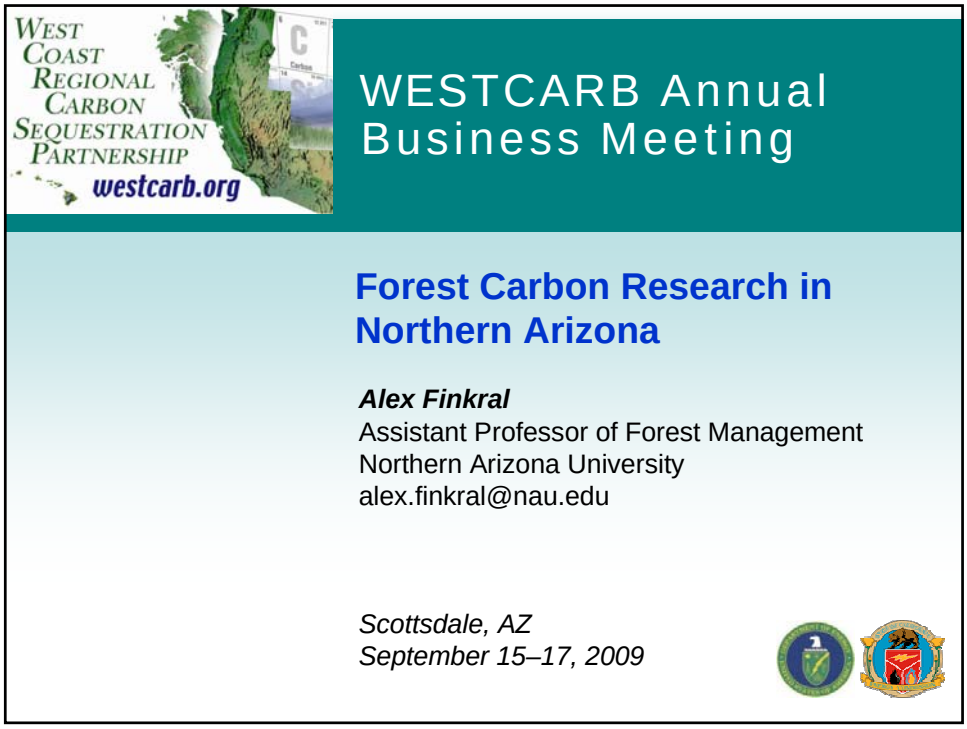
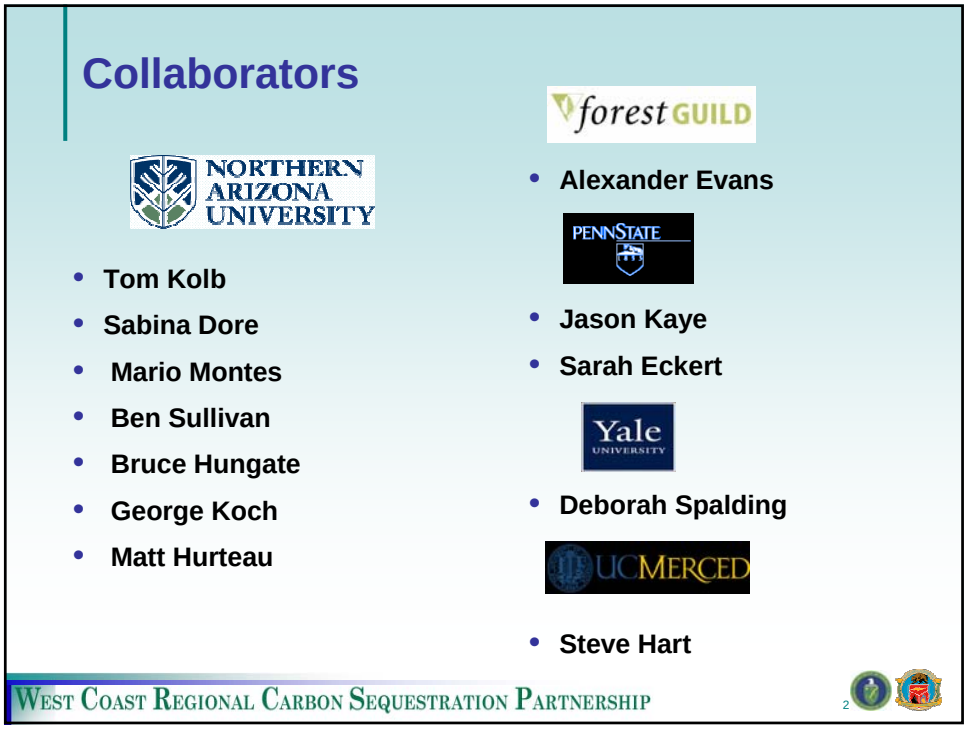

West Coast Regional Carbon Sequestration Partnership
westcarb.org
WESTCARB Annual Business Meeting
Forest Carbon Research in Northern Arizona
Alex Finkral
Assistant Professor of Forest Management
Northern Arizona University
alex.finkral@nau.edu
Scottsdale, AZ
September 15–17, 2009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NORTHERN ARIZONA UNIVERSITY
Ecological Restoration Institute

Arizona Technology & Research Initiative Fund

RMRS Rocky Mountain Research Station

WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP 3

Context

Risks of intense fire in Southwestern ponderosa pine forests have prompted fuel-reduction, or "restoration" thinning treatments

What is the impact of thinning on the ecosystem service of carbon sequestration?

WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP 4

Three Foci:

- **ECOSYSTEM**

West Coast Regional Carbon Sequestration Partnership 5

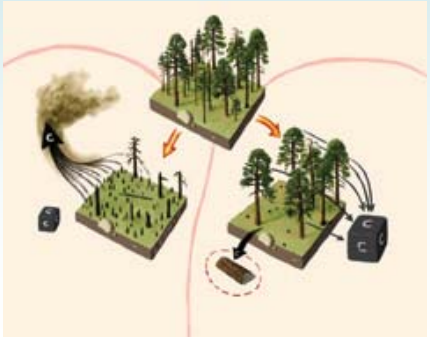
Three Foci:

- **ECOSYSTEM**
- **OPERATIONS**

West Coast Regional Carbon Sequestration Partnership 6

Three Foci:

- **ECOSYSTEM**
- **OPERATIONS**
- **POLICY**



From Hurteau et al. 2008 Front Ecol Environ 6:493-498

Fuel Reduction Thinning

167 ha in the eddy covariance instrument tower footprint thinned Sept.-Oct. 2006 after collection of ~ 1 year of pre-thinning flux data

Thinning reduced:
- Tree density by 70%
- Tree basal area by 35%
- Leaf area index by 40%

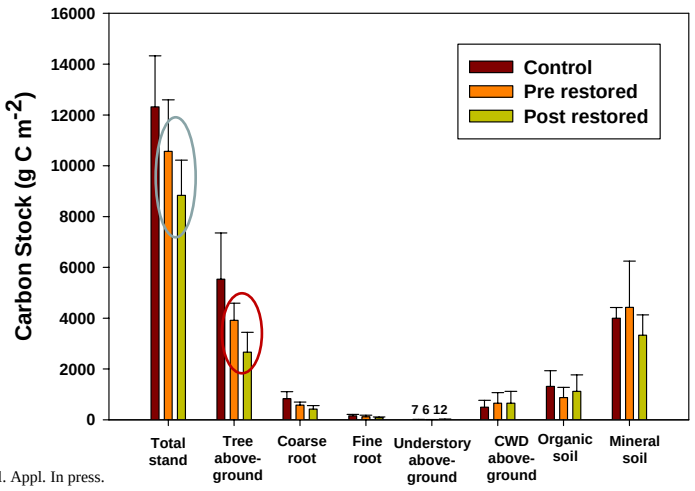
Before

During

After

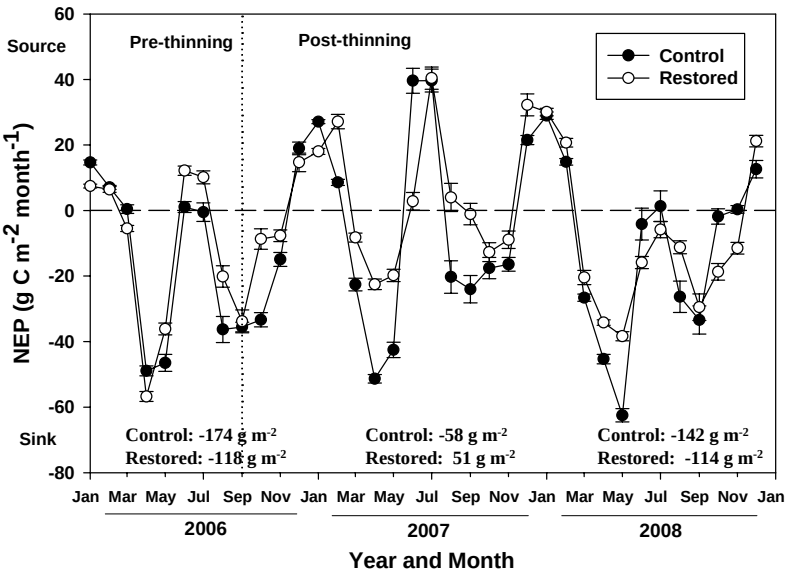
Carbon Stocks: Impact of Restoration Thinning

Thinning reduced total site carbon ~16% via reduction of tree stocks



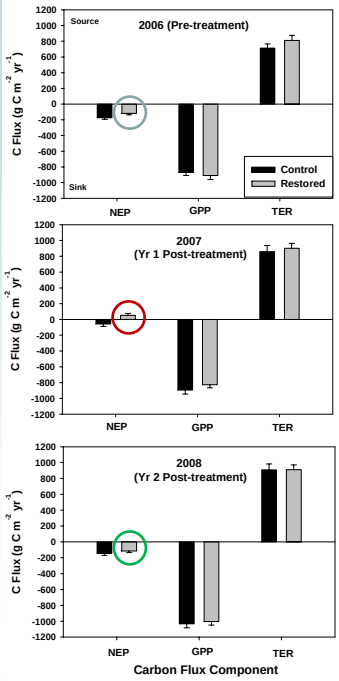
Dore et al. Ecol. Appl. In press.

Carbon Sequestration: Eddy Covariance-Measured Net Ecosystem Production (NEP)

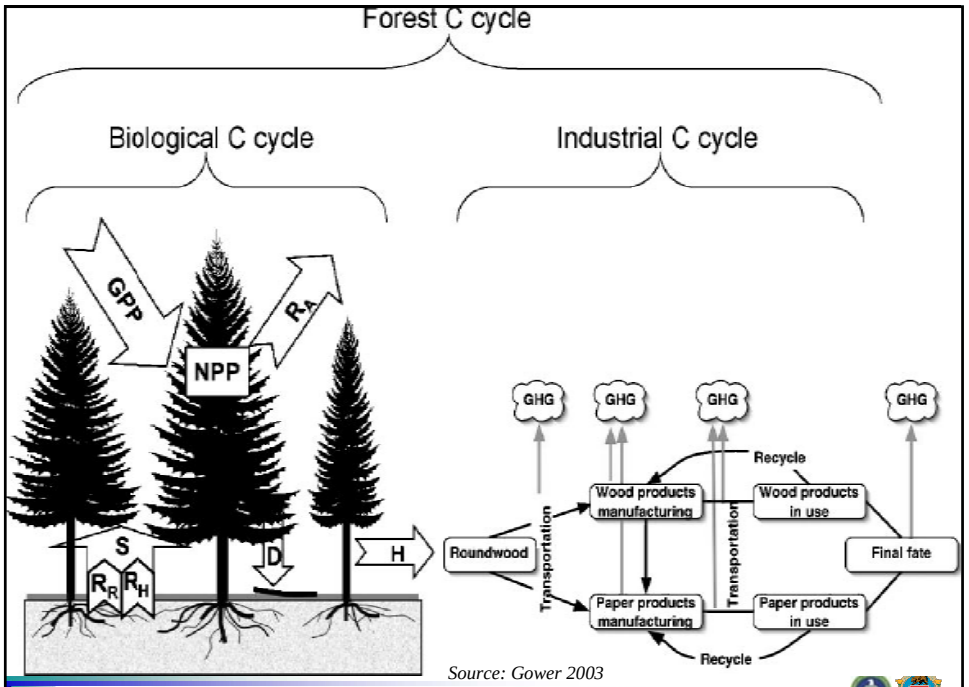


Components of Annual Net Ecosystem Production (NEP = GPP - TER): Control vs. Thinned

- Restored site shifted from C sink in 2006 to source in 2007 (1st post-trt yr) mostly because GPP declined
- Restored site shifted back to a C sink in 2008 (2nd post-trt yr) due to partial recovery of GPP and reduced TER, relative to control site



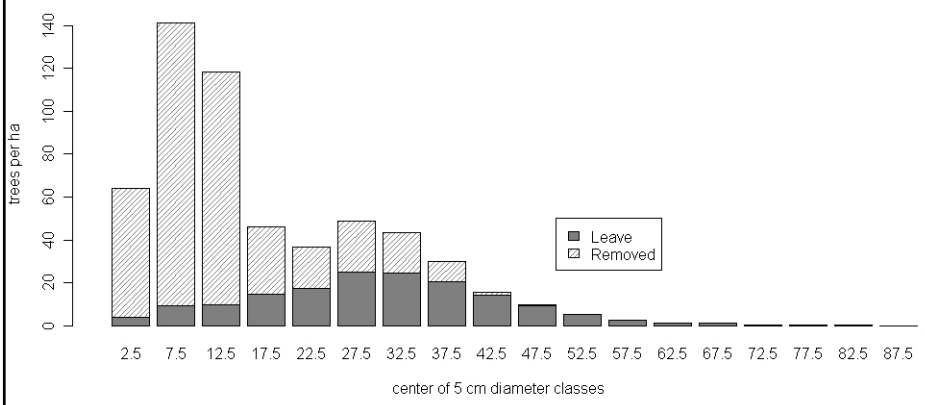
WEST COAST REGIONAL CARBON SEQUESTRATION PA



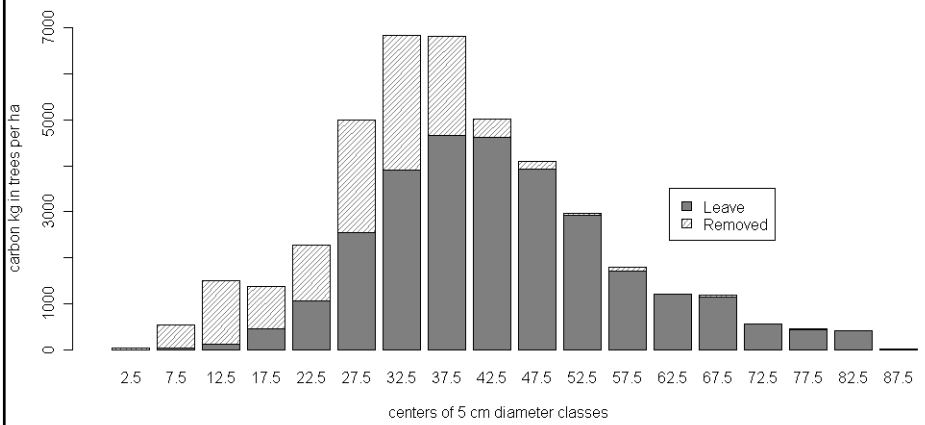
Source: Gower 2003

WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP 12

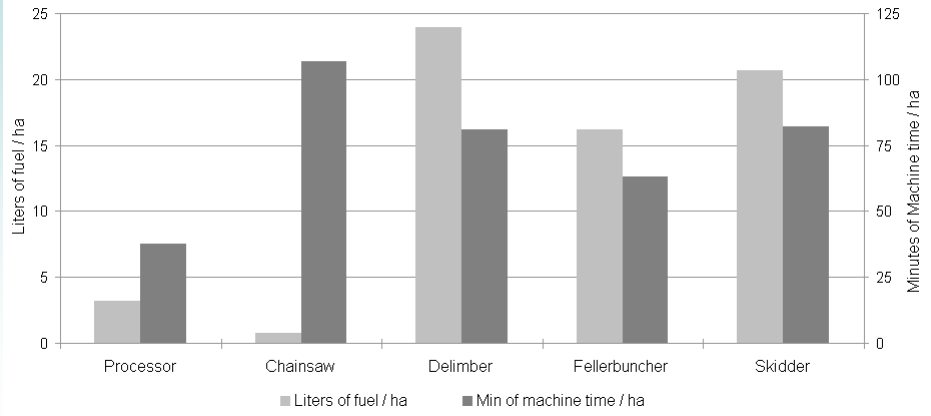
Size Class Distribution of Ponderosa Pine



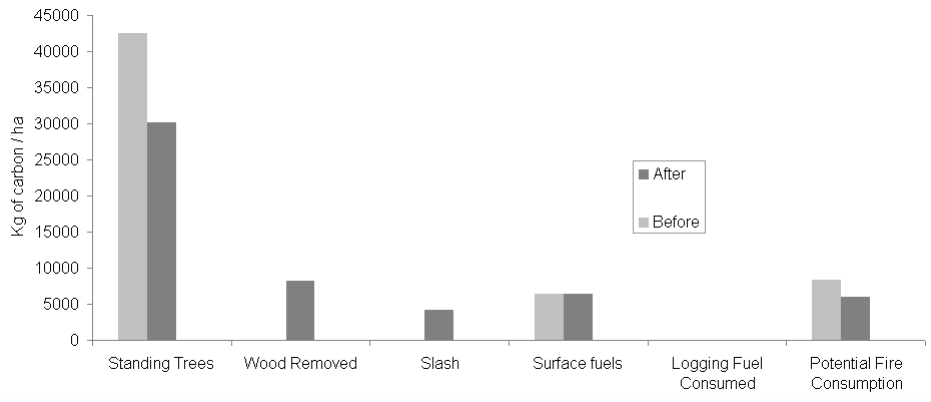
Distribution of Above Ground Carbon by Size Class



Fuel Used and Machine Hours per Hectare by Machine Type



Carbon Stocks Before and After Restoration Treatment



Carbon stocks (kg C ha^{-1}) for thinning project under different wood utilization scenarios

	Firewood	Paper	Pallets & construction	Composite materials
Carbon released from thinning				
Storage half-lives[1] (years)		1 to 6	6 & 70 to 100	45
Slash burning	4,140	4,140	4,140	4,140
Diesel fuel consumed - Logging	51	51	51	51
Firewood burning	8,240			
Diesel fuel consumed - Trucking	20	149	65	73
Carbon released Subtotal	***12,451***	***4,340***	***4,256***	***4,264***
Stored carbon and avoided releases				
Reduction in potential wildfire releases	2,410	2,410	2,410	2,410
Avoided used of oil or gas	6,980			
Storage in wood products		6,820	6,110	6,820
Carbon sequestered Subtotal	***9,400***	***9,240***	***8,530***	***9,240***
Net storage (or release) of carbon	**(3,061)**	**4,890**	**4,264**	**4,966**

Carbon storage measured in kg C ha^{-1}.

[1] From (Skog and Nicholson 1998; Houghton and Hackler 2000; Penman et al. 2003)

Policy

- Hurteau et al 2008
  - Carbon accounting should recognize the value of management actions that reduce the risk of carbon loss through stand replacing fire
- Spalding et al 2009 *(in press)*
  - The reduced risk of fire from thinning and the subsequent use of harvested wood in long lived wood products have the capacity to sequester carbon at rates that may make such activities economically attractive within developing carbon markets while at the same time lowering the risk of incurring high financial, ecological, and social costs of severe fires.
- Developing protocol for Ponderosa Pine

Conclusions

1. Restoration or fuel-reduction thinning causes a small reduction in C stocks (~16%), & a short-term (1 yr) depression of carbon uptake because reduced tree leaf area reduces GPP.
2. Recovery of carbon uptake capacity from 1 thinning appears to be rapid due to rapid stimulation of tree production.
3. The end use of wood products plays an important role in how forest management treatments affect the C balance in forest stands.
4. Forest management treatments that reduce the risk of stand-replacing fire may qualify to be credited in the marketplace as avoided deforestation.