Challenges for Native Forest Establishment on Surface Mines in a Time of Climate Change

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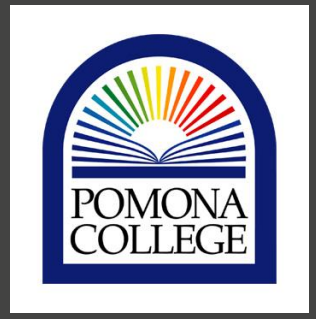
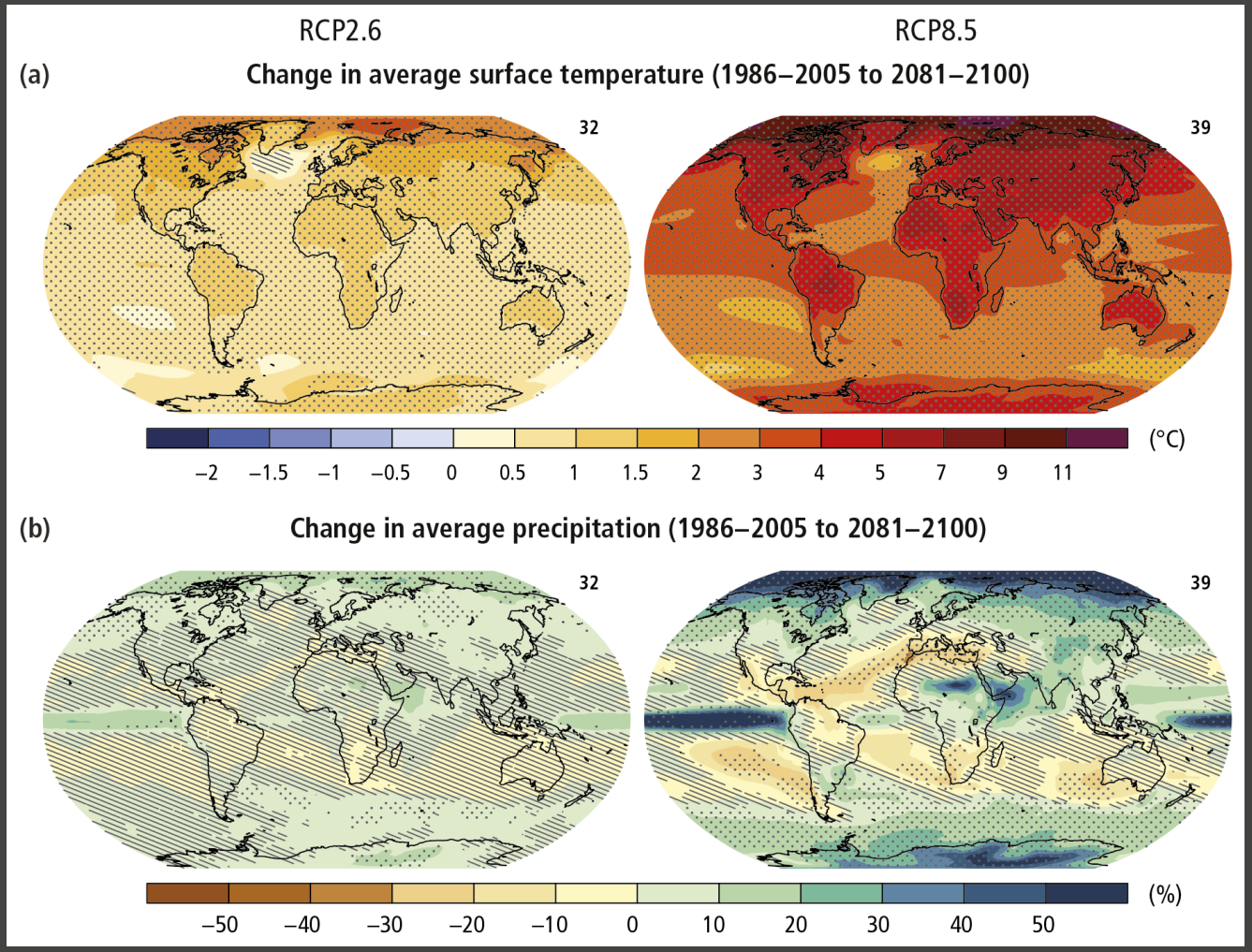


The Issue With Mine Soils

- Highly disturbed
- Physical & chemical differences
- Low levels of organic material

The Increasing Threat of Climate Change



IPCC 2014

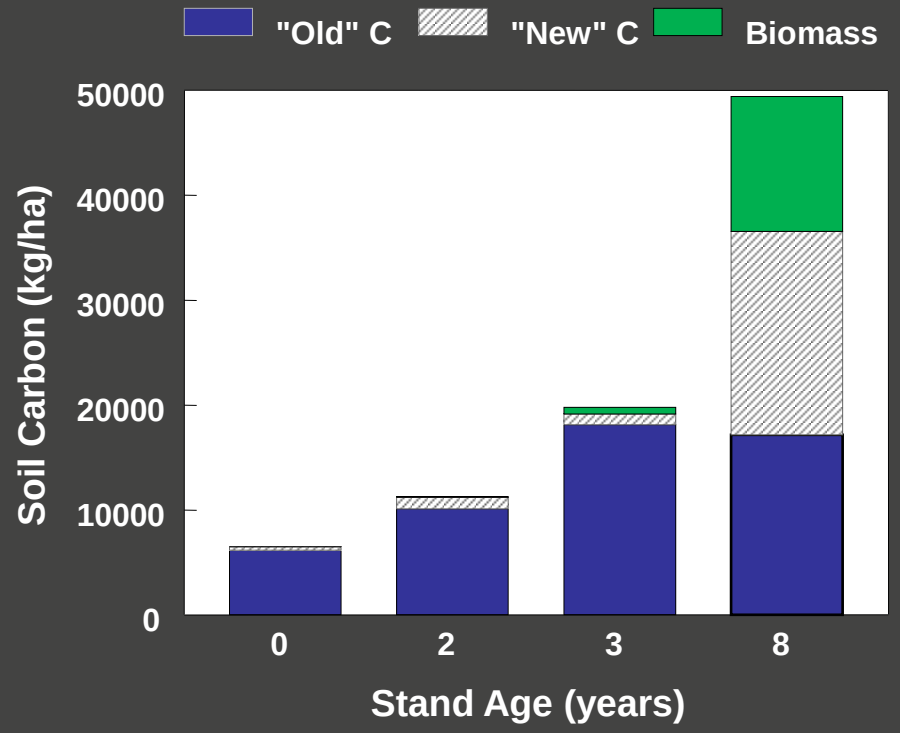
Global C Reservoirs

- Terrestrial & freshwater ecosystems absorbed ~1/4 of anthropogenic atmospheric CO_2 over past 3 decades (IPCC 2014)

Global C Reservoirs (Gt)			
Atmosphere	Ocean	Biosphere	Soil
750	40,000	610	1600

Forests as a C Reservoir

- Potential to increase C sink at mine sites through soils and forest growth



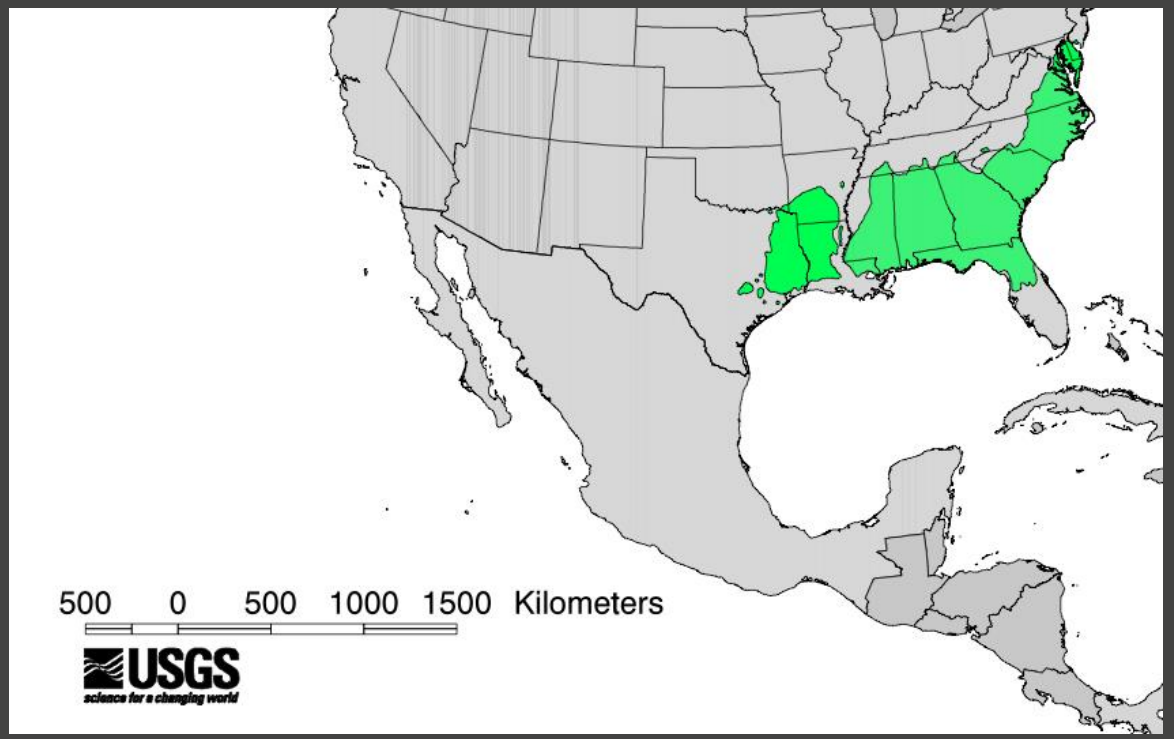
Carbon Sequestration
(*1-3 Mg/ha/yr*)

Maharaj et al. 2007

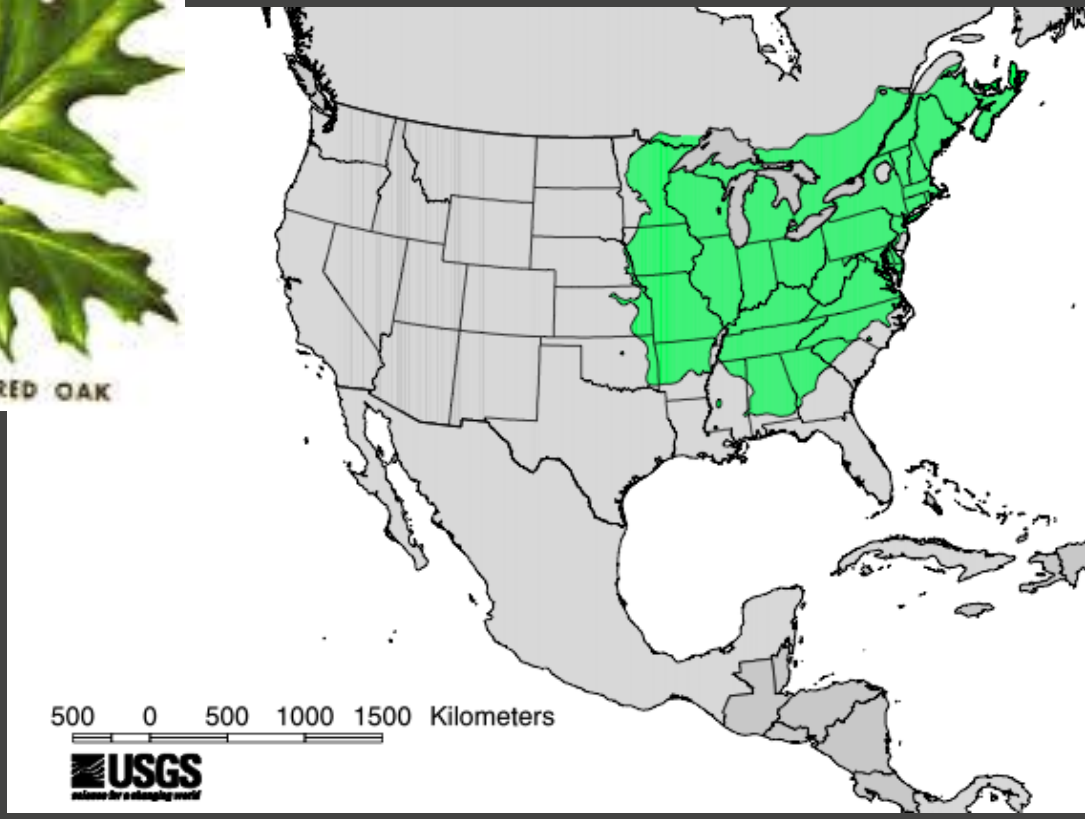
Laurel Fork Study

- Will non-native but potentially migratory loblolly pine (LP) species be able to establish themselves on disturbed mined lands as well or better than native species northern red oak (RO) that may lose range with future climate change?
- How do these species compare with improvement in soil quality and carbon sequestration?

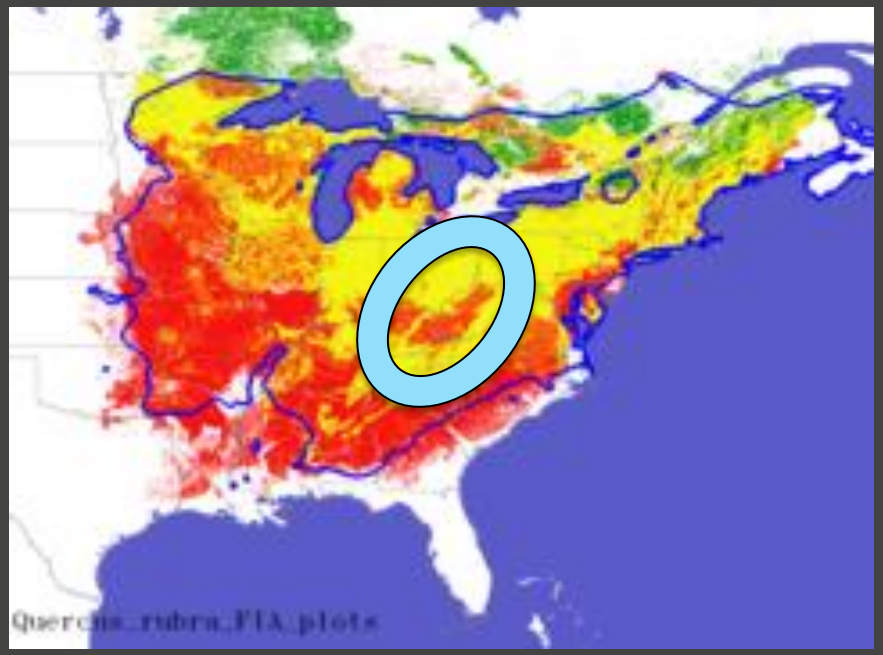
Planning ahead for forest management with a changing climate



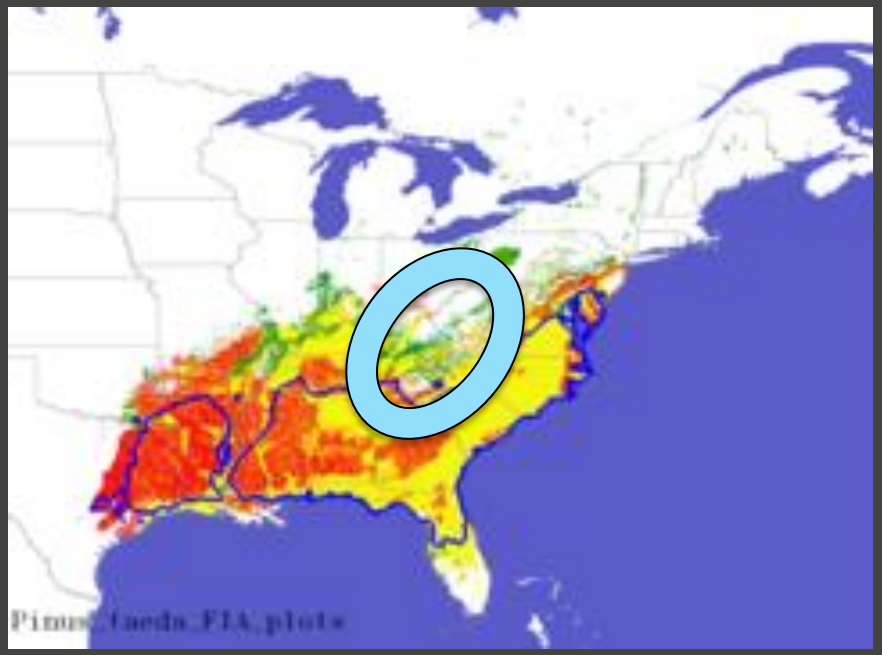
Planning ahead for forest management with a changing climate



Northern Red Oak



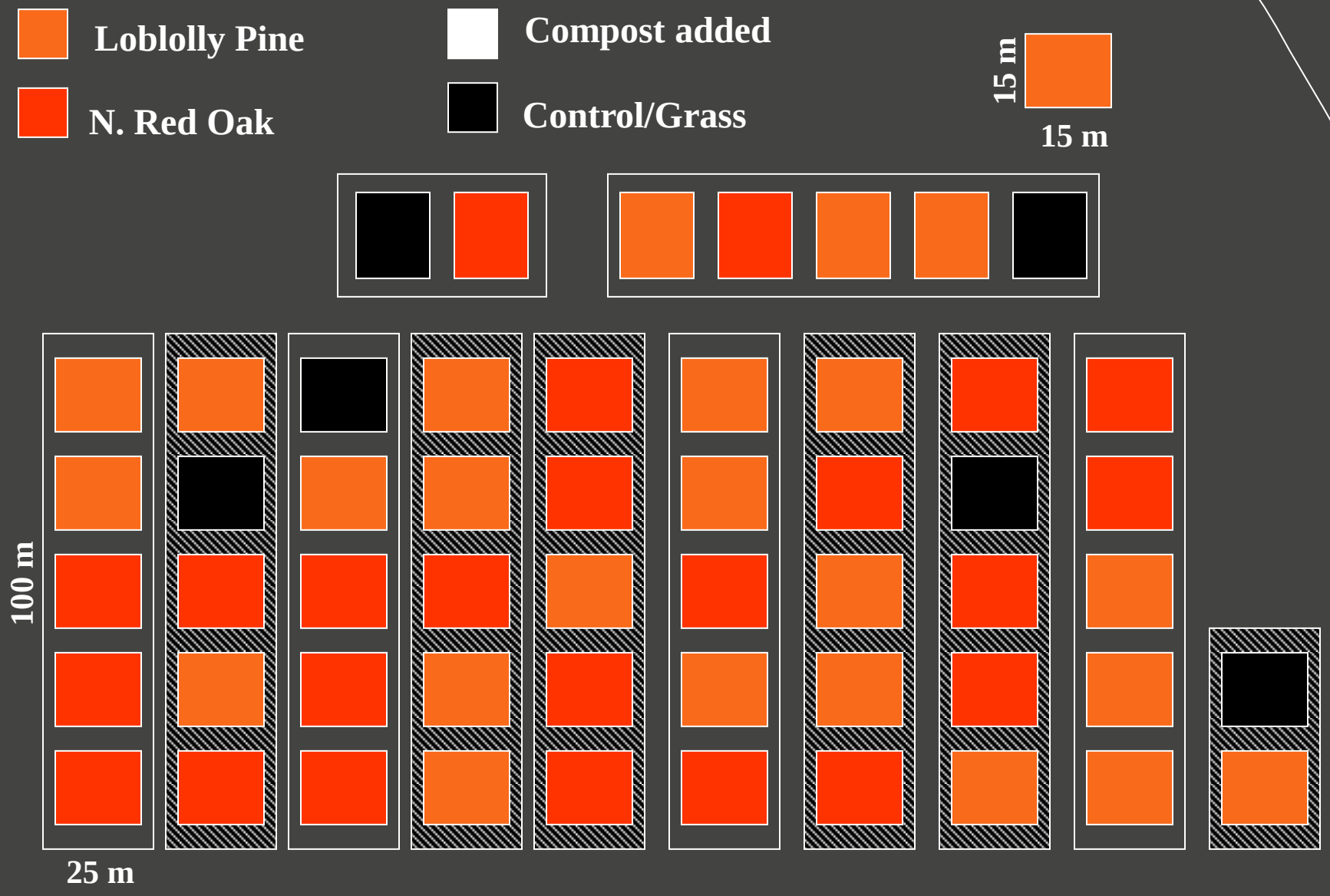
Loblolly Pine



Lost suitable habitat

Consistent suitable habitat

New suitable habitat


Loblolly Pine
N. Red Oak
Compost added
Control/Grass
15 m
15 m
100 m
25 m
Road
Laurel Fork

Laurel Fork Study

- Carbon Sequestration occurring in
  - Soil
  - Biosphere
- Carbon Sequestration important
  - Ecologically: improves soil quality, more reforestation
  - As climate change mitigation
- Tree species important
  - To maximize C sequestration now
  - To provide forests that will work with future climate change

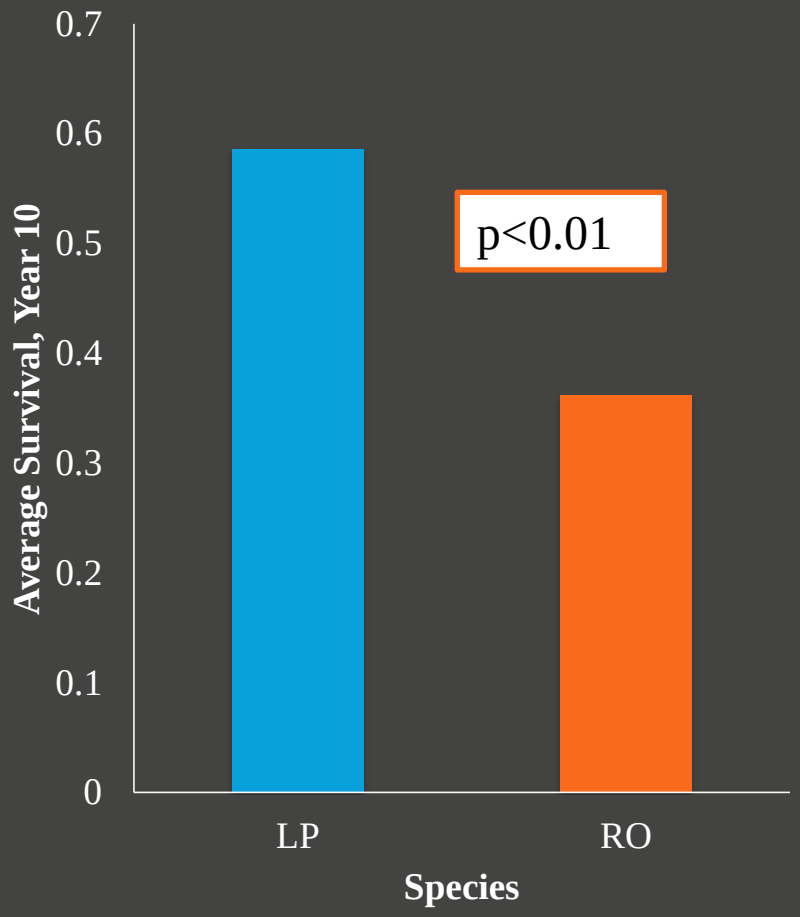
Laurel Fork 2004

Laurel Fork 2008

Laurel Fork 2014

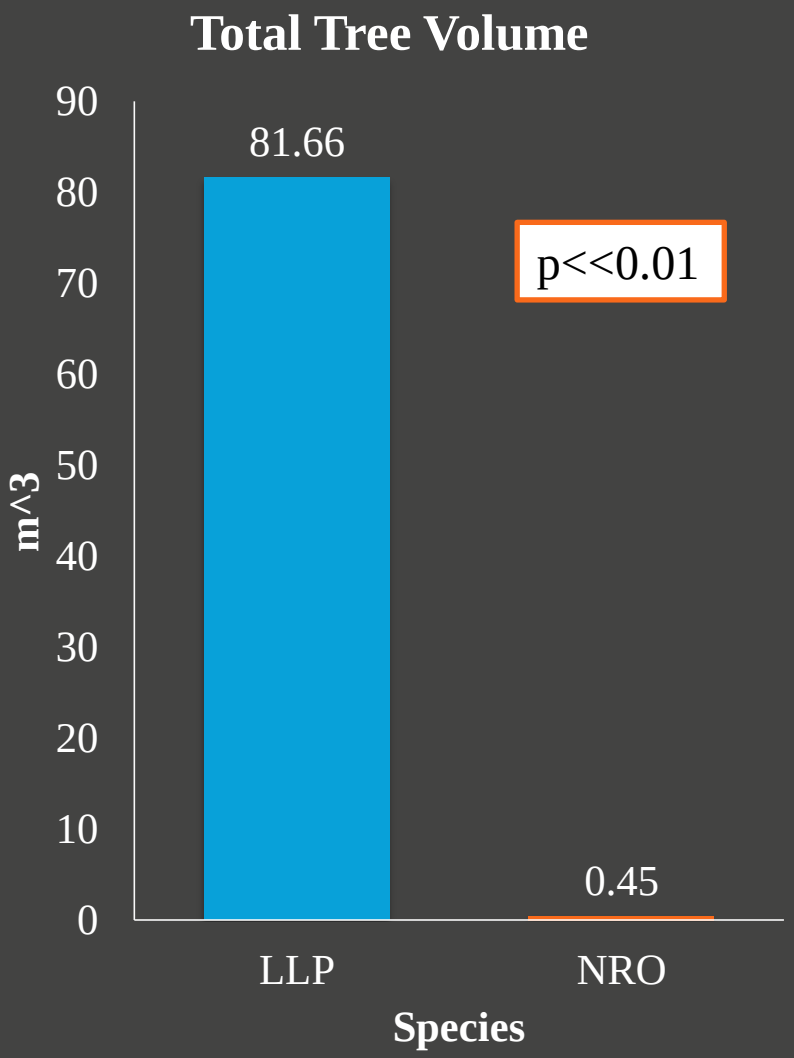
Survival

- LLP experienced average survival rates of 58% in plot
- NRO experienced average survival of 36.1% in plot

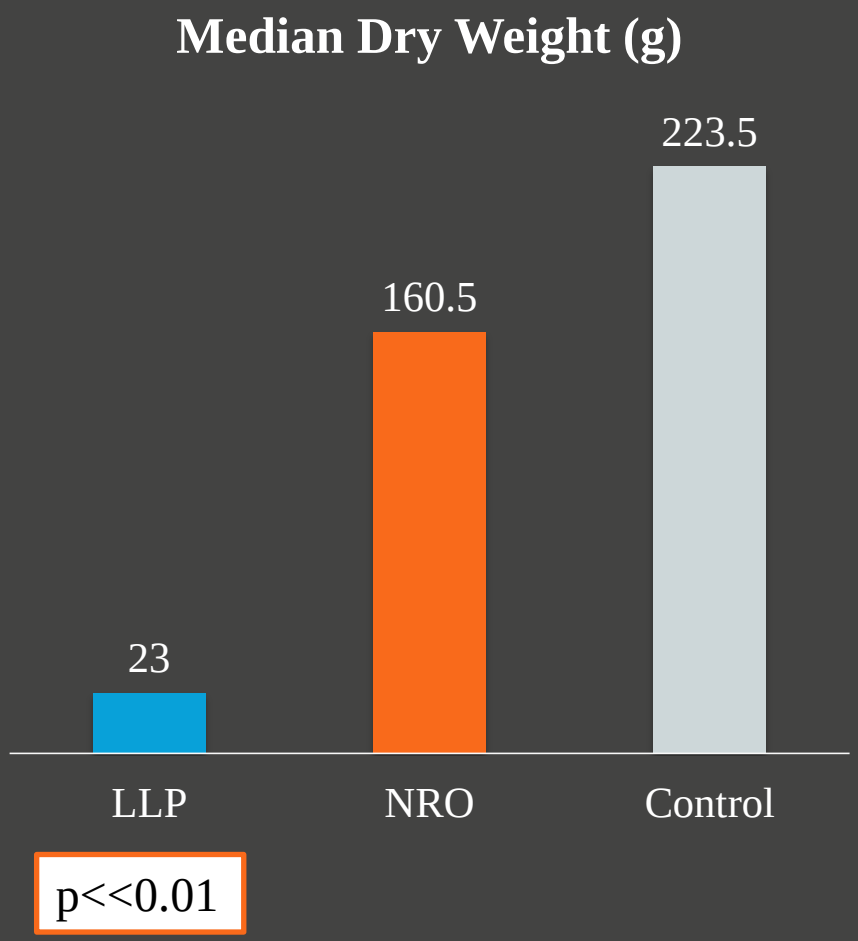


Tree Volume

- Total LLP tree volume exceeded 80 cubic meters (81.66)
- Total NRO tree volume was under a cubic meter (0.45)

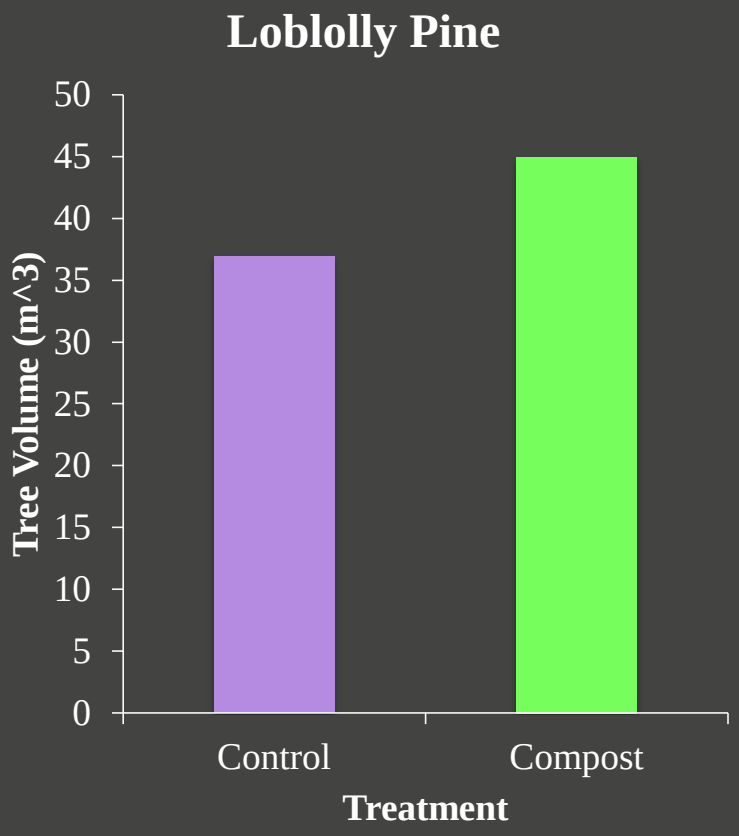


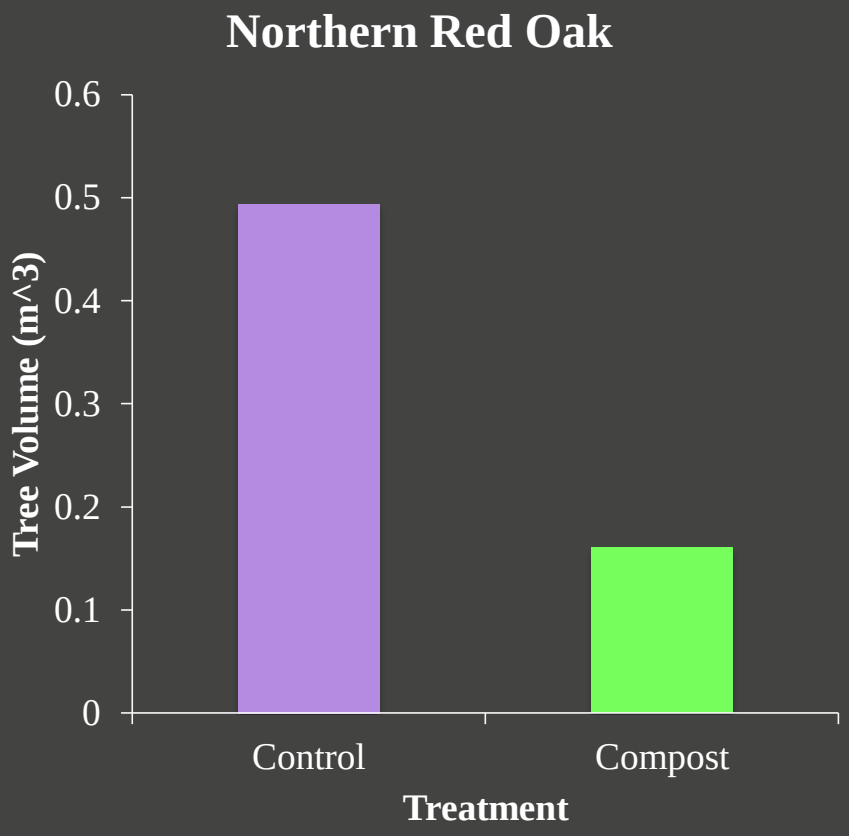
Ground Cover



Laurel Fork 2014

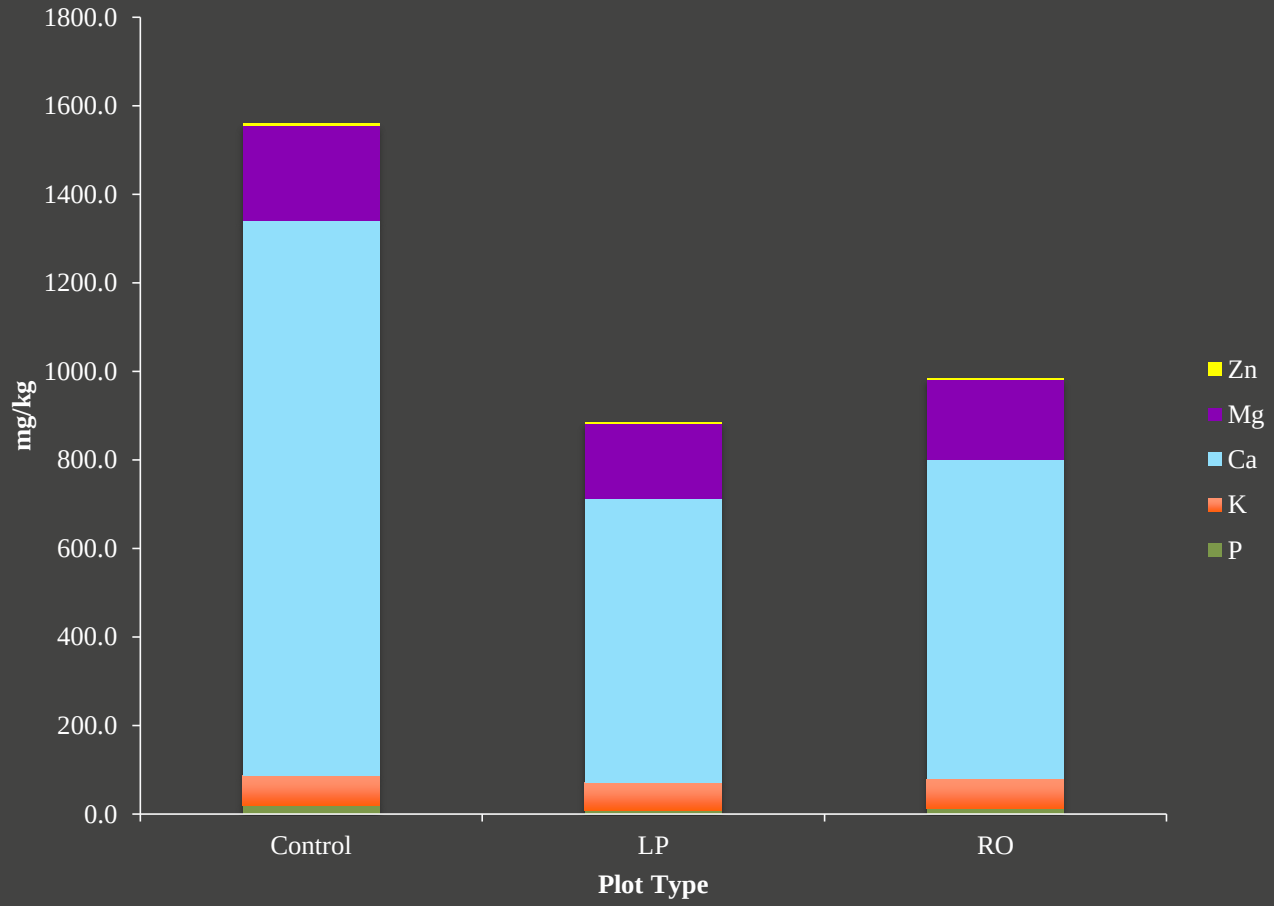
The Compost Effect





Species	Total Volume (m^3)	
	Control	Compost
LLP	36.9124	44.9584
NRO	0.494	0.1608

Soil Nutrient Analysis (Year 10)



Species	N	P	K	Ca	Mg	Zn
	%	mg/kg				
NRO	0.14	11	67	723	179	4.0
LP	0.11	8	63	640	170	3.5

Results

- Which tree did better?
  - LLP: higher survival, greater tree volume, little GC, some indications of improved soil quality
- Where is there more carbon sequestration?
  - Biosphere: LLP
  - Soils: Still examining, hypothesis that it is LLP from qualitative analysis of plots

Future Native Forest Reclamation

- Native forest establishment
- Conifer versus hardwood
- Early versus late successional
- Economic implications

Future Studies

- Laurel Fork: fractionation of C in soils to better understand C sequestration in soils, esp. relative to initial treatments
- *The consequence of combined land use disturbance from mining and climate change on native forest establishment needs further study*