Effects of Wood Pellet Production on Forest Conditions in the Southeastern United States

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http://www.ornl.gov/sci/ees/cbes/

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US industrial wood pellet trade has been growing

Converted power plant, Drax, UK (www.bbc.com)

From E. Parish, A. Herzberger, C. Phifer, and V. Dale (2018) *Ecology & Society*

Key questions

- How does SE US pellet production for export to EU differ from business-as-usual case of no pellet production?
  - Ø Under what conditions does the pellet industry complement or compete with pulpwood use?
  - Ø Will pellet industry alter amount of land staying in the forest?

- Are there significant changes to key environmental indicators?
  - Ø Biodiversity
  - Ø GHG emissions
  - Ø Soil quality
  - Ø Jobs
  - Ø Water & air quality
  - Ø Preserving land as forest

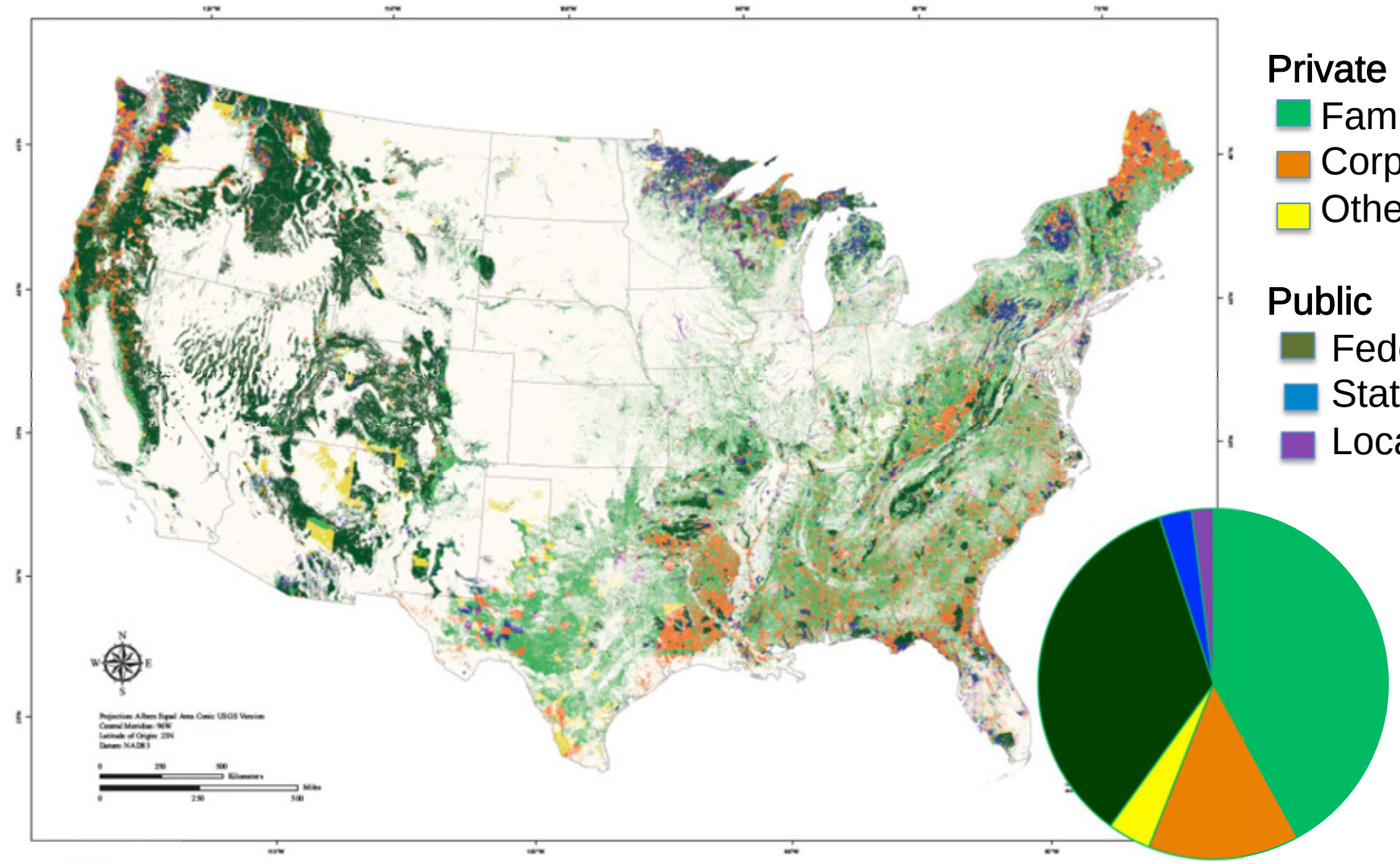
- How can forest conditions be monitored & good practices implemented?
  - Ø Analysis of USDA Forest Service's Forest Inventory & Analysis (FIA) data
  - Ø Best Management Practices (BMPs)

Participants on ORNL's Bioenergy Study Tour helped address these questions

Dale et al. (2017) GCB Bioenergy

Private forest land in the SE is the “timber basket” of the US

Pellets come from those private lands



Hewes et al. (2014)

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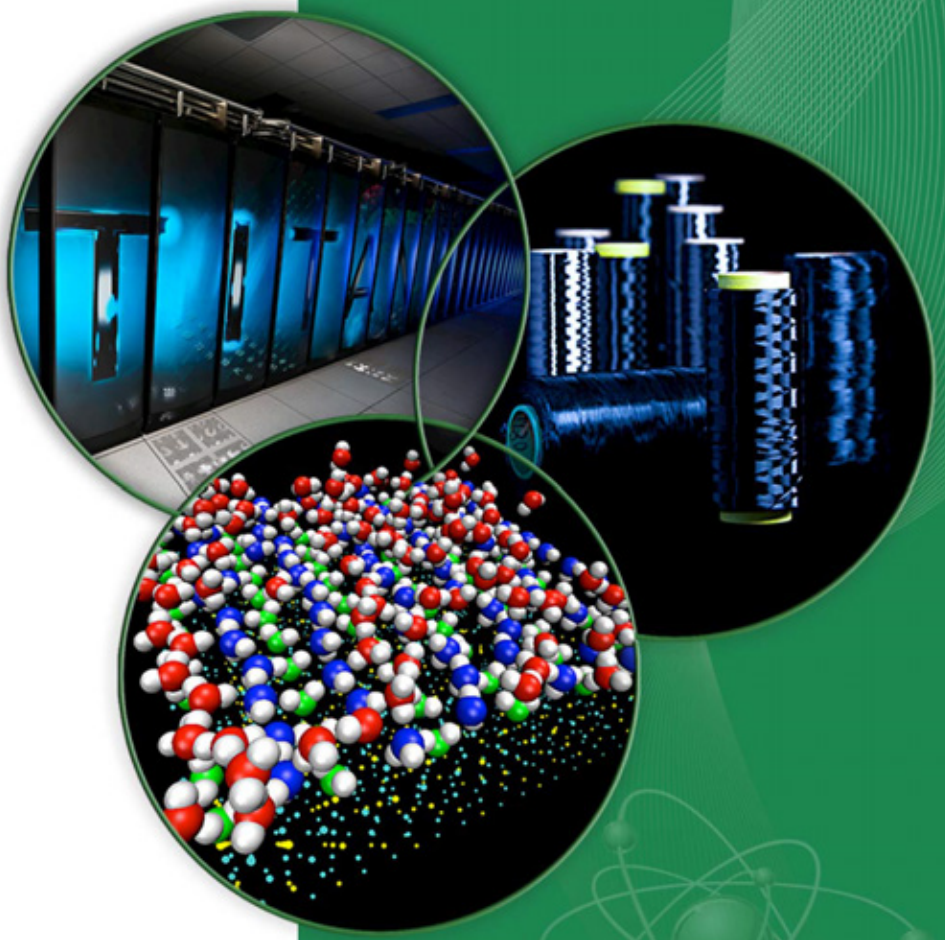

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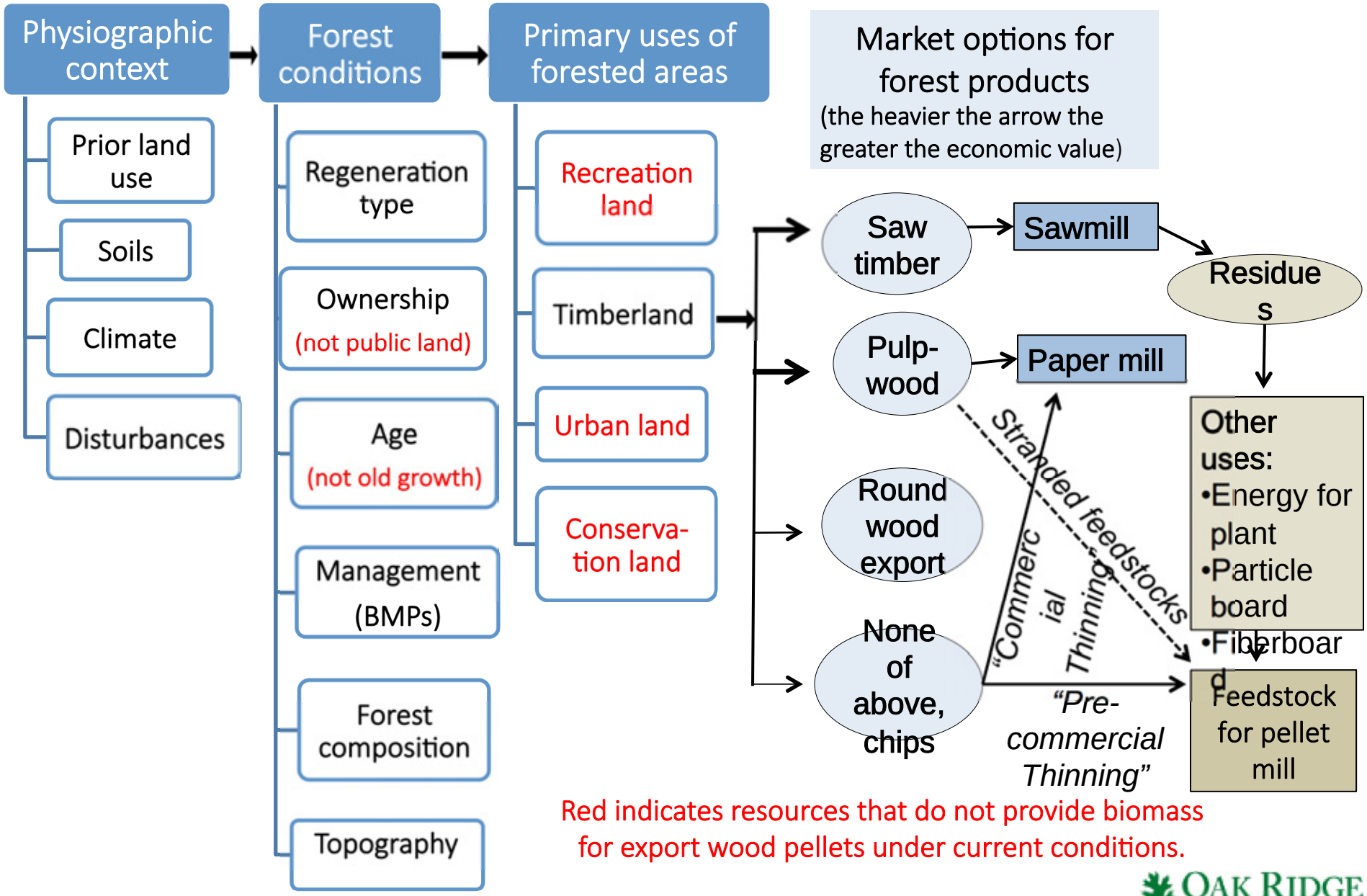
Influences on SE US export wood pellet production



Red indicates resources that do not provide biomass for export wood pellets under current conditions.

Parish et al. (2017)

Biomass stranded without markets ("unloved wood")

- Eventually burns or decays
- Reduces incentives to keep private lands forested

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Opportunity created by European demand for pellets for biopower

Sawdust → Wood based pellets

The pellet industry constitutes < 1% of US forest products by weight in 2014 and is growing.*

*Stewart (2015)

When assessing effects of woody biomass, the counterfactual or reference scenario should be based on

- Historical conditions
  - Past agriculture cleared much of the SE US forests
    - For example - only 3% of original long leaf forest remains
  - Remaining old growth forests are largely protected

Rare historical photo of large trees in SE US

Sources: Davis 1996; Varner et al. 2005; Southern Forest Futures Report; Wear & Greis, 2013

When assessing effects of woody biomass, the counterfactual or reference scenario should be based on

- Historical conditions
  - Past agriculture cleared much of the SE US forests
  - Remaining old growth forests are largely protected
- Realistic assumptions for future projections & risks of disturbances
  - Development is prime pressure for deforestation in SE US
  - Forest management decisions largely driven by demand for higher price forest products than pellets

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Sources: Southern Forest Futures Report, Wear & Greis, 2013; Wear & Coulston, 2015

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Status of Forests in US

- **Systems are in place for**
  - Monitoring, reporting, & regulating
  - Stewardship of public forests
- **Examples**
  - USDA's Forest Inventory & Analysis
  - Public & private land conservation
  - State-driven programs
    - "Best management practices"
    - "State Forest Action Plans"
    - 1,500 state government entities implement forest policies & programs (Ellefson et al. 2002)
- **Forestry & agriculture laws & regulations**
  - Target air, water, & endangered species
  - Complex due to multiple layers of authorities: federal, s local, tribal

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Methods: Analysis of USDA's FIA data

USDA Forest Service's Forest Inventory & Analysis

- Long-term survey
- All forests in the US
- Information on a variety of forest statistics
  - Forest area & location
  - Species
  - Tree size, growth, health, & mortality
  - Removals by harvest
  - Carbon accumulation

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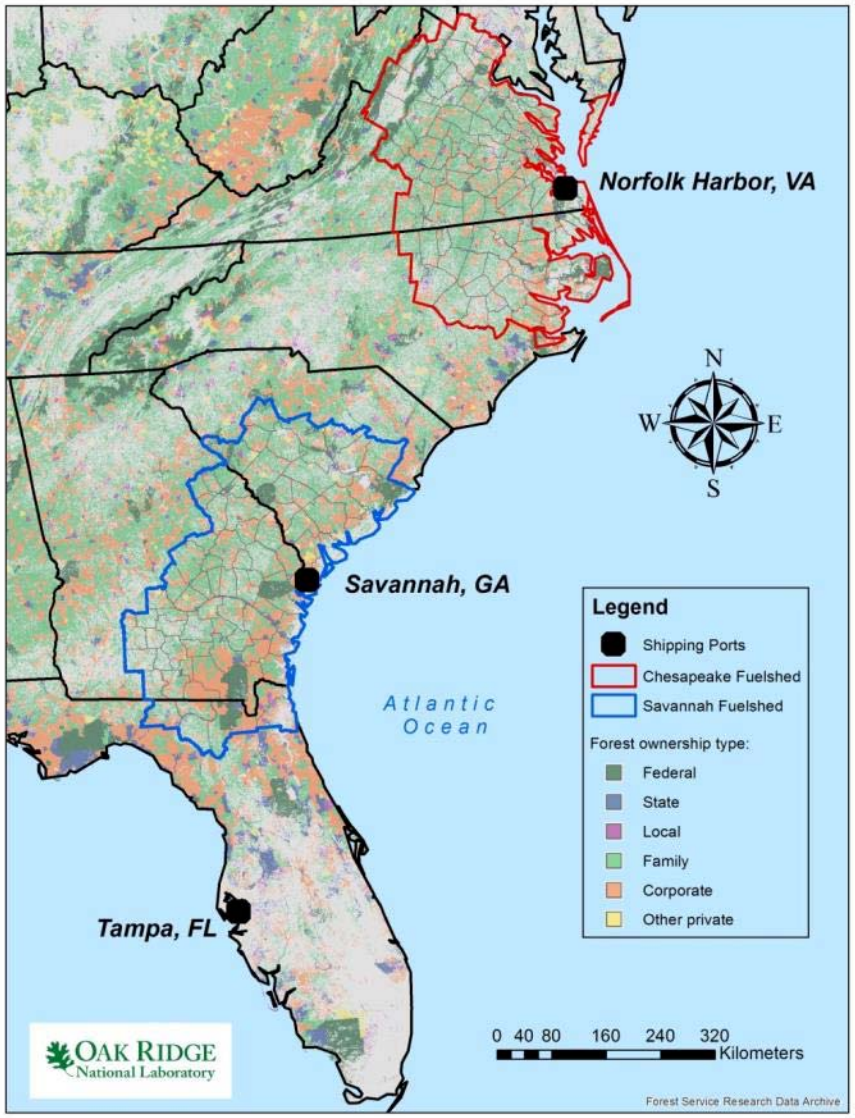
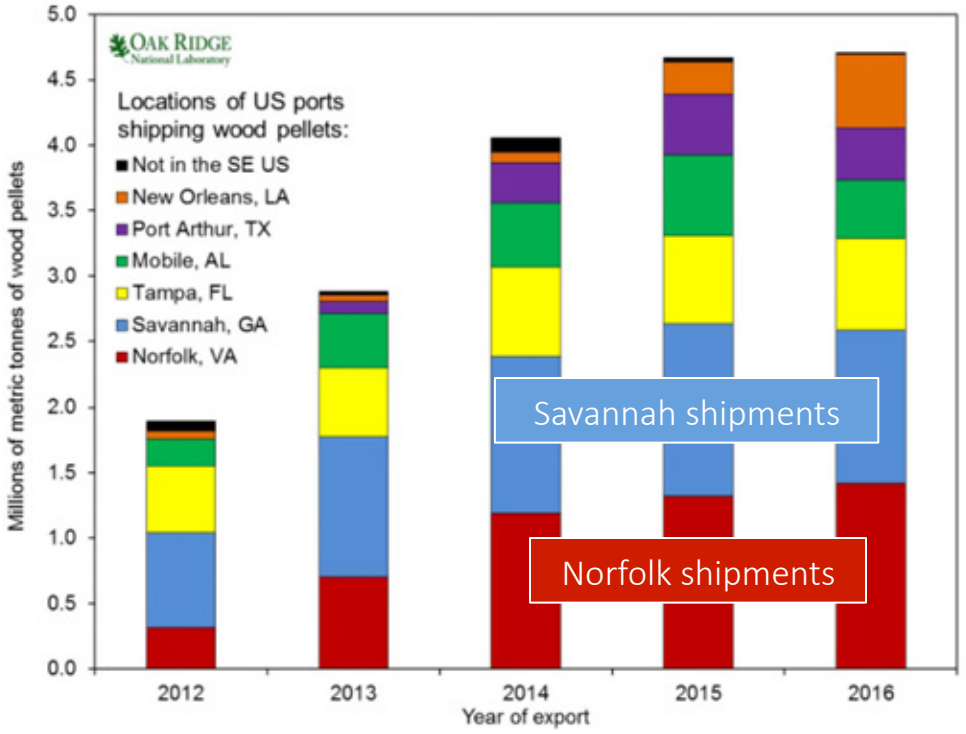
Over half of US wood pellets ship to Europe come from Norfolk/ Chesapeake & Savannah ports

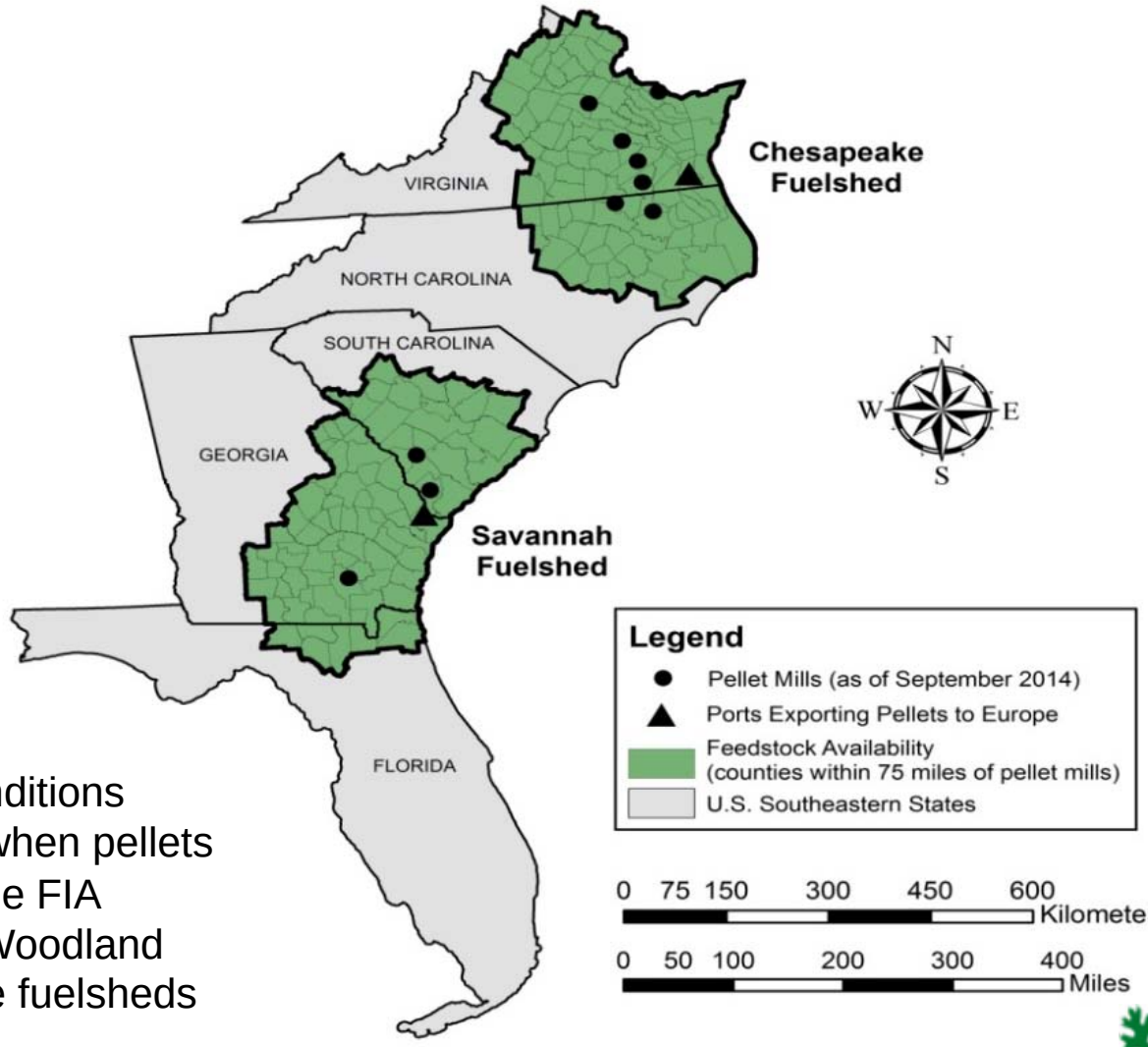




We looked for timberland changes in the two fuelsheds supplying these ports before and after export pellet production began in 2009.

E. Parish, V. Dale, K. Kline (2017) Has pellet production affected Southeastern US forests? *World Biomass*

Study area: focused on family-owned forests considering two fuelsheds that dominate exports of wood pellets to Europe from the SE US



Analyses
1, Compared forest conditions before & after periods when pellets were produced using the FIA
2. Examined National Woodland Owner Survey for these fuelsheds

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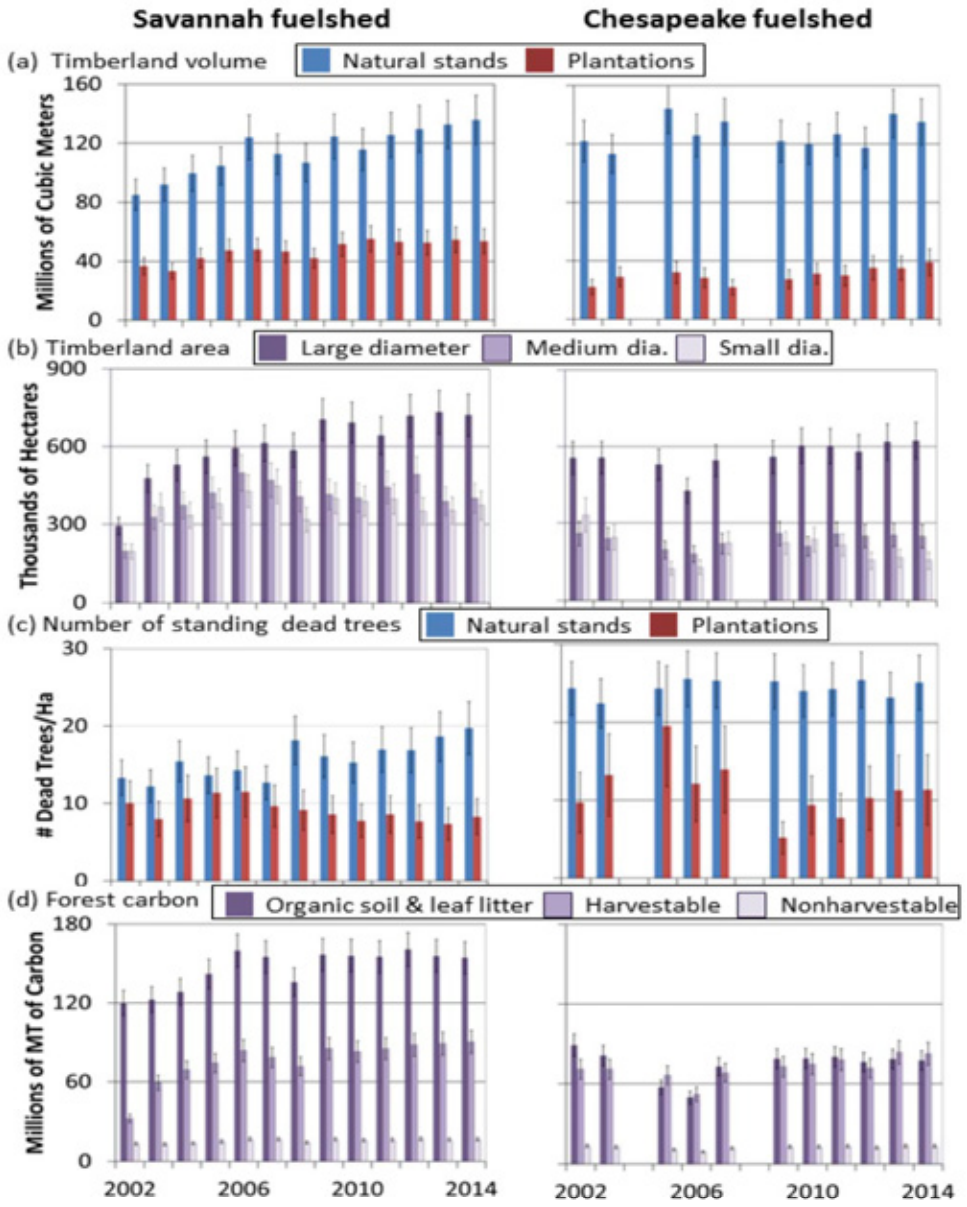
Results: volume, area, number of dead trees, & carbon for "natural" stands and plantations in two fuelsheds pre & post 2009



Dale et al. (2017)
For Ecol & Mgt

Results: volume, area, number of dead trees, & carbon for "natural" stands and plantations in two fuelsheds pre & post 2009

Timberland Characteristic	Savannah Fuelshed	Chesapeake Fuelshed
Naturally regenerating stand volume	Increased	No change
Plantation volume	Increased	Increased
Large-diameter tree area	Increased	Increased
Medium diameter tree area	No change	No change
Small diameter tree area	No change	No change
Standing dead tree density of natural stands (#/ha)	Increased	No change
Standing dead tree density of plantations (#/ha)	Decreased	No change
Carbon content of soil and leaf litter	Increased	No change
Carbon content of live harvestable material	Increased	Increased
Carbon content of dead non-harvestable material	Increased	No change

Parish, Dale, Kline (2017) *World Biomass*

Conclusions from analysis of FIA data

- GHG sequestration and pellet production increased in SE US during a period of reduced timber harvesting.

- Calls for further study of effects on biodiversity of declines in # of standing trees/ha
  - Ø Yet some recommend thinning & hardwood midstory control in pine plantations to provide habitat for declining bird species (consistence with use of biomass for energy & reducing risk of fire).
  - Ø ORNL is focusing analysis on organisms potentially affected by such declines

Dale et al. (2017) For Ecol & Mgt

Income from pellet exports can encourage SE US forest owners to invest in forest management (e.g., thinning)

From E. Parish, V. Dale, K. Kline (2017) *World Biomass*

Land owners work to address their goals while obeying environmental laws

Clean Water Act

Clean Air Act

Endangered Species Act

Local ordinances

US Forests

Current approach:
Employing loggers trained in BMPs

Designated use

Do Not Disturb

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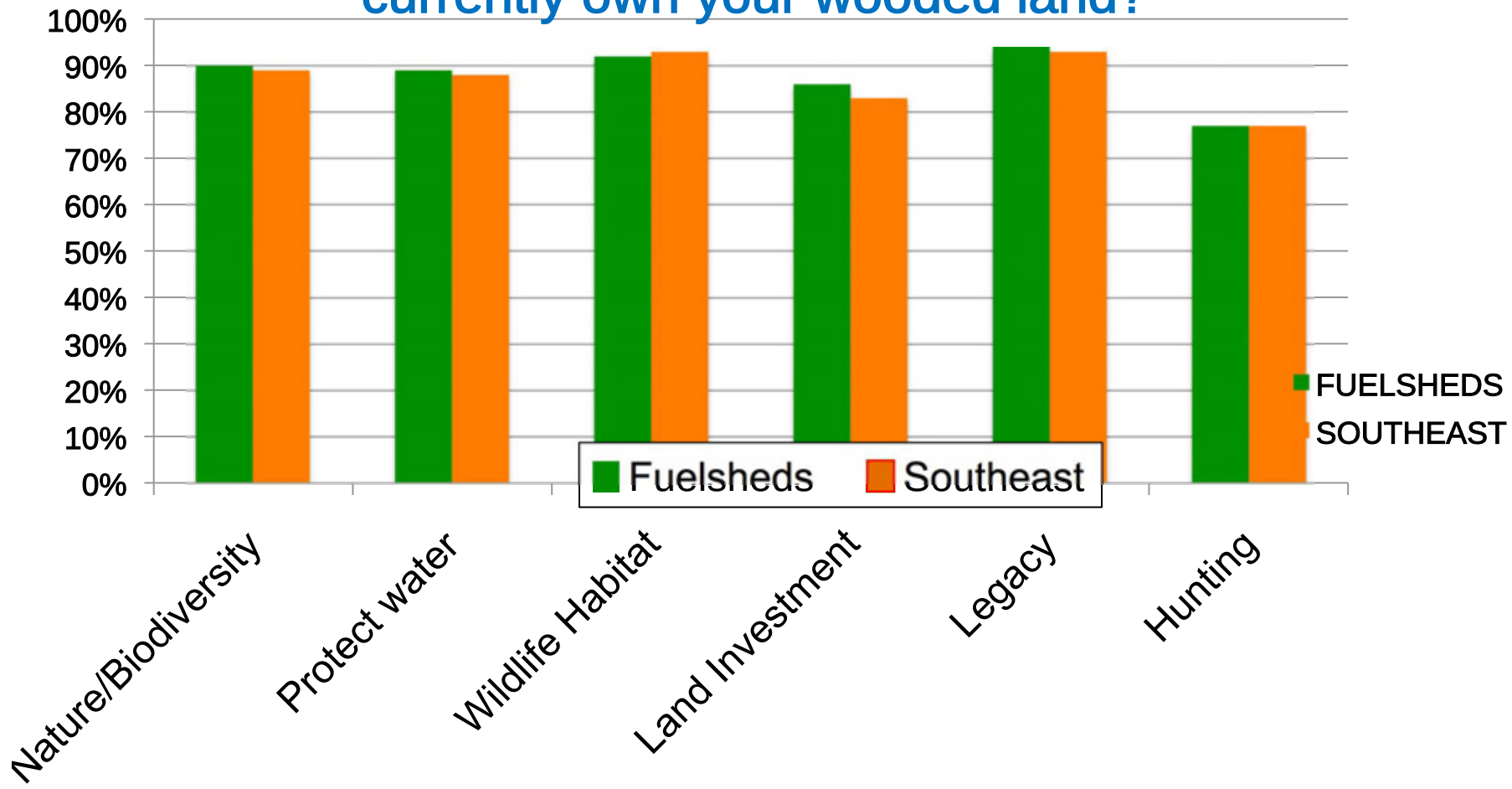
Past Management Activities

Comparing Study Fuelshed Owners to SE Owners

How important are the following as reasons for why you currently own your wooded land?



Subset of data from Butler et al. (2016)

Consideration of noncorporate forest land owners' perspectives regarding wood-based energy

Survey of ~900 family forest land owners in eastern US on biomass for energy:

- Concern for the environment is paramount
- Potential impacts on existing industries are a concern
- There was a willingness to support use of biomass for energy as long as
  1. Land health is not compromised
  2. The price is right

Hodges et al. (2016 & in prep.)

There is no one key for effective timber management, but having a bioenergy market can help#

- Reduce inefficiencies
- Improve forest habitat
- Reduce risk of fire & insect outbreaks
- Lower carbon emissions & mitigate effects of global climate change*
- Retain forests: as demand for wood increases, net forest area typically expands**
- Provide “green” jobs

2016 Gatlinburg fire

Poorly managed pine forest that would benefit from thinning

Dale et al. (2017a)
* Cowie et al. (2013)
** Miner et al. (2014), Stewart (2015)

Recommended practices

- Accentuate benefits
  - Identify & conserve priority biodiversity areas
  - Apply location-specific management of biofuel feedstock production systems
- Attend to site selection & environmental effects in
  - Selection & location of the feedstock
  - Transport of feedstock to the refinery
  - Refinery processing
  - Final transport & dissemination of bioenergy
- Monitor, assess & report on key measures of sustainability
- Focus on what is “doable”
- Communicate opportunities & concerns to the stakeholders & get their feedback
- Employ adaptive management

Thank you!

http://www.ornl.gov/sci/ees/cbes/

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GCB Bioenergy paper has 35 authors from 9 countries & 29 institutions

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