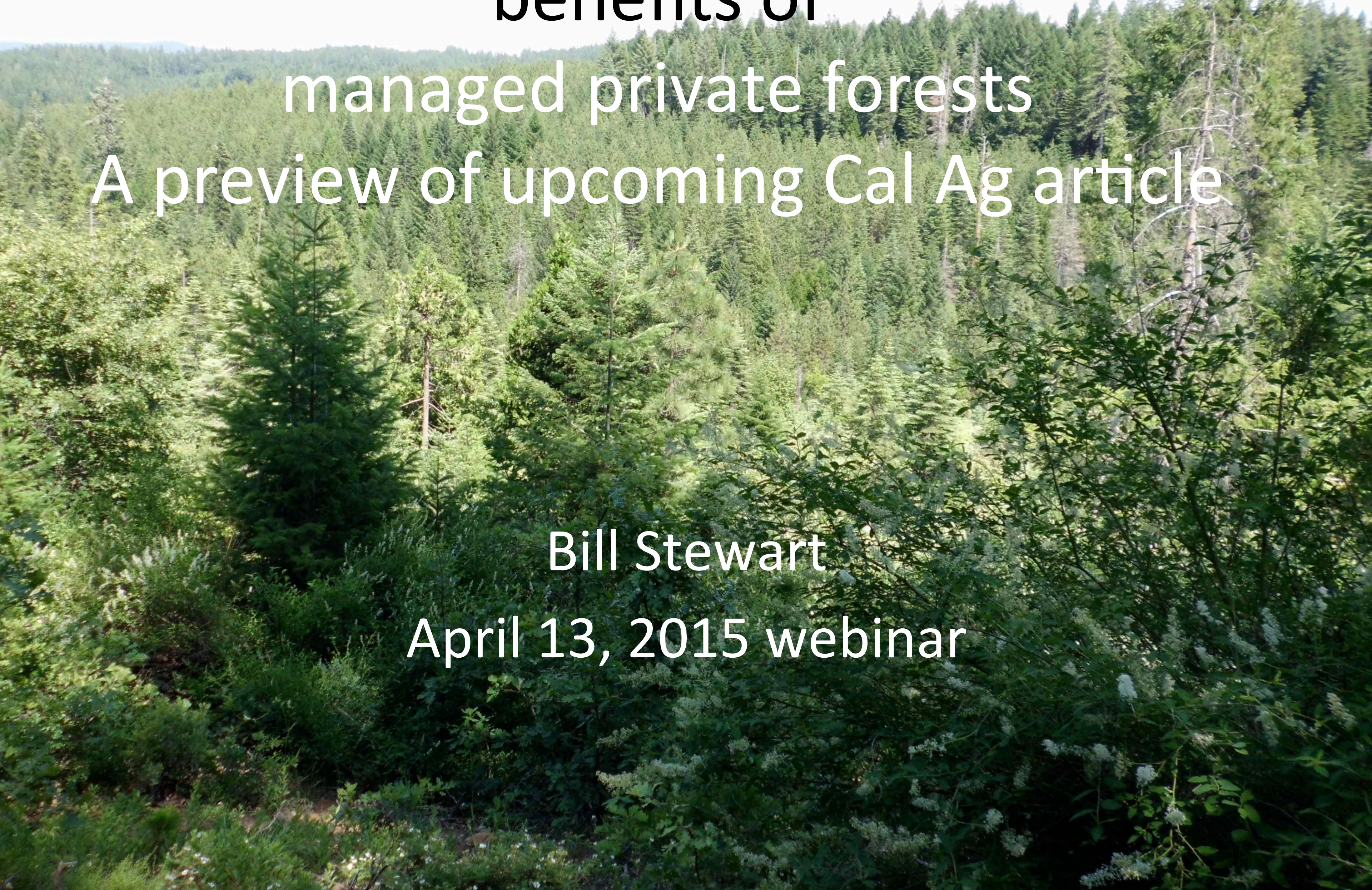
Carbon calculator tracks the climate benefits of managed private forests

A preview of upcoming Cal Ag article



Bill Stewart

April 13, 2015 webinar

Organization of webinar

- Introduce our carbon calculator
- Review background on CEQA need for GHG assessments on all projects
- Review what is essentially a scaled down version of the IPCC 2014 compliant Canadian model (Smyth et al. 'Quantifying the biophysical climate change mitigation potential of Canada's forest sector'. Biogeosciences. 2014)
- Goal is a cost-effective and transparent calculator that can be used for THPs and grant applications to increase GHG benefits from forestry projects

Research Article

Carbon calculator tracks the climate benefits of managed private forests

by William C. Stewart *and* Benktesh D. Sharma

As part of California's strategy to reduce greenhouse gas emissions, private forest landowners are now required to address carbon sequestration as a management goal when submitting timber harvest plans. Using public data on forests and forest products, we developed a calculator that tracks the carbon sequestration benefits related to live trees, wood used for bioenergy and wood going into products. The calculator is adapted for different forest types, forest management techniques and time frames. Based on current best practices used in California, we estimate that harvested and regenerated forests will provide approximately 30% more total carbon sequestration benefits than forests left to grow for an equal time. More than half of the total benefits relate to harvested wood substituting for fossil fuels and fossil fuel–intensive materials such as cement and steel. With relatively efficient management practices, harvesting a ton of wood provides more sequestration benefits than leaving that ton growing in the forest.

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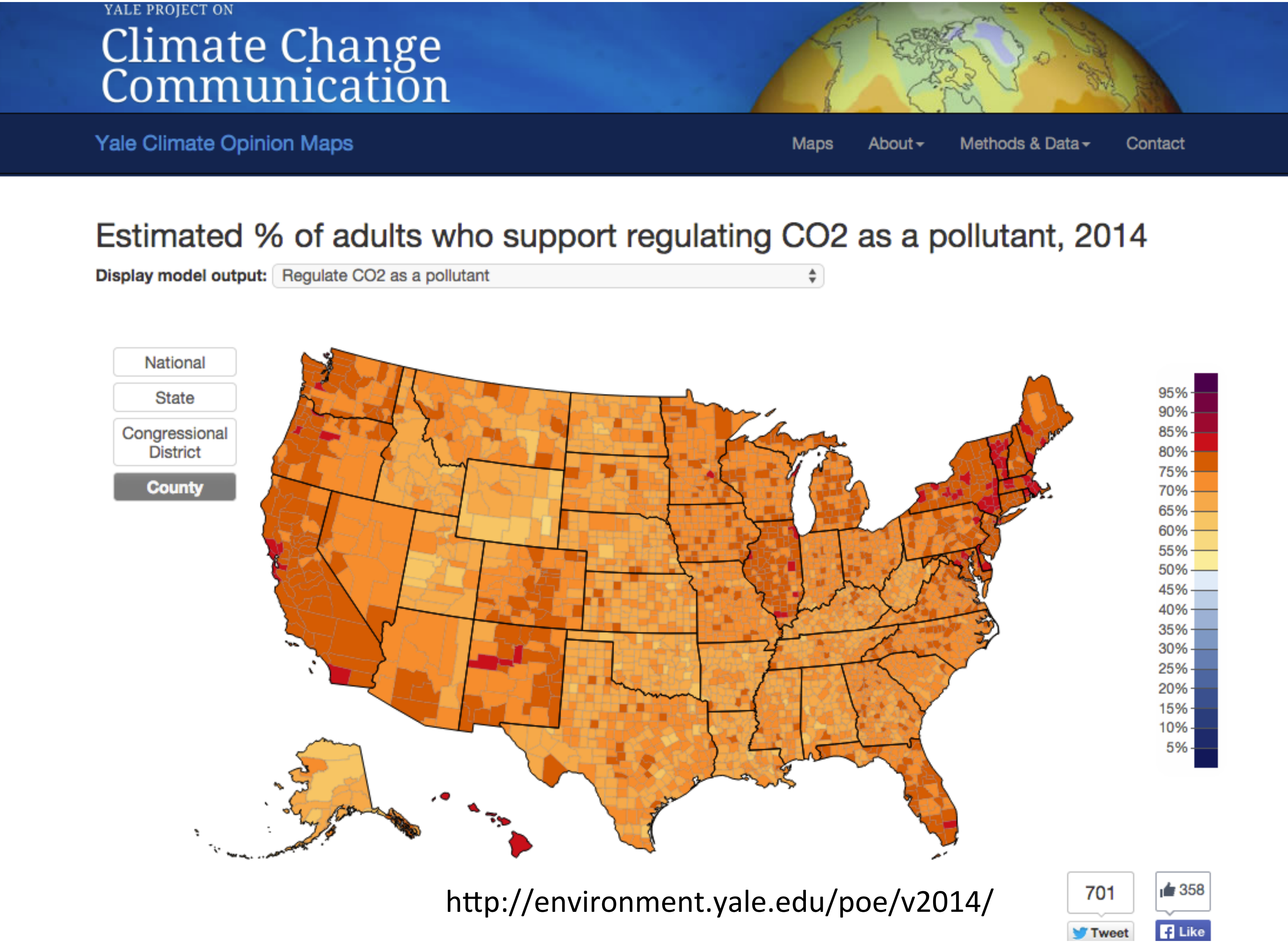
The full article can be downloaded at no cost from
http://californiaagriculture.ucanr.edu (after publication in late April 2015)
http://ucanr.edu/sites/forestry/Carbon_Sequestration_Tool_for_THPs/ (preprint)

Why create another generic forest and forest product carbon calculator?

- UC owns less than 5,000 intensively inventoried acres
- But thousands of forest owners without permanent inventories or full time inventory foresters are stuck as regulators want more documentation
- More stringent 2014 IPCC guidance for forest carbon will require better methods than were accepted under 2006 IPCC guidance
- Canada appears to be the first nation to publish 2014 IPCC compliant methods (important since Quebec is now our carbon partner)
- Correctly measuring ‘actual forest carbon (metric tonnes) sequestered or offset’ (Calfire 2/20/15) can provide added financial benefits to sustainably managed forests
- There is broad public agreement on regulating CO2 as a pollutant, even if they are split on whether scientists are in agreement on global warming



http://environment.yale.edu/poe/v2014/

YALE PROJECT ON

Climate Change Communication

Yale Climate Opinion Maps

Maps | About | Methods & Data | Contact

Estimated % of adults who believe most scientists think global warming is happening, 2014

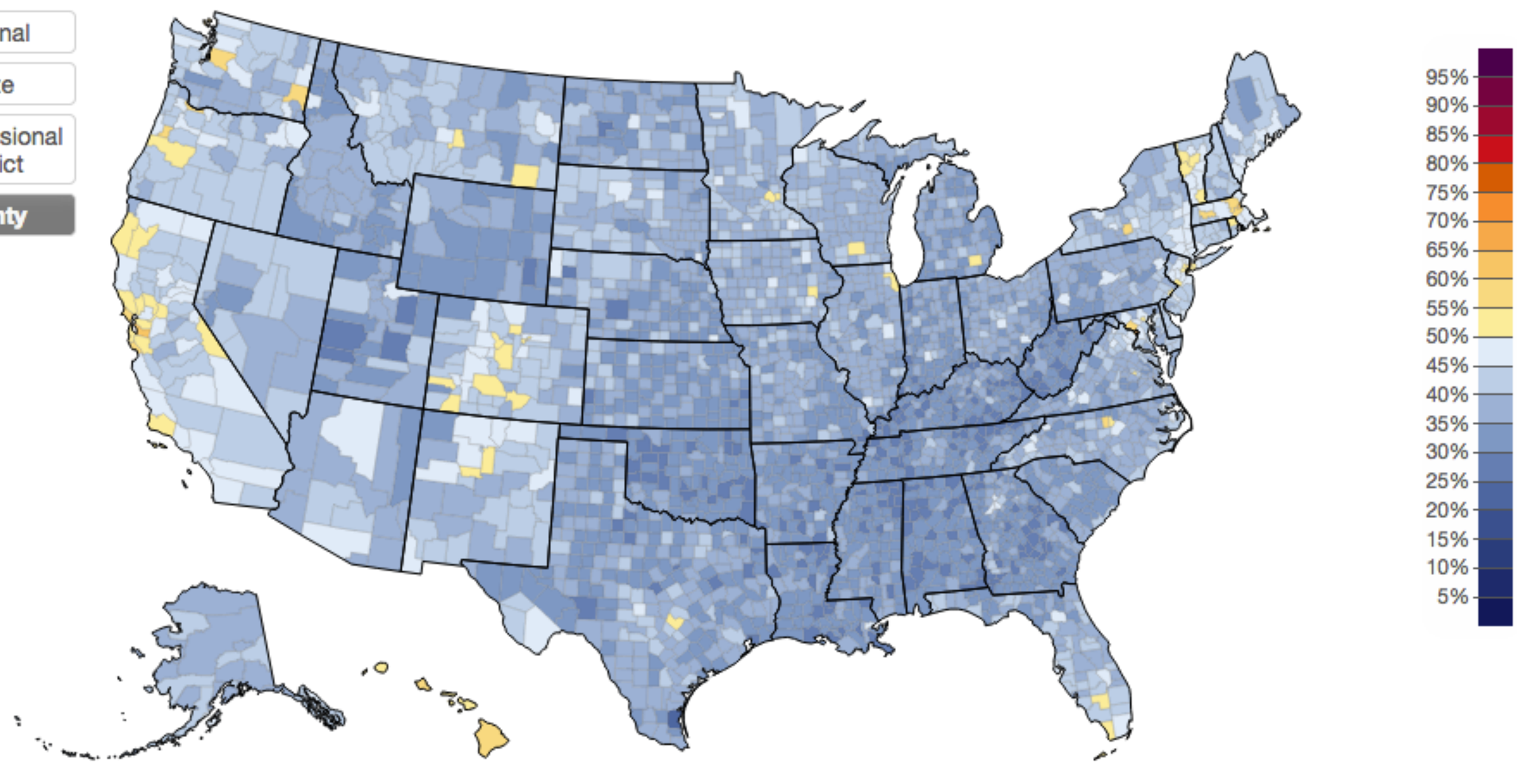
Display model output: Most scientists think global warming is happening

National

State

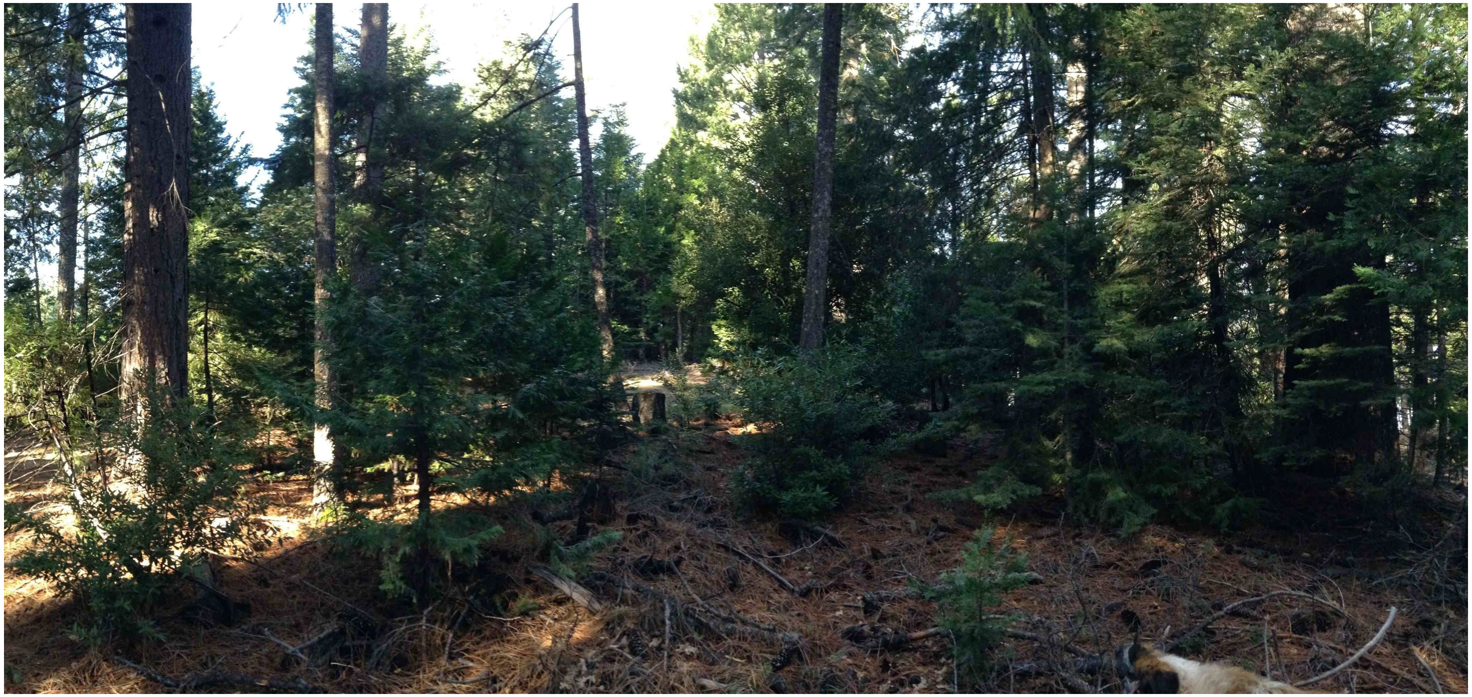
Congressional District

County



http://environment.yale.edu/poe/v2014/

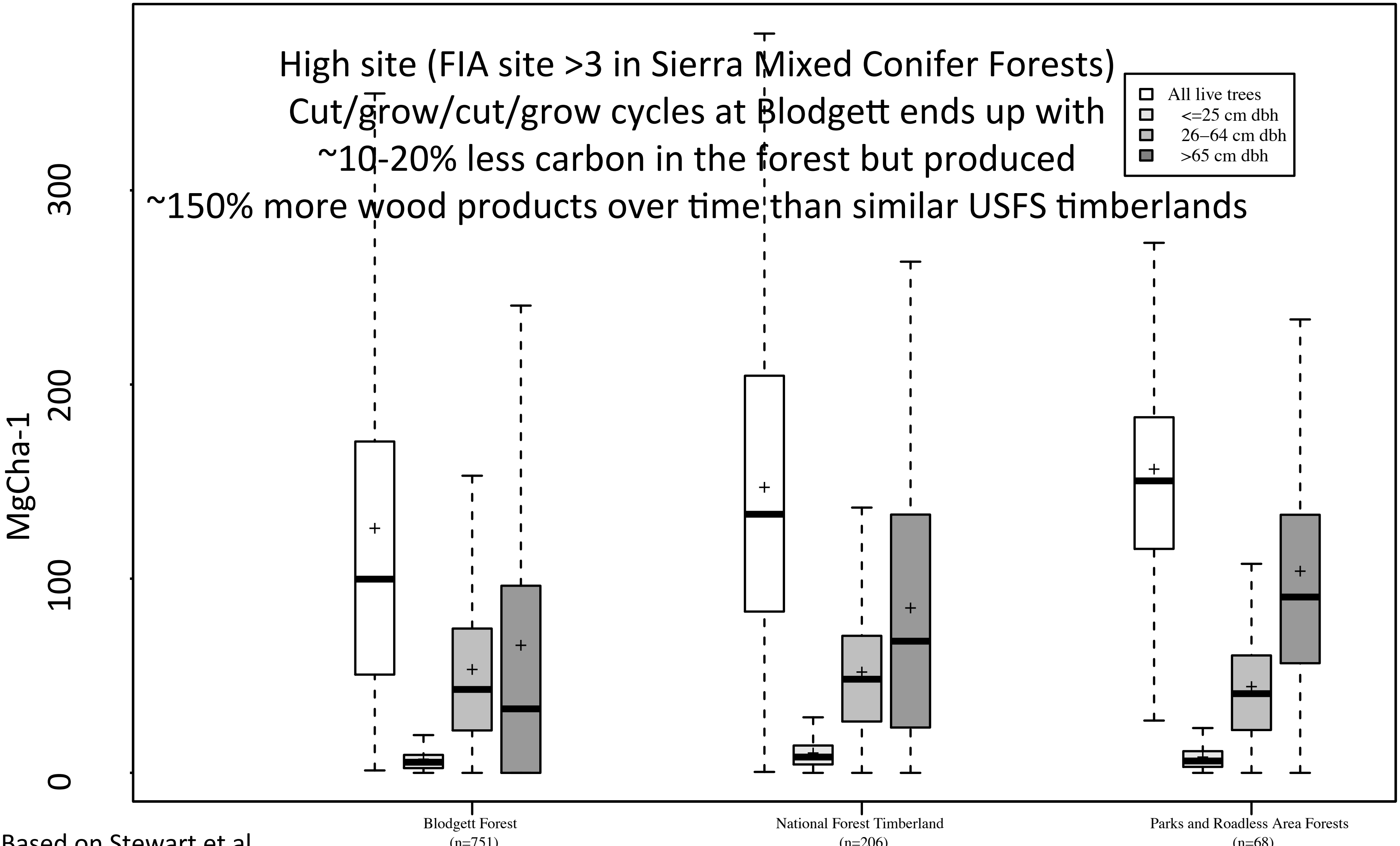
701 Tweet 358 Like



Go from this ⇧ To this ⇩ to reduce CO2 pollution?

100 Year Forest Management Productivity Quasi-Experiment:

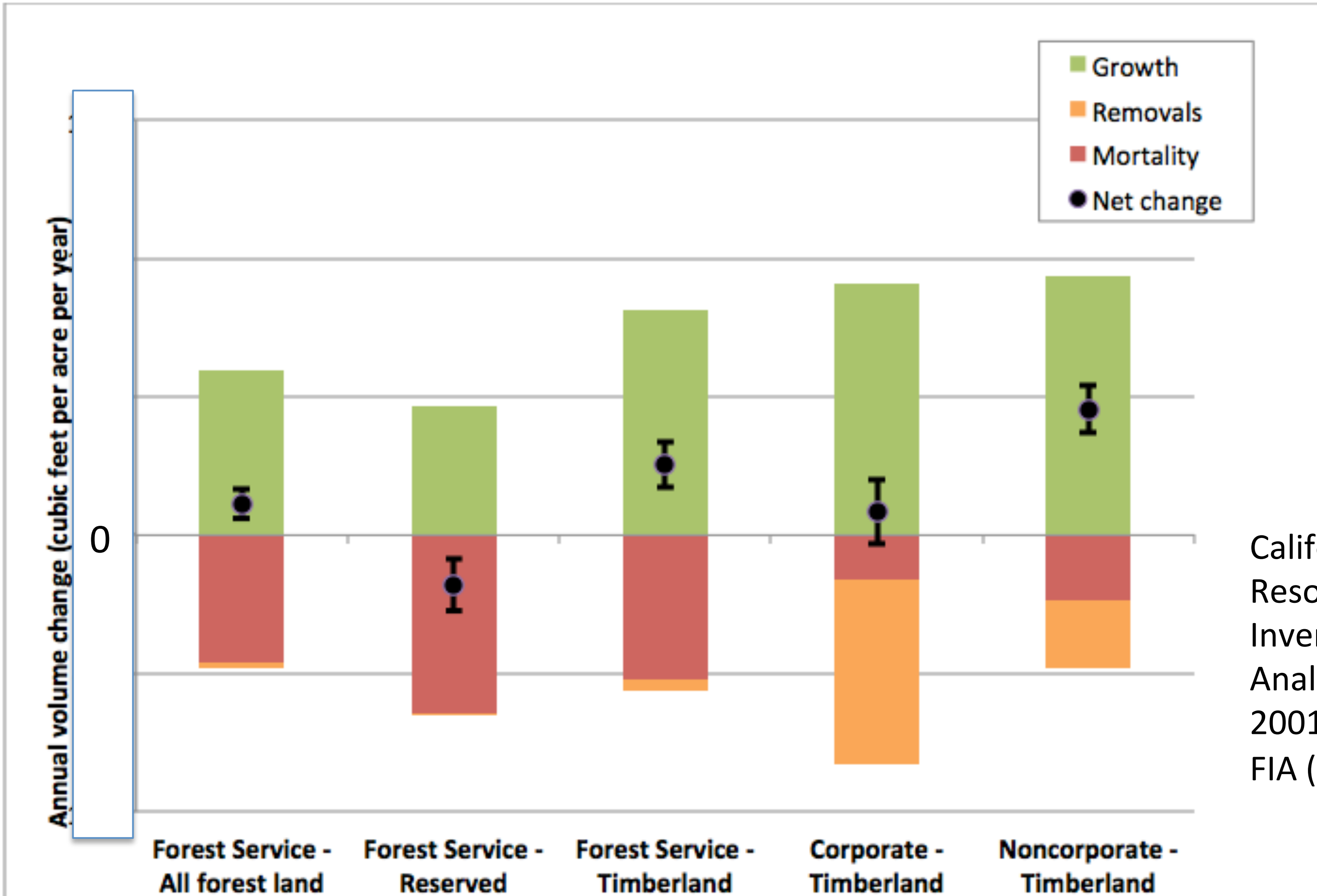
High site (FIA site >3 in Sierra Mixed Conifer Forests)
Cut/grow/cut/grow cycles at Blodgett ends up with
~10-20% less carbon in the forest but produced
~150% more wood products over time than similar USFS timberlands



Based on Stewart et al., *Forestry* in Ecosystems of California, UC Press. forthcoming

Blodgett (n= 751)	USFS Timberlands (n= 206)	Reserve Forests (n= 68)
200 <10" trees/ac	500 < 10" trees/ac	400 < 10" trees/ac
Heavy harvesting	Light harvesting	No harvesting

FIA remeasurements by ownership shows the allocation of tree carbon created by a decade of sunshine

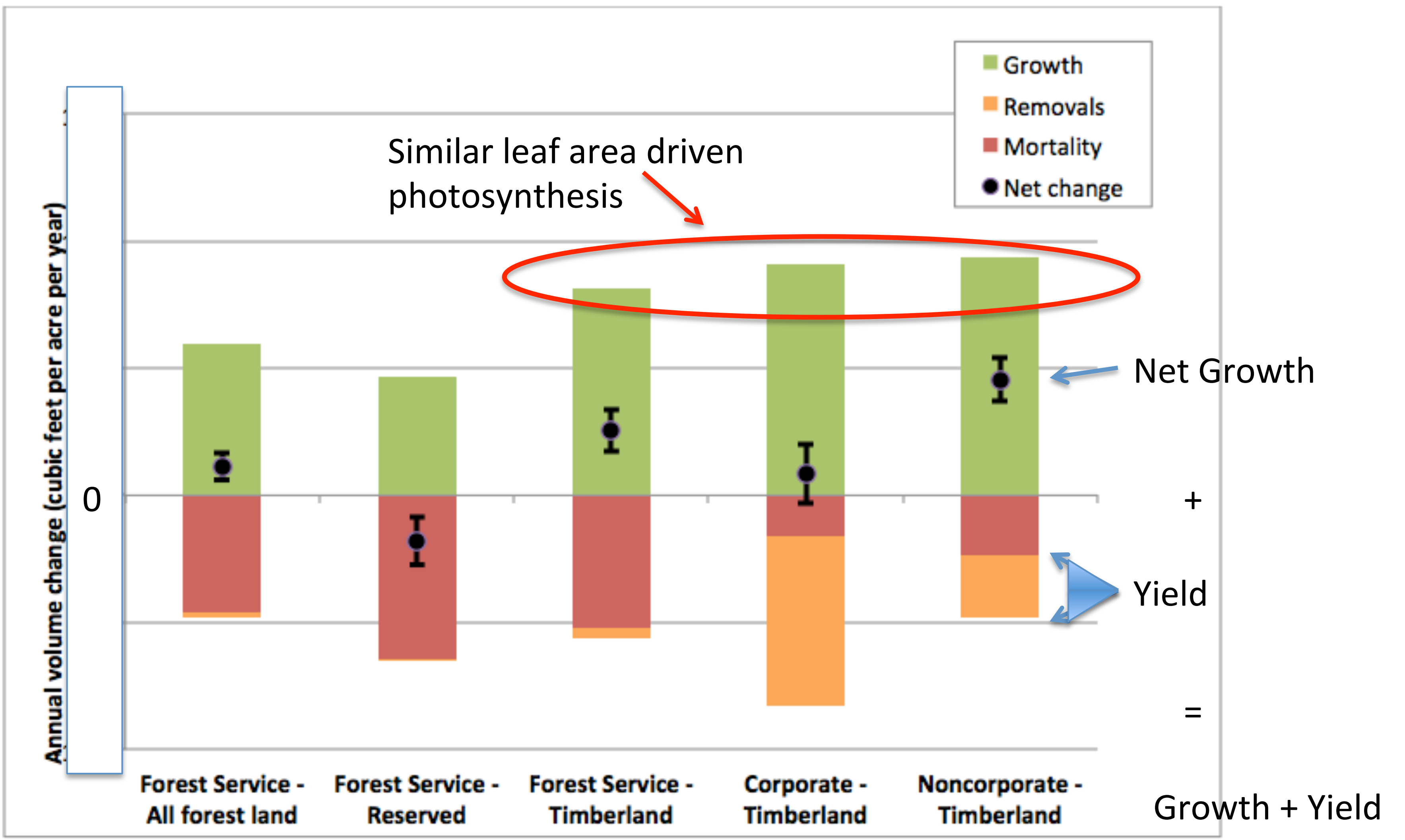


California's Forest Resources: Forest Inventory and Analysis, 2001-2010. USFS FIA (in press)

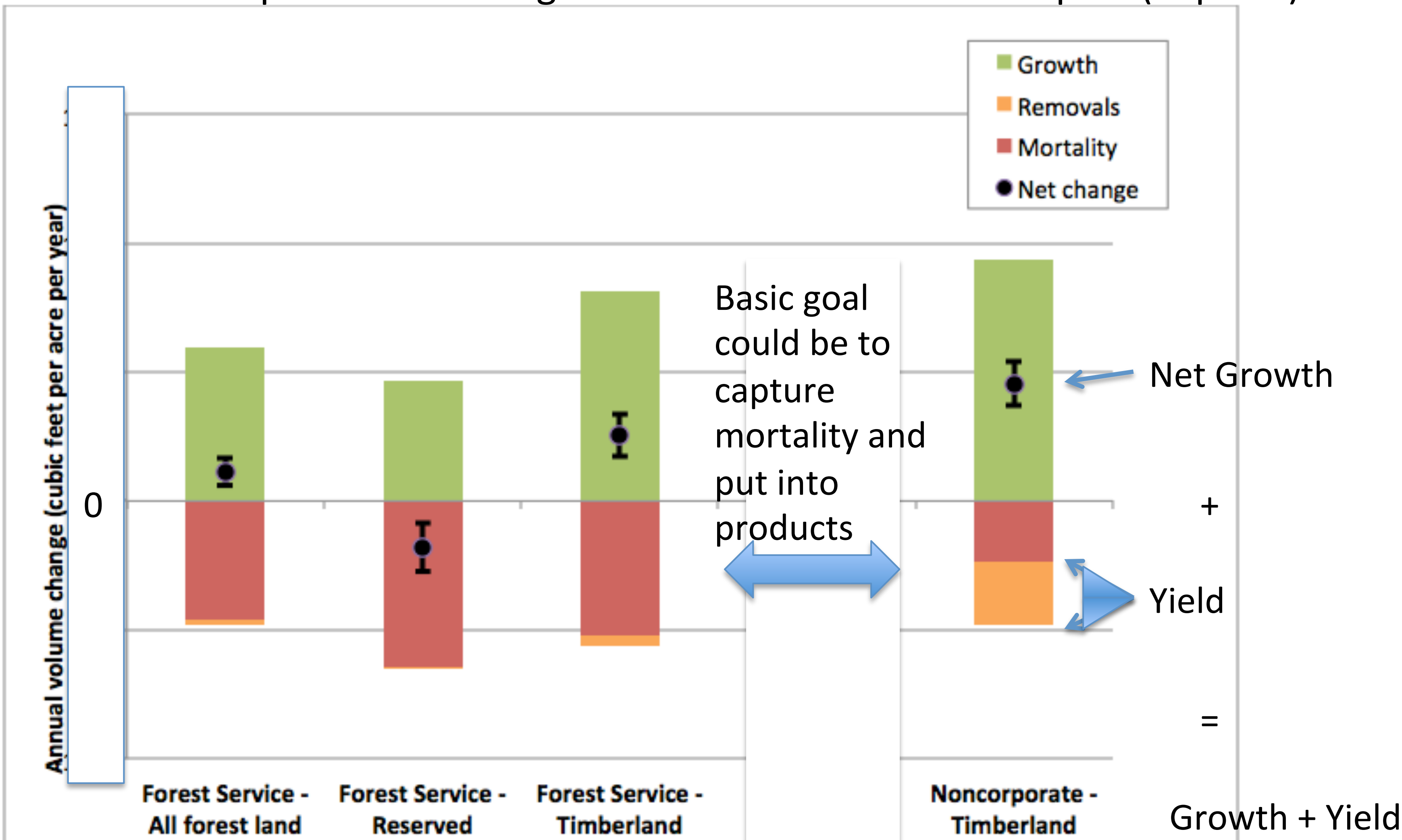
Published statewide data shows ~2x growth & yield by owner

FIA remeasurements across ownerships with similar gross growth rates

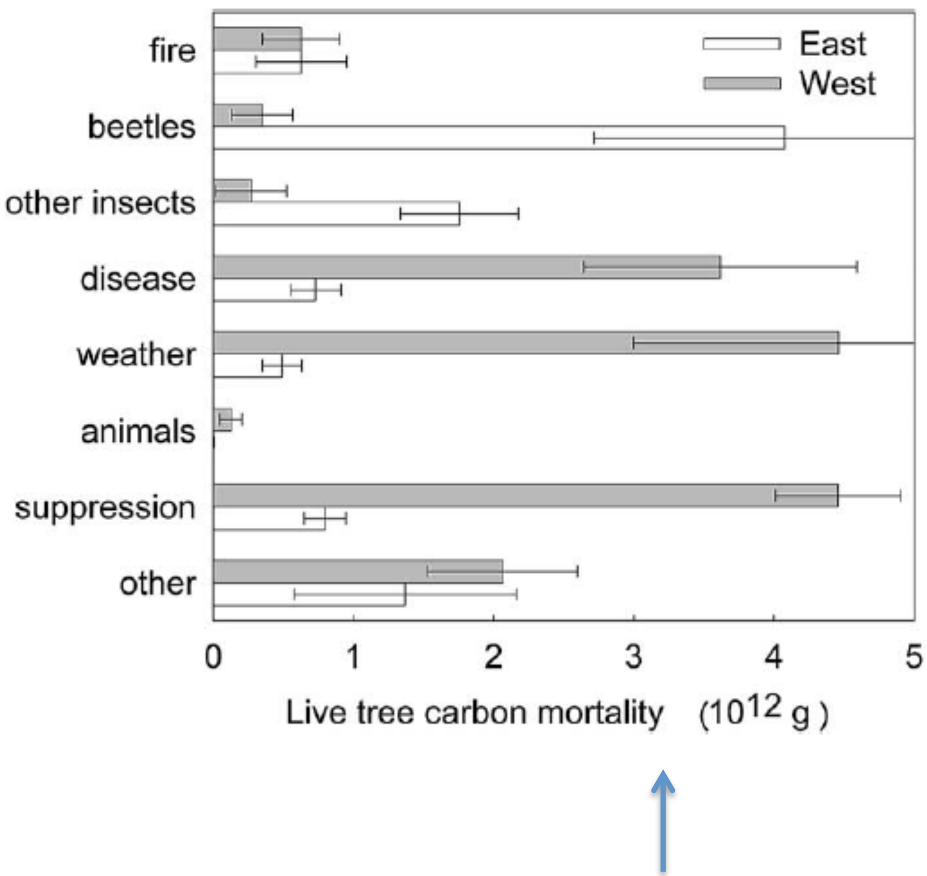
G+Y	13	-20	25	65	65

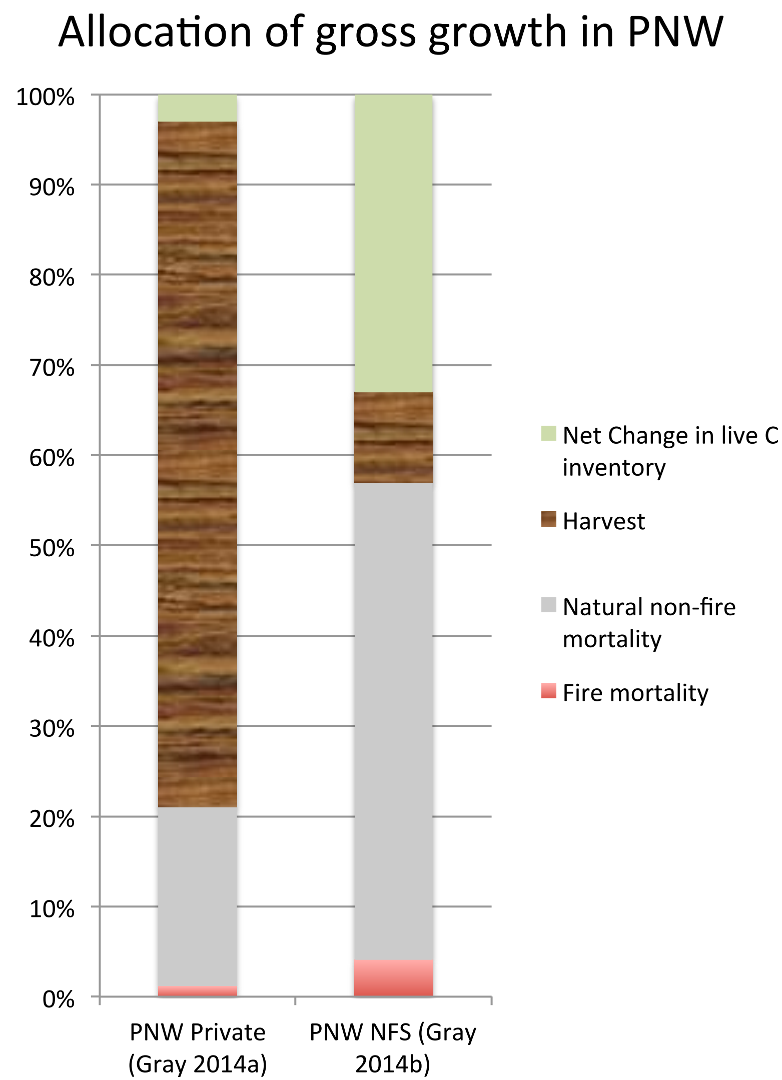


FIA forest plot remeasurement data shows USFS and family owned timberlands have similar rates of growth but that family forests allocate much more to wood products (removals) and less to mortality than the USFS. When we build and generate energy with wood, family forests generate far more climate benefits per acre. This figure is from FIA 2001-2010 report (in press)



Sources of mortality on private timberlands in OR
'Forest Health' is more than just fire risk reduction
Private forest lands in PNW allocate more to products, less to mortality than National Forest timberlands





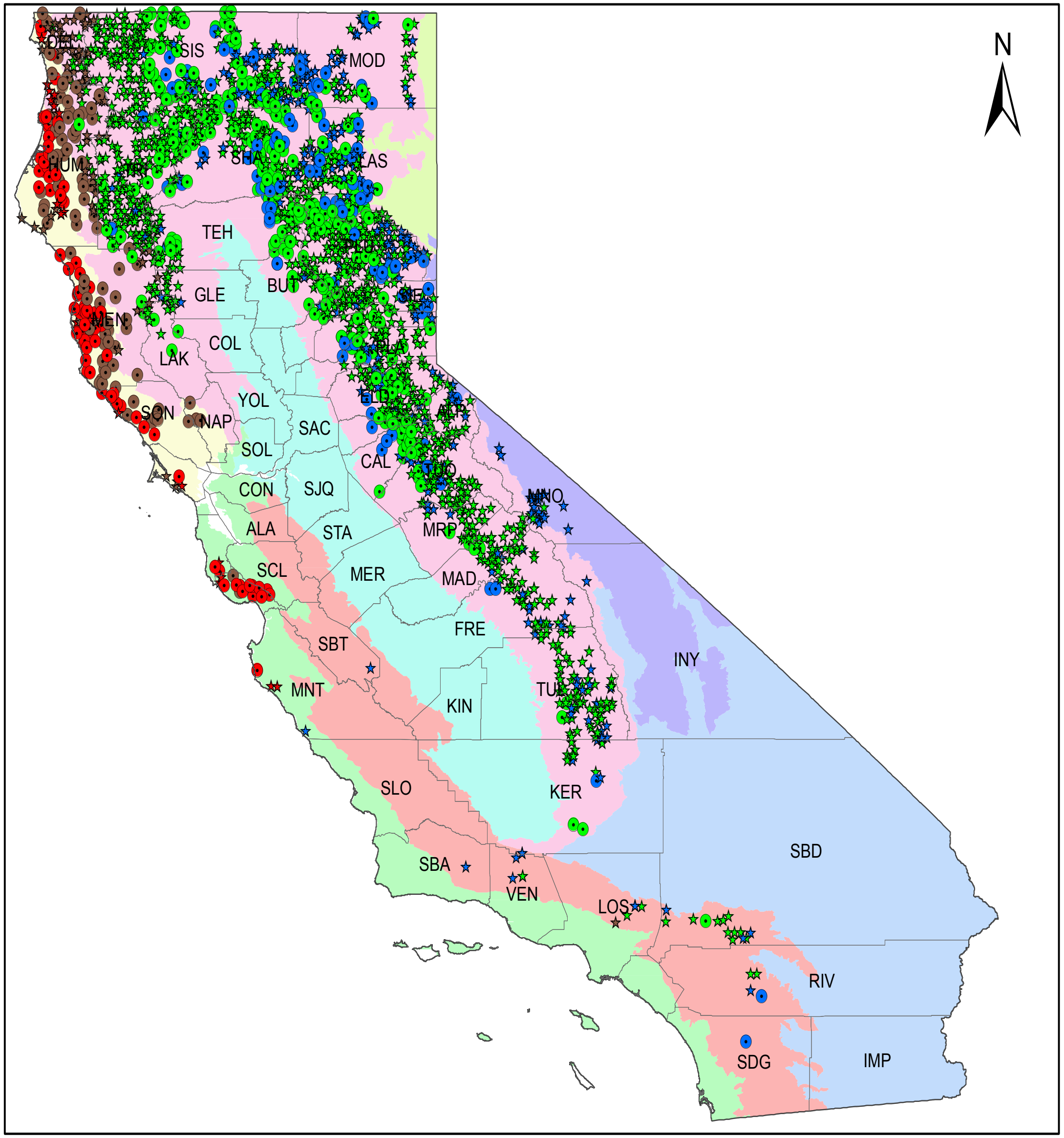
Gray AN, Whittier TR, Azuma DL. 2014a. Estimation of Aboveground Forest Carbon Flux in Oregon: Adding Components of Change to Stock-Difference Assessments. Forest Science 60: 317-326.

Gray AN, Whittier TR. 2014b. Carbon stocks and changes on Pacific Northwest national forests and the role of disturbance, management, and growth. Forest Ecology and Management 328: 167-178.

3 steps to estimate the relative benefits of forest management actions

1. Compare the carbon dynamics of mature California forests under different management regimes
2. Use current information on the efficiency of processing harvested logs and branches into products and bioenergy
3. Track the global carbon sequestration and GHG emissions from wood products and what they substitute for

Use measured and remeasured FIA plots (rather than plantation growth models) to capture what actually happens in forests rather than what modellers hope will happen



Dominant forest in FIA Plots

- Redwood
- Douglas fir
- Mixed Conifer
- P. Pine

Forest	Mill. Acres	FIA plots
Redwood	0.6	118
Douglas fir	0.9	187
Mixed conifer	6.4	1,374
Pond. Pine	1.9	263

COLE 1605(b) Report for California

COLE Development Group *

February 19, 2014

1 Abstract

This is a standard report produced by COLE, **The Carbon Online Estimator**. COLE is an online package that was developed under a cooperative agreement between NCASI and the USDA Forest Service, RWU-4104 in Durham, NH.

*NCASI: http://www.ncasi2.org/, USDA Forest Service: http://www.fs.fed.us/ne/durham/4104/

1

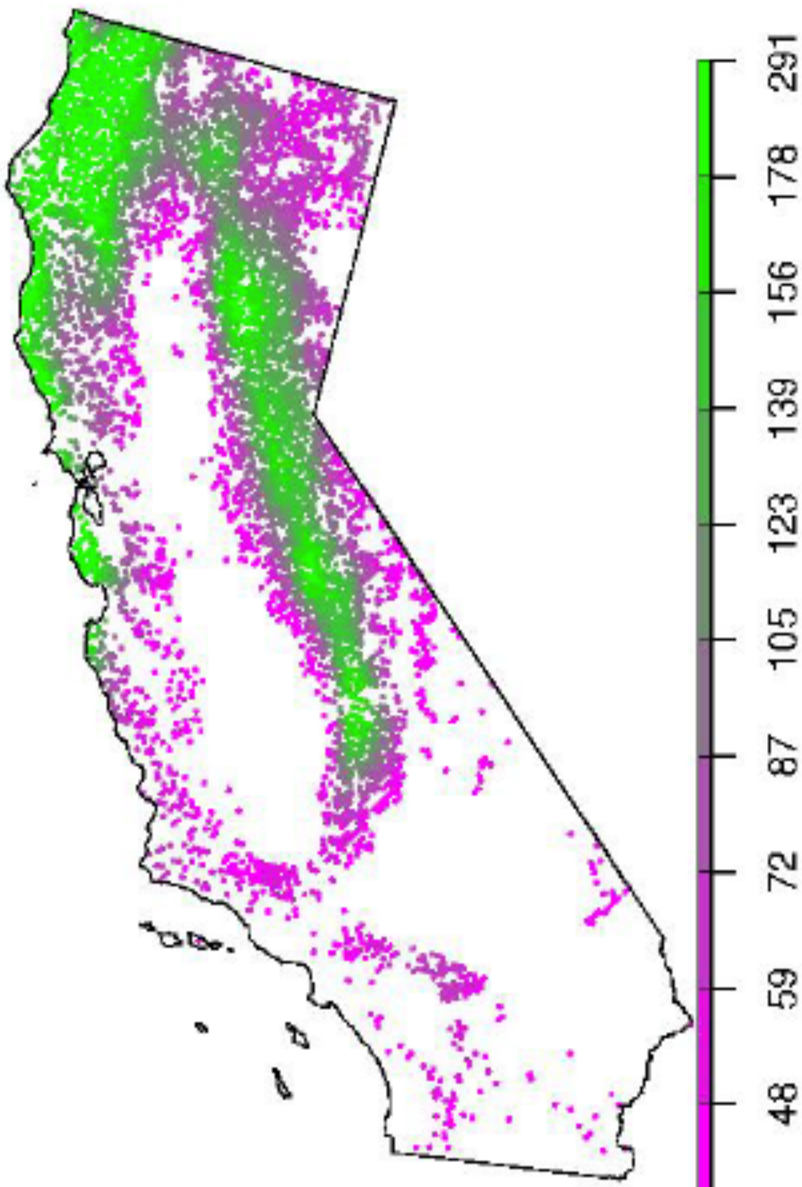
Approach: Use a very simple open source growth model combined with evidence-based analysis of harvested products

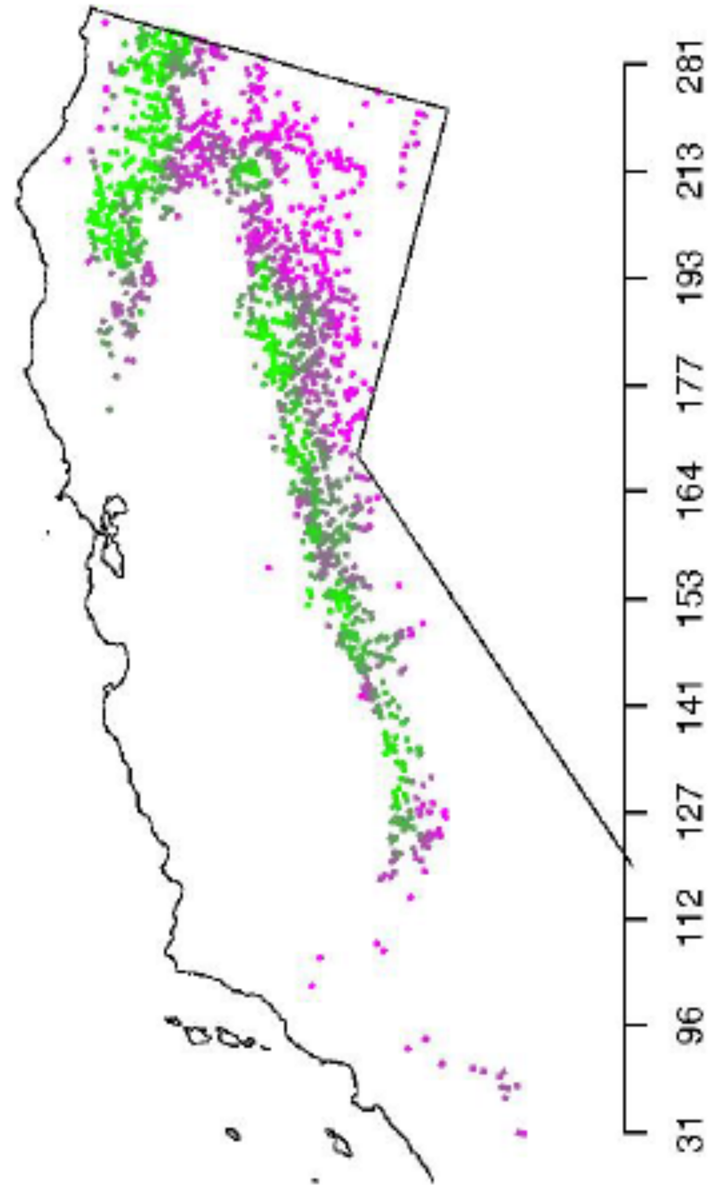
NCASI continues to update their COLE model and always uses the most up to date compilation of released FIA data

http://www.ncasi2.org/GCOLE3/gcole.shtml

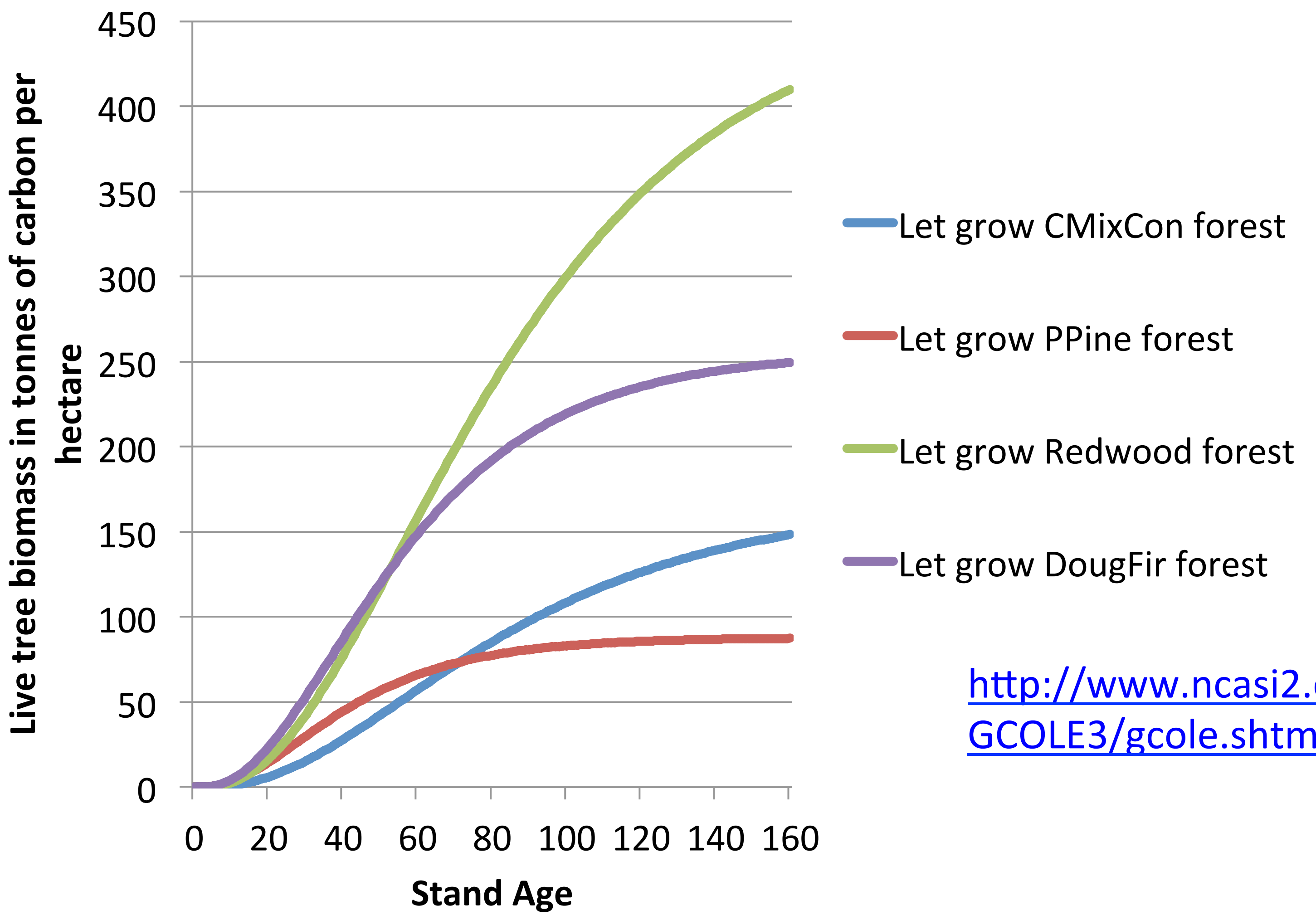
COLE Forest carbon density map of FIA plots

All Forest Plots | California Mixed Conifer





But sequestration is harder to measure than sinks: Start with growth rates for 4 forest types (from the COLE model) that show variations in productivity and mortality factors



http://www.ncasi2.org/GCOLE3/gcole.shtml

And follow the products used by Californians

- We build homes and apartments with wood
- We increasingly use bark and wood chips as landscaping mulch to reduce irrigation
- We use wood for process heat in timber and agricultural processing, as well as to feed RPS electricity into the grid
- We collect some of our wood and paper refuse and send it to engineered landfills that control methane emissions and often generate more bioenergy

Where do harvested products go?

- Morgan et al. (PNW-GTR-866) 2012 – analysis of 2006 wood flows
  - 43% to long lived products (LLP)
  - 21% to miscellaneous and pulp chips (could go to LLP or bioenergy if the price was right)
  - 36% to bioenergy
- McIver et al. (PNW-GTR-908) 2015 – will summarize 2012 wood flows
- Canadian re-analysis of US housing stocks clearly shows half life of ~130 years rather than ~25 years used in GTR-NE-343 and higher than the ~80 years used in this calculator

Estimate-driving coefficients in the UC Mixed Conifer model to allocate wood based carbon - live:dead and product:energy:waste

from COLE:Carbon On Line Estimator		www.ncasi2.org/COLE/	
	All California Mixed Conifer	Private California Mixed Conifer	
FIA est. of live tree carbon/ ha	121.4	84.4	
Von Bertalanffy growth equation coefficients			
a	168.03	110.94	
b	0.02	0.04	
std error	120.14	77.91	
No of FIA plots in COLE2 dataset	1374	351	
Product Allocation Ratios	Used-Bioenergy	Used-Products	Unused
Thinning utilization energy/ products	0.72	0.28	0
Logging residues - use/ leave ratios	0	0	1
Sawmill energy/product/ waste ratios	0.24	0.75	0.01
Substitution benefits for wood products used in buildings (McKeever 2011)		0.57	

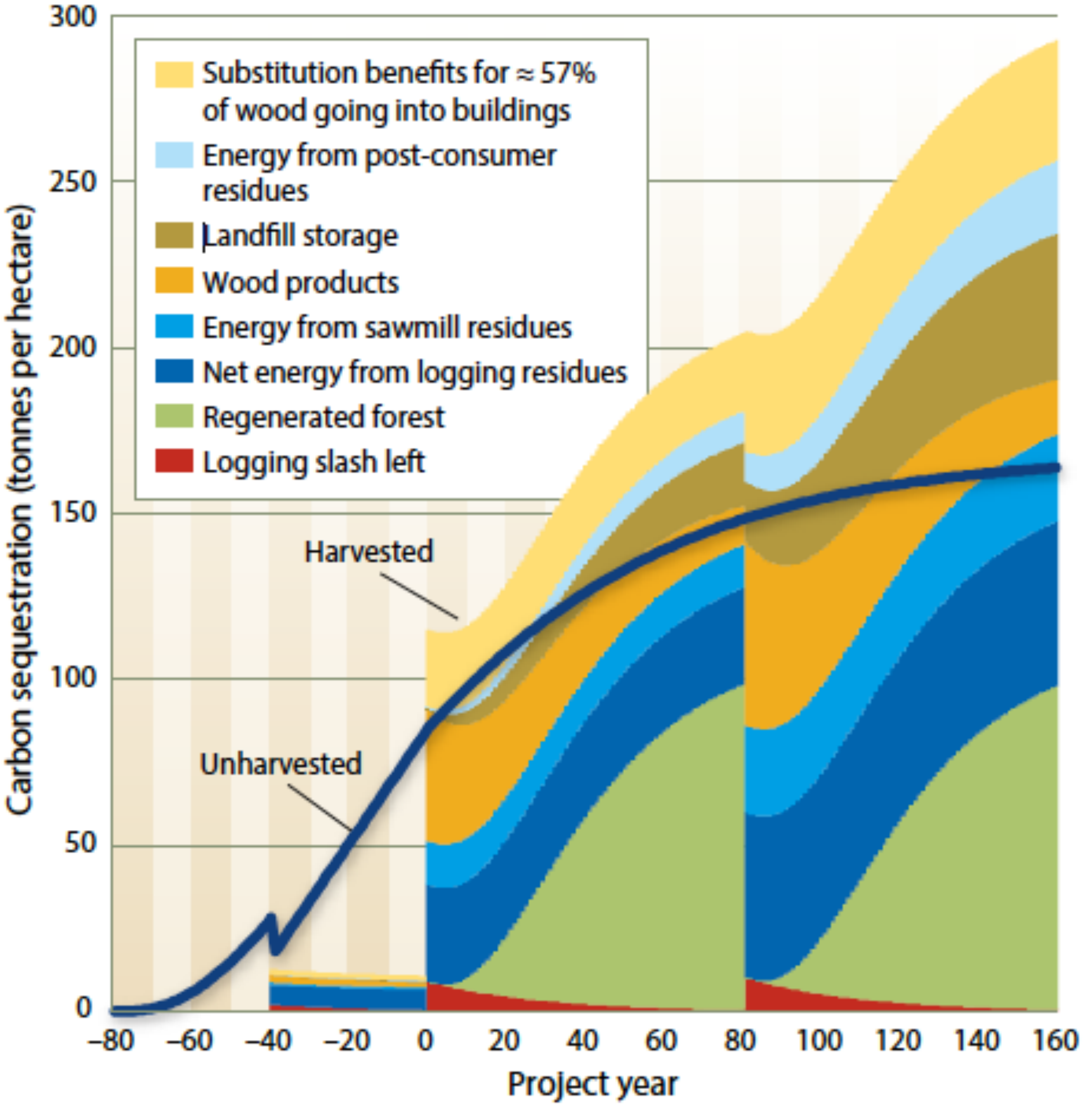
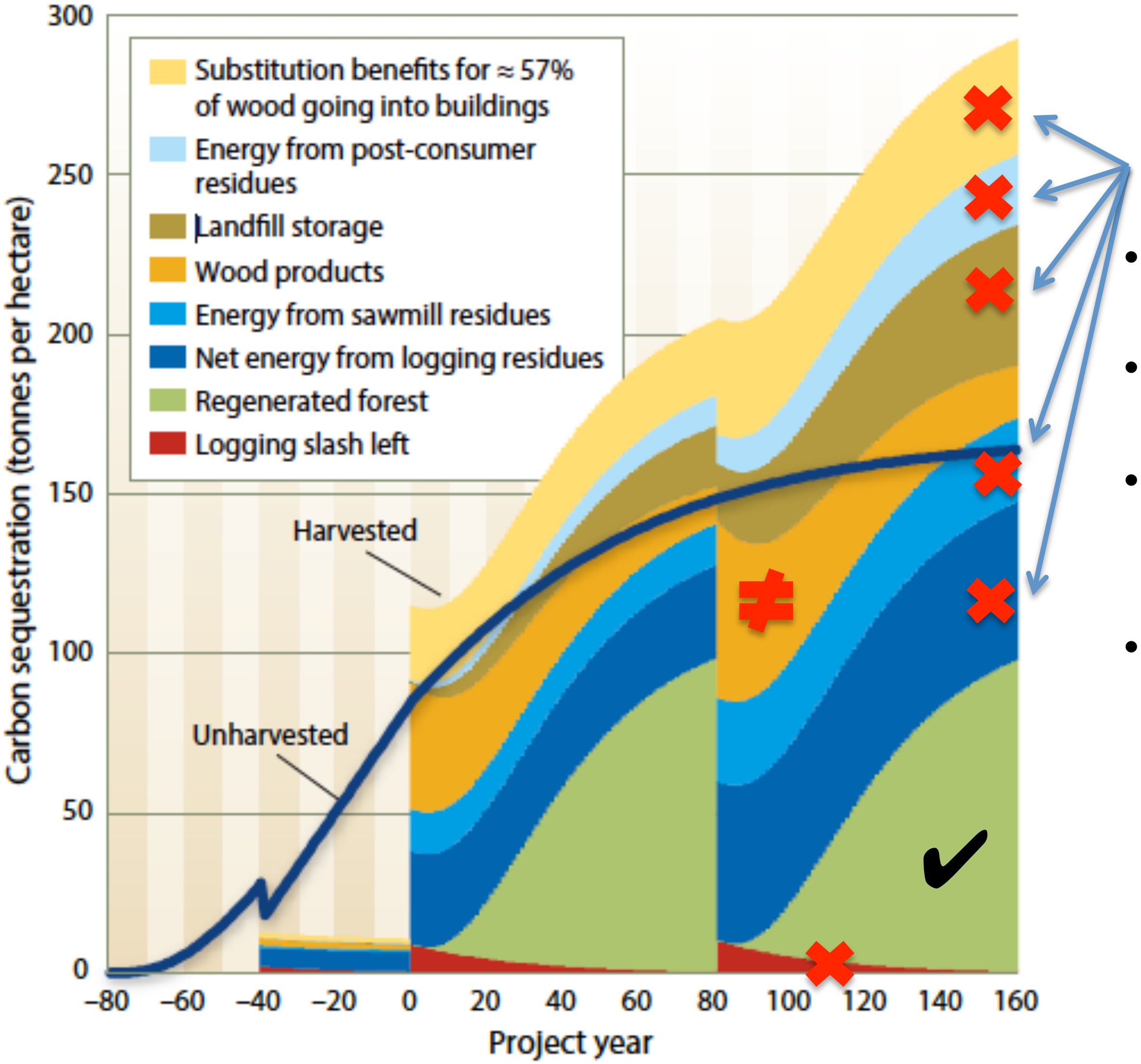


Fig. 1. Sequestration benefits over time from 1 hectare of a mixed-conifer forest under two scenarios: unharvested (or let-grow), and even-aged harvest and regeneration with 75% of slash (logging residues) used for energy at a harvest at year 0. The life cycle includes the 80 years since the forest started from seedlings as well as two cycles of harvesting and replanting.

- Simple graphic of our carbon calculator results
- Total mass balance method
- Simple forest growth model
- Evidence-based product model
- Full inclusion of bioenergy benefits
- Could be used by family forest owners to highlight climate benefits of management

Stewart and Sharma. *California Agriculture*. March/April 2015



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Which carbon pools are <u>not counted</u> in ARB (2014) and Calfire (2010) calculators

- Energy savings (substitution benefits)
- Bioenergy benefits (substituting for fossil fuels)
- Landfill storage of carbon and methane capture at landfills
- Historic carbon flow models (eg GTR-NE-343) assume wood products come from very inefficient processing mills (16% waste), have short lifespans, and go to inefficient waste collection systems
- Unclear if carbon storage in decomposing dead trees are included in some models

Table 2 : Average annual sequestration benefits of two management scenarios

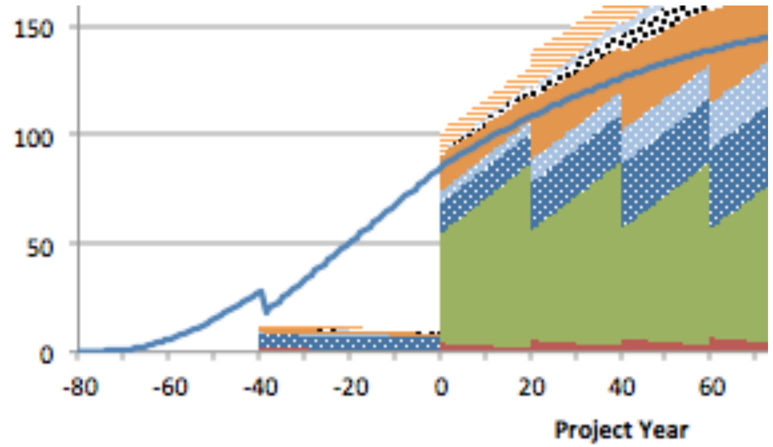
Carbon stock	Let-grow	Harvest & Regenerate
Live trees	77	43
Wood products	0	12
Bioenergy	0	26
Landfill storage	0	6
Building product substitution	0	12
Total	77	99

Source: Stewart and Sharma. 2015. in California Agriculture

Table 4. Estimating relative benefits 5 treatments, 4 forests, 3 time frame results (very conservative compared to the actual USFS v family timberlands sequestration)

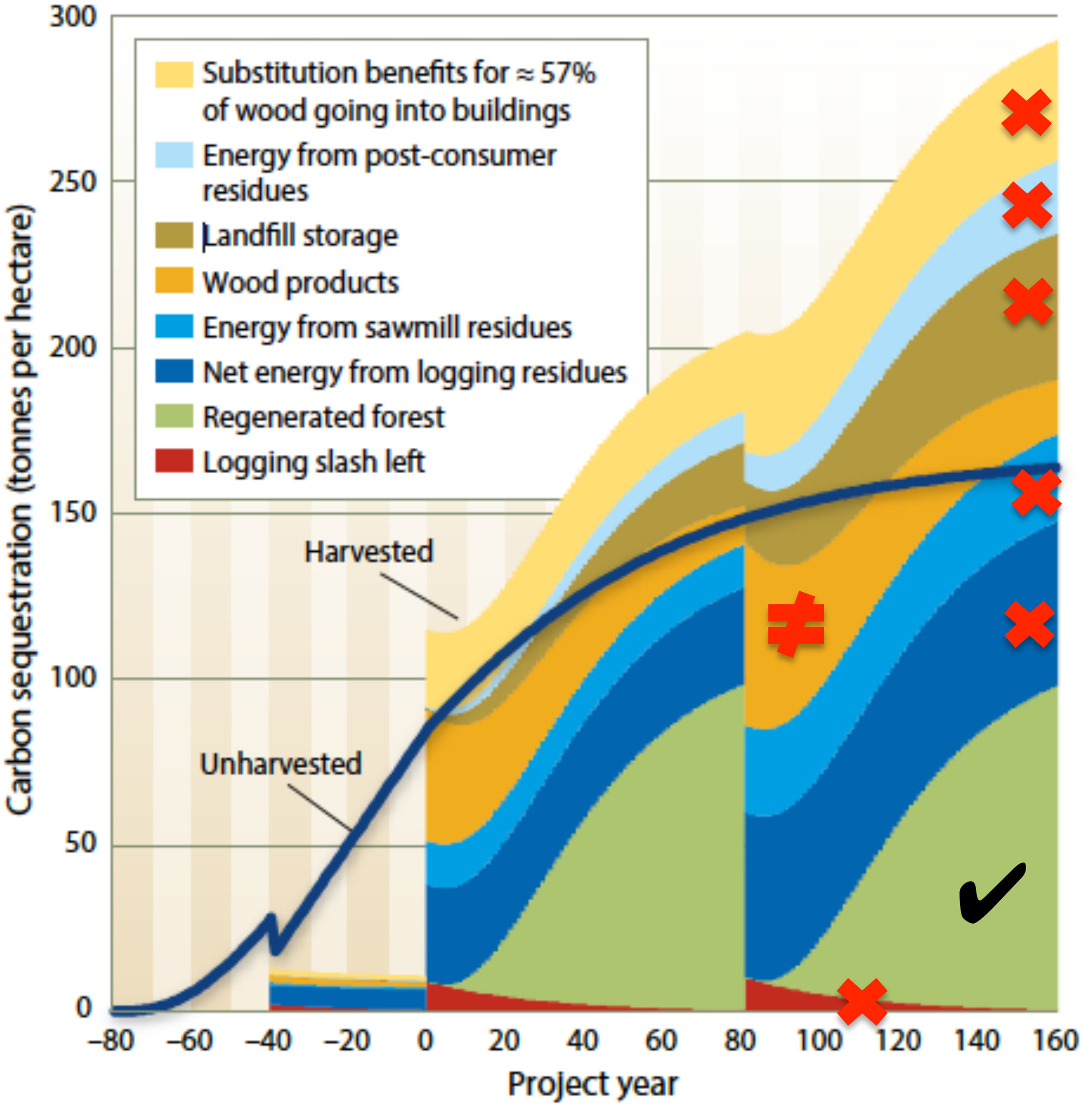
Management, logging residue utilization	80 year rotation plus 40 years after harvest	80 year rotation plus 80 years after harvest	80 year rotation plus 160 years after harvest
Let-grow baseline	1.00	1.00	1.00
Even aged, 0%	1.15	1.18	1.28
Even aged, 25%	1.19	1.24	1.36
Even aged, 75%	1.28	1.35	1.51
Uneven aged, 75%	1.28	1.40	1.70
Four-treatment average	1.23	1.29	1.46

Sequestration in tonnes of carbon per hectare for 2 treatment/no treatment pairs



- Empirical growth 'curves' document higher mortality than most models
- Yields shift from bioenergy chips to higher value building products as stands age
- Global carbon sequestration and offset benefits depend mainly on what products the carbon yield is converted into

Stand Age	Project Year	No treatment			Forest Health/Fire Thinning		
		C Growth	C Yield	C G&Y	C Growth	C Yield	C G&Y
40	-40						
60	-20	23	0	23	23	10	33
80	0						
100	20	24	0	24	34	34	68



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Concluding Points

- We try to count all carbon and GHG pools, including bioenergy, based on best practices
- Empirical data from California illustrates the significant GHG benefits of capturing mortality and converting carbon into socially useful products
- Reforestation, thinning, forest health projects, and fuels reduction projects can all increase the 'efficiency' of forests as they convert sunshine into carbon
- Conservative modeling suggests around 30% more GHG benefits from conservative management in California's high risk forests - as opposed to doing nothing

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Thank You
Questions ?

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