mentioned methodology for data collection, the bird, amphibian and reptile communities of the property were covered sufficiently. Binoculars were necessary to view birds from substantial distances. Birds could be identified by visual observation, songs or calls, or lost feathers (Henderson and Ryder 2012). For amphibians, a small net was used to catch and gently immobilize frogs or salamanders for closer observation of colorations and markings. Catching and gently handling snakes was also necessary to observe markings and other features that distinguished between closely related species. For all of these represented taxa, identification manuals were consulted to positively identify each species. The field manuals used for reptile, amphibian and bird identification were *Reptiles of the Northwest* (St. John 2002), *Amphibians of the Pacific Northwest* (Jones 2005), and *Field Guide to the Birds of North America* (Dunn and Alderfer 2011) respectively. If possible, photos of species were also taken. If field identification of any species was not possible, local experts with particular taxonomic expertise were consulted for help with identification.

2.3) Mammals

Identifying mammal species was completed utilizing a variety of methods. Through conducting general field observations, some mammals were encountered on the property or evidence of their presence was spotted. Photographing these species in the flesh, their scat, or their prints and later consulting identification manuals was the most effective method for identification. The manual, *Animal Tracks of Washington and Oregon* (Sheldon 1997) was used to identify tracks in the field. However, this study did recognize the limitations of these methods in providing an accurate depiction of the mammalian communities on the property as many of the local species are elusive, nocturnal, and/or wary of humans.

Two wilderness trap cameras were set up within the park to photograph any mammal species that appeared in the absence of humans. For best results, trap cameras were cycled throughout the property in three week-long rotations (Heilbrun et al. 2006). This was done to ensure that a variety of habitats were sampled on the property (Heilbrun et al. 2006). This also helped provide evidence for several areas of the property being utilized by mammals. The trap cameras were checked every 3-4 days to make sure they had not been tampered with and to have their contents uploaded onto a computer. Camera adjustments were made as necessary. After securing the trap cameras in randomly selected, discrete locations on the property, they were left untouched for a 3-4 day period in order to minimize site disturbance (Heilbrun et al. 2006). Cameras were typically placed on well-trodden game trails to increase the likelihood of capturing mammalian activity, or positioned in areas where there was a large, open area where animals could easily be spotted passing through. After the two-week cycle had finished in one location, the cameras were re-positioned in new areas of the property to sit untouched for another series of 3-4 day increments (Heilbrun et al. 2006). Cameras were secured at least 30cm off of the forest floor and positioned to allow a maximum detection spectrum that was not impeded by any ground coverage or surrounding vegetation (Heilbrun et al. 2006). The cameras used in this study were Bushnell HD Trophy cameras which could take as many as three pictures per second. These cameras came with straps which could secure the cameras to trees (of varying size) so that they could be kept off of the forest floor with larger viewing spectrums. These particular cameras use a passive infra-red motion sensor system which is tripped by any movement within the scope of the camera (Bushnell 2012). When the sensor is tripped, as many as three photos are taken every second that an animal is present within the camera's view (Bushnell 2012). These cameras also employ infra-red flash so that high-resolution photographs can be taken in the absence of any sunlight (Bushnell 2012). The cameras operated for 24 hours a day and the clarity of images varied between 3-8M pixels, depending on the available light (Bushnell 2012). No baiting was necessary for this procedure (Heilbrun et al. 2006).

2.4) Macro-Invertebrates

The inventory for macro-invertebrates followed similar methodology to that utilized for reptiles and amphibians. Photography and online identification manuals were essential for smaller species, as well as consulting local experts to confirm positive identification particularly in taxa with closely related species (e.g. damselflies). Since macro-invertebrates include a large number of species locally, they were only briefly explored in this inventory.

2.5) Vascular and Nonvascular Plants

Vascular plants were the prime target of plant surveys, but both vascular and non-vascular plants were covered by following the general field methods and the use of identification manuals. The manual, *Plants of the Pacific Northwest Coast* by Pojar and Mackinnon (1994) was used for field identification. Samples and photos of particular species were sometimes taken from the field to be later identified if identification in the field is proving too difficult.

2.6) GIS Mapping

Another aspect of this study was to produce a comprehensive map for the Blaauw ECO Forest. GPS tracks of the property trails and waypoints of the water sources and swamps of the property were taken in from the field in February 2014 via a Garmin 76 GPS unit. This raw data was then uploaded onto ArcGIS 10.0 and the map (Figure 1) was configured in March 2014. The main objective for creating a comprehensive map of the forest was to further aid future conservation efforts which may require detailed maps for trail maintenance, restricted areas from public use, or other management concerns.

3.) Results

Table 1: The total number of different species representing each taxonomic group of vertebrates and invertebrates, along with the total number of fauna discovered to date

Fauna:	
Birds	64
Mammals	15
Amphibians	8
Reptiles	3
Fish	1
Macro-Invertebrates	18
Molluscs	10
Total	119

Figure 2: Downy Woodpecker (*Picoides pubescens*)

Figure 3: Coyote (*Canis latrans*)

Figure 4: Rough-skinned Newt (*Taricha granulosa*)

Figure 5: Common Garter Snake (*Thamnophis sirtalis*)

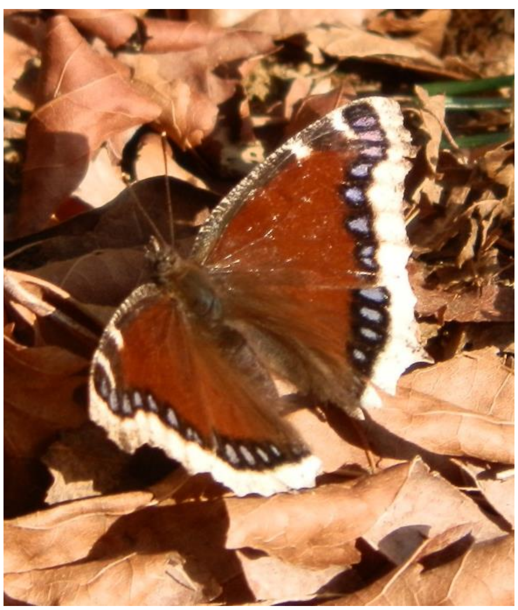

Figure 6: Mourning Cloak (*Nymphalis antiopa*)

Figure 7: Pacific Banana Slug (*Ariolimax columbianus*)

Table 2: The total number of different species representing each taxonomic group of vascular plants, along with the total number of vascular flora discovered to date

Vascular Flora:	
Trees	9
Grasses	6
Shrubs	29
Herbs	71
Total	115


Figure 8: White Fawn Lily (*Erythronium oregonum*)


Figure 9: Salmonberry (*Rubus spectabilis*)

Table 3: The total number of different species representing each taxonomic group of nonvascular plants, along with the total number of nonvascular flora discovered to date

Nonvascular Flora:	
True Mosses	15
Liverworts	4
Lichen	1
Fungi	4
Total	24

Figure 10: *Xylaria hypoxylon*

Figure 11: *Ramaria formosa*

Table 4: Provincially blue-listed species discovered to date

Blue-Listed Species	
Band-tailed Pigeon	*Patagioenas fasciata*
Great Blue Heron	*Ardea herodias ssp. fannini*
Northern Red-legged Frog	*Rana aurora*
Pacific Sideband Snail	*Monadenia fidelis*

Figure 13: *Rana aurora*

Figure 12: *Monadenia fidelis*

Table 5: Invasive species of fauna according to each taxonomic group discovered to date

Invasive Fauna	
Birds	
European Starling	*Sturnus vulgaris*
Mammals	
Eastern Cottontail	*Sylvilagus floridanus*
Eastern Grey Squirrel	*Sciurus carolinensis*
Virginia Opossum	*Didelphis virginiana*
Amphibians	
American Bullfrog	*Rana catesbeiana*
Green Frog	*Rana clamitans*
Invertebrates	
Black Slug	*Arion rufus*
Cabbage White Butterfly	Pieris rapae
Gray Fieldslug	*Deroceras reticulatum*
Grove Snail	*Cepaea nemoralis*
New Zealand Mud Snail	*Potamopyrgus antipodarum*

Table 6: Invasive species of flora according to each taxonomic group discovered to date

Invasive Flora	
Grasses	
Common Bentgrass	*Agrostis capillaris*
Common Rush	*Juncus effusus*
Creeping Bentgrass	*Agrostis stolonifera*
Reed Canary Grass	*Phalaris arundinacea*
Herbs	
Canada Thistle	*Cirsium arvense*
Common Burdock	*Arctium minus*
Common Dandelion	*Taraxacum officinale*
Common Foxglove	*Digitalis purpurea*
Creeping Buttercup	*Ranunculus repens*
English Ivy	*Hedera helix*
European Bittersweet	*Solanum dulcamara var. dulcamara*
Field Bindweed	*Convolvulus arvensis*
Hairy Cat's Ear	*Hypochoeris radicata*
Hemp-nettle	*Galiopsis tetrahit*
Mullein	*Verbascum thapsus*
Nipplewort	*Lapsana communis*
Oxeye Daisy	*Leucanthemum vulgare*
Policeman's Helmet	*Impatiens glandulifera*
Robert's Geranium	*Geranium robertianum*
Scotch Broom	*Cytisus scoparius*
Self-heal	*Prunella vulgaris*
Shepherd's Purse	*Capsella bursa-pastoris*
Tufted Vetch	*Vicia cracca*
Wall Lettuce	*Lactuca muralis*
White Clover	*Trifolium repens*
Wild Carrot	*Daucus carota*
Woodland Ragwort	*Senecio sylvaticus*
Yellow Archangel	*Lamium galeobdolon*
Shrubs	
Cutleaf Evergreen Blackberry	*Rubus laciniatus*
English Holly	*Ilex aquilifolium*
Himalayan Blackberry	*Rubus bifrons*

Table 7: List of species documented in the Blaauw ECO Forest, according to their respective taxa, which were challenging to ID in the field and required external resources to ID

COMMON NAME	LATIN NAME	ID REFERENCE
True Mosses		
	Buckiella undulata	Web: E Flora BC Gallery
	Claopodium crispifolium	Web: E Flora BC Gallery
	Dichodontium pellucidum	Web: E Flora BC Gallery
	Hookeria lucens	Web: E Flora BC Gallery
Lichen		
	Parmelia sulcata	Web: E Flora BC Gallery
Fungi		
	Lycoperdon sp.	Web: Pacific Northwest Key Council
	Morchella esculenta	Web: Pacific Northwest Key Council
	Ramaria formosa	Web: Pacific Northwest Key Council
	Xylaria hypoxylon	Web: Pacific Northwest Key Council
Grasses		
Common Bentgrass	*Agrostis capillaris*	Web: E Flora BC Gallery
Creeping Bentgrass	*Agrostis stolonifera*	Web: E Flora BC Gallery
Sweet Grass	*Hierochloe odorata*	Web: E Flora BC Gallery
Mollusks		
Beaded Lancetooth	*Ancotrema sportella*	Land Snails of Pacific Northwest ID Manual
Robust Lancetooth	*Haplotrema vancouverense*	Land Snails of Pacific Northwest ID Manual
Tadpole Physa	*Physa gyrina*	Web: E Fauna BC Gallery
Woodland Pondsnail	*Stagnicola catascopium*	Web: E Fauna BC Gallery
Macro-invertebrates		
California Darner Dragonfly	*Rhionaeschna californica*	Ted Goshulak
Canada Darner Dragonfly	*Aeshna canadensis*	Stan Olson
Northern Bluet Damselfly	*Enallagma annexum*	Stan Olson
Pacific Forktail Damselfly	*Ischnura cervula*	Stan Olson
Western Forktail Damselfly	*Ischnura perparva*	Stan Olson
Reptiles		
Northwestern Garter Snake	*Thamnophis ordinoides*	Web: Reptiles of BC (TRU)
Western Terrestrial Garter Snake	*Thamnophis elegans vagrans*	Web: Reptiles of BC (TRU)
Birds		
Lincoln's Sparrow	*Melospiza lincolnii*	Ted Goshulak
Northern Waterthrush	*Parkesia noveboracensis*	Web: Cornell Lab of Ornithology
Mammals		
Bobcat	*Lynx rufus*	Web: Michigan DNR

4.) Discussion

As the results of this study have shown, the Blaauw ECO Forest is home to a substantial amount of flora and fauna. Although it is difficult to qualify the biodiversity of a property only 25 acres in size, even more so to compare this biological diversity to other regions of similar size and ecology, it can be safe to assume that a composition of at least 258 different species is a reputable figure. This amounts to ten different species for every acre of the forest, not even including the many species which have yet to be documented on the property such as many invertebrates and nonvascular plants. Thus, 258 species is a highly conservative number. Even within taxa which have been covered more extensively than others, such as birds and mammals, there is the possibility for many of these species to be missed given their nocturnal or migratory nature. In particular, many raptors and passerine birds, as well as bats and other nocturnal small mammals gone undetected in this study, but this does not mean that they are not using the forest, at least in passing.

A biological inventory of Stanley Park in metro Vancouver that was thorough, albeit done over a brief period of just two days in late summer, documented 395 different species, including historical species records (BioBlitz Summary Report 2011). The Stanley Park bioinventory report concluded that Stanley Park is considered a region of high to very high relative biodiversity (BioBlitz Summary Report 2011). Though the two forests are slightly different geographically and ecologically, the Blauuw ECO Forest inventory completed here comprised to 2/3 of Stanley Park's biodiversity while being only 2.5% of its size. Although not a perfect comparison, it helps emphasize the relatively high biological diversity found in the Blaauw ECO Forest, and perhaps the amount of diversity which has yet to be discovered in the forest and its surrounding area. The species diversity found in the Blaauw ECO Forest is likely indicative of a healthy ecosystem, despite the forest's proximity to urban and agricultural development, and highlights the importance of preserving mature forest stands (Castle 2000). Part of the reason why a high level of biodiversity can be found in the Blaauw ECO Forest is due to the forest's diverse habitat, or spatial heterogeneity; scores of fallen trees, decaying logs, swamps, ponds, streams and other features provide microhabitats which can be exploited by a greater wealth of organisms (Tamme et al. 2010). The forest also boasts a variety of different ecological communities, including wetlands, mixed forests, and coniferous woodlands which adds to the spatial heterogeneity of the environment (Tamme et al. 2010, Henderson & Ryder 2012). The heterogeneity of an environment positively correlates to greater biodiversity, and this may hold true of the Blaauw ECO Forest (Tamme et al. 2010).

Fifteen mammal species have currently been documented using the Blaauw ECO Forest, at least to some capacity. What is interesting about this number is that due to the methodological limitations of exploring the mammalian diversity in the forest, the majority of the mammals documented are medium to large-sized (e.g. Figure 3). Medium and large-sized mammals clearly require more space than just 25 acres of forest, but wilderness trap cameras and other evidences demonstrated that the Blaauw ECO Forest is a well-used forest patch by many of these mammal species. In particular, large species such as black bears, bobcats, coyotes, deer, and even cougars have left evidence such as claw marks, footprints and scat in the Blaauw ECO Forest. Medium-sized mammals such as opossums, raccoons, and cottontails have also been documented on the wilderness trap cameras. The evidence of medium and large-sized mammals using the property is an ecologically promising sign because this signifies that the Blaauw ECO Forest serves as an important patch of habitat (Hudson & Noss 1991). Large mammals, especially, require extensive habitat ranges, and in fragmented habitats they rely on forest patches and biological corridors which can facilitate their movement from one patch of habitat to the next (Hudson & Noss 1991). Although it is almost certain that none of these larger mammal species are full-time residents of the Blaauw ECO Forest, their occasional use of the property speaks volumes for the refuge the small forest stand may offer mobile species within a landscape that is being fragmented by development (Hudson & Noss 1991).

Another benefit of the Blaauw ECO Forest which can be interpreted from Table 2 is the sheer amount of plant diversity which can be found in the forest (Figures 8 & 9). Overall, the Blaauw ECO Forest represents a mixed forest comprised of several coniferous and deciduous tree species. Mixed forest stands are known to not only support more tree diversity, but also contribute to greater understory and ground level plant diversity (Knoke et al. 2005). In addition to this, mixed forest stands can also be more ecologically stable than monoculture forests, not just in terms of their ability to support more biological diversity but also their greater resilience to storm damages, flood and drought affects, insect damage, and exotic species invasions (Knoke et al. 2005). As has been previously discussed, the mixed forest found in the Blauuw ECO Forest also supports a wide array of ecological communities and microhabitats which may be essential for at-risk species which require diverse habitat.

Two of the at-risk species which have been spotted regularly on the property have been the Pacific Sideband snail (*Monadenia fidelis*) and the Northern Red-legged Frog (*Rana aurora*). These are both provincially blue-listed species which are threatened due to their specific ecological requirements and their loss of suitable habitat (BC Ministry of Environment 2014). *M.fidelis* is a species which is becoming increasingly rare, especially in the Fraser Valley portion of its range (Brown & Durand 2007). There have not been many distinguishing factors defined about the habitat which *M. fidelis* prefers, however research has proven that this species only inhabits low-lying forests of the Pacific Northwest (Brownd & Durand 2007). There may be many more limiting factors to this snail's ecology, but *M. fidelis* has been determined to be even further restricted to relatively undisturbed, mixed forest stands which are mature or old-growth (Brown & Durand 2007). *R. aurora* is another species which has specific niche requirements (Hayes et al. 2008). Throughout its lifecycle, *R. aurora* requires still and shaded water bodies in order to reproduce and raise young, a matrix of both wetland habitat and terrestrial forests, as well as near-constant shade (Hayes et al. 2007). Fortunately for both *M. fidelis* and *R. aurora*, their ecological requirements are met in the Blaauw ECO Forest, and their regular presence within the forest testifies to the rich and ecologically diverse Blaauw ECO Forest and surrounding area.

The ecological richness of the Blaauw ECO forest is not just proven by the presence of at-risk species, but also by the species which reside on the property either seasonally or year-round. Throughout the duration of this study, several bird species have been seen not only courting, but nesting in the forest. On March 31st, 2014 there was even a mating ball of garter snakes spotted on the forest fringe. Since garter snakes mate almost immediately after emerging from hibernation, it is very likely that a snake hibernaculum resides directly on the Blaauw ECO Forest property (Costanzo 1986). Garter snakes hibernate in groups, sometimes several hundred strong, and are also known to share their hibernacula, which have rather specific ecological requirements, with several other snake species (Costanzo 1986). Therefore, the presence of a hibernaculum in the Blaauw ECO Forest not only ensures that the forest is a safe place to overwinter, but that the forest may in fact serve as a refuge for an entire local population of garter snakes, potentially even all three species of garter snakes found in this region (Costanzo 1986). In addition to birds and reptiles mating on the property, there has also been a myriad of amphibian egg masses spotted in and around the many water bodies of the Blaauw ECO Forest. Many species of both salamanders and frogs have been documented laying egg masses within the Blaauw ECO Forest, including the blue-listed *Rana aurora* (Loubser 2014). Clearly the Blaauw ECO Forest does not just serve as a mere shelter for many organisms, but as a place where species of many taxa come to breed, feed, and even hibernate. If it were not for the observations of this study, there would have been little known about which species would have been lost or had their homes destroyed had the Blaauw ECO Forest been cleared for residential development.

Although there are many factors which may contribute to high biodiversity and an overall healthy ecosystem, the Blaauw ECO Forest is far from a pristine wilderness. As can be seen in Table 5, many non-native organisms call the Blaauw ECO Forest home. At first glance these exotic species may seem to contribute to the overall diversity in the forest, but their role in the local ecology may be quite the opposite. For example, the American bullfrog (*Rana catesbeiana*) can cause severe ecological damage (Kiesecker et al. 2001). Even as tadpoles *R. catesbeiana* can compete vigorously with other amphibian species over food resources, especially in small breeding ponds (Kiesecker et al. 2001). *R. catesbeiana* is known to not only outcompete other amphibians, but prey on them as well, and these invasive frogs have had a tremendous impact on *R. aurora* in particular (Kiesecker et al. 2001). The ecological impacts of *R. catesbeiana* are not limited to other amphibians, however. These frogs have a seemingly insatiable appetite and will eat virtually any prey item which they can fit into their mouths, including other frogs, ducklings, and small mammals and this can have a detrimental effect on the entire freshwater ecosystem (Kiesecker et al. 2001). The impacts of *R. catesbeiana* in isolation help illustrate just how destructive one non-native species can be in an ecosystem. The fact that over ten invasive species of fauna have already been documented using the Blaauw ECO Forest, and potentially many others yet to be identified, could mean future negative impacts on the forest's ecology are inescapable.

Unfortunately for the The Blaauw ECO Forest, there is another major source of ecological disturbance which may pose a risk to the region's biodiversity. The Blaauw ECO Forest is skirted by residential roads to the west and east, an active gravel site to the south, and ongoing land development to the north (Figure 1). All of these areas are zones of regular disturbance which may have a rather profound impact on the local ecology. These zones provide sources of noise pollution and chemical inputs which may reduce localized biodiversity, especially around the road and gravel site borders (Forman & Alexander 1998). However, typical of all of these zones is another deleterious factor – invasive plant species. The volume of invasive plant species is notably higher along the regions of site disturbance, and these species pose arguably the largest risk to the local ecology. The impacts of the American bullfrog may be evident, but it is the silent killers which may pose an even greater risk to the forest's diversity. There is a long list of invasive plant species which have been documented in the Blaauw ECO Forest (at least 31 species of non-native vascular plants as recorded in this study). For the majority, many of these invasive plant species are restricted to the more disturbed areas around the perimeter of the forest where the disturbance is greatest, and they have not intruded too far into the forest itself. However, a few of these species such as Himalayan blackberry, yellow archangel, and English holly are fast growing plants which are capable of establishing within the forest, and they have already made their way several meters into some regions of the forest. Invasive plant species capitalize on available resources and easily outcompete slow-growing native vegetation (Keller et al. 2009). Exotic plants can also parasitize native vegetation (e.g. English holly), or simply overgrow the native understory (Keller et al. 2009). This can lead to an overall decline in biodiversity, for if plant diversity decreases, other organisms which rely on those native plants will also disperse (Keller et al. 2009). Alarmingly, exotic species are also known to grow at their greatest rates when in a non-native environment, and this means that many of the invasive species in Table 6 could have the potential of growing out of control into the Blaauw ECO Forest (Keller et al. 2009). The amount of damage that both invasive flora and invasive fauna can cause on an ecosystem merits serious concern (Keller et al. 2009), and may be the biggest single threat facing the biological diversity of the Blaauw ECO Forest.

4.1) Study Limitations

This study was subject to many limitations, but the lack of expertise of the researcher(s), especially for nonvascular plants and invertebrate taxa, was the largest constraint of this study. Without all of the present taxa being thoroughly explored in the Blaauw ECO Forest, a truly accurate portrayal of the forest's diversity could not be compiled. Despite the best efforts of the researcher(s), some taxa proved to be too challenging and too time-intensive to cover in this study. In addition, there is the possibility that some species which have been documented in this bioinventory have been misidentified.

Every taxon which was represented in the Blaauw ECO Forest had species which were difficult to identify, and this was a challenge dealt with regularly by the researcher(s). Since the researcher(s) did not have a comprehensive field guide specific to nonvascular plants or invertebrates, the only way these species could be positively identified was by taking photographs of them on site, and later comparing these images to online species galleries, or by emailing them to local experts with specific taxonomic expertise for confirmation (e.g. local naturalist, Stan Olson). For the most part, the nonvascular plant species which could not be identified in the field were left alone in the hopes that future studies could do a more accurate inventory of them. There were not many issues identifying vascular plants, however the grasses did prove to be the most challenging species to identify for this taxon (Table 7). Samples of each grass specimen were taken from the field and then compared to online species galleries in order to identify them. The mollusks and other macro-invertebrate species listed in Table 7 were identified solely by photograph comparisons online, or emailing the photos to Stan Olson to confirm the identity of the species.

The three garter snake species which are all found in the area were challenging to identify in the field, mostly because it was difficult to get clear photographs of the specimens and because the distinguishing characteristics between these closely related species are subtle. However, what proved to be most helpful was noting down the visible characteristics (e.g. color patterns, approximate length, and head size) of each snake spotted in the field, and then consulting online identification sites which were specific to distinguishing between the garter snake subspecies. The birds and mammals documented in this study did not prove to be too challenging to identify, however the sparrows in particular were difficult to tell apart. Ted Goshulak, a local naturalist, was incredibly knowledgeable about the local bird species and their calls, and was able to help with more challenging species identifications. The Northern Waterthrush listed in Table 7 was unfortunately never photographed on site, and is considered uncommon in the area (Goshulak 2014, pers. Comm.). However, the behaviour and physical characteristics of the bird were noted and were largely consistent with online manuals' descriptions of the species, so the Northern Waterthrush was either misidentified, or it made a rare appearance to the area. For the mammals, the only species which was difficult to identify was the bobcat, and this was because only two footprints of the animal were spotted on the property. The lack of claw impressions in the prints is typical of bobcats (easily distinguishable from coyote's), but a large house cat may leave very similar tracks, and therefore misidentification cannot be ruled out. A bird carcass was spotted nearby to the prints, and therefore the presence of a bobcat does seem likely.

Another downfall of this study was its timing. Because of the limited time frame in which research could be conducted, almost no field research was completed in either April or May. These spring months are crucial times of year to spot migratory birds, flowering plants, and many other species which are most active at this time of year. Countless species could be documented within April and May alone, and it is unfortunate that the entire spring season could not be included in this study.

4.2) Recommendations for Future Studies

For future studies seeking to expand on this bioinventory, it is strongly advised to include a full calendar year of data collection if possible. The ecological communities found in the Blaauw ECO Forest undergo many changes seasonally, with new species moving in and out, so a full year's study encompassing all of the seasons is imperative for bioinventory accuracy. Future research is highly recommended on nonvascular plants and invertebrates; some nonvascular plants have already been inventoried in spring of 2014 but are not yet documented here (Hall 2014, pers. Comm.). Using sonar, which may be possible by working in conjunction with BCIT, to identify the bat species which use the Blaauw ECO Forest could be very beneficial for many of the bat species found in the Lower Mainland are provincially listed as at-risk species. Regular owling expeditions, with the use of call recordings, completed throughout the year may also prove to be beneficial for the forest's avian inventory. Small mammal trapping is strongly advised for future studies as there is a very high potential for at-risk mammal species residing on the property, and this would also give a more accurate depiction of the site's mammalian diversity. Lastly, it is imperative for the health and longevity of the Blaauw ECO Forest to conduct conservation work such as invasive species removal. Site remediation, if permitted, is also recommended where the gravel site meets the forest edge to prevent harmful effluents and invasive species from advancing into the forest. Particular remediation work in disturbed areas such as planting native vegetation which is beneficial to at-risk species may encourage the settlement of other threatened species in the Blaauw ECO Forest. Some other considerations for the future management of this property is appropriate signage posted at the forest's main trailhead (e.g. leashed dogs only), general trash cleanup, and potential trail closures of the secondary trails as seen in Figure 1 where trails may fragment sensitive habitat.

4.3) Conclusions

Given its rather precarious location amongst a matrix of development and agriculture, the Blaauw ECO Forest appears to be coping well ecologically. The rich diversity of flora and fauna on the property testify to the stability of this mature forest stand. The evidence of large mammals on the property, as well the regular use by at-risk species help support that the Blaauw ECO Forest has ecological integrity and is a patch of prime habitat that species clearly seek out. Overall, this study recognizes that the biological diversity of the Blaauw ECO Forest is extremely difficult to qualify, especially within a 10-month span, but there is ample evidence indicating the biological richness of the forest and its surrounding area. In order to protect the biodiversity of the Blaauw ECO Forest, the forest's variety of habitats must be preserved and therefore future conservation work will be necessary, especially to ensure the control of invasive species and to minimize negative disturbances from recreational use.

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7.) Appendices

7.1) *Appendix A: Vertebrate Fauna Inventory*

Birds: * Signifies birds which were identified by their calls only

COMMON NAME	LATIN NAME
American Goldfinch	*Spinus tristis*
American Robin	*Turdus migratorius*
Anna's Hummingbird	*Calypte anna*
Bald Eagle	*Haliaeetus leucocephalus*
Barred Owl	*Strix varia*
Belted Kingfisher	*Megaceryle alcyon*
Bewick's Wren	*Thryomanes bewickii*
Black-capped Chickadee	*Poecile atricapillus*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Black-throated Gray Warbler	*Dendroica nigrescens*
Brown Creeper	*Certhia americana*
Bufflehead	*Bucephala albeola*
Canada Goose	*Branta canadensis*
Cedar Waxwing	*Bombycilla cedrorum*
Chestnut-backed Chickadee	*Poecile rufescens*
Common Goldeneye	*Bucephala clangula*
Common Nighthawk*	*Chordeiles minor*
Common Raven	*Corvus corax*
Common Yellowthroat	*Geothlypis trichas*
Dark-eyed Junco	*Junco hyemalis*
Double-crested Cormorant	*Phalacrocorax auritus*
Downy Woodpecker	*Picoides pubescens*
European Starling	*Sturnus vulgaris*
Fox Sparrow	*Passerella iliaca*
Great Blue Heron	*Ardea herodias ssp. fannini*
Golden-crowned Kinglet	*Regulus satrapa*
Hairy Woodpecker	*Picoides villosus*
Hooded Merganser	*Lophodytes cucullatus*
House Finch	*Carpodacus mexicanus*
Hutton's Vireo	*Vireo huttoni*
Lincoln's Sparrow	*Melospiza lincolnii*
Mallard	*Anas platyrhynchos*
Merlin	*Falco columbarius*
Northern Flicker	*Colaptes auratus*

Northern Waterthrush	*Parkesia noveboracensis*
Northwestern Crow	*Corvus caurinus*
Pacific-slope Flycatcher	*Empidonax difficilis*
Pacific Wren	*Troglodytes pacificus*
Pileated Woodpecker	*Dryocopus pileatus*
Pine Siskin*	*Carduelis pinus*
Purple Finch	*Carpodacus purpureus*
Red-tailed Hawk	*Buteo jamaicensis*
Ruby-crowned Kinglet	*Regulus calendula*
Rufous Hummingbird	*Selasphorus rufus*
Song Sparrow	*Melospiza melodia*
Spotted Towhee	*Pipilo maculatus*
Steller's Jay	*Cyanocitta stelleri*
Swainson's Thrush	*Catharus ustulatus*
Turkey Vulture	*Cathartes aura*
Varied Thrush	*Ixoreus naevius*
Western Tanager	*Piranga ludoviciana*
Western Wood Peewee	*Contopus sordidulus*
White-Crowned Sparrow	*Zonotrichia leucophrys*
Willow Flycatcher	*Empidonax traillii*
Wilson's Warbler*	*Wilsonia pusilla*
Wood Duck	*Aix sponsa*

HISTORICAL RECORDS	
Cooper's Hawk	*Accipiter cooperii*
Band-tailed Pigeon	*Patagioenas fasciata*
Great-horned Owl	*Bubo virginianus*
Red-Breasted Sapsucker	*Sphyrapicus ruber*
Killdeer	*Charadrius vociferus*
Spotted Sandpiper	*Actitis macularius*
Red-eyed Vireo	*Vireo olivaceus*
Brown-headed Cowbird	*Molothrus ater*

Mammals: * Signifies mammals which were identified by other features such as claw marks, scat, and/or prints

COMMON NAME	LATIN NAME
Black-tailed Deer*	*Odocoileus hemionus columbianus*
Black Bear*	*Ursus americanus*
Bobcat*	*Lynx rufus*
Coast Mole	*Scapanus orarius*
Cougar*	*Puma concolor*
Coyote	*Canis latrans*
Douglas Squirrel	*Tamiasciurus douglasii*
Eastern Cottontail	*Sylvilagus floridanus*
Eastern Grey Squirrel	*Sciurus carolinensis*
Muskrat	*Ondatra zibethicus*
Pacific Jumping Mouse	*Zapus trinotatus*
Raccoon	*Procyon lotor*
Short-tailed Weasel	*Mustela erminea*
Virginia Opossum	*Didelphis virginiana*

HISTORICAL RECORDS	
American Shrew Mole	*Neurotrichus gibbsi*

Reptiles

COMMON NAME	LATIN NAME
Common Garter Snake	*Thamnophis sirtalis ssp. pickeringii*
Northwestern Garter Snake	*Thamnophis ordinoides*
Western Terrestrial Garter Snake	*Thamnophis elegans vagrans*

Amphibians

COMMON NAME	LATIN NAME
American Bullfrog	*Rana catesbeiana*
Ensatina	*Ensatina eschscholtzii*
Green Frog	*Rana clamitans*
Long-toed Salamander	*Ambystoma macrodactylum*
Northern Red-Legged Frog	*Rana aurora*
Northwestern Salamander	*Ambystoma gracile*
Pacific Tree Frog	*Pseudacris regilla*
Rough-skinned Newt	*Taricha granulosa*

Fish

COMMON NAME	LATIN NAME
Three-spined stickleback	*Gasterosteus aculeatus*

7.2) Appendix B: Invertebrate Fauna Inventory

Macro-invertebrates

COMMON NAME	LATIN NAME
Cabbage White Butterfly	*Pieris rapae*
California Darner Dragonfly	*Rhionaeschna californica*
Canada Darner Dragonfly	*Aeshna canadensis*
Cardinal Meadowhawk Dragonfly	*Sympetrum illotum*
Common Whitetail Dragonfly	*Plathemis lydia*
Four-spotted Skimmer Dragonfly	*Libellula quadrimaculata*
Harvestmen	*Opiliones sp.*
Milbert's Tortoiseshell Butterfly	*Aglais milberti*
Mourning Cloak Butterfly	*Nymphalis antiopa*
Northern Bluet	*Enallagma annexum*
Pacific Forktail Damselfly	*Ischnura cervula*
Paddle-tailed Darner Dragonfly	*Aeshna palmata*
Satyr Anglewing	*Polygonia satyrus*
Striped Meadowhawk Dragonfly	*Sympetrum pallipes*
Two-striped Grasshopper	*Melanoplus bivittatus*
Western Forktail Damselfly	*Ischnura perparva*
Western Tiger Swallowtail Butterfly	*Papilio rutulus*

HISTORICAL RECORDS	
False Hemlock Looper	*Nepytia canosaria*

Mollusks

COMMON NAME	LATIN NAME
Pacific Banana Slug	*Ariolimax columbianus*
Beaded Lancetooth	*Ancotrema sportella*
Black Slug	*Arion rufus*
Gray Fieldslug	*Deroceras reticulatum*
Grove Snail	*Cepaea nemoralis*
Pacific Sideband Snail	*Monadenia fidelis*
Robust Lancetooth	*Haplotrema vancouverense*
New Zealand Mud Snail	*Potamopyrgus antipodarum*
Tadpole Physa	*Physa gyrina*
Woodland Pondsnail	*Stagnicola catascopium*

7.3) Appendix C: Vascular Flora Inventory

COMMON NAME	LATIN NAME
GRASSES	
Common Bentgrass	*Agrostis capillaris*
Creeping Bentgrass	*Agrostis stolonifera*
Reed Canary Grass	*Phalaris arundinacea*
Sweet Grass	*Hierochloe odorata*

HISTORICAL RECORDS OF GRASSES	
Common rush	*Juncus effusus*
Slender rush	*Juncus tenuis*

HERBS	
American Water Plantain	*Alisma trivial*
Arrowleaf Groundsel	*Senecio triangularis*
Baneberry	*Actaea rubra*
Bracken Fern	*Pteridium aquilinum*
Broad-leaved Starflower	*Trientalis borealis ssp. latifolia*
Common Burdock	*Arctium minus*
Common Cattail	*Typha latifolia*

Common Dandelion	*Taraxacum officinale*
Common Foxglove	*Digitalis purpurea*
Cow Parsnip	*Heracleum lanatum*
Cow's Clover	*Trifolium wormskioldii*
Creeping Buttercup	*Ranunculus repens*
Deer Fern	*Blechnum spicant*
Dune Tansy	*Tanacetum bipinnatum ssp huronense*
English Ivy	*Hedera helix*
False Lily of the Valley	*Maianthemum dilatatum*
Field Bindweed	*Convolvulus arvensis*
Fireweed	*Epilobium angustifolium*
Indian Thistle	*Cirsium edule*
Lady Fern	*Athyrium filix-femina*
Large-leaved Avens	*Geum macrophyllum*
Licorice Fern	*Polypodium glycyrrhize*
Manna Grass	*Glyceria sp.*
Mullein	*Verbascum thapsus*
Oak Fern	*Gymnocarpium dryopteris*
Oxeye Daisy	*Leucanthemum vulgare*
Pacific Bleeding Heart	*Dicentra formosa*
Pacific Water Parsley	*Oenanthe sarmentosa*
Piggy-back Plant	*Tolmiea menziesii*
Policeman's Helmet	*Impatiens glandulifera*
Robert's Geranium	*Geranium robertianum*
Scotch Broom	*Cytisus scoparius*
Shepherd's Purse	*Capsella bursa-pastoris*
Skunk Cabbage	*Lysichiton americanum*
Small-flowered Forget-me-not	*Myosotis laxa*
Starry Solomon's Plume	*Smilacina stellata*
Stinging Nettle	*Urtica dioica*
Sweet Scented Bedstraw	*Galium triflorum*
Sword Fern	*Polystichum munitum*
Three-leaved Foam Flower	*Tiarella trifoliata*
Tufted Vetch	*Vicia cracca*
Vanilla Leaf	*Achlys triphylla*
Wall Lettuce	*Lactuca muralis*
Western Trillium	*Trillium ovatum*

White Clover	*Trifolium repens*
Wild Carrot	*Daucus carota*
White Fawn Lily	*Erythronium oreganum*
Woodland Ragwort	*Senecio sylvaticus*
Yellow Archangel	*Lamium galeobdolon*

HISTORICAL RECORDS OF HERBS	
Hemlock Dwarf Mistletoe	*Arceuthobium tsugense ssp. tsugense*
Bittercress	*Cardamine sp.*
Enchanter's-Nightshade	*Circaea alpine*
Vari-leaved Collomia	*Collomia heterophylla*
Purple-leaved Willowherb	*Epilobium ciliatum*
Hemp-Nettle	*Galiopsis tetrahit*
Rattlesnake Plantain	*Goodyera oblongifolia*
Northern Water Horehound	*Lycopus uniflorus*
Self-Heal	*Prunella vulgaris*
Pink Wintergreen	*Pyrola asarifolia*
Marsh Skullcap	*Scutellaria galericulata*
European Bittersweet	*Solanum dulcamara var. dulcamara*
Hedge-Nettle	*Stachys chamissonis var. cooleyae*
American Speedwell	*Veronica beccabunga var. americana*
Marsh Violet	*Viola palustris*
Spiny Wood Fern	*Dryopteris expansa*
Canada Thistle	*Cirsium arvense*
Miner's Lettuce	*Claytonia perfoliata*
Siberian miner's lettuce	*Claytonia sibirica*
Hooker's fairybells	*Disporum hookeri*
Hairy cat's ear	*Hypochoeris radicata*
Nipplewort	*Lapsana communis*

SHRUBS	
Baldhip Rose	*Rosa gymnocarpa*
Beaked Hazlenut	*Corylus cornuta*
Black Gooseberry	*Ribes lacustre*
Black Huckleberry	*Vaccinium membranaceum*
Black Raspberry	*Rubus leucodermis*
Cascara	*Rhamnus purshiana*
Cutleaf Evergreen Blackberry	*Rubus laciniatus*
Devil`s Club	*Oplopanax horridus*

Douglas Maple	*Acer glabrum*
Dull Oregon Grape	*Mahonia nervosa*
English Holly	*Ilex aquilifolium*
Himalayan Blackberry	*Rubus armeniacus*
Indian Plum	*Oemleria cerasiformis*
Mountain Ash	*Sorbus scopulina*
Oval-leaved Blueberry	*Vaccinium ovalifolium*
Red Elderberry	*Sambucus racemosa ssp pubens*
Red Huckleberry	*Vaccinium parvifolium*
Salal	*Gaultheria shallon*
Salmonberry	*Rubus spectabilis*
Trailing Black Currant	*Ribes laxiflorum*
Trailing Blackberry	*Rubus ursinus*
Vine Maple	*Acer circinatum*
Western Trumpet	*Lonicera ciliosa*

HISTORICAL RECORDS OF SHRUBS	
Red-Osier Dogwood	*Cornus stolonifera*
Black Hawthorn	*Crataegus douglasii*
Black Twinberry	*Lonicera involucrata*
False Azalea	*Menziesia ferrugine*
Thimbleberry	*Rubus parviflorus*
Willow	*Salix sp.*

TREES	
Bigleaf Maple	*Acer macrophyllum*
Black Cottonwood	*Populus trichocarpa*
Coast Douglas-fir	*Pseudotsuga menziesii*
Pacific Crab Apple	*Malus fusca*
Paper Birch	*Betula papyrifera*
Red Alder	*Alnus rubra*
Sitka Spruce	*Picea sitchensis*
Western Hemlock	*Tsuga heterophylla*
Western Redcedar	*Thuja plicata*

7.4) Appendix D: Nonvascular Flora Inventory

True Mosses
Buckiella undulata
Claopodium crispifolium
Dichodontium pellucidum
Hookeria lucens

HISTORICAL RECORDS OF MOSSES
Brachythecium rutabulum
Eurhynchium oreganum
Eurhynchium praelonga
Hylocomium splendens
Isothecium stolonifera
Rhytidiadelphus loreus
Rhytidiadelphus triquetrus
Atrichum selwynii
Brachythecium asperrimum
Plagiomnium insigne
Plagiothecium undulatum

HISTORICAL RECORDS OF LIVERWORTS
Cephalozia divaricata
Chiloscyphus polyanthos
Pellia neesiana
Riccardia multifida

Lichen
Parmelia sulcata

Fungi
Lycoperdon sp.
Morchella esculenta
Ramaria formosa
Xylaria hypoxylon