

# Oregon Forest Ecosystems Carbon Report

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ODF Stakeholder Meeting – July 17, 2018

# Overview

- FIA 101 and inventory program in Oregon
- Highlight FIA forest ecosystems carbon reporting in California
- Oregon forest ecosystems carbon report

# What is FIA?

- We are the Nation's Forest Inventory
- Program authorized by Congress in 1928
- Initially an inventory of marketable timber
  - 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

# What is FIA – 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

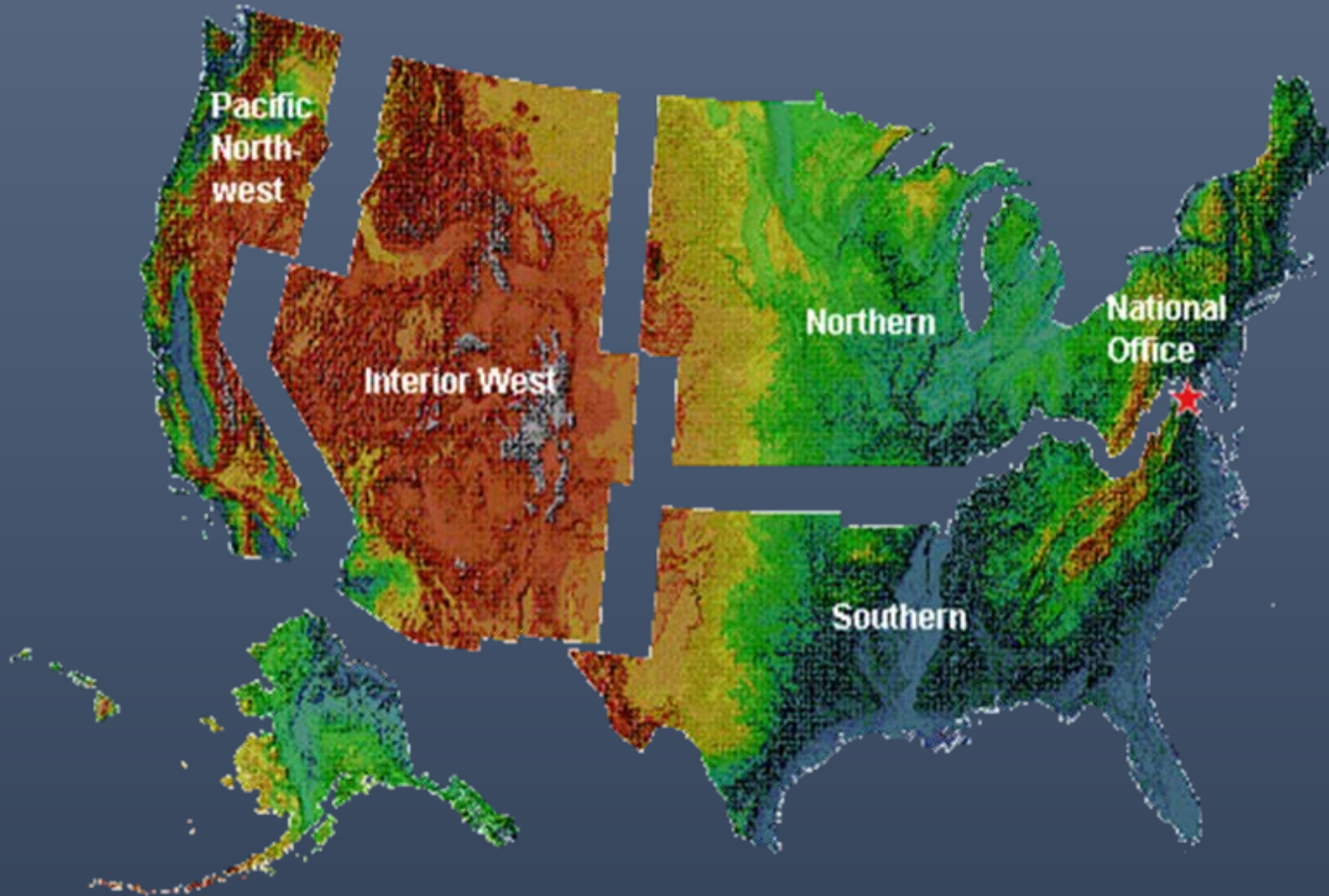
# What is FIA?

- Annual Inventory to provide data on forest status and trends
- All forest lands sampled
- Multi-year cycles (PNW=10 year)
- Consistent across regions and through time
- Confidentiality protects land owners and data integrity

# What is FIA - Confidentiality

- Private ownership information is confidential
  - All plot estimates are provided as summary information in tables
  - Database only provides plot ownership group, ex. Private.
- Plot location is confidential
  - Exact plot location information is not made public
  - Database provides “fuzzed” plot locations
- Why – To protect landowners and integrity of sample data

# FIA is a National Program of 4 Regions



# Pacific Northwest (PNW-FIA)



- Alaska
- Washington
- Oregon
- California
- Hawaii
- Guam
- American Samoa
- Palau
- Marshall Islands
- Federated States of Micronesia
- Northern Mariana Islands



# FIA at PNW

- McSweeney-McNary Forest Research Act of 1928
- 1929 – Secured \$30,000 of funding to conduct first survey in PNW region
- 1930 – Hired H.J. Andrews to lead timber survey, initiated in Washington County.
- 1933 – WA Co. survey completed including updates from first Tillamook burn



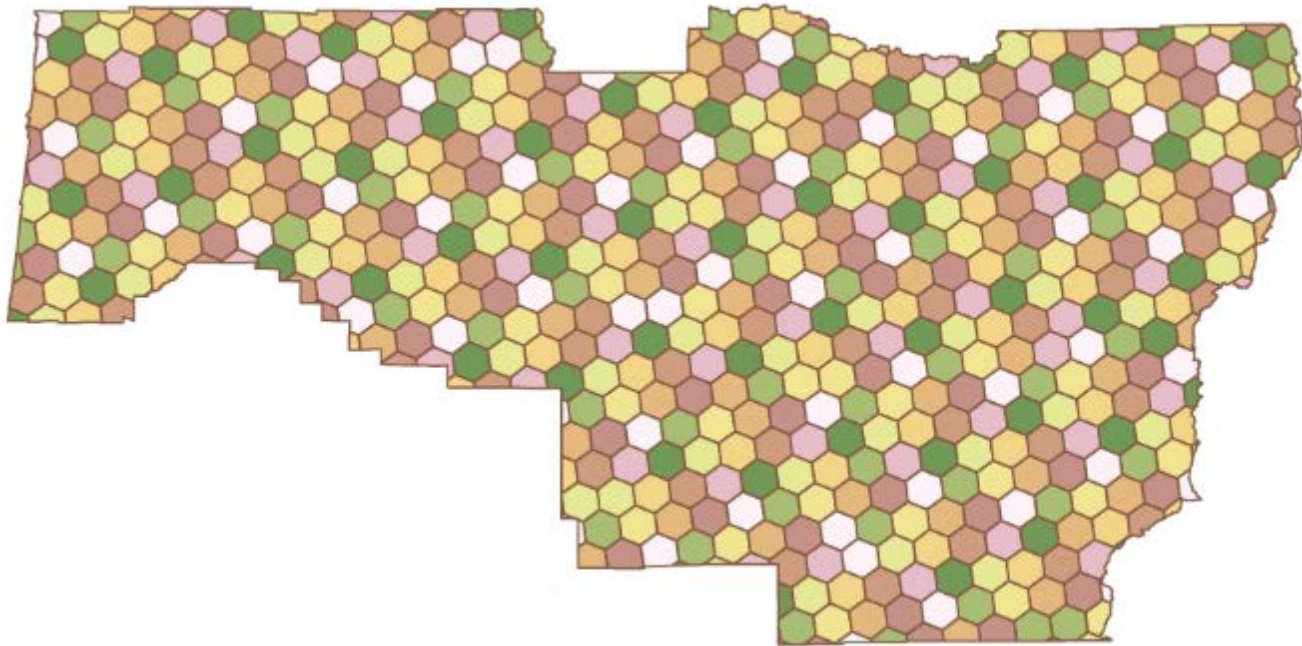
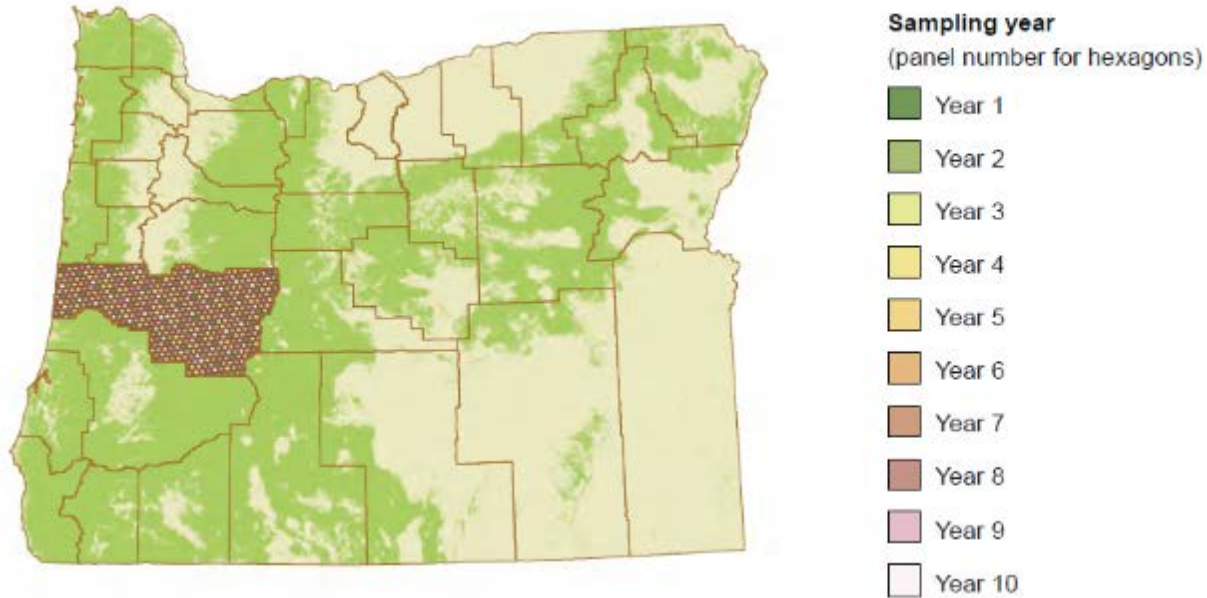
H. J. Andrews – Circa 1930

# FIA Today – Sampling & Plot Design

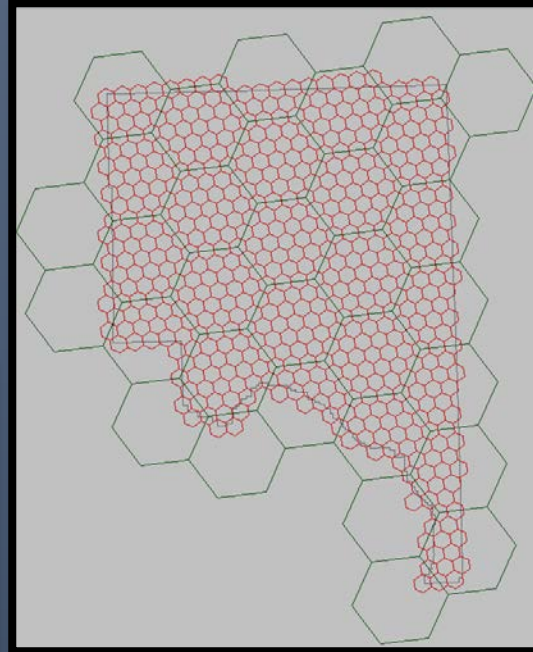
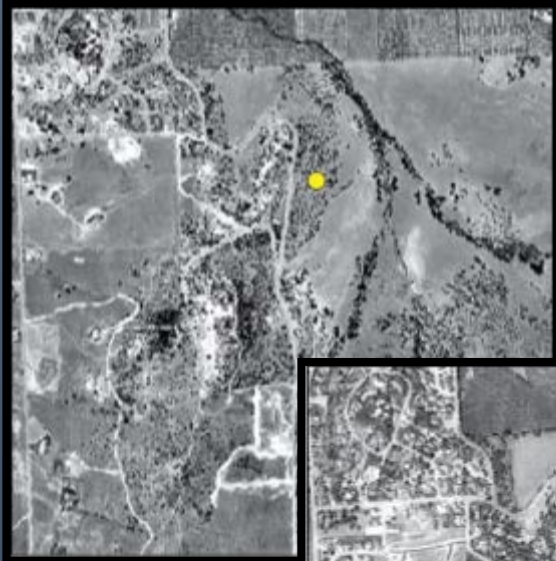
- All forested lands
  - All states, territories, and U.S. affiliated islands
  - All ownerships – public, private, National Forests, National Parks, wilderness areas, military installations, etc.
- Sampling intensity
  - 10% of all plots measured every year in the western states, 10 year remeasurement 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 Sampling Strategy Today

**10-Year Cycle: 1/10<sup>th</sup> of FIA field plots are sampled per year in western U.S.**



# 3 Phase Sampling Design\*



Phase 2: Inventory Plots



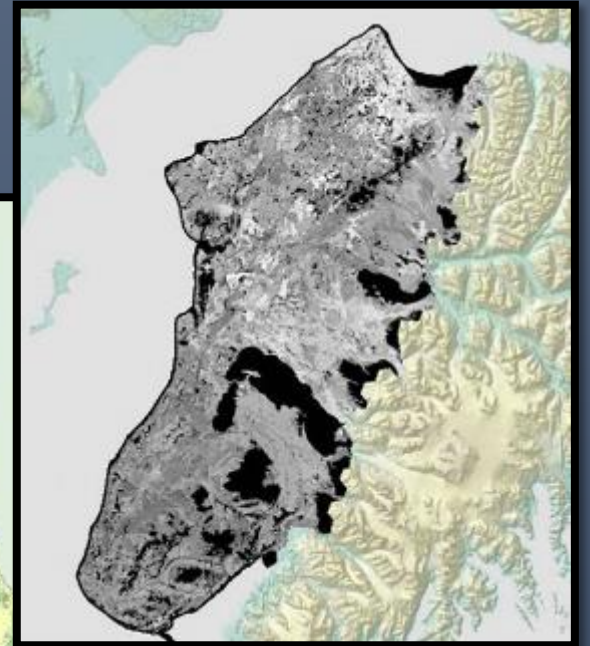
\*Phase 3: Forest Health, now optional add-ons collected in Phase 2

Phase 1: Remote Sensing

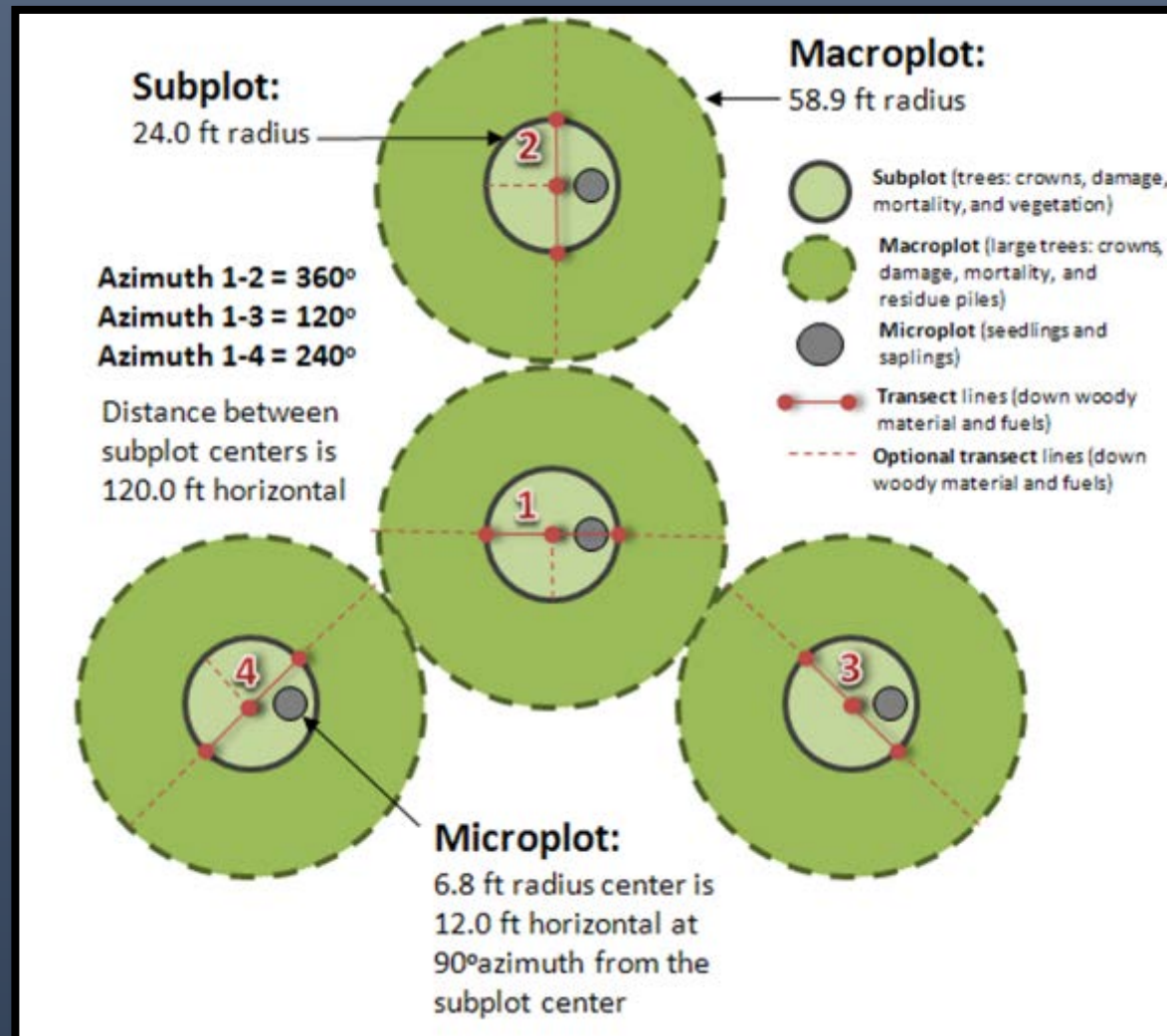


# Phase 1: Remote Sensing

- Forest/ Non-Forest
- Stratification to reduce SE
- Navigation

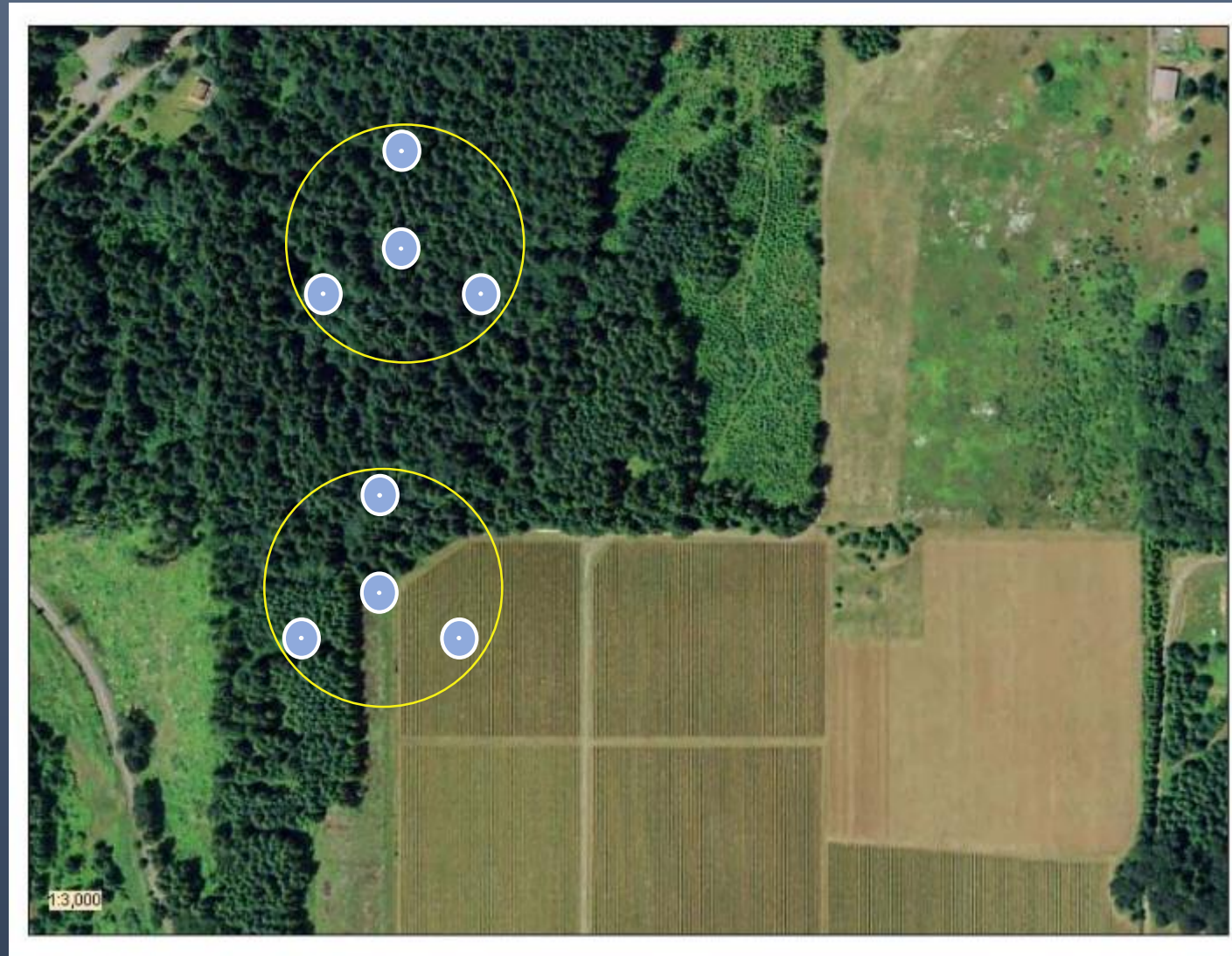


# Phase 2: Field Plot Design





# Field Plots and Condition Classes



# Condition Classes





# Field Plot Measurements

- Plot Level Data

Location   Elevation   Topography   Cover

- Condition Data

*Owner   Forest Type   Size Class   Stand Age*

Land Use   Disturbance   Silvicultural Treatments   Physiographic Class

- Tree Data

Location   Species   Diameter   Height   ~Age   Crown   Form   Damages

# Field Plots

- Regional Add-Ons
  - Down Woody Material
  - Understory Vegetation
- National Forest Add-Ons
  - Ground Cover
  - Non-Forest Lands

# How are the data used?

PNW 2016 – FIADB (PUBLIC 32 bit) -- \* Main Menu \* -- Click a button below to work with the database



**PNW -- FIADB 2016**  
**Annual Inventory Database**  
**California \_Oregon:2001-2016**  
**Washington: 2002 - 2016**

EXIT  
EXIT Compact  
?

**Database and Queries**

- Open and View a Table
- Run or Create QUERIES
- 5-Year Report Queries
- Inventory Status - ReadMe!
- CHEAT Sheets

**Documentation**

- View Definitions and Codes (on-screen popup form)
- View Table Structures
- View PNW FIADB User Manual
- View User Interface Guide
- View National FIADB Manual
- View Field Manuals**
  - CA-OR-WA
  - AK
  - View older manuals

Version 1.4 Loaded: 7/25/2017



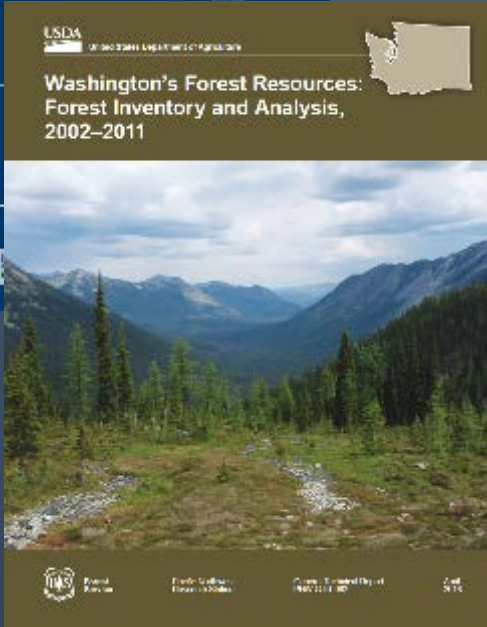
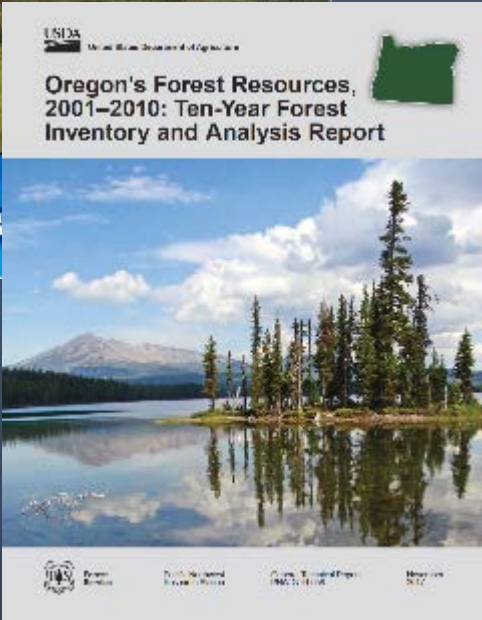
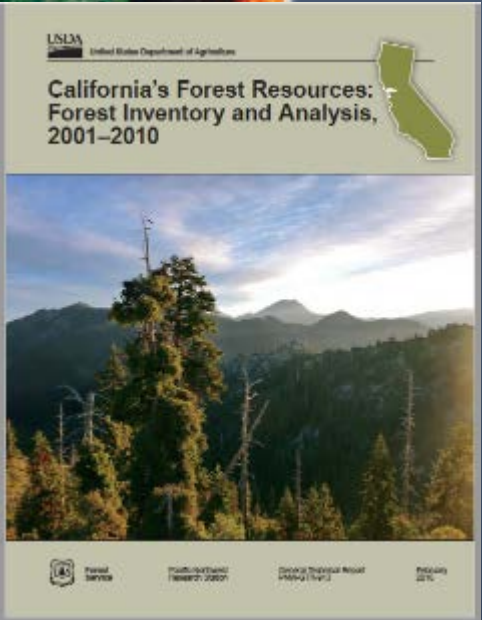
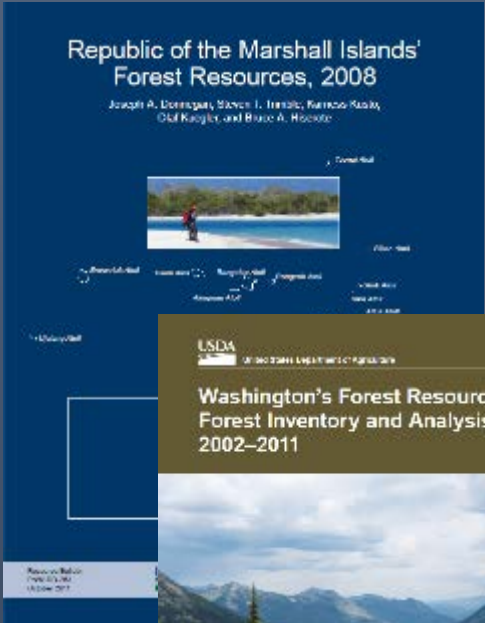
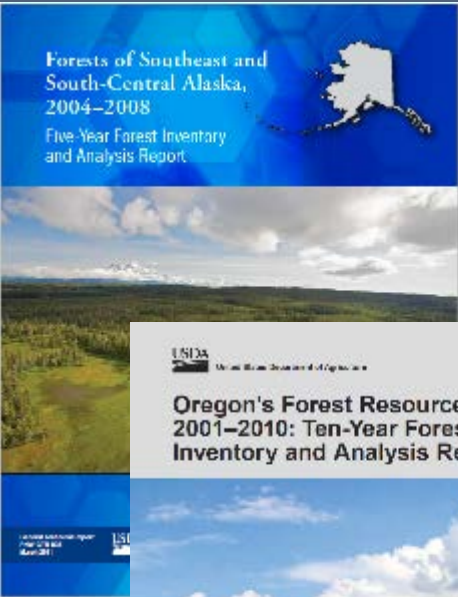
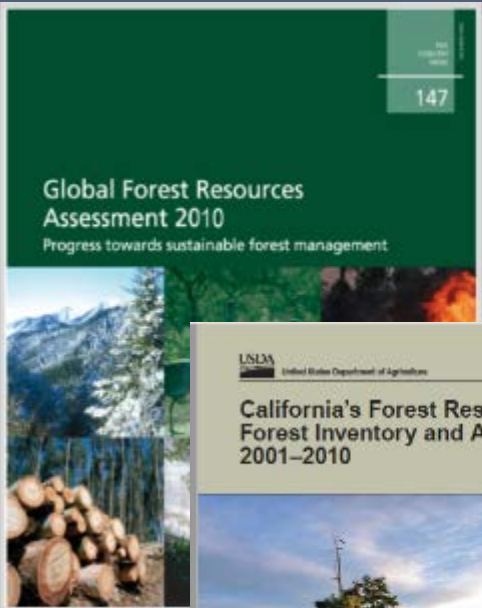
F:\IRAM\State Reports\WA2016\PUBLIC2016

Ribbon (show/hide)    Navigation Pane    Show PNW Categories    Show All Tables

# What is all this data used for?

It's summarized, analyzed, published and shared...

By resource managers, scientists, state agencies, private land owners, investors and legislators



# What is FIA data used for?

A 6 year longitudinal study of post-fire woody carbon dynamics in California's forests

Bianca N.I. Eskelson, Vicente J. Monleon, and Jeremy S. Fried

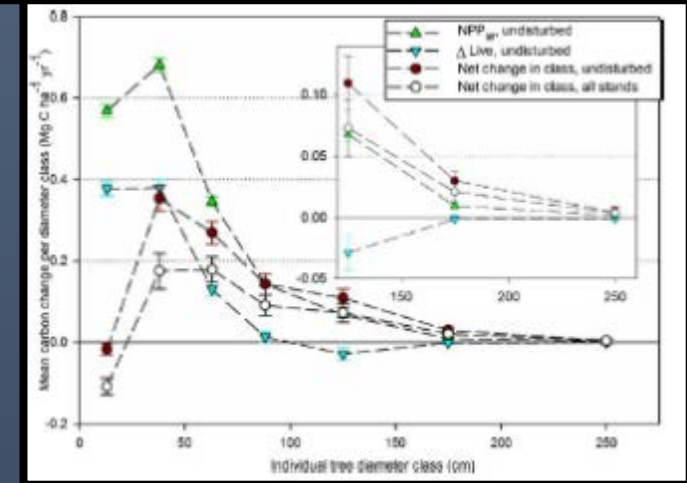
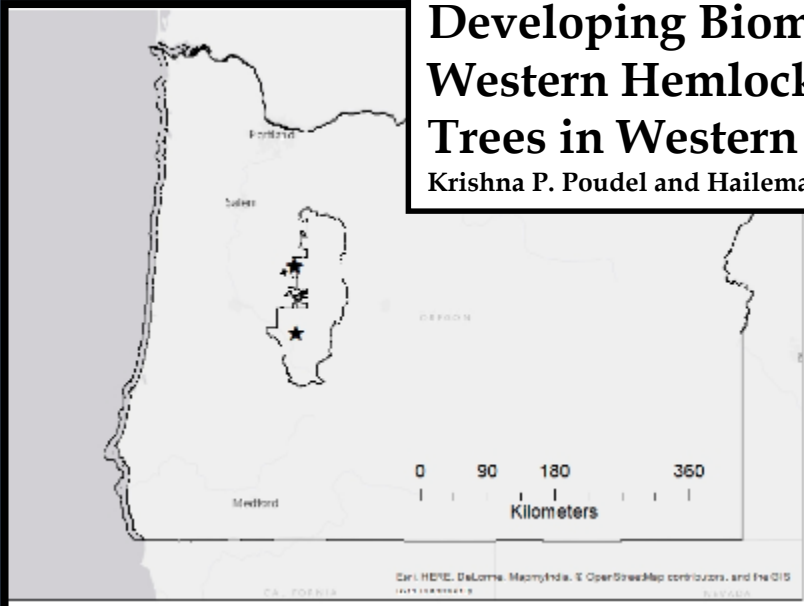
Carbon stocks and accumulation rates in Pacific Northwest forests:  
role of stand age, plant community, and productivity

Andrew N. Gray,<sup>1,†</sup> Thomas R. Whittier,<sup>2</sup> and Mark E. Harmon<sup>2</sup>

Article

**Developing Biomass Equations for Western Hemlock and Red Alder Trees in Western Oregon Forests**

Krishna P. Poudel and Hailemariam Temesgen \*



Analysis of spatial correlation in predictive models of forest variables that use LiDAR auxiliary information

F. Mauro, V.J. Monleon, H. Temesgen, and L.A. Ruiz

# What is FIA – National Website

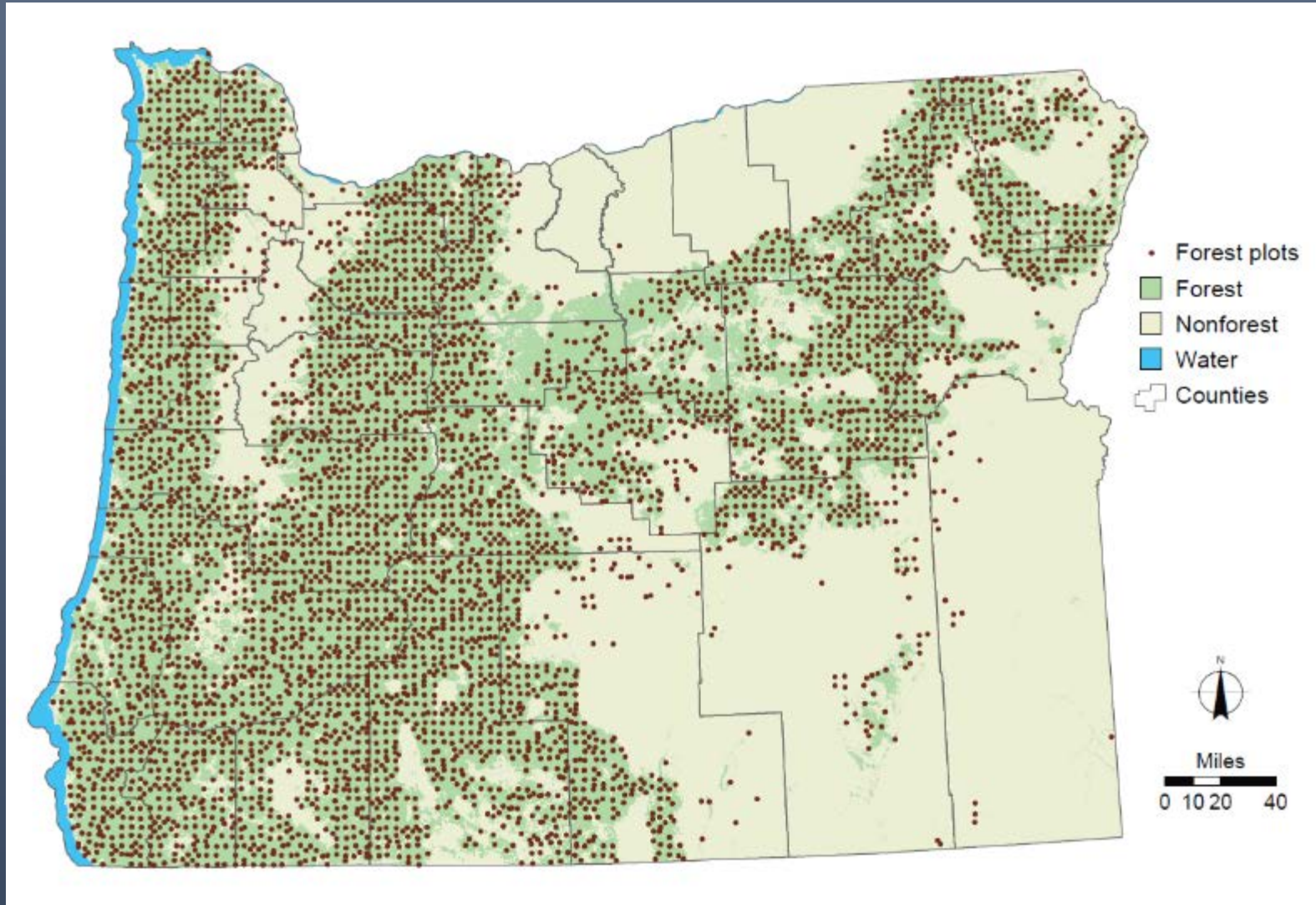
- Online data retrieval and custom query tools
- FIA DataMart – Forest land and Urban forest data
- Documentation
  - Field procedures
  - Database
- National Woodland Owner Survey – tables

FIA online: [www.fia.fs.fed.us](http://www.fia.fs.fed.us)

# FIA in Oregon

- Initial measurement completed 2001-2010
  - Statewide forest resource statistics for all 30 million acres of forest land
  - Data collected on 5,180 field measured plots on all forest land
    - 47% National Forest
    - 36% private ownerships (corporate and individual)
    - 17% other public lands (non-National Forest federal, state, and local)
- 2018 field season – Completed 80% plot remeasurement using annualized sample design
- Timber products output (TPO) – Partnership with ODF, 2017 operating year mill survey in progress





## FIA Field Measured Plots in Oregon: 2001-2010

- 5,180 plots measured on 30 million acres of forest land

- 2011 started remeasurement



# FIA in Oregon

## Recent reports

- PNW-GTR-958, 2017:  
Reporting first full 10 year measurement cycle.
- In Press: Oregon's forest resources, 2005-2015.  
Includes first estimates of growth, removals, and mortality from annual inventory.

# Forest Carbon Accounting in California

- 2006: Global Warming Solutions Act, Assembly Bill 32 (AB 32)
  - Reduce GHG emissions to 1990 levels by 2020, later updated to 40% below by 2030
- 2008: Established initial forest sequestration target
  - 2004 Winrock International analysis estimated forest sector net annual uptake of 5 million metric tons (MMT) CO<sub>2</sub>e (+/- 38%)
- 2010: AB 32 forest sector targets formalized in AB 1504 – ensuring CA Board of Forestry rules and regulations governing timber harvest also ensure forests have capacity to sequester 5 MMT CO<sub>2</sub>e/yr by 2020

# FIA – Forest Ecosystem Carbon Reporting

## Why is FIA a good fit?

- National program providing consistent
  - Field collection protocol
  - Compilation system
  - Public database
  - Summary reporting
- Statistically defensible sampling design
  - Unbiased and independent estimates of current status and change
  - Permanently located plots providing ground-based remeasurement
- Accurate estimates over large area providing annual updates on all forest land and carbon pools with sampling error
  - Oregon Statewide %SE: Area = <1% (95% CI +/- 1.02%) Volume = 1.27% (95% CI +/- 2.50%)
  - California Statewide %SE: Area = <1% (95% CI +/- 1.2%) Volume = 1.45% (95% CI +/- 2.84%)
- Current net rate of carbon sequestration based on measured change
- FIA forest carbon estimates currently used for reporting to national and international reporting mandates – ex. FAO, IPCC, US and other developed countries GHG assessments

# CA AB1504 2015 Report: Carbon stocks by pool

- Above-ground live trees: Calculated from FIA regional biomass equations, added foliage weight
- Above-ground dead trees: Same as live trees, included reduction for decay and tendency for bark and branches to shed faster than bole biomass
- Roots on live and standing dead trees: National FIA protocol
- Down wood: Measured and calculated using National FIA protocol, piles not included
- Understory vegetation: As modeled and populated in National FIA database (FIADB)
- Forest floor (litter and duff): Not included in 2015/2016 reports, added to 2017+ reports
- Organic soils: As modeled and populated in FIADB

# CA AB1504 2015 Report: Carbon Flux

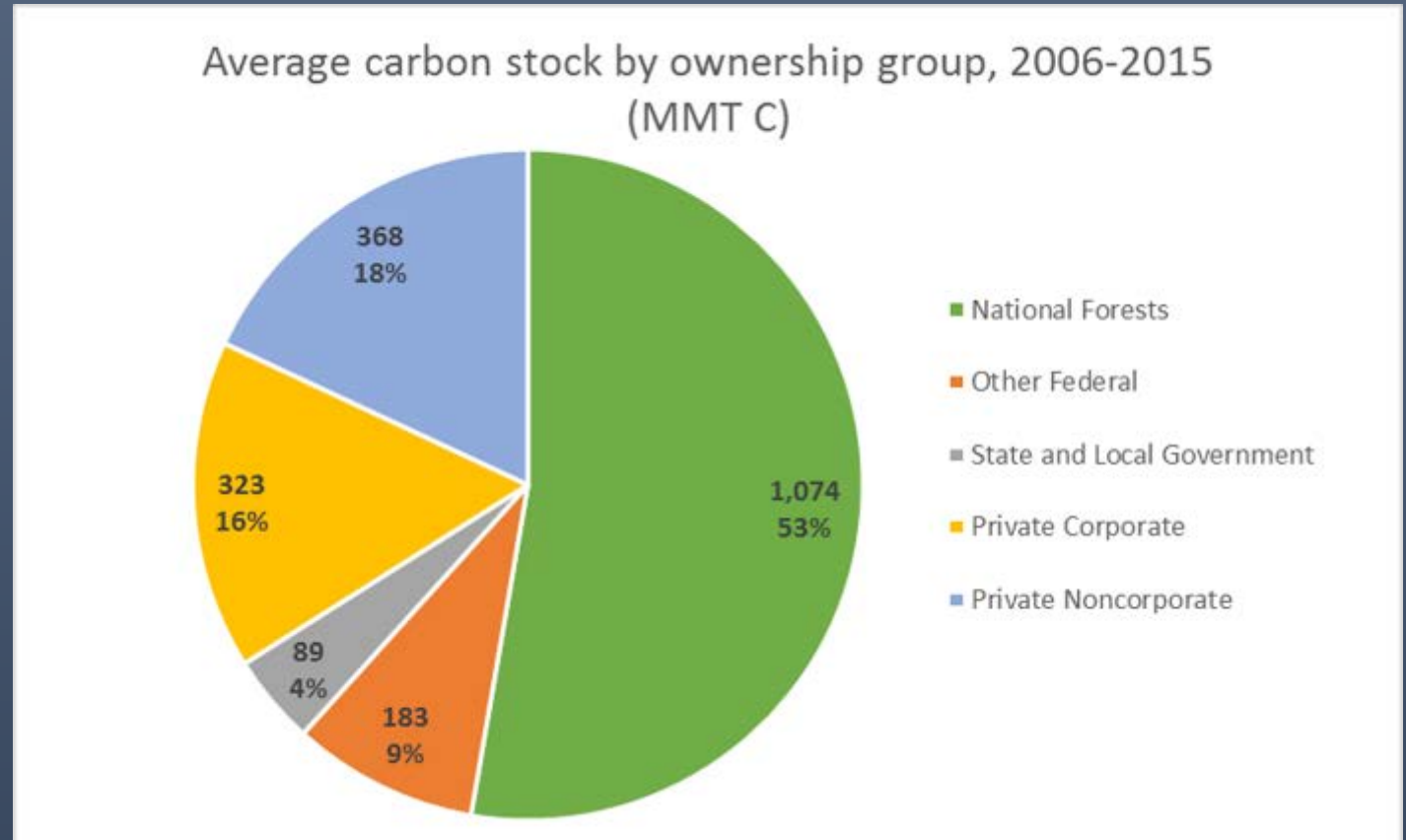
- Based on first 5 years of re-measured plots: 2001-2005 to 2011-2015
- Used condition classification at the initial measurement
- By pool
  - Trees - live and dead: FIA growth, removals (harvest), and mortality estimation protocol
  - Down wood: Flux based on plot level change
  - Below-ground, live and dead roots: Net change based on FIA modeled estimates
  - Understory: Net change based on FIA modeled estimates
  - Forest floor: Not used in 2015 report
  - Soil: Modeled using FIADB estimates from Smith et al. 2006
- Land use change – forest land conversions

# California Forest Land Overview

- By ownership
  - 58% Federal managed
  - 3% State and local government
  - 39% Private ownership
- By land status
  - Forest land: 32 millions ac.
  - Timberland: 16.9 million ac.
  - Reserved: 6.5 million ac.

# 2015 Results – C stocks by ownership

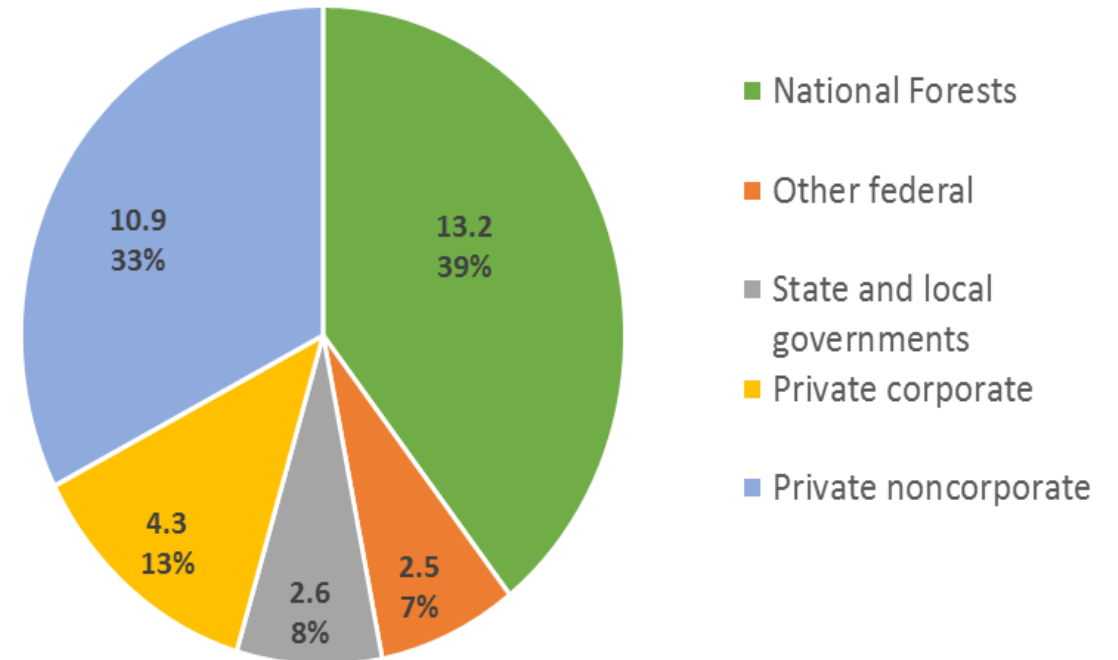
- Two-thirds C stocks found on public forests, 80% on FS
- The remaining third is divided between:
  - Corporate forests (16%)
  - Non-corporate forests (18%)



# 2015 Results – Annual C flux by ownership

- National Forests account for 39% of the statewide CO<sub>2</sub>e flux
- Individual noncorporate owners account for 33% of the total CO<sub>2</sub>e flux
- Corporate forests account for 13% of the total CO<sub>2</sub>e flux

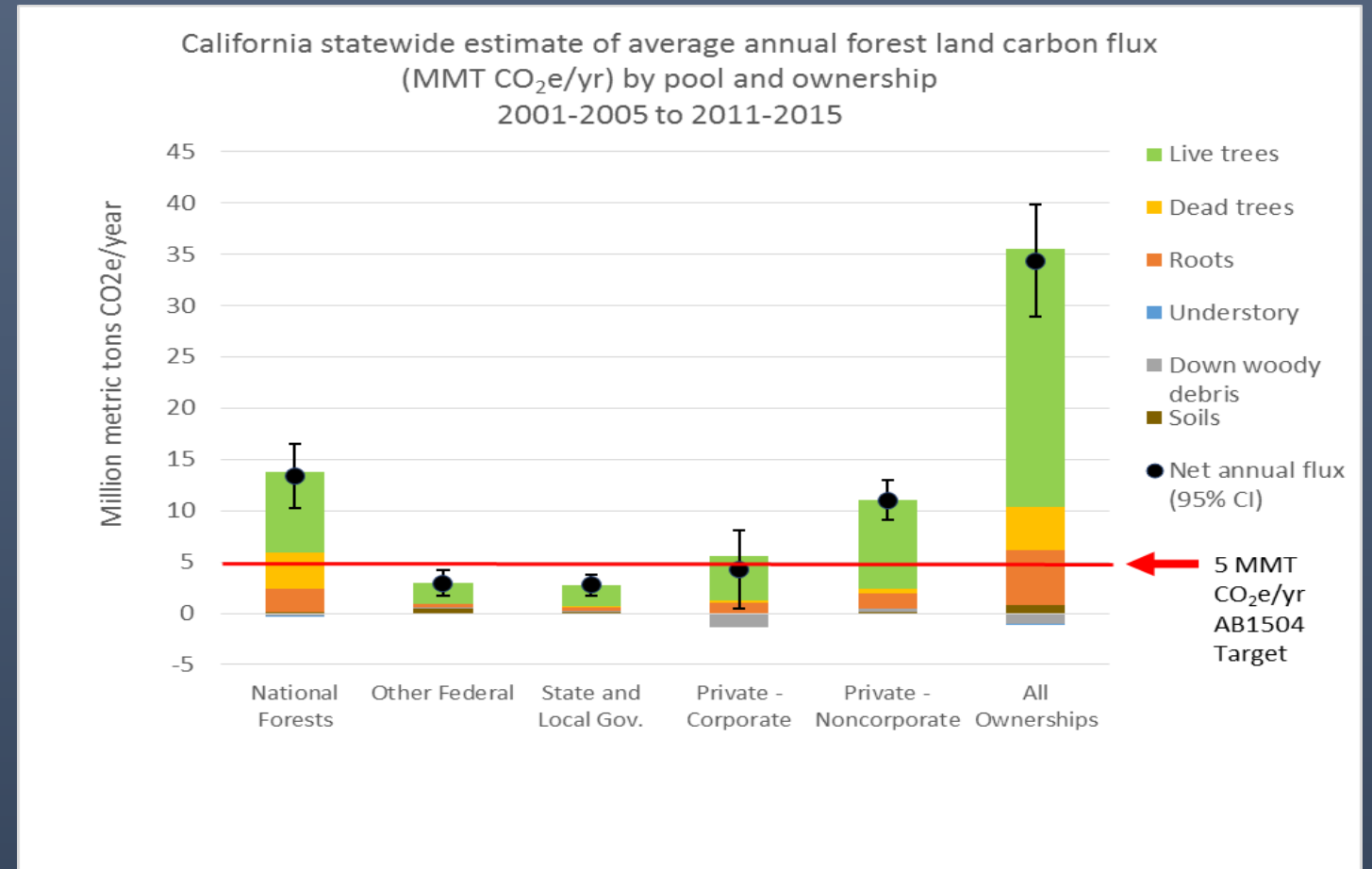
Average annual carbon sequestered by ownership group, 2001-2005 to 2011-2015 (MMT CO<sub>2</sub>e/yr)





# 2015 Results – C flux by ownership

- 2015 statewide rate of forest CO<sub>2</sub>e sequestration is  $33.6 \pm 5.3$  MMT CO<sub>2</sub>e/yr. (95% CI)
- Growth on live trees makes up 89% of annual CO<sub>2</sub>e flux on forest land
- Standing dead tree, down wood, and understory veg. make-up the remaining 11%



# 2015 Results – Annual statewide C flux

	<b>Net flux</b>	<b>SE</b>
	<i>million metric tons CO<sub>2</sub>e</i>	
<b><i>Carbon pool</i></b>		
<b><i>Forest</i></b>		
Aboveground live*	25.0	2.3
Aboveground dead**	3.2	1.5
Belowground live***	4.8	0.5
Belowground dead****	0.5	0.02
Litter	TBD	TBD
<b><i>net flux</i></b>	<b>33.6</b>	<b>2.8</b>
Soil Organic C	0.8	0.5
<b><i>Harvested Wood</i></b>		
Products in use	TBD	TBD
Products at SWDS	TBD	TBD
<b>Total net flux</b>	<b>34.4</b>	<b>2.8</b>
*includes live trees, foliage, and understory veg		
**includes standing and down dead wood		
***includes live tree and understory veg roots		
****includes dead tree roots		

# California regions

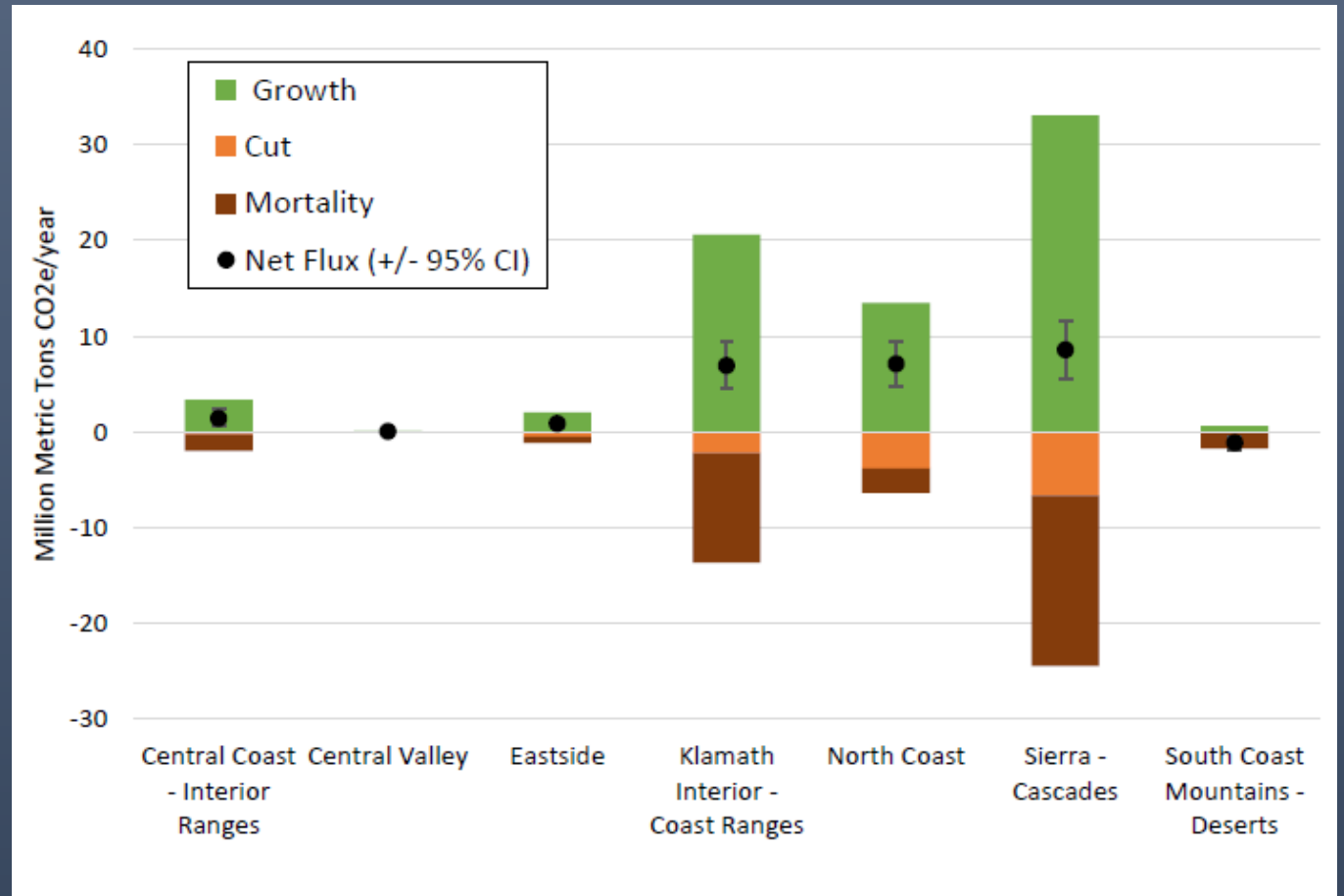
Ecological regions used  
for this analysis



Data - CAL FIRE

# 2015 Results – C flux by region, TREES ONLY

- Sierra/Cascades Mtns and Klamath/Interior-Coast Ranges driving flux
- Emissions exceeding gross growth in southern regions



# 2015 Results – C Flux by forest land-use and land conversions

<b>Land-use category</b>	<b>Net flux</b>	<b>SE</b>
	<i>million metric tons CO<sub>2</sub>e</i>	
<b>Forest land remaining forest land</b>		
changes in forest carbon stock	33.6	2.7
changes in soil carbon stock	0.8	0.5
non- CO <sub>2</sub> emissions from forest fires	-0.4	0.05
<b>net flux</b>	<b>34.0</b>	<b>2.8</b>
<b>Forest land conversions</b>		
changes in forest carbon stock, forest to non-forest	-2.5	0.5
changes in forest carbon stock, non-forest to forest	1.3	0.3
<b>net flux</b>	<b>-1.2</b>	<b>0.6</b>
<b>total net flux</b>	<b>32.8</b>	<b>2.8</b>

# Next CA Forest Carbon Reports -

- 2016 Update:
  - Update all 2015 tables and figures with 2007-2016 plots measurements
- 2017 Full report, followed by 2018 Update:
  - Implement planned improvements in stock and flux estimates
    - Adding forest floor measurements
    - Use updated soil carbon models, Domke et al. 2017
  - Include stakeholders and CA Board of Forestry requested stock/flux summary tables by
    - Forest practice districts
    - County
    - National Forest
- Final 2015 report available online

# Oregon Forest Ecosystems Carbon Report

- Based on Oregon FIA plot measurements collected 2001 through 2016
- Uses California forest carbon report as basis and approach to
  - Provide summaries of total forest carbon stocks and flux by pool using regional biomass equations for components as found in US National Greenhouse Gas Inventory
  - Provide current statewide rate of net annual forest carbon sequestration and emissions
  - Determine annual forest carbon flux based on measured growth, removals, and mortality
  - Establish an IPCC forest management reference level for reporting trends

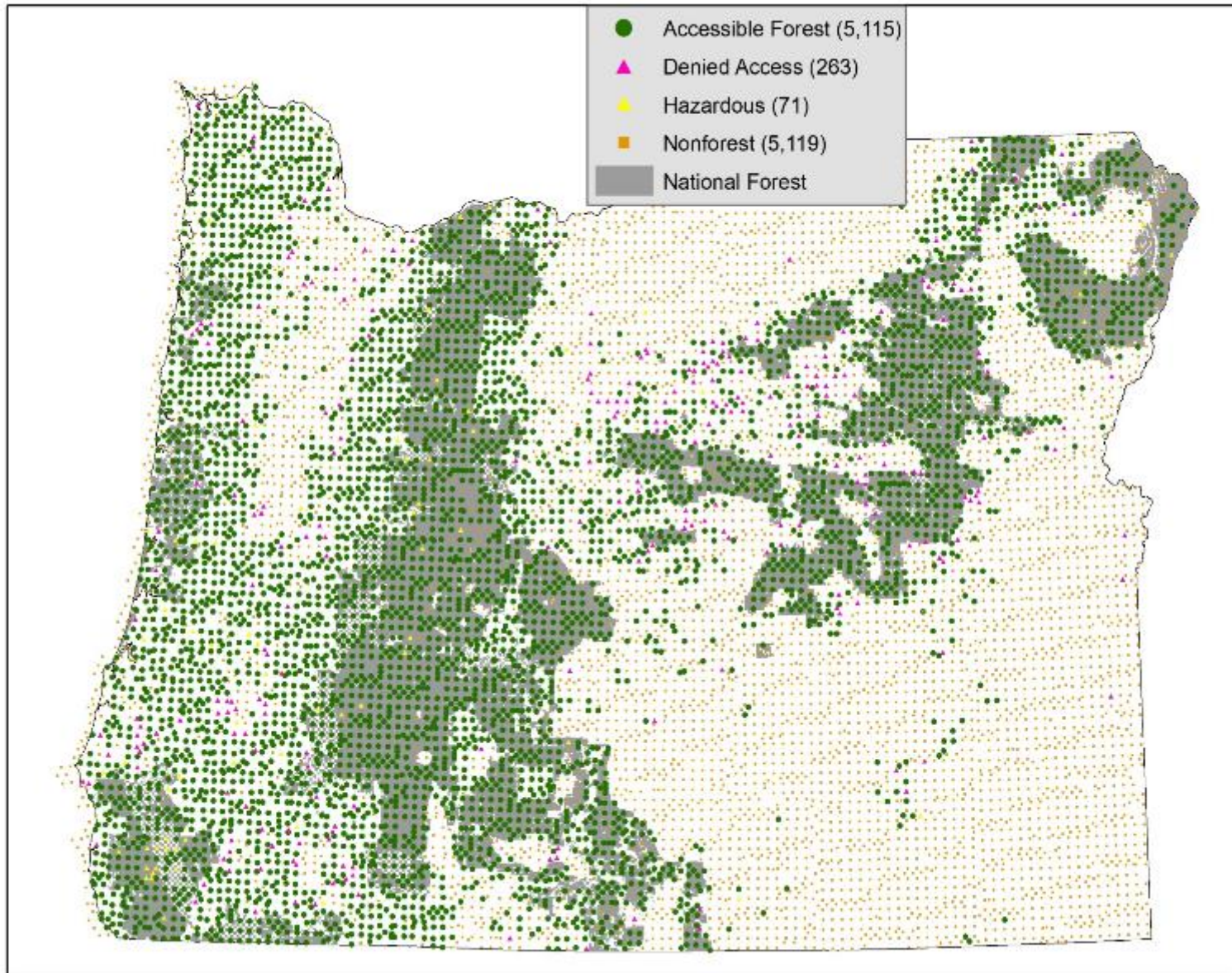
# Oregon Forest Ecosystems Carbon Report

- Forest carbon stocks by pool:
  - Above-ground live trees: Based on FIA regional biomass equations, adds foliage
  - Above-ground dead trees: Same as live trees, including reductions for decay
  - Roots on live and standing dead trees: Use National FIA protocol
  - Down wood: Use collected measurements and National FIA estimation protocol, piles not included
  - Understory vegetation: As modeled and populated in FIADB
  - Forest floor: Use collected measurements and national estimation protocol
  - Organic soils: As modeled and populated in FIADB using Domke et al. 2017



# Oregon Forest Ecosystems Carbon Report

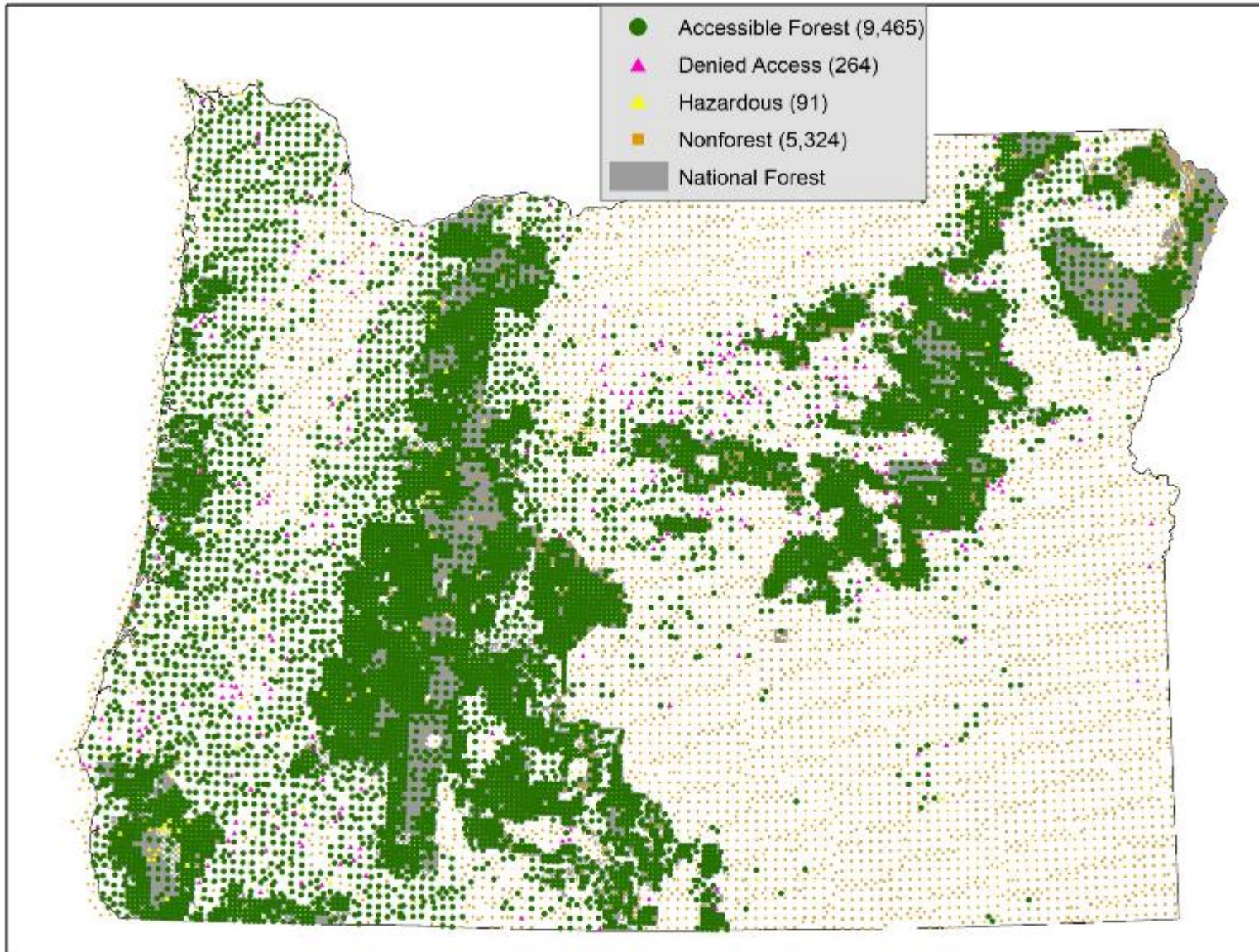
- Forest carbon flux by pool based on re-measured plots: 2001-2006 to 2011-2016
  - Use condition classification at the initial measurement
  - By pool
    - Trees - live and dead: FIA growth, removals (harvest), and mortality estimation protocol
    - Down wood: Flux based on plot level change
    - Below-ground, live and dead roots: Net change based on FIA modeled estimates
    - Understory: Net change based on FIA modeled estimates
    - Forest floor: Flux based on plot level change
    - Soil: Modeled using FIADB estimates from Domke et al. 2017
- Forest Management Reference Levels: 2001-2010 as basis of stock-change
- Land use change – forest land conversions



## FIA Field Measured Plots in Oregon: Base grid 2007-2016

- Plot density of approx. 1 per 6,000 ac.
- 2011 started remeasurement
- 2016 field season 60% of plots remeasured





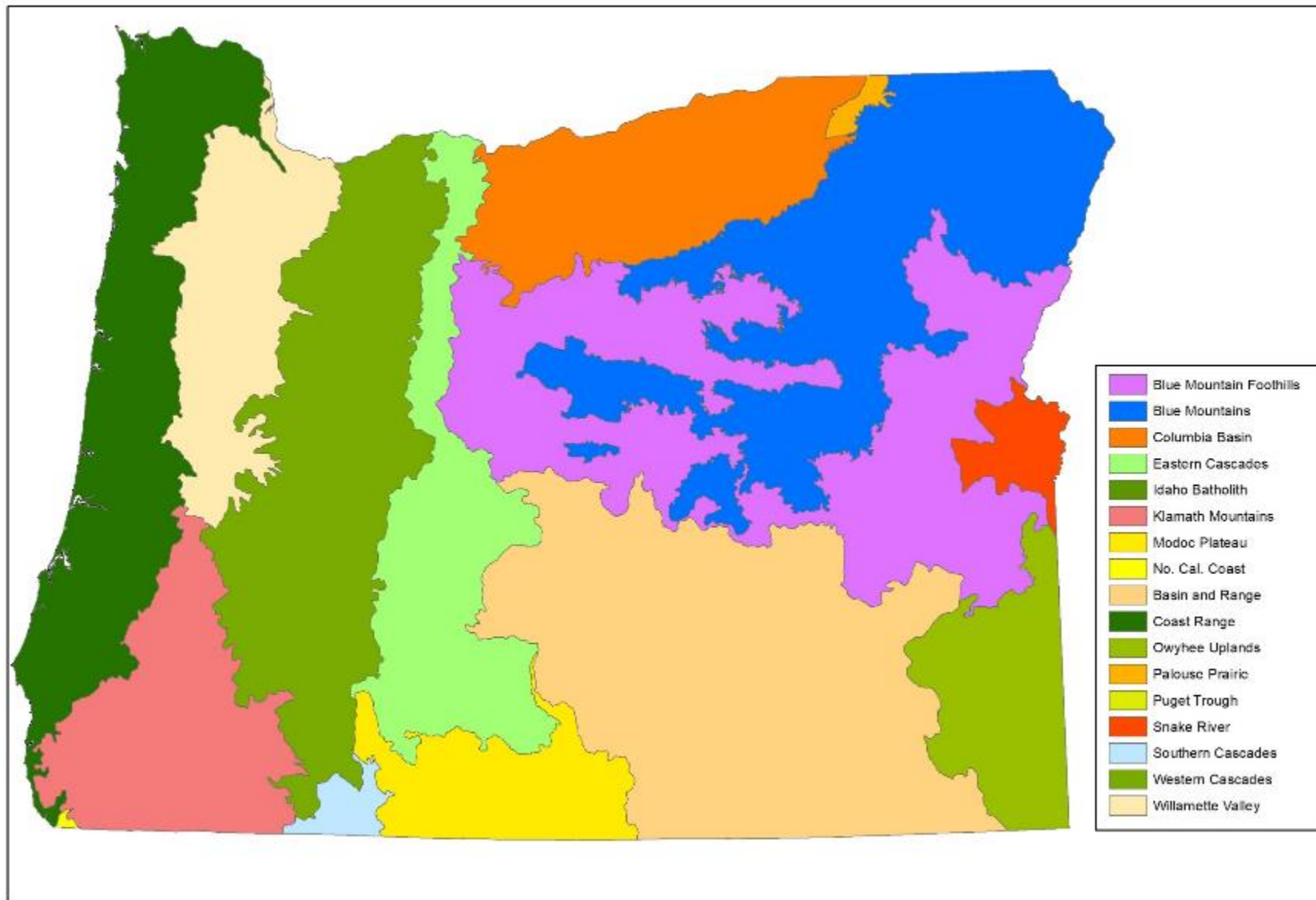
## FIA Field Measured Plots in Oregon: Base plus R6 Intensified grid 2007-2016

- Adds 4,350 National Forest plots
- Plot density of 1 per 1,850 ac. outside of wilderness

# Oregon Forest Ecosystems Carbon Report

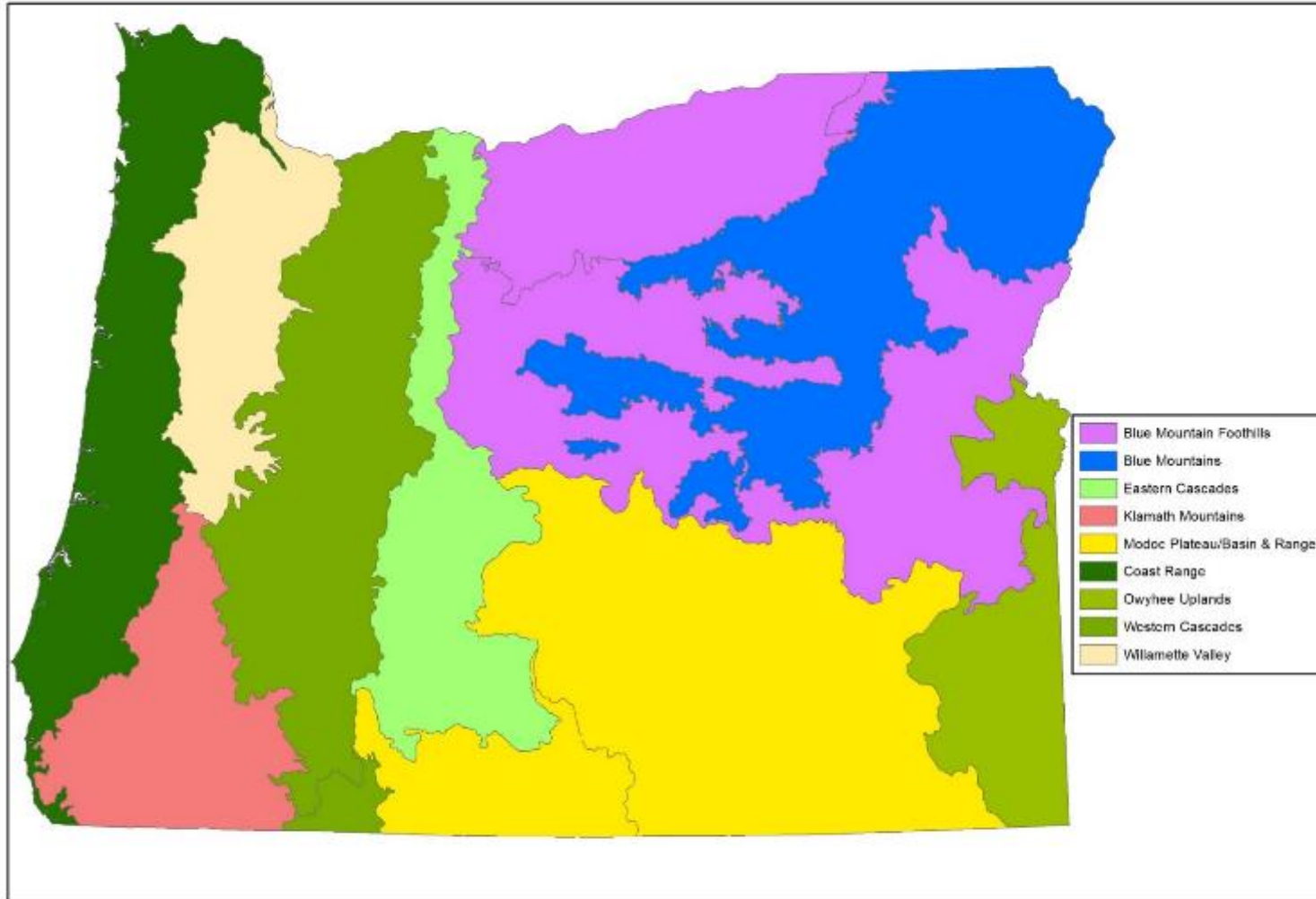
- Forest ecosystem summarized results: carbon stocks, flux, and trend
  - Stocks and flux by pool, ownership, and land status
    - National Forest
    - Other Federal
    - State and local governments
    - Private corporate
    - Private noncorporate
  - Stocks and flux by FIA forest type
  - Stocks by region, use ecoregions from Cleland et al. 2005

OR ecoregion sections from FS ecomap (Cleland et al. 2005)





OR ecoregions, grouping sections from FS ecomap (Cleland et al. 2005)



## Proposed Ecoregion Lumping:

- Columbia Basin with Blue Mountain Foothills
- Snake River with Owyhee Uplands (all non-forest)
- Southern Cascades with Western Cascades
- Modoc Plateau with Basin and Range



# Oregon Forest Ecosystems Carbon Report

- Stakeholder feedback
  - Proposed summary tables and groupings
  - Report content/outline, especially chapters 2 and 8
- Other comments?