Recovery of Vegetation After Relieving Soil Compaction on a Reclaimed Surface Mine

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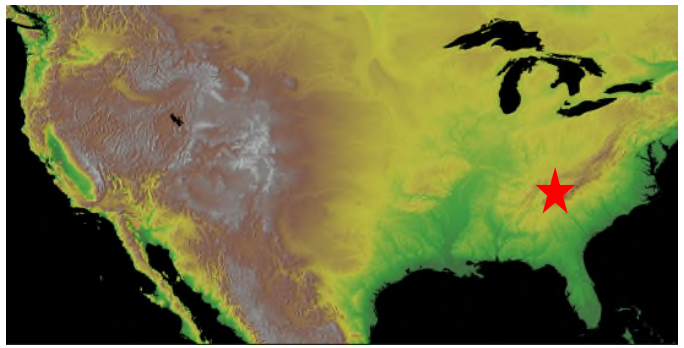
Site history

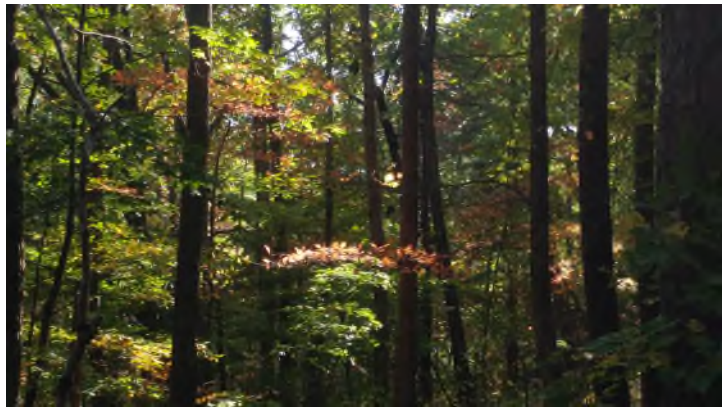
Pre-1998 Hardwood forest

1998 – 2000 Mined for coal

2000 – 2004 Reclaimed to "wildlife habitat"

2016 Restoration initiated





Timber harvest

1-5 years | 6-10 years | 11-15 years | 16-25 years | Undisturbed





Reclaimed mine sites





Initial survey

10 ha, slopes less than 30°

<u>Vegetation (1m^2 quadrats)</u>

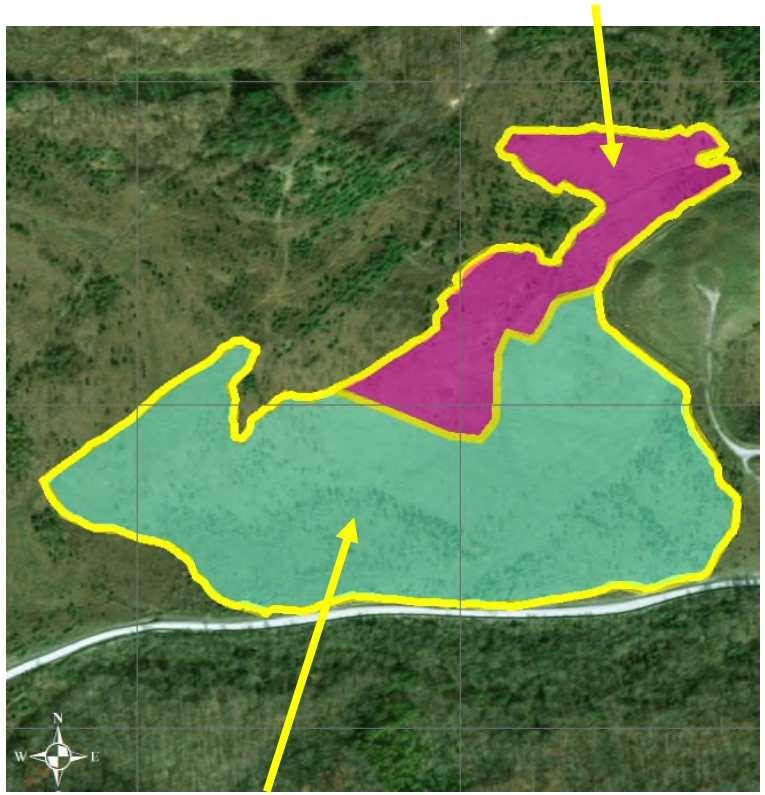
Dominant species:
sericea lespedeza 42% of plots
(*Lespedeza cuneata*)

Non-native grasses 58% of plots

Native cover < 5%
10% of plots had 0% native cover

Soils

Site divided into 2 zones based on soils:
Lowland – poorly drained, silty, high pH



Upland – well drained, rocky, neutral pH

	Upland	Lowland
pH	7.4	7.7
	(ppm)	(ppm)
P	34	164
K	247	167
Ca	11129	6755
Mg	367	1098
Zn	27.9	7
Mn	101	160
B	2.5	0.9
Cu	0.4	3.3
Na	21	18
pH	7.4	7.7

Ref. 4.5 – 6.5

Treatments

- Exotic invasive shrubs (*Eleagnus umbellata*) cut and treated with herbicide.
- Subsoiled to 1.2 m depth to relieve compaction

Common Name	Scientific Name	Number of Seedlings Planted	% of Total
Shortleaf pine	*Pinus echinata*	11,000	49
Black oak	*Quercus velutina*	1,600	7
Chinkapin oak	*Quercus muehlenbergii*	3,000	13
Northern red oak	*Quercus rubra*	1,600	7
Southern red oak	*Quercus falcata*	1,600	7
American chestnut	*Castanea dentata*	2,000	9
Buttonbush	*Cephalanthus occidentalis*	300	1
Elderberry	*Sambucus nigra*	400	2
Staghorn sumac	*Rhus typhina*	300	1
Hazelnut	*Corylus americana*	600	3
	Total:	**22,400**	**100**

Smother crop – dense vegetation that suppresses weeds

Criteria:

Early spring growth
Rapid spring growth
High biomass or leaf area
Tolerant of site conditions
Native OR non-persistant

Common Name	Scientific Name	Seeding rate (kg/ha)
ragweed	*Ambrosia artemisifolia*	8.4
annual ryegrass	*Lolium multiflorum*	28
partridge pea	*Chamaecrista fasciculata*	16.8
black mustard	*Brassica nigra*	16.8
lablab	*Lablab purpureus*	16.8
sorghum	*Sorghum bicolor*	28
German millet	*Setaria italica*	28
smartweed	*Polygonum pensylvanicum*	16.8
sunn hemp	*Crotalaria juncea*	44.8
control	-	-

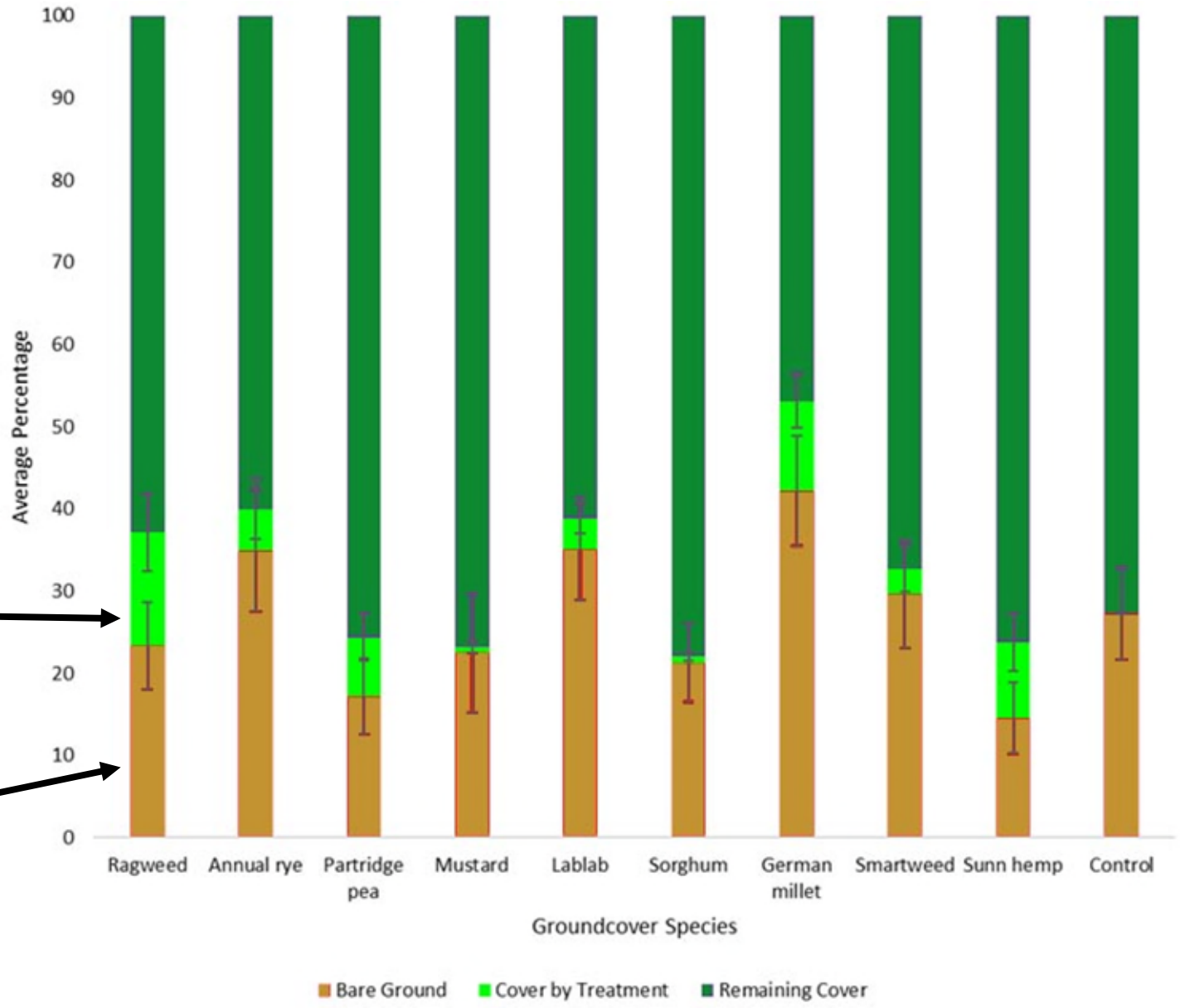
Results: herbaceous, Sept.2017

Smother crop unsuccessful

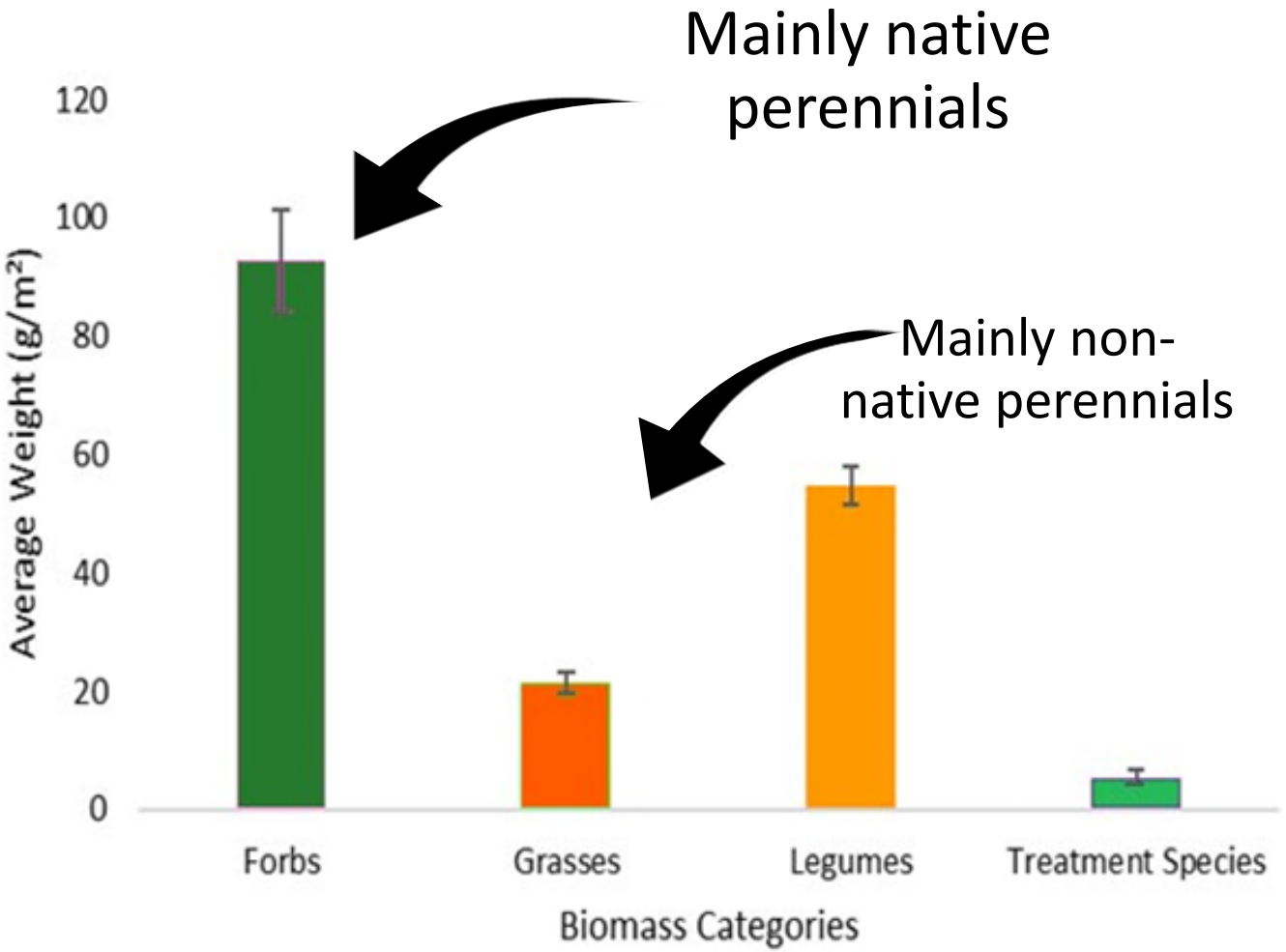
Cover by planted “smother crop” species was very low (green)

Same trend for biomass

Bare ground ave. < 30% (tan)

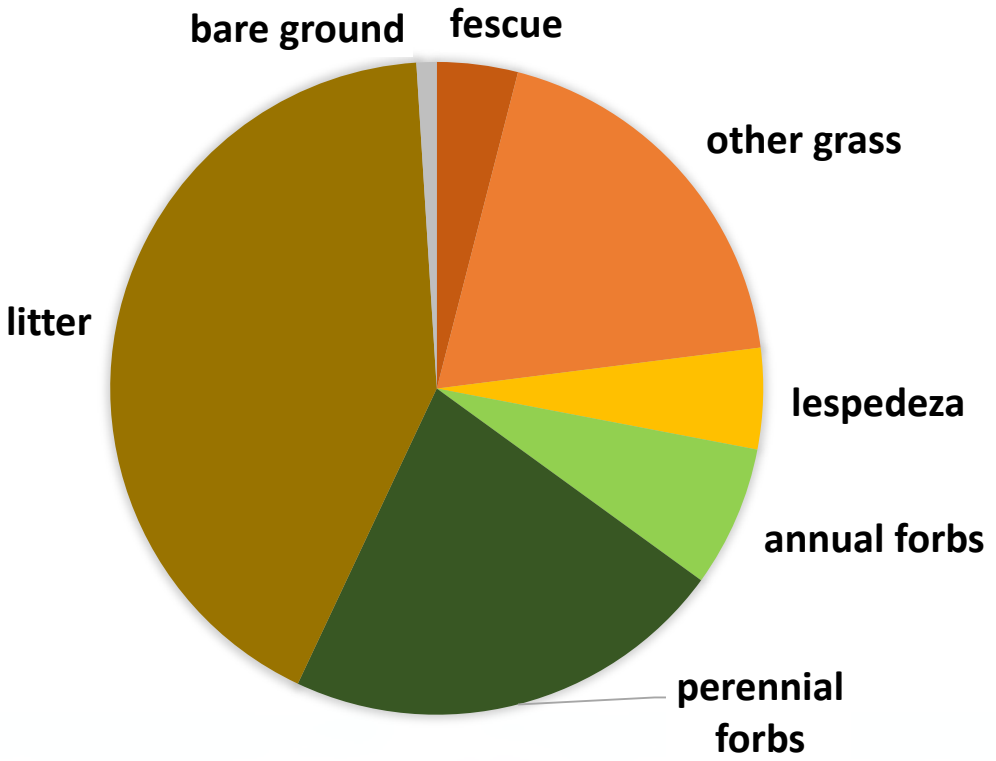


Results: herbaceous, Sept. 2017



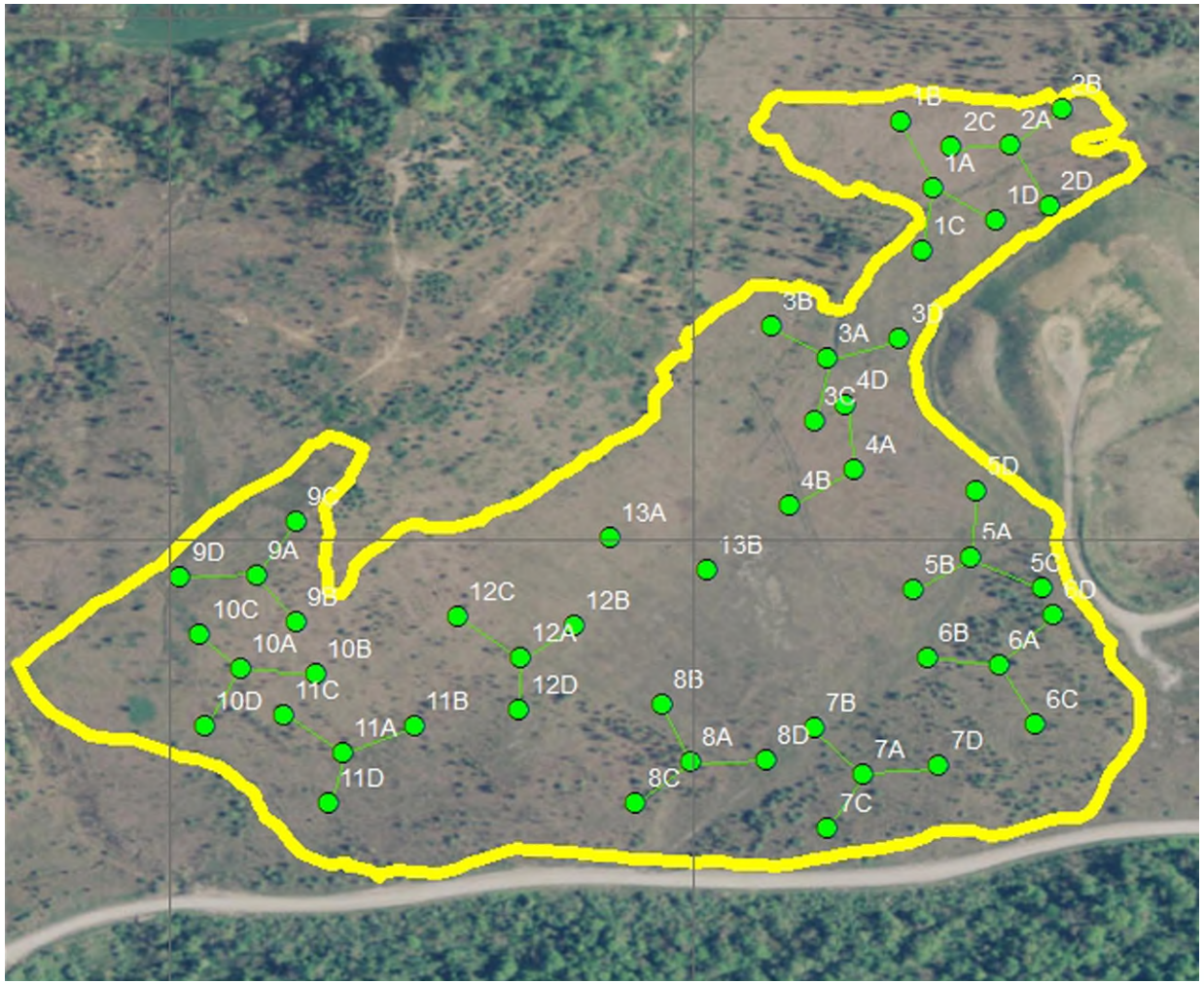
Results: herbaceous, May 2021

- Vegetation in 1m^2 quadrat photographed in mid-May
- 100 point grid overlain, and species tallied

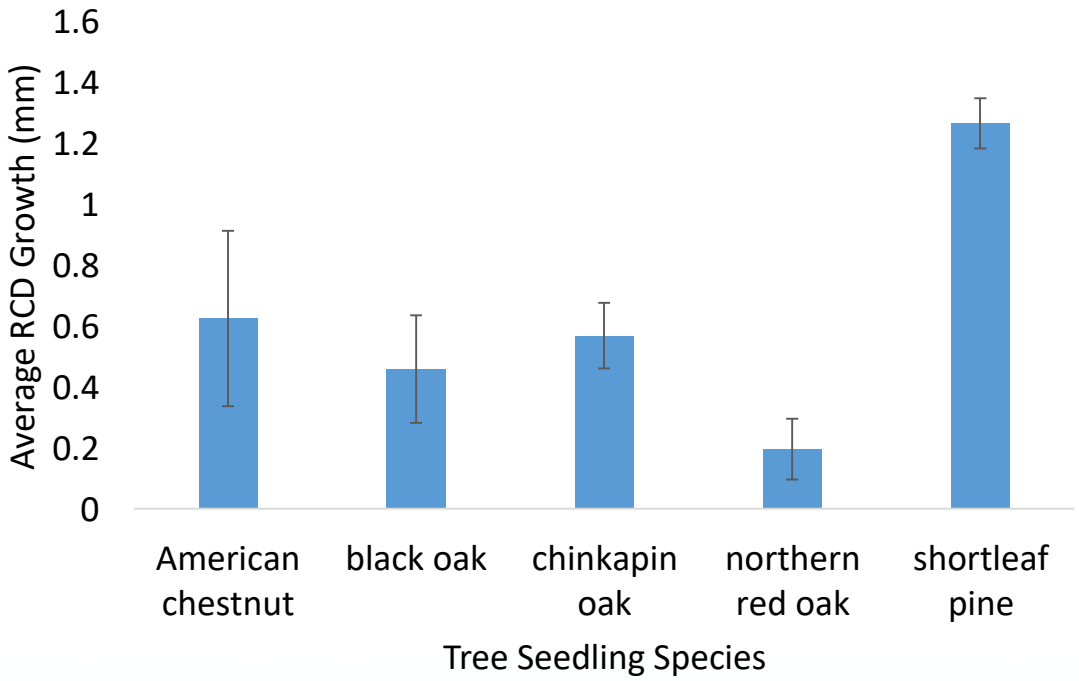


Monitoring: trees and shrubs

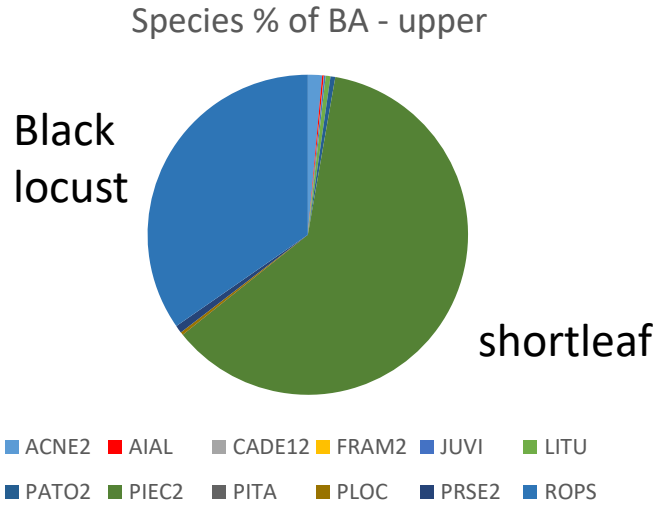
- Permanent FIA style plots established in summer 2017 with 4 tenth acre (0.0405 Ha) subplots per plot
- Trees tagged, height, RCD and browse damage measured June 2017 and March 2018
- All woody plants measured in June-Aug. 2023:
- Trees: DBH if > 1.37m tall, or RCD
- Shrubs: height, number of stems

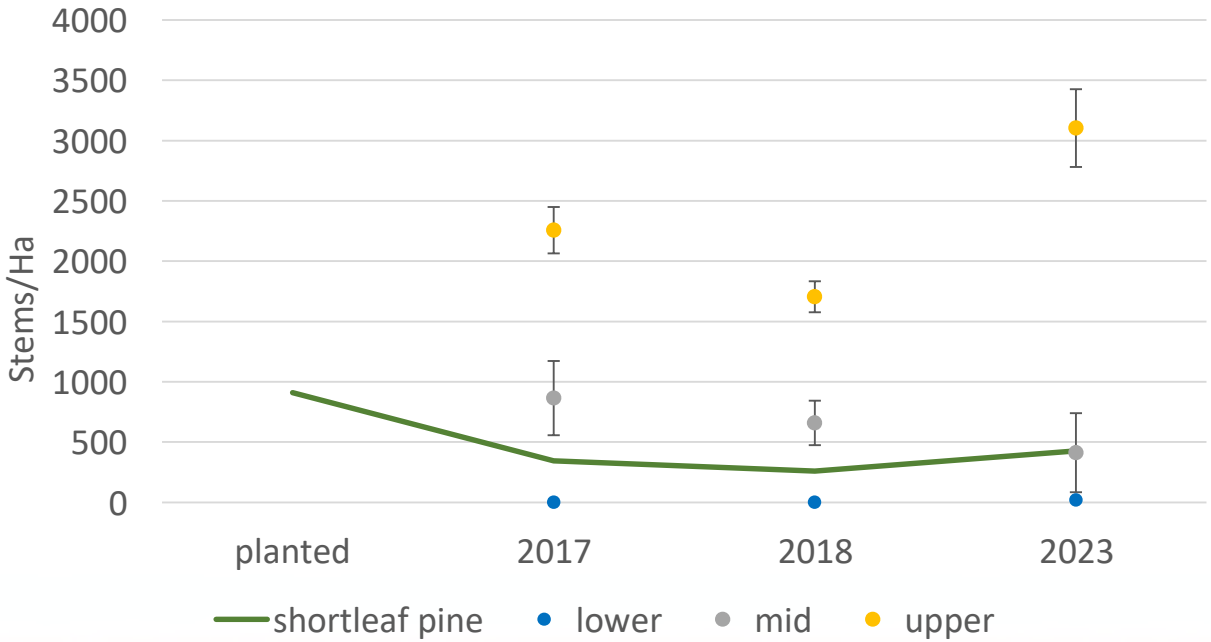


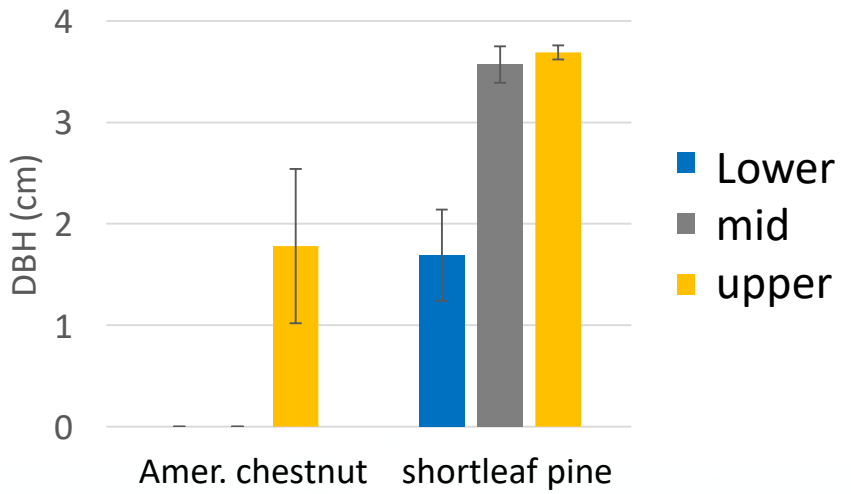
Results: trees 2018



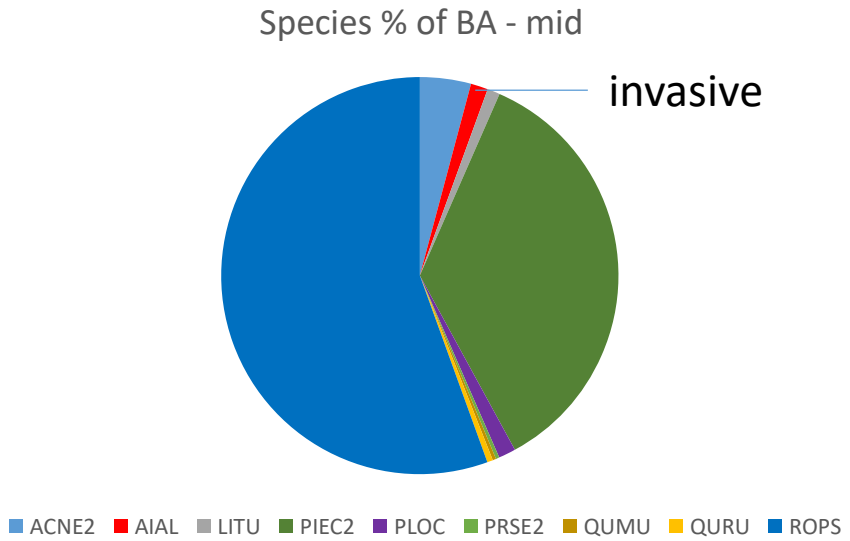
Results: trees upper zone

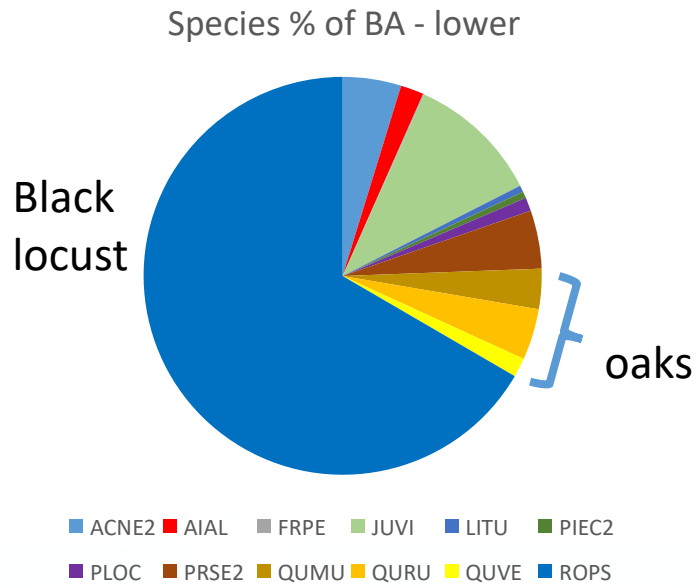




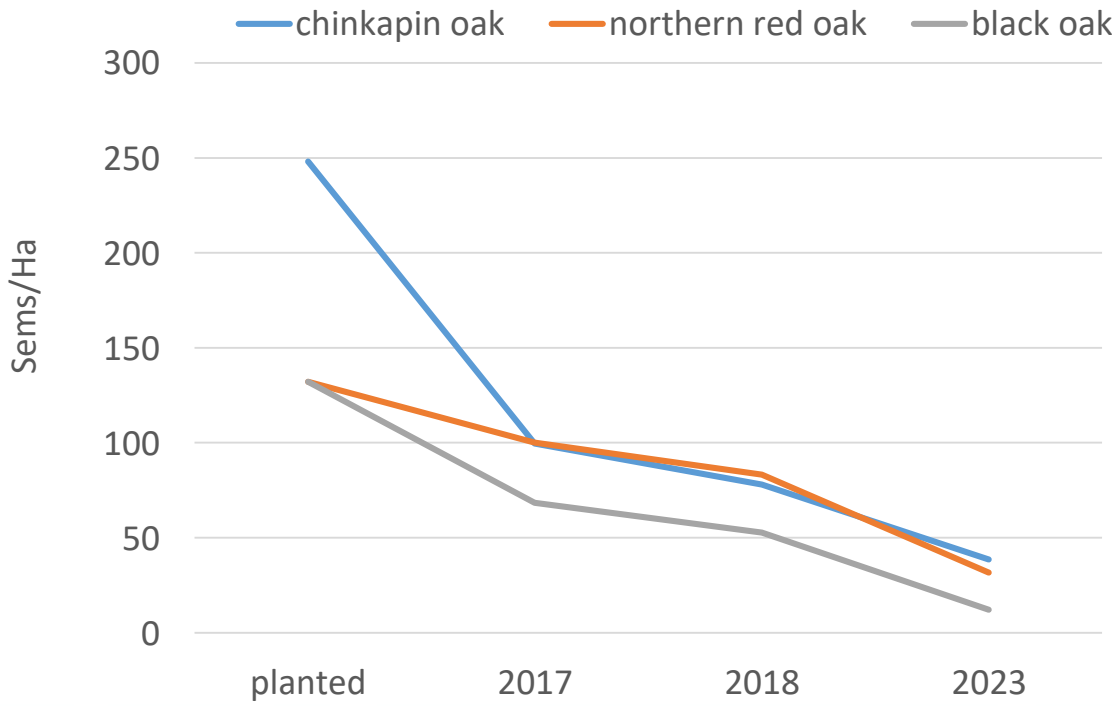


Results: trees - lower zone

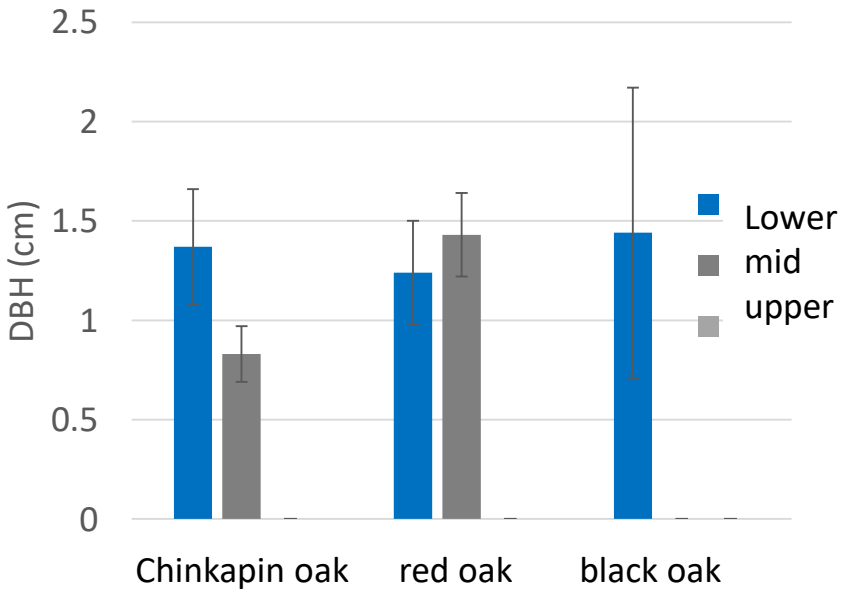




Results: trees lower zone



1/3 of oaks were less than 1.4m tall

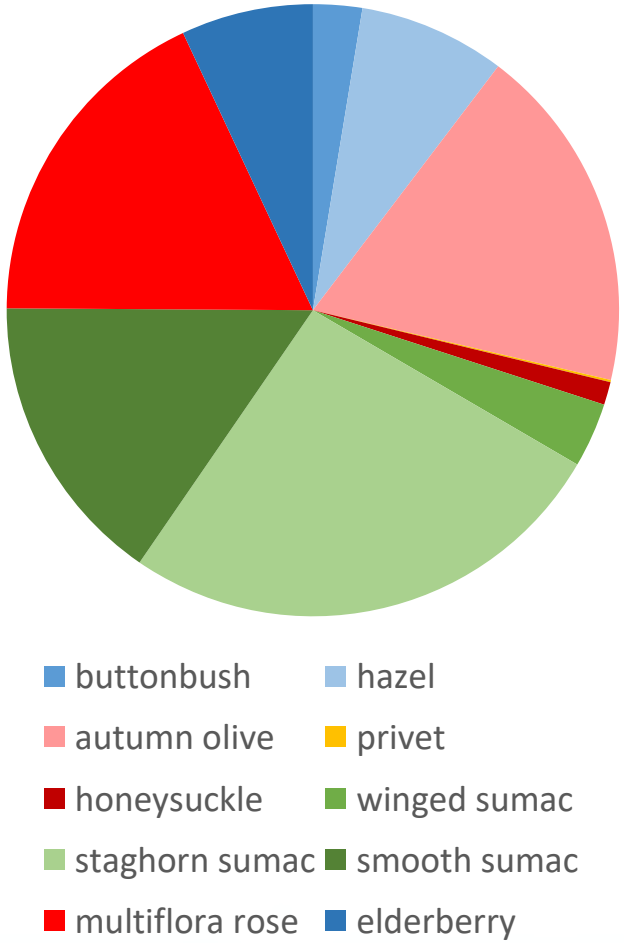


Oak species	% of trees browsed*	
	2018	2023
northern red	33	17
chinkapin	24	6
black	38	17

Results: shrubs 2023

	buttonbush	hazel	staghorn sumac	elderberry
planted stems/ha	25	50	25	33
stems/ha in 2023	35	104	351	94
% browsed	0	11	41	70



Conclusion

- Six years after treatment many non-native species persist but plant diversity is high and a successional sequence typical of southeastern ecosystems has been restored.
- Value for forestry is still low, but high value for wildlife and pollinators

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