Testimony to the Joint Committee on Carbon Policy of the Oregon Legislature

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Thank you for the opportunity to provide testimony and for addressing these issues in the legislature. In my prepared remarks, I am going to address three questions and conclude with points for additional consideration. First, I will briefly address the question of what will climate change mean for Oregon's forests.

I. Climate Change Effects on Forests

Anticipated climate shifts are likely to affect working and natural lands in several ways, many of which are already observable:

Water stress

- Shifting precipitation patterns, drier summers, and reduced snowpack will likely result in increasingly water-limited forest systems, with resultant droughts, tree mortality, and wildfires occurring over larger areas.

- Increasing temperatures, combined with unchanging or decreasing available summer moisture, will lead to more frequent water deficits. Water stress can lead to reduced growth rates, increased tree mortality from insects and disease, and increased wildfire risk (Van Mantgem et al. 2009; Creighton et al. 2015). Water stress can also counter effects of CO_2 fertilization.

Wildfire

- Declining snowpack and earlier snowmelt lengthen the fire season. Warmer, longer seasons dry out forest fuels, and could double the average annual area burned and increase average fire intensity throughout the region (Creighton et al. 2015).

- Thus far, forests of Western Oregon (save for southwest Oregon) have largely been spared fire and tree mortality experienced elsewhere. Hotter, drier summers are leading to increasing chance of wildfire in Westside forests.

* In a scenario where global emissions continue to climb dramatically, the Willamette River Basin could see ~6 million total acres burned over the next century (OCCRI).

Shifts in site suitability

* Forests likely begin to change composition around mid-century. For instance, USDA Forest Service research suggests that, "*Based on statistical models of climate suitability, by the 2060s, climate changes west of the Cascade crest will be sufficient to put Douglas-fir at risk of maladaptation, particularly at low elevations throughout its current distribution*." (Anderson and Palik 2011)

* Models show drier vegetation ensembles of southern Oregon migrating north by 2100 (Rellatack et al 2018).

II. PRACTICES FOR JOINT MITIGATION & ADAPTATION (JMA)

Long-term conservation to attain higher forest carbon stocks should balance the risk of increasing mortality rates associated with climate change. Simply extending rotations, without attentive management, may expose forests to higher risk from disease, insect, and fire related mortality. This highlights the need for an adaptive management approach to forest management, and the need to be strategic with the application of adaptation, mitigation, and JMA practices. Restoring diversity of species, density, and age of forests across the region will increase resilience to impacts of climate change including, drought, insects, and wildfire. This strategy would also result in increased carbon storage in moist, westside forests.

Adaptation Practices

Climate vulnerability assessments can inform the development of adaptation plans.

* Increase forest diversity at the stand and landscape-scales by:
    * Extending rotation lengths on westside, through variable density thinning/harvesting;
    * Planting diverse species mixes in naturally occurring (e.g. in areas of wind throw or in areas of root rot) or management initiated gaps within the canopy.
    * USDA NRCS programs for forest landowners are using these approaches to increase forest diversity and resilience.

* In places where summer water deficits are likely to be exacerbated, planting drought tolerant species such as ponderosa pine, incense cedar, or Oregon white oak will likely provide more adaptive capacity than monocultures of Douglas fir.

- For Douglas fir dominant forests, test mixtures of lower elevation or more southerly seed sources, e.g. 450 to 600 meters lower in elevation, or 1.8 to 2.5 degrees south) (St. Claire and Howe 2007). Test introductions of new seed sources in small areas and/or in areas most stressed, or likely to become so, by climate change.

- In dry forests, adaptation strategies generally call for silvicultural treatments that retain and release older trees, reduce stand densities, shift composition toward fire and drought-tolerant tree species, and incorporate spatial heterogeneity at multiple scales.

Mitigation Practices

- Adjust forest management planning to include carbon inventory and management scenario modelling to forecast forest growth and carbon storage potential, and to weigh tradeoffs between carbon stocks and timber supply.

- Identify opportunities for forest conservation, afforestation/reforestation post-disturbance, and improving forest management.

- Forest management that shifts rotation lengths toward the culmination of mean annual increment (CMAI)1 is optimal from a carbon management perspective (Oliver et al. 2017; Franklin et al. 2018). In west Oregon Douglas fir forests, CMAI occurs around 80 – 117 years depending on site class (Curtis 1997; Curtis 1982; Curtis 1995).

- Analysis of Pacific Northwest region-wide FIA data covering the majority of forest types and ownerships found that by year 127 (+ 35 years) forests had sequestered 75% of their potential carbon stores (Gray et al. 2016). Industrial timber lands currently dominated by young stands storing approximately 1/3 of their ecological potential carbon.

JMA Practices

- In Western Oregon, older more carbon dense and diverse forests are more resilient to drought pressures, but also serve to moderate stream flows during extreme rain events, alleviating pressure on, and energy demand from, water treatment plants and reducing flood risk.

- Studies at Oregon State University's HJ Andrews Experimental Forest found:

[1] The age at which average rate of annual tree growth stops increasing and begins to decline.

  - Younger vigorously growing forests can transpire >3X more water than old forests (Moore et al. 2004; Perry 2008).
  - Longer forest harvest intervals maintain higher summer and fall streamflow enhancing salmonid recovery (stream temperature and connectivity), while storing more carbon.

- Maintain and/or expanding riparian forests enhances carbon stocks and improves adaptive capacity of aquatic ecosystems.

III. IDENTIFYING STRATEGIES FOR OREGON

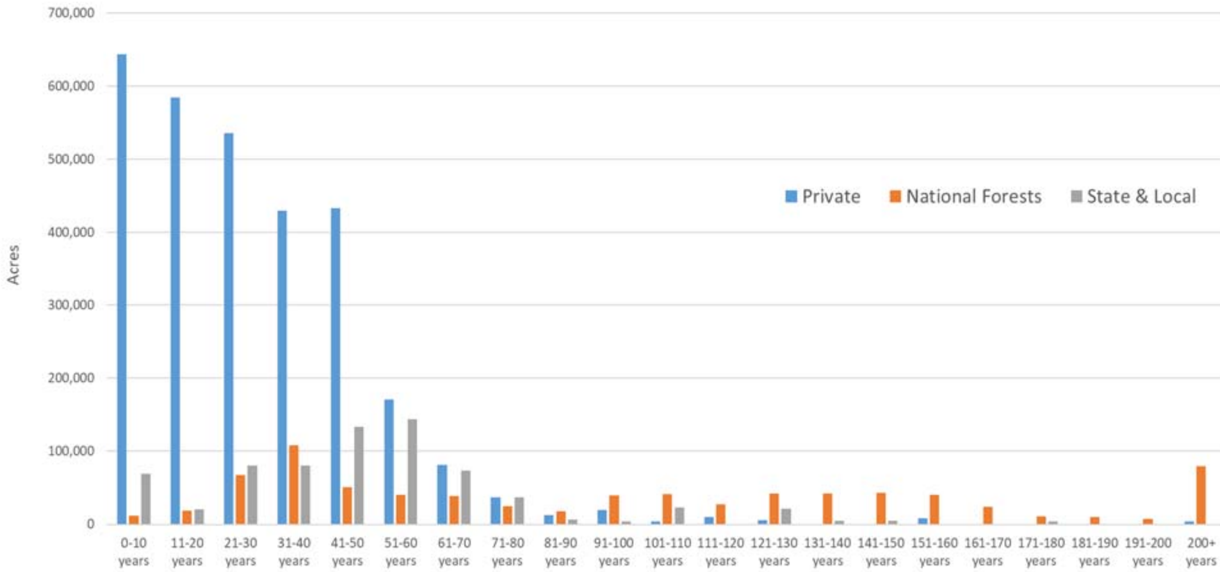
- In eastern and southern Oregon, efforts should continue to encourage forest adaptation by a combination of mechanical thinning and prescribed fire to reduce stand density and lower risk of high severity fire. e.g. the work being accomplished through ODF's Federal Forest Restoration Program.

- In the moist forests of Western Oregon, strategies will focus on: (1) conservation and sustainable management of high carbon stock forests, and (2) recovering carbon stocks in young forests.

- In the Coast Range, Forest Inventory and Analysis (FIA) data show that **carbon stocks on privately owned forests are roughly a third of their ecological potential** (Smithwick et al. 2002; Oregon Global Warming Commission 2018).

- Nearly two-thirds (63%) of private forestland in the Coast Range contain a dominant age-class of under 40 years old (see Figure 1).

Figure 1. Forest Age Class Distribution in the Oregon Coast Range.



Source: USDA Forest Service FIA 2016.

- Increasing age class diversity and average age in the Coast Range could have profoundly positive carbon impacts.

- Using Curtis' (Curtis 1982; Curtis 1995) growth chart and a reference ratio of 15.335 C lbs/ft3 (= 0.026 mtCO2e/ft3) (Franklin et al. 2018) for coastal Douglas fir, we find extending rotations (assuming productive class II sites) in the Oregon Coast Range from 40 to 90 years could gain up to 216 mtCO2e/acre over the interim 50 years.

- Moving the 862,000 acres of private coastal timberland currently between the ages of 31 - 50 years (see Figure 1) to the 81 - 90 year age class could technically result in an overall gain of an estimated ~200,000,000 mtCO2e over the next 40 to 50 years (not discounting for leakage).

- Considering economic, social, and political constraints, increases on this scale are likely not be feasible. Non-industrial forestlands and municipal watersheds present the greatest opportunities for carbon gains in Western Oregon.

- For the former, conserving and sustainably managing older non-industrial forests using a partial cutting and/or continual thinning systems is one option. This is conducive with existing carbon offset protocols.
    - For example, Raincloud Tree Farm in Clackamas County at 116 acres this is the smallest California Air Resources Board registered improved forest management (IFM) offset project ever.

Actively managed for 45 years, enough wood has been harvested to build 130 homes while growing timber volume by 66%. The offset project will ensure that carbon stocks built up through good stewardship will remain onsite for 125 years. Offset payments will cover the carrying cost of owning the property. Management going forward will allow for harvesting roughly half of annual growth.

- Offsets will ultimately affect a limited amount of forestland and only appeal to a select group of landowners at current prices. Given the structure and challenges to entry in current carbon offset markets, participation has been limited to date.

- Since carbon storage aligns with many family forest owner's goals and objectives, another approach in addition to offsets would be a "forest carbon incentive program" similar to existing Farm Bill programs (Pinchot Institute 2011; S.2350 - Forest Incentives Program Act of 2018)

    - The core of the concept is to: (1) assign emission reduction rates for certain practices (e.g. rotation extension, reduced impact logging) based on the best-available science, modelling, and sound carbon accounting principles, and (2) quantify emission reduction benefits not at the parcel level, as is done in carbon offset projects, but at the programmatic level, via periodic inspections by state forestry stewardship foresters and/or via remote sensing.

IV. OVERARCHING STRATEGIES

The state should seriously consider aligning policies and programs--ranging from market-based offsets, to landowner assistance, to building materials--to accelerate emissions reductions on the land and to do so in a way that complements the economics of land ownership.

1. **Secure forests sinks**. No net loss of land-based carbon stores.

    a. *Monitor, quantify, and report on land-based carbon stocks* at a state-level on continual basis with common data sources (e.g. coinciding with five-year FIA data updates). Report on carbon stocks by ownership type, forest type, and ecoregion.

    b. *Develop targets for maintaining forest carbon stocks*. These targets can be organized across ecoregions and ownership categories and adjusted to account for variability in ecological potential, carbon stocking, and resilience to disturbance.

c. *Avoid backsliding.* Maintain the forestland base by employing ‘No net loss of forests and/or no net loss of forest carbon’ in Oregon.[2]

d. *Consider ways to integrate emissions from land-use change into mitigation policies*.

e. *Expand investments in forest resilience* programs to minimize risk of high severity wildfire and reduce climate driven forest mortality, and associated forest carbon stock loss.

2. **Optimize forest sink growth**. Expand landscape carbon stores by taking advantage of Oregon’s ability to grow carbon dense forests.

a. *Develop targets for expanding forest carbon stocks*, segmented by ecoregion and ownership. Emphasize storage in ecosystems with high ecological potential and lower risk of losing carbon through climate driven disturbance.

b. *Increase retention at harvest* (e.g. leaving wider riparian buffers, leaving groups of standing live and dead trees).

c. *Extend forest harvest rotations through a combination of mechanisms*. Options include:

i. Option 1--Offset protocols that conserve carbon dense forests and encourage long-rotations, verify additional carbon storage at the project-level, and have a degree of permanence. Upside--offsets are long-term carbon conservation projects. Downside--offsets will affect a small portion of the overall forested landscape;

ii. Option 2--Incentives that “rent” carbon by compensating landowners for incrementally expanding forest carbon stocks beyond regional average stocking, through some combination of extended rotations and enhanced retention (e.g. wide riparian buffers). Upside--may affect change across a larger area than offsets alone. Downside--may lack the permanence feature of offsets.

[2] A recent study of FIA data across Oregon and Washington found that forestland conversion occurring between the 1990s and early 2000s negated 25% of the additional forest carbon that accumulated in these states over the same period (Watts et al. 2017). Oregon, frequently held up as a paragon of land use policy, lost an average of nearly 51,000 acres each year between 2000 and 2014 (Hubner et al. 2016).

d. Mitigate potential negative leakage through comprehensive policy design and careful implementation.

3. **Invest in the forest economy to align with carbon goals.**

   a. Align forest management (e.g. long rotations) and forest product pathways (e.g. long-lived building systems) that increase the carbon carryover from in-forest to off-forest carbon pools and displace GHG intensive pathways (Oliver et al. 2014; Franklin et al. 2018).

      i. Advance research and deployment of wood utilization technologies and markets that encourage the use of 'big wood,' i.e. timber grown on longer than average rotations, and 'small wood,' i.e. byproducts of forest health and resilience treatments.

   b. Align economic incentives (tax breaks, loan guarantees, grants, etc.) to overcome barriers to realizing the most beneficial forest management and linked wood product pathways. Build markets and infrastructure (e.g. capacity to process larger logs) needed to move toward longer rotation forestry.

      i. Leverage public and private investments to retool and/or expanding wood utilization infrastructure to expand the market for wood produced from (a) lengthened rotations, and (b) forest health and resilience treatments.

V. CONCLUSIONS

Climate change will impact Oregon's forests in several ways. A range of impacts will occur in the variety of forest types existing across the state. Flexibility will be needed by forest managers to address climate change through mitigation, adaptation, and where possible, joint mitigation and adaptation (JMA) strategies. Flexibility will also be needed in technical assistance and funding programs.

Critical to all this is: (1) maintaining forests as forests, (2) preserving forests with high carbon stocks, and (3) aiding the recovery of forests with depleted carbon stocks.

In Southern and Eastern Oregon, increased prescribed burning and mechanical treatments may be needed to protect against increasing fire risk and subsequent carbon loss. In some instances this may result in short-term negative carbon consequences. Whereas strategies in Western Oregon can take advantage of having some of the most productive forests globally.

Current harvesting cycles on private lands in Western Oregon leave the most productive forests predominantly under 40 years old, consequentially they are storing a third or less of their ecological potential as a carbon sinks. Extending rotations to the culmination of mean annual increment, i.e. the point of maximum wood accumulation, is a more optimal carbon strategy than the current scenario.

In doing so, it is possible to sequester roughly an additional 200,000,000 metric CO_2e over the next 40 - 50 years. This is a technical maximum that assumes 100% participation on all forests currently 40 years or less. Feasible opportunities for improved stocking in the Coast Range will be dictated by economics, social acceptability, and policy.

A range of strategies can be implemented to secure existing carbon sinks, expand the forest carbon sink while keeping it resilient, and invest in the forest economy in a manner aligned with carbon goals. Co-benefits to these strategies include an increase in the value of wood at harvest, diversifying the forest products sector, enhanced adaptive capacity, as well as many other ecological benefits.

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