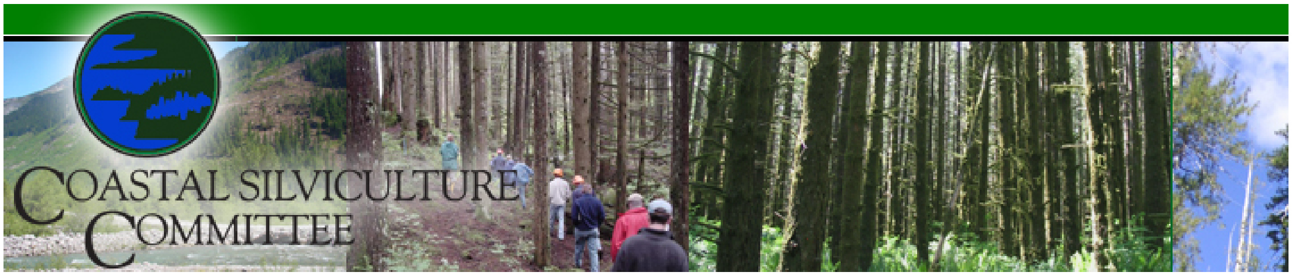


REASSESSING OUR SILVICULTURAL PRACTICES FOR UNCERTAIN TIMES

Summ*er* Workshop
June 10th & 11th 2015

Port McNeill, BC

The Coastal Silviculture Committee

55 Years of Collaboration and Sharing!

Acknowledgements

The Coastal Silviculture Committee (CSC) wishes to thank the following people for contributing their time and efforts in organizing the 2015 Winter Workshop…

- Bryce Bancroft
- Paul Barolet – ***Co-Chair***
- Ron Elder
- Cosmin Filipescu
- Lauchlan Glen
- Shaun Mason
- Lisa Meyer
- Don Pigott
- Jack Sweeten
- Michel Vallee
- Dave Weaver – ***Co-Chair***
- Craig Wickland

The CSC would like to offer a special thanks to the folks on the North Island for all their work in organizing this event, specifically ***Paul Barolet, Kevin Mintz, and Annette Van Niejenhuis.***

On behalf of the CSC, the organizing committee would like to thank all the presenters for taking the time out of their very demanding schedules and lives to share their experience and knowledge with the rest of us.

REASSESSING OUR SILVICULTURAL PRACTICES FOR UNCERTAIN TIMES

The focus of this year's CSC summer workshop will be *"Reassessing Silviculture, What's worked, and Where's the uncertainty"*. As silviculture changes let's look back on past management practices and discuss our successes, our risks, our failures, and our uncertainties while re-assessing our basket of silvicultural tools and options. Looking back and assessing what we've done is our greatest learning tool.

Day one of the workshop will focus on small scale woodlot operations and intensive management regimes on Malcolm Island (Sointula); we will look at site preparation treatments, ditching, planting, spacing, and aerial fertilization.

Day two will be spent on Vancouver Island and promises to be just as exciting and interesting. We will again focus on looking back at our intensive silviculture practices and consider what we've learnt through various research projects such as the SCHIRP trial (salal cedar hemlock integrated research program), Cedar and Cypress espacement trials, and tree improvement or variable retention practices; a drone survey demonstration is also planned!. The program will also include stops to view some management practices around non-timber values such as karst topography, aesthetics and recreation.

The 2015 Summer Workshop promises to be interesting, varied, and thought provoking. The speakers will have been tasked to engage the group, encourage discussion and draw on your experiences and viewpoints for everyone's benefit and challenge current assumptions. So, please join the discussions, learn, and enjoy!

Coastal Silviculture Committee

"Reassessing our Silviculture Practices for Uncertain Times"

Port McNeill – June 10th and 11th, 2015

Program – Day 1

Malcolm Island

Estimated Time	Sites	Topic	Speakers
8:00 – 9:00	Transportation to Malcom Island		
9:00 – 9:20	Registration and welcome on Malcom Island		Dave Weaver
9:30 – 10:30	1	Red Cedar Management and Red Alder Trials	Ken McGregor & John Salo
10:45 – 11:45	2	Alder Management on Low Sites	Ken McGregor & John Salo
12:00 – 13:00	**Lunch at Bear Point or Sointula Hall (depending on the weather)**		
13:15 – 14:00	3	Past FRBC work in Salal Ecosystems	Mike DesRochers
14:15 – 15:15	4	Ecological suitability of coastal Douglas fir on Malcom Island	Rod Negrave (Craig Wickland)
15:15 – 15:45	Afternoon break		
16:00 – 17:00	5	Spaced and Fertilized Western Hemlock	Rene De Jong
17:00 – 18:15	Malcolm Island	**Happy Hour - Sointula Hall**	
18:15 – 19:00	Malcolm Island	**Dinner - Sointula Hall**	
19:00- 20:00	Malcolm Island	Featured Speaker	Robbie Boyes

Bus #2 will reverse the tour, as follows…

First Stop – Site #5
Second Stop – Site #4
Third Stop – Site #1
Forth Stop – Site #2
Fifth Stop – Site #3

Malcolm Island - North

Malcolm Island - South

SITES #1/2

Red Cedar Management and Red Alder Trials

Ken McGregor & John Salo

Presenter Biography and Abstract

Biography:

Name: Ken McGregor, RFT
Affiliation: Island Woodlots
Position: Owner
Responsibilities: Manage woodlots with emphasis on getting my hands dirty.
Academic training: Forest technology 1998
Previous employment: Mid coast logger

Presentation Abstract:

Since the first woodlots were established on Malcolm Island in 1998 we have toiled with how to deal with the slow generation on salal dominated sites. We had limited knowledge or skill at the time so we took every opportunity to garner more knowledge. Particular interest to us was the SCHIRP reports and trials that were common to our situation. No expenses were spared – full site prep with some ditching as well as fertilizing with special SCHIRP formulas. We recognized that these sites didn't suit the typical definition of harvesting, we were land clearing. With that in mind we wanted to expand outside the accepted norm to improve the site. So we felt it would be best to change the site permanently by mimicking a natural disturbance such as wind throw to bring the minerals to the surface and kick start a better growing medium. We started with a 0.3 hectare area split in half. One area was heavily site prepped with mineral mixing and adjacent to this was a control plot where we only did typical site prep with minimal mineral mixing. The entire area was planted with alder as well as cedar. Each year the area with the heavily disturbed site prep we found a drastic improvement in alder growth relative to the control area. What benefits were we seeking? We had to remember that these were low volume, low quality, and low productivity sites. We realized that we could harvest volume outside our inventory, potentially improve the site productivity by drying the site through ditching as well as mixing mineral into the organics, plant a species with a shorter rotation, as well as avoid the cost of installing deer protectors. There were a variety of both short and long term benefits. There was a decrease in the cost of silviculture as well as a potential increase to our AAC by addressing our mid-term timber supply short fall. We also expanded our product diversity by adding alder to the inventory. There was a bit of doubt originally as alder is typically reserved for sites with a higher site index. But we felt that anything can grow there, what would grow better on the sites with site indexes of 13 and under. Now, with the support of many professionals, we have managed to take the leap and try the trial on a much larger scale. After two years there are some real positive signs.

Presenter Biography and Abstract

Biography:

Name: John Salo
Affiliation: Island Woodlots Ltd.
Position:
Responsibilities:
Academic training: Gr 12
Previous employment: Self employed
Born 1951 to second generation logging family in the Coastal inlets of B.C. Educated away from home from Grade 1 to 12. Fished commercially, beachcombed, trapped, and logged until 1994. Moved to Malcolm Island and got first Woodlot License on the Island in 1998. Currently manage 3 licenses with family.

Red Alder Trial on Low Sites:

The woodlot land-base has some remaining decadent old growth cedar salal that is low site cedar available for harvesting. Previous harvesting and second growth indicates that these areas are about site index 12. These sites were established on Malcolm Island prior to the woodlot tenure. The second growth is not vigorous but slow growing due to the topography, species deployed, soil development, nutrient limitations, and excess moisture.

The vision for the woodlot is to always leave it in better condition than it was received. This is done through site preparation including mounding and ditching, and planting conifers at high densities that all have to be browse protected. Our approach is very hands on.

Costs and ongoing maintenance of plantation establishment are always a concern with conifers but it was time to try a new approach with reforestation. Based on an earlier woodlot success with red alder trial planted on a reclaimed borrow pit the concept developed of meeting stocking obligations, improving low site over the long term while diversifying the woodlots fiber basket.

This is not a large scale trial so keep your socks and hat on as we are now deploying some red alder on what was a low site salal ecosystem. Research from abroad indicates forest productivity can be increased when the water table is reduced. To my knowledge there are no research trials of this kind anywhere on the coast of BC. The site has been prepared with salal raking, mounding, ditching, and planting at 2000 sph of red alder.

I look forward to discussing our red alder trial with the CSC group.

NOTES

SITE #3

FRBC Funded Backlog Reforestation

or

How I Learned to Hate Salal!

Mike DesRochers

Strategic Natural Resource Consultants

Presenter Biography and Abstract

Biography:

Name: Mike DesRochers, RPF
Affiliation: Strategic Natural Resource Consultants Inc.
Position: Forestry Team Lead
Responsibilities: Site Plans, auditing, silviculture, forest health, rehabilitation, forest fire stuff, invasive plants, re-measuring 2nd time fertilizer trials for Annette

Academic Training: HBScFor Lakehead
Mike's forestry career in a snapshot:
1978 – Tarr Logging (Kaslo) – Chokerman (17 years old…..don't ask me how I pulled that off!)
1979-83 OMOH – Arborist/Landscaping, learning about chainsaws through the school of hard knocks!
1984-85 Ontario Hydro – Sprayed chemicals on plants, didn't grow any extra appendages….that's good!
1986-88 OMNR - Fire fighter, saved trees, even a few cottages…Smokey would be proud!
1988-96 OMNR - Project forester, Area technician, GIS technician and saved more trees and cottages….who you gonna call?
1996-04 WFP Port McNeill – was banished to Malcolm Island to work in salal for 4 years!
2004-06 MoF Port McNeill – Tenures stuff….nothing exciting here….at least I wasn't working in Malcolm Island salal!
2006-12 FNRO Port McNeill – C&E Forester …..the only thing I remember from this era was someone in a black suit wearing sunglasses hold up a black pen, followed by a bright flash of light!
2012-Now SNRC – Lots and lots of forestry stuff

Pesentation Abstract:

Topic: FRBC Funded Backlog Reforestation or How I Learned to Hate Salal!

Malcom Island lies within the CHWvm1 and the local site series are typically 01, 01s, 06s, 13 and 14. For this discussion, let's stick to the salal phases. And this certainly isn't the same salal phase you'll find growing with dull-Oregon grape on mid-lower Vancouver Island or even the Coastal mainland. Where salal brush competition is normally referred to as Low, Moderate or High, Malcolm Island and many of the Broughton Islands have their own level of salal competition….I refer to it as "Ridiculous" or "absolutely freakin' horrible"! Salal here can grow as high as 5 metres and is responsible for pushing more than a few foresters into the cushy ecosystems of the Interior.

Many of the stands you will see are a result of harvesting carried out during the 1980s and most of these sites where left to regenerate naturally. The terms "Natural Regeneration" and "ridiculous" salal should never be used in the same thought, let alone the same sentence and as a result, these stands failed to develop to meet even minimum standards.

From 1999 to 2004, the MoF secured FRBC funding to treat over 400 ha of backlog forestry on Malcolm Island Crown Land. WFP at this time was leading the charge on salal ecosystem management and was approached to carry out this reforestation work for the MoF. What you will see is the result of patch scarification using a small hoe with a salal rake, planting of 415D Cw with FATOP, browse protection installation and ultimately browse protector removal at year 8-10. During the first year of treatments, the exorbitant costs of these treatments drew the attention of FRBC executives and the second in command of the FRBC program came to Malcolm Island for a look. He didn't say much. He just shook his head and got back on the ferry.

Oh yeah….. the SNRC drone is here too. Affectionately called the "Beast", this 15 kg UAV quad-copter is very stable in light winds, completely customizable and can be configured with an array of sensors and cameras (including: Near Infrared, Hyperspectral, Thermal Infra-Red and even LiDAR). The SNRC UAV crew will be here to demo the drone's capabilities and to answer all of your technical questions. If you want a sneak peak at the Sassin X1 "Beast" watch this cool video:
http://www.immersioncreative.com/clients/strategic/UAV

NOTES

SITE #4

The Ecological Suitability of Douglas Fir on Malcolm Island

Rod Negrave

(Craig Wickland)

BC Ministry of Forests, Lands and Natural Resource Operations

Presenter Biography and Abstract

Biography:

Name: ~~Rod Negrave~~
Affiliation: FLNRO, Coast Area
Position: Research Section Head/Research Silviculturist
Responsibilities: Research Section administration
Silvicultural research
Academic training: PhD (Forestry), UBC 2004; MSc, Forest Science, U of Alberta, 1993; BSc (Agr), UBC, 1988
Previous employment: Alberta Parks & Protected Areas, Northern Lights College, self-employed consultant/contractor/farmer, BC Forest Service

Craig Wikland

presented instead of

Rod Neagrave

Topic: The Ecological Suitability of Douglas Fir On Malcolm Island

Between 1970 and 1980 many sites on Malcolm Island were planted with Douglas Fir, a tree species not common on the island, as it was viewed as a desirable commercial species on the coast at the time. The performance of Douglas Fir on Malcom Island, in terms of health, growth and wood quality characteristics is questionable and debatable to say the least.

The CSC group is going to walk through a stand of recently fertilized, 40 year old second growth Douglas Fir, to discuss ecological suitability of Douglas fir under the climatic and site conditions found on Malcom island.

What does offsite Fdc mean and can this be defined?

What are the characteristics of offsite Douglas Fir and how or do these characteristics affect timber growth and wood quality objectives? What is the influence of proximity to the ocean for Fdc in this area?

How Does Fdc perform on wet, hyper-maritime-influenced sites if the soils are not well drained and on a southerly-exposed (or limestone-derived soils)?

These questions become even more complex in the context of Douglas Fir ecological suitability on Malcolm island if Fdc is to deployed north under climate change influences, nursery seed-lots available today, and the desire to increase species diversity at the stand and landscape level.

I look forward to discussing with the CSC group in the field while observing the performance of Douglas Fid to date.

Ecological suitability of Douglas-fir on Malcom Island

Site Description:

Ecology – CWH vm1 site series 01 (moisture nutrient regime 3-4/c)

Aspect – North

Terrain – gentle to 20 % slope

Regeneration – Planted to Douglas-fir (seedlot not known)

Inventory label: Fd57Hw34Dr09 21 m 60.8 m^2

Height / diameter ratio Fdc – average 0.62

Site index Fdc Breast Height age 50: 27-35 (source fertilization prescription)

Fertilization 2013 – 435 kg per ha of Urea (equivalent to 200 Kg per of N)

Broad Regional Climate Description (source Climate BC 1960-90 normals**)**

Latitude 50.6 N / Longitude 127.06 W

Mean annual temperature – 8.5 C

Mean annual precipitation – 1734 mm

Mean summer precipitation – 374 mm (May through September)

Mean Temperature warmest month – 14.8 C

Mean summer maximum temperature – 18 C

Site – Stand / stock table (Source 2015 PITA survey Paul Barolet)

Species	**Log Descriptor Class ***	**Diameter (cm) distribution – BA (m^2/ha)**								
		15	**20**	**25**	**30**	**35**	**40**	**45**	**50+**	total
Fd	A – Premium log									
	B – Saw log		3.2		1.6	1.6	3.2	3.2		12.8
	C – Utility log			3.2			3.2		3.2	9.6
	D - Pulp		3.2	1.6		3.2	3.2		1.6	12.8
	Sub total		6.4	4.8	1.6	4.8	9.6	3.2	4.8	35.2
Hw	A – Premium log									
	B – Saw log		1.6	1.6		1.6	1.6			6.4
	C – Utility log	3.2	1.6		1.6	1.6				8.0
	D - Pulp	4.8	1.6		1.6	1.6				6.4
	Sub total	8.8	4.8	1.6	3.2	4.8	1.6			20.8
Dr	A – Premium log									
	B – Saw log									
	C – Utility log				1.6					1.6
	D - pulp						1.6	1.6		3.2
	Sub total				1.6		1.6	1.6		4.8
									Total	60.8

*source PITA survey methodology
http://www2.gov.bc.ca/gov/DownloadAsset?assetId=970A7EF8131748D494C9451E986A4CA4&filename=final_lbis_post_incremental_treatment_assessment_sept_30_2013.docx

Ecological suitability of Douglas-fir on Malcom Island

Ecological suitability of Douglas-fir on Malcom Island

NOTES

SITE #5

Spaced and Fertilized Western Hemlock Trials On Malcolm Island

Experimental Project 703

Installation #30

Mario Di Lucca/René de Jong

BC Ministry of Forests, Lands and Natural Resource Operations

Presenter Biography and Abstract

Biography:

Name: Mario Di Lucca, MSc, RPF
Affiliation: FLNRO
Position: Growth and Yield Applications Specialist
Responsibilities: Applied research on tree and stand development, technical review of managed stand yield tables for timber supply applications, and transfer of growth and yield information.
Academic training: BF (La Plata, Argentina), MSc (UBC)

Name: René de Jong, RPF
Affiliation: FLNRO, Victoria BC
Position: Growth and Yield Forester / Data Analyst
Responsibilities: Manages FAIB's ground sample data, and coordinates ground sample applications with timber supply reviews.
Academic training: BsF (UBC)

Presentation Abstract:

Topic and/or Title:

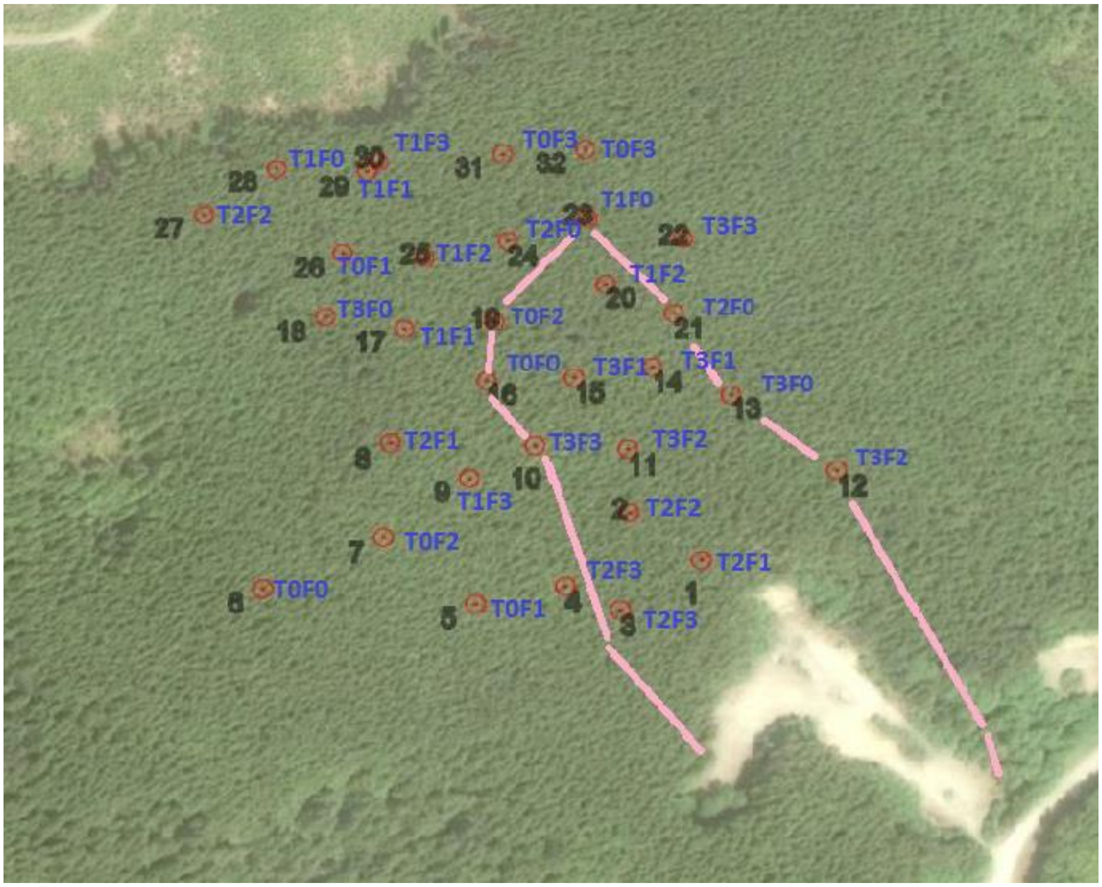
Experimental Project (EP) 703 was established by the BC Forest Service's former Research Branch, to investigate the long term impacts of thinning and fertilization in coastal BC. Installation # 30 is located on Malcom Island and is one of 85 installations within EP-703's network of permanent sample plots throughout the coastal range of immature Douglas-fir and western hemlock.

Installation #30 was established as a randomized complete block design in a complete factorial arrangement with four levels of thinning (0, 20, 35, 50% basal area removal), and four levels of fertilization (0, 225, 450, 675 kg N/ha), replicated twice over 16 treatment combinations.

Treatments were applied in 1973 when the stand was 32 years old. Composition was Hw95 Ss5, and site index estimated at 28m (@BH age 50) at time of treatment. All ground samples were measured 11 times since 1973, the most recent this past winter 2014.

We will compare treatment differences (if any!) of installation #30 after 40 years since treatment, including density, volume, piece size, plus lumber recovery estimates from TASS / SAWSIM.

Coastal Silviculture Committee Field Tour 2015
EP 703-30, Malcolm Island, B.C.



EP 703

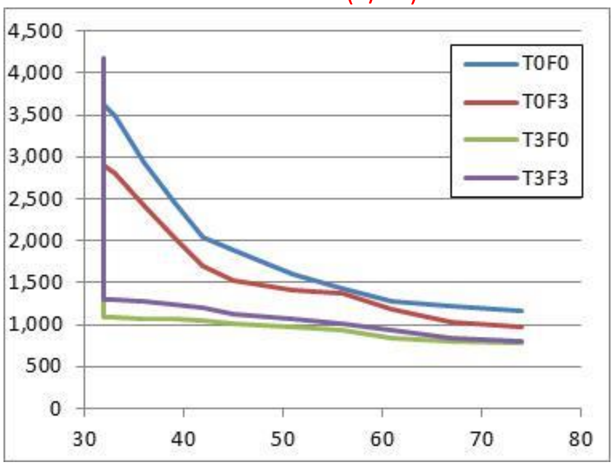
- Extensive field program of 85 experimental project installations, established by BC Forest Service's Research Branch to investigate response of coastal immature Fd and Hw to thinning and fertilization across a range of site conditions and ages.
- Provides a baseline of mensuration data to quantify the variability of treatment responses.

EP 703 – 30

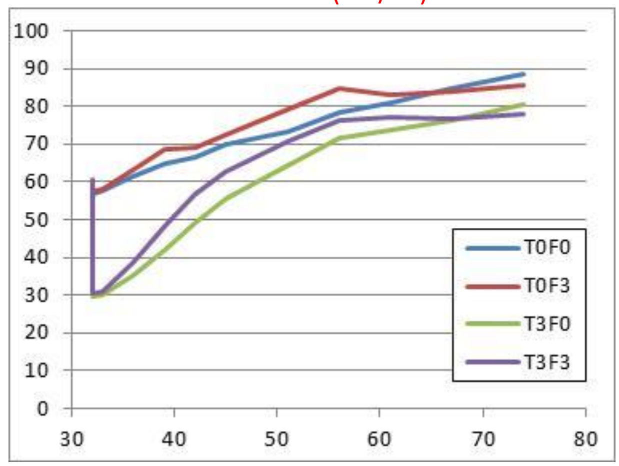
- Experiment established 1972, Stand age: 32yrs, Species Comp: Hw95Ss5, SI: 30m, BGC: CWHvm1 (SNR=med SMR=submesic), Soils: Duric humo-feric podzol, loamy sand, 112cm rooting depth.
- Randomized complete block design, complete factorial - four levels of thinning T0, T1, T2, T3 (0, 20, 35, 50% BA removed) & four levels of fertilization F0, F1, F2, F3 (0, 225, 450, 675 kg N/ha) applied at establishment, replicated twice over 16 treatments.
- 0.05ha square plots, all trees >5cm DBH tagged, subsample for heights, treated buffers.
- Re-measured every 3-6yrs, most recently 2014 @ age 74yrs, 42 years post-treatment response.

Growth and Yield Trends by Total Stand Age for the four Extreme Treatments

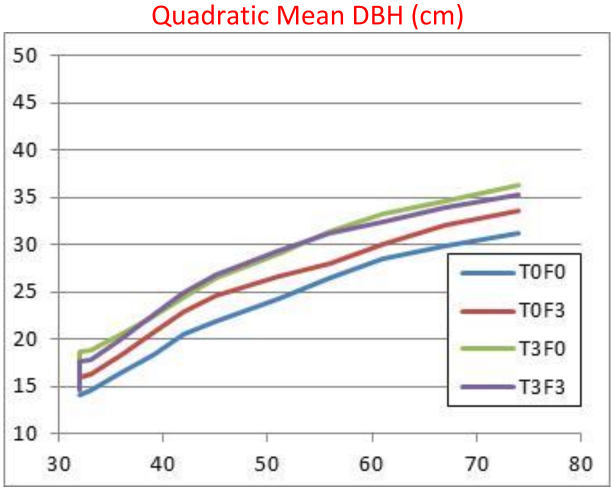
Total Stems (#/ha)



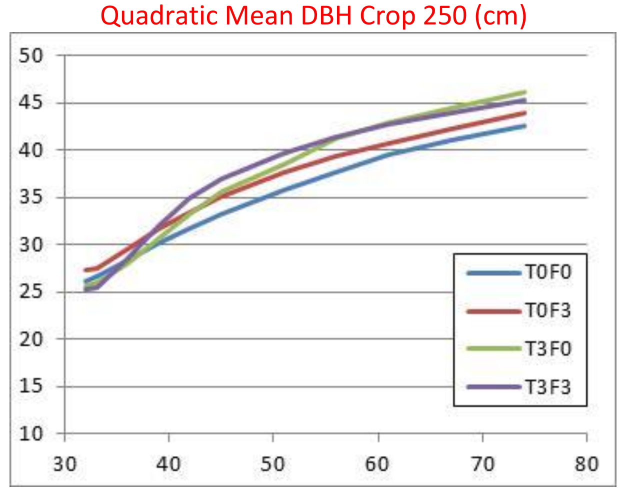
Basal Area (m2/ha)



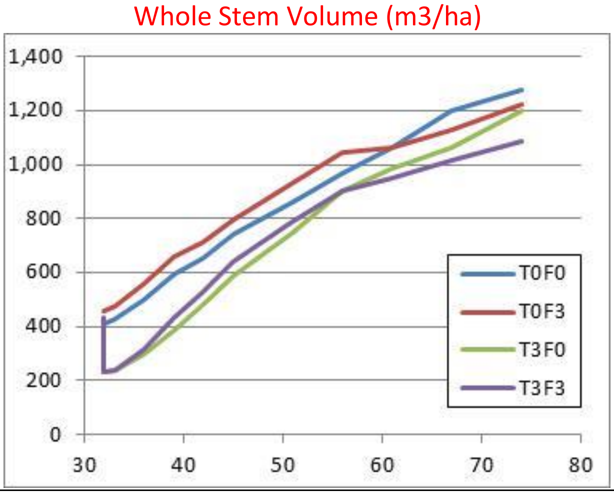
Quadratic Mean DBH (cm)



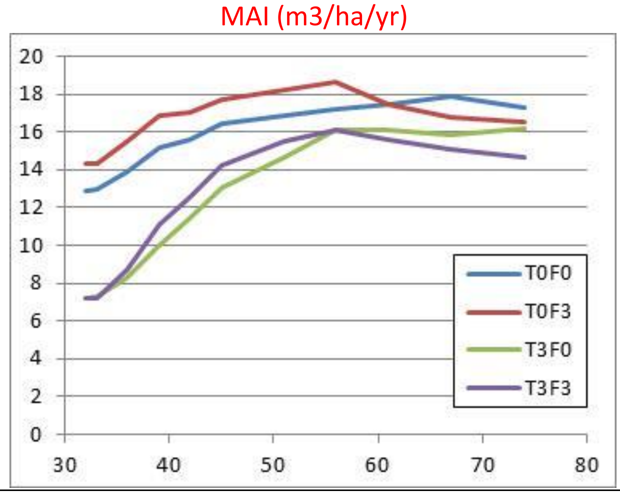
Quadratic Mean DBH Crop 250 (cm)



Whole Stem Volume (m3/ha)

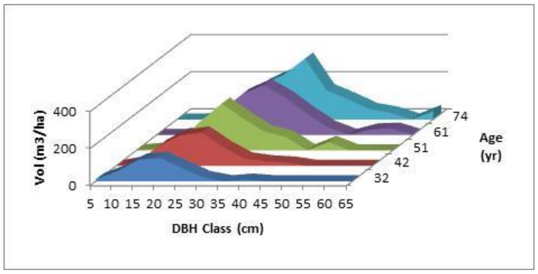


MAI (m3/ha/yr)

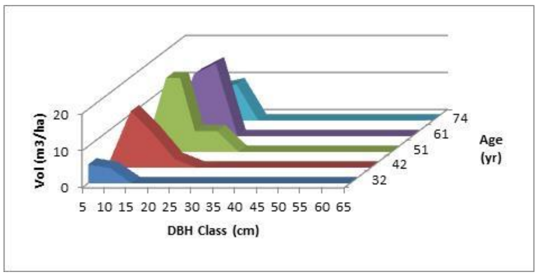


Stock Tables by measurement, both Live & Dead trees, for the four Extreme Treatments

T0F0

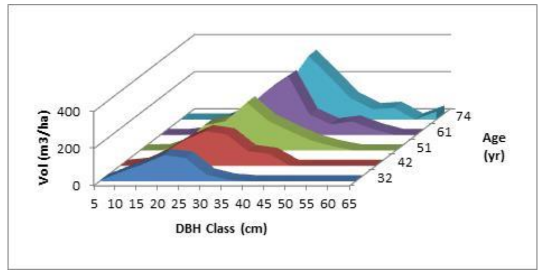


Live

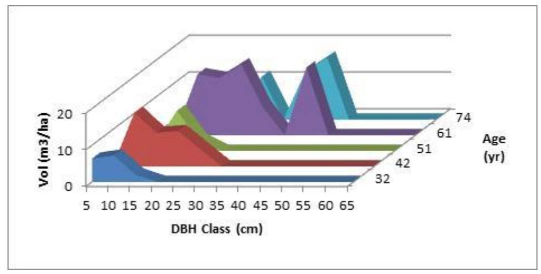


Dead

T0F3



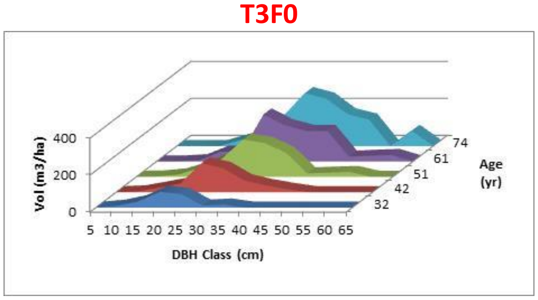
Live



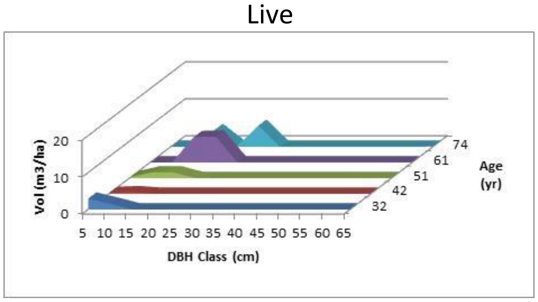
Dead

(42cm DBH Ss died betw 1996-2001, brk. top)

T3F0

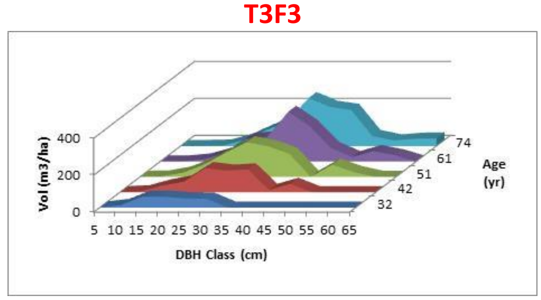


Live

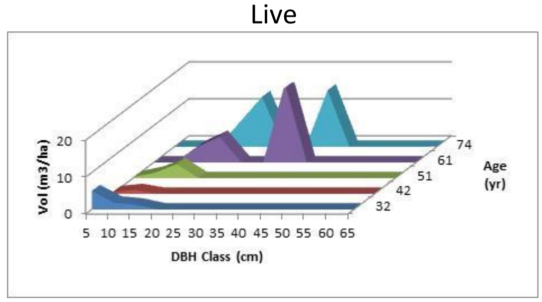


Dead

T3F3



Live



Dead

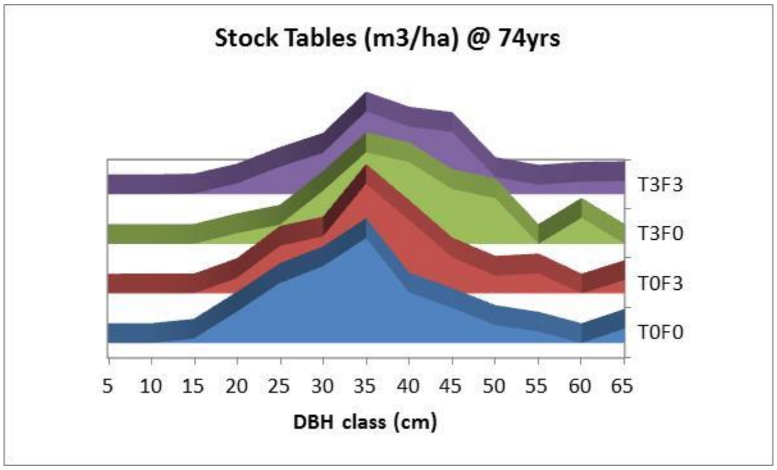
(34cm DBH Hw died betw 1996-2001, brk. Top)

Compiled Plot Level Attributes @ End of 2014 Growing Season

TRTMT	PLOT #	SPH #/ha	BA m2/ha	DBHq All cm	DBHq C250[6] cm	TVOL[1] m3/ha	MVOL[2] m3/ha	HTop[3] m	SI[4] m	MAI[5] m3/ha/yr
T0F0	EP703_30_06	1,300	90.5	29.8	41.8	1,293	1,233	35.9	29.9	16.7
	EP703_30_16	1,040	86.4	32.5	43.2	1,261	1,210	36.7	31.3	16.3
T0F1	EP703_30_05	1,040	81.5	31.6	43.8	1,167	1,116	36.4	29.0	15.1
	EP703_30_26	1,080	85.6	31.8	43.2	1,243	1,191	37.3	31.5	16.1
T0F2	EP703_30_07	1,200	79.7	29.1	37.2	1,096	1,044	33.2	28.3	14.1
	EP703_30_19	820	82.5	35.8	49.5	1,210	1,162	36.7	30.8	15.7
T0F3	EP703_30_31	940	88.9	34.7	45.3	1,251	1,201	35.6	30.8	16.2
	EP703_30_32	1,000	82.3	32.4	42.5	1,198	1,149	37.2	30.4	15.5
T1F0	EP703_30_23	1,040	81.3	31.5	40.8	1,192	1,142	36.0	30.8	15.4
	EP703_30_28	780	81.0	36.4	48.3	1,183	1,138	37.2	32.7	15.4
T1F1	EP703_30_17	840	74.2	33.5	43.1	1,066	1,023	37.0	31.7	13.8
	EP703_30_29	840	71.7	33.0	42.9	1,043	1,001	36.6	31.8	13.5
T1F2	EP703_30_20	880	87.0	35.5	49.6	1,260	1,210	37.0	30.5	16.4
	EP703_30_25	840	75.8	33.9	43.2	1,085	1,043	35.5	30.6	14.1
T1F3	EP703_30_09	820	85.0	36.3	47.5	1,247	1,200	37.4	30.6	16.2
	EP703_30_30	840	88.2	36.6	47.6	1,239	1,191	35.9	31.3	16.1
T2F0	EP703_30_21	980	84.2	33.1	44.6	1,160	1,110	36.2	30.6	15.0
	EP703_30_24	920	91.7	35.6	46.3	1,404	1,353	38.9	32.1	18.3
T2F1	EP703_30_01	980	71.9	30.6	40.0	1,025	979	37.0	30.0	13.2
	EP703_30_08	840	75.5	33.8	42.4	1,184	1,141	39.9	32.2	15.4
T2F2	EP703_30_02	880	83.0	34.7	45.0	1,260	1,213	37.6	30.4	16.4
	EP703_30_27	840	76.6	34.1	44.1	1,082	1,039	36.1	31.4	14.0
T2F3	EP703_30_03	1,060	80.3	31.1	44.4	1,148	1,096	35.3	28.4	14.8
	EP703_30_04	820	71.8	33.4	42.1	996	955	34.3	28.7	12.9
T3F0	EP703_30_13	840	83.4	35.6	46.3	1,244	1,198	38.1	31.2	16.2
	EP703_30_18	720	77.3	37.0	46.0	1,155	1,114	38.2	32.5	15.1
T3F1	EP703_30_14	820	78.9	35.0	41.8	1,173	1,130	36.4	30.0	15.3
	EP703_30_15	700	76.5	37.3	46.1	1,145	1,105	38.3	30.9	14.9
T3F2	EP703_30_11	800	87.6	37.3	45.6	1,281	1,236	37.3	30.8	16.7
	EP703_30_12	880	81.4	34.3	42.1	1,159	1,115	35.4	28.0	15.1
T3F3	EP703_30_10	740	84.0	38.0	47.5	1,152	1,109	34.9	29.3	15.0
	EP703_30_22	860	72.0	32.6	42.9	1,017	974	35.6	29.5	13.2

[1] TVOL: Whole stem volume, using Kozak's 2002 BEC-based tree taper equations, incl. top & stump
[2] MVOL : Gross merch volume, close utilization 12.5cm DBH, 30cm stump ht, 10cm top DIB, no deduction for DWB
[3] HTOP: Top height estimated as the average height of the largest 5 (by DBH) trees / plot.
[4] SI: Site index estimated as the average SI from all available suitable site trees.
[5] MAI: mean annual increment at total age 74 yrs.
[6] C250: Quadratic mean DBH of the potential crop trees (largest 250 trees / ha by DBH).

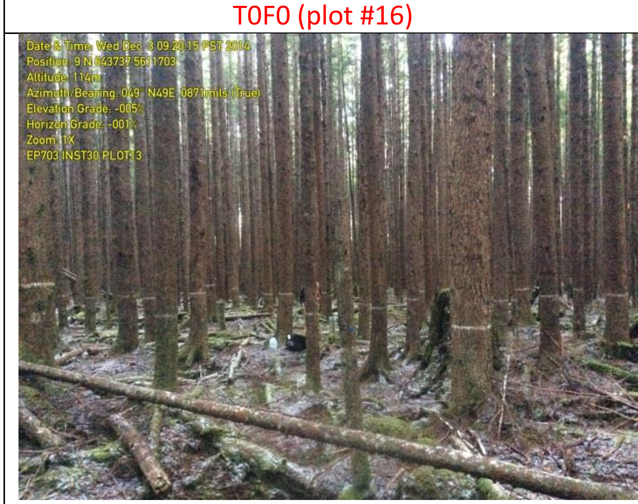
2014 Stock Tables (@ 74yrs) for the four Extreme Treatments



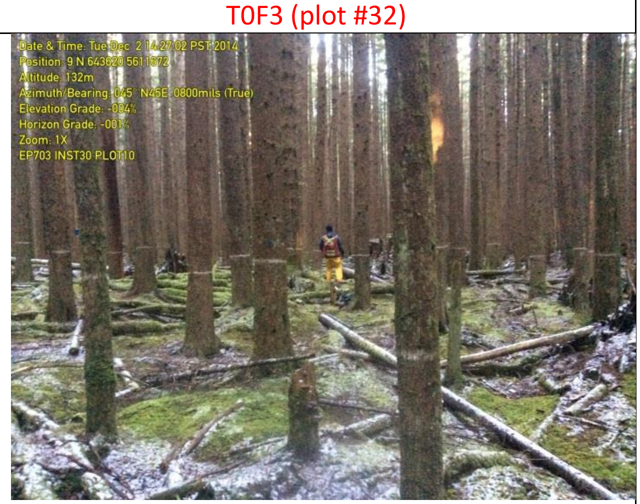
2014 Plot Photos for the four Extreme Treatments

T0F0 (plot #16)

T0F3 (plot #32)



T3F0 (plot #13)

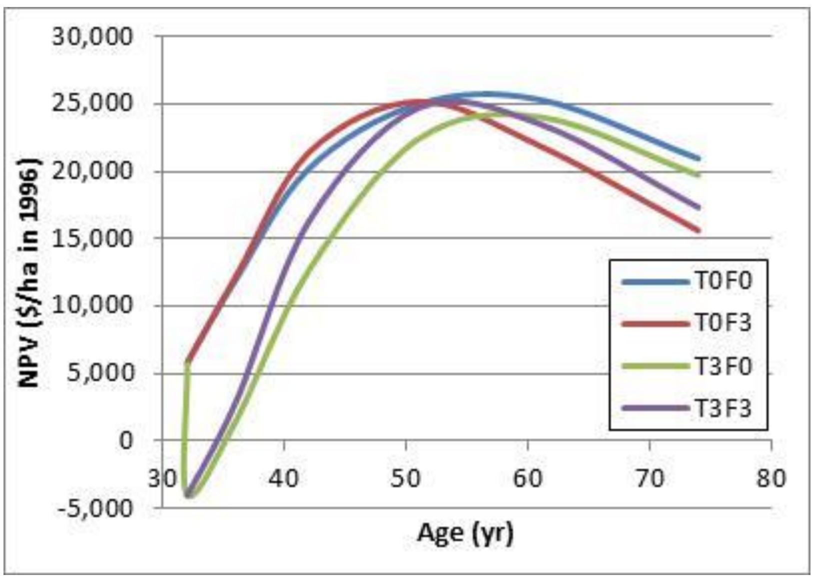


T3F3 (plot #10)

Financial Analyses – Using SAWSIM / FAN$IER on EP703-30 Data

SAWSIM / FAN$IER Assumptions:

- NPV calculated separately for each of the four extreme treatments across all measurements
- 4% discount rate applied
- Fertilizer Cost @ $500/ha (treated at age 32, 2015 dollar cost)
- Pre-commercial thinning cost @ $1,500/ha (treated at age 32, 2015 dollar cost)
- NPV based on Lumber & Mill Residue (#2&better)
- NPV values are averages of two plots per treatment
- Plotted NPV values for each treatment were standardized by the difference at age 32 from the untreated NPV (eg., NPV at age 32 : T0F0=$5,830/ha while T0F3=$10,060, therefore the T0F3 NPV was shifted by -$4,230/ha across all measurements).



NOTES

Evening Program

Day 1

Malcolm Island

Dinner at Sointula Hall

5:00 to 8:00 pm

Guest Speaker

Robbie Boyes

Live from beautiful downtown Sointula….

Robbie Boyes was born and raised in Gibson's BC and is now a retired Sointulan who seasonally spends time in Mexico every year.

Robbie began his career and livelihood in the early 1970's when he moved permanently to Sointula and took up tree planting as an adventurous young man.

One of the first planting contracts was for a Tree Co-op or Tree Sing on Malcolm Island that consisted of local hippies, seasonal workers, and colourful draft dodgers who found a safe haven on BC's coast.

The planting crew began at 40 people and dwindled down to 20 people able to do the hard work and live the reality outdoor and camp life which often consisted of pitching a tent on a logging road. Robbie was one of the survivors and tree planting took him up and down coast from Knight Inlet to Bella Coola to Woss.

Compared to today's tree planting, Robbie found that tree planting was more of a social adventure with no rules, no regulations, and no WCB. Girl friends and family pets were most welcome in camp and the tree plants were view as employment opportunities for women from Malcolm Island which only had a male dominated workforce of fisheries and logging in the 1970's.

Robbie planted trees for MacDonald Cedar which became Whannock and then INTERFOR.

After tree planting Robbie became a carpenter by trade and worked building many logging camps on the coast and structures on Malcolm Island.

Coastal Silviculture Committee

"Reassessing our Silviculture Practices for Uncertain Times"

Port McNeill – June 10th and 11th, 2015

Program – Day 2

Vancouver Island

BUS #1			
8:00	**IGA Parking Lot**		**Site**
8:30-9:35	Cw/Cy Espacement	Louise de Montigny	#3
9:55-10:40	Karst	P. Griffith	#1
10:40-11:15	Drone Demo - Strategic NR Consultants		
11:15-12:15	VR and Regeneration	N. Smith	#2
12:30-1:30	Lunch – Cluxewe Campground		
1:45- 2 :45	SCHIRP	Annette Van Niejenhuis/Rod Negrave	#4
3:00-3:15	Wrap-up at the Roadside Lookout - Dave Weaver		

BUS #2			
8:00	**IGA Parking Lot**		**Site**
8:30-9:20	SCHIRP	Annette Van Niejenhuis/Rod Negrave	#4
9:40-10:40	VR and Regeneration	Nick Smith	#2
10:40-11:15	Drone Demo - Strategic NR Consultants		
11:15-12:00	Karst	Paul Griffith	#1
12:15-1:15	Lunch - Cluxewe Campground		
1:30-2:45	C/Cy Espacement	Louise de Montigny	#3
3:00-3:15	Wrap-up at the Roadside Lookout - Dave Weaver		

DAY 2 – SITE LOCATION MAP

DAY 2

Vancouver Island

SITE #1

Karst Management

Paul Griffiths

P.A. Griffiths & Associates, Inc.

Presenter Biography and Abstract

Biography:

Name: Paul Griffiths
Affiliation: P.A. Griffiths & Associates, Inc.
Position: Principal
Responsibilities: Conducting and directing consulting and contract studies in varied cave and karst related issues, and natural resource management of karst regions.
Academic training: B.Sc. University of Victoria, 1973
Completing doctoral program in karstology (2009 to present).
Previous employment: Nearly 20 years with Canadian Pacific Forest Products Limited and its predecessors as environmental biologist and corporate environmental and industrial hygiene manager.

Presentation Abstract:

Topic and/or Title:

Karstified soluble rocks cover 7-10% soluble rocks of the Earth's surface. 25% of the planet's population depends upon karst for drinking water (Ford and Williams 2007). In British Columbia (BC), 10-11% of the land surface is underlain by soluble rocks with the potential to form karst, with more than 95% of it in publicly managed lands.

Karst is recognized as an ecosystem comprised of infinitely complex surface-subsurface connections that permit the passage of air, water, biota, and soil. The biological and ecohydrological characteristics of the karst over much of coastal BC are influenced by the nature of the forest cover. Forest trees and soils are integral to karst resource features and karst processes.

The unique interconnectedness between surface and subsurface karst elements is one of the reasons why Parise (2010) and many others consider karst to be one of the most fragile and vulnerable of natural environments.

High-value timber, minerals and other important natural resource values associated with karst in BC have been sought out for development for many decades. BC has made significant strides in some aspects of managing karst, particularly in relation to industrial forestry activities on the coast, but regular monitoring, assessment and local karst research are needed to ensure the BC succeeds in achieving its sustainable management goals and commitments.

This presentation will target the management of forested karst in the coastal BC region within these main thematic areas:

1. What karst is and where is it found – including a few BC karst facts and figures
2. Managing karst from the 1970s onwards – timber harvesting, roads and silviculture activities (e.g., prescribed burning)
3. Second-growth karst management
4. Karst and climate change
5. Top 5 strategies for successful karst management- a karstologist's perspective

References cited:

Ford, D. and Williams, P. 2007. Karst Hydrogeology and Geomorphology. Chichester: John Wiley & Sons, Ltd.

Parise, M. 2010. Hazards in Karst. In the Sustainability of the Karst Environment. Proceedings of the International Interdisciplinary Scientific Conference. Plitvice Lakes, Croatia, 23-24 September 2009. Edited by Ognjen Bonacci. United Nations. Educational, Scientific and Cultural Organization. Page 155

Description of Site #1 (Karst Management)

Prepared by P. Griffiths for the June 11, 2015
Coastal Silviculture Committe Summer Workshop Tour

This karst site is located along a non-gazetted second-order tributary of the Cluxewe River, which drains into the marine waters of Broughton Strait. The elevation at the site is approximately 98 m above sea level (asl).

The bedrock at the site is mapped as the Upper Cretaceous Suquash Sequence sedimentary rocks but the site is actually hosted in a unit of very pure gently-dipping Upper Triassic Quatsino Formation limestone. The nearest mapped Karst Potential Area (KPA 32422) is located 310 m to the southwest of the site and described as a block-faulted unit of Quatsino Formation.

Fluvio-glacial deposits mantle the area surrounding the karst site, making the delineation of the limestone bedrock difficult away from the incised stream channel that bisects the site. The surface expression of the terrain (landform) can be generally described as subdued and ridged. Several topographically closed depressions with wet bottoms are present in the area. These depression features cannot definitively be attributed to karst processes. They may be glacial kettles. An esker is located 100-150 m to the northeast of the karst site.[1]

The karst site is situated within CWHvm1. The age of the second-growth forest covering the site ranges from 41 to 80 years. [Photo 1] Primary old growth tree stumps are present on the site. The regenerating stand covering the karst site is adjoined by second pass harvest units to the northeast (Block 5505 in 2006) and to the southwest (Block 5599 in 2005).

The principal karst features of the site include:

- A sinking stream[2]
- A dry valley[3] segment
- A karst window[4]

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[1] An esker is a long, narrow, winding ridge composed of stratified sand and gravel deposited by a subglacial or englacial meltwater stream.
[2] A small stream that disappears underground at a karst insurgence, usually a distinct sink point (swallet).
[3] A valley that lacks a surface water channel.

- A karst spring[5] (functioning as a base flow resurgence[6])
- A 62-m long karst cave[7] with two entrances, which carries streamflow at higher water stages

The sinking stream reach flows from a 2.4-ha wetland 100-150 m to the southeast of the perennial sink point [Photo 2], and forms part of a 185-ha contributing topographical catchment rising to about 400 m asl. A specific conductance (electrical conductivity) of 78 μS/cm obtained on May 31, 2015 indicates some likely upstream contact with carbonate bedrock. The riparian classification of the sinking stream reach is S3 (i.e., fish-bearing and channel width within 1.5–5 m). The average width of the reach for 40 m upstream of the perennial sink point is 3-4 m (based on five separate measurements). A 15–m long, 2–3 m high limestone rock face overhanging a low meander cut borders the southern edge of the sinking stream approximately 20-25 m upstream of the perennial sink point. [Photos 3 and 4]

The base stream flow can be observed at the 5-m long, 4-m deep karst window. [Photo 5] This window is situated in the axis of the dry valley segment which runs between the perennial sink point and the base flow resurgence [Photo 6] some 30 m away. The dry valley feature is likely the result of the unroofing or collapse of the underlying active solution cave or conduit. A horizontal shelf formed at a bedding plane is visible inside the karst window [Photo 7]. The rising stream from the base flow resurgence [Photo 8] joins the Cluxewe River mainstem approximately 2 km downstream of the karst site.

The stream cave has two known entrances and is traversable. The rim of the greater depression enclosing the upstream entrance (E1) and the perennial sink point measures about 15–20 m in width. The entrance threshold at the drip line is about 8-10 m wide and 2-3 m high (maximum) with an easterly aspect [Photos 9

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[4] A karst window is a depression revealing part of an underground stream flowing across its floor (also an unroofed part of a cave).
[5] A karst feature where water is discharged to the surface from subsurface flows.
[6] A resurgence is where water collected at sink points (swallets) is transmitted by solution conduits and discharged to the surface environment to form a surface stream (i.e., rising stream).
[7] A karst cavity large enough to admit a human and containing a zone of complete darkness. This cave length is approximately mid-range for mapped Vancouver Island caves.

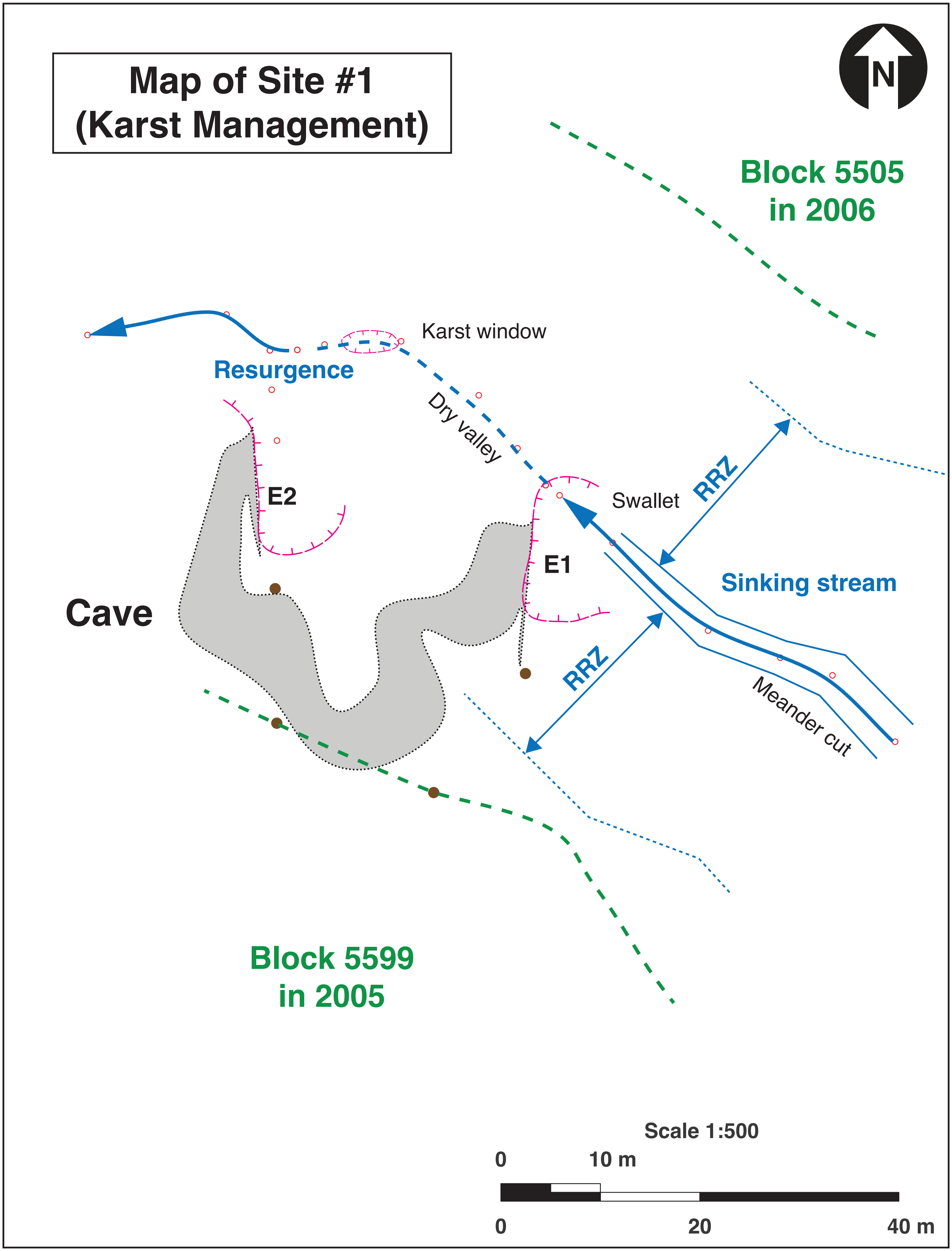
and 10]. This upstream cave entrance is presently functioning as an intermittent swallet. Natural and harvest-related woody debris has accumulated at this upstream entrance. There is a minimal amount of woody debris inside the cave away from the entrance.

The interior passage of the stream cave is of a sinuous phreatic character – the passage is mostly walking height with less than a 3–4 m elevation drop between the two entrances. Passage walls are mostly clean, grey limestone with occasional calcite deposition. The upstream passage series has some large breakdown blocks. A pool of water occupies the final 15 m of passage before the downstream entrance (E2). The specific conductance of the standing water is 264 μS/cm (May 31, 2015). This high reading reflects prolonged contact with carbonate bedrock. The E2 entrance resembles the upstream entrance in size and aspect. [Photos 11 and 12] The subsurface airflow is outward from the downstream entrance. The paleoflow direction indicated by pronounced wall scalloping is consistent with the contemporary water flow direction.

The outflow channel from the stream cave is sculpted in limestone bedrock and joins the resurgent base flow about 15 m downstream.

Harvest operations conducted in 2005 and 2006 accommodated a 20-m riparian reserve along the sinking stream reach with an adjacent management zone of variable width. This reserve appears to have been continued over the dry valley segment which overlies the presumed subsurface flowpath from the active sink point to the base flow resurgence. To date there is minimal tree windthrow along the cutblock edges. The “reserve area” encompasses all of the main surface karst features. A small area of the 2005 harvest unit overlies the interior of the cave near its midpoint. The cave passage ceiling at this point is about 5 m beneath the ground surface. The ceiling height is about 2.7 m and the passage width is about 6.4 m in this same area.

Otherwise, the nearest recent harvesting area (Block 5599 in 2005) occurs within about 20 m from E1 (upstream cave entrance) and about 15 m from E2 (downstream cave entrance), and at greater distances from the other karst features of the site.



P. Griffiths – May 31, 2015

Second-growth forest covering the karst site

Perennial sink point of sinking stream

Limestone rock face overhanging a low meander cut on sinking stream

Limestone rock face overhanging a low meander cut on sinking stream (close-up)

5-m long, 4-m deep karst window

Base flow resurgence

Horizontal shelf formed at a bedding plane is visible inside the karst window

Rising stream from the base flow resurgence

The upstream cave entrance (E1)

The upstream cave entrance (E1) looking outward

The downstream cave entrance (E2)

The downstream cave entrance (E2) looking outward

NOTES

DAY 2

Vancouver Island

SITE #2

Variable Retention and Regeneration

Nick Smith
Nick Smith Forest Consulting

Joe McDonald
Western Forest Products

Presenter Biography and Abstract

Biography:

Name: Nick Smith, RPF, PhD
Affiliation: Nick Smith Forest Consulting
Expertise: Biometrics, Inventory, Growth and Yield
Academic training: BSc. (UCNW), MF (UBC), PhD (OSU)

Name: Joe McDonald, RFT
Affiliation: Western Forest Products Inc.
Position: Area Planner, North Island Forest Operation
Expertise: Development planning, cutting, road, and other permits submissions, layout, production supervision, government liaison
Academic training: Dipl. For. Tech. (Malaspina), Cert. For. Tech. (BCIT)

Presentation Abstract:

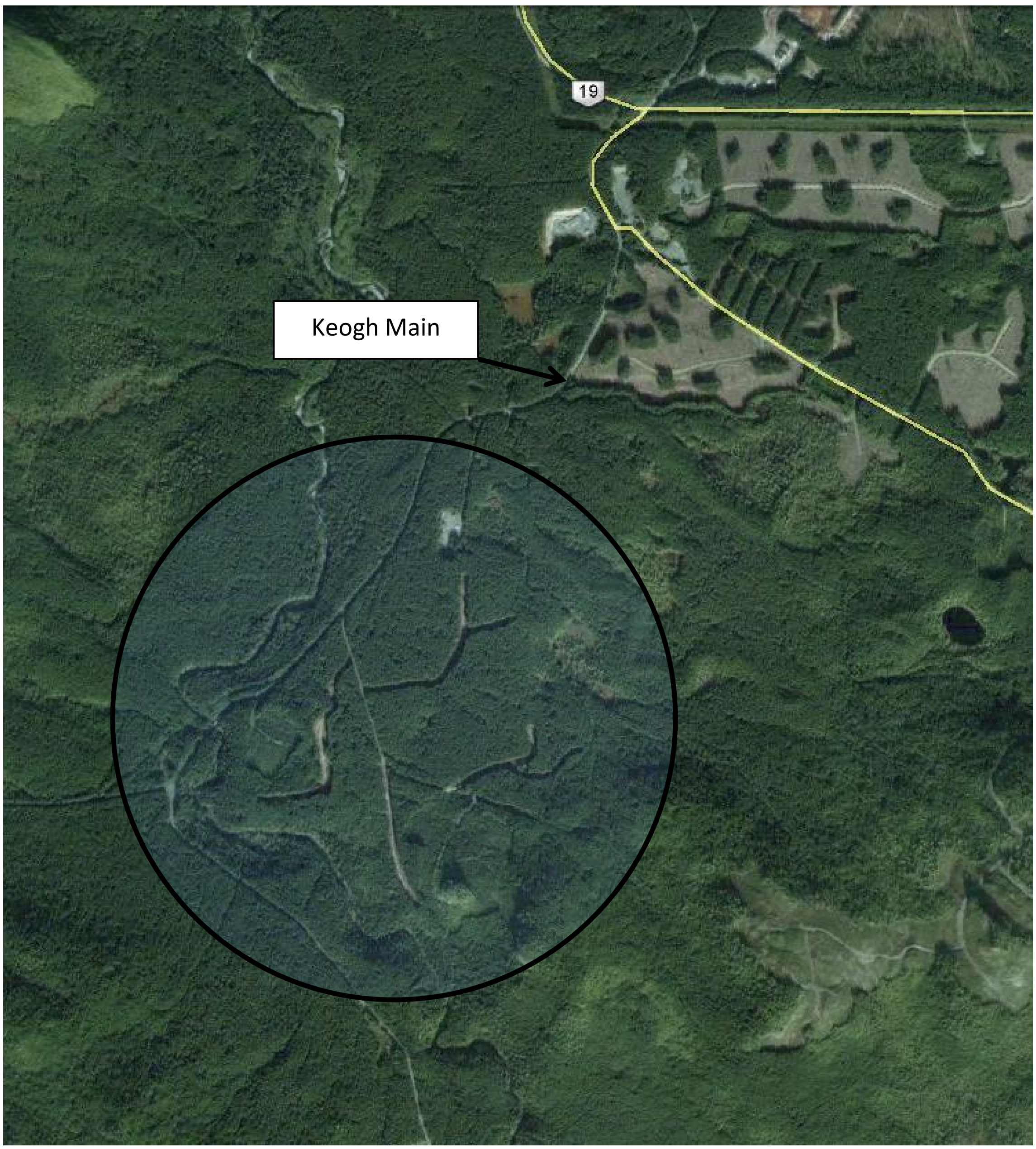
Topic: Variable Retention and Regeneration

Variable retention (VR), a recently recognized silviculture system in BC, retains structure, complexity, and diversity within harvest units. VR is implemented to meet social and ecological expectations of forest management. As VR has become more widely applied, its impacts on growth and yield, as well as on ecological function and biodiversity, need consideration. Studies in BC and the Pacific Northwest are examining these issues.
We are looking at some of the impacts of VR on growth and yield: How is regenerating western-hemlock and Douglas-fir tree growth and survival affected by

- Distance from edge of retained tree groups?
- Bearing of retained tree edge: N,S,E,W?
- Retained tree characteristics?

Dispersed and aggregate retention sites were examined for early (<5 year) tree growth and survival of planted stock. Results to date indicate some edge effect on early growth of planted trees occurs in a narrow zone adjacent to residual aggregate retention. High variance makes effects difficult to detect. Mortality was increased close to the boundary. Dispersed retention effects were most evident at higher retention levels.

Adaptive Management Project Location

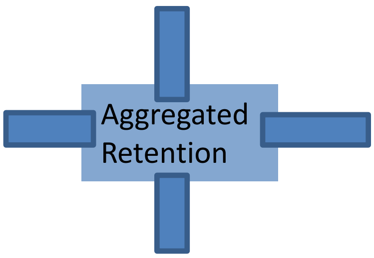



Adaptive Management Forest Structure
Port McNeill Experimental Block
R817
Est. 2002
McNeill
Port McNeill
OP 5599
1:6,000
Point of Control
Transect
Block Boundary
Roads
Drainage
Water Body
10m Contour
KARST STOP
VR STOP
BUS STOP
~6km WEST MAIN
KEOGH61
KEOGH
1 ha Groups
Clearcut Area
Control Area
1/10 ha Groups
1/4 ha Groups
Keogh Main
Keogh 61B
Keogh 61B2
Keogh 61A
Keogh 61C
Keogh 61
Keogh 61E
Keogh 61F
Keogh 61E1
Keogh 61E1A
West Main
0
300
m
1 centimeter equals 60 meters
Western Forest Products Inc.
North Island Forest Operation

VR G&Y Experiments

More edge is created, mainly aggregated retention (AR): focus for research on impacts on planted regen.

1) Rectangular Transects (example below)

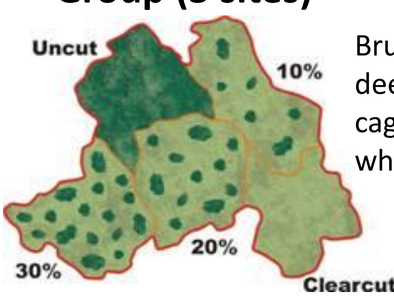


~20 sites
Easy to set up, 1999-2003

Brushed and deer/elk cages all sites where needed

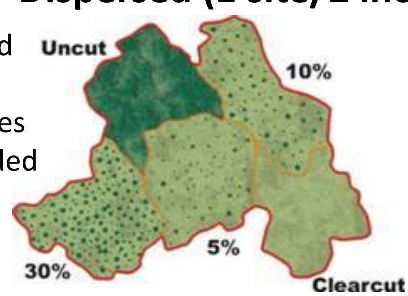
2) VRAM (Experimental: random allocation, 20ha treatments, same seed-source stock-type per site)

Group (3 sites)

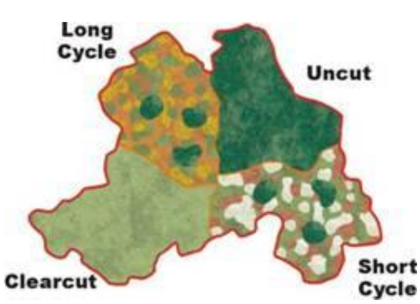


Brushed and deer/elk cages all sites where needed

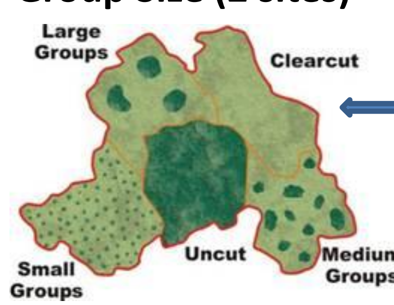
Dispersed (1 site/2 incr)



Group Selection (1 site)



Group Size (2 sites)



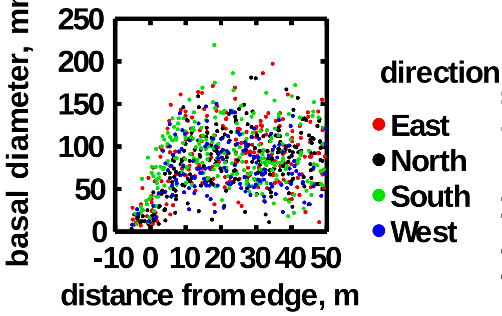
Port McNeill Site is this type

Established 2002-2006. More difficult to set up and remeasure. Other experiments: MASS, Capitol Forest and STEMS, DEMO, CFIRP

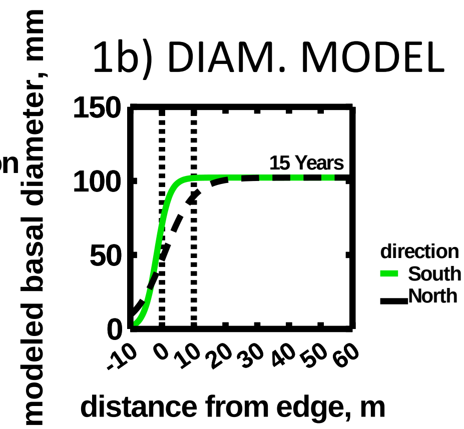
Results(interim)

- Rectangular Transects around AR: lots of growth variability at edges; to 14 yrs, several sites. Brushed/vexar/cages.
- Dynamic growth response close to edge
- Survival- similar once >5m from edge

1a) DIAM. ACTUAL



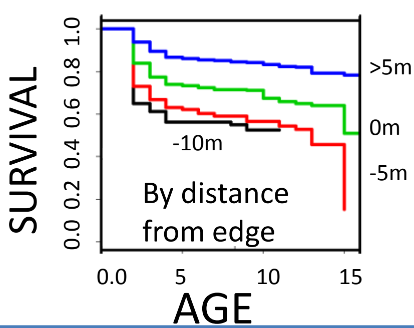
1b) DIAM. MODEL



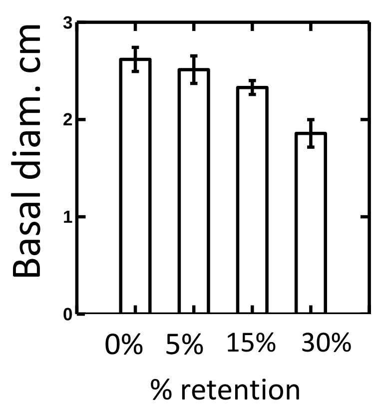
Note preliminary findings only

With Val LeMay and Bill Beese IUFRO World Congress 2014

- 1c) SURVIVAL DATA



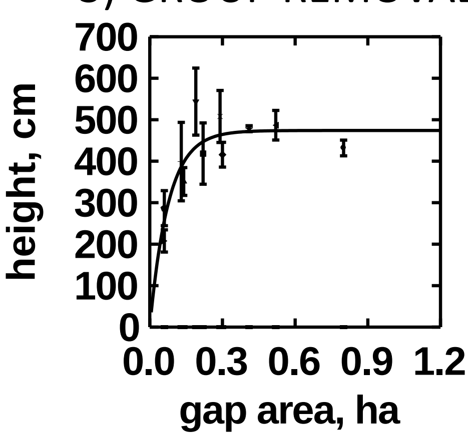
2) DISPERSED RETENTION (Fd)



Only 30% 5th yr BA retention regen: (~14m²/ha) was significantly different from clearcut.
MASS Hw and Ba different 30% DR versus 0% and 5%.

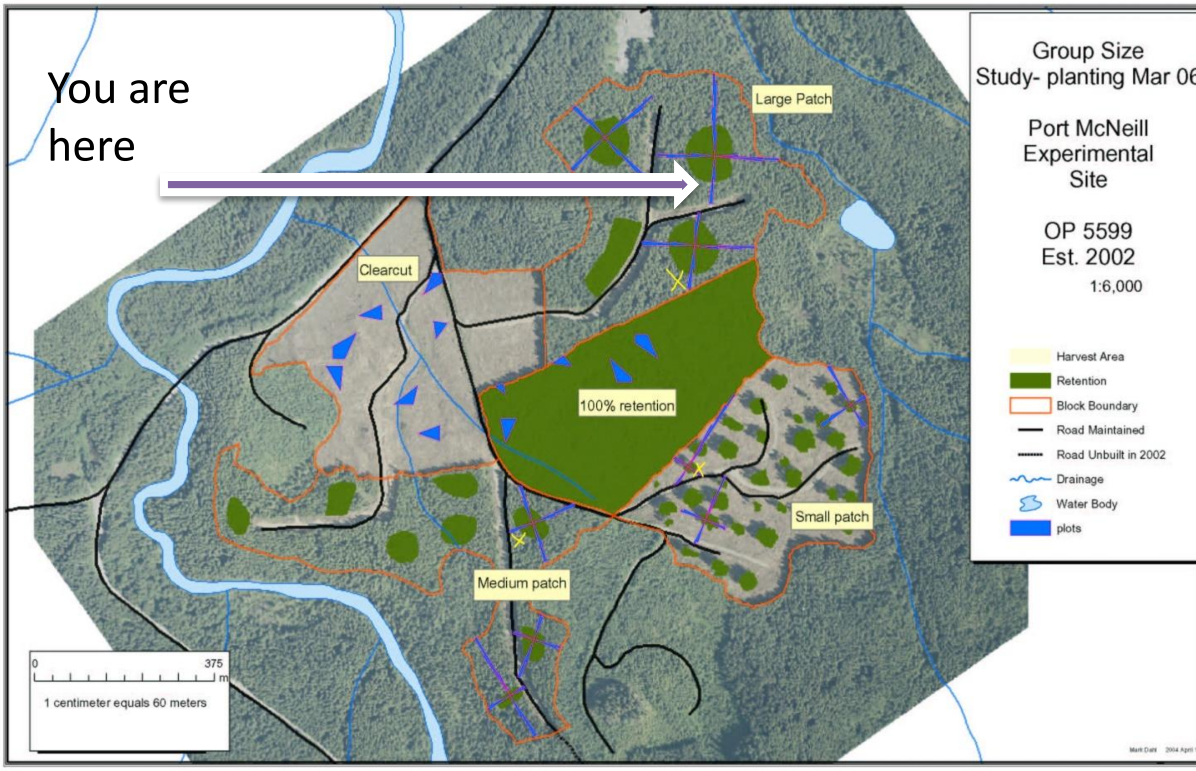
With Bill Beese
Forests 2012, 3, 230-243

- 3) GROUP REMOVAL (Fd)



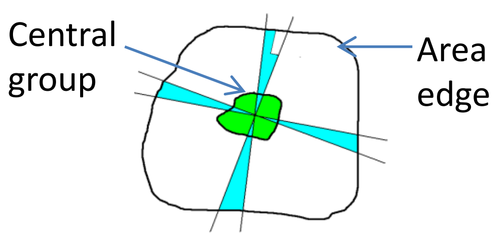
- STEMS data (Silviculture Treatments for Ecosystem Management in the Sayward)
- At least a 0.3ha opening may be needed for adequate regeneration growth
- 0.05ha-1.1ha 11 year response
- With Louise de Montigny and Kim Iles

Keogh 61 VRAM SITE



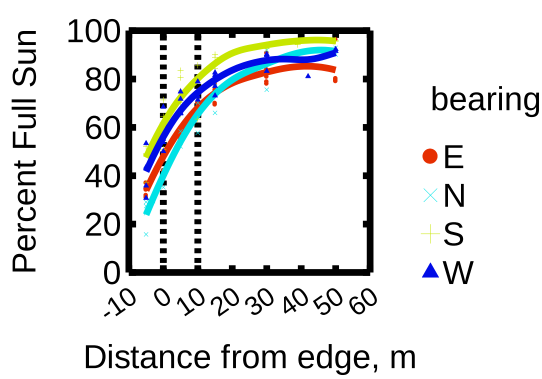
Logged 2003-2005. 700m^3/ha, 70 yrs old, SI 31, CWHvm1(05),BA 85m^2/ha, 860 stems/ha. Leaf Area Index 8. Planted (transects) Apr. 2006. Hw 4-12 seedlings. 1200 stems/ha. Group amount: 15% retention with small (0.06ha), medium (0.3ha) and large (0.8ha) AR groups. Measured 2 years after planting; only 1/3rd plots measured at 5 years (2010).

4

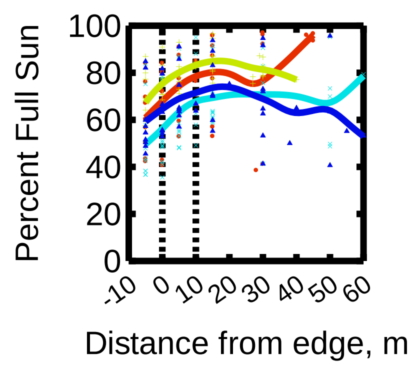


Sector plots- a new design to sample VR with lots of edge: with Kim Iles, For. Sci. 2006, 52, 148–154

5a Large Patch

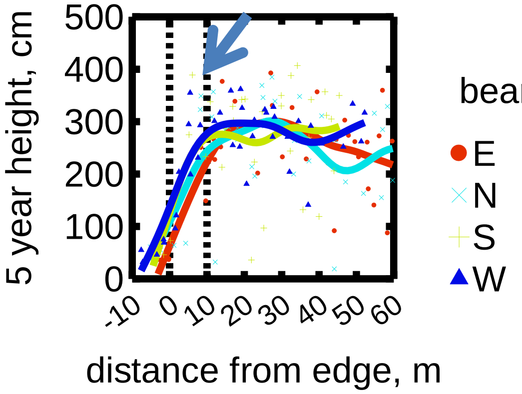


5b Small Patch

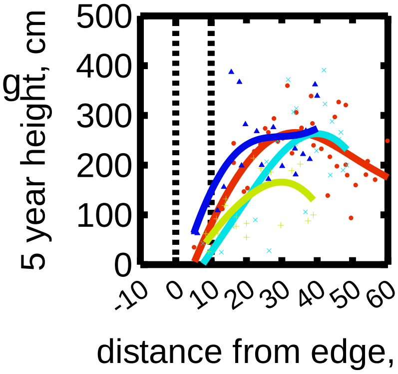


Light is apparently reduced more around small patches

6a Large Patch

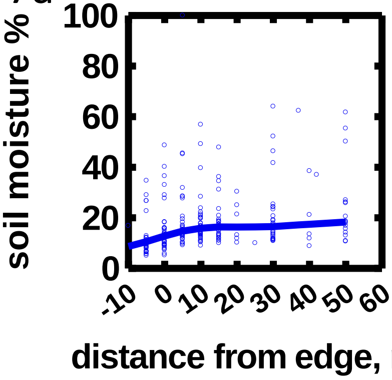


6b Small Patch

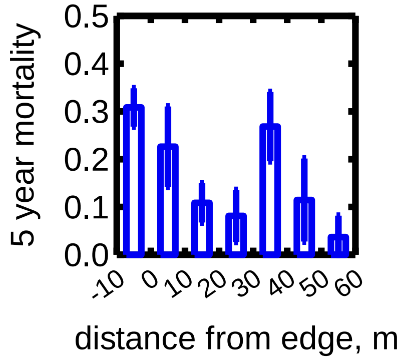


Steep and short-ish growth impact zone.

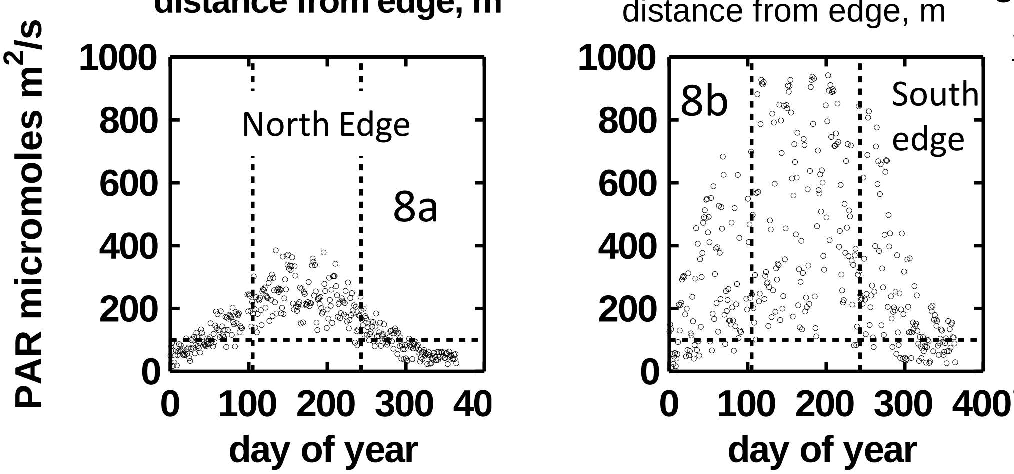
7a



7b Large Patch



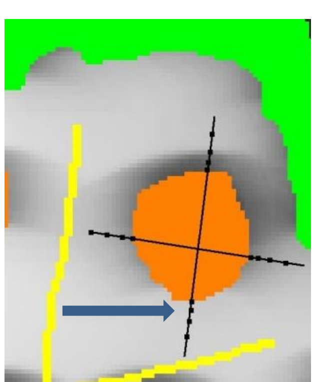
Soil moisture and soil temperature fairly constant with distance to VR edge. Mortality highly variable.



With Andy Black

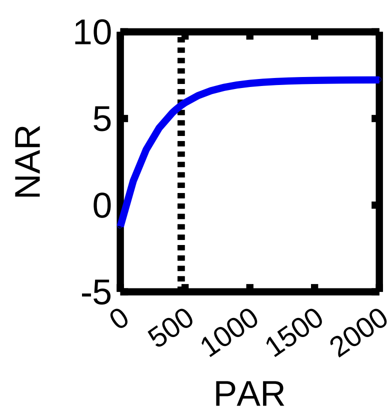
Radiation never drops below compensation point (~50 micromoles m^2/sec) during growing season even at N edge.

9



Light model

Proportion of diffuse light: 50%
Quantum efficiency 400-500 PAR (micromoles m^2/sec).



NOTES

DAY 2

Vancouver Island

SITE #3

Espacement Trials of Western Redcedar and Yellow Cedar

Louise de Montigny

BC Ministry of Forests, Land and Natural Resource Operations

Presenter Biography and Abstract

Biography:

Name: Louise de Montigny
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Position: Research Leader, Silviculture
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Academic training: BSF (UBC), MFS (Yale), PhD (UBC)
Previous employment: Research Branch

Presentation Abstract:

Espacement Trials of Western Redcedar and Yellow Cedar

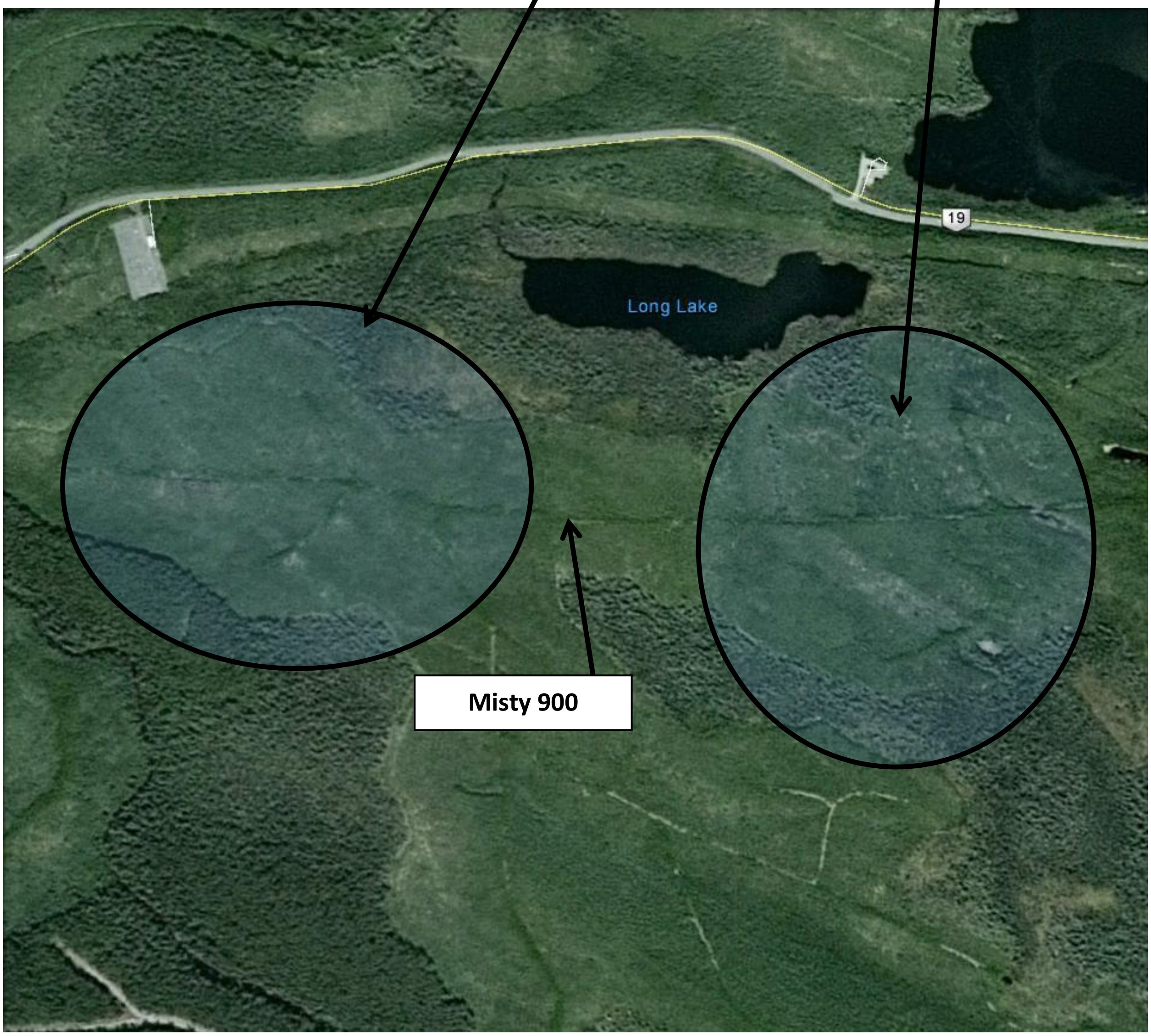
Planting density (espacement) has large potential impacts on the amount, size, and value of timber harvested from managed forests and on biological and technical rotation lengths. The long-term measurement of espacement trials can provide information on optimum plantation management regimes for achieving specific timber yield and product objectives. Experimental project 1206 was established to determine the effects of espacement on the growth and yield of different coastal species including western redcedar.

Two espacement trials planted with western redcedar (both near Port McNeil) were established in 1988 by Western Forest Products. Within each plantation, 6 - 1.2 ha blocks were randomly selected to be planted at densities from 240 to 2990 stems per ha. In 1995, Research Branch established 2 plots in each block of each plantation, plots were thinned to their original densities and all trees in the plots were tagged and measured. Plots were periodically remeasured with the most recent measurement in 2013. The 25 year results are summarized as follows:

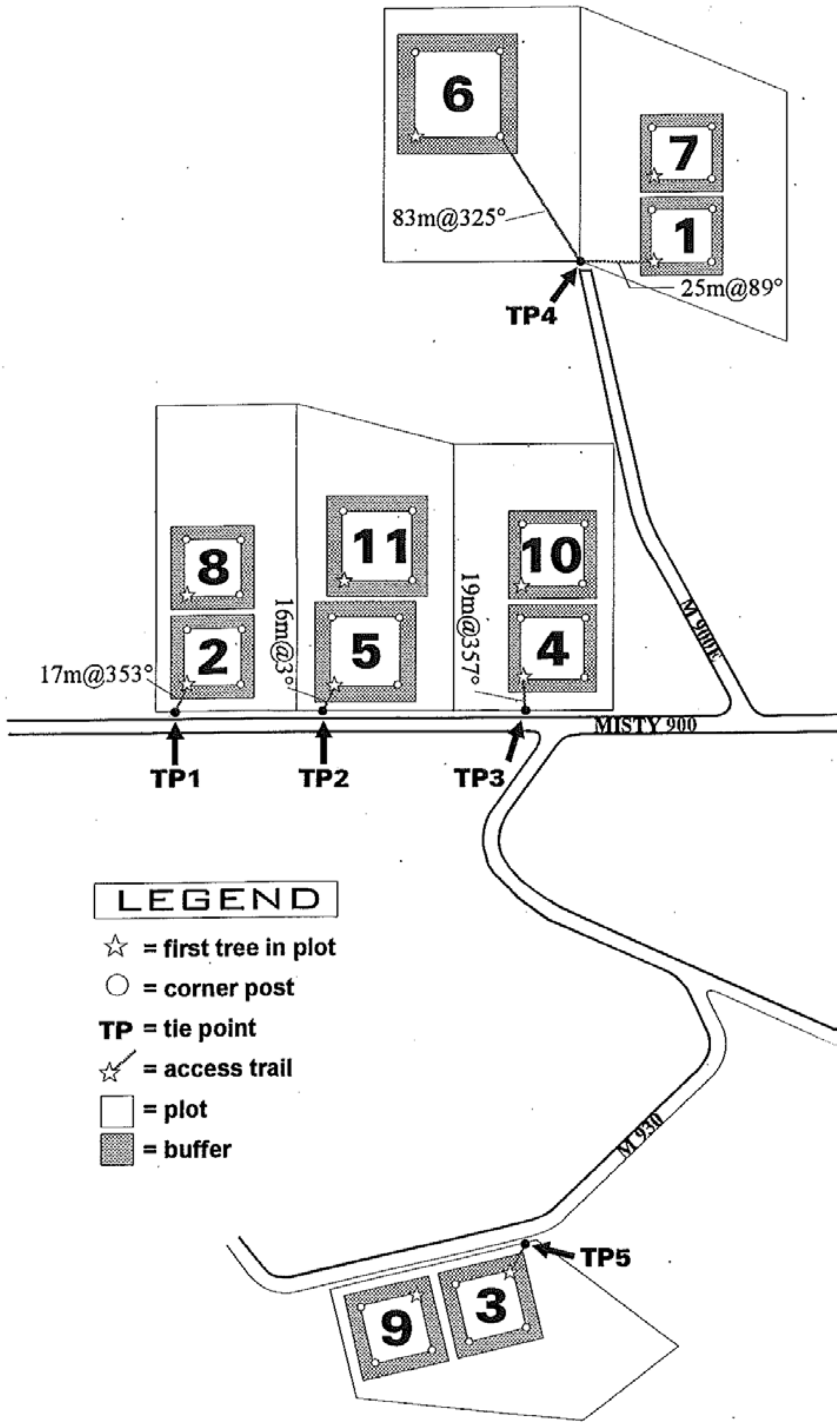
Density (tph)	DBH (cm)	Height (m)	Ht to live crown (m)	Taper (cm/m)	Tree volume (m^3)	Volume per ha (m^3)
240	19.8	10.1	1.1	1.9	0.24	93.5
480	19.2	10.1	1.2	1.8	0.22	105.5
720	16.0	8.9	1.4	1.7	0.17	110.9
1090	13.4	8.8	2.3	1.5	0.10	114.3
1680	11.2	8.0	2.2	1.4	0.07	94.5
2990	8.7	6.9	2.2	1.2	0.04	115.2

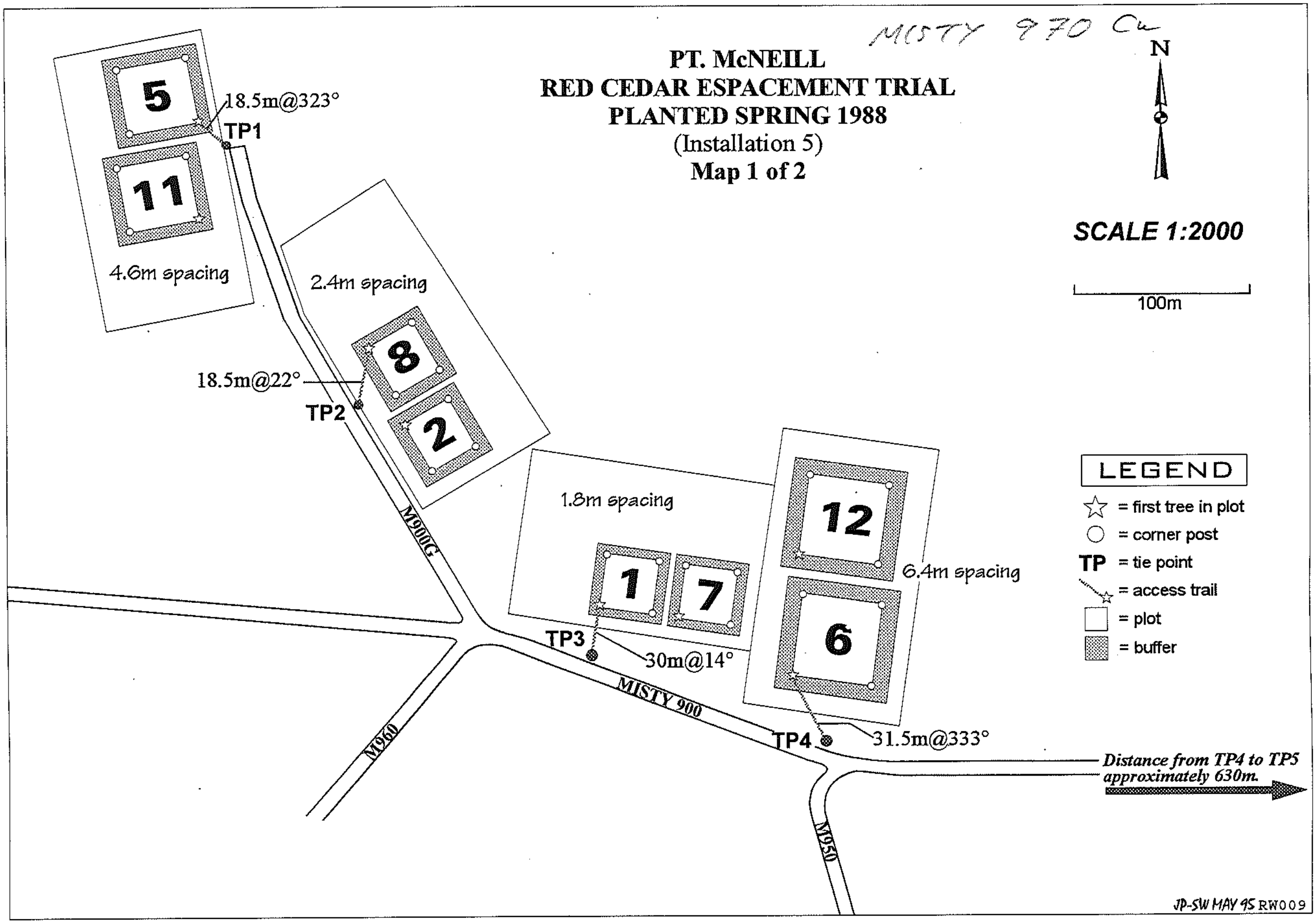
SITE #3

Espacement Trials of Western Red Cedar and Yellow Cedar



PT. McNEILL
YELLOW CEDAR ESPACEMENT TRIAL
PLANTED SPRING 1988
(Installation 6)




MISTY 970 Cu
PT. McNEILL
RED CEDAR ESPACEMENT TRIAL
PLANTED SPRING 1988
(Installation 5)
Map 1 of 2
N
SCALE 1:2000
100m
5
11
4.6m spacing
18.5m@323°
TP1
2.4m spacing
8
2
18.5m@22°
TP2
M900G
1.8m spacing
1
7
TP3
30m@14°
MISTY 900
12
6
6.4m spacing
TP4
31.5m@333°
M960
M950
Distance from TP4 to TP5 approximately 630m.
LEGEND
= first tree in plot
= corner post
TP = tie point
= access trail
= plot
= buffer
JP-SW MAY 95 RW009

EFFECTS OF PLANTING DENSITY ON WESTERN REDCEDAR GROWTH AFTER 25 YEARS

Louise de Montigny, PhD, RPF[1] and Gord Nigh, PhD, RPF[2]
Coastal Silviculture Summer Field Tour
June 10-11, 2015

Introduction

Western redcedar is a shade-tolerant species that can be productively grown in relatively dense even-aged pure stands, even-aged cohorts in mixed-species stands or even aged cohorts in uneven-aged stands (Klinka and Brisco 2009). However, to maximise growth, productivity and wood quality, even-aged pure stands are typically recommended. This is because western redcedar's leader does not maintain epinastic control under open-grown or shaded conditions resulting in undesirable stem properties including large, spreading crowns with long-lived branches, slow crown recession and a tendency for a highly tapered and fluted stems (Oliver et al. 1988).

Espacement trials can provide information on the optimum planting densities for achieving specific timber yield and product objectives. Experimental Project 1206 was established with the objective of determining the effects of espacement on the early growth and stem form of coastal species including western redcedar, yellow cedar, Sitka spruce and amabilis fir. Presented here are the 25 year results for western redcedar.

Methods

Two western redcedar espacement trials (Misty 920 and 970) were planted in 1988 by Western Forest Products. The sites are within the CWHvm1/01 BEC subzone on Duric Humo-ferric Podzols. Within each plantation, 6 - 1.2 ha blocks were randomly selected to be planted at densities of 240, 480, 720, 1090, 1680 and 2990 stems per ha (sph). In 1995, Research Branch of the Ministry of Forests and Range established 2 plots in each block of each plantation, except in the 240 sph treatment at Misty 920 had room for only 1 replication. The plots were thinned to their original densities and all trees in the plots were tagged and measured. The total tree height (m) and diameter at breast height (DBH in cm) were taken on all trees. The following measurements were taken on 42 trees selected across the range of heights:

- diameter (cm) at a height of 15 cm
- height to lowest live branch (cm)
- crown width in the east-west and north-south directions (m).

The plots were initially measured in 1995 and were re-measured in 1997, 1999, 2001, 2005, 2009 and 2013. In 2013, the height to the lowest live branch and the height to the base of the live crown were also measured on all trees.

[1] Silviculture Research Leader, Resource Practices Branch, FLNRO Victoria
[2] Team Lead Strategic Analysis, Forest Analysis and Inventory Branch, FLRNO Victoria

Data Analysis

The average DBH and height were graphed against age. The averages were taken over all the trees and over the largest 100 DBH trees per hectare. We also created histograms of height to the base of the live crown (HLC) and taper (DBH/height) for all trees and the crop trees defined as the 100 largest trees per ha by DBH in 2013. Procedure MIXED in SAS was used to compare the average height, DBH, HLC, and taper using the data collected in 2013. We used an alpha=0.1 instead of the usual 0.05 because some responses were on the cusp of being significant at alpha=0.05.

25 Year Results

DBH

- Mean DBH of all trees by treatment ranged from 8.7 to 19.8 cm, increasing as density decreased (Fig.1).
- Mean DBH of trees in the 240, 480 and 720 sph treatments were significantly larger than those in the 1090, 1680 and 2990 sph treatments.
- Mean DBH of crop trees by treatment ranged from 17.3 to 27.6 (Fig. 2), which is about 10 cm larger than for all trees but there were no significant difference between the treatments at this time.

Height

- The mean height for all trees by treatment ranged from 6.9 to 10.0 m and like DBH, tended to decrease with increasing density (Fig. 2a).
- The average heights of trees in the 240 and 480 sph treatments were significantly greater than those in the 1680 and 2990 sph treatments.
- Height of crop trees by treatment ranged from 10.1 to 11.8 m but there were no significant differences (Fig. 2b).
- The difference in mean height by treatment between all trees and crop trees increased with increasing density (1.7 m difference for the least dense to 3.2 m for the most dense).

Volume

- Mean tree volume ranged from 0.04 to 0.24 m^3 for all trees and 0.15 to 0.42 m^3 for crop trees. In general, tree volume decreased with increasing density but there were no significant differences (Fig. 3).
- Volume per ha for all trees ranged from 94 to 115 m3/ha and there were no significant differences between treatments and no clear trends by density (Fig. 4a).

Height to Live Crown (HLC), Taper and Crown Width

- Mean crown width by treatment ranged from 3.9 to 5.4 m for all trees and 5.3 to 7.0 m for crop trees, decreasing with increasing density (Fig. 5).
- HLC ranged from 1.1 to 2.2 m, increasing with increasing density (Fig. 6a); the 240, 480 and 720 sph treatments had significantly higher HLC than those in the 1090, 1680 and 2990 sph treatments.
- Taper ranged from 1.3 to 1.9 cm/m, increasing with increasing density (Fig. 6b); mean taper in the 240, 480 and 720 sph treatments was significantly greater than in the 1090, 1680 and 2990 sph treatments.

Discussion

After 25 years, western redcedar mean tree height and DBH were smaller with higher planting density. Trees growing at the widest spacings (240 and 480 sph) had 71-126% larger mean DBH and 26-47% larger mean height than in the densest treatments (1680 and 2990). The increase in DBH with decreasing density is expected and widely documented. The increase in height with decreasing density is likely a reflection of the larger number of trees in lower crown classes in the densest treatments rather than a treatment response; density did not affect mean dominant height growth. Individual tree stem volume is not significantly different at this time although wider spacings appear to be leading to larger individual tree sizes. However, the espacement density is significantly affecting redcedar crown and stem form. The least dense treatments have resulted in 30 to 42% wider mean crown widths, 43 - 50% lower mean crown recession and 34 to 53% greater mean taper.

Total volume per ha was not significantly different between treatments. Interestingly, the volume over age curves for the densest treatment appears to be increasing relative to the less dense treatments. Plotting the treatment densities and their current DBH on stand density management diagrams (Farnden, 1996) indicates that at this time, the two densest treatments have likely achieved crown closure and are maximising current annual volume increment (CAI) while other treatments have not. Achieving crown closure at the earliest possible time on these salal sites is important to reduce below-ground competition for nutrients; on CWHvh and vm subzones salal was found to be inversely related to crown cover when the canopy cover was >85% (Klinka et al. 1996).

One of the disadvantages of planting at high densities is the need for thinning to maintain stand productivity. However, a number of studies suggest that higher redcedar plantation density of >1600 sph will allow for unimpeded growth to minimal merchantable diameters (15 cm) allowing for a commercial thinning before the onset of competition with adjacent redcedar (See Klinka and Brisco 2009 for a complete listing of references). In this study, even the densest treatment has reached a DBH of 15 cm making a commercial thinning viable.

These early results show that plantation density affects the early development of western redcedar. The long-term measurement of these espacement trials will determine differences in the yield and quality of wood products at harvest.

Literature Cited

Farnden, C. 1996. Stand density management diagrams for western redcedar. Silviculture Br., B.C. Min. For.

Klinka, K, H.Y.H. Chen, Q. Wang, and L.de Montigny. 1996a. Forest canopies and their influence on understory vegetation in early-seral stands on west Vancouver Island. Northwest Science. 70(3): 193–200

Klinka, K. and D. Brisco. 2009. Silvics and silviculture of coastal western redcedar: a literature review. B.C. Min. For. Range, For. Sci. Prog., Victoria, B.C. Spec. Rep. Ser. 11. www.for.gov.bc.ca/hfd/pubs/Docs/Srs/Srs11.htm

Oliver, C.D., M.N. Nystrom, and D.S. DeBell. 1988. Coastal stand silvicultural potential for western redcedar. In: Western red cedar—does it have a future? N.J. Smith (editor). Conf. proc., Univ. British Columbia, Fac.For., Vancouver, B.C., pp. 39–45.

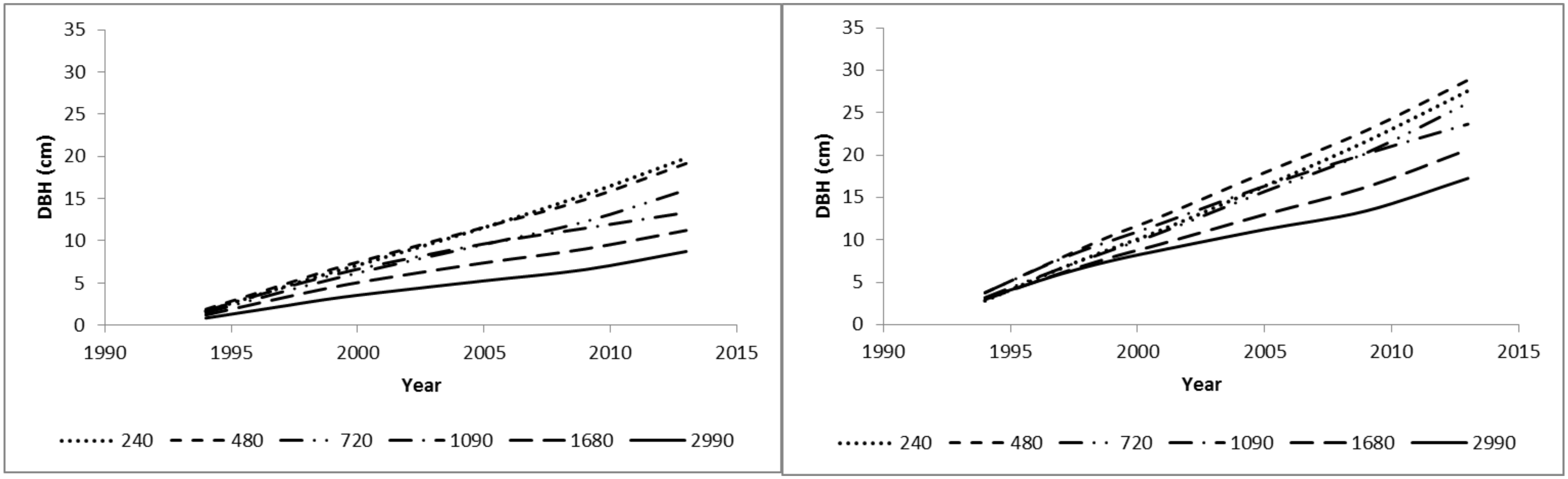


Fig 1. DBH growth of western redcedar by treatment for a) all trees and b) crop trees.

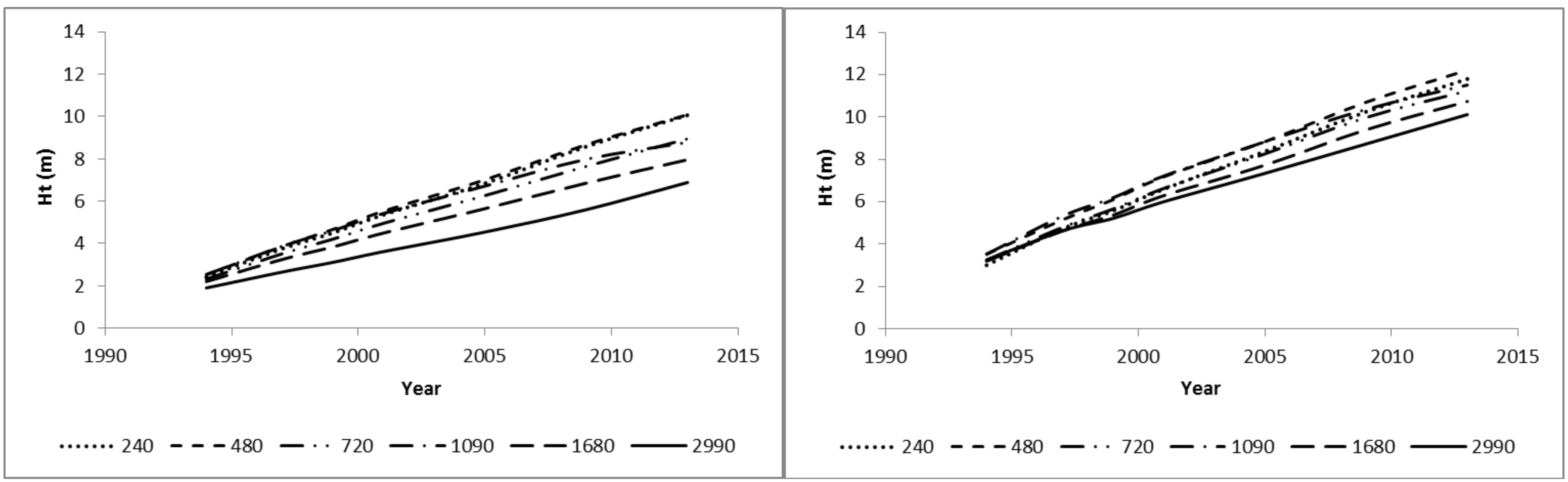
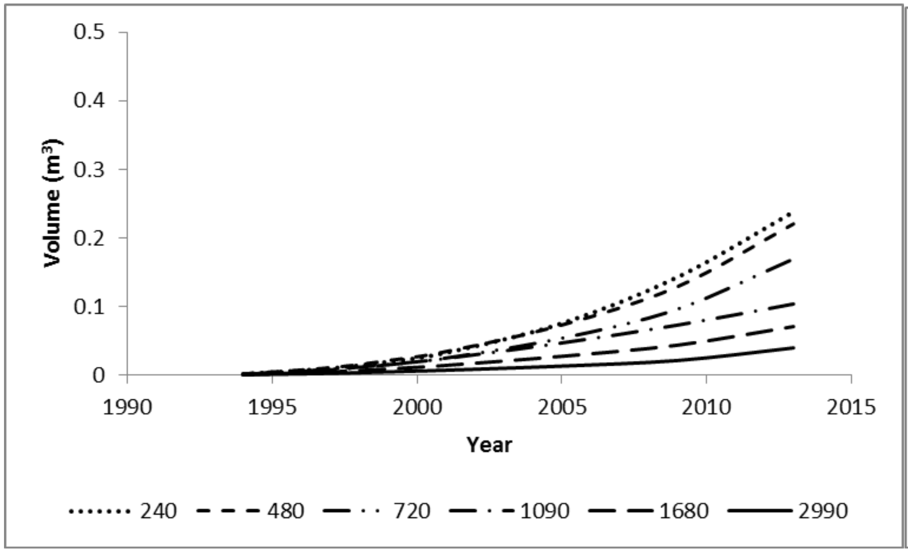


Fig 2. Height growth of western redcedar by treatment for a) all trees and b) crop trees.



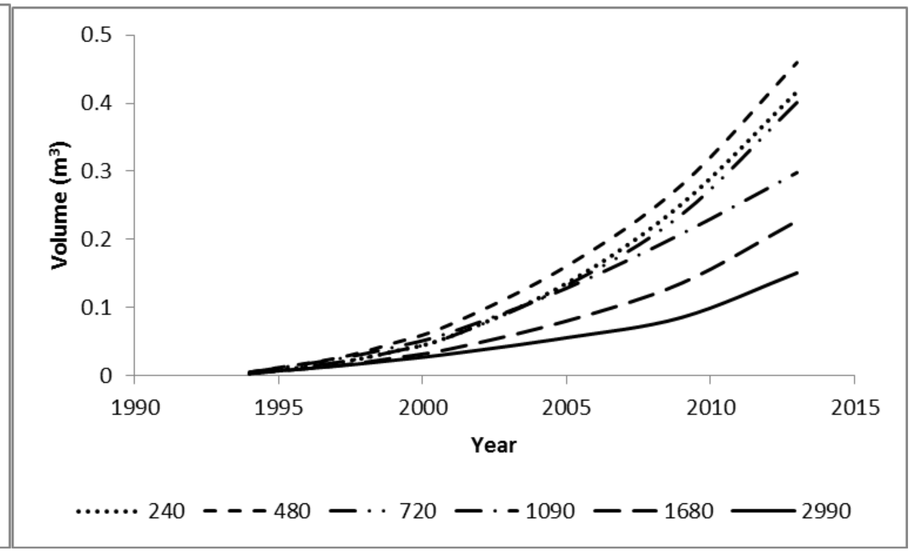


Fig 3. Individual tree volume growth of western redcedar by treatment for a) all trees and b) crop trees.

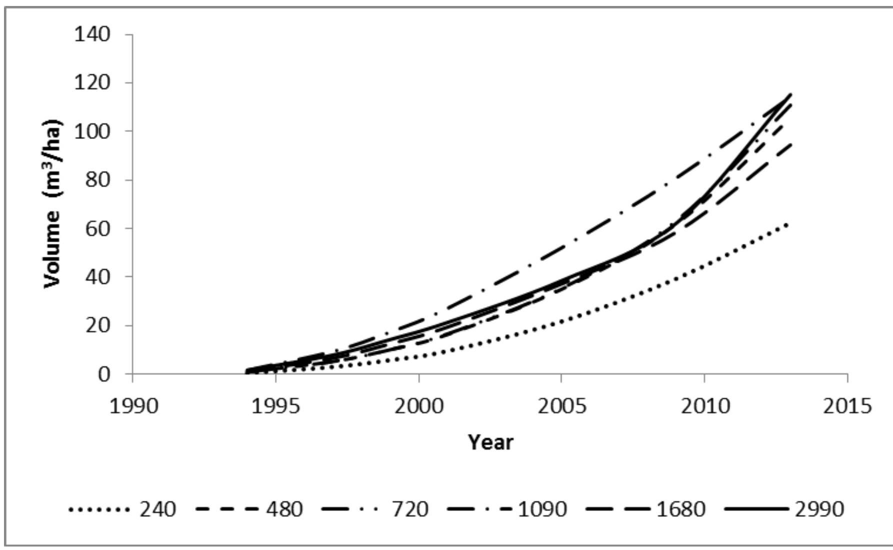


Fig 4. Volume per ha growth of western redcedar by treatment

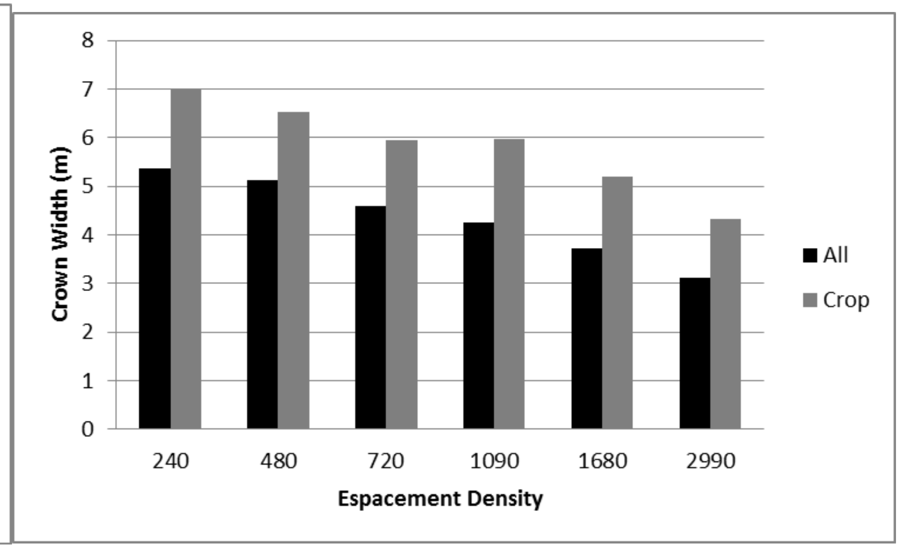


Figure 5. Crown width by treatment for all trees and crop trees

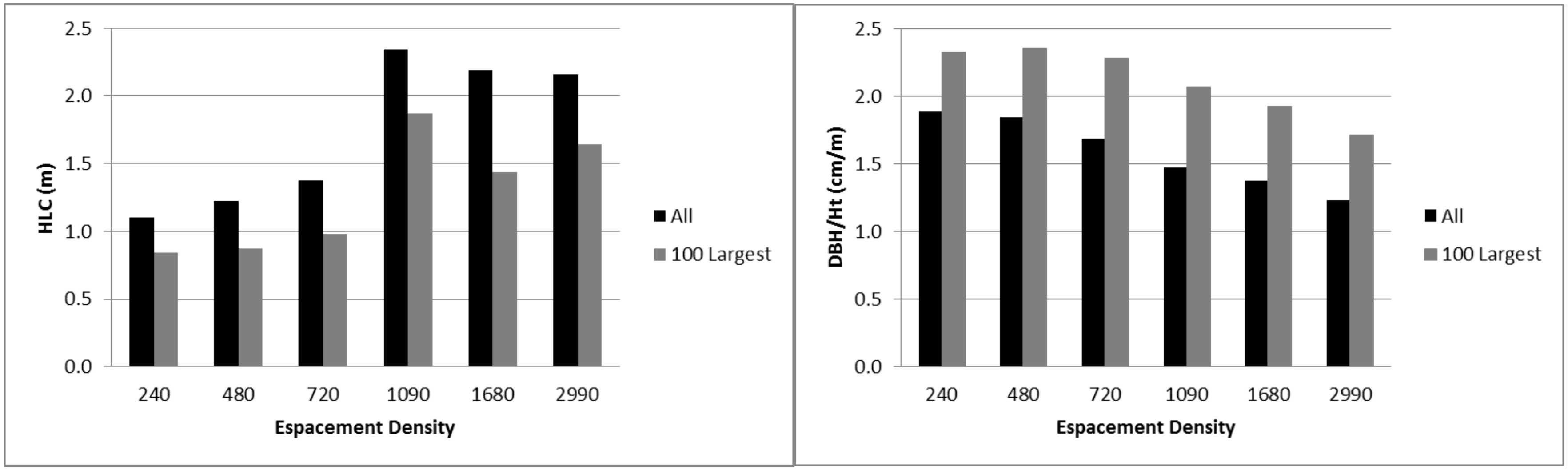


Figure 6a). Western redcedar height to live crown by treatment for all trees and crop trees. b) Taper of western redcedar by treatment for all trees and crop trees.

NOTES

DAY 2

Vancouver Island

SITE #4

Salal Cedar Hemlock Integrated Research Program

(SCHIRP)

Fertilization Trail

Annette Van Niejenhuis
Western Forest products

Rod Negrave
BC Ministry of Forests, Lands
And Natural Resource Operations

Presenter Biography and Abstract

Biography:

Name: Annette van Niejenhuis RPF
Affiliation: Western Forest Products Inc.
Saanich Forestry Centre
Position: Tree Improvement Forester
Responsibilities: Seed Orchard Development, Sowing Requests, Silviculture Research, and Silviculture Investment
Academic training: MScFor, HBScFor (Lakehead U)

Presentation Abstract:

Topic and/or Title: SCHIRP – Salal Cedar Hemlock Integrated Research Program

SCHIRP leads the Coastal Forestry Community with management through understanding, and informs early-rotation fertilization applications of salal-dominated western redcedar and hemlock sites. SCHIRP has led to more effective and efficient use of investments in fertilization applications. This results in increased available volume and value of timber on an ever-shrinking working forest.

Fertilization screening trials demonstrated good response of conifers to fertilization on these sites, leading to the establishment of this trial in 1988. A suite of additional trials have been examined since then. Much is now understood about ecological function. The underlying cause of growth check on these sites is recognized to be aeration and soil moisture status.

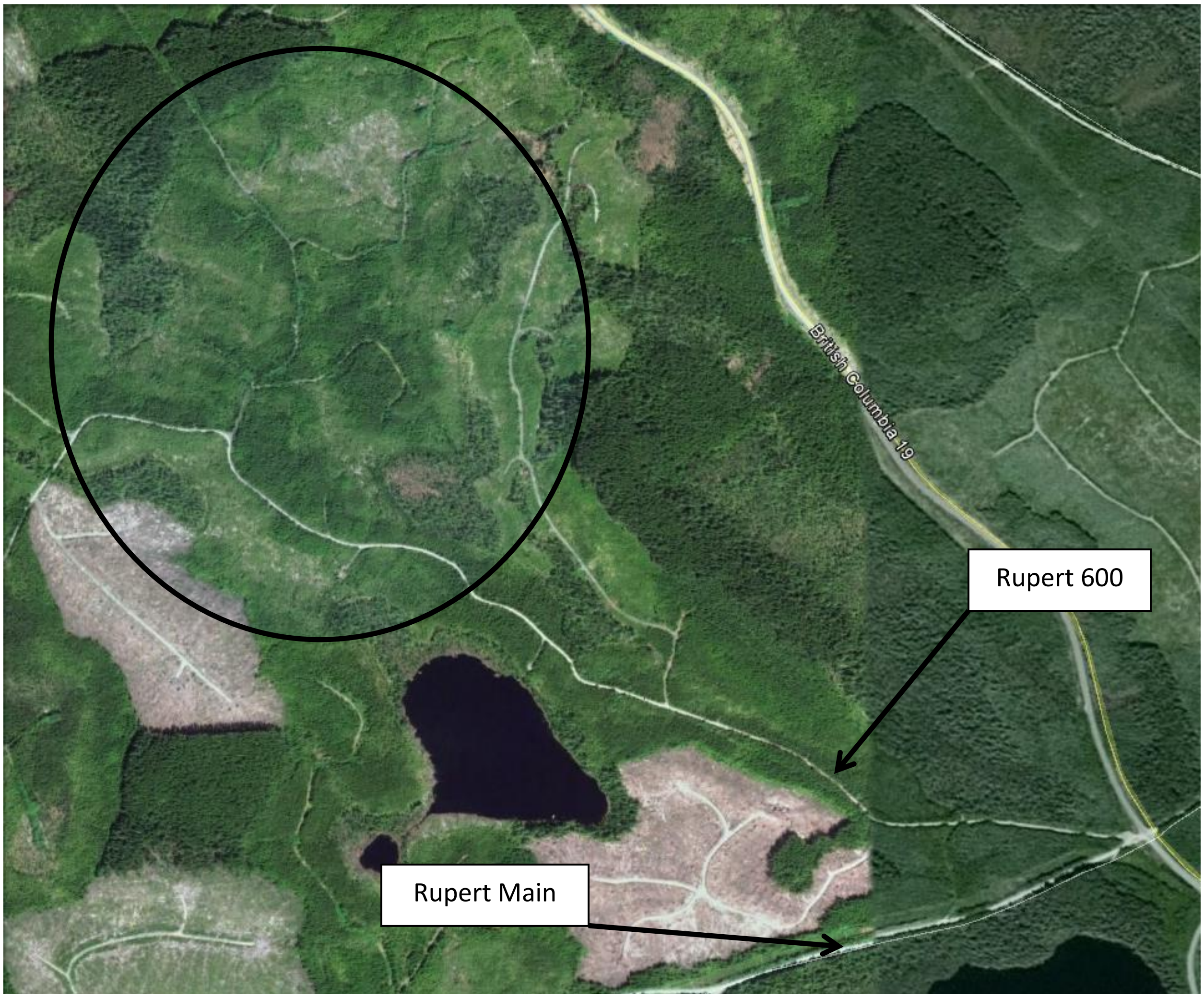
This long-term trial was last measured in 2009, 21 years after establishment. Findings confirmed the response at age 15:

Cw	SI (m)	MAI (m^3/ha)	Hw	SI (m)	MAI (m^3/ha)
CH – Control	22	7.4	CH – Control	17	4.2
CH – Fertilized	30	10.8	CH – Fertilized	31	12.2
HA – Control	26	8.1	HA – Control	31	16
HA – Fertilized	32	15.7	HA – Fertilized	39	26

To date, WFP has implemented broadcast fertilization based on SCHIRP findings on more than 11,000 ha of salal-dominated sapling stands on northern Vancouver Island. Other Licensees have implemented similar fertilizer programs. Investment to date on northern Vancouver Island is projected to yield more than 3 million cubic metres of wood over a 60-year rotation.

http://web.forestry.ubc.ca/schirp/reports.htm

SCHIRP Project Location



SCHIRP INSTALLATION

NOTES

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