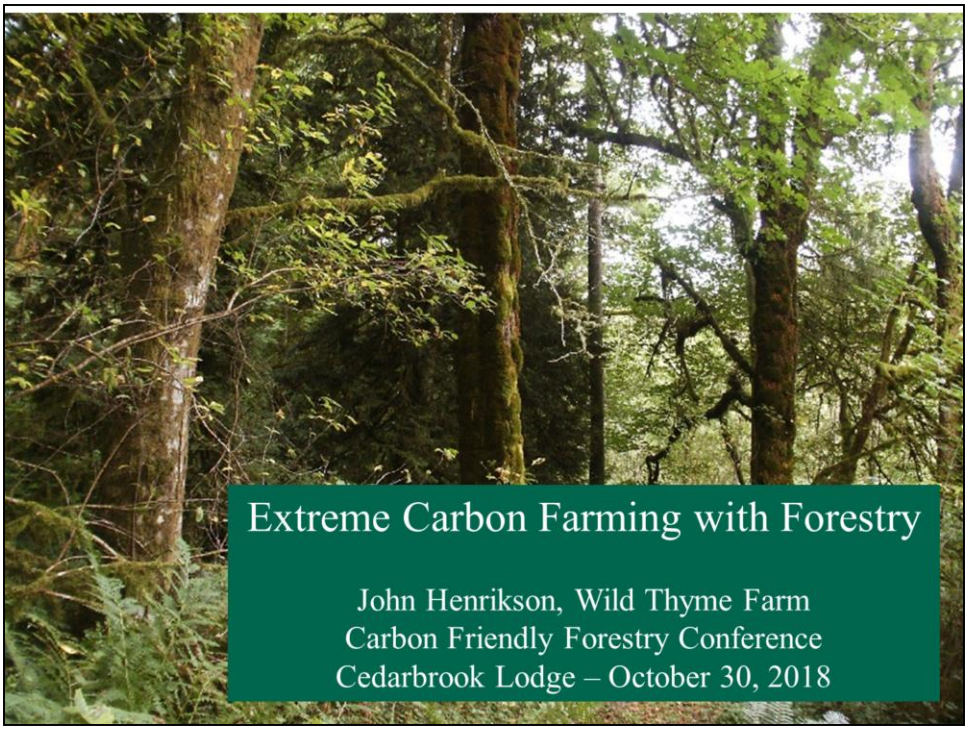


The opening slide – a TEST

Wild Thyme Farm in Oakville WA - 2009

Wild Thyme Farm was founded in 1987 by four urban-dwelling brothers who had no experience in land ownership or management. Over the past 30 years, we have fully engaged the landscape to produce a mosaic of cropland (hay), native forest, arboretum, agroforestry, riparian and wildlife habitats.

Ice Storm Devastation – December 26, 1996

We were “hands-off” landowners initially, as are most people outside of the rural community. This ice storm was our very expensive wake-up call to take an active role in managing our land. Could have paid the mortgage off in 2 years instead of 20, and still end up with a more valuable forest decades later.

Legacy stand up top, after a harvest - 2014

After nearly 20 years of attending workshops, joining forestry organizations and visiting other tree farms (WFFA, WTFP), becoming certified (FSC and ATFS), we aggressively implemented a forest management plan adapted to our topographically-challenged site and an uncharacteristically hardwood-dominated forest, with our first major commercial timber harvest in 2014. This further evolved into a desire to create a “legacy” forest dominated by big trees. A pilot project to enroll the forest in a carbon offset program in 2009 failed due to a low carbon price and a restrictive 100-year term. This gave us an opportunity to achieve the same result via a more economical and less restrictive route.

Clearwater Creek conservation parcel - 2012

As if I didn't have enough land to work with on WTF's 150 acres, in 2012 I purchased another 40-acre parcel in Naselle WA on Willapa Bay, featuring a conservation easement held by Forterra and a salmon-bearing creek running through the middle of it. The mixture of legacy stands and recent patch-cuts created an ideal test-environment for fast-tracking the forest towards Desired Future Condition, DFC is the State of WA's goal for riparian buffers and other sensitive sites – essentially a forest with mixed species and age classes, on a trajectory for old-growth characteristics (at least 140 years old).

Legacy stands mixed with patch-cut openings

Up close on the Clearwater Creek parcel at the time of purchase. Age classes ranging from 0 to over 100, with the majority of leave trees between 60 and 80 years old.

Ellsworth Glacier in 1909 – east of Seward AK

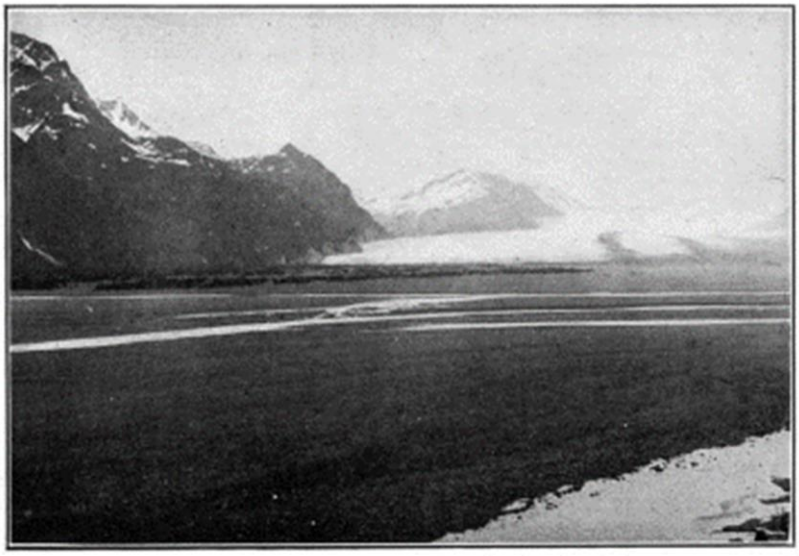


FIG. 5—Ellsworth Glacier from Point A of Fig. 4, July 12, 1909.

But let's step back all the way. How does Nature create large old growth stands? Alaska is a great place to study natural succession – so much wilderness! Starting from scratch on bare mineral soil after the recent glacial retreat from the Little Ice Age…

Sparse Regeneration is the key to big trees

Approximately at the same location, over a hundred years later. The forest is still slowly advancing across the gravel plain. Natural afforestation (phase change from grassland to forest) is spotty and sparse, creating open-grown trees with large, live crowns all the way to the ground.

Mature forest with room to grow

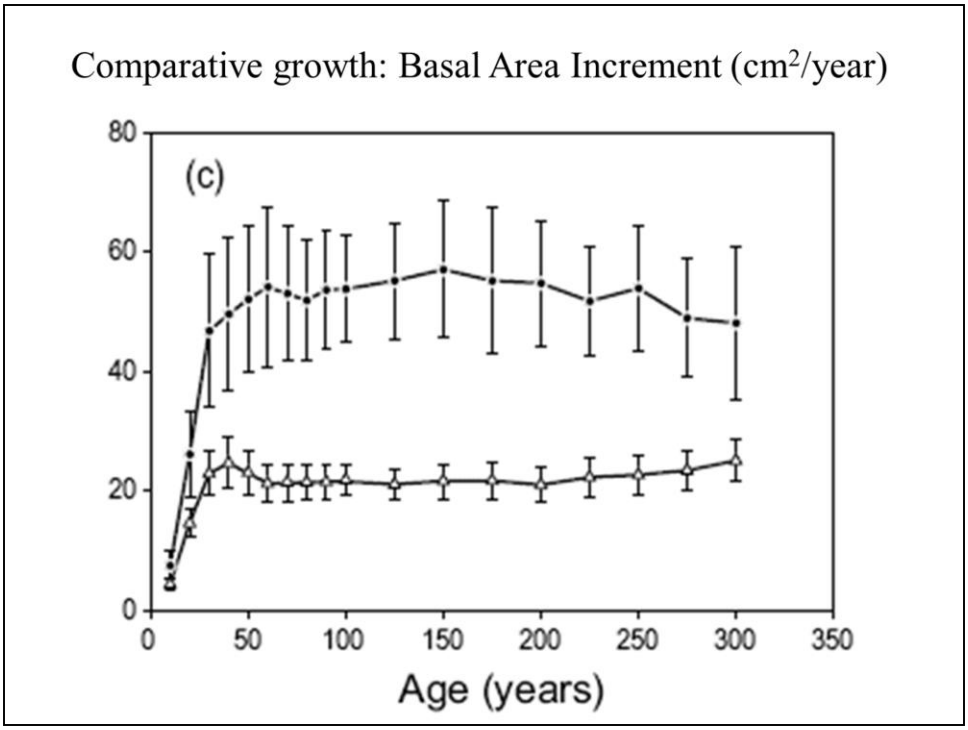
80 years or so later, the initial wide spacing produces a legacy stand of large, vigorous trees. Still enough sunlight filtering through the canopy to give these trees decades more of unimpeded growth.

Forest regenerates with small openings

As it “ages out”, periodic disturbances and gradual senescence create openings where sparse regeneration perpetuates the cycle of big tree development. An established shrub layer and undisturbed soil inhibits seedling establishment. Larger disturbances like wildfire will start the process over again, frequently with dense regeneration which may delay large tree development for more than one forest cycle.

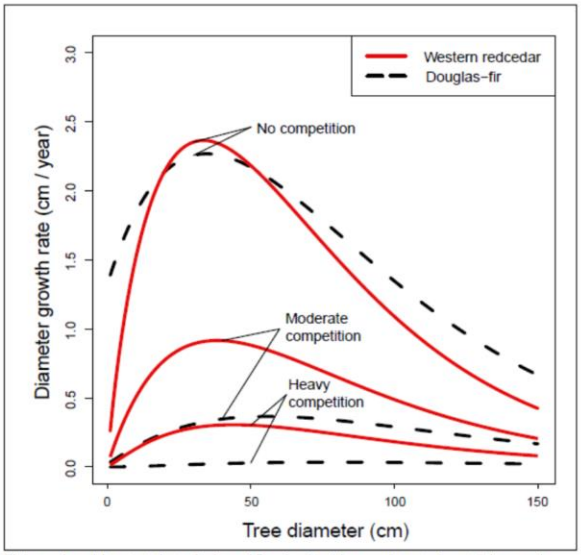
Young, mixed wild stand – Kenai River Gorge, AK

Frankly, much of wilderness has densely packed trees that do not lend themselves to the “big tree” paradigm that we associate with iconic old-growth forests. We could geo-engineer these wild spaces to sequester more carbon, but why go there when we have so much previously harvested forest land with road infrastructure to work with?



Plot of large diameter trees versus small diameter trees in an old growth stand. Need to "launch" properly within the first 50 years to reach the maximum potential sustained growth rate. Suppressed trees do not generally recover after the initial growth spurt and should be culled to release resources for the dominant trees. Basal Area (amount of horizontal space taken up by tree trunks) is the simplest single metric for carbon volume.

A real growth curve – finding the sweet spot

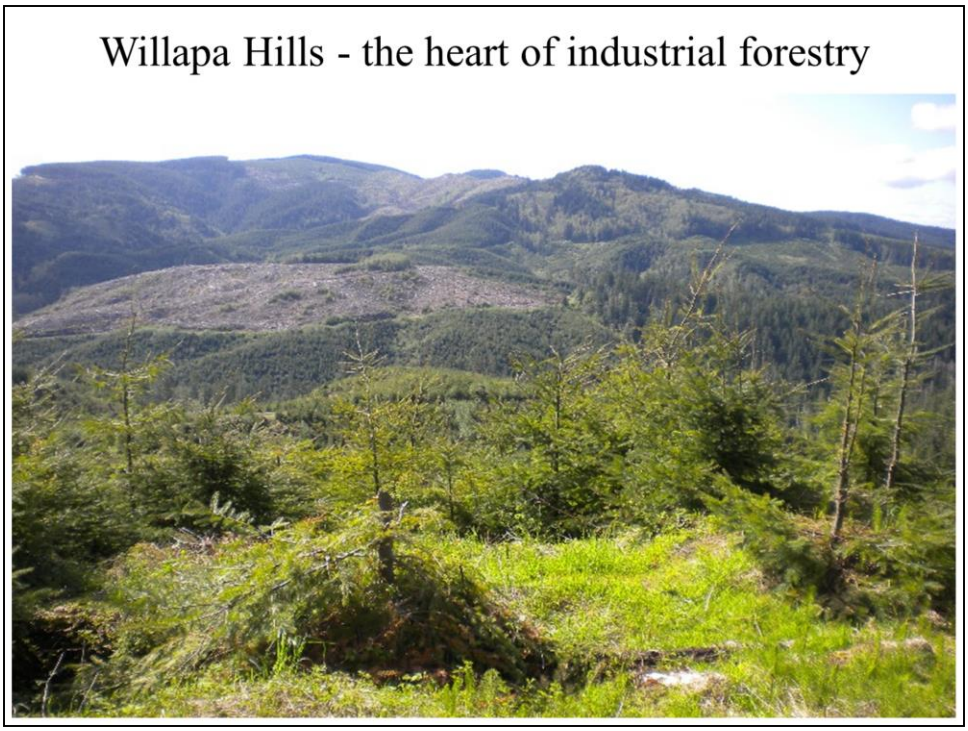


This growth model projects that redcedar and Douglas-fir of the same diameter have similar growth rates when growing in open conditions. Growth rate declines for both species under moderate to heavy competition from larger trees. The decline is less for redcedar, however, because it is more tolerant of shade than is Douglas-fir.

Another graph that clearly shows the difference in tree growth at different levels of competition for light, water and soil. Shade-tolerant species like Western Red Cedar have a better shot at rebounding from competition. Note that diameter growth rate necessarily declines over time, even though the tree may be steadily accumulating biomass – it's a function of geometry: a bigger tree needs smaller growth rings to grow the same mass as big rings on a smaller tree.

40 year-old Doug fir from the same stand

A tale of two trees. One of them was suppressed and shutting down by age 20, then culled from the stand at 40. The other was on the optimum growth track with a steady annual increment, but it succumbed before its time to laminated root rot fungal disease..



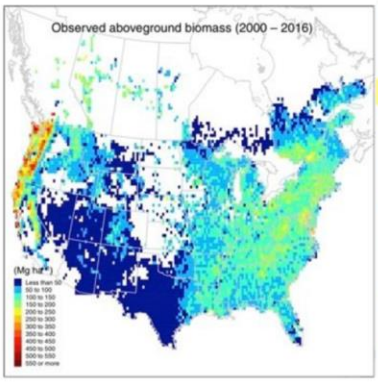
How do we mimic this natural process with a human-altered landscape? This is our “starting point” – a mosaic of forested stands primarily in the youngest age classes from zero to 50 years old. What is the site capable of producing?

Are we nearly maxed out for sequestration?

PHYS.ORG

New research calculates capacity of North American forests to sequester carbon

13 July 2018



environmental studies at the University of California, Santa Cruz.

Zhu's team found that North American forests have reached 78 percent of their capacity to sequester carbon and will gain only 22 percent capacity—at most—over the next 60 years. That's a cautionary finding that has implications for forest managers, climate scientists, and policy makers.

A better methodology

Unlike previous attempts to quantify forests' capacity to sequester carbon, which relied on simulation models or satellite data, Zhu's findings are based on exhaustive, ground-based measurements of forests across the continental United States and Canada.

The latest research is not encouraging. 78% of capacity now with only a 22% gain looking forward? Seems plausible if we maintain the status quo and allow overcrowded forests to stagnate or burn. If we change the initial assumption and intentionally manage or even re-set the forests to put them on a high-growth trajectory, the PNW coastal forests could grow by an order of magnitude, meaning we are more likely at 10% capacity with a 90% potential gain. For example, it should be non-controversial to get from the now typical average of 20 mbf/acre to a historically proven 200 mbf/acre. (mbf = 1,000 board feet) Perhaps we can even do better than that!

Legacy stumps are a clue to site potential

What is your site potential? Large old stumps and historical records can reveal the timber volume previously achieved on the site. With more than one of these large stumps per acre on this parcel, we can assume a minimum of 100 mbf/acre as a carbon sequestration goal.

20-30 year-old plantation – needs thinning!

Let's follow the progression of the forest through the centuries. Most plantations and naturally regenerated stands become overcrowded within 25 years, and if not thinned via harvesting or natural selection, will stagnate and fail to achieve Desired Future Condition (DFC). They will indeed have little capacity to store additional carbon.

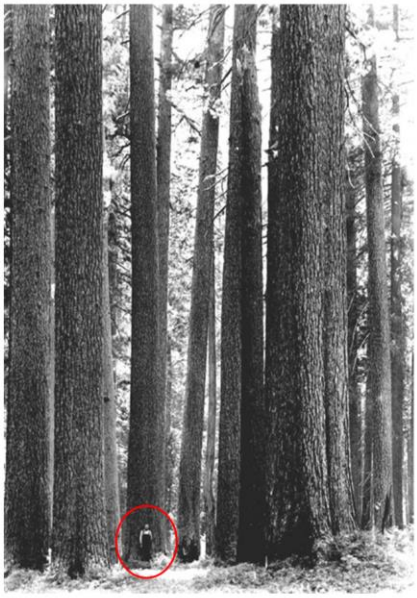
A light-duty thin that maintains canopy closure will produce quality timber with small knots due to crown recession, but it will likely inhibit the trees from achieving DFC. This is the divergence point at which the forest reaches "escape velocity" or not. Rough rule of thumb for coastal PNW forests: 1.000 board feet (1 mbf) of volume growth per acre per year. Note the bottom right-hand corner of the slide indicating a rough estimate of timber volume associated with the picture.

Heavier thinning – lots of space and light

A more aggressive thinning brings in more sunlight and allows trees to develop deeper live crowns, accelerating them up the growth curve towards maximum Basal Area Increment (BAI). Additional thinning or management may not be required after this point. The forest can be left to evolve naturally, or occasional entries to salvage downed and damaged trees can help offset the cost of development.

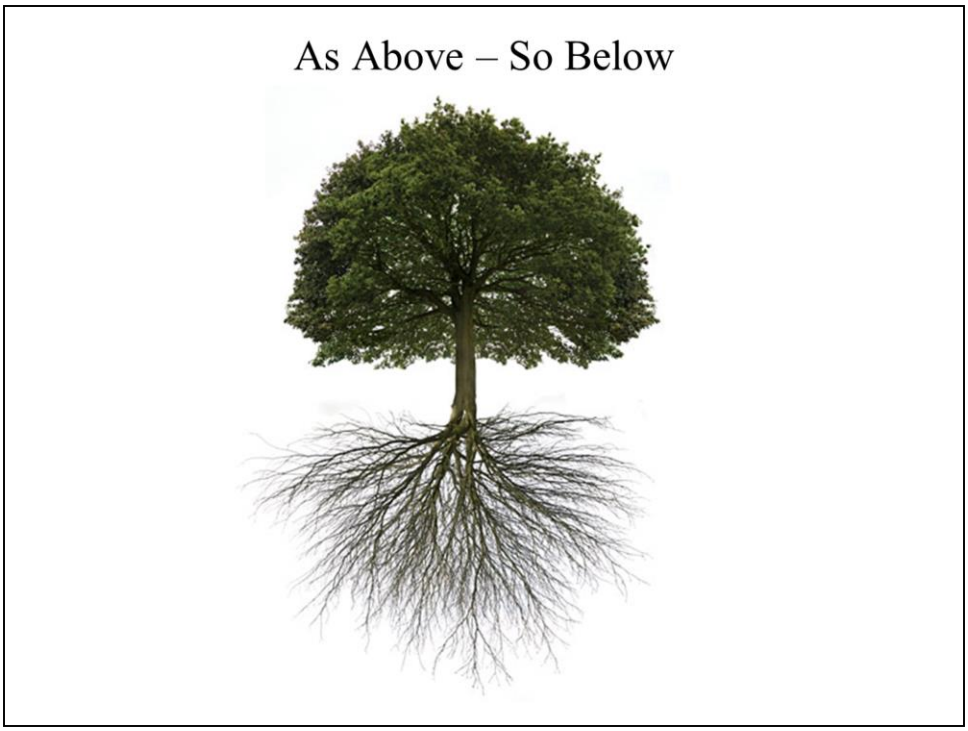
This is what a Doug fir plantation would look like if thinned early enough to keep the remaining trees on an optimum trajectory. Finest stand of timber I have encountered – not far from Multnomah Falls in the Columbia River Gorge. A fire burned through here about 20 years ago to no ill effect; not sure about the effect from the 2017 wildfire.

500+ year-old, high-density stand

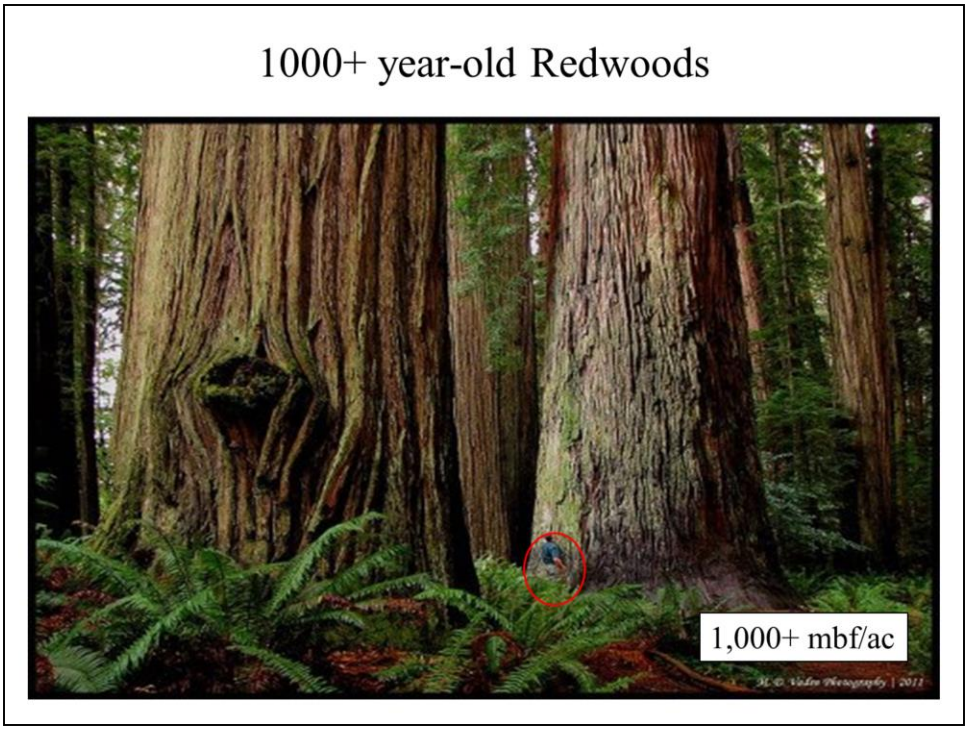


500+ mbf/ac

Exceptionally dense old growth stand, likely due to high site class with deep, rich soil. Note the logger standing next to the tree for scale.



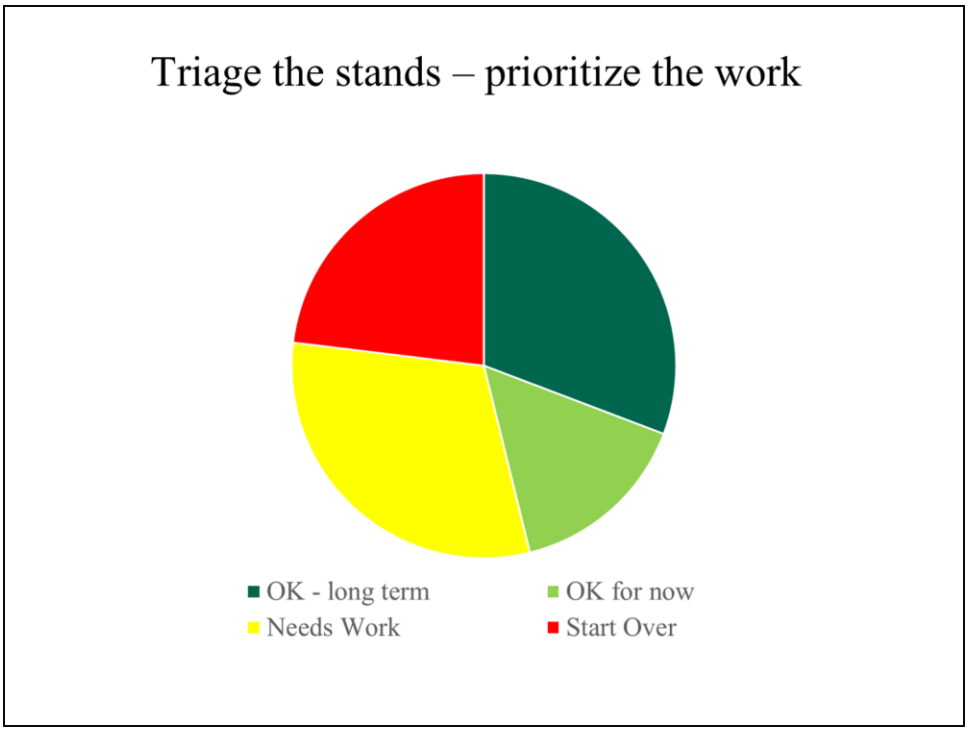
Biomass above ground is roughly mirrored by biomass below ground. Deep soils with abundant minerals and moisture allow trees to grow closer together than on poorer quality sites. The slope and aspect of the site also need to be taken into consideration when determining final tree spacing. South-facing hillsides can support higher timber volumes than those facing north, if soil moisture content is equal.



Forest porn! Not just the redwoods in California – in our own backyard as well. From the book “Mountain in the Clouds” : “..the Humptulips and nearby Chehalis valleys were covered with the heaviest stands of timber on the Olympic Peninsula. Several 640-acre sections contained more than one billion board feet … apiece.” – an AVERAGE of 1.5 mmbf/acre., 75 TIMES the volume of our default commercial stand!

Mixed age & species old-growth stand

Back to reality – this is a more likely outcome for landowners seeking to create DFC. Scattered large older trees with plenty of well-spaced younger trees in position to grow vigorously. So how do we get here, staring with a young forest with variable conditions?



Take an inventory of the forest stands or management units. Classify them using the Triage methodology. The Green Zone is for stands that are in good shape and need no further management at this time. Dark Green = long term stability and not likely to change. Light Green = OK for now but will probably need work in the next decade or so. Yellow Zone is for stands that need management now if they are to stay on track for DFC. Successful work moves them into the Green Zone; neglect moves them into the Red Zone. Red Zone is for stands that will likely not improve even with management, Best option is to remove the trees and start over with a new cohort. Re-assess every 10 years or so. Anything that is not Deep Green usually trends downwards!

Let’s start in the Red Zone and see what we can harvest right now. We will need the funds to do the restoration work in the Yellow Zone. From a nearby property, this is an example of a Doug fir plantation that has no future aside from sawlogs to the mill. The trees have small live crowns (less than 40%) and will not resume vigorous growth – almost no potential trajectory for DFC. It is structurally weak and is vulnerable to extreme weather events.

Speaking of extreme weather… Across the road, this similar Doug fir stand went down hard in the December 2007 windstorm.

45 year-old Red Alder, maxed-out

Similar situation at both the Oakville and Naselle properties. This Red Alder has reached its maximum height and its ring growth has slowed to the millimeter level. It also has structural damage from repeated ice storms, and is starting to break apart. Time to harvest and capture the timber value before it degrades further.

Oops – too late for the neighbor's alder stand. Needed to be thinned 10 years earlier so the trees could develop wider crowns and lose individual branches instead of the whole spindly, "lollipop" tree. Triple whammy here: Doug fir plantation overtopped by naturally regenerated alder. Alder would have been a good replacement crop if it had been managed, but now that is lost and the brushy understory is preventing new regeneration. At least logging disturbs the soil to create a seedbed for regeneration.

Red Alder removed, Conifers retained

At the WTF Oakville property just this past summer (2018), after following a similar prescription to the Naselle property. Five minute prescription for the logger: remove all alder and poorly formed maples, retain all conifer and large, legacy maples. Phase change from the Red Zone to the Yellow Zone, as replanting and intensive care for the next several years is on the docket.

Clearwater Creek property in Naselle, WA - 2012

The “green-up”. 5 Years after the patch-cuts of alder and other blowdown. The great windstorm of 2007 (with sustained winds above 100 mph – highest gust of 145 mph recorded on nearby Naselle Ridge), occurred WHILE this parcel was being harvested. It was still a tangled mess when I acquired it 5 years later.

Clear-cut area with 5 year-old natural regeneration

Natural regeneration can take a few years to get started. In the meantime, the explosion of wildflowers, grasses and forbs are a bonanza for wildlife. But this is short-lived. The Naselle property provides a valuable template for how to proceed with stand development in Oakville.

Opening wide enough for good alder regeneration

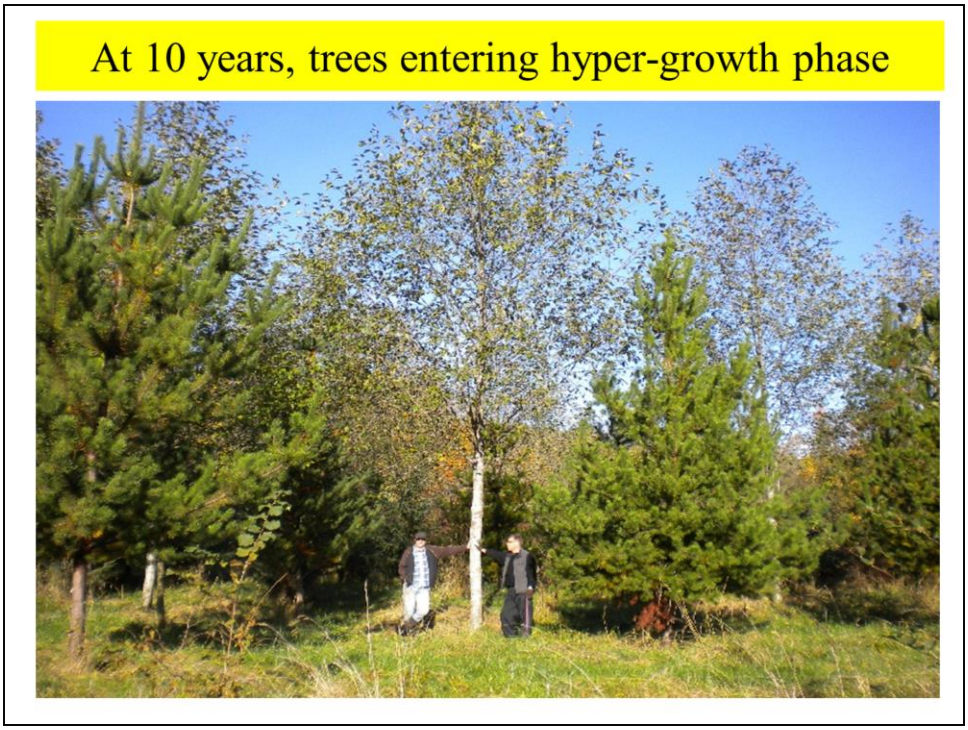
On disturbed, bare mineral soils (especially roads!), alder can sprout in thickets with stems inches apart. Will need to be thinned within a few years to avoid spindly growth.

Alder thinned at 8 years – a first pass

Alder thicket reduced to the best specimens at year 8. Still way too many stems, but enough room to grow another 5 years to see which ones really take off. Need “insurance” trees to account for future mortality and damage (elk rubbing most likely).

16 y/o alder crowding out planted Doug fir

A stand nearby with trees 10 years older that was part of a Weyerhauser Doug fir plantation. The alder out-competed the Doug fir in the wet low spots and some Doug fir survived on the drier ridges. Some natural thinning left the alders in decent shape, but additional thinning is ongoing.

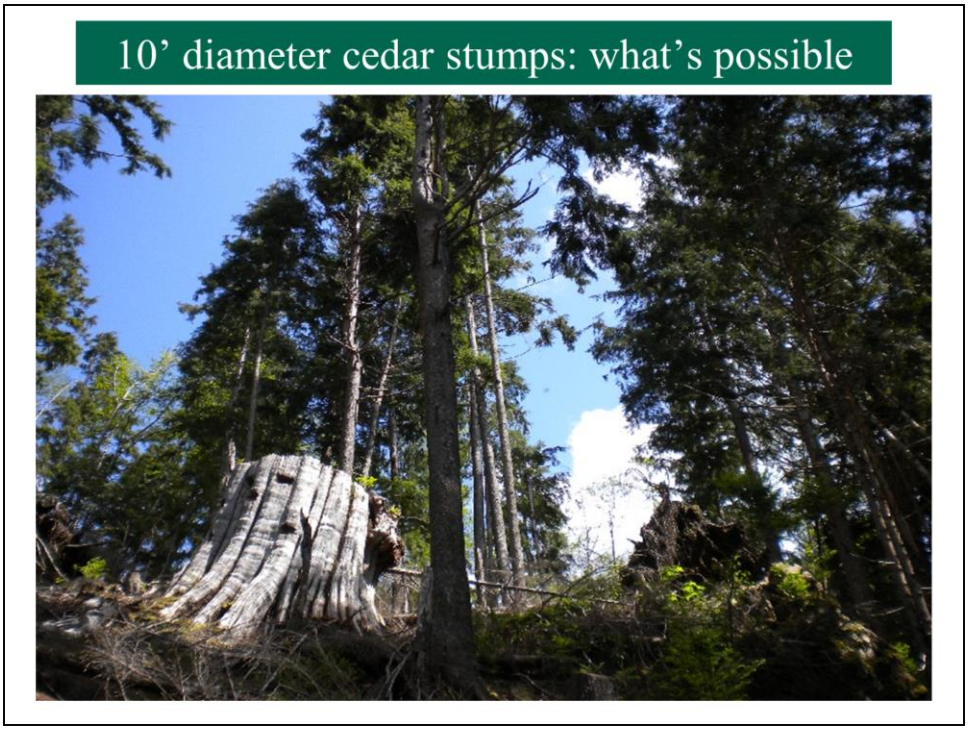


In the Riparian Zone at Wild Thyme Farm, a mixed-species plantation is approaching the “release” phase at 10 years. Management has dwindled to occasional thinning, pruning and re-planting.

This portion of the Riparian Zone is “complete” – for now. The alder trees have dominated and they are properly spaced for the duration of their lifetimes. Sitka spruce is holding its own in the understory and may wait out the alder to claim the site 50 years from now. Shade-intolerant understory trees have withered away.

End result of thinning, pruning & trail work

Deep Green Zone. Although parts of this stand have smaller-diameter trees that are less than optimal for DFC, further thinning and management would provide little benefit to the long-term outcome. In other words, scarce management resources are best directed elsewhere.



Legacy trees are well established in this stand. Sparse natural regeneration in the small openings will ensure the next generation. No need to replant or thin at this stage. Nice to have the big stumps juxtaposed with the existing trees to envision the path forward.

Variable-density thinning in NE Washington

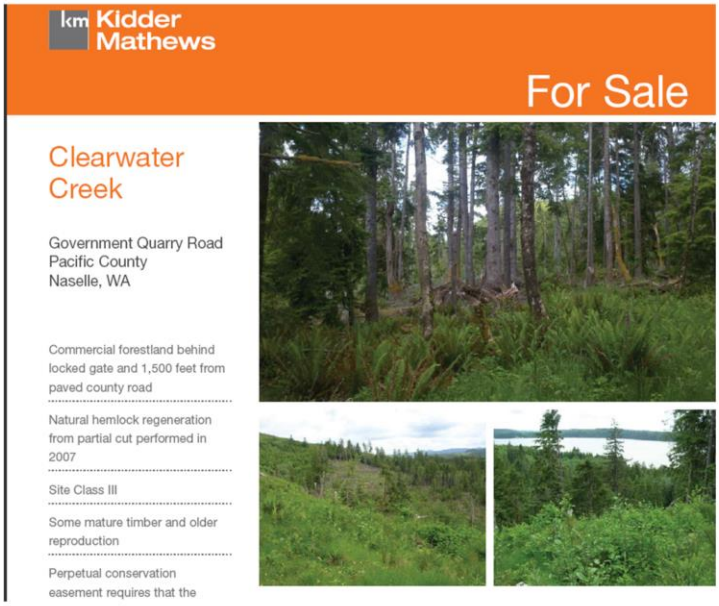
In regions like the intermountain west, which are less suitable for timber production, the open-grown format that leads to DFC also enhances wildlife habitat and wildfire resilience. Eastside landowners are more familiar and comfortable with this methodology than those on the Westside.

Finally, some challenging situations. Typical case in NE Washington where some would clear-cut this as a Red Zone and others would attempt to thin this as a Yellow Zone. It's more plausible to salvage this stand on the Eastside – would be foolhardy to attempt to save a stand in this condition on the Westside.

Salmon-bearing creek choked with woody debris

Another challenging situation where management is prohibited by regulation – the no-cut riparian core zone. Unfortunately, the retained alder is old and breaking apart. Brush and ferns are seizing the opportunity to take over as the sunlight increases, thwarting regeneration by long-lived conifers. The recent clear-cut just outside the riparian zone already has vigorous conifer re-growth, giving it a multi-decade head start on achieving DFC. Wood in the creek is a good thing, but small diameter alders melt away within 5 years.

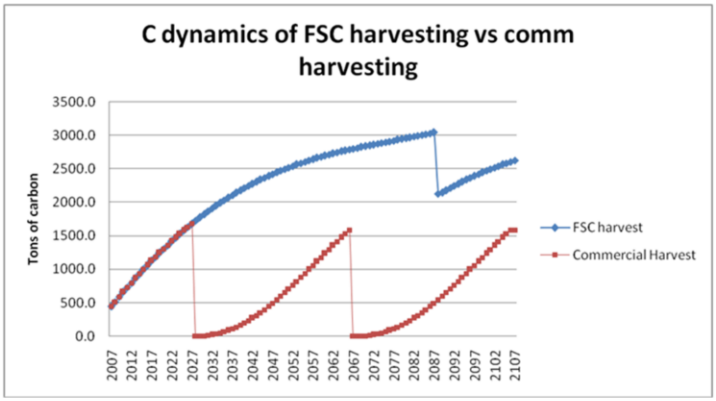
Challenges: Investment threshold is high



Challenges to growing big trees to scale are numerous. It costs as much as growing timber. Need to harvest at every opportunity where it does not conflict with the primary objective. Must be made whole financially (or at least 50% like Forest Riparian Easement Program - FREP) to encourage landowner participation. Selling a "timber easement" (hard asset-based investment) opens up funding source that bypasses issues with taxpayer subsidies. Harvestability (however far off in the future) must be legally guaranteed (Safe Harbor Agreement?) to make the investment credible. I'm going broke doing this by myself – not a good sign for scalability if landowner bears the full cost. 40-acre Clearwater Creek property: $100K minimum investment at year 15 – up to $500K by year 40.

Longer rotations push economic return later

Longer time in peak growth phase means less time in ramp-up phase and lots more sequestration



Beyond long-rotation forestry – this is indefinite-rotation forestry. Eventually every tree falls – we make the conscious decision whether to harvest or leave it to rot. You can create DFC and take no trees at all – it is just that much more expensive. Will want to have some unharvested sites anyways, so that we have control plots to compare to.

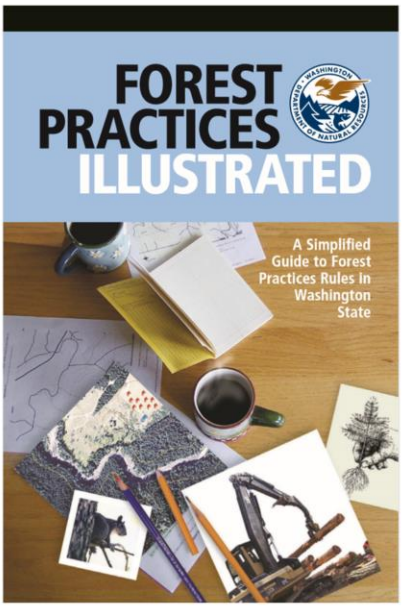
Inter-generational transfer is not assured

Timeframe of project/investment is measured in centuries. Cannot happen without the legal assurance and financial basis just described. Regulatory creep/uncertainty is toxic for engaging the next generation in forest management. It is difficult to recruit young people to take on this multi-generational endeavor if forestry has a bad reputation. It needs to be “cool” to be a tree farmer, like it is in Germany where forest managers are revered by the public for stewarding a cherished resource. (h/t Ken Miller)

Social license and potential litigation

The public needs to value forest management and support those who provide the investment and effort to make that happen. Growing big trees attracts endangered species along with increased resistance to harvesting and potential litigation. Environmental organizations need to champion this initiative in order for it to succeed, as small landowners are politically powerless and have no voice to shape the debate. We need advocates, not adversaries! This is the most critical challenge – with public support, all other challenges can be resolved relatively easily.

Regulatory process needs to emphasize positive outcomes



USDA NRCS Natural Resources Conservation Service

United States
Department of Agriculture

Natural Resources
Conservation Service

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Wild Thyme Farm
Conservation Reserve Program
FY 2000

Practice Implementation Schedule

490 – Forest Site Preparation:		612 – Tree Planting	
Field 1 @ 150 ft.	5.5 acres	Field 1 @ 150 ft.	5.5 acres
Total	5.5 acres	Total	5.5 acres
Implementation Date:		Implementation Date:	
Fall 2000		Spring 2001	

Cost Share Practices--Estimated Funding:

S10 *Hydro-Tiller*	- 500/ac (5.5 ac)	@ 50% NTE $0.35/tree or shrub	= $ 962.50
TS11 *Tree Planting Cost*	- (2750 t/s)	@ 50% NTE $0.50 each	= $1375.00
TS12 *Tree and Shrub*	- (2750 t/s)	@ 50% NTE $1.00 each	= $2750.00

Total Cost Share @ 50%.....$5,087.50

Post-regulatory paradigm: Like the Conservation Reserve Program (CRP), utilize a positive, forward-looking CONTRACT that aims for and achieves the stated objective (DFC) directly. Current regs (Forests & Fish) tries to achieve DFC via one-time, one size fits-all harvest restriction which is little better than a crap shoot: too little effect and definitely implemented too late. (80-20 rule: 80% positive outcome is determined by active management in first 20% of a tree's lifespan). Proposal: Freeze existing regulations as a "backstop" to ensure a skeptical public that protections will remain in place, then work towards voluntary, compensated programs to create better outcomes than what is currently provided by F&F regulations.

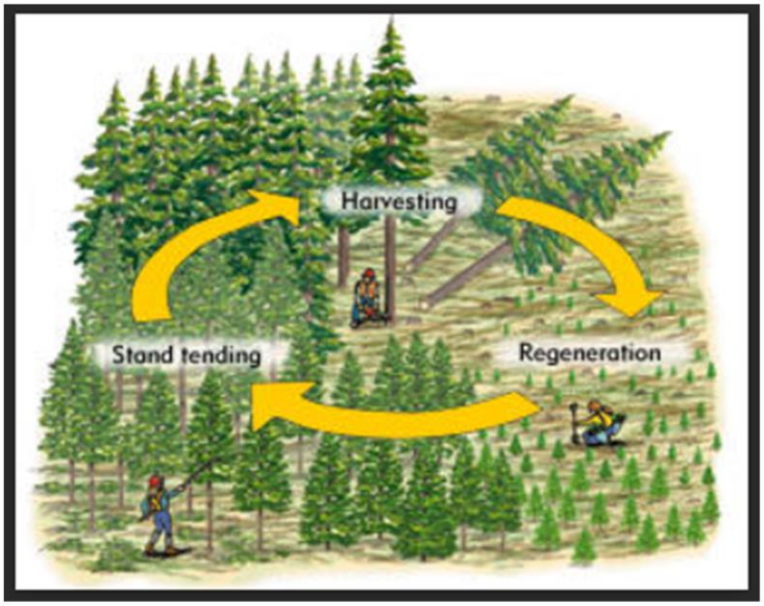
Logistics: Selective harvesting is costly and inefficient

Commercial thinning, single-tree extraction, large log handling is less efficient and more damaging than clearcut harvesting. Higher carbon cost in fuel per unit output, waste due to collateral damage, etc. Can be mitigated by future technological innovation.

Markets: Big logs can be a liability

Big log market is shrinking and losing value. Will require some re-tooling by mills, in a chicken and egg dilemma: need lots of big logs (and the legal certainty to cut them!) to justify the investment. It won't take long to grow big trees – this redwood is only 35 years old!

Silviculture for DFC is undeveloped

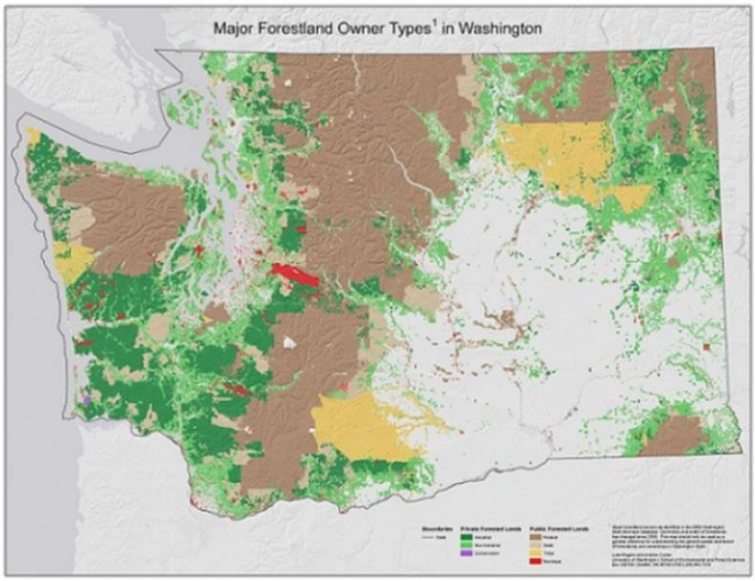


Not like conventional forestry, with over a hundred years of research and development. We are in uncharted territory. Seems easy as I just outlined, but very little practical research to draw on with the mix of species over long time frames; we'll have to learn as we go.

Extreme Weather & Climate Change

High risk exposure to extreme weather damage over a long time frame, even without climate change influence. Long-term climate change impacts could influence species selection when re-establishing stands. Lower stocking levels to increase tree vigor and reduce stress from competition dovetails with DFC focus on large trees with high crown to height ratios. Big, deep forests enhance the hydrological cycle by retaining moisture/generating clouds to mitigate drought and wildfire impacts; also better buffer for high precipitation events.

More than 50% of forestland in WA is non-commercial



Where can we do this? Easiest to implement on non-commercial ownerships – mostly federal and other public lands. Many of the aforementioned challenges do not apply here. Riparian, wetland and other buffers on industrial and private lands are also prime sites. If it's not growing timber commercially, and it's not designated parks or wilderness, it should be on the track towards DFC.

Extended rotations for commercial forestry

Longer-rotation commercial forestry on productive sites will also boost carbon sequestration. No silvicultural change aside from extending rotation (clear-cut harvest) age. This keeps the site in the high-growth section of the curve more of the time – with proportionately less time in the current 35 to 40 year ramp-up phase, Port Blakely voluntarily uses a 60 year rotation on a portion of their holdings, what about 80-100 years? Many of the same challenges listed above would apply - mostly financial and logistical, plus exposure to endangered species and litigation.

How do we coordinate all ownerships in this process?

Grand bargain: Industrials increase rotation age proportionate to new harvest on public lands to make up the difference. No net loss in statewide production – otherwise you just shift and magnify the impact elsewhere to less productive sites on the planet (100% leakage). Public land could all be shifted to longer rotation (on productive sites) and indefinite rotation (DFC) on sensitive sites. Wilderness areas, parks and undisturbed forests are left alone. Over time, industrial land footprint shrinks due to higher productivity overall. Trees get bigger across all ownerships and everyone wins.

Multi-generational Tree Farm – Toledo WA

Tree Farmers across the state are already developing legacy stands and are highly motivated to protect these special sites. They could do much more with financial incentives and greater public support for their overall operations. It's a lot of hard work for those who love the land and enjoy a working relationship with nature. Over time, by heeding and promptly responding to nature's cues., they become expert stewards in service to a forest that will long outlast them. These small, private landowners can provide the cheapest, fastest and most reliable path to big trees and carbon sequestration.

End of Slideshow