An Overview of the Stand Characteristics of the Intensively Studied Chronosequence Plots

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Introduction

In 1991, Forestry Canada Pacific and Yukon Region initiated a program of research to study the changes occurring as a result of conversion of coastal old-growth to second-growth forests. At 10 locations on Vancouver Island, plots were established in suites of seral stands. Five of these suites—chronosequences—are located on east Vancouver Island in the transition between the Coastal Douglas-fir (CDF) and the Very Dry Coastal Western Hemlock (CWHxm) biogeoclimatic zones, and the other five are located on west Vancouver Island in the Very Wet Maritime Coastal Western Hemlock zone (CWHvm) (Pollard and Trofymow, in these proceedings).

In addition to the carbon and nutrient survey being conducted on these chronosequences (Trofymow and Blackwell, in these proceedings), more intensive studies of small vertebrate, invertebrate, plant and mycorrihzal fungal diversity and microbial dynamics are being done on three of the chronosequences, Greater Victoria Watershed South, Greater Victoria Watershed North. and Koksilah. This paper summarizes the mensuration data for the intensive plots.

Methods

At all 10 chronosequences, triangular plots have been established for the survey of carbon and nutrient contents. From each benchmark, three 30 m radial lines were run to define three additional subplot centres 120° apart. Each of the four subplot centres is identified with a 1.5 m orange painted cedar stake that is flagged with a blue-, orange-, or lime-coloured ribbon. In addition, a 15-cm spike is inserted into the forest floor and flagged with the ribbon corresponding to the cedar stake. Subplot centres define the centre points of 5- or 10 m radius plots for standing biomass measurements. For the intensive chronosequences, the triangular plots are superimposed on 60 x 60 m square plots. These are further subdivided into 10 x 10 m square subplots that were used to facilitate the assignment of work areas for the different component studies (Figure 1).

Mensuration measurements of all dead and living overstory trees (DBH, height to live crown, and total height) by species and class (suppressed, intermediate, co-dominant, and dominant) were made to estimate plot biomass. Within each plot, three randomly chosen subplots were measured from the four subplots previously established. The size of tree inventory plots was either 78.5 m^2 or 314 m^2 (circular plots with a radius of 5 m or 10 m), depending on tree density. For the 10 m plot radius a minimum of 10 trees was required. In regeneration plots and in some other plots, trees less than 3 m made a significant contribution to total biomass. Total height and caliper at 5 cm from the base of each tree was measured. At each plot a minimum of five increment cores at breast height of dominant trees were collected to estimate stand age.

Results

Mensurational data for the three intensive chronosequence plots are summarized in Tables 1–3. In all 12 chronosequence plots the dominant overstory species was Douglas-fir. Western hemlock made a significant contribution to stand density in the immature and old-growth (02 and 06) plots in the Greater Victoria Watershed South (GVWS) chronosequence. Basal area attributable to hemlock was less notable (Table 1).

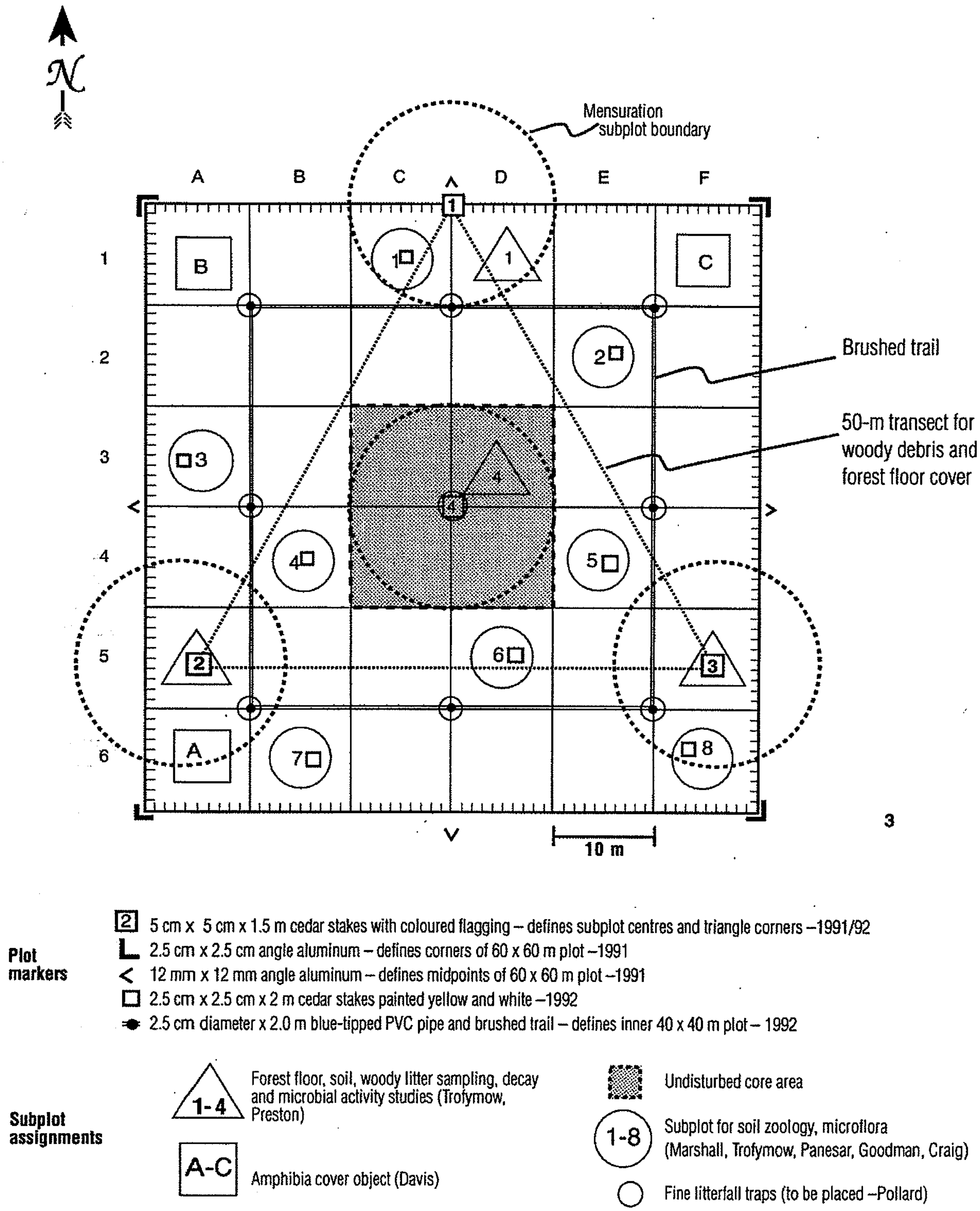

FIGURE 1. Forestry Canada coastal forest chronosequences. Example of intensive studies plot layout and subplot assignments.

Except in old-growth plots, stand density was high and in most plots exceeded 1000 stems per hectare. The highest stand density was recorded for the immature plot at Koksilah (plot 23) where more than 3300 stems per hectare were measured (Table 3). The number of dead standing trees, including stumps for the 12 plots, was quite variable, ranging from 40 to 1500 stems per hectare. The largest number of standing dead trees was measured in the immature plot at Koksilah (plot 23).

When plots of the same age were compared, basal area measurements were similar for living trees for all three old-growth plots (Tables 1–3). For the living trees in the immature and mature plots, basal area was more variable. Basal area in immature plots (02, 12, and 22) ranged between 30.4 and 48.6 m^2/ha (Tables 1–3). The basal area measurements for the mature plots were more variable ranging from 63.0 to 87.3 m^2/ha (Tables 1–3). This variation was attributed to site differences in tree diameter and stand density. The basal area in old-growth plots (06, 15, and 24) was uniform, ranging only from 83.1 to 87.7 m^2/ha.

Diameter at breast height (DBH) measurements were largely a function of stand density (Tables 1–3). Mean DBH decreased with increasing stand density. The largest mean diameter trees were measured in the GVWS old-growth plot (06), where the mean of Douglas-fir trees was 76.8 cm (Table 1). In the GVWN, mean DBH values of 51.5 cm and 41.7 cm were measured for Douglas-fir trees and Koksilah chronosequences, respectively, (Table 2 and 3). Trends in mean height were similar to DBH measurements. Mean height of Douglas-fir was highest for the GVWS old-growth plot, where the mean height was 47.5 m. Mean Douglas-fir height in GVWN and Koksilah old-growth plots was 32.0 m and 21.4 m, respectively. The lower heights in Koksilah can be attributed to the large number of old-growth trees with broken tops. Aspect and topographic position made trees in this plot more susceptible to wind damage, compared to trees in the GVWS and GVWN plots.

Summary

From the mensuration data collected for the three intensive chronosequences, it can be concluded that plots equivalent in age are similar in tree species composition and stand density. Comparison of basal area measurements indicated that old-growth plots for the three chronosequences were very similar while other plots were more variable. This was attributed to variation in diameter and stand density between these sites. Future work on this project will involve the quantification of stand biomass and carbon and nutrient budgets.

References

Blackwell, B.A. 1992a. Effects of converting coastal old-growth forests to managed forests: changes in site carbon and nutrient contents during post disturbance succession. Phase 1: plot location and establishment. For. Can., Pac. and Yukon Reg., Victoria, B.C. ENFOR P-404 contract report.

________. 1992b. Effects of converting coastal old-growth forests to managed forests: changes in site carbon and nutrient contents during post disturbance succession. Phase 2.1: report on plot measurements and sampling. For. Can., Pac. and Yukon Reg., Victoria, B.C. ENFOR P-404 contract report.

Table 1. Mensurational data (and standard error) from plots in the Greater Victoria Watershed South (GVWS) chronosequence - includes all living and dead trees greater than 3.0 m height only.

Plot	Lifeform	Spp.	n	Mean Density #/ha	Basal Area m^2/ha	(SE)	Mean DBH cm	(SE)	Mean Height m	(SE)	Maximum Height m	Mean Age years	(SE)
Living Trees													
01 (1)	tree	all sp.	**34**	**1793**	**0.1**		1.6		1.1		1.9	4	(1)
02 (2)	tree	Hw	28	1188	7.7	(0.0)	6.8	(1.1)	7.7	(0.8)	18.2	18	(1)
		Fd	24	1019	22.7	(0.0)	13.2	(2.2)	11.9	(1.1)	22.6		
			52	**2207**	**30.4**								
05 (3a)	tree	Hw	1	11	0.0		22.5		20.5		20.5	89	(2)
		Cw	7	74	3.6	(0.0)	23.1	(3.6)	16.9	(2.5)	28.3		
		Fd	40	647	82.1	(0.0)	38.4	(3.1)	33.5	(1.6)	50.1		
		Pw	1	42	0.1		6.5		8.0		8.0		
		Dr	1	11	1.1		36.2		37.4		37.4		
			50	**785**	**87.3**								
06 (4)	tree	Hw	32	340	5.7	(0.0)	12.4	(1.4)	10.4	(1.3)	34.0	235	(15)
		Cw	4	42	2.9	(0.0)	26.9	(7.4)	16.7	(4.8)	27.6		
		Fd	14	149	73.6	(0.1)	76.8	(5.6)	47.5	(2.0)	58.4		
		Dr	1	11	0.9		32.5		16.9		16.9		
			51	**542**	**83.1**								
Standing Dead Trees													
01 (1)	stump	Hw	30	318	49.5	(0.0)	38.1	(3.6)	0.4	(0.0)	0.7		
	stump	Fd	3	32	13.2	(0.1)	71.7	(9.0)	0.6	(0.3)	1.2		
			33	**350**	**62.7**								
02 (2)	stump	Fd	3	127	67.1	(0.1)	81.7	(4.4)	0.7	(0.1)	0.8		
	tree	Hw	6	225	0.2	(0.0)	3.0	(0.4)	4.7	(0.5)	6.5		
		Fd	12	509	0.3	(0.0)	2.8	(0.2)	4.2	(0.3)	5.8		
			21	**861**	**67.6**								
05 (3a)	tree	Fd	13	170	6.0	(0.0)	19.3	(3.4)	11.6	(2.4)	27.3		
		Dr	4	42	2.9	(0.0)	29.3	(1.5)	15.5	(6.7)	31.2		
			17	**212**	**8.9**								
06 (4)	tree	Hw	22	223	2.1	(0.0)	8.8	(1.6)	5.1	(0.6)	10.6		
		Fd	1	11	5.0		77.7		47.6		47.6		
		Dr	1	11	0.6		26.6		4.9		4.9		
			24	**267**	**7.7**								

Plot numbers in brackets indicate the original chronosequence plot number in the plot location and establishment report (Blackwell 1992).
Bold numbers indicate plot totals.

Table 2. Mensurational data (and standard error) from plots in the Greater Victoria Watershed North (GVWN) chronosequence - includes all living and dead trees greater than 3.0 m height only.

Plot	Lifeform	Spp.	n	Mean Density #/ha	Basal Area m^2/ha		Mean DBH cm		Mean Height m		Maximum Height m	Mean Age years	
Living Trees													
11 (1)	tree	all sp.	**24**	**1018**	**0.3**		2.7		1.5		2.3	6	(1)
12 (2)	tree	Fd	**49**	**2080**	**48.6**	(0.0)	16.4	(0.8)	18.2	(0.5)	23.5	32	(1)
13 (3)	tree	Cw	3	32	0.8	(0.0)	15.2	(6.7)	9.2	(3.5)	16.0	89	(2)
		Fd	60	1210	78.1	(0.0)	20.8	(1.9)	19.1	(1.5)	37.6		
			63	**1242**	**78.9**								
15 (4)	tree	Hw	16	170	3.1	(0.0)	10.9	(2.8)	7.7	(1.7)	29.0	306	(3)
		Cw	8	85	6.0	(0.0)	24.3	(5.7)	15.2	(3.4)	26.6		
		Fd	34	361	77.7	(0.0)	51.5	(2.6)	32.0	(1.1)	47.4		
			58	**616**	**86.8**								
Standing Dead Trees													
11 (1)	stump	Hw	3	32	0.5	(0.0)	13.3	(1.8)	0.3	(0.0)	0.3		
		Cw	5	53	15.1	(0.1)	53.2	(14.1)	0.4	(0.1)	0.7		
		Fd	24	255	78.1	(0.0)	60.2	(3.5)	0.4	(0.0)	0.8		
			32	**340**	**93.7**								
12 (2)	stump	Fd	3	127	15.3	(0.1)	37.3	(8.4)	0.6	(0.1)	0.7		
	tree	Fd	12	509	2.1	(0.0)	6.5	(1.0)	8.8	(1.3)	15.2		
			15	**636**	**17.4**								
13 (3)	stump	Fd	1	42	14.1		65.0		0.5		0.5		
	tree	Fd	25	520	2.5	(0.0)	7.2	(0.8)	8.0	(0.8)	16.4		
			26	**562**	**16.6**								
15 (4)	tree	Cw	2	21	1.7	(0.0)	19.8	(1.8)	12.9	(0.5)	13.4		
		Fd	4	42	1.0	(0.0)	26.8	(5.8)	8.6	(3.4)	18.8		
			6	**63**	**2.7**								

Plot numbers in brackets indicate the original chronosequence plot number in the plot location and establishment report (Blackwell 1992).
Bold numbers indicate plot totals.

Table 3. Mensurational data (and standard error) from plots in the Koksilah chronosequence - includes all living and dead trees greater than 3.0 m height only.

Plot	Lifeform	Spp.	n	Mean Density #/ha	Basal Area m^2/ha		Mean DBH cm		Mean Height m		Maximum Height m	Mean Age years	
Living Trees													
21 (1)	tree	all sp.	**18**	**764**	**0.1**		1.0		0.7		0.4	2-5	
22 (2)	tree	Hw	1	42	0.0		3.8		3.5		3.5	33	(2)
		Cw	12	509	2.7	(0.0)	7.7	(0.9)	6.5	(0.8)	12.3		
		Fd	49	2080	36.5	(0.0)	12.9	(1.1)	12.0	(0.7)	23.1		
			62	**2631**	**39.2**								
23 (3)	tree	Fd	**79**	**3353**	**63.0**	(0.0)	13.7	(0.8)	12.8	(0.6)	27.3	76	(2)
24 (4)	tree	Hw	1	11	0.5		24.5		15.4		15.4	278	(14)
		Fd	44	467	87.2	(0.0)	41.7	(3.8)	21.4	(1.7)	35.9		
			45	**478**	**87.7**								
Standing Dead Trees													
21 (1)	stump	Cw	2	21	7.4	(0.2)	65.0	(15.0)	0.5	(0.0)	0.5		
	stump	Fd	28	297	97.7	(0.0)	61.7	(5.3)	0.4	(0.0)	0.6		
			30	**318**	**105.1**								
22 (2)	tree	Fd	**1**	**42**	**0.1**		6.3		6.2		6.2		
23 (3)	tree	Fd	**35**	**1485**	**4.6**	(0.0)	5.8	(0.4)	7.3	(0.7)	22.9		
24 (4)	tree	Fd	**5**	**53**	**4.0**	(0.0)	26.9	(7.6)	12.4	(3.9)	26.1		

Plot numbers in brackets indicate the original chronosequence plot number in the plot location and establishment report (Blackwell 1992).
Bold numbers indicate plot totals.