Opportunities for oak regeneration?

Contributors:

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Opportunities for Oak Regeneration

1) Assessing regeneration of any species: At what stage does it count? What impacts its' development?

2) Factors driving oak regeneration in red pine stands

Regarding predicting future composition from regeneration: “What you see is what you get”*

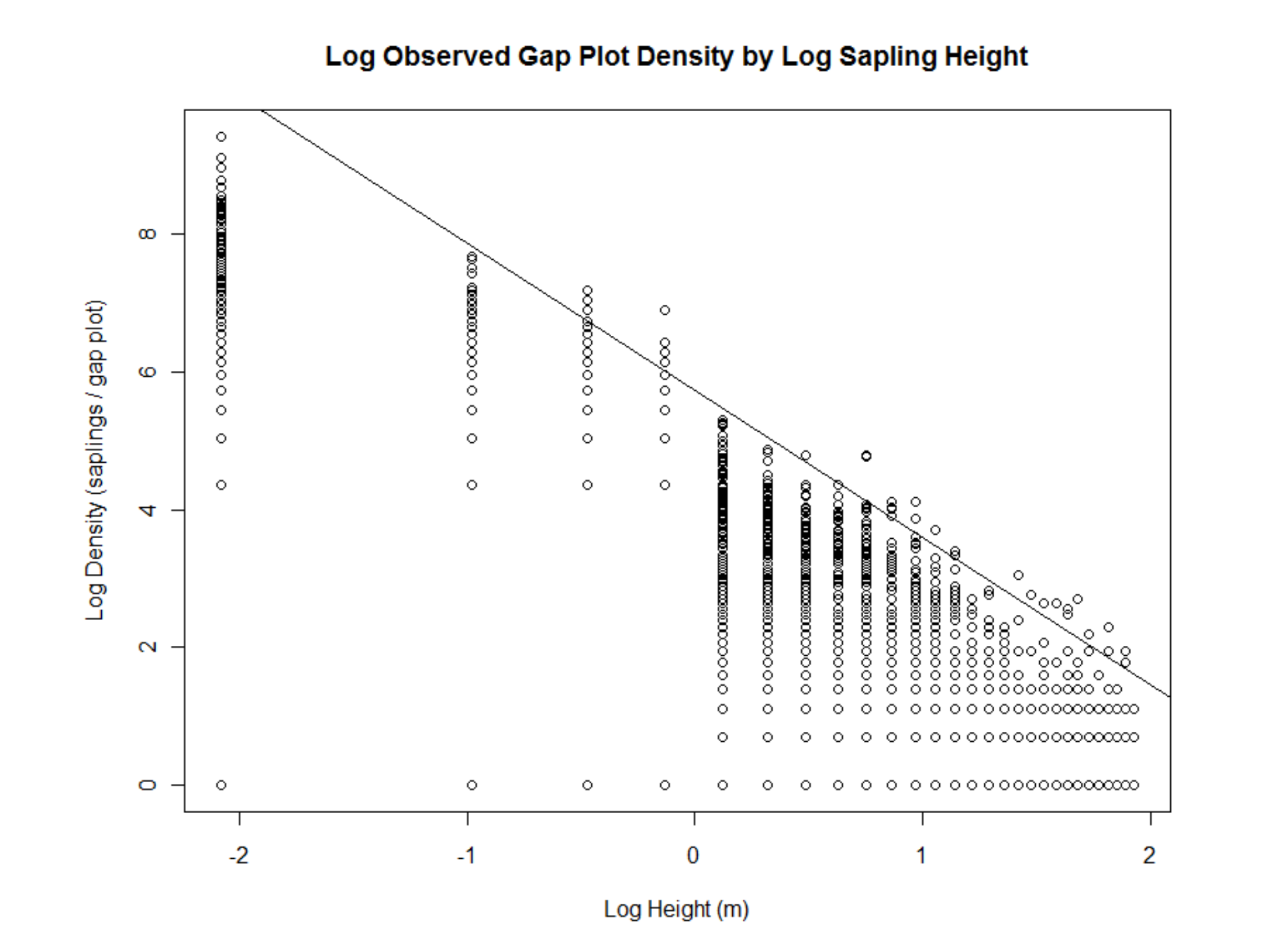
*old forester, date unknown but not any older than the old forester

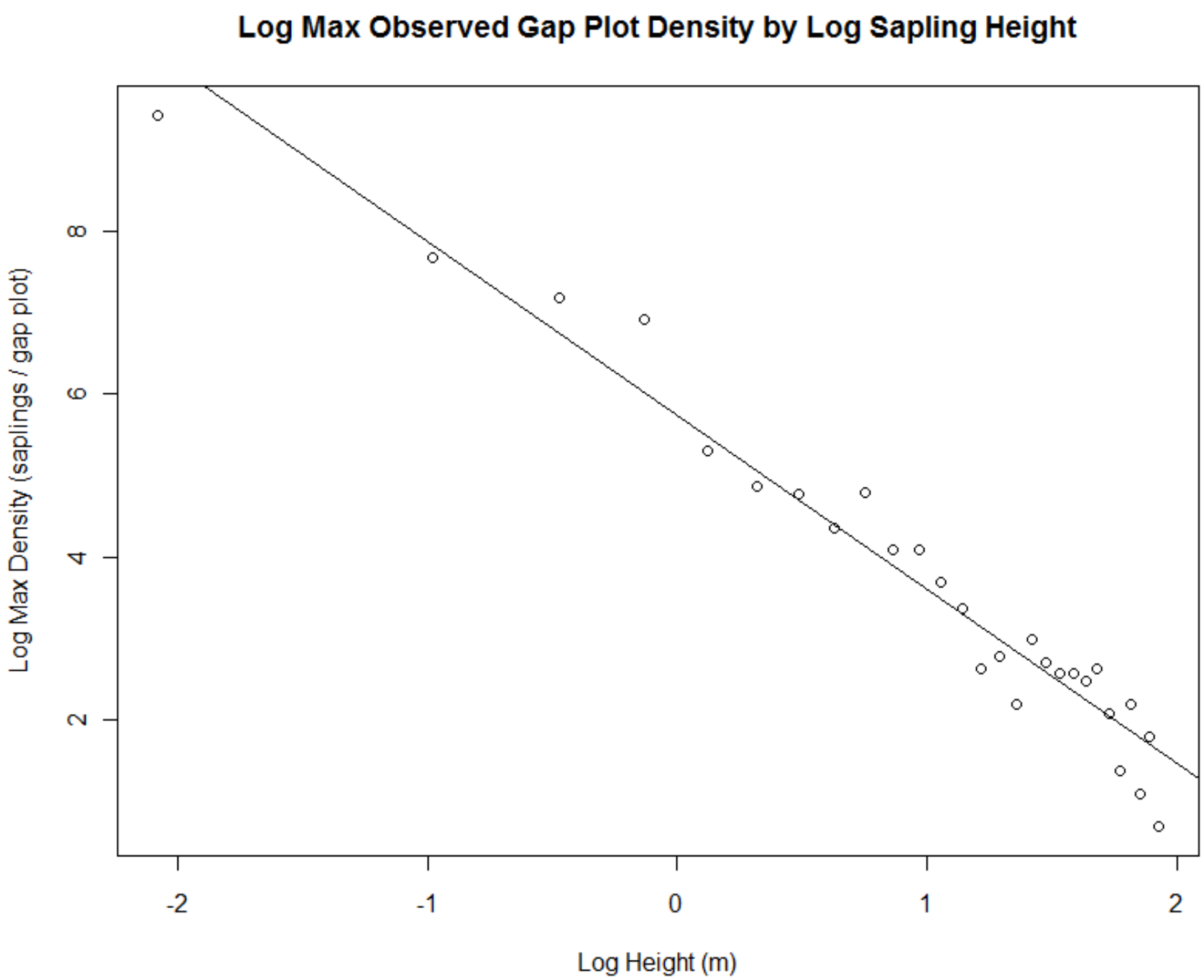
- My take on this: OK if regeneration is over my head, is the largest and has somewhere to go, otherwise…… might be calling it too early
  -

Why is it a problem to call it early?

1) Many more seedlings are (or could be) present than can possibly fill the growing space of an adult tree.

   ----i.e. few possible winners..Which one? Is it acceptable or desirable as regeneration?--

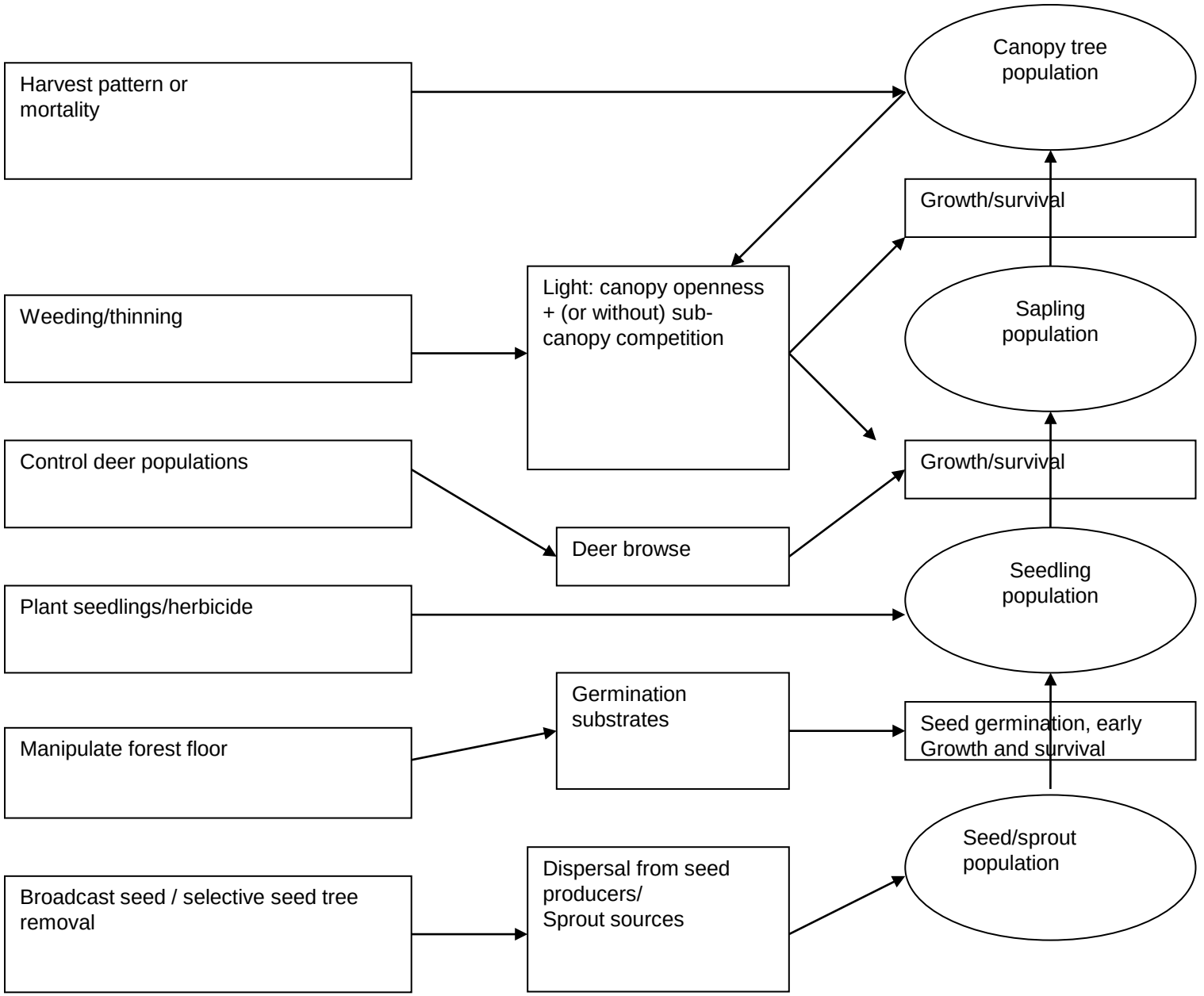

Log Observed Gap Plot Density by Log Sapling Height
Log Density (saplings / gap plot)
0
2
4
6
8
-2
-1
0
1
2
Log Height (m)


Log Max Observed Gap Plot Density by Log Sapling Height
Log Max Density (saplings / gap plot)
2
4
6
8
-2
-1
0
1
2
Log Height (m)

Why is it a problem to call it early?

2) Many things impact who wins adult tree growing space from the seed to the sapling.

---things that may appear inevitable given adult tree composition or young seedling densities may not be inevitable after all--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Harvest pattern or mortality
Weeding/thinning
Control deer populations
Plant seedlings/herbicide
Manipulate forest floor
Broadcast seed / selective seed tree removal
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Sapling population
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Seedling population
Seed germination, early Growth and survival
Seed/sprout population

Case of the oaks

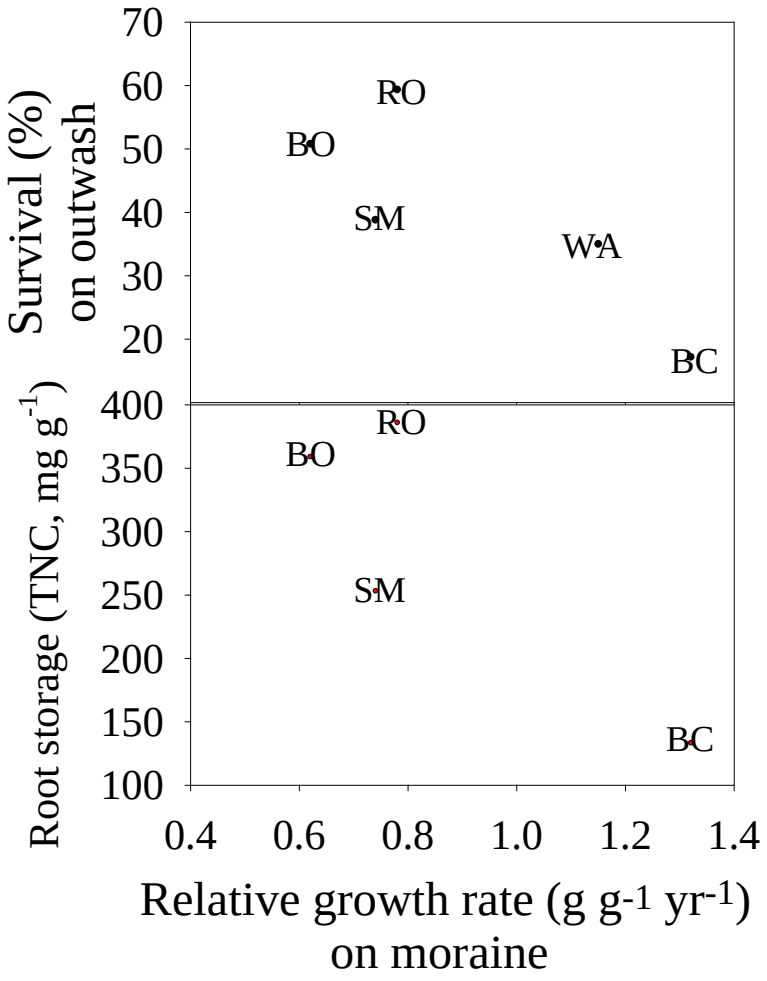
- Dispersal broader than for many species because animals move them around
- Large seeds means establishment substrate limitation probably not great
- Not shade tolerant AND slow growing as juvenile, so especially sensitive to competition from both lower vegetation and the canopy

(Reasons for this are a negative consequence of oaks being superbly adapted to low resource sites and fire)

Sprouting ability is related to root fraction and % starch in roots

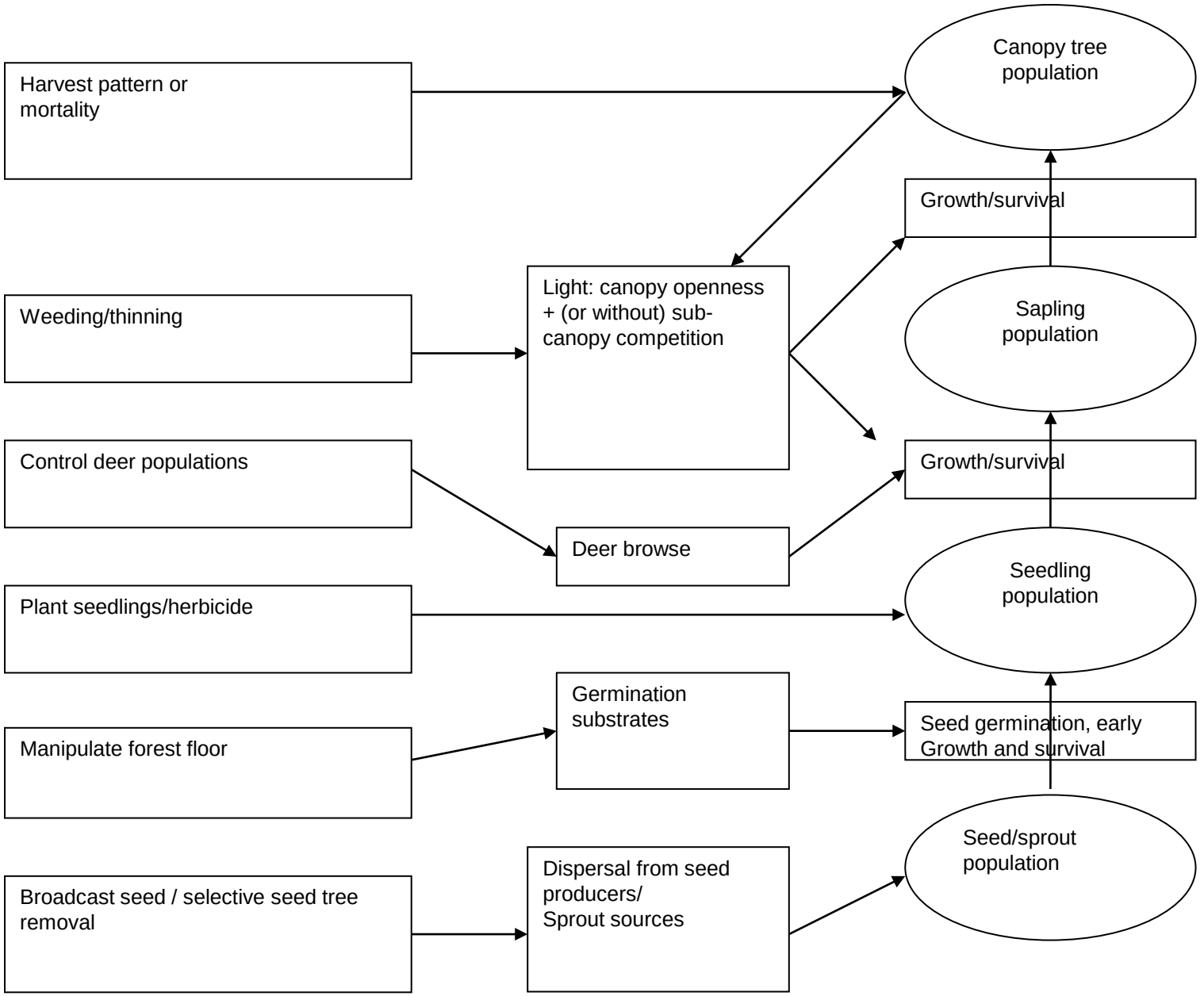
Species	root fraction	%storage
Red oak	73%	33%
White oak	70%	25%
Red maple	38%	18%
Paper birch	41%	10%
Sugar maple	56%	20%
American elm	40%	8%
Douglas fir	26%	3%
White pine	17%	2%
Ponderosa pine	21%	2%

Why don’t all species have big starchy roots?



Implications of this: Oaks are well suited to losing their tops and coping with low soil resources, but at the cost of not being suited to competing with lower vegetation or hanging out in a forest understory

Crex meadows, Wisconsin, Oak grubs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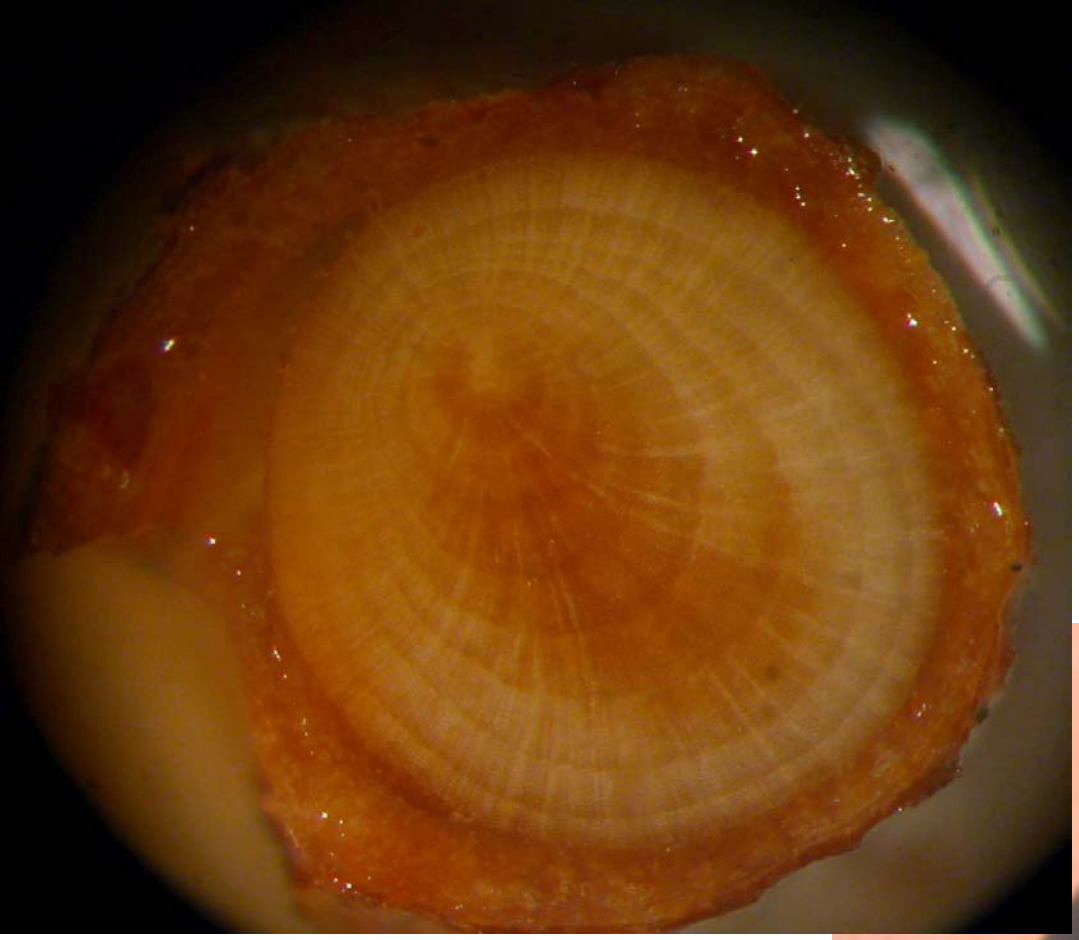
So many seed trees but so few small hemlocks and yellow birch seedlings (not deer).

	Seedling substrate	Seedling species, established seedlings		
		Tsuga	*Betula*	*Acer*
Porcupine	*Tsuga*	0.70 (0.21)	1.22 (0.53)	0.09 (0.03)
	Betula	0.41 (0.18)	0.16 (0.09)	0.05 (0.05)
	Acer	0.02 (0.02)	0.02 (0.01)	0 (0)
	Soil			

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ONE DIME

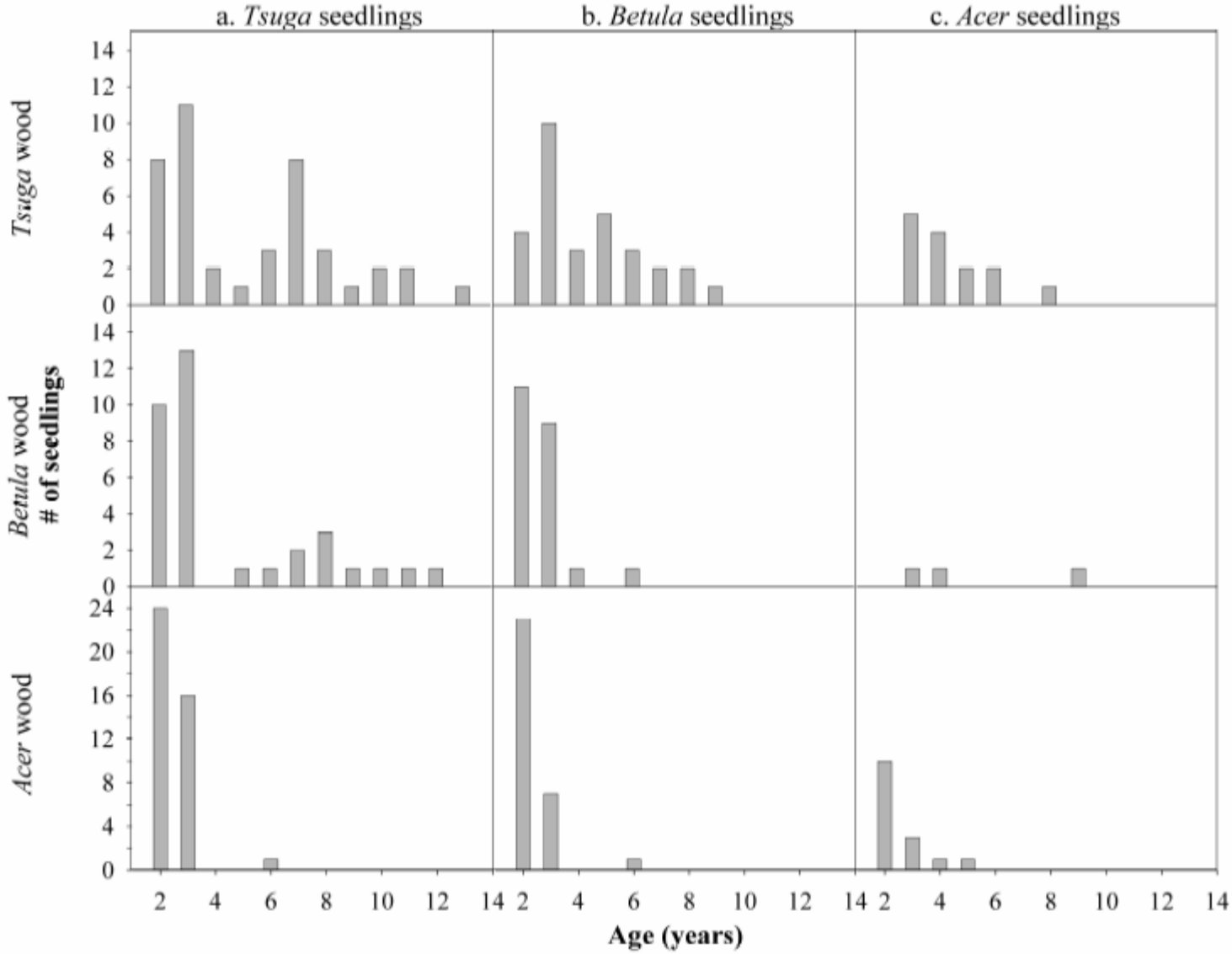
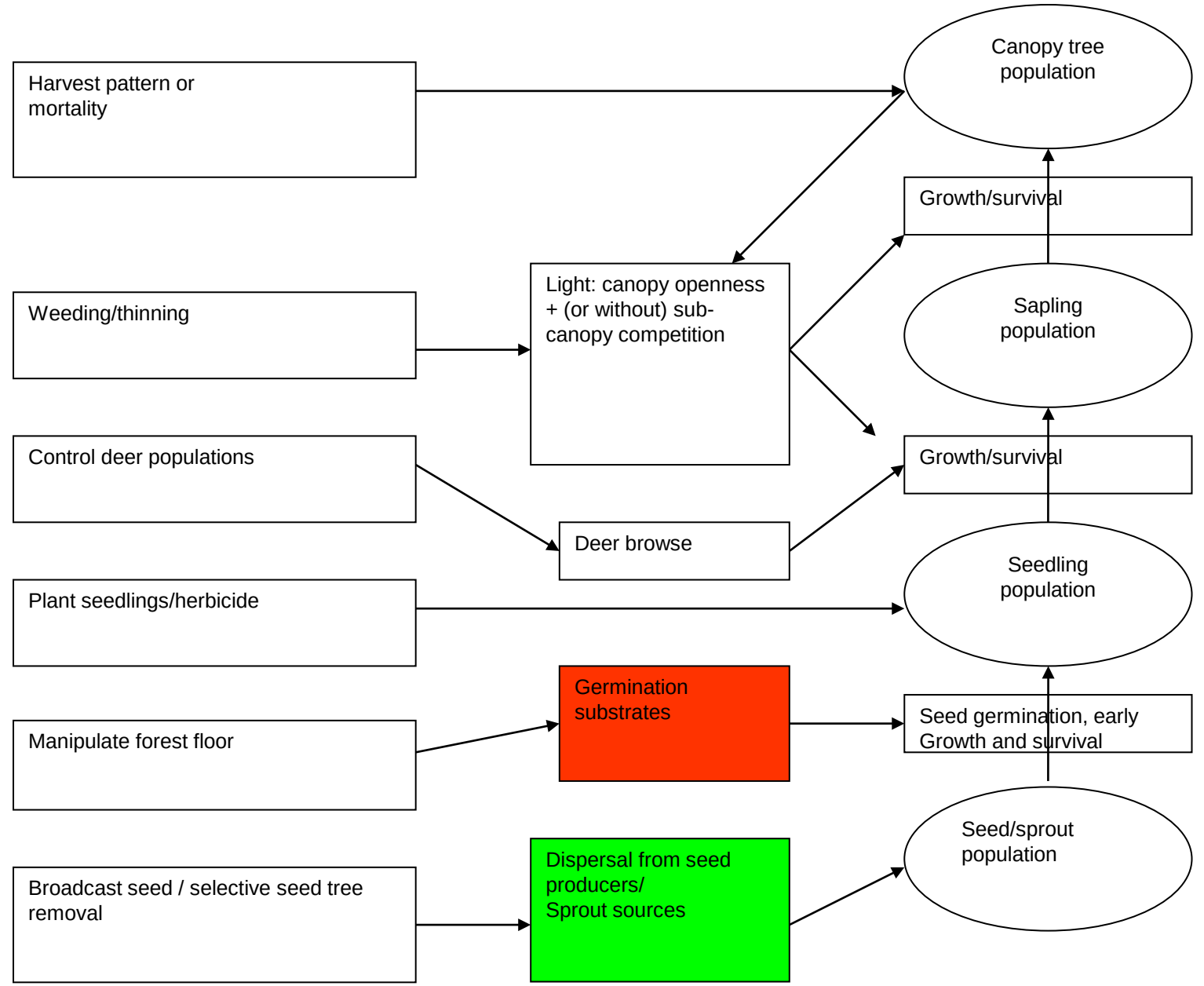


Fig. 3. Age distribution of *Tsuga*, *Betula*, and *Acer* seedlings on different wood species. the different Y-axis scale for *Acer* logs. n = 42 *Tsuga*, 30 *Betula*, and 34 *Acer* wood piec sites pooled.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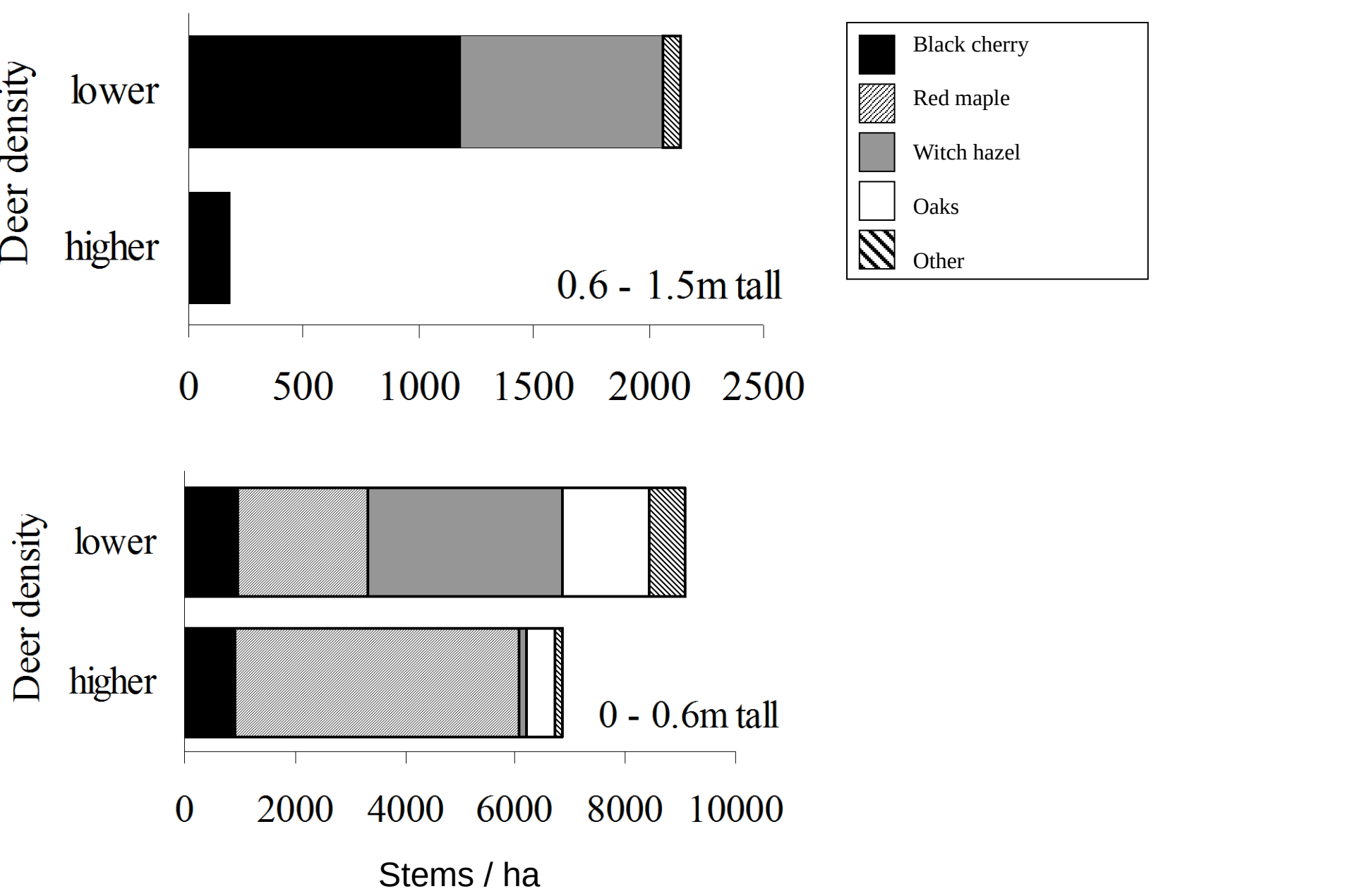
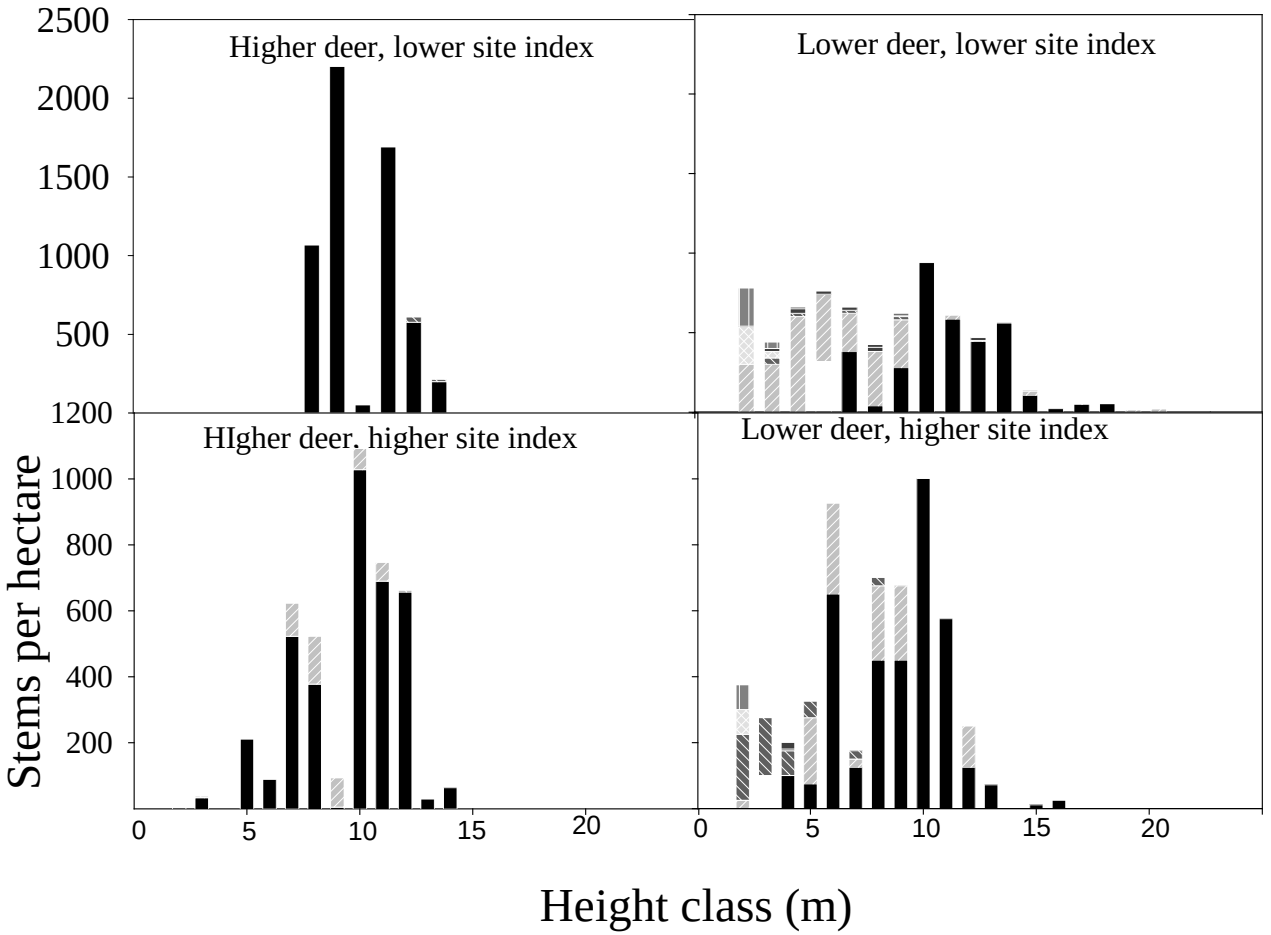
Differences in deer density for several decades between state and MFL lands

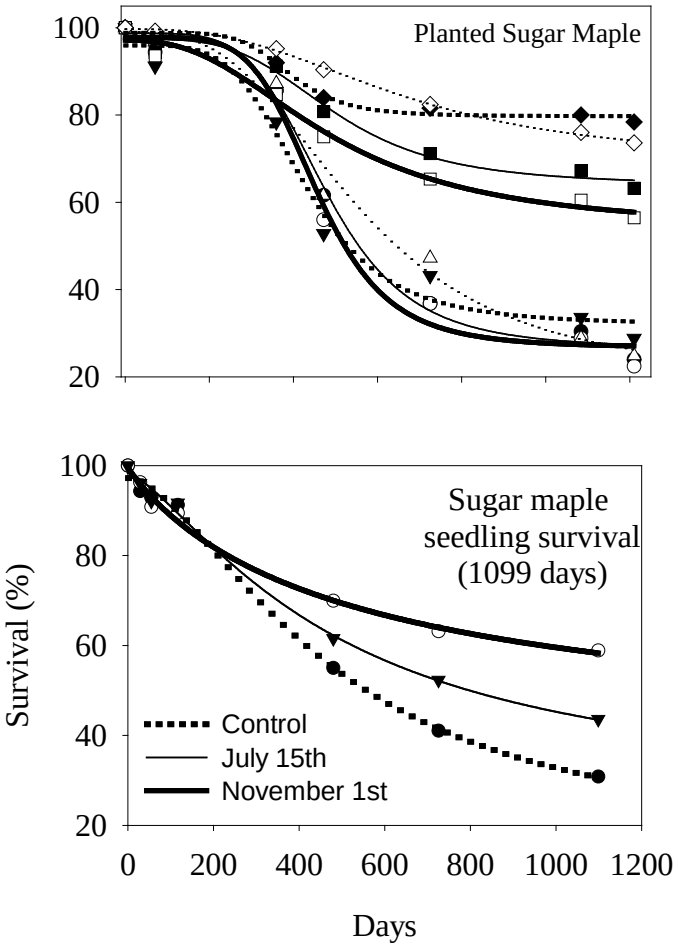
Effects of deer on seedling to sapling transitions in aspen understories

	MFL	State
Pellet estimate	28.5/mi^2	17.6/mi^2
Mayflower/ lily-of-the-valley	1/30	17/29


Deer density
lower
higher
0.6 - 1.5m tall
0
500
1000
1500
2000
2500
Black cherry
Red maple
Witch hazel
Oaks
Other
Deer density
lower
higher
0 - 0.6m tall
0
2000
4000
6000
8000
10000
Stems / ha


Higher deer, lower site index
Lower deer, lower site index
HIgher deer, higher site index
Lower deer, higher site index
Stems per hectare
Height class (m)
2500
2000
1500
1000
500
1200
1000
800
600
400
200
0
5
10
15
20
Mean(aspen)
Mean(red maple)
Mean(black cherry)
Mean(witch hazel)
Mean(oak)
Mean(witch hazel)

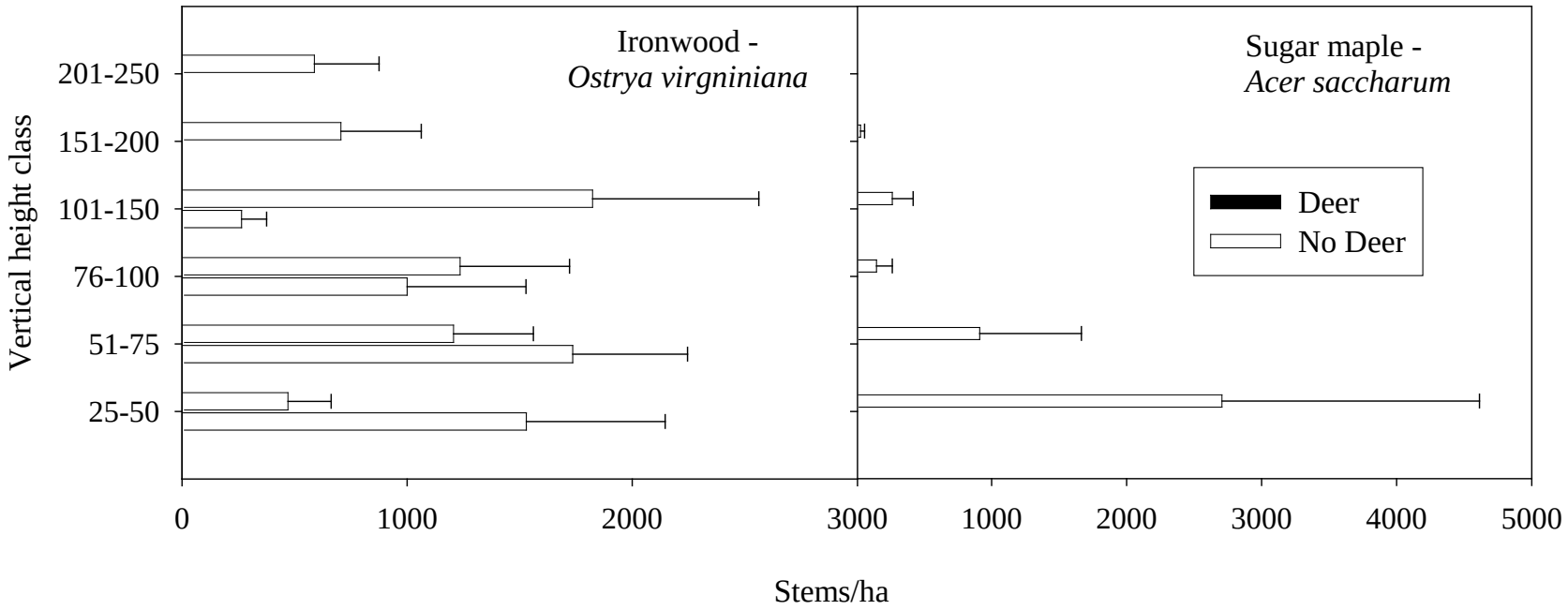
The combination of sedge and deer on maple seedlings



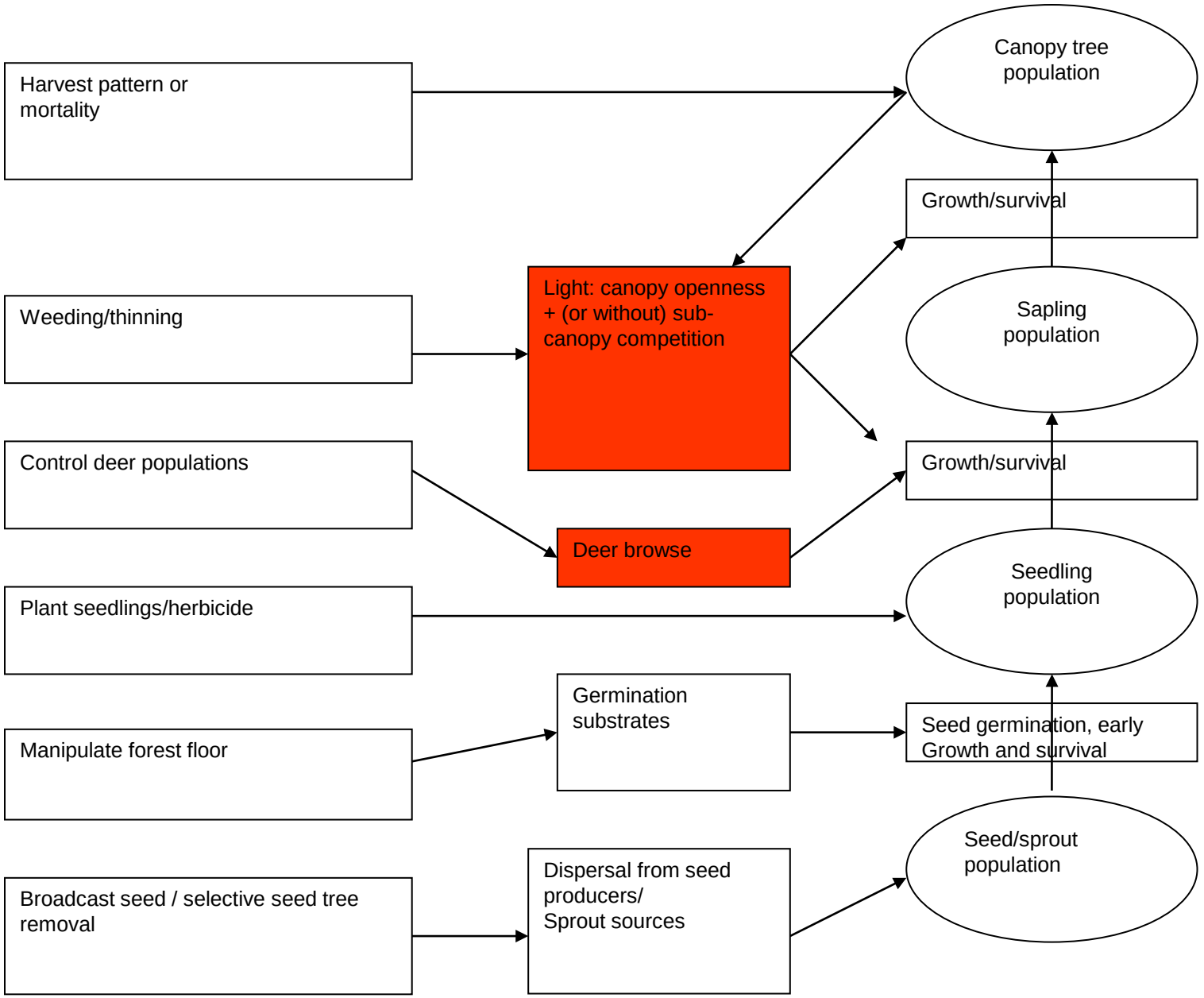
Older seedlings, growth diminished modestly by sedge (not shown), but deer do them in..

Young seedlings: sedge competition cuts survival in half.

After five years of exclosures partial cut northern hardwoods, Menominee County



What you get is a function of sedge impacts young seedling survival and growth, deer impacts on older seedling survival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Points

- The number of factors influencing regeneration from seed to sapling stage are many, they vary with site conditions, and species respond differently to them.
- Understanding which bottlenecks are most important can help direct management
- Careful approach in anything but weeded plantations would preclude calling winners until trees are > 5-6 ft tall which (conveniently) is about as high as deer reach and the max. height of *most* non-tree competing vegetation

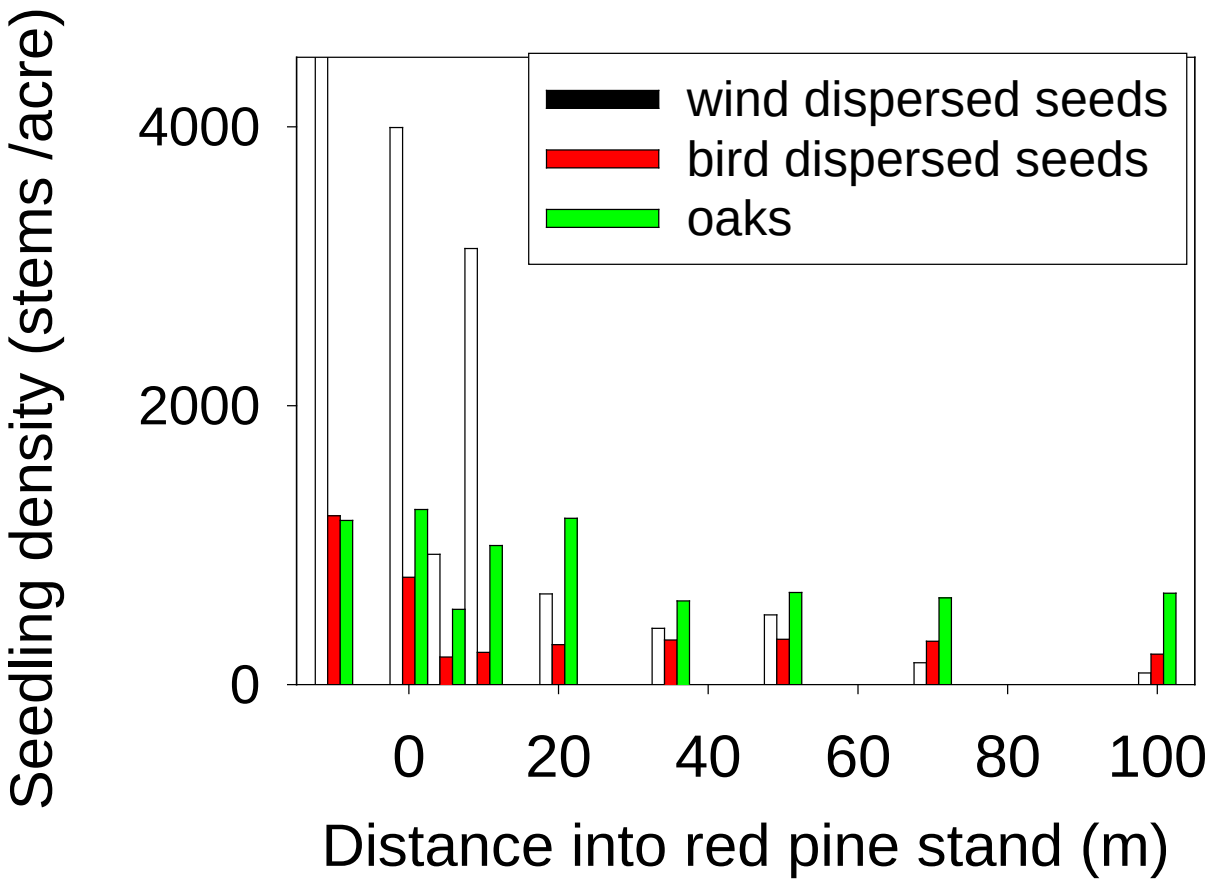
Factors favoring oak regeneration in red pine plantations:

-Observations and rough analysis of FIA data indicate that oak regeneration is more abundant in red pine plantations than broad-leaved stands.

Why interested: May be one of the only good opportunities for promoting oaks on good sites.

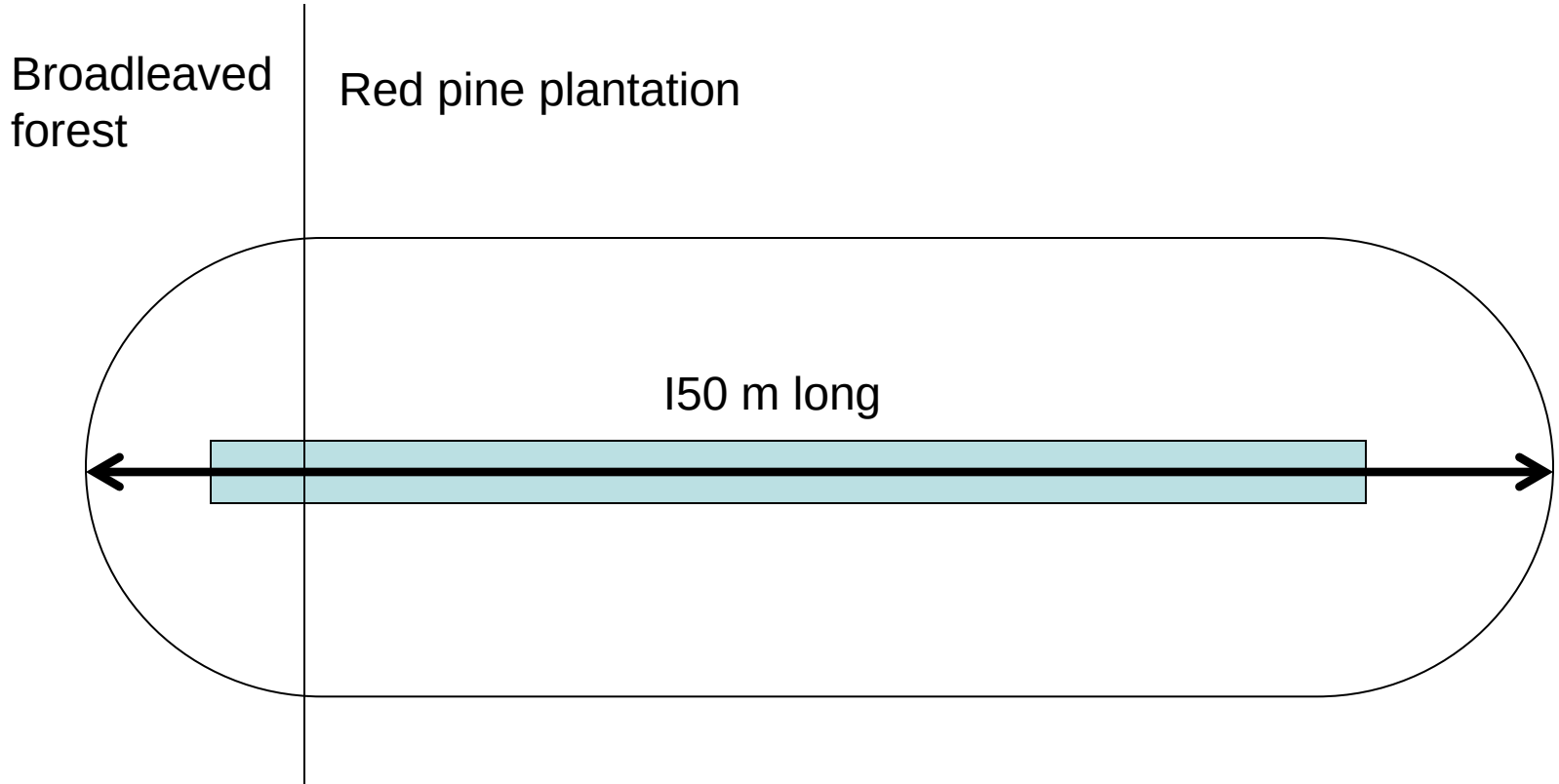
-Why?? Mycorhizzae, fewer competitors due to forest floor impediments, dispersal, regular thinning?

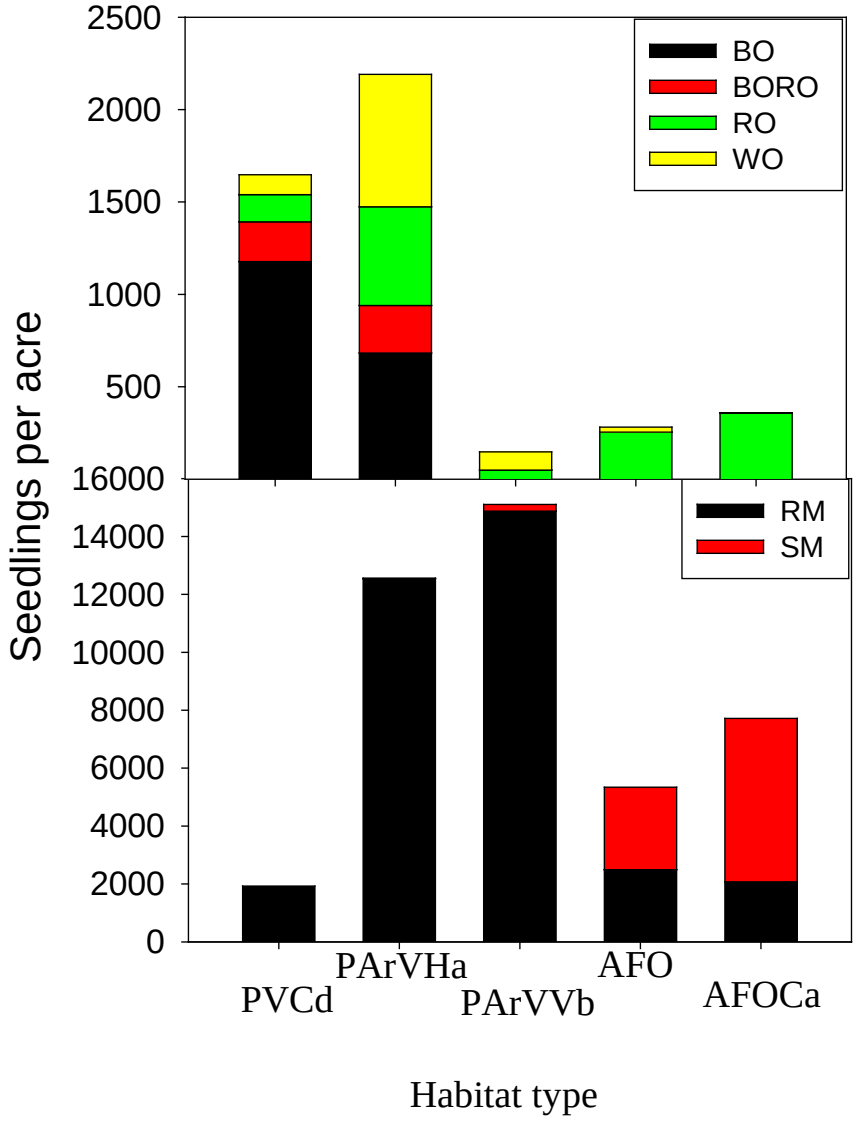
Mono-dominant plantations may shift the balance in seedling numbers to oaks due to long dispersal distances



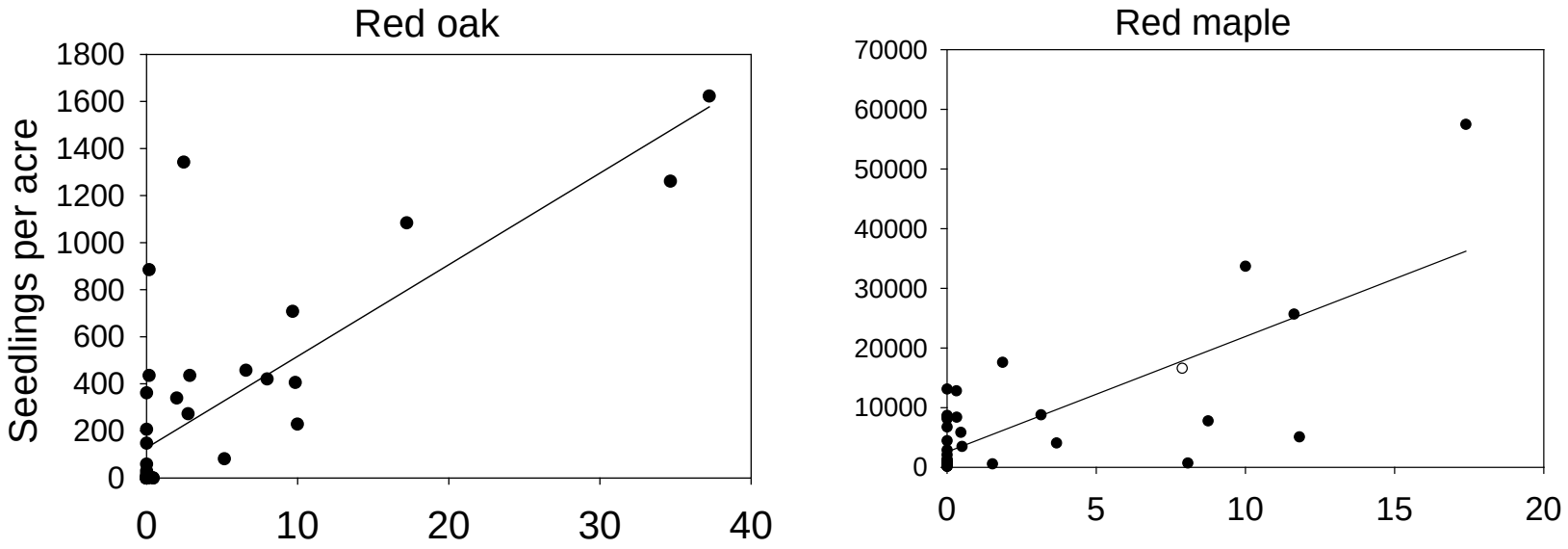
Oak (other species) seedling numbers, survival and growth (five years of data)

Function of: local seed source strength, thinning (light), competion from low vegetation and habitat type (40 stands)




Seedlings per acre
2500
2000
1500
1000
500
16000
14000
12000
10000
8000
6000
4000
2000
0
BO
BORO
RO
WO
RM
SM
PVCd
PArVHa
PArVVb
AFO
AFOCa
Habitat type

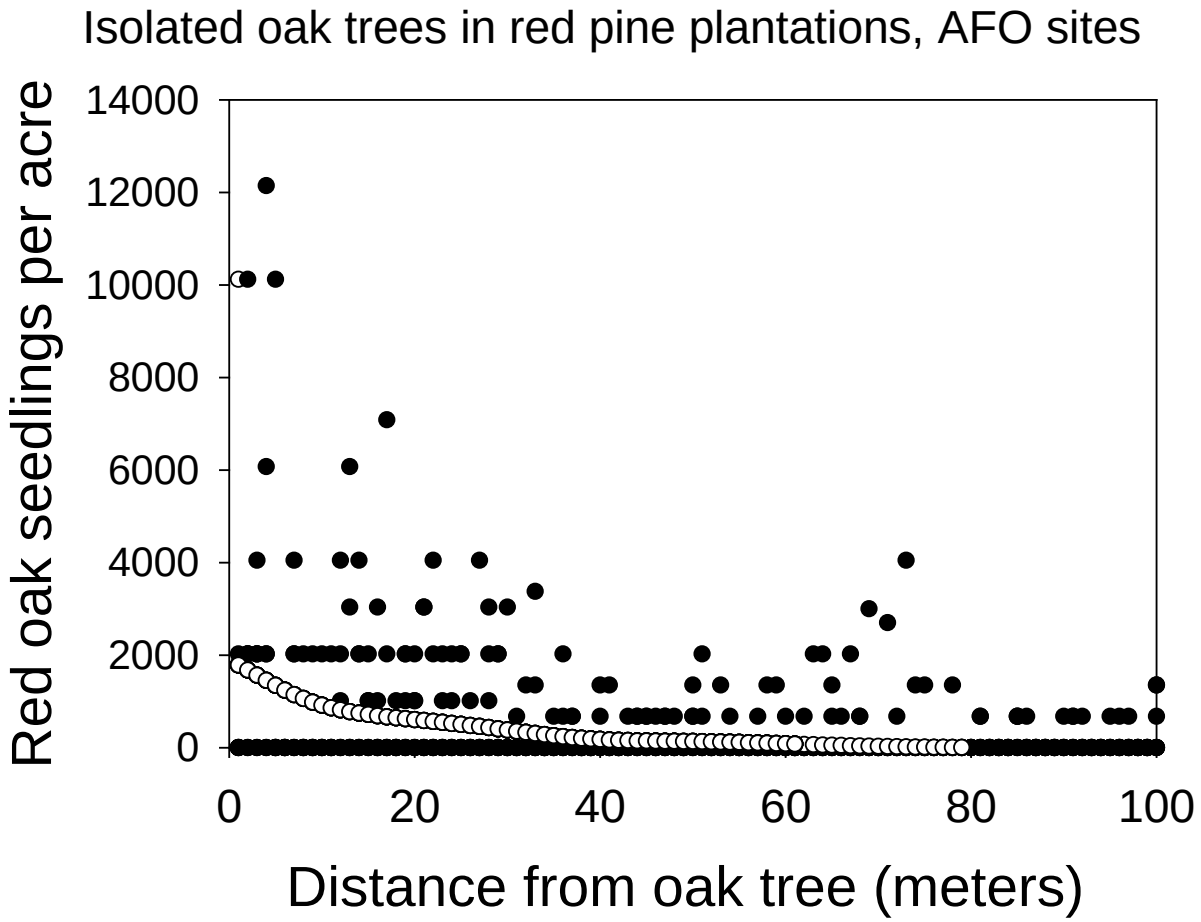
Density of both species strongly dependent on seed trees in close proximity

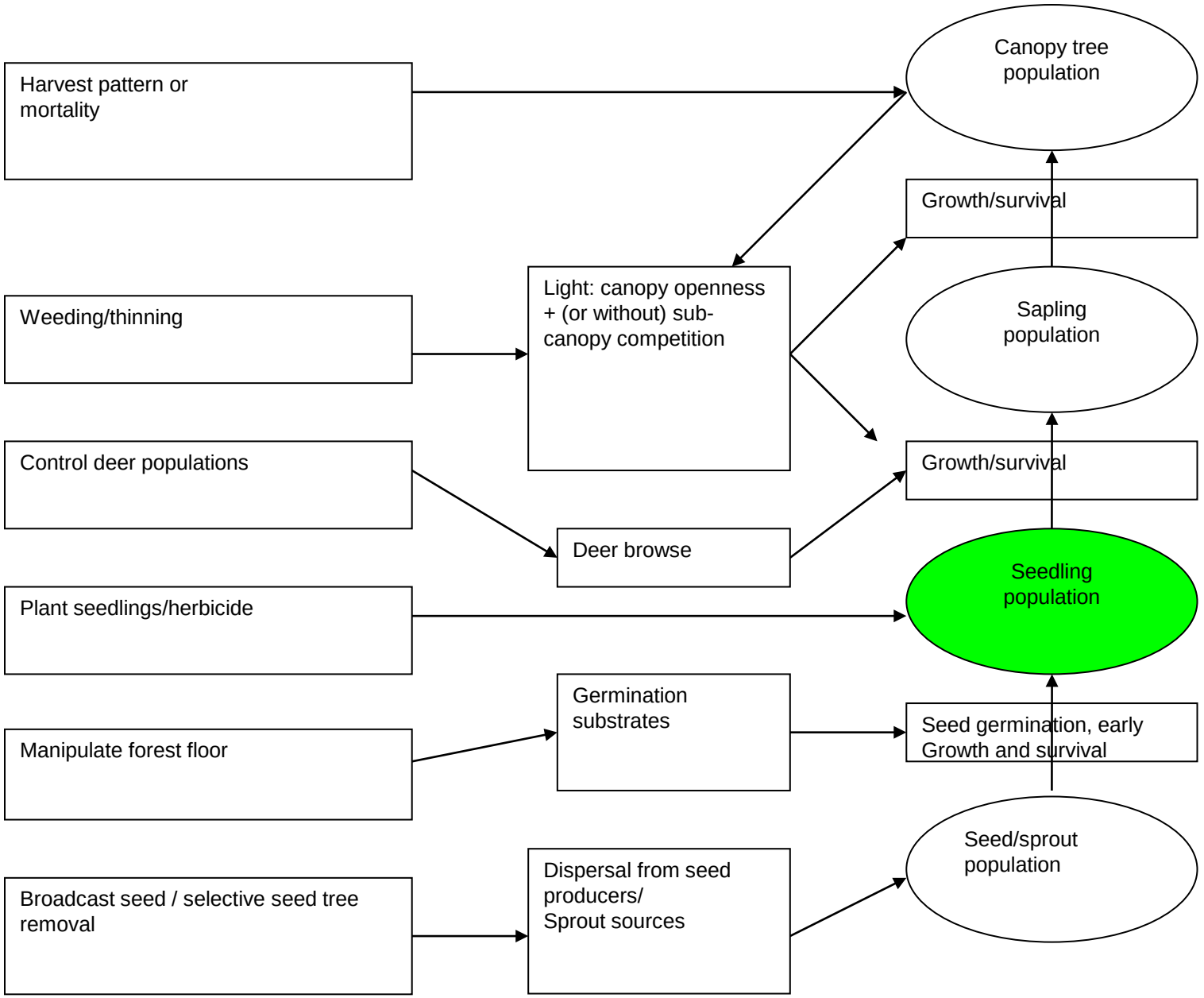


BA/acre, trees > 10" dbh within 50 m

Average of nearly 2000 seedlings/acre near parent tree, 300 at 35 meters

Retaining oaks at 70 m spacing within pine plantations ought to buy you 600 Seedlings/acre

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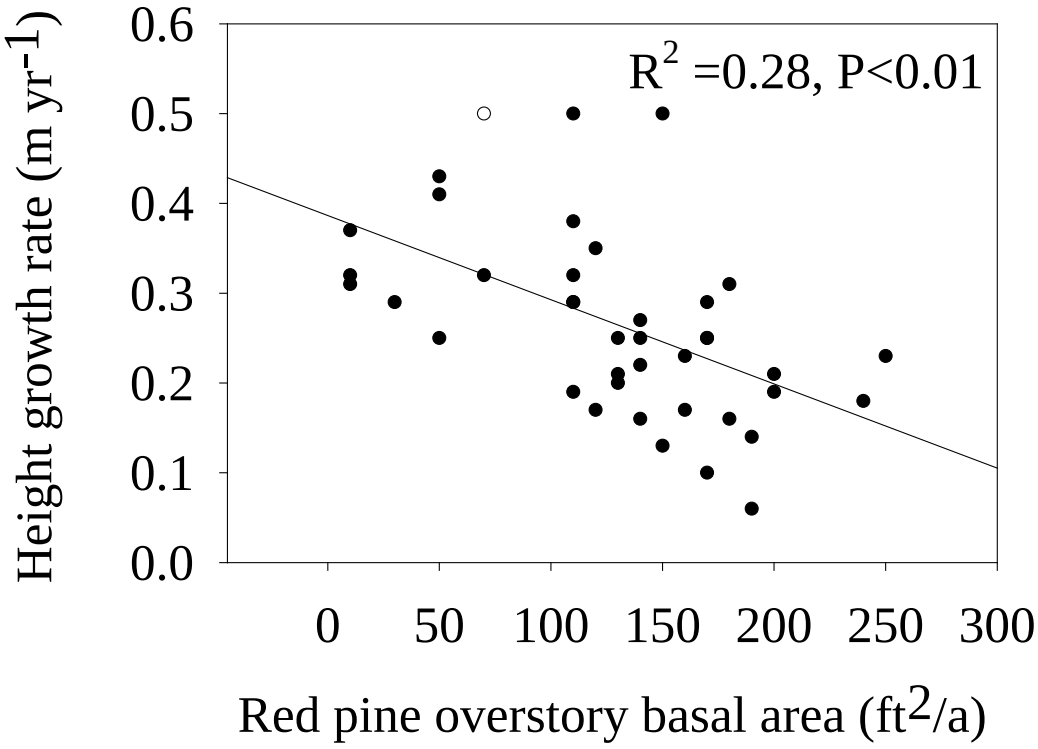
Thinning mattered too, but only for oaks

- Red oak: overall: thinned 333/acre
  unthinned 204/acre

  AFO, AFOCa: thinned 387/acre
  unthinned 138/acre


R^2 =0.28, P<0.01
Height growth rate (m yr^{-1})
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
50
100
150
200
250
300
Red pine overstory basal area (ft^2/a)

Implications of this for management based on our results and oaks physiology

- Oak is cursed by slow juvenile growth AND low shade tolerance

Oak management without fire

- Winter log to maintain forest floor to discourage small seeded competitors?

- Favor oak seed sources: Remove undesirable seed sources from plantations/bordering stands. Leave oaks in bordering stands and in plantation interiors

- Heavy late rotation thinning in pine to insure high survival of seedlings (natural or planted origin) and rapid recruitment of oak saplings

I

- May be the only game in town for AFO/AFOCa types. Consider alternative oak-heavy broadleaved stands with plantations.