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Hello everyone; **thanks** for having me.

Just a couple of **introductory remarks...**



It is becoming a bit of a tradition to invite old, retiring guys to come in and talk to the winter workshop. We had John this morning. Last year it was Rick Monchak with a great big grin, tossing chocolate bars. I'll always remember Graham Hues for his farewell from a couple of years ago.

Somewhere along the way, my hair fell out. My belt got a lot longer. Now it's my turn.

[CLICK SCREEN FOR ANIMATION]

That's a sunset. That's me riding into it. So yes folks, I expect this is my last winter workshop as an employed forester. The horse is headed for the glue factory, and I'm going to be fishing, and watering petunias.



The views and opinions expressed in this presentation are solely those of an old fart and probably do not reflect the viewpoint of my employer, spouse or anyone else that matters. Any action you take, or belief you develop, relying on the information provided is strictly at your own risk and should be personally verified before proceeding.

Silvicultural discretion is advised.

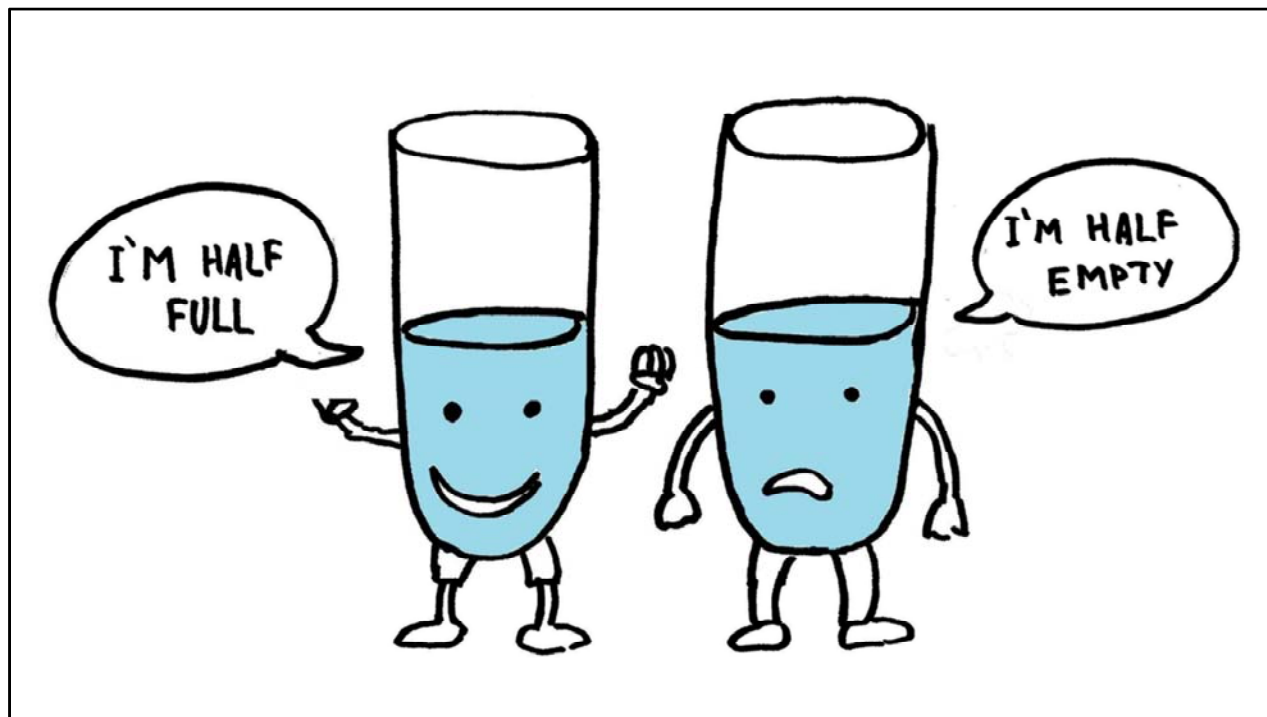
I am known for suggesting the **unconventional**, **speaking my mind** and occasionally using **coarse language**. I'll probably blurt out a few things today that my **employer or somebody else won't agree** with.

successes...



Over 40 years I can say that there is **silvicultural progress**. I'm happy to have been a **part of that**.

- All of us do a great job of **planting** seedlings and getting cutblocks to **free growing**.
- Nurseries have figured out how to produce **consistently great seedlings**.
- Kudo's to the **tree improvement program**.
- **Inventory, growth & yield and stand modeling** have come a long ways.
- Silviculture **safety** is miles ahead of where it was when I started.
- **Technology** is transforming the way we collect and use data.



That said, there is room for improvement. I make **no apologies** for being the **dude on the right**. I do believe the coastal **silviculture glass is half empty** and needing more effort. There's a bunch of stuff I wish I could have **convinced the decision makers** of. I lament that I - and my age cohort - could have done more for future generations.

There's just 'way too many life observations and suggestions to fit into **30 minutes**. My apologies... I'm going to **bounce all over the place**.

If I **accomplish nothing else today**, it is my hope that I get each of you to write down a couple of notes about things that **make you curious**. If you underline just one of those, and **generate an idea that you use to better** silviculture, I'll **then** feel like I accomplished something. If you don't hear anything worth underlining, then have a look at the posted version of this presentation - I'm going to add bonus slides with ideas that wouldn't fit into this 30 minutes.

Me?; I've run **out of career time**. In retrospect, getting the world - and silviculture - to a better place can be a **glacial process**.

My advice to millennials and gen X/Y/Z's: **don't procrastinate** like I did.



Hemlock. I think I drew the short straw... how do you make a talk on "hemlock" **interesting and engaging??**



Experiment!

surnames: “J...” and above

Last year, I thought Rick Monchak did a great job of **getting everyone engaged** by coming up with a quiz, with **Toblerone rewards**. Unfortunately my **pension plan** isn't as good as Ricks', so I can't afford to toss you all chocolates. Besides that, the similarity to the image of Mr. Trump **tossing paper towels** to hurricane victims gave me pause...

Instead, to get into the spirit of the **afternoon theme**, I thought we could try our own little **ad hoc, collaborative and participatory trial**...

Everyone has to **stand up** for a few moments. No groans, **no excuses**; unless you have crutches, a wheelchair or a note from a doctor.

[CLICK FOR ANIMATION]

If the first two letters of your surname begins with **“To” and above**, take a seat. Surnames: U,V,W,X,Y,Z. The rest of you keep standing. Now I'll ask everyone to **look all around the room**. If you're standing, you are my estimate of the proportion of inventory polygons on the BC Coast that have **hemlock present in their inventory label**.

[CLICK FOR ANIMATION] If your surname begins with **“J” and above** now you too may take a seat. Look around again and digest. That's roughly the proportion of productive forest that has a **hemlock leading inventory label**.

OK, you can all sit down. **THANK YOU**

Inventory (THLB)

Polygons with Hw present in the inventory label: 85%

Polygons with Hw > ¼ of inventory label: 64%

Polygons with a hemlock-leading inventory label: 44%

Wet CWH variants (where Hw thrives)

RPFs & RFTs living there: 10%

colleges & universities based there: 0%

coastal FLNRORD offices there: 20%

The point is: there is a hell of a **lot of hemlock** out there. Hemlock has to be **part of “Team Conifer”**. *[Based on WFP TFLs plus TSAs GIS data that was freely available – should be fairly representative of the Coast overall]*

I agree there is **too much** hemlock, and in reforestation we should take every opportunity to **diversify**, where **ecologically feasible**. But even if we’re wildly successful at imposing species shifts, there’s still going to be lots and lots of hemlock out there. We can’t get away from the stuff, so maybe we should **embrace the management of it?**

[CLICK for ANIMATION]

Meet the **coastal “Havacone” family**. Mr. & Mrs. Havacone had the **perfect family**: two kids and a mortgage. What did they name the kids?: “Douglas-the-fir” and “Sarah-the-cedar”. Doug-the-fir is **tall and handsome** and a star player on the basketball team. Sarah-the-cedar is **also attractive**, and a great goalie. You can always count on Sarah-the-cedar to backstop Team Conifer when the offence turns sour. ‘Same for a **sour lumber market**, Sarah-the-cedar will bail you out when times are tough.

So now the **husband, with his irrepressible smile, convinces the Mrs.** to try for just one more. [CLICK for ANIMATION] Surprise! Along come the hemlock twins! Diaper production doubles. The parents are **run off their feet**. There’s no time for anything.

A few years later... one of the hemlock twins opens the **family album**: “Mommy, why are there so many pictures of Doug-the-fir and Sarah-the-cedar?” Even though the hemlock twins make up **half of the children**, they don’t get much attention. The novelty is gone; the grandparents don’t want to babysit anymore. And so the hemlocks are mostly left to themselves, and **under-loved**.

[CLICK ANIMATION for %’s] (This is like the **game show Jeopardy**, where I give you the answer, and you have to guess the question.) Here are some **more percentages** to chew on.

[CLICK ANIMATION for answers] Does where we humans spend **most of our time** create an inherent bias?? For the most part we **don’t like rain**; we don’t live where hemlock thrives; we **don’t learn there**; and we **don’t spend our office days there**. Could it be the hemlocks are **out-of-sight, out-of-mind**?



[8:15]

Do we think climate change will **solve the hemlock issue** for us?

CWHxm will transform itself into CDF. Vm will become xm, mm or dm. We can **grow more Doug-the-fir**.

But at the same time, vm2 will start to look like vm1; part of the MH zone will become vm2.

When we looked at how the **shifting BEC variants** might impact us 50 years out. The analysis suggested that: the most likely climate scenario wouldn't really change the overall **hemlock area frequency** from what we know right now.

Eventually we run out of mountain tops to recruit.But if it gets that bad, isn't it game over anyways?

More percentages (2017)...

Coast Region harvest that was hemlock: 37%

Coast non-WFP harvest that was hemlock: 33%

WFP harvest that was hemlock: 47%

[9:00]

You'll recall that the inventory percentages for hemlock leading and hemlock present ranged from **44 to 85%**.

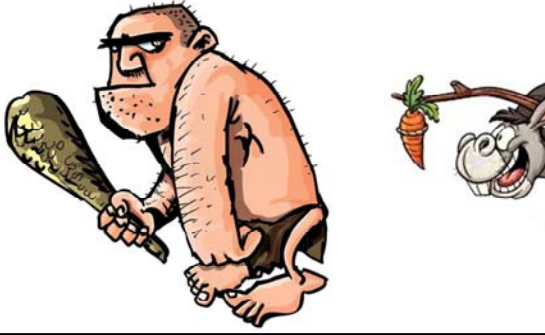
37% is the Jeopardy **game show answer**.

[CLICK ANIMATION for question] "**What is ...the hemlock proportion of the scaled harvest?**" Not quite apples-to-apples I recognize, but doesn't the **disparity between harvest and inventory** suggest that there is an issue with sustainability?

[CLICK ANIMATION for 47% + question]

For your info, Western Forest Products cut **47% hemlock**, and with balsam added, 61% HB. Everyone else combined in the database averaged 33% hemlock. **Why is this?**

licensee behaviour modification



[9:45]

There's possibly **two ways** you could interpret this slide. I've been called a **knuckle-dragging, Neanderthal**, so you could be forgiven if you're thinking this is a licensee forester. As a licensee forest professional, you do find yourself in this **strange place**. Back at the office you have to convince the **bean counter looking for a 20% rate-of-return** and the **logging manager under pressure to save every penny**, that it's good to spend more money on silviculture, which can make you a bit of a **corporate pariah**. But then, when you head up to the Ministry office the next day, you end up lobbying to **prevent proposals** that complicate and increase costs. That can make you seem like the **enemy of sustainability**.

What I really wanted to talk about here is the approach to **getting licensees to do what society wants**. Since collaboration is a theme today, I thought I'd make a pitch to help everyone understand **the licensee brain**.

When I first started in the industry, the foresters were complaining about having to fill out the paperwork necessary to receive **section 88 credits**. This was a direct, **dollar-for-dollar offset** against your stumpage fee for doing silviculture works and growing the AAC. This was a great incentive, and the company foresters tried to **do as much silviculture as they could**. They would routinely prioritize for best return for money spent. Target stocking was the focus. Rarely was there any talk about minimums.

In the harvest profile situation we were just talking about, Western is able to harvest its **hemlock profile**

more sustainably due to “**cutblock blending**”. Stumpage managers can blend low-value hemlock cutblocks with high-value cedar and/or fir cutblocks for an overall **blended average** stumpage rate. That means both stand types get harvested. If you are a big enough licensee that can harvest **multiple cutblocks** at the same time, this is helpful. It’s another example illustrating that an **incentive** can and will **modify licensee behaviour**.

[CLICK FOR ANIMATION] Licensees are businesses and driven by operating margin. If policy initiatives can be **framed with that carrot in mind**, licensees are **capable of good things**.

[<11:00....go]

When it comes to policy clubs such as **partitions, minimum stocking and average stumpage rate**, I have a number of ideas that I don’t have time to go into – check the website.

*[Unfortunately, incentives aren’t the norm and policy initiatives can tend towards the **clubbing approach**. Given the **relentless cost pressures** created by the American lumber lobby, the licensee response to clubbing tends toward finding ways to **mitigate or avoid any new cost** imposed.]*

There are many examples:

- *If you want licensees to cut more hemlock, is a cedar harvest partition really the most effective approach?*
- *What if licensees were rewarded for reaching **target stocking**, instead of penalized for missing w.s. minimum density by a few trees?*
- *Instead of charging an **average rate on every m3**, what if the stumpage rate was applied to individual pieces based on the value of that individual piece? **Marginal pieces of hemlock** might be loaded out instead of being broken and left in the bush as unbillable “breakage”, to avoid the average rate.The coastal pulp mills are screaming for wood. Unfortunately pulp mills struggle to pay equal to or more than the delivery cost of a pulp log, and the latest **American duty** on the pulp sector isn’t going to help that situation. Sorry to say it..., but if you really want that low value wood to leave the woods, you may need to get more creative than tinkering with stumpage. What if there were an **avoided-emissions credit** for getting low value hemlock out of burn piles? That or some other incentive might help.*
- *If an investor is interested in incremental silviculture, why would they invest if most of the incremental value goes to increasing the stumpage payment? Wouldn’t the public be better off incenting the investor by giving ownership of all of the incremental wood value, and reaping the trickle-down benefits of the increased silviculture, harvesting, and processing activities??*
- *IF the next SLA is a **quota system** (as rumoured), there would then be no need for our present stumpage system – maybe there is a chance to start over? What if there was an **export tax** on lumber and log exports? Could the **money collected be used for increased utilization, silviculture** investment and silviculture job generation?]*

Why do we dislike thee so??

- rots easily
- high moisture content
- sinks
- ?



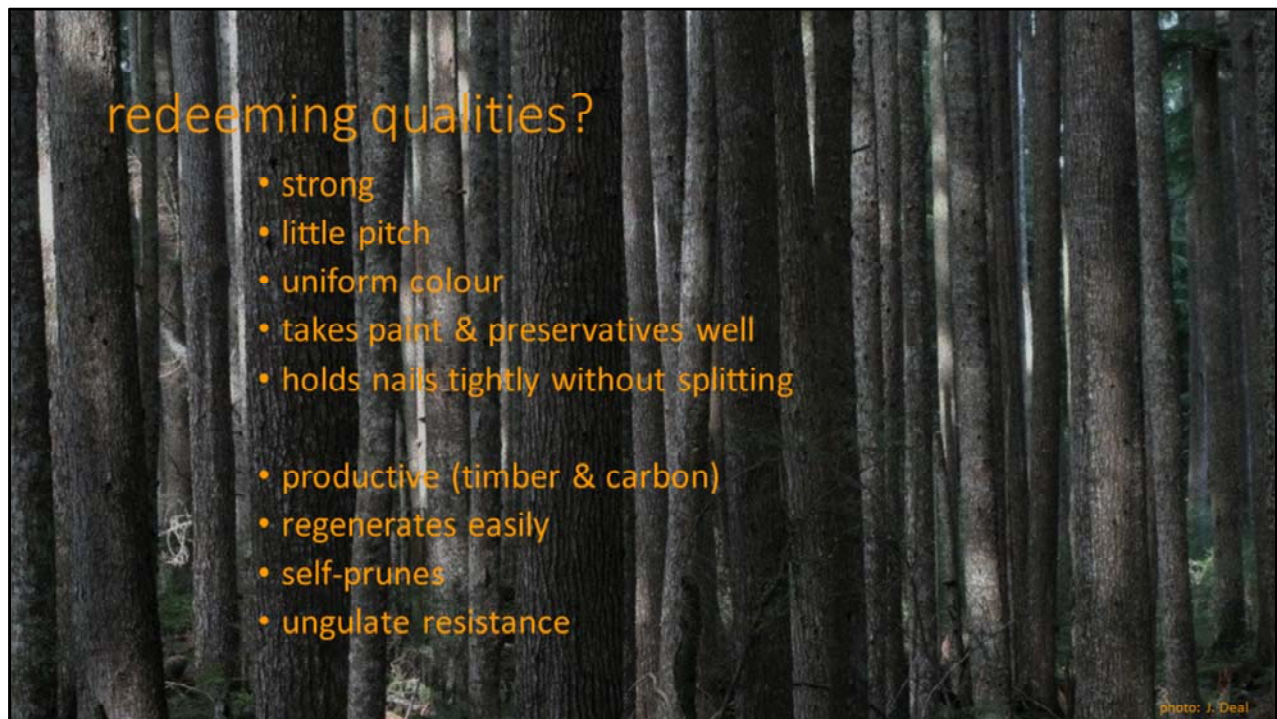
[12:00]

So why this **disdain** for hemlock?

- If you let it get wet in service, it's **not very durable**. But if you keep it dry, it's fine.
- **Kiln drying** lumber takes a fair bit of energy, and it'll **warp** if you don't do it right.
- Transporting that **embodied water** costs money, and log and green lumber loads have to be smaller due to the weight.
- If you are going to move it in a log boom, you have to **bundle to prevent sinkage** losses.
- If you wanted to make **pellets**, you'd have to use a portion of the caloric content to dry the pellets you want to ship.
- If you're a **seedling nursery**, it tangles up coming out of the styroblocks and slows down your grading line.

Folks, none of these issues seem particularly insurmountable!

I don't know... maybe it's just that it makes a **lousy Xmas tree**?



[12:45]

Among the coastal conifers, 2nd growth hemlock is **second only** to Doug-the-fir when it comes to **wood density** and strength. Wes-the-hemlock can pretty much do most things older brother Doug can do.

It's **lack of pitch and uniform, light colour** means it can do some things that other species don't do so well, such as taking paint and preservatives. Long fibres make for strong pulp. It notably **holds nails very tightly** without splitting.

Due to its shade tolerance and relatively narrow crown, western hemlock can **carry a lot of stems** per hectare and thus very **high stand volumes** too. This is of interest from both a **timber** and a **carbon** perspective.

It **regenerates easily** either by planting, or by natural regeneration (more on this later).

It's ability to self-prune means you can get **clear wood** relatively sooner.

Deer and elk might **nibble it, in desperation**, but just like the rest-of-us, ungulates much favour Sarah-the-cedar and Doug-the-fir.



[13:45]

There's **more fungi and bugs** that digest hemlock than I can list.

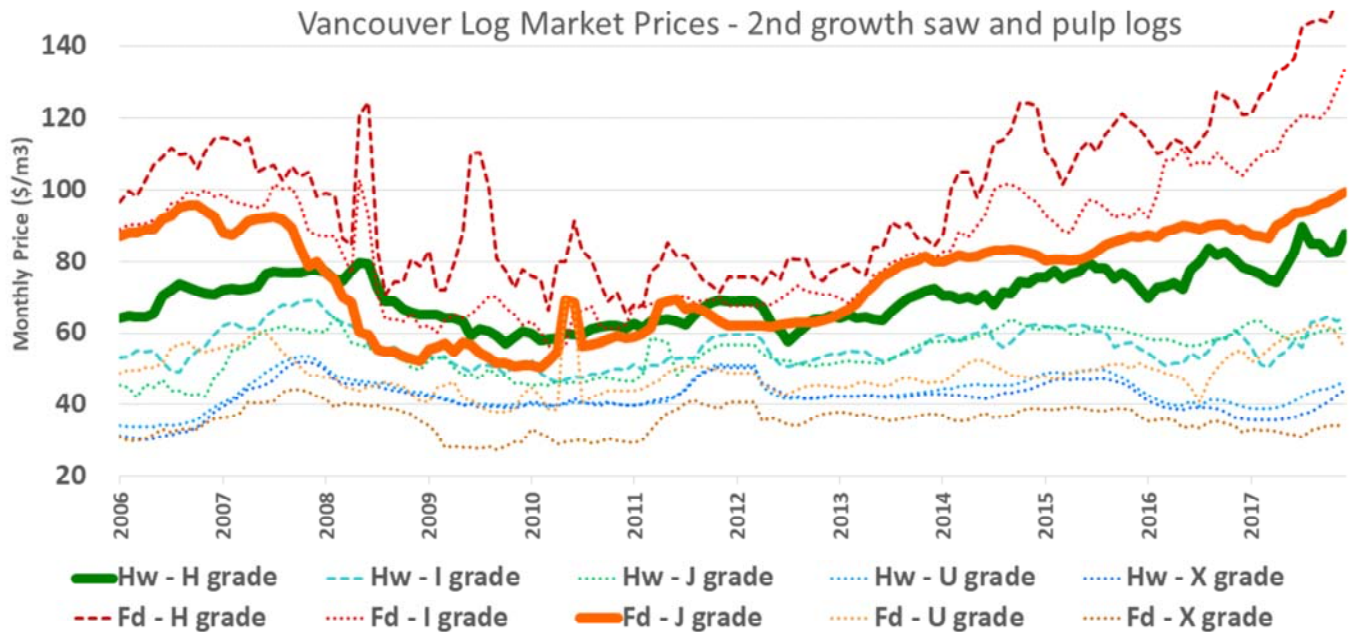
It's vulnerable to **stem rots**. **Commercial thinning** that causes wounds was not one of my better adventures. **Root rot** to me doesn't seem that prevalent in the **wet climates** where moisture stress is low and hemlock grows best.

There are a few **defoliators**. As bad as these cyclical attacks can appear, most of the time, overall stand damage isn't too bad and stands do recover. *[There is one study that predicts looper damage will increase if climate change provides us with more early summer drought stress.]*

In my experience, under even-aged management hemlock **grows so fast** on a decent site that mistletoe is not an issue. If you want to do increasing variable retention, partial cutting or small openings, then you might want to think about it a little harder.

All-in-all, **nobody's perfect**, but 2nd growth hemlock is pretty **darn reliable**. Maybe climate change will pop something on us, but so far so good.

elephant in the room...



[15:00]

The selling **price of a Hw log** sucks. The **thick orange line** is a small Douglas-fir sawlog (J grade; >16 cm); whereas the **thick green line** is a large hemlock sawlog (H grade; >38 cm, small knots). **On average**, a small Douglas-fir log fetches a price in the ballpark of a larger hemlock log. In a **hot market**, a small Douglas-fir sawlog is worth even more.

Only when you get into the **pulp log grades (X)**, is hemlock worth more than Douglas-fir, but there, both are often **below the harvest cost**.

So what is it with hemlock? Just **too much supply**? We need **new, innovative products** to stimulate demand. FPIinnovations' came up with sound fencing, cross-laminated equipment mats for the oil industry, and treated decking, but none have really taken off.

Hemlock lumber goes to China – what do they do with it? It's strong, and holds nails well, ... so instead of building things they make **forms for pouring concrete** into. We still make **squares** for Japan, but their **population is stagnating** and I understand there is less traditional post & beam construction going on. And they're **growing their own** wood.

Hemlock is reasonably **strong**, with **superior nail holding** ability, & it's **cheap & freely available**. Wouldn't those be the ideal characteristics for making Nail-Laminated Timber

(NLT) or other laminated panel products??

On TreeFrog, **wooden skyscrapers** are all the rage. I see the Japanese are planning a **70-storey wood-hybrid** skyscraper. The wood needed is 185,000 m³. 35 wooden skyscrapers per year would eat up our coastal hemlock production. Maybe we should **team up with Ikea** to sell easily-assembled hemlock skyscraper kits, that can be delivered by freighter to anywhere on the Pacific Rim?

war story...



[17:00]

Change gears with a little bit of trivia for you...

If you saw the “**Bomb Girls**” sitcom a few years ago, you’ll know that during WW2, thousands of Canadian women **made munitions** for the war effort.

In **eastern Europe**, Hitler’s army **forced 3 brothers from a lumber family** to flee their homeland. They ended up in BC and one of the brothers **buys a derelict sawmill** for cheap. Nobody wants hemlock logs, so he buys those cheap too. In the 1st known hemlock marketing attempt, and **being a polite European**, he asks the Provincial Chief Forester if it’s **OK to call hemlock “Alaska Pine”**. The Chief Forester says: “If you can sell it to the Brits, you can call it any ****bleep**** thing you want”. His business **expands 10-fold** during the war, by making munitions and ration boxes out of hemlock. The **nail-holding properties** of hemlock were particularly important. Think about slinging bombs and mortars on and off of trucks, trains, and ships and moving them 1000’s of kms. You don’t want your boxes falling apart.

Here’s the trivia stat for you: **of the Commonwealth munitions** produced in Canada, **75% made their way to the front lines in hemlock boxes** manufactured here in BC by the Koerner brothers.

[Long version:]

During WW II, the young men of our country were sent off to war. If you saw the “Bomb Girls” television show a few years back, you’ll know that 1000’s of Canadian women worked in factories making the artillery shells, bombs, cartridges, rifles and all sorts of munitions in support of the war effort.

Back to our coastal conifer family, many of you will know the story about the cousin of the hemlock twins’. Sitka-the-spruce made an important contribution to the war effort by supplying the wood to make light-weight wing spars for Mosquito fighter-bombers. What you may not know, is that hemlock also made an important – but less glamorous – contribution to the war effort. You’ll recall earlier that hemlock holds nails really well, and you could imagine that this had some importance when you were slinging boxes of artillery shells on and off of trains, ships and trucks on their way to the front lines.

A prominent Jewish lumbering family – the Koerners – had to flee their home in eastern Europe ahead of invasion of their country by Adolf Hitler. Most of the brothers settled in BC after Leon Koerner bought a shuttered sawmill in New Westminster. As they had some experience with drying a wet conifer wood back in Europe, and sensing an increase in demand with war imminent, they thought they could make a business out of milling hemlock - which to them was high-quality material. (Even back then, no one liked hemlock.) Being a polite European, Leon asked the then Chief Forester of BC if it would be legal to call it “Alaska Pine” instead of hemlock. The response he got was “If you can sell hemlock to Britain, you can call the stuff any darn name you like”

And so it was the “Alaska Pine Co.” was born. During the war, the Alaska Pine Co increased it’s operations 10-fold by supplying ammunition and ration boxes. According to an article I found, 75% of the wooden crates used by the Commonwealth armed forces in the war effort were manufactured right here in BC by Leon Koerner’s Alaska Pine Co. He did very well for himself in BC, but a sad twist of irony I suppose, given that after the war Leon and his brothers learned that three of his sisters had died in Nazi concentration camps.

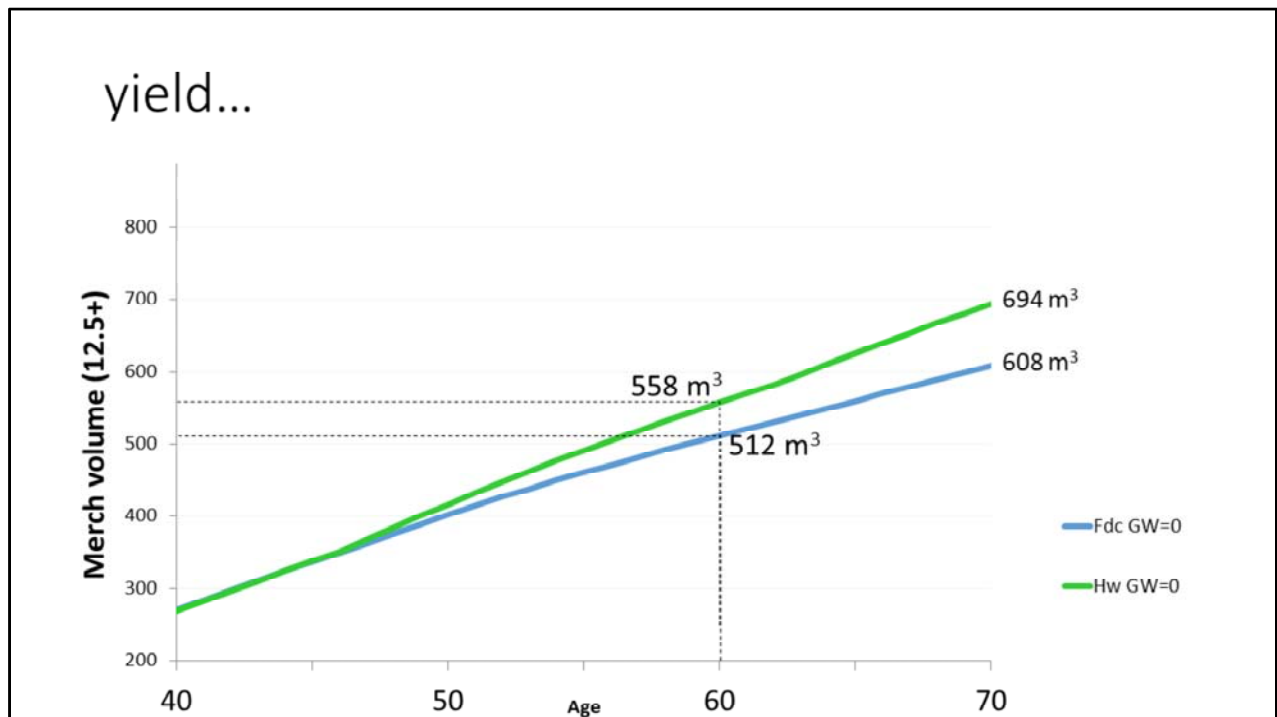
log
exports?



[18:30]

A **touchy subject** in our part of the world...

From a purely-**selfish, silvicultural perspective**, I AM happy to see some land harvested that probably wouldn't be otherwise. And if there's a little more profit margin, because the export price is higher than the domestic price, then maybe there is a little more money to be had for doing hemlock silviculture on that land.



[19:00]

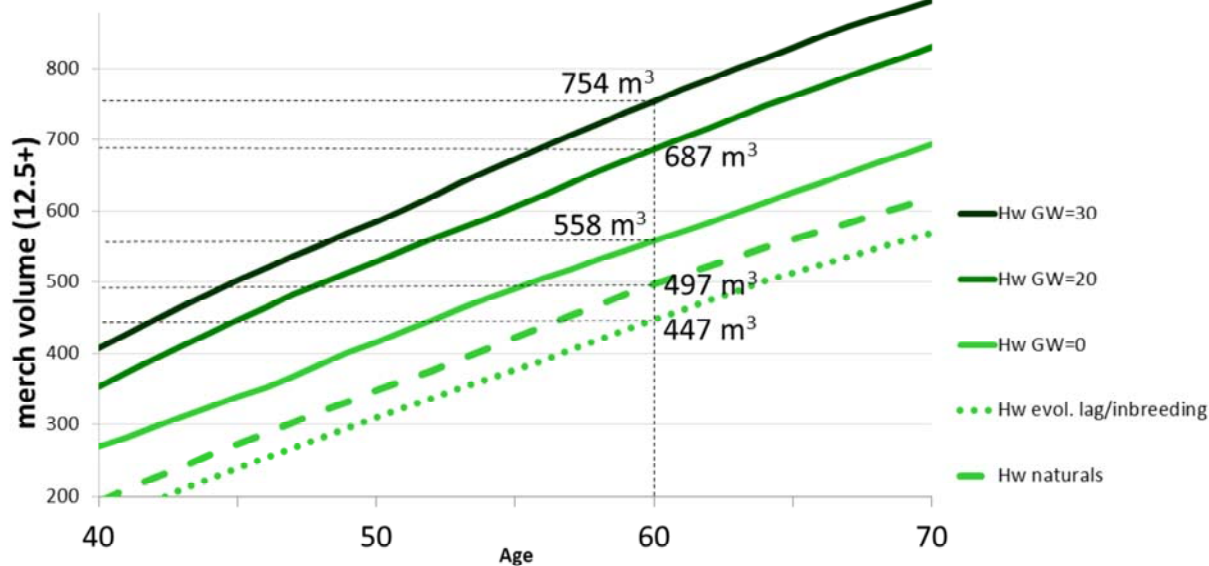
Most of you **already know** this...

Here's the TIPSy **volume-over-age** curve for Doug-the-fir: **SI=30m; Medium site; 1100/ha** planted. I've zoomed into the **40-70 year window** where we'd be most likely to harvest.

[CLICK FOR ANIMATION] Here's the curve for **Western Hemlock**: **SI=26.5m** from **SI conversion equation**.

Wes-the-hemlock can give you a little more volume than Doug-the-fir, which helps to **offset the log price differential** we talked about earlier.

yield...



[19:30]

In the **middle** you have the curve from the previous slide where planted Hw with no genetic gain gives us **558 m³/ha at age 60**.

Compare that to the **dashed line immediately below**. That's TIPSy's version of a naturally regenerated hemlock stand at 5000/ha. You lose almost **two highway truckloads** due to the erratic spacing and regen delay (+4 yrs).

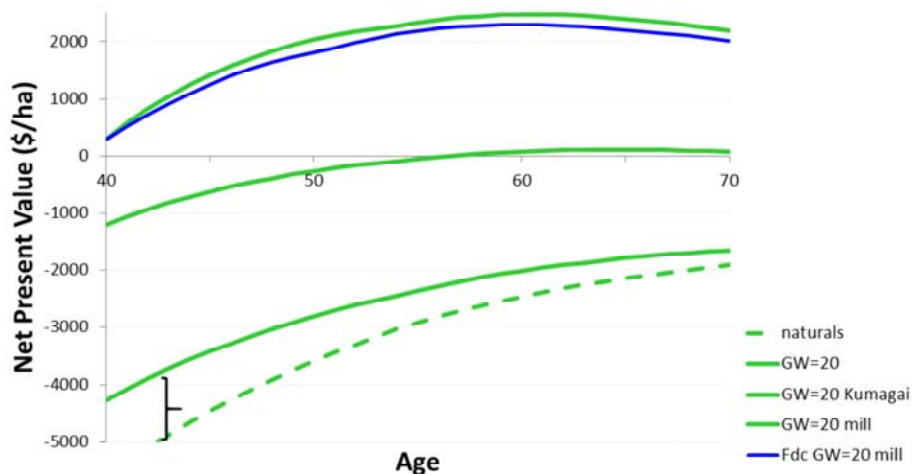
Then there's the **next one down**. If you think about a bunch of **old growth, wind-pollinated hemlocks** happily regenerating in their little valley for a thousand years, you can imagine that there is a lot of **inbreeding**. Given relatively little climate variation over that thousand years, that **local genome** is getting more and **more focused** on that nice **steady historic climate**. When the climate suddenly starts warming, those genes are no longer necessarily best adapted to the new climate. **Provenance trials** tell us this is already happening. For example, in Port McNeill trees from Nitinat grow taller than the local ones. At Nitinat, Washington State trees do the best. Typically, seed sources from further south growing in local trials are today growing **3-5% taller** than the local seed source. I have little idea of how to model what that **impact is - or more importantly what it will soon become**. So just for the sake of argument, I knocked off 50 m³ for the evolutionary lag.

Going the other direction from the 558, planting with seed orchard seed (currently approaching GW 20) you're gaining 129m³ to 687m³.

Right now today, based on these assumptions, a **decision to use natural** regeneration is costing future generations 240 m³, or over a **1/3rd of potential volume**.

Adding to that, we could potentially get up to GW 30 if the breeding program hadn't been **parked**, because the **demand for hemlock seed** has been so low.

economics...



[21:30]

While generating the previous graphs, I got **distracted** by the financial analysis module in TIPSy.

[CLICK FOR ANIMATION] The dashed line is NPV for our **hemlock naturals using default assumptions**. Wow, that's **ugly**. According to this, naturally regenerated hemlock never gets even close to break even.

[CLICK FOR ANIMATION] So I **planted with GW20** seedlings. Even with the cost of planting added in, the better volume and grade distribution you get from planting gives you a better NPV. **Still horribly ugly** though. One thing to note in the bottom left: **the gap between the natural and planted line diverges as the rotation age shortens**. Do you believe the **erosion of the THLB** to non-timber uses is going to continue? If **harvesting will be forced into younger** and younger rotation ages, driven by the ongoing loss of THLB, then it is even more worth it to plant.

Still scratching my head, I know these horrendously negative NPVs **can't be right**. My employer logs 2nd growth hemlock all the time. It must be the assumptions. So I called up Justin Kumagai, an engineer, and asked him to give me some reasonable **2nd growth harvest costs with access roads** already close by.

[CLICK FOR ANIMATION – breakeven] When I plugged those costs in, low and behold the planted line gets **close to breakeven**. That seems closer to reality.

But **not the end** of the story. There's a lot of **dogma** in our industry, and this is one I've been **guilty** of earlier

in the presentation. Hemlock is **wet and it costs a lot to mill and kiln dry** – right? TIPSy includes a place for milling costs and calculates **NPV based on product out turn** instead of log values. So I phoned up some mill managers and asked them: “Hey, **what does it cost you** to mill 2nd growth hemlock?”. “How about Doug-fir?” To my surprise they told me that their milling costs for hemlock, even including the kilns, were **less than for Douglas-fir**. So I plugged in their estimates [CLICK FOR ANIMATION]. Low and behold, hemlock is apparently not such a dog after all.

Just for the hell of it, I plugged in all the same assumptions for **Doug-fir GW20 with the fir milling costs**. [CLICK FOR ANIMATION]. So there you have it, hemlock and fir are about equivalent.

So lots of **assumptions**. **Try it yourself**. I really don’t know. But for me, the **moral of the story** is that there is more to it than just the price difference between 2nd growth hemlock and Douglas-fir logs in the Vancouver Log Market. You have to **also think about yield, harvest cost, milling costs, rotation age**, and probably other stuff. Don’t stereotype poor old hemlock based on what you thought you knew.

fertilization...

“hemlock doesn’t respond”

“hemlock responds only erratically”

TIPSY 4.4 help files:

- “...few hemlock sites (e.g. CWHvm1/Salal/North Island) known to respond...”
- “...field research has shown that western hemlock response is quite inconsistent, i.e., heavily site dependent. For example, young hemlock stands growing on sites not prone to salal in the vicinity of Port McNeill (northern Vancouver Island) respond to applications of N + P. Research plots fertilized at age 0 and again at age 5 produced an extra 18 m3/ha (assuming 1200 planted trees/ha) 10 years after planting.”
- “...very recent and limited data suggest that Sitka may be as responsive as Douglas-fir. Consequently, TIPSY uses the coastal Douglas-fir default” *[and assumes 0 for Hw even though there is 128-plot, replicated trial saying otherwise]*

Salal-Cedar-Hemlock Integrated Research Project (SCHIRP) says:

“hemlock responds fine, and every time”

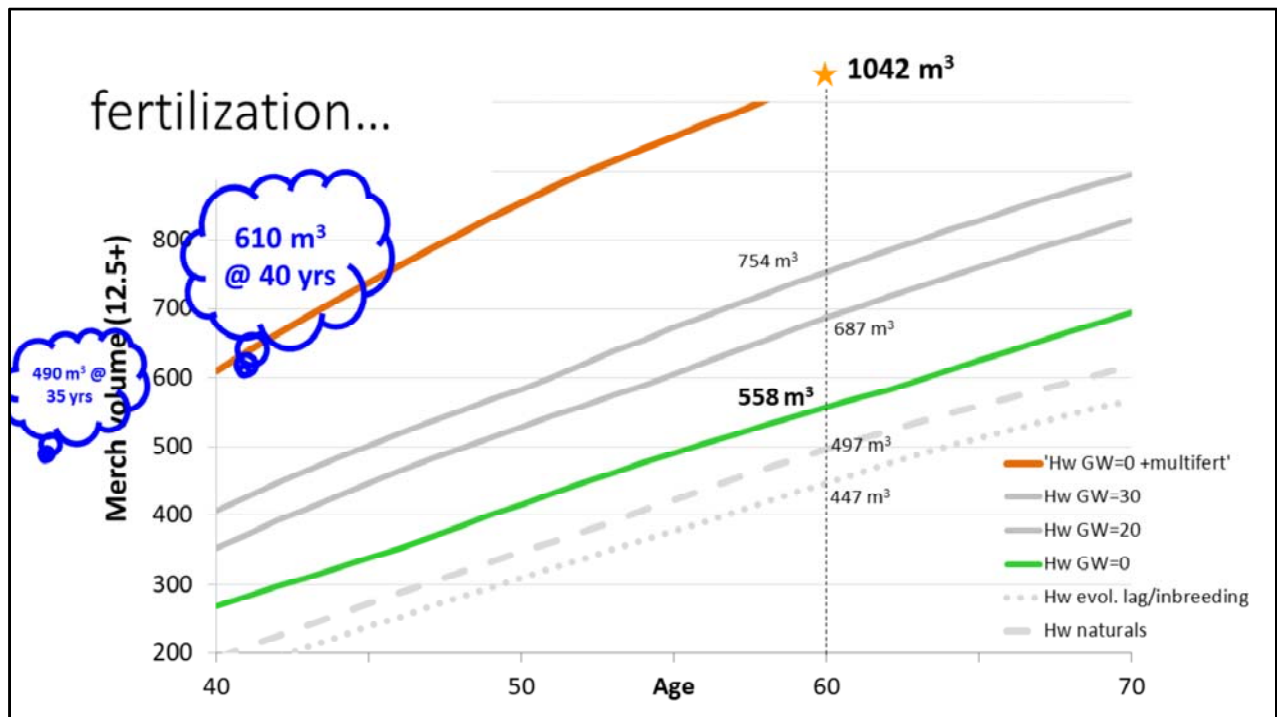
[24:20]

Another case of **dogma**.

The **SCHIRP trial** has been **in the ground 30 years**. There is this persistent myth out there that SCHIRP results **only apply to cedar-salal sites**. In fact, the great surprise that came out of SCHIRP was that hemlock on **ordinary, run-of-the-mill, mesic sites responds** tremendously well, so long as you include a little **phosphorus** in the initial application. Instead, based on **trials done with N-only**, and way back while I was still in forestry school, the dogma that hemlock doesn’t respond persists.

I’ve created **a new dogma** for you to recite: [CLICK FOR ANIMATION]

We need more **science and scientists**... to verify results, seek new insights and more importantly to dispel dogmas. Too often in silviculture, practitioners have snippets of old information that they end up having to embellish with assumptions. And then we wildly extrapolate across long geographic, ecological, climatic and genetic distances. More information please.



[25:20]

The latest SCHIRP **re-measure after 22 years** says fertilization of Hw on mesic vm1 sites at time-of-plant, at age 5, and at age 15 bumps the apparent **site index by 11m** (yes, 11!), and that the response is detectable for years **longer than the response** in Doug-the-fir!

To be conservative, here I **modeled a 10m SI shift** on the planting baseline with GW = 0. That's the **orange line**.

If I added the fertilization response to the GW=30 line it would be **off the screen to 1340** cubic metres, but I don't know how to **model the fert + GW interaction**. Suffice it to say, it seems conceivable and conservative that we **could top 1100 m3/ha** and **exceed the natural regen baseline by a factor of 2.5X**. Although I haven't done it, this suggests that even if you **"hydroponically"** re-applied fertilizer as necessary to maintain the growth response, the economics would be favourable. Tonnes and tonnes of **CO2 equivalent too**. **Bigger logs** means **better selling prices** and more **carbon sequestered**: isn't this a win-win scenario?

[CLICK ANIMATION] Of course, maybe you **don't want to wait** 60 years...you could have a shorter rotation too.

planting...



[26:45]

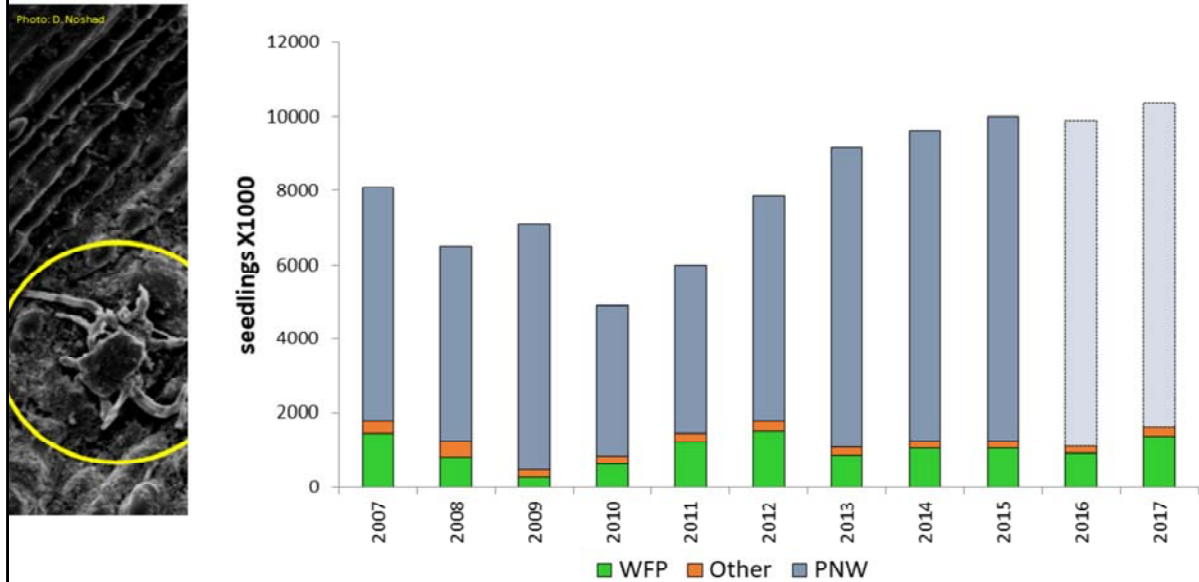
So what's been going on **on the ground**? 20 years ago we were planting **5 million** hemlocks per year. It has been declining ever since.

[CLICK ANIMATION]

For the last decade we've settled into **1 to 1.5 million** per year. And my employer has been doing about **85% of that**.

Why are the **orange bars so small**? Are the orange guys not harvesting hemlock ground? Are they logging hemlock ground, but planting alternate species? Are they relying on natural regen? ...don't know.

a pest impacts planting...



[27:15]

There is a **pest that impacts planting programs in this part of North America.**

This is an electron micrograph of **Swiss Needle Cast clogging** the stomata on the underbelly of a Douglas-fir needle.

So what's this got to do with hemlock, you may ask?

[CLICK FOR ANIMATION]

Here are the planting numbers for western **hemlock in the US PNW**, with the BC **Coast numbers overlain** at the bottom. The Americans are having to shift many of their Doug-the-fir stands to hemlock because Swiss Needle Cast is becoming so severe. The **changing climate projections** suggest that here in BC we are going to have similar problems in our west side, maritime climates.

If that premonition comes true, **Wes-the-hemlock will be a lot more likeable.**

too much stocking...

- site preparation
 - burning
 - chemical
- genetics
- stock size?
- individual tree fertilization
- juvenile spacing



[28:00]

There is one thing we **have to figure out**. Earlier I had listed “easy regeneration” as an advantage. But really, hemlock’s tendency towards **prolific advance natural regeneration** might be an **Achilles heel**. Often a hemlock clearcut has an abundance of advance natural regeneration and a substantial deposit of recent seed that threatens to **overwhelm your planting** efforts.

How are we going to ensure those **improved seedlings that we plant** will grow up into a **well-spaced stand** with **good crown development** to accept the **multiple fertilization treatments** we want to undertake?

[28:40]

I think there are lots of options. But I’m behind so you’ll have to check the website for details....

- *In my years, **broadcast burning** followed by planting is the best hemlock stocking control I’ve ever seen. Such stands are a silvicultural dream. Natural infill is years behind and will never amount to much. Broadcast burns (the intentional ones at least) have disappeared on the Coast due to **smaller opening sizes**, more **wildlife and riparian reserves**, and **public backlash** against smoke. There is a glimmer of hope - if the public can come around to the idea of prescribed fire for its abatement benefits.*
- *I understand that in the US, it’s not uncommon to use **aerially-applied chemicals** to do site prep. Having some experience with glyphosate oversprays, I can tell you first hand that glyphosate will knock back*

advance hemlock regen pretty well. The PR aspect is another story.

- What about the genetics? If you **promptly planted that GW30 seedling** that Charlie Cartwright is going to breed for us **before he retires**, would it accelerate away from those advanced naturals? I've heard of some anecdotal evidence, but that's an adhoc trial I never got to do. I hope someone will plan to **do that trial**, and communicate the results.
- How about if we plant **larger stock** and/or **fertilize** at-time-of-plant? How about if we did crop tree fertilization **at age 4 with a soup can**? Add that on to the **ad hoc trial** list.
- We old guys all learned in a previous century that **juvenile spacing is a waste** of money and that the "**chainsaw effect**" can reduce yields. By the time the money was running out, personally I had figured out that **10 to 12 years was the optimum** time for hemlock spacing. If you could leave the **tallest trees**, cut **stumps low** and not get too excited about **inter-tree distance** and **whips**, the cost was almost reasonable. Those stands looked great once the canopy closed. Is the "**JS is bad**" mantra going to be another **50-year dogma**?]

silviculture stumpage allowance...

- poor markets
- average rate vs actual
- role of BCTS professionals
- allowance \neq credit/re-imbursement
- silviculture disincentive

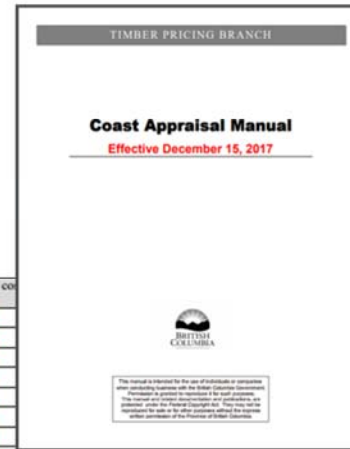
5.1 Tenure Obligation Adjustment

1. Except where a cutting authority area is the area authorized for harvest under a timber sale licence entered into under Section 20 of the Act and subject to subsection 2 of this section, the kinds of costs that may be used in the calculation of a tenure obligation adjustment in the appraisal or reappraisal of a cutting authority area are:

- the forest planning and administration costs,
- the road development costs,
- the road management costs,
- the road use charges,
- the basic silviculture costs, and
- the low volume cost.

Table 5-5: Basic Silviculture Cost

Where the cutting authority area is located in:	The basic silviculture cost expressed in \$/m ³ is:
Campbell River Forest District	3.18
Chilliwack Forest District	5.02
Coast Mountain (North Coast) Forest District	10.64
Haida Gwaii Forest District	5.11
North Island - Central Coast Forest District	3.01
Sea to Sky (Squamish) Forest District	6.05
South Island Forest District	3.43
Sunshine Coast Forest District	3.95



[30:30]

In 2004, the BC stumpage **system was renovated** and replaced with a Market Pricing System (**MPS**), to **appease** the US lumber lobby.

*[This involved **expropriation** of timber tenures from licensees to set up BCTS and **timber auctions to benchmark licensee stumpage** rates. Expropriation and its impact on tenure security and investment is another story. See the **bonus slide** for some thoughts on that.]*

To replace the old stumpage offset for silviculture expenditures, under MPS today you get a **silviculture allowance** that **reduces your indicated stumpage rate** per m3 harvested.

- If the **indicated stumpage rate is low** (often the case with hemlock), then the stumpage allowance can't help - the stumpage rate isn't allowed to go below 25 cents per m3, no matter how big the allowance is.
- The allowance is a **District-wide average**, so if you are the unlucky licensee with very brushy sites, your costs could be higher than the allowance. If you rely on **natural regen**, your costs are lower than the average. You get to pocket the difference.
- **Initially**, the District average had been based on an **annual survey of actual licensee costs**, so if you were an "average operator" in a good market you were alright.

In theory, this allowance idea **sounds like** more or less the same thing as an offset or a credit. At the start, licensees may have actually thought of it that way, but today we know it's not.

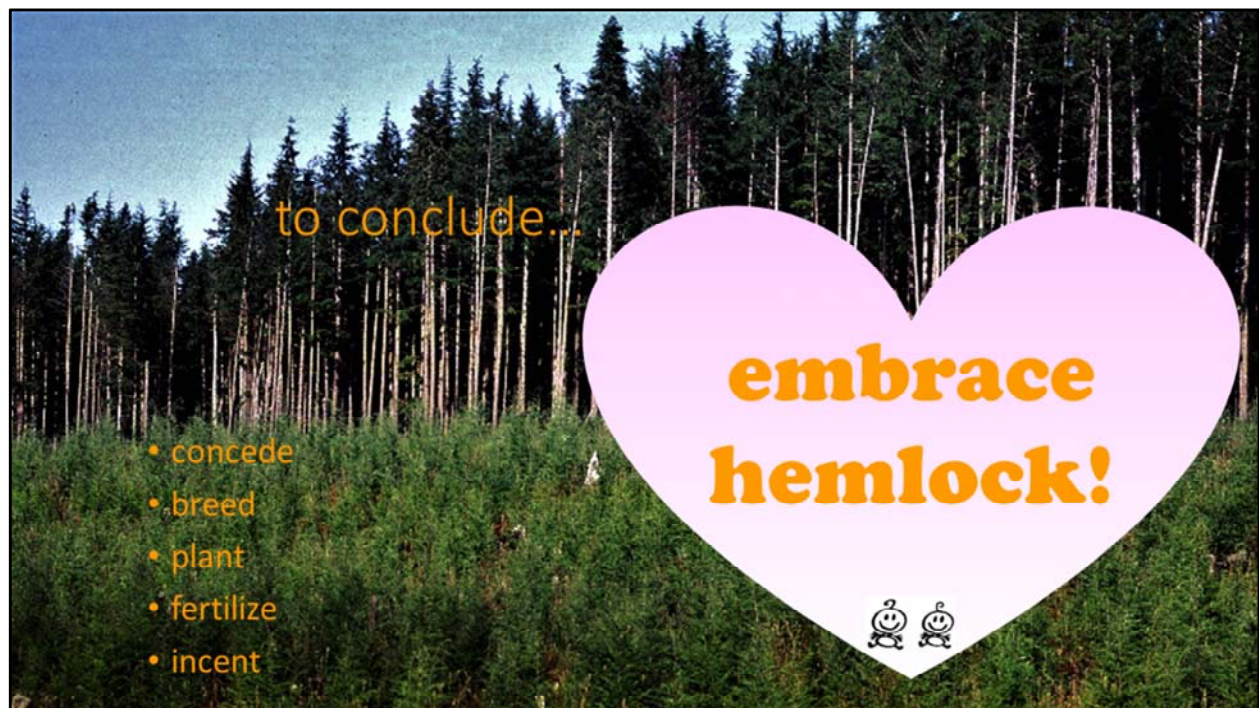
Over time, as the **cost pressures** continued to build and then the **great recession** hit, the more efficient licensees realized that if they could get to **free growing for less** than the District average allowance, that difference was in effect a **bonus to add on top** of their logging margin. And so begins the **race to the bottom**. Licensee A cuts silviculture costs, and that lowers the District average. Licensee B then realizes her costs are higher than average, and cuts costs in response. The average goes lower again. On and on it goes.

More recently, coastal licensees convinced government that the basic silviculture rate should be **based on BCTS average silviculture costs only**, instead of licensee costs. This puts BCTS forest professionals in the

position of in effect **defining the expected level of spending** and the **expected standard of silviculture** for the licensees. I believe the Coast industry lobbied for this because they believed BCTS average silviculture costs were higher than their own. This would provide a stumpage buffer to help offset the other cost pressures coming at them. So **instead of setting the standard, BCTS professionals in effect establish the profitability bar**. Licensees then crank up the **Caribbean music** and practise “the limbo” to keep themselves below the bar.

Now I wonder.... Will BCTS be under pressure to match licensee costs, which would further fuel the downward spiral? In any case, the **system is just plain dumb**. It **incentivizes licensees** (and maybe BCTS too?) **to spend less** and less and less.

And before anybody races out the door to grab the **legislative club**, think about what I said back at the **caveman slide**. Look for ways to reward each licensee in proportion to the amount of silviculture they actually do. Make it more **profitable to do silviculture well**, and to do **more of it**!



[34:10]

Concede to the hemlock; it's not going away.

Breed the hemlock. It dramatically improves productivity and buffers against climate change. But **catch 22** – if you don't plant it, they don't breed it.

Plant the hemlock. You need to plant to deploy the breeding benefits, to control stocking and set the stage for fertilization. **Hashtag:** #NO-NATS-ALLOWED!

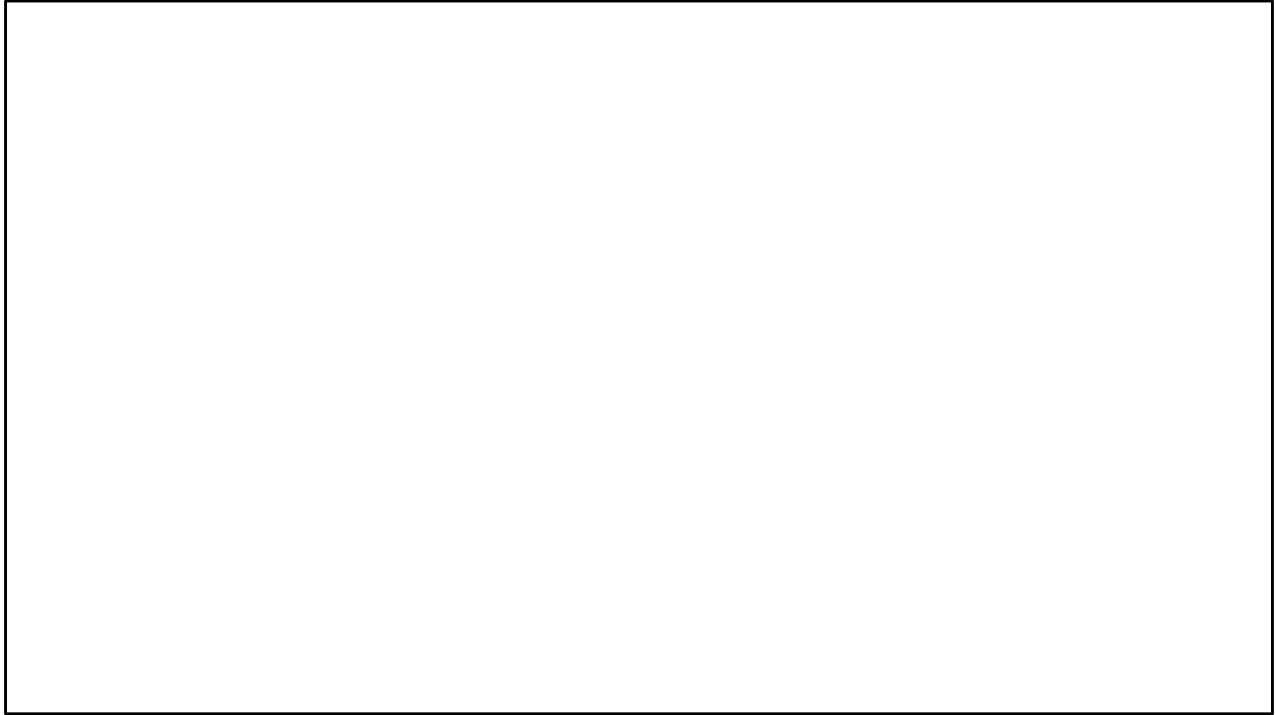
Dump the dogma, get stocking under control and fertilize the hemlock – once, twice, thrice and you've got yourself a rotation.

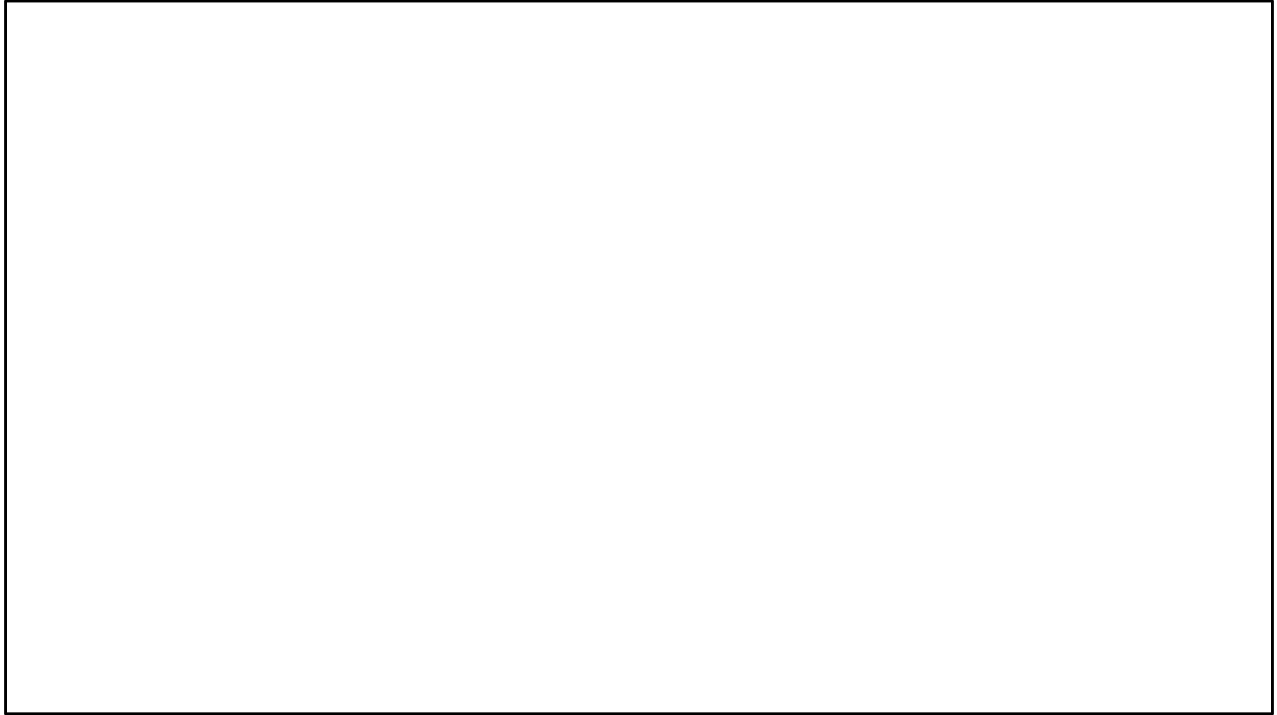
Enable and incent licensees to do the right thing. Start by replacing the stumpage allowance!

LOVE the hemlock twins, they're part of the coastal conifer team too.

[CLICK ANIMATION]

Go **hug** a hemlock... then **log it** and **re-plant**.





Bonus Slides

Hw mixtures...

- With Cw
 - Avoid medium or better sites (Hw will dominate)
 - Beware fertilization plans (Hw may dominate)
 - Avoid salal sites (Cw will dominate)
 - May need fertilizer to keep Hw meaningfully in the mix
- With Fdc
 - Seems to work in CWHvm1
 - Inadequacy of TIPSy/TASS modeling of tolerant/intolerant species interactions
- With Ba
 - Occurs naturally
 - Market value even lower
- With spruce
 - Occurs naturally
 - Medium or better sites
 - Use Hw to manage spruce knot size

stem fluting...

- better sites more susceptible?
- larger branch senescence/death
 - stocking density to manage branch diameter?
- https://www.fs.usda.gov/detail/r10/communityforests/?cid=fsbdev2_038418

Silviculture funding options....

Re-imburement concepts

1. Re-imburement = costs (breakeven)
 - Mostly a non-financial incentive
 - Improved future timber supply/value
 - Social licence (silviculture jobs, bureaucratic favour)
 - Added financial value difficult to demonstrate
 - future incremental revenues heavily discounted
 - tenure insecurity
 - social licence may not be highly valued (until it is lost!)
2. Re-imburement > costs (profitable)
 - Appeals to corporate ganglia
 - Non-financial incentives above still apply

Silviculture funding options....

Re-imbursement activities included:

- Basic only?
 - planting
 - brushing
 - surveys
- Basic + Incremental
 - Site preparation (+abatement)
 - ATOP fertilization
 - Individual tree fertilization (3-5 yrs)
 - Broadcast fertilization after FG
 - Stocking control, pruning

Silviculture funding options....

Re-imbursement mechanisms:

- Cost only re-imbursement for bare bones silviculture
- Accelerating re-imbursement for above & beyond silviculture
 - Silviculture becomes increasingly profitable, the more you do
 - Licensee has to do great silviculture to be financially rewarded

Silviculture funding options....

Re-imbursement classes:

- Direct – government writes a cheque to proponent. Could be to:
 - Large TFL holder undertaking work
 - Silviculture consultant/contractor acting for small tenure holders (and BCTS?)
 - Financial incentive requires profit & risk be built in
- Indirect
 - Stumpage
 - Allowance doesn't work!!!!
 - Silvicultural disincentive and race-to-bottom
 - Problems with average rates vs geographically variable actual costs
 - Offset/credit against current stumpage bill
 - Works when markets buoyant
 - Doesn't work for negative indicated stumpage rates
 - Poor markets
 - Low value stands
 - Doesn't work if high proportion of low value (low stumpage) stands
 - Credit banking
 - Deploy offsets/credits when markets/stumpage are higher
 - Accumulate credits during poor markets/low stumpage times

Stumpage can't fund everything

- Not a cash cow
 - Market fluctuations mean erratic funding
 - silviculture programs – need to follow medium to long term plan
 - efficient deployment
 - optimum response
 - Not enough \$ to service all of the desired ecological services
 - Silviculture
 - Wildlife inventories
 - Carbon sequestration
 - Biomass subsidy
 - Ecological restoration
 - Etc.
 - Need alternate funding sources

Silviculture funding options....

Re-imbursement classes (cont'd):

- Direct – government writes a cheque to proponent.
- Indirect
 - Stumpage
 - Tax and tenure levy breaks
 - Based on quality of silviculture
 - Indicator basis. E.g.:
 - Average stocking as % of target stocking
 - Average % of improved seed deployed
 - Average years to height benchmark
 - Fertilization % of potential
 - Promotes both high deployment + implementation efficiency
 - Treatment area basis – ha by treatment
- Could apply to other Ecosystem Services
 - Hazard abatement
 - Wildlife habitat protection/enhancement
 - Carbon sequestration
 - Avoided greenhouse gas emissions

Silviculture funding options....

Re-imbursement classes (cont'd):

- Direct – government writes a cheque to proponent.
- Indirect
 - Stumpage
 - Tax and tenure levy breaks
 - Tenure security?
 - Licensee contributes silviculture \$ (see P3 elsewhere)
 - government contractually obligates itself to fairly compensate (private investment + interest) for future timber expropriations (a poison pill of sorts to reduce frivolous expropriations)

Silviculture funding options....

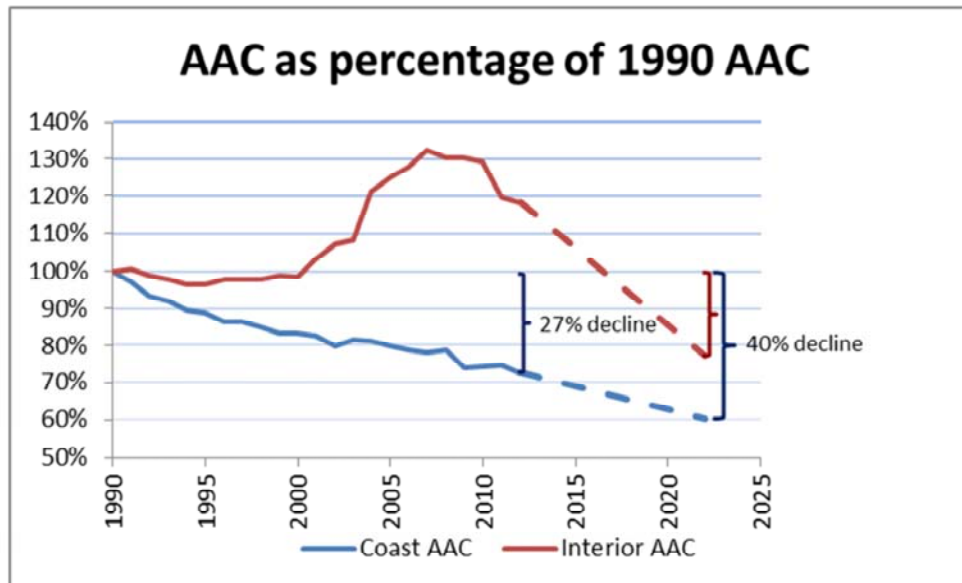
Re-imbursement details:

- Cost claims by treatment?
 - Onerous
 - Bureaucratic
 - Need Profit & Risk to create small incentive
- Look-ups of tabular treatment costs?
 - BCTS benchmarking
 - Potential for Licensee to do better than the average operator
 - Disincentive for locations/small licensees with costs above average
- Licensee/tenure-specific look-up of tabular treatment costs?
 - Based on rolling average from licensee cost survey data (audit needed)
 - Lack of incentive to increase spending efficiency. Incentive possibilities:
 - Profit & risk built into tabular look-ups
 - Bonus for incremental deployments (see activities earlier)
 - Carbon sequestration credits (\$ per tonne-year of incremental wood/biomass)

large licensees aren't so bad...

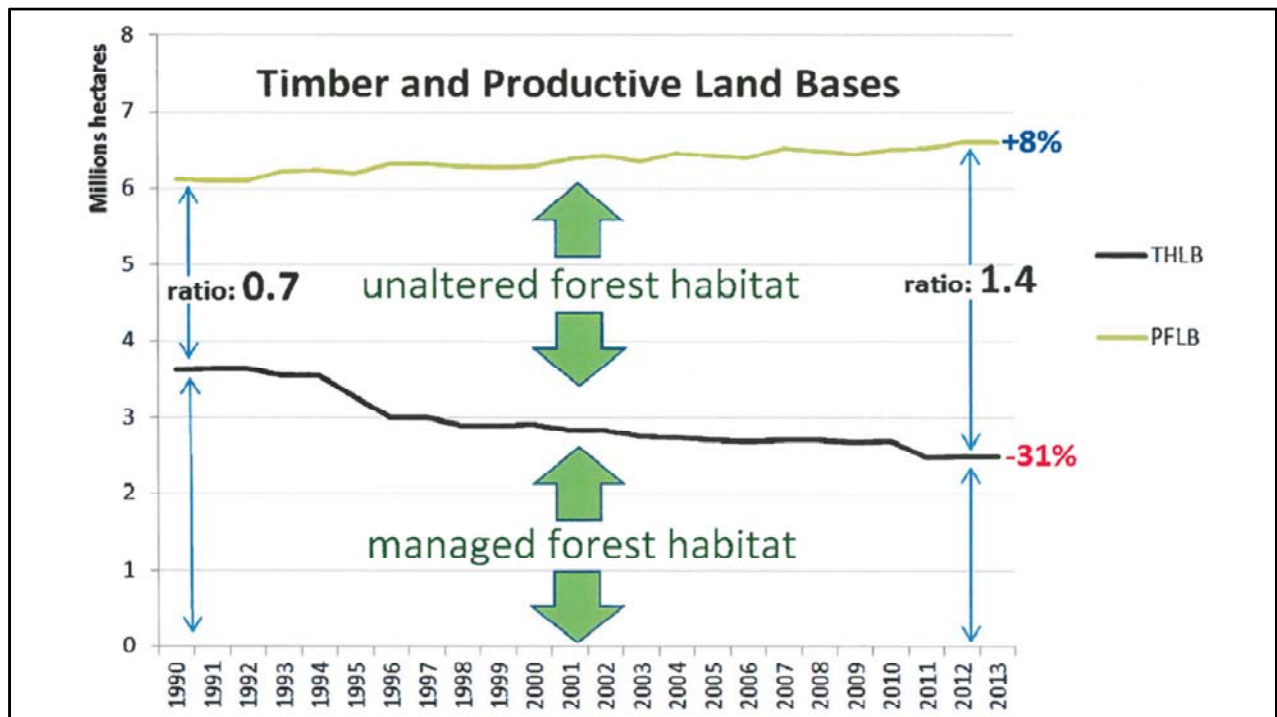
- they're easier to control and manipulate
 - C&E
 - Social licence
 - Maintain a higher stewardship standard
- They're better able to do some things
 - FN Info sharing
 - Defend the THIR (ENGOs, government agencies)
 - Harvest the profile
 - Program spending
 - Fertilization
 - Seed orchards
- They're efficient
 - Economies of scale
 - Attract capital to BC
- Employment
 - Unionized labour
 - "Permanent" staff

Dendroctonus reserveitallii...



In coastal BC, Allowable Annual Cut (AAC) declines have amounted to 6.5 million m³ of AAC over the last two decades. Decline projections of similar magnitude in Interior forests due to the mountain pine beetle (MPB) infestation (11.7 vs 9.4 Mm³ Coast) have attracted extensive press coverage locally, nationally and internationally and have triggered investigation by legislative committee and various Branches of government. Already the coastal percentage decline since 1990 is greater than the Interior decline is projected to be. If current trends continue, by the time MPB wanes, the Interior AAC will have declined by 23%, versus 40% on the Coast. In spite of coastal BC being blessed with the most productive tree-growing sites in all of Canada, the Coast AAC Decline 'beetle' (CAD-beetle) has already wreaked havoc, having led to mill closures and pervasive economic malaise in resource-dependent communities..

Since 1990, probably \$21 billion in manufacturing activity and \$900 million in stumpage revenue has already been foregone. If even a small portion of the continuing loss could be avoided, significant socio-economic benefit could be realized. For example, if the 17% decline projected by 2022 could be avoided, the Province could expect to prevent the loss of \$75-150 million in stumpage revenues and the economic loss of \$3-4 billion worth of foregone forest products sales values.



Besides the short term mentality created by the stumpage system, the other big disincentive to doing full rotation silviculture is lack of tenure security. You hear the oft-used phrase “tenure security”, and it seems to mean different things to different folks.

When the TFLs were created, tenure security was the intent, but then over the decades subsequent governments lost sight of that idea.

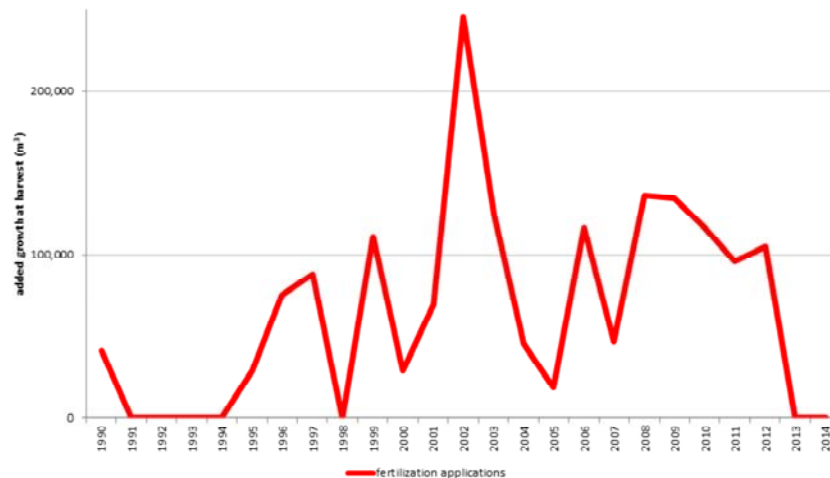
The upper green line shows the amount of productive forest through the last 25 years on the Coast. Productive forest is the land that could theoretically produce merchantable trees if we didn’t care about any other values. It has increased because inventories have improved and we found out that there was more out there than we thought. The black line is the trend in the so-called Timber Harvesting Land Base, or the area where we can practise active forest management. As we have created more and more conservancies, parks, wildlife habitat and riparian reserves the area available for growing timber has declined by 31% in half a rotation, with even more reduction imminent for Marbled Murrelets and Northern Goshawks. Conceivably 2/3rds of the landbase could be gone by the time you get through one rotation. So when the TFLs started, there was this feeling that you could make investments in the land and expect to get your money back. Now it looks like you’re likely to lose 67% of your investment.

To add insult to injury at the stand level, if you succeed at increasing growth and stand value and you managed to pick one of those stands that didn't get turned into a protected stand, government then wants to collect a disproportionate amount of the added value you created by increasing the stumpage charged per m3 .

In my experience corporations have been weakened by loss of social licence, eroding landbase, accelerating costs, gyrating markets, and ownership and philosophy changes. An industry on the brink of financial collapse is not healthy, and just like an unhealthy forest, is not very resilient. More and more CEOs are under pressure to keep improving operating results. This isn't conducive to thinking about the long term or for doing silviculture or research. Every time a new owner comes along, they tend to have a new bright idea for improving the financial situation: cut costs.

Fertilization Partnership

Government/WFP Fertilization (1990 – 2014)



- WFP has been a willing partner to government fertilization programs dating back to 1980, and most recently the Provincial Land-Based Investment Strategy (LBIS).
- Funding for these programs has been erratic, in spite of the well-understood benefits:
 - 1.7 million m³ of incremental volume growth since 1990 on >60,000 ha treated.
 - Each incremental m³ generates in excess of \$350 in total forest products sales value, at a fertilization cost of about \$15 per m³ added.
 - Potential area available to fertilize on WFP tenures each year is much greater than the historic average indicated, and incremental growth potential is well off the top of this chart.
- In both 2013 and 2014 program spending was diverted away from the Coast in favour of the Interior, in spite of superior growth response on the Coast and AAC declines that are just as severe as in the Interior.
- As the chart indicates, coastal funding has been erratic with changing governments and political priorities. Silviculture deployment and efficiency benefits from planning and steady deployment of funds, as does growth response.

Silviculture

Sustaining our future

The idea is to do some brainstorming to generate ideas that might encourage investment in the silviculture side of industry's business. That investment and encouragement might involve internal funds, investors, and/or government.

Why silviculture? – tenure holder

- Improve value of forest estate (TFL)
 - Increase future margin potential
 - increase stand values (grade profile + merch volume)
 - ameliorate harvest flow gaps by advancing stand development
 - Increase current margin opportunity
 - green-up harvest flexibility
 - shorten time and/or reduce cost to FG
 - Strengthen tenure security
 - social, community, and bureaucratic licence
 - sustainability
 - climate adaptation
 - near term (silviculture) & long term (harvest) employment
 - a history of occupancy and spending (ought to?) builds resource rights

As tenure holders do **we see ourselves** as:

- tenants with few responsibilities and a few legal obligations, or
- land managers with the potential to enhance our business and the worth of our long term timber lease?

Assuming the latter, or at least that we're somewhere along the spectrum towards the latter, **why might we be interested in doing silviculture?**

The **first** and most obvious thing is to **make more money**. This is the same whether you are a private land owner, a lease holder, or just a short term tenant. From the perspective of an evergreen TFL holder there is the potential to:

- increase future stand values and to **tailor** them to **match** predictions of **product demand and milling capabilities**, and
- sometimes to mitigate forthcoming **age class gaps**, both unknown and those as yet undefined (e.g. SARA)

Silviculture also does some **things in the short term**, that are **seldom recognized nor monetized**. For example time-of-plant fertilization can knock 1 or more years off time to green-up at a cost of say \$4000 for a 40 ha cutblock. If that provided the **flexibility** to log another 40 ha clearcut a year or more earlier than you would have had to wait otherwise,

is it worth it? Or what is the **NPV of reducing size of the silviculture provision** on the balance sheet.

Another **intangible - but valuable** nonetheless – benefit of doing silviculture is the potential **leverage** for strengthening tenure security. Silviculture is generally **labour intensive**, and creates jobs. It **demonstrates a commitment** to sustainability, and is absolutely **critical to** any sort of **climate adaptation** strategy. Deciding **deployment** of silviculture treatments might be a great way to **involve and engage public** advisory groups.

And finally, we ought to figure out some way to **make our silvicultural performance count** when it comes to tenure security, compensation for expropriation, or even the resource rent we pay.

Why silviculture? – GOVERNMENTS

- Revenues
 - >\$350 in forest products sales value per m³ harvested on the Coast
 - A big chunk = employment income, supplies
 - Taxation of income, goods, and services related to the above
 - **Stumpage** - might average \$5-10/m³ in a good year
- Green Economy
 - Climate friendly products and economy
 - Increasingly wood products seen to be sustainable, renewable, re-usable, recyclable
 - Forestry mostly compatible with tourism, consistent with 'Super Natural BC' image
- First Nations
 - Well paying jobs close to home meshes well with growing, youthful, and largely rural First Nations communities

From **the perspective of governments**, whether Federal, Provincial or even local/FN communities **what buttons** might we need to push?

Usually governments, particularly the Provincial one, are interested in **driving economic growth**.

If you **divide total forest product sales on the coast by the annual harvest** volume, you get a pretty big number of **mostly imported foreign exchange**. A big chunk of that revenue services our costs of production. Government taxation of those incomes and downstream suppliers is the biggest benefit to government, but the **bureaucratic layer may have tunnel vision for stumpage** revenues.

Every **government wants** to sell itself as **green**. As forestry emerges as the **greenest industry around**, governments should want to clamber aboard. It's critical to **keep the ENGOs engaged** and to try to bring some of them along if we can.

And finally, forestry is an obvious **fit with First Nations**. Silviculture can provide **local employment** that is **complementary to harvesting** (harvesting isn't always available, silviculture work provides training)

Why not silviculture? – 2 perspectives

- Government

- Where are the votes in the next election?

- hospitals & highways
- megaprojects

- Where's the harm?

- trees grow themselves
- no one's squawking (on the Coast)
- coastal industry (WFP/CFPA) disinterest

Stumpage revenues - modest, erratic

- INVESTOR

- Risky

- investment horizon long
- expropriation track record
- compensation unreliable

Modest rate-of-return

- short term (20% ROR) mentality vs long term reality (4-6%)
- operating costs (regulatory, labour, etc.)
- domestic log prices (?) vs end product revenue

So **what's the problem?** Why is there a barrier?

From the **government perspective**, this is what I perceive. Maybe you can **think of others**.

Fundamentally, certain politicians **don't see votes** in forestry in general. Almost no one see votes in **conducting silviculture** that generates **benefits more than 2 election cycles from now**. So **money flows to infrastructure and health care**, or some other soup-de-jour.

There is **no harm to politicians in ignoring** forestry (**unless** the media creates an environmental **crisis** such as MPB). Trees grow themselves and if **no one is squawking** why do anything? We need to squawk!

From the point of view of the investor, you probably all know the story. There's a **lot of political risk** given the typical rotation length is a **baker's dozen of election cycles**. Given our location in the **temperate rainforest with modest growth** rates and longer rotations rate-of-return tends to be modest at best. We've got the short term capital **expectation of 20%** versus the **long term reality** of much less than that. We tend to have **higher operating costs**, and our regulatory environment doesn't do much to offset our labour costs in BC. And then there is the question of **what revenue and margin numbers to use** in financial analysis.

The Coast – what's to like?

- in Canada...
 - best growth rate
 - shortest rotation age
- benign risk of timber damage/loss
 - comparatively few insect, fire, or disease problems
 - maritime climate change muted
- **markets**
 - ready access to Pacific Rim
 - diversity of products (species, grades, logs, lumber, residuals)
- **operational**
 - stable legal system & governance
 - skilled, local labour force
 - First Nations partnerships

In spite of all the problems, there are **lots of things to like** about investing silviculture money into the Coast.

While clearly we are not the tropics, from a **Canadian perspective** we can **grow trees pretty quickly**.

The average **MAI on the Coast is at least double** that of the Interior, **where government** wants to **focus** their efforts. At the **SCHIRP** research site at Port McNeill, treated research plots on **medium to poor sites have – for nearly 3 decades – yielded up to 25 m³/ha/year**. This is comparable to the MAI in **subtropical timber** plantations. At IUFRO UBC 2016, I was lamenting that my 20 m³ couldn't keep pace with 65 m³/ha/yr eucalyptus plantations in the tropics and was told that 20 m³ was pretty good and would attract investors to a plantation scheme.

From a biological perspective, the BC Coast is one of the **safest places I can think of to grow a tree**. We don't have **typhoons** or **hurricanes**. Fires are uncommon, and since the advent of modern fire suppression **large fires are virtually unknown**. **MPB** doesn't eat most of our tree species. **Fungal diseases** are chronic but not devastating, and **silviculture can help** too! While there are occasional **insect** outbreaks, **devastating historic outbreaks are unheard of**. Because of the maritime influence, **climate change** is expected to be

relatively **muted**. Biologically-speaking the **risk of catastrophic timber damage is low**.

From a **market perspective**, we have good access to **ocean transport**, and our **diversity** of tree **species and sites** gives us the opportunity to provide a **variety products and market diversification**. From an investment perspective, this **helps stabilize opportunities and earnings** over time.

DISSOLVING barriers - governments

- Revenue Perceptions
 - more than just stumpage \$ (existing system actually a disincentive to silviculture investments)
 - direct revenues from personal income taxes, business taxes, fees
 - indirect revenues from taxation of suppliers, service industry
 - exported forest products = new \$ imported to BC
- Social
 - Forestry labour intensive
 - employees per \$ of forestry revenue higher than oil & gas, high tech
 - local work for rural and First Nations communities
 - Non-polluting , green, and a sustainable timber spigot never runs dry
- Votes
 - Is crisis needed (MPB)?
 - How to make forestry “sexy”

So there is good **biological potential**...How can we **overcome the people barriers**?

Governments and in particular their advisory bureaucracies need to be continually reminded and convinced that there is **more to forestry revenues than just stumpage payments**. The dollars that forestry brings are **mostly foreign exchange** that might have gone elsewhere.

While **politicians** are always in **favour of employment**, they are sometimes **too eager to buy into** the perception created by ENGOs and unions that **automation in harvesting and milling** has eliminated most of the jobs. Even with all of the modernizations that have occurred, forestry is still a labour intensive business, and silviculture even more so. For fun some day, pick a few industries and **divide revenues by number of employees**. From an employment perspective, forestry looks **better than various “pipedreams” (LNG, northern gateway, Kinder-Morgan)**. **Google sucks** in terms of employees for \$ of revenue.

And unlike a mine or well head, there is **little pollution** associated with forestry and the **trees grow back**. What could be better than that if you want a green economy?

So it all **comes down to votes**. What do we need to get **public support**? Is a **crisis** the only thing that gets attention. **How can we become “sexy”** in the political and bureaucratic

eye?

BREAKING barriers – what can government do for investors?

- Remove or reduce RISK
 - Compensation for expropriation or regressive policy
 - fair, pre-set, and reliable
 - return of capital invested (and some interest?) **assured** (contractual?)
 - political “poison pill” to dissuade expropriation - pill grows over time with further investment (& compounding interest)
 - Enshrine principle that ongoing, cumulative investment builds tenure rights/security
- Improved rate-of-return
 - Government-funded preparatory treatments
 - Value gains stemming from private investment accrue to investor exclusively
 - no stumpage payable
 - compensation for imposed cost increases over original agreed estimate

What do we need from government to make silviculture investment **attractive for private investors**?

This is what I came up with:

Compensation is needed to **alleviate risk**. It has to be **fair, known** at the time of investment and **assured**. In the past we’ve seen the government **change the rules**, and repeatedly and turn it into a **negotiation**. Governments can’t help themselves – so **what mechanisms** might be used to prevent them from shooting investors and themselves in the foot?

Could the cumulative amount of **silviculture investment over time** be the **basis of a compensation** formula, and thus could that amount become a **poison pill** to future politicians that might consider expropriation a piece of forest land for some political purpose of the day?

There are a few things that government could do to **make the financial analysis** (that a private investor inevitably will do) a little more **attractive**.

First thing is to **fund preparatory treatments**, especially early in the rotation and many

years before the timber can be monetized by harvesting. Treatments like aerial fertilization require a favourable crown structure so that the fertilizer ends up in the crop trees and the desired response is achieved. This crown structure is achieved via **density control** many years earlier (e.g. planting density, juvenile spacing, or/and brush control). The **long time period between these costs and harvest** revenues generally mean that the **rate-of-return** on a dollar invested tends to be **low** in the eyes of a private investor.

The **second thing** that government could do is **make the incremental gains** in volume and value arising from private investment **more profitable** to harvest and process. For example, **eliminating or at least reducing stumpage** due on the incremental wood grown would **improve the apparent rate-of-return** to the private investor. If government could **guarantee the cost assumptions** of the original estimate, or re-imburse where subsequent government actions cause cost increases, then expected investment returns would be maintained.

BREAKING barriers – what can tenure holders do for themselves?

- Financial
 - Accounting practices – should the incremental m³ carry the average harvest cost?
 - fixed costs + some variable costs ... are they sunk costs?
- Financial Analysis – stand level
 - Shorten investment horizon
 - VLM log values inappropriate for financial analysis?
 - Use product values and milling costs
 - short cut - add milling margin to log value?
 - Use export log prices?
 - Long term price appreciation assumption – flat?
 - Need a realistic interest rate assumption for the long haul
- Financial Analysis – estate level
 - How much is even timber flow worth to us? Or at least temporal control of timber flow?
 - Is future operating viability worth something? Do you discount it? What interest rate?

I also wonder if there aren't some **things that could be done** corporately to improve our outlook on silviculture.

For example, when a silviculture investment is projected to create an incremental or extra m³ over and above what would have been produced without the silviculture, in financial analysis of a proposed treatment does it make sense that the average cost per m³ should be extended to the incremental m³? Aren't the various fixed costs already sunk in the base volume? **In theory**, aren't certain **variable costs such as falling, loading, sorting more or less unchanged by adding girth** to pre-existing tree stems?? As a consequence, isn't the **margin on the incremental wood greater than the margin on the original base volume**. If you had **400 stems** per hectare and merch volume of **450 m³/ha** and the **margin was \$10/m³**, what would the margin be on an **additional 100 m³/ha spread over the same 400 stems**?

Whenever you do a **stand-level financial analysis** of silviculture treatments in the temperate zones, you run into the same problem of length of investment horizon and the **wet blanket of the discount rate** effect on NPV. The **only technical way** around that is to **shorten** the rotation age (which some silviculture does) or look to make treatment **expenditures late in the rotation**.

Financial **analysis typically relies on VLM** species and grade prices, but there's always lots of controversy around how well VLM prices **actually reflect log values** and how well **letter grades actually reflect end uses**. From my level at least, how much **margin the sawmills make always seems cloaked in secrecy**. So what numbers should be used and how can those be spread to the government letter grades that the growth models generate?

Wood seems to be entering a **new era of popularity**, based on its carbon-friendly nature and source sustainability. We've never really seen **price appreciation** before, but is it a possibility?

And always the elephant in the financial analysis room is: "**What is the appropriate discount rate?**" 20% is for loan sharks, not foresters.

And finally, there is the need to look beyond the stand level and consider the **benefits** that silviculture treatments might bring at the level of the **overall forest estate**. Are there **gaps** in the timber supply that will cause future disruptions in the flow of timber? Could **silviculture** help to **avoid** these to some degree? If so, how do you calculate the **PV of that benefit** so that you know how much to spend today? How much is the "**existence value**" of knowing you will have a future business, and **can you discount existence?**

BREAKING barriers – finding the right investor?

- Pension funds vs speculators?
- Ethical funds?
- Which rate-of-return profile do we promote?
 - 20% + 20% + ? + ? + ?
 - 8% + 8% + 8% + 8% + 8%...

There's a whole **spectrum of investors** out there. Is the industry attracting **the right ones**?

As an emerging green industry, are there **ethical funds** out there that might be interested in a company with a **strategic and steady silviculture investment strategy**?

Can industry break the mould of being a **cyclical investment**?

DAMN!– it's still not enough

- Only mid to late rotation private investments may pass the financial analysis test
- Privately funded treatments may still require preparatory treatments years earlier
- Could government funding leverage private funds similar to NSERC or other models for research funding?
- **Public Private Partnership (P3)**

At the end of the day, even if we could get all of the forgoing ducks to line up, it's still **tough to make the numbers work** in a **temperate** forest with relatively **high treatment** costs.

Private investment probably **won't work on its own**. The solution may lay in some sort of **partnership** between private and public interests. The **P3 concept**, though somewhat tarnished, has been used in various **infrastructure** projects; is there a **similar opportunity** in forestry with silviculture investment?

Public Private Partnership?

- Public land
 - need better security, but evil 'ownership' word to be avoided
 - need steady, long term funding, but from a landowner that has proven inherently unreliable (4-yr political rotation)
 - need contractual certainty of ground rules, risk/reward
- Division of Benefits
 - Private funds
 - directed to treatments with highest (quickest) financial returns
 - no stumpage on the incremental wood production (+ credits against baseline wood production?)
 - Government funds preferential to other treatments that are
 - preparatory to and leveraging later private investment, and/or
 - labour intensive, wage & tax generating

As we're dealing with **Crown land**, we need to **find ways to address the key barriers** from earlier as summarized briefly here.

- We know that the **public cannot stomach divesting ownership** to private interests, so **such perceptions** must be **avoided** at all cost. Perhaps we need to **own** only **the trees** that we have invested \$ in, and **land tenure** remains **unchanged**. Improved tenure **security** might be **attained in practice** with **compensation and/or poison pill mechanisms instead** without any high profile "tenure reform".
- We **can't go it alone**. We **need leveraging money** from government.
- We need **certainty of assumptions** and no political risk of an altered playing field. Maybe we **only need this at the stand level**, if TFL-level security is too hard to swallow.

Who gets what benefits, and **who does what** treatments, are **basic principles** that must be resolved to ensure that all parties are getting what they need out of a partnership.

Public Private Partnership

- Shared Funding

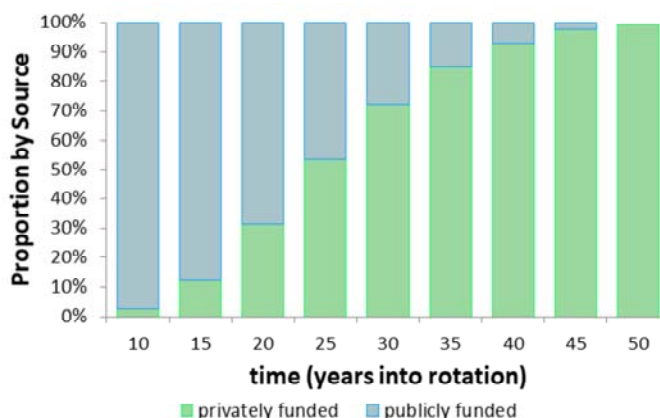
- Private funds

- increased proportion late in rotations
 - shorter investment horizon, reduced risk

- Government funds

- early in rotation
 - labour-intensive generating jobs & taxes

P3 Funding Principle - Stand Level



As has been alluded to, some sort of **investment formula** would need to be **negotiated** to allocate the **pooled funds** from an investment partnership. It might look something like this...

In this case, something like planting that occurs in **year #1** might be **5%** funded by the **tenure holder** and **95%** funded by **government** (either **directly**, or in the form of direct **stumpage credits** for costs expended). For something like aerial fertilization occurring in **year 40**, the **funding reverses** and the tenure holder might contribute 90% of the cost and government 10%. Mid-rotation fertilization or CT might be shared 50:50.

As the **tenure holder** would be the **implementer** of the program **from site prep right through to final harvest**, would it be reasonable that the tenure holder would “**own**” the **incremental gains throughout** by way of that participation and a contribution to each treatment along the way, or would the **government say that ownership is proportional to dollars contributed** at each step and the gain associated with that step (this would be a **computational nightmare**). Can we get back to **basic principles**, that **everyone wins** if government can make private investment attractive, which includes government relinquishing financial interest in the incremental wood value created?

P3 - public funding contribution

- General revenue, federal job creation, carbon tax, ...?
- If stumpage,
 - Existing “maximize stumpage” mentality will quickly gravitate to increasing the stumpage rate to fund the program
 - Silviculture amount built into Tenure Obligation Allowance (TOA) doesn't incent private expenditure
 - Alternate stumpage approaches?
 - legislated trust fund for silviculture
 - revamping stumpage for direct silviculture credits against tenure-level payments
 - replacing Byzantine stumpage system with flat rate export tax
 - percentage of tax collected proportional to the licensee or licences generating the tax (CoC tracking?)
 - allocated to direct re-imbursement of realized costs with separate percentage for each of:
 - silviculture treatment
 - road and infrastructure development
 - logging cost variables??
 - Add more rate variables as necessary (e.g. value-added, log exports, etc.)

We've already alluded to some of this, but **where could public funding contributions come from?**

Traditionally forestry has been seen as a **contributor to General Revenues**, so the idea that General Revenues might fund silviculture may be a bridge to far. On the other hand, maybe a way for government to **make fossil fuel revenues more palatable** is to **funnel resource rents** from that into forestry and its **ameliorating benefits** (more and long term jobs, C sequestration, low environmental impact, habitat benefits)

In the past we've seen Federal-Provincial agreements with **FRDA** in the amount of **\$300 million per year** being the most notable (many of the spaced stands we are harvesting today were funded under that program).

What about the good old **carbon tax**? That would be a good source for funding at least **those treatments which will help** with climate change adaptation and mitigation (e.g. assisted migration via planting).

The **natural gravitation for funding** will be to the **stumpage** system. If industry is OK with that funding door, there is a danger that **industry ends up paying** the whole shot through higher stumpage. The **Revenue mentality** may drive the bus there and blow the whole

idea up before it can even start. The existing **TOA doesn't incent** corporations to do silviculture (perhaps the opposite) and **at \$0.25** the TOA is **meaningless**.

If we are going to go down the stumpage road, reform is essential.

Are there alternatives, particularly under a quota system, where MPS or other American appeasements are irrelevant

P3 - private funding sources

- External
 - Pension funds
 - Ethical funds
 - Investment schemes - TIMOS (27 million ha in US); TREITs (7 million ha in US)
 - How about a silviculture treatments investment trust (STIT)?
- Internally
 - Percentage of operating margin?
 - Annual budgeting exercise?
 - How to maintain funding through market cycles?

On the **private** end of the **funding** stick, where might funds come from? Here are some of the **possibilities** that come to mind for me.

Could government **invent something new** for British Columbia, that could attract investments to incremental timber grown on Crown lands?

Corporately is there a way to **direct funds to incremental silviculture** treatments? How do you make it an **investment, rather than a \$/m3 variable cost** that inevitably becomes a **cost-cutting target**? How can such an investment **compete for capital** in the world of 20% ROR expectations?

- There has to be a way...