The Forest Carbon Picture in Oregon:

A Key Role in the State’s Carbon Footprint and Performance

(Final)

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Oregon Global Warming Commission Member
Chair – Commission Forest Advisory Task Force
Oregon’s Forest Carbon Picture

Task Force member representation:

Oregon State University
US Forest Service Forestry Sciences Lab
Geos Institute
The Nature Conservancy
Weyerhaeuser
Green Diamond Resources Co.
Mater Ltd.
Pinchot Institute for Conservation
Spatial Informatics Group

Agency Assist:  ODOE
               ODOF
               ODEQ
OGWC Forest Advisory Task Force challenges:

Obtain and analyze new forestry data to help determine Oregon’s forest carbon picture **by carbon pool and flux across pools**.

- ✓

*Analyze by eco-region.* This analysis should include carbon emissions due to forest fire.

- ✓

Develop **forest carbon annual monitoring and reporting template** by eco-region to be used by OGWC in their future reporting to the legislature. Sound, uniform protocol established but intervals for updates likely every five years.

- ?
In-boundary carbon only – analysis intentionally stays within forest boundaries. 2001-2005 compared to 2011-2015 (ten years).

Full carbon life-cycle - analysis considers all aspects of carbon source and sink life-cycle: harvest, transportation to mill, product processing; life span of product, product substitution (wood vs concrete, steel, etc.).
**Key Sources of Data:** *(In peer-review for publication)*

**USFS PNW Research Station:** *(Fried, Gray, et al)*

- Updated *forest inventory* data *(gross carbon, emissions, net carbon)*
- Statewide; by eco-region; by landowner type
- **No modeling**
- All Oregon field-based data (4800 field plots; 150,000 trees; 10 years; one plot every two acres cruise protocol)

**OSU College of Forestry:** *(Law, et al)*

- New field data on carbon *emissions due to fire*
- Statewide; by eco-region; by public and private ownership
- **No modeling**
- All Oregon field-based data (analysis covers 32 years)
All data sorted by six eco-regions . . .

- Coast Ranges
- Klamath
- Western Cascades
- Eastern Cascades
- Blue Mountain
- Northwest Basin (very small carbon contribution)

. . . then analyzed by forestland owner in the eco-regions:

- National Forest System (NFS)
- National Park Service (NPS)
- BLM
- State
- Private Industrial (PI)
- Private Non-Industrial (PNI) (“family forests”)
- “Other”
### Oregon’s Forest Carbon Picture

#### Who owns what?

(\(~30\) million acres)

<table>
<thead>
<tr>
<th>Public</th>
<th>Private</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>21,008,569</td>
<td>10,147,775</td>
<td>25,993</td>
</tr>
<tr>
<td>67%</td>
<td>33%</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Acres</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>1,034,416</td>
<td>3%</td>
</tr>
<tr>
<td>NFS</td>
<td>15,377,308</td>
<td>49%</td>
</tr>
<tr>
<td>NPS</td>
<td>166,922</td>
<td>1%</td>
</tr>
<tr>
<td>BLM</td>
<td>4,429,923</td>
<td>14%</td>
</tr>
<tr>
<td>PI</td>
<td>4,923,737</td>
<td>16%</td>
</tr>
<tr>
<td>PNI</td>
<td>5,224,038</td>
<td>17%</td>
</tr>
<tr>
<td>Other</td>
<td>25,993</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>31,182,337</strong></td>
<td></td>
</tr>
</tbody>
</table>
Oregon’s Forest Carbon Picture

Ownership Optics

Who owns what where? (~30 million acres)

- West Cascades (5.7 million acres)
- Coast Range (5.2 million acres)
- Blue Mountain (8 million acres)
- Klamath (3.3 million acres)
- East Cascades (3.7 million acres)
Oregon’s Forest Carbon Picture

<table>
<thead>
<tr>
<th>Pool</th>
<th>Ctn/ac</th>
<th>35%</th>
<th>47%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Statewide</td>
<td>~90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>above ground live tree</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>above ground snag</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>downed and woody material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>forest floor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>carbon/soil/org</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ranges between 3% to 7% for each pool no matter which eco-regions

- Biggest pools in above-ground live tree and soils (70%-80% for every eco-region).
- Above-ground live tree most dynamic carbon pool; soil carbon fairly constant per eco-region and over time.
- State average ~ 90 metric tons of carbon per acre. West Cascades, Coast Range, and Klamath eco-regions highest metric tons of carbon per acre.
4 Important **In-Boundary Numbers to Track in Forest Carbon:**

1. **Gross Growth:** Gross carbon sink due to *tree growth*

2. **Emissions due to mortality:** Carbon emitted due to *tree death* (includes fires)

3. **Emissions due to harvesting:** Carbon emitted due to *tree removal*

4. **Net growth:** Gross carbon sink minus *mortality and harvesting*
Oregon’s Forest Carbon Picture

[Diagram showing forest carbon sinks and sources per year with detailed data points.]

For example:
- **Total emissions**: 60 million metric tons CO2e yr
- **Forest carbon sources and sinks**: 88 mm CO2e yr gross sinks, 58 mm CO2e yr emissions, 30 mm CO2e yr net sinks

**Key points**:
- **Net carbon sinks from forests**: 30 mm CO2e yr
- Equivalent to 50% of all other statewide emissions per year

**Forest carbon by the numbers**
Blue Mountains and West Cascades eco-regions supply majority of forestlands in the state . . . .

... but 73% of statewide net forest carbon gains come from three eco-regions (Coast Range, West Cascades, and Klamath)

% of state totals:

- Gross carbon growth: (75%)
- Carbon loss/yr: (76%)
- Net carbon gain/yr: (73%)
## Oregon’s Forest Carbon Picture

### Overall. (2001-’05 compared to 2010-’15): all forestland owners show a net growth in CO2e sinks per year. It is notable that private non-industrial forestlands produce the third largest net carbon sinks.

<table>
<thead>
<tr>
<th>All Eco-Regions in Oregon</th>
<th>CO2e thousand metric tons/yr</th>
<th>% loss mortality*</th>
<th>% loss harvest*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gross growth</td>
<td>loss*</td>
<td>net growth</td>
</tr>
<tr>
<td>BLM</td>
<td>11429</td>
<td>2405</td>
<td>9024</td>
</tr>
<tr>
<td>NFS</td>
<td>32028</td>
<td>18214</td>
<td>13814</td>
</tr>
<tr>
<td>State</td>
<td>4558</td>
<td>3615</td>
<td>943</td>
</tr>
<tr>
<td>PI</td>
<td>27062</td>
<td>25920</td>
<td>1142</td>
</tr>
<tr>
<td>PNI</td>
<td>5619</td>
<td>3358</td>
<td>2261</td>
</tr>
</tbody>
</table>

### But devil is always in the detail . . .
### Overall Blue Mountain Eco-Region

#### Thousand metric tons CO2e/yr

<table>
<thead>
<tr>
<th>Blue Mountain</th>
<th>BLM</th>
<th>NFS</th>
<th>State</th>
<th>PI</th>
<th>PNI</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>gross growth</td>
<td>189</td>
<td>6848</td>
<td>65</td>
<td>1180</td>
<td>1009</td>
<td>9291</td>
</tr>
<tr>
<td>mortality</td>
<td>9</td>
<td>3187</td>
<td>33</td>
<td>184</td>
<td>153</td>
<td>3566</td>
</tr>
<tr>
<td>removals</td>
<td>49</td>
<td>524</td>
<td>0</td>
<td>1042</td>
<td>250</td>
<td>1865</td>
</tr>
<tr>
<td>net growth</td>
<td>131</td>
<td>3137</td>
<td>32</td>
<td>-46</td>
<td>606</td>
<td>3860</td>
</tr>
</tbody>
</table>
Overall East Cascades Eco-Region

East Cascades
(Thousand metric tons CO2e/yr)

<table>
<thead>
<tr>
<th>East Cascades</th>
<th>BLM</th>
<th>NFS</th>
<th>State</th>
<th>PI</th>
<th>PNI</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>gross growth</td>
<td>55</td>
<td>3561</td>
<td>126</td>
<td>1581</td>
<td>324</td>
<td>5647</td>
</tr>
<tr>
<td>mortality</td>
<td>23</td>
<td>1861</td>
<td>18</td>
<td>38</td>
<td>38</td>
<td>1978</td>
</tr>
<tr>
<td>removals</td>
<td>38</td>
<td>648</td>
<td>73</td>
<td>878</td>
<td>5</td>
<td>1642</td>
</tr>
<tr>
<td>net growth</td>
<td>-6</td>
<td>1052</td>
<td>35</td>
<td>665</td>
<td>281</td>
<td>2027</td>
</tr>
</tbody>
</table>
Overall Coast Range Eco-Region

Coast Range
(thousand metric tons CO2e/yr)

<table>
<thead>
<tr>
<th>Thousand metric tons CO2e/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLM</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>gross growth</td>
</tr>
<tr>
<td>mortality</td>
</tr>
<tr>
<td>removals</td>
</tr>
<tr>
<td>net growth</td>
</tr>
</tbody>
</table>

Overall Coast Range Eco-Region

Oregon’s Forest Carbon Picture

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Oregon’s Forest Carbon Picture

Overall Klamath Eco-Region

<table>
<thead>
<tr>
<th>Klamath</th>
<th>Thousand metric tons CO2e/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BLM</td>
</tr>
<tr>
<td>gross growth</td>
<td>2904</td>
</tr>
<tr>
<td>mortality</td>
<td>690</td>
</tr>
<tr>
<td>removals</td>
<td>33</td>
</tr>
<tr>
<td>net growth</td>
<td>2181</td>
</tr>
</tbody>
</table>
Oregon’s Forest Carbon Picture

Overall West Cascades Eco-Region

West Cascades
(Thousand metric tons CO2e/yr)

<table>
<thead>
<tr>
<th>West Cascades</th>
<th>Thousand metric tons CO2e/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BLM</td>
</tr>
<tr>
<td>gross growth</td>
<td>2608</td>
</tr>
<tr>
<td>mortality</td>
<td>474</td>
</tr>
<tr>
<td>removals</td>
<td>54</td>
</tr>
<tr>
<td>net growth</td>
<td>2080</td>
</tr>
</tbody>
</table>
Performance in net forest carbon sinks per year

Performance in net forest carbon sinks per year

Net Carbon Growth per Year
(thousand metric tons CO2e/yr)

- BLM: 33%
- NFS: 51%
- State: 3%
- PI: 4%
- PNI: 8%

High contributors: BLM, NFS
Low contributors: State, PI, PNI
Oregon’s Forest Carbon Picture

A worrisome trend: Gross growth in carbon sinks declining since 1986 . . .

<table>
<thead>
<tr>
<th></th>
<th>2010-2015</th>
<th>Thousand metric tons CO₂e/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLM</td>
<td>12,175</td>
<td></td>
</tr>
<tr>
<td>NFS</td>
<td>32,893</td>
<td>37,392</td>
</tr>
<tr>
<td>State</td>
<td>4,845</td>
<td>5,377</td>
</tr>
<tr>
<td>NPS</td>
<td>334</td>
<td>228</td>
</tr>
<tr>
<td>Other</td>
<td>559</td>
<td>74</td>
</tr>
<tr>
<td>Totals</td>
<td>75,467</td>
<td>77,260</td>
</tr>
<tr>
<td>Private</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PI</td>
<td>28,568</td>
<td>22,714</td>
</tr>
<tr>
<td>PNI</td>
<td>8,268</td>
<td>11,475</td>
</tr>
<tr>
<td>Totals</td>
<td>36,834</td>
<td>34,189</td>
</tr>
<tr>
<td>NFS:</td>
<td>12% loss</td>
<td></td>
</tr>
<tr>
<td>State:</td>
<td>10% loss</td>
<td></td>
</tr>
<tr>
<td>PNI:</td>
<td>~30% loss</td>
<td></td>
</tr>
</tbody>
</table>

Significant gross carbon loss in private non-industrial forestlands (PNI). Why?

Over 90% of total forestland loss in Oregon from this sector. Over 300,000 acres lost since 1974.
GHG emissions due to fire:

Of 58 million metric tons CO2e/yr emissions generated from Oregon forests each year, how much due to forest fires?

**Answer:**

Public lands: ~2-4 million metric tons CO2e/yr, only 5% of total forest carbon emissions/yr but as much as generated by .....  

Private lands: between 350,000 to 650,000 metric tons CO2e/year.
## Oregon’s Forest Carbon Picture

### Emissions due to fire . . . a worrisome trend for private forestlands?

<table>
<thead>
<tr>
<th>Ecoregion:</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Mountains</td>
<td>69%</td>
<td>300%</td>
</tr>
<tr>
<td>Cascades</td>
<td>-66%</td>
<td>23%</td>
</tr>
<tr>
<td>Coast Range</td>
<td><em>no fires</em></td>
<td><em>no fires</em></td>
</tr>
<tr>
<td>Columbia Plateau</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Cascades</td>
<td>-20%</td>
<td>60%</td>
</tr>
<tr>
<td>Klamath</td>
<td>-73%</td>
<td>180%</td>
</tr>
<tr>
<td>Northern Basin</td>
<td>-57%</td>
<td>81%</td>
</tr>
</tbody>
</table>

Public lands: Decreased by ~60%. Decreases occurred in every eco-region where fire occurred save the Blue Mountain eco-region.

Private lands: Increased by ~80%. Increases occurred in every eco-region where fire occurred.
Burned acres don’t directly translate to CO2e emissions . . .

<table>
<thead>
<tr>
<th>Year</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>500,000</td>
</tr>
<tr>
<td>2003</td>
<td>91,000</td>
</tr>
<tr>
<td>2007</td>
<td>195,000</td>
</tr>
<tr>
<td>2012</td>
<td>1.17 million</td>
</tr>
</tbody>
</table>
Oregon’s Forest Carbon Picture

Average annual CO2e emissions from fire
(2001-2005 compared to 2011-2014)

2002: ~500,000 ac
2007: ~200,000
2003: ~91,000 acres

BUT, in 2012: ~1 million acres

Why the difference?
Forestlands vs grasslands...

Acres burned don’t tell the story . . .

Statistically, no changes in fire severity over last 30 years
Oregon’s Forest Carbon Picture

7 key findings:

- **Forests are a key carbon sink performer in the state.** Oregon forests produce a net sink of CO2e/year that is equivalent to 50% of all other annual statewide emissions combined (net ~30 million metric tons of CO2e sink annually).

- ~ 75% of forest carbon performance in the state is located in three western eco-regions.

- Private industry (PI) forestland owners and the BLM are releasing more carbon into the atmosphere per year than they are sinking in two of state’s five eco-regions (Blue Mountain and East Cascades). In two of the five eco-regions, all forestland owners produce a net carbon gain/yr (Klamath and West Cascades). In the Coast Range eco-region, private industrial forestland owners produce no net carbon gains.

- Net carbon sink/yr by forest landowner type is a key performance criteria. Annual net carbon sinks from private industrial and state forestlands are notably low compared to private non-industrial and federal forestlands.

- Emissions due to tree mortality across all landowner forests appear to be decreasing over time, while emissions from harvesting are increasing.

- A worrisome trend: gross growth in carbon sinks especially from private non-industrial forestlands is notably decreasing over time.

- Emissions due to fires do not appear to be increasing overtime. However, emissions due to fire from private forestlands are notably increasing.