Ecological Inventory of Wildwood Marsh and Wildwood Interpretive Forest, Comox Valley Regional District - 2014

Prepared By

Ian Moul RPBio.
1585 Birch Avenue, Comox, B.C.
V9M 2N5

and

Wendy Kotilla RNS Dip.
Youth and Ecological Restoration Program
4327 Minto Road, Courtenay, B.C.
V9N 9P7

30th of October 2014

TABLE OF CONTENTS

	ACKNOWLEDGMENTS	3
I	INTRODUCTION	3
	A Background	3
	B Purpose of the Study	4
	C Location	5
II	METHODS	6
III	RESULTS and DISCUSSION	7
	A Vegetation Study Plot 1	7
	B Vegetation Study Plot 2	12
	C Observations of Birds, Animals, Amphibians and Fish	16
	D The Importance of Wetlands and Forests	17
IV	RECOMMENDATIONS	18
V	REFERENCES	21
	APPENDIX 1	22
	APPENDIX 2	24

ACKNOWLEDGMENTS

Funding for Wendy Kotilla and the youth was provided by the BC Ministry of Children and Family Development. Funding for Ian Moul was provided by the Comox Valley Regional District (CVRD), Community Services Branch.

We very much appreciate Bryan Allen, who is a Wildwood resident and retired Community Advisor for the Department of Fisheries and Oceans, for sharing his knowledge of the history and wildlife of Wildwood Marsh. Many thanks also to Doug DeMarzo, Manager of CVRD Community Services Branch, for talking with us about the history, issues, and greater plans for Wildwood Marsh and the Wildwood Interpretive Forest.

I INTRODUCTION

I-A Background

This report documents information collected during an ecological inventory of Wildwood Marsh and Wildwood Interpretive Forest with the Youth and Ecological Restoration Program (YER) from the 16th to 20th of July 2014. YER provides work experience, training and support for youth aged twelve to eighteen (YER 2014). Through studying local watersheds with community members, youth gain a sense of worth, belonging and place. The focus of YER, Phase I is to work one on one with youth conducting ecological restoration activities with a variety of environmental organizations; YER, Phase II has two youth and two adults concentrating on a specific project to further develop teamwork, research techniques and communication skills.

The four ecological inventory contributors were YER coordinator, Wendy Kotilla; Registered Professional Biologist Ian Moul; and two youth participants, Lilly Garnett and Shaughn Macintyre (Photograph 1). This is a citizen science project with a goal of using scientific methods in ways that are interesting to the youth, helping them gain a more in-depth understanding of what makes up a functioning ecosystem, while documenting meaningful information for the CVRD. The first three days of this program included habitat assessment, on day four the youth focussed on preparing for the presentation of a public tour on the fifth and final day of the project.

Photograph 1:
Youth and Environmental Restoration Team for the Ecological Inventory of Wildwood Marsh and Interpretive Forest, 2014
(from left to right) Ian Moul, Lilly Garnett, Shaughn Macintyre and Wendy Kotilla

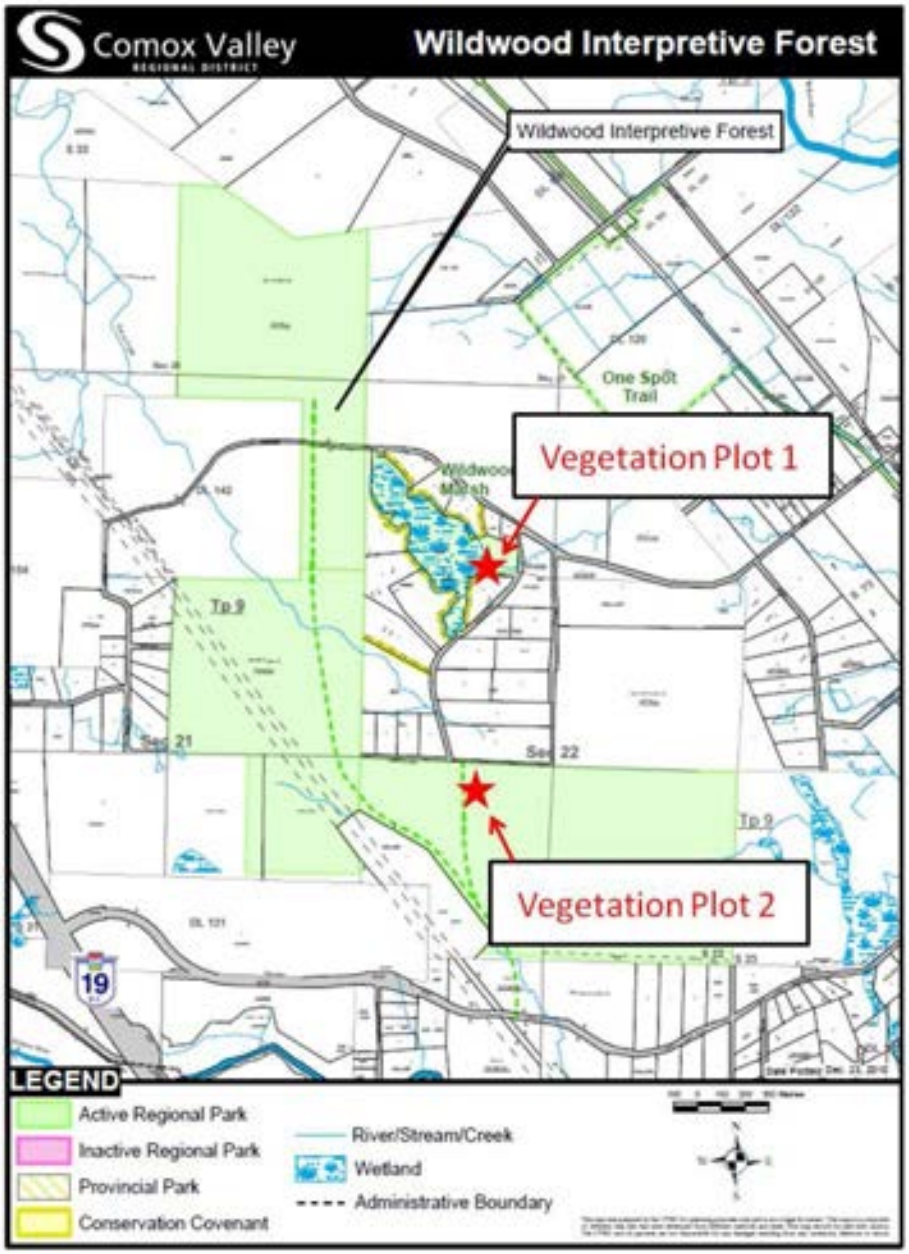
I-B Purpose of Study

The purpose of this study is twofold:

1) To further the understanding of natural habitat at this study site as a baseline living laboratory for Wildwood Marsh and Wildwood Interpretive Forest.
2) To develop a methodology for an educational experience that is scientifically sound yet is interesting, hands on and understandable by youth that may or may not have experience working or spending time in the natural world.

I-C Location

Map 1: The location of the two Vegetation Study Plots in Wildwood Marsh and Wildwood Interpretive Forest



II METHODS

Wetland conservation methods were discussed based on the Wetlandkeepers Handbook (Southam and Curran 1996) and the Wetlands of British Columbia (MacKenzie and Moran 2004). The forested ecosystem inventory method used in the vegetation study plots was an abbreviated reconnaissance form of the Biogeoclimatic Ecosystem Classification described in MOELP (1998) and Green and Klinka (1994). As the wetland and nearby forest contains delicate vegetation it was decided to work as much as possible along the existing trail. At Wildwood Marsh a vegetation study plot 10m wide by 60m deep was measured and marked with temporary flagging tape starting at the open wetland and moving inland. The marsh vegetation study plot was divided into six 10m x 10m sub-plots for inventory of the plant community transition from the open wetland into the forest.

The position of the trail and the wet boundary of the marsh were recorded on graph paper maps. All trees were identified by species, plotted on the graph paper and measured for diameter at breast height (Appendix 1). Plant species within each sub-plot were inventoried and scored based on relative abundance in each of the forest layers of: Moss/Lichen; Herb; Shrub; and Tree. We assigned quantities of vegetation based on looking at the sub-plots and through mutual discussion and consensus to determine the relative percentages of vegetation. Birds were not systematically inventoried, though incidental observations were recorded.

Vegetation Study Plot 2, was completed at a later date and given the homogeneous nature of the forest a circular study plot (11.3m in diameter) was inventoried, for tree, shrub and herb layer vegetation.

The use and function of global positioning (GPS) devices and laser rangefinders was demonstrated but kept to a minimum. It was decided that hands on measuring by the youth was more engaging than the use of electronic instruments. To avoid trigonometry and still teach the use of handheld compasses we made measurements based on magnetic north. Fixed points were measured with a Trimble GeoXH GPS and differentially corrected using the CANSEL base station in Courtenay.

Following the field exercises, the collected data was compiled and digital maps were produced by Ian Moul. The sketch map of the trail route and water boundary was imported into ArcMap 10 and geo-referenced based on the known fixed points of each study plot.

III RESULTS and DISCUSSION

III-A Vegetation Study Plot 1

The centre line of Study Plot 1 was measured from the fixed point of a young crab-apple tree near the shoreline of the marsh. The centre line of the plot was established at a bearing of 137° Magnetic North. A tape was laid out and the plot was marked temporarily by flagging in six 10 x 10m square sub-plots (Map 2). Vegetation plots typically used to inventory plant communities are 400m^2. Plots may be of any convenient dimension but are often either a 20 x 20m square or an 11.3m radius circle established in what appears to be a homogeneous patch of forest. For this vegetation study plot, next to the wetland, we chose a long narrow plot of six 10m x 10m sub-plots (600m^2 in total). Our goal was to document the transition between the wetland and the forest. Working together we discussed the various components of the site and how they interrelate (Table IIIA 1).

Table IIIA 1: Site description for Vegetation Study Plot 1

General Location: Starting at the south shore of Wildwood Marsh and extending inland along a public footpath towards Wildwood Road			
Fixed point of study plot coordinates at a tree	UTM Zone: 10	Easting: 341263. Northing: 5508723	Horizontal precision: +/- 0.9m
Elevation: 79m above sea level	Slope: Flat - <1%	Aspect: Open towards the north	
Moisture Regime: Water is received both from precipitation and from seepage. Water is removed slowly enough to keep the soil wet for most of the growing season			
Succession and Structural Stage: Young forest of between 20 to 40 years. The first growth of red-alders is starting to die out. Self thinning where the forest canopy has begun to differentiate into distinct layers. The wetland has both open water and patches of dense vegetation so falls into the classification of a marsh.			
Terrestrial substrate (%)	Organic Matter: 80	Rocks: 0	Decomposing wood: 20
	Mineral Soil: 0	Bedrock: 0	

Photographs of Wildwood Marsh and the nearby forest in association with Study Plot 1.

2) Wildwood Marsh looking north from the fixed point of Study Plot 1

3) Vegetation Study Plot 1, Subplots C and D

4) Vegetation Study Plot 1, Subplots E and F

Moving through each of the marked sub-plots, from the open wetland into the forest, we considered the mix of plant species within various vegetation classes and how this changed in relation to soil conditions and the light levels penetrating the tree canopy (Table IIIA 2).

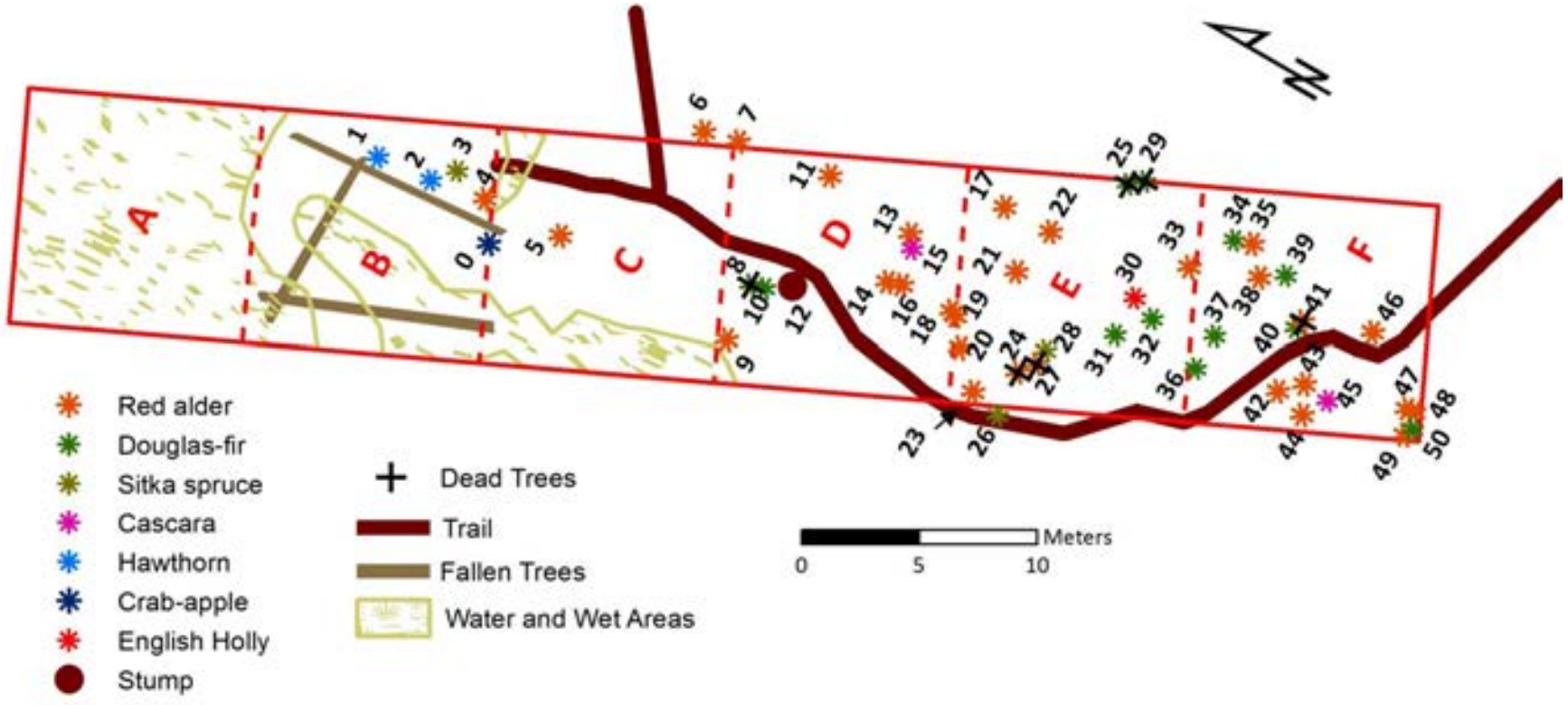
Table IIIA 2: Vegetation in Study Plot 1, % cover by Layer (the bare ground of the trail was not counted)

Sub-plot	Tree	Shrub	Herb	Moss/Lichen	Aquatic plants	Open water
A	0	0	0	0	96	4
B	Trace	16	50	Trace	34	Trace
C	Trace	50	24	Trace	25	Trace
D	6	75	14	5	0	0
E	8	43	44	5	0	0
F	7	63	25	5	0	0

All trees were mapped based on the distance from the centre line tape (Map 2). Sixty-one trees and one stump were measured for diameter at breast height (DBH), or as high as possible if we were measuring a stump (Appendix 1). We had six tree species in Study Plot 1 (Table IIIA 3), with red alder being the most common. The mix of trees tells a story of how most trees on the area had been cut some 20 to 30 years ago and have been regenerating as expected, first with red alder and more recently with a mix of other deciduous and coniferous trees.

Table IIIA 3: Summary of Trees measured in Study Plot 1

Species	Number of trees	Average DBH (cm)	Range in DBH (cm)
Red alder	37	19.4	1 to 36
Western red cedar	12	33.5	5 to 90
Sitka spruce	7	15.3	1 to 40
Cascara	2	17.6	3 to 32
Hawthorn	2	10.5	8 to 13
English Holly	1	1	
Crab-apple	1	2.5	
Stump	1	38	



Map 2: Layout of Study Plot 1 showing the locations of the trail and the edge of the marsh. Details on the individual trees may be found in Appendix 1.

An inventory of the shrub and herb layers helped us to understand the competition for light between the tree canopy and the forest floor (Table 4). Over time, as the forest ages and matures, red alder is expected to die back and be replaced with conifers, such as red cedar, Sitka spruce and Douglas fir. As the canopy closes, we except changes in the understory vegetation to less salmonberry and more swordfern.

Table 4: Inventory of shrub and herb layers in Study Plot 1				
Quadrant	**Species of shrubs**	**% coverage[1.]**	**Species of herbs**	**% coverage[1.]**
A			Watershield	81
			Yellow pond-lily	15
B	Hardhack	16	Reeds, sedges, grasses	42
	Hucklyberry	Trace	Pond lillies	5
	Young red alder	Trace	Cattail	3
			Skunk cabbage	Trace
			Salal	Trace
			Trailing blackberry	Trace
C	Salmonberry	40	Grasses	20
	Hardhack	10	Sedges	4
	Elderberry	Trace	Lady fern	Trace
			Marsh skullcap	Trace
D	Salmonberry	73	Swordfern	10
	Red huckleberry	2	Bracken	Trace
	Baldhip rose	Trace	Vanilla leaf	Trace
			Oregon grape	Trace
			Cleavers	Trace
E	Salmonberry	35	Sword fern	35
	Huckleberry	8	Trailing blackberry	7
			Vanilla leaf	2
F	Salmonberry	63	Swordfern	20
	Huckleberry	Trace	Trailing blackberry	5
			Vanilla leaf	Trace
			Oregon grape	Trace
			Cleavers	Trace

1. % coverage is based on the amounts presented in Table 2. Trace represents about 1% ground coverage.

III-B Vegetation Study Plot 2

Vegetation Study Plot 2 was in a stand of mature forest approximately 900m south of the Wildwood Marsh vegetation study plot. It was chosen for being both within the Wildwood Interpretive Forest and being a very different habitat type than Wildwood Marsh. As this forested area has a very homogeneous mix of vegetation a 11.3m diameter circular plot was developed (Table IIIB-1; Map 3) with a total area of 400m^2. A tree was chosen as the plot centre point and surrounding trees were measured based on their distance and compass bearing to the centre tree. The species and diameter breast height was measured for each tree in the plot.

Table IIIB-1: Site description for Study Plot 2

General Location: South of the Forest Hill Road Wildwood Interpretive Forest trail entrance and east of the trail			
Fixed point of study plot coordinates at the north-east corner of the viewing platform	UTM Zone: 10	Easting: 351192.0 Northing: 5507834	Horizontal precision: +/- 1.4
Elevation: 94m above sea level	Slope: Gentle slope 6% east	Aspect: Towards the east	
Moisture Regime: Water is received primarily from precipitation and. Water in the root zone is removed slowly enough to keep the soil moist for most of the growing season.			
Succession and Structural Stage: Mature forest of between 80 to 100 years. This is Douglas-fir dominated forest and it is unclear if the trees were planted or naturally re-seeded.			

Substrate (%)	Organic Matter: 90	Rocks: 0	Decomposing wood: 10
	Mineral Soil: 0	Bedrock: 0	Water: 0

This mature forest has stratified in clear levels of the upper canopy, some shade tolerant shrubs and then a thick herb layer (Table IIIB-2; Photographs 5 and 6).

Table IIIB-2: Vegetation in Study Plot 2, % cover by Layer

Tree	Shrub	Herb	Moss/Lichen	Bare ground
10	10	80	0	0

Of the 26 trees measured, (listed in Appendix 2), the majority were Douglas-fir, estimated to be in the 70 year plus age range (Table IIIB-3; Map 3). The density of the canopy makes it unlikely that in the upcoming years there will be any new growth of Douglas-fir. Where trees have died or fallen and sunlight is able to penetrate to the forest floor there is growth of western hemlock and big-leaf maple. Over the next couple of hundred years we could expect a shift from dominant Douglas-fir to more western hemlock. North of the Vegetation Study Plot, along Forest Hill Road, we observed a mixed forest-edge of grand-fir, black cottonwood and western hemlock.

Table IIIB 3: Summary of Trees measured in Study Plot 2

Species	Number of trees	Average DBH (cm)	Range in DBH (cm)
Douglas-fir	19	50.1	14 to 95
Western hemlock	4	5.2	3 to 9
Big-leaf maple	2	3.5	3 to 4
English Holly	1	1.0	
Stumps	3	84.4	50 to 103

Much of the lower level vegetation in Study Plot 2 was the shade tolerant swordfern (Table IIIB-4). Outside of the study plot, in locations where trees had fallen and there was greater light penetration, we noticed a dominance of salal. This may be seen along the edge of the footpath in Photograph 13.

Table IIIB 4: Inventory of shrub and herb layers in Study Plot 2

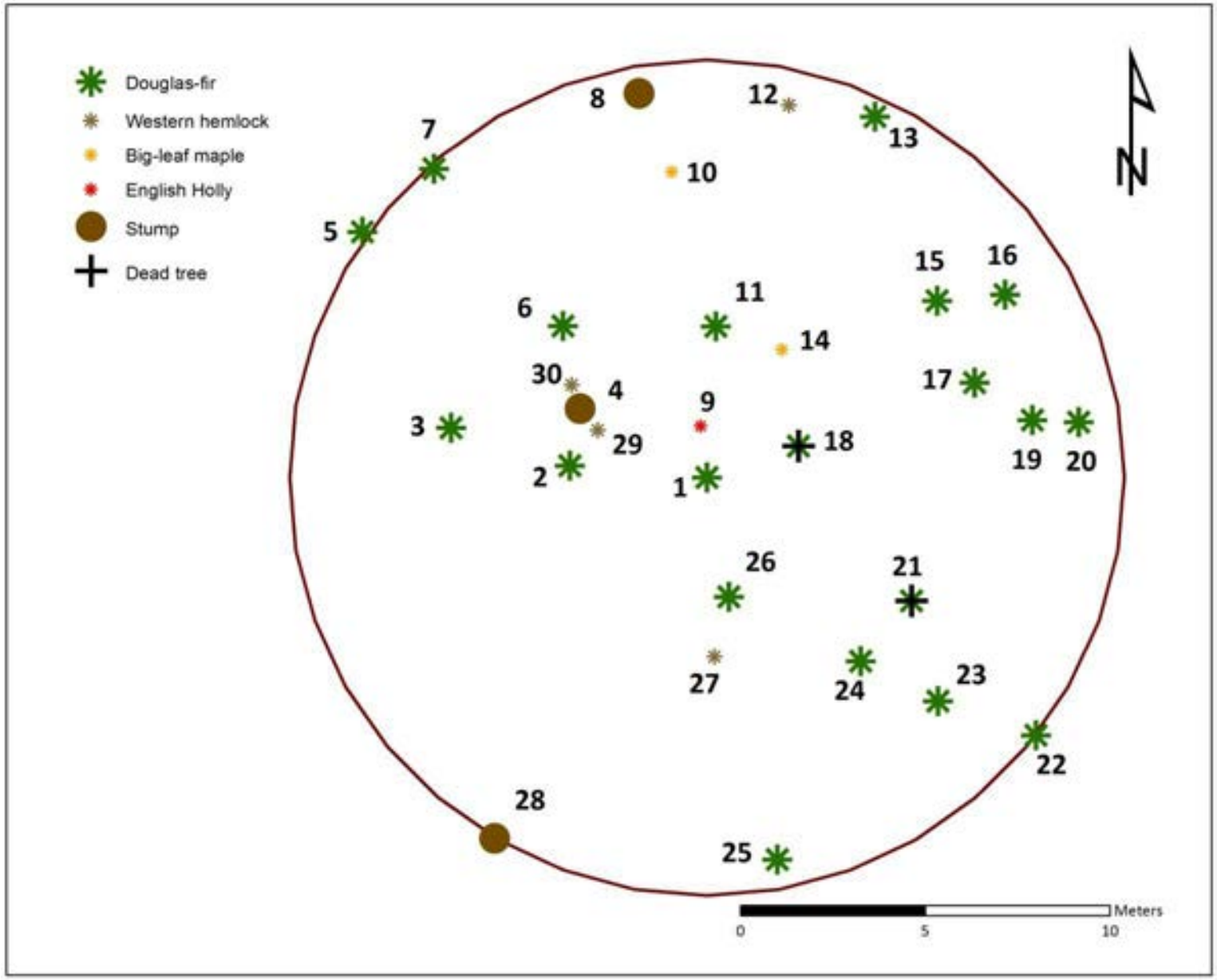
Species of shrubs	% coverage[1.]	Species of herbs	% coverage[1.]
Red huckleberry	9	Swordfern	70
Oceanspray	1	Vanilla leaf	6
Willow	Trace	Trailing blackberry	Trace
		Bracken	Trace
		Oregon grape	Trace
		Cleavers	Trace

1. % coverage is based on the amounts presented in Table 2. Trace represents about 1%

Photographs of the Wildwood Interpretive Forest in association with Vegetation Study Plot 2.

5) Wildwood Interpretive Forest looking north-east, the blue flagged central tree is on the right hand side of the view.

6) Wildwood Interpretive Forest looking South-east, the blue flagged central tree is on the left hand side of the view.



Map 3: Vegetation Study Plot 2 - Details on the individual trees may be found in Appendix 2

III-C Observations of Birds, Animals, Amphibians and Fish.

The timing of this study during the week of July 16th was past the breeding season for most birds in the Comox Valley and we found fewer birds than we might have in mid spring. In total, eight species of birds were observed in the marsh and none were noticed in the forest (Table IIIC-1). During his talk with the group, Bryan Allen noted a recent bird survey recorded 45 species in the marsh and surrounding forest. Most noticeable to us around the marsh was the ever present call of American bullfrogs, an invasive species that has become firmly established in the marsh. We were quite thrilled to see several Pacific Tree Frogs on the leaves of shrub near the edge of the marsh (Photograph 7).

Table IIIC 1: Birds and Amphibians observed in Wildwood Marsh and Wildwood Interpretive Forest

	Habitat where the species was observed	
Species	**Forest**	**Marsh**
Great Blue Heron		X
Mallard		X
Bald Eagle		X
Band-tailed Pigeon		X
Pileated Woodpecker		X
Common Raven		X
North-western Crow		X
American Goldfinch		X
American Bullfrog		X
Pacific Tree frog		X
Rough Skinned Newt		X

No mammals were observed. We could see the results of beaver activity and were interested to hear that the beavers may have now been replaced by muskrats. Six minnow traps were left overnight in an attempt to document fish presence. While no fish were caught, to definitively demonstrate an absence of fish would require a more intensive search regime. We were saddened to have caught an immature Rough-skinned Newt in our fish trap and to have it drown (Photograph 8).

Photograph 7: Pacific Tree Frog

Photograph 8: Immature Rough skinned Newt

III-D The Importance of Wetlands and Forests

The public tour presented by the youth participants of this program drew 28 very interested local residents. That this number of people were interested in the marsh and forest is a good reminder of the importance in preserving these sites.

In the book Wetlands of British Columbia (MacKenzie and Moran 2004), wetlands are defined as: *Areas where soils are water saturated for a sufficient length of time such that excess water and resulting low soil oxygen levels are principle determinants of soil development*. The life cycle of wetlands typically begins with a shallow water lake in a water catchment basin that over time will gradually fill with decaying vegetation to become either a raised bog or a forest.

Wildwood Marsh has a history of being manipulated by the human hand (NHC 2008; Bryan Allen and Doug DeMarzo personal communications). The wetland was drained for agriculture in the 1920s. The agriculture was abandoned with the start of WWII, and gradually returned to a marsh ecosystem. In recent years there have been issues regarding the need to keep water levels low to preserve a nearby septic field and the desires to allow nature to take its course; water outlets and water levelling controls have been installed. One discussion point was about how several years ago the water level of the marsh was lowered in the late spring. Later in the season around the newly exposed shore there was much evidence of dead dragonfly eggs and dead hatched dragonflies in their nymph stage of life. That year there was tremendous numbers of mosquitoes – a favorite prey item of dragonflies. In the year of this study, we noticed thousands of dragonflies and almost no evidence of mosquitoes.

The Ministry of Environment website (MOE 2012) tells us that:

> *Wetlands are one of the most important life support systems on earth. Currently comprising about 5.6% or 5.28 million hectares of British Columbia, they provide critical habitat for fish, birds, and other wildlife. Most wildlife in the province use wetland habitat at some point in their life cycle, and many red and blue-listed species are wetland-dependent. The functional contribution of wetlands in helping to minimize or remediate environmental problems is substantial. Wetlands absorb and filter sediments, pollutants, and excess nutrients; recharge groundwater; maintain stream flows; control runoff; store flood waters; reduce erosion; stabilize shorelines; and help regulate atmospheric gases and climate cycles. In short, wetlands absorb water quickly and release it slowly with an improvement in quality.*

Wildwood Marsh and the Wildwood Interpretive Forest are extremely valuable in both supporting the local natural biodiversity and as an example of how we can have both human settlement and natural areas.

IV RECOMMENDATIONS

Wildwood Marsh and the Wildwood Interpretive Forest are important living classrooms for residents of the Comox Valley. While it is understood that Wildwood Marsh will have ongoing needs for water level management, long term goals might consider the periodic excavating of portions of the wetland to maintain examples of all stages of wetland classes ranging from the more dry bogs, through fens, marshes and the open water of swamps. An inventory of dragonfly species would add to the knowledge base of Wildwood Marsh and could result in an interpretive sign. The Wildwood Forest Reserve is lovely example of naturally regenerating

mature forest. We recommend it be allowed to grow in a natural condition. The health of forests is always dependant on a supply of soil moisture. We suggest it is important to watch the areas surrounding the forest and consider how land development proposals might lead to changes in hydrology that could have adverse affects on the wellbeing of the forest.

Throughout the Comox Valley invasive species are common. Invasive plants are detrimental to natural plants and animals when they become dominant, alter the soil hydrology or chemistry and do not provide the nutrients that other species depend upon. Amphibian species like the American Bullfrog, and plants like reed canary grass; yellow flag iris; and purple loosestrife, are extremely difficult or impossible to remove once they are established. The removal of individual stems of invasive plants such as the English Holly observed in both study plots is possible.

Photograph 9: Lilly Garnett with rough skinned newt

Photograph 10: Public Tour of Wildwood Marsh

Photograph 11: Public Tour of Wildwood Marsh

Photograph 12: Public Tour of Wildwood Marsh

Photograph 13: Public Tour of Wildwood Interpretive Forest

Photograph 14: Shaughn Macintyre by Wildwood Marsh

V REFERENCES

Green, R.N. and K. Klinka 1994. A field guide to site identification and interpretation for the Vancouver Forest Region. Land Management Handbook No. 28. BC Ministry of Forests, Victoria BC

MacKenzie, W.H. and J.R. Moran 2004. Wetlands of British Columbia: a guide to identification. Land Management Handbook Number 52. BC Ministry of Forests, Victoria, BC.

MOE 2012. http://www.env.gov.bc.ca/wld/wetlands.html

MOELP 1998. Field manual for describing terrestrial ecosystems. Land Management Handbook No. 25. BC Ministry of Environment, Lands and Parks and BC Ministry of Forests, Victoria BC

NHC 2008. Wildwood Marsh Water Control Feasibility Study. Unpublished Draft Report for Comox Valley Regional District. NOrethwest Hydraulic Consultants, Nanaimo BC.

Southam, T. And E.A. Curran (eds) 1996. The Wetlandkeepers Handbook: a practical guide to wetland care. BC Wildlife Federation, Surrey, BC and Environment Canada, Delta, BC

Appendix 1: Tree measurements in Study Plot 1.

Tree Number	Sub-plot	Tree Species	Dead Trees	DBH (cm)	Measurement along centre line (m)	Measurement from centre line (m)	UTM Zone 10	
							Easting	Northing
0	B	Crab-apple		3	0	0	351262.82	5508723.42
1	B	Hawthorn		8	-5.0	-3.3	351263.7	5508729
2	B	Hawthorn		13	-2.7	-2.5	351263.9	5508727
3	B	Sitka spruce		1	-1.6	-3.0	351264.9	5508726
4	B	Red alder		1	-0.3	-1.9	351264.4	5508725
5	C	Red alder		3	3.0	-0.6	351264.6	5508721
6	Outside	Red alder		36	8.7	-5.5	351271.5	5508718
7	Outside	Red alder		31	10.2	-5.2	351271.9	5508716
8	D	Douglas-fir	Dead	29	11.2	0.8	351266.9	5508713
9	D	Red alder		24	10.4	3.2	351264.4	5508713
10	D	Douglas-fir		67	11.8	0.9	351267.0	5508712
11	D	Red alder		14	14.2	-4.1	351272.6	5508712
12	D	Stump		38	13.0	0.7	351267.7	5508711
13	D	Red alder		29	17.8	-1.9	351272.1	5508708
14	D	Red alder		26	17.0	0.2	351269.9	5508708
15	D	Cascara		32	17.9	-1.3	351271.6	5508708
16	D	Red alder		25	17.6	0.3	351270.1	5508707
17	E	Red alder		18	21.7	-3.4	351275.1	5508705
18	D	Red alder		17	19.8	1.2	351270.2	5508705
19	D	Red alder		14	20.0	1.4	351270.1	5508705
20	E	Red alder		15	20.3	2.7	351269.0	5508704
21	E	Red alder		12	22.4	-0.7	351273.0	5508703
22	E	Red alder		15	23.7	-2.5	351275.2	5508703
23	E	Red alder		15	21.0	4.5	351267.7	5508703
24	E	Red alder	Dead	15	22.8	3.5	351269.4	5508701
25	E	Douglas-fir	Dead	36	26.8	-4.8	351278.6	5508701

Appendix 1: Tree measurements in Study Plot, continued...

Tree Number	Sub-plot	Tree Species	Dead Trees	DBH (cm)	Measurement along centre line (m)	Measurement from centre line (m)	UTM Zone 10	
							Easting	Northing
26	Outside	Sitka spruce		40	22.1	5.4	351267.3	5508701
27	E	Red alder	Dead	16	23.6	3.1	351270.1	5508701
28	E	Sitka spruce		5	23.9	2.5	351270.7	5508701
29	E	Douglas-fir	Dead	27	27.5	-5.0	351279.1	5508701
30	E	English Holly		1	27.5	0.0	351274.5	5508699
31	E	Douglas-fir		68	26.8	1.6	351272.8	5508698
32	E	Douglas-fir		7	28.3	0.8	351274.1	5508697
33	E	Red alder		22	29.7	-1.5	351276.8	5508697
34	F	Douglas-fir		6	31.5	-2.8	351278.8	5508696
35	F	Red alder		19	32.3	-2.7	351279.0	5508695
36	F	Douglas-fir		6	30.3	2.7	351273.3	5508695
37	F	Douglas-fir		55	31.0	1.3	351274.8	5508695
38	F	Red alder		16	32.7	-1.3	351277.9	5508694
39	F	Douglas-fir		6	33.8	-1.5	351278.6	5508693
40	F	Douglas-fir		5	34.4	0.7	351276.8	5508692
41	F	Red alder	Dead	14	34.7	0.4	351277.2	5508692
42	F	Red alder		12	33.9	3.4	351274.2	5508691
43	F	Red alder		25	35.0	3.0	351275.0	5508690
44	F	Red alder		19	35.0	4.3	351273.8	5508690
45	F	Cascara		3	36.0	3.6	351274.9	5508689
46	F	Red alder		22	37.7	0.6	351278.3	5508689
47	F	Red alder		28	39.4	3.7	351276.3	5508686
48	F	Red alder		27	39.7	3.8	351276.3	5508686
49	F	Red alder		19	39.4	4.8	351275.3	5508686
50	F	Douglas-fir		90	39.7	4.5	351275.7	5508686

Appendix 2: Tree measurements in Study Plot 2

Tree #	Bearing (MN)	Distance from centre (m)	DBH (cm)	Tree Species	Dead Trees	UTM Zone 10	
						Easting	Northing
1	0	0.00	61	Douglas-fir		351192	5507834
2	256.5	3.72	44	Douglas-fir		351188	5507834
3	262.5	7.05	71	Douglas-fir		351185	5507835
4	280	3.90	100	Stump		351189	5507836
5	287	11.45	71	Douglas-fir		351183	5507841
6	298	5.66	51	Douglas-fir		351188	5507838
7	300	11.15	89	Douglas-fir		351185	5507842
8	331.5	10.55	50	Stump		351190	5507844
9	335	1.41	1	English Holly		351192	5507835
10	335	8.32	4	Big-leaf maple		351191	5507842
11	345	4.09	39	Douglas-fir		351192	5507838
12	354	10.32	4	Western hemlock		351194	5507844
13	6.5	10.77	35	Douglas-fir		351197	5507844
14	12	4.02	3	Big-leaf maple		351194	5507837
15	34	7.86	52	Douglas-fir		351198	5507839
16	40	9.47	34	Douglas-fir		351200	5507839
17	52	7.69	78	Douglas-fir		351199	5507837
18	52.5	2.63	45	Douglas-fir	Dead	351194	5507835
19	61.5	8.96	71	Douglas-fir		351201	5507836
20	63	10.18	16	Douglas-fir		351202	5507836
21	102.5	6.47	14	Douglas-fir	Dead	351198	5507831
22	109.5	11.31	82	Douglas-fir		351201	5507827
23	115.5	8.70	40	Douglas-fir		351198	5507828
24	121.5	6.48	16	Douglas-fir		351196	5507829
25	151	10.50	21	Douglas-fir		351194	5507824
26	151	3.28	95	Douglas-fir		351193	5507831
27	159	4.84	9	Western hemlock		351192	5507829
28	192	11.32	103	Stump		351186	5507824
29	275	3.21	3	Western hemlock		351189	5507835
30	286	4.43	6	Western hemlock		351188	5507837