Overview

- FIA 101: Overview of FIA program and sample design
- FIA forest carbon reporting at the PNW Research Station
- Carbon inventory methodology – stocks and flux
- Washington carbon inventory results
FIA 101: What is FIA?

• Forest Inventory and Analysis (FIA): Forest Service R&D Program – We are the Nation’s Forest Inventory

• Congress authorized the program with the McSweeney-McNary Forest Research Act of 1928

• Initially started as a marketable timber survey
  • Periodic data collection - State-by-state basis, intervals varied by state

• 1998 Farm Bill - Annualized inventory for all forest resources
  • Annual inventory to provide data on status and trends
  • Inventory all forest lands, on all ownerships
  • Consistent sampling protocol, compilation, database, reporting requirements
FIA 101: Funding and Direction

• How is FIA funded?
  • Annual Congressional appropriations
  • Agreements with state cooperators, universities, government agencies
  • Partnerships with other branches of the Forest Service: National Forest Systems, State and Private, other R&D programs

• Who provides FIA direction and oversight?
  • 2014 Farm Bill set current national direction
  • Strategic plans implement direction – guided by national office, FIA regions, national stakeholders, and regional representatives
FIA – Current Sampling Design

• **All** forested lands
  - All states, territories, and U.S. affiliated islands
  - All ownerships – public, private, National Forests, National Parks, wilderness areas, military installations, etc.

• **Sampling intensity** – Annualized design
  - 10% of all plots measured every year in the western states, 10 year remeasurement cycle
  - Field measured plots permanently located on a base grid of 1 plot per 6,000 acres
  - Some states “buy down” the cycle length and sampling grid intensity through matched contributions
FIA is a National Program of 4 Regions a.k.a. “work units”

FIA at PNW
Alaska
California
Oregon
Washington
Hawaii
Guam
American Samoa
Palau
Marshall Islands
Federated States of Micronesia
Northern Mariana Islands
FIA online: www.fia.fs.fed.us

- State summary reports
- Reporting tools
- Data Mart: Download inventory databases
- Documentation and training
- Status of inventory
FIA National Program: Carbon Assessments

- US EPA Greenhouse Gas Inventory
- National Climate Assessment
- National Forests Carbon Assessments
- FAO Global Forest Resources Assessment
- UN Land use, Land change and Forestry Assessment
Forest Carbon Reporting at PNW-FIA

• California –
  • 2008: PNW-FIA completed initial forest baseline carbon estimates for California Air Resources Board in support of California Cap & Trade forest protocol and AB32
  • 2014: Agreement with CAL FIRE for first carbon report
  • 2016: First report to meet California Assembly Bill 1504 needs based on 2006-2015 inventory years
  • 2018: Second AB 1504 report based on 2008-2017 inventory years
    • Added carbon in harvested wood products (HWP)

• Oregon –
  • 2018: Oregon Department of Forestry requests forest carbon and harvested wood products report similar to California reports. Completed October 2019

• Washington –
  • 2018: Washington Department of Natural Resources requests forest carbon report similar to Oregon and California reports. Draft completed November 2019
FIA in Washington

Annual field measurements began 2002
Current 10-year period, 2007-2016:
• 6,112 field plots measured
• 22.1 million ac of forest land
• 9.3 billion trees > 1-inch DBH
• 46% True fir/Douglas-fir
Washington
Forest Carbon Stocks and Flux
FIA Forest Carbon Pools

• Forest carbon pools include:
  • Live trees
    • Foliage
    • Roots
  • Standing dead trees
    • Roots
  • Downed woody debris
  • Understory vegetation
    • Roots
  • Forest floor – duff and litter
  • Soils

• Carbon stored as harvested wood products is not included
Forest Carbon Stocks – CA, OR, WA

- Above-ground live trees: Uses PNW regional biomass equations, added foliage weight
- Above-ground dead trees: Same as live trees, reduction for decay and tendency for bark and branches to shed faster than bole biomass
- Below-ground live and standing dead trees (roots): National FIA protocol
- Downed woody debris: National FIA protocol, piles not included
- Understory vegetation: As modeled and populated in FIADB
- Forest floor: As modeled and populated in U.S. National Greenhouse Gas Inventory
- Organic soils: As modeled and populated in U.S. National Greenhouse Gas Inventory
Carbon Stocks, estimate of current status: 10-yr cycle

Installation

Re-measurement

Current status

## Total Carbon Stocks on Forest Land by Pool, All Ownerships: 2007-2016

<table>
<thead>
<tr>
<th>CARBON POOL</th>
<th>Total (million metric tons C)</th>
<th>SE (metric tons C per acre)</th>
<th>Total (metric tons C per acre)</th>
<th>SE (metric tons C per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Live trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aboveground live¹</td>
<td>901.6</td>
<td>10.5</td>
<td>40.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Belowground live</td>
<td>182.0</td>
<td>2.2</td>
<td>8.2</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Dead trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aboveground dead</td>
<td>80.5</td>
<td>2.0</td>
<td>3.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Belowground dead</td>
<td>22.1</td>
<td>0.5</td>
<td>1.0</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td><strong>Understory vegetation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aboveground</td>
<td>25.4</td>
<td>0.2</td>
<td>1.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Belowground</td>
<td>2.8</td>
<td>&lt;0.1</td>
<td>0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td><strong>Downed wood</strong></td>
<td>149.8</td>
<td>2.3</td>
<td>6.8</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Forest Floor</strong></td>
<td>129.0</td>
<td>0.8</td>
<td>5.8</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td><strong>Soil Organic C</strong></td>
<td>1,224.8</td>
<td>6.9</td>
<td>55.4</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>TOTAL FOREST STOCKS</strong></td>
<td>2,718.2</td>
<td>18.5</td>
<td>122.9</td>
<td>0.7</td>
</tr>
</tbody>
</table>

¹includes live tree foliage
Forest Carbon Flux: Estimates of change

- Results represent 50% remeasurement of all FIA plots in Washington, all will be remeasured by 2021.
- Every pool of forest carbon has a rate of carbon input and rate of carbon output.
- Flux represents the amount of carbon going into a pool minus the amount going out.
- Flux is reported in units of CO2 equivalents.
- Current estimates of forest carbon flux are based on one repeat plot measurement.
- Annual forest carbon flux is estimated from actual measurements of growth, removals, and mortality.
- Carbon removed as a harvested wood product is not included.
Change (flux) is based on the measured growth on the same set of plots and trees 10 years apart. Estimated carbon flux is the average change of the 10 year periods. Ex. Average annual carbon flux (CO2e) in Washington is based on 10 year time periods starting in 2002 through 2006, compared to 10 years later in 2012 through 2016. As of 2016 50% of all FIA plots have been remeasured.
### Statewide Forest CO₂e Net Flux

<table>
<thead>
<tr>
<th>CARBON POOL</th>
<th>Total</th>
<th>SE</th>
<th>Total</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>million metric tons CO₂e per year</td>
<td></td>
<td>metric tons CO₂e per year</td>
<td></td>
</tr>
<tr>
<td><strong>Live trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aboveground live</td>
<td>15.14</td>
<td>3.29</td>
<td>0.65</td>
<td>0.15</td>
</tr>
<tr>
<td>Belowground live</td>
<td>3.11</td>
<td>0.75</td>
<td>0.14</td>
<td>0.03</td>
</tr>
<tr>
<td><strong>Dead trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aboveground dead</td>
<td>4.08</td>
<td>0.91</td>
<td>0.18</td>
<td>0.04</td>
</tr>
<tr>
<td>Belowground dead</td>
<td>0.64</td>
<td>0.23</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Understory vegetation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aboveground</td>
<td>-0.06</td>
<td>0.04</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Belowground</td>
<td>-0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td><strong>Downed wood</strong></td>
<td>-6.85</td>
<td>1.19</td>
<td>-0.31</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>NET VEGETATION FLUX</strong></td>
<td>16.06</td>
<td>4.27</td>
<td>0.73</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>Forest Floor</strong></td>
<td>0.25</td>
<td>0.21</td>
<td>0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td><strong>N-fertilization</strong></td>
<td>-0.13</td>
<td>0.10</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td><strong>Soil Organic C</strong></td>
<td>-0.17</td>
<td>0.30</td>
<td>-0.01</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>TOTAL FOREST NET FLUX</strong></td>
<td>16.00</td>
<td>4.40</td>
<td>0.73</td>
<td>0.20</td>
</tr>
</tbody>
</table>

1 Includes live tree foliage
2 Estimated CO₂e emission associated with nitrogen fertilization on commercial timberland in western Washington

Unpublished draft data – do not cite
## Live Tree Annual Carbon Flux (CO$_2$e), All Ownerships: 2002-2006 to 2012-2016

### CARBON POOL

<table>
<thead>
<tr>
<th>Standing live trees(^1)</th>
<th>Total</th>
<th>SE</th>
<th>Total</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>-32.9</td>
<td>1.2</td>
<td>-1.49</td>
<td>0.06</td>
</tr>
<tr>
<td>Removals</td>
<td>-31.2</td>
<td>2.7</td>
<td>-1.42</td>
<td>0.12</td>
</tr>
<tr>
<td>Gross growth</td>
<td>78.4</td>
<td>1.2</td>
<td>3.56</td>
<td>0.05</td>
</tr>
</tbody>
</table>

| **Net Live Tree Flux**    | **14.3** | **3.3** | **0.65** | **0.15** |

\(^1\) excluding live tree foliage

Unpublished draft data – do not cite
Carbon Stocks and Flux on Forest Land by Western/Eastern Region

**Western Region**
- Total stocks: 1,763 MMT (SE: 20.6 MMT)
- C Stocks/ac: 146.2 MMT
- CO$_2$e Flux: 15.0 MMT/yr (SE: 4.2 MMT/yr)
- Flux/ac: 1.26 MT/yr

**Eastern Region**
- Total stocks: 955 MMT (SE: 13.9 MMT)
- C Stocks/ac: 94.4 MMT
- CO$_2$e Flux: 1.1 MMT/yr (SE: 1.3 MMT/yr)
- Flux/ac: 0.11 MT/yr

Unpublished draft data – do not cite
## Forest Carbon Stocks by Region and Pool: 2007-2016

<table>
<thead>
<tr>
<th>Forest Carbon Pools</th>
<th>Total Carbon (MMT)</th>
<th>Per Ac (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Western Washington</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live Trees</td>
<td>792.7</td>
<td>65.7</td>
</tr>
<tr>
<td>Standing Dead</td>
<td>55.8</td>
<td>4.6</td>
</tr>
<tr>
<td>Understory Veg</td>
<td>15.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Down Woody Debris</td>
<td>101.7</td>
<td>8.4</td>
</tr>
<tr>
<td>Forest Floor</td>
<td>75.8</td>
<td>6.3</td>
</tr>
<tr>
<td>Soil Organic C</td>
<td>721.9</td>
<td>59.9</td>
</tr>
<tr>
<td><strong>All Pools</strong></td>
<td>1,763.3</td>
<td>146.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Forest Carbon Pools</th>
<th>Total Carbon (MMT)</th>
<th>Per Ac (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eastern Washington</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live Trees</td>
<td>290.9</td>
<td>28.9</td>
</tr>
<tr>
<td>Standing Dead</td>
<td>46.8</td>
<td>4.6</td>
</tr>
<tr>
<td>Understory Veg</td>
<td>12.9</td>
<td>1.3</td>
</tr>
<tr>
<td>Down Woody Debris</td>
<td>48.1</td>
<td>4.8</td>
</tr>
<tr>
<td>Forest Floor</td>
<td>53.1</td>
<td>5.3</td>
</tr>
<tr>
<td>Soil Organic C</td>
<td>502.9</td>
<td>50.0</td>
</tr>
<tr>
<td><strong>All Pools</strong></td>
<td>954.8</td>
<td>94.4</td>
</tr>
</tbody>
</table>

Unpublished draft data – do not cite
Annual Carbon Flux (CO$_2$e) by Region and Pool: 2002-2006 to 2012-2016

### Western Washington

<table>
<thead>
<tr>
<th>Forest Carbon Pool</th>
<th>Net flux (CO$_2$e)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total (MMT/yr)</td>
<td>Per Ac (MT/yr)</td>
<td></td>
</tr>
<tr>
<td>Live Trees</td>
<td>16.3</td>
<td>1.37</td>
<td></td>
</tr>
<tr>
<td>Standing Dead</td>
<td>0.7</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Understory Veg</td>
<td>-0.21</td>
<td>-0.01</td>
<td></td>
</tr>
<tr>
<td>Down Woody Debris</td>
<td>-5.5</td>
<td>-0.46</td>
<td></td>
</tr>
<tr>
<td>Forest Floor</td>
<td>0.4</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Roots</td>
<td>3.3</td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td>Soil</td>
<td>-0.1</td>
<td>-0.01</td>
<td></td>
</tr>
<tr>
<td>Net flux All Pools</td>
<td>15.0</td>
<td>1.26</td>
<td></td>
</tr>
</tbody>
</table>

### Eastern Washington

<table>
<thead>
<tr>
<th>Forest Carbon Pool</th>
<th>Net flux (CO$_2$e)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total (MMT/yr)</td>
<td>Per Ac (MT/yr)</td>
<td></td>
</tr>
<tr>
<td>Live Trees</td>
<td>-1.2</td>
<td>-0.12</td>
<td></td>
</tr>
<tr>
<td>Standing Dead</td>
<td>3.3</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>Understory Veg</td>
<td>0.1</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Down Woody Debris</td>
<td>-1.4</td>
<td>-0.13</td>
<td></td>
</tr>
<tr>
<td>Forest Floor</td>
<td>-0.2</td>
<td>-0.02</td>
<td></td>
</tr>
<tr>
<td>Roots</td>
<td>0.4</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Soil</td>
<td>&lt;-0.1</td>
<td>&lt;0.01</td>
<td></td>
</tr>
<tr>
<td>Net flux All Pools</td>
<td>1.1</td>
<td>0.11</td>
<td></td>
</tr>
</tbody>
</table>

Unpublished draft data – do not cite
Carbon Stocks and Flux on Forest Land by Ecological Region
Carbon stocks in Washington’s forests by ecoregion and pool for the 2016 reporting period

Unpublished draft data – do not cite
Annual carbon flux in Washington's forested ecoregions by pool for the 2016 reporting period

Average annual net flux (± 95% confidence interval)
Carbon stock in Washington's forests by forest type and pool 2007 - 2016

Softwoods
- Western white pine
- Western larch
- Western Hemlock / Sitka spruce
- Ponderosa pine
- Other western softwoods
- Lodgepole pine
- Fir / spruce / mountain hemlock
- Douglas-fir

Hardwoods
- Woodland hardwoods
- Western oak
- Other hardwoods
- Elm / ash / cottonwood
- Aspen / birch
- Alder / maple

Legend:
- Live Trees
- Standing Dead
- Understory
- Down Wood
- Forest Floor
- Roots
- Soil

Unpublished draft data – do not cite
Density of forest Carbon in Washington
by forest type and pool 2007 - 2016

Softwoods

- Western white pine
- Western larch
- Western Hemlock / Sitka spruce
- Ponderosa pine
- Other western softwoods
- Lodgepole pine
- Fir / spruce / mountain hemlock
- Douglas-fir

Hardwoods

- Woodland hardwoods
- Western oak
- Other hardwoods
- Elm / ash / cottonwood
- Aspen / birch
- Alder / maple

Metric Tons Carbon per Acre

Unpublished draft data – do not cite
### Forest Carbon Net Flux: California’s changing forests?

<table>
<thead>
<tr>
<th>Reporting year</th>
<th>Net flux*</th>
<th>SE (MMT CO2e/yr)</th>
<th>*HWP not included</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 2006-2015 Report (50%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Aboveground live:</td>
<td>25.0</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>• Aboveground dead:</td>
<td>3.2</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>• Net flux:</td>
<td><strong>33.6</strong></td>
<td><strong>2.8</strong></td>
<td></td>
</tr>
<tr>
<td>• 2007-2016 Report (60%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Aboveground live:</td>
<td>23.4</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>• Aboveground dead:</td>
<td>3.3</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>• Net flux:</td>
<td><strong>31.8</strong></td>
<td><strong>2.6</strong></td>
<td></td>
</tr>
<tr>
<td>• 2008-2017 Report (70%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Aboveground live:</td>
<td>19.1</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>• Aboveground dead:</td>
<td>5.8</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>• Net flux:</td>
<td><strong>29.2</strong></td>
<td><strong>2.5</strong></td>
<td></td>
</tr>
<tr>
<td>• 2009-2018?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.1 M acres of forested land
1 M acres of ag and grazing land
165,000 acres in 95 natural area sites
2.6 M acres of state-owned aquatic lands
13 M acres of wildfire suppression
Forest practices rules (state and private lands)
Forest Health (statewide)
Geological Survey (statewide)
Washington State
GHG Reduction Legislation

RCW 70.235.020 (Enacted in 2008)

- By 2020, reduce overall GHG emissions to 1990 levels
- By 2035, reduce overall GHG emissions 25% below 1990 levels
- By 2050, reduce overall GHG emissions to 50% below 1990 levels.

2015 Estimated Results (most recent)

- 2015 GHG emissions = 97.4 MMT, or 7.4 MMT above 1990 baseline of 90.0 MMT
- GHG emissions increased 6.1% from 2012 to 2015

Forest Carbon Pools

In Forest

Wildfire Emissions

Forest Ecosystem
- Live trees above and below ground
- Dead trees above and below ground
- Understory Veg above and below ground
- Down wood, Forest Floor, Soil

Conversion from Forest to non-forested uses
Forest Carbon Pools

In Forest

- Wildfire Emissions
- Forest Ecosystem
  - Live trees above and below ground
  - Dead trees above and below ground
  - Understory Veg above and below ground
  - Down wood, Forest Floor, Soil
- Conversion from Forest to non-Forested uses

Harvest / Removal

- Harvested Wood Products
  - In Use
  - In Landfill
- Wood Burned for Energy
- Wood Burned w/o Energy Capture
- Harvest / Transport Diesel Emissions
Forest Carbon Pools

In Forest

Forest Ecosystem
- Live trees above and below ground
- Dead trees above and below ground
- Understory Veg above and below ground
- Down wood, Forest Floor, Soil

Conversion from Forest to non-forested uses

Harvest / Removal
- Wood Burned for Energy
- Wood Burned w/o Energy Capture

Wildfire Emissions
1. Conduct Carbon Inventories on Natural & Working Lands
   - Harvested Wood Products
   - Sawmill Energy Use and Emissions
   - Wildfire Emissions
   - Land Management Activities
     - Reforestation, thinning, prescribed fire
2019 Legislative Budget Proviso
ESHB 1109

1. Conduct Carbon Inventories on Natural & Working Lands
   - Harvested Wood Products
   - Sawmill Energy Use and Emissions
   - Wildfire Emissions
   - Land Management Activities
     - Reforestation, thinning, prescribed fire

2. Compile Info on Carbon Compensation Services

3. Convene NWL Carbon Sequestration Advisory Group

4. Report to Leg
   - Results of Inventories
   - Options to Improve the Efficiency and Effectiveness of Inventories
   - Barriers to Use of Carbon Compensation Services
   - Recommendations
Coordination with California, Oregon, British Columbia

- CA, OR, WA: Consistent Forest Ecosystem, HWP, and Sawmill Energy Assessments
- Carbon Dynamics Workshop, Sept. 2019
- Considering west coast wide carbon assessment
- Future workshops:
  - Remote Sensing
  - Projecting Carbon change
• 25 States participating

• Goal
  o Implement policies that advance goals of the Paris agreement, aiming to reduce GHG emissions at least 26-28% below 2005 levels by 2025

• Natural and Working Lands
  o Best practices for protecting and enhancing resilient carbon sinks
  o Increase long-term carbon sequestration in forests and forest products
  o Reduce losses from catastrophic wildfire
  o Protect existing natural and working lands from conversion
  o Support healthy soils on farms and ranches
  o Grow the urban forest and other greenspace
Memorandum of Understanding
Pacific Coast Temperate Forests

1. WHEREAS global forests are the largest terrestrial carbon sinks and are an essential component in the fight against climate change;
2. WHEREAS Pacific Coast temperate forests include those with the capacity to sequester more carbon per acre than any other globally;
3. WHEREAS these forest ecosystems capture, clean, and store essential water supplies for communities, agriculture and hydropower and they provide rich biodiversity and diverse habitats;
4. WHEREAS these forests also offer some of the most productive timber-growing conditions in the country and support vital forest-related communities and economies;
5. WHEREAS the health and resilience of these forests are tightly linked with the health and resilience of rural and natural resource-dependent communities;
6. WHEREAS some regions of the Pacific temperate forest are increasingly susceptible to insects, disease and high-severity wildfires;
7. WHEREAS climate change and human activities have exposed vulnerability to fire and forest mortality and threaten forest health and resilience, youth, carbon, biodiversity, water supplies, public health and safety, recreation opportunities, and rural economies;
8. WHEREAS climate change is threatening the ability of some areas to continue supporting a viable forest industry;
9. WHEREAS resilient forests and a sustainable forest industry will provide jobs, improve hydrologic functions, support myriad native species, and support a broad range of public benefits;
10. WHEREAS we can benefit from working together to better understand forest carbon dynamics and how forests are responding to climate change in the respective jurisdictions of the parties to this MOU through scientific study, adaptive practices, improved data and modeling, and indigenous traditional knowledge;
11. WHEREAS integration of forest products, building materials, building codes, and policy can diversify the markets for forest materials, creating commercial opportunities derived from forest management and supporting ongoing forest restoration activities.

THEREFORE, THE PARTIES PLEDGE THEIR INTENTION TO:

1. Share and explore innovations in fuel management methods, including prescribed and managed fire, pre-fire management, post-fire reinvigoration, post-treatment monitoring and evaluation, tools and equipment, best practices, and technology to mitigate and reverse the negative impacts of increased wildfires and tree mortality.
2. Share and explore innovations in climate-informed silviculture, including strategies for climate-adapted species, genotypes, planting techniques, and ongoing management needs.
3. Share and explore approaches to evaluate and account for changes in forest carbon over time.
4. Share and explore advances in forest-related science and data collection to better understand how forests are responding to changes in climate conditions.
5. Share and explore innovations in low-carbon logging, or carbon sequestration, utilization of harvested wood products sourced from the forest through forest management or restoration activities.
6. Share and explore innovative mechanisms to reduce conversion of forestland to non-forest uses, establish afforestation projects, increase carbon sequestration and storage in urban forests, and promote carbon-rich, climate resilient forests.
7. Share and explore opportunities for investments in natural and carbon-based lands that increase carbon sequestration, sequester forest carbon, encourage multi-benefit forest uses, and support rural resource dependent communities.

[Signatures and dates]
MOU Pledge

Share and explore…

1. Fuel Management and post-fire restoration
2. Climate-informed restoration
3. Forest carbon accounting
4. Forest science, data collection and monitoring
5. Utilization of harvested wood products
6. Reduce conversion of forest lands
7. Investments to enhance carbon, resilience and other benefits
Carbon Sequestration Advisory Group

- Help guide carbon inventories and other activities
- Composed of a balance of representatives reflecting diverse interests and expertise
  - Large Forest Landowners
  - Small Forest Landowners
  - Urban Forests
  - Tribes
  - Mill Operators
  - Conservation Organizations
  - Buyers and Project Developers
  - Researchers
  - Government