

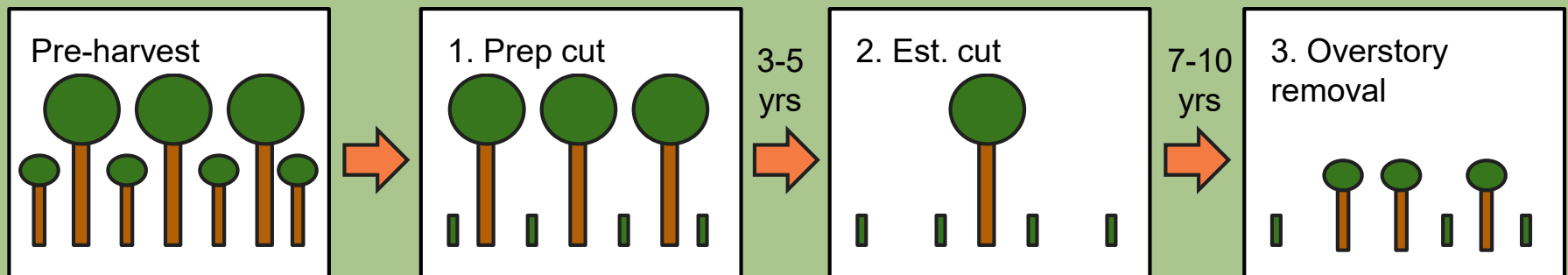


Effects of silviculture on predation and dispersal of oak (*Quercus*) acorns by small mammals

Kenneth F. Kellner & Robert K. Swihart

Silviculture & Oak

- Silviculture: economic and regeneration goals
- Methods: even/uneven-aged
- Shelterwood method (even-aged)
 - Series of cuts
 - Promote advance regeneration, then release



Small mammals



- Key role as acorn predators & dispersal agents
- Affected by harvest-induced habitat change
- How will changes in small mammal behavior interact with oak regeneration under the shelterwood system?

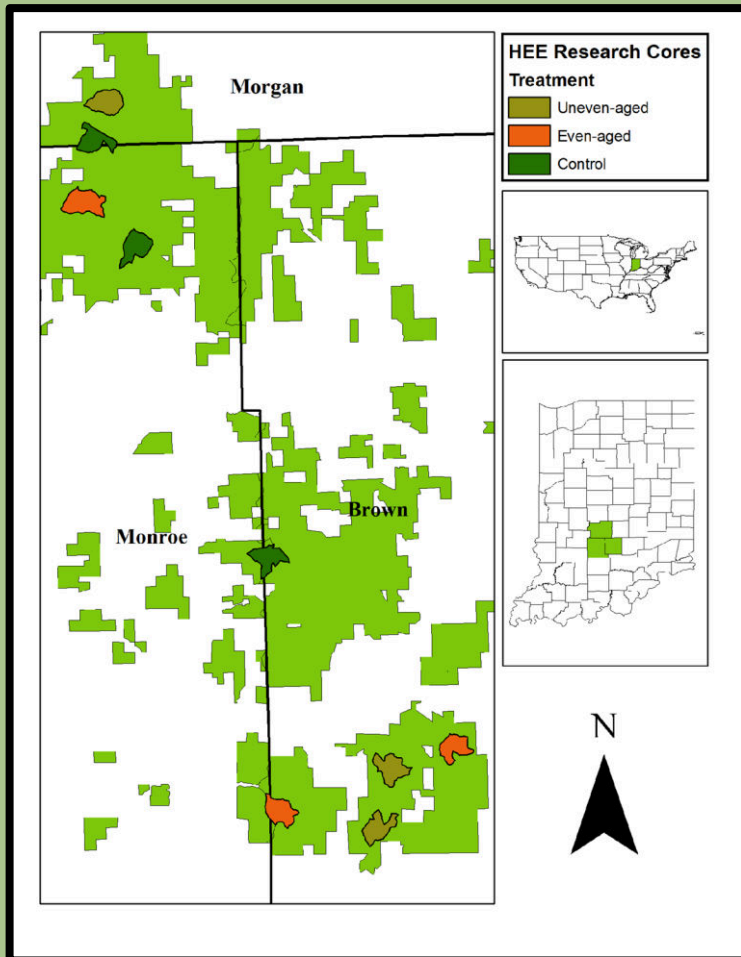
Objective

Determine the short-term effects of shelterwood harvests on dispersal and predation of acorns by small mammals.

Hypotheses

1. Acorns in shelterwood harvests are **less likely** to be removed by predators due to reduced cover
2. Dispersal distances will **differ** between treatments
3. Removal, dispersal, and caching of acorns will **differ** between oak species

Methods - Location



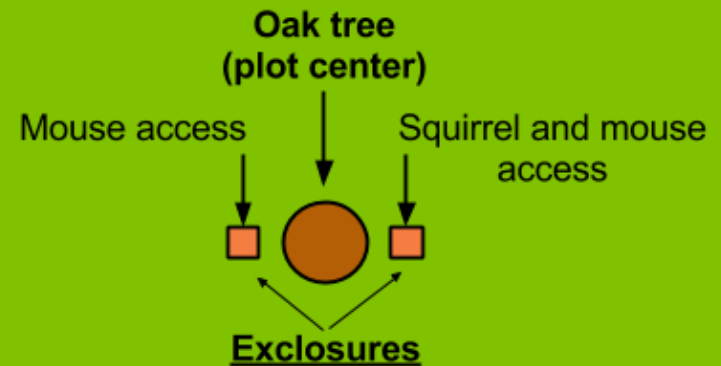
- Hardwood Ecosystem Experiment (HEE)
- 3 years (4th planned)
- 10 total sites
 - 5 control
 - 5 post-shelterwood
- Each site centered around mature oak tree
- Oaks part of related mast monitoring study

Methods - Design

- 2 exclosure treatments
 - Mouse+squirrel
 - Mouse only
- 2 species
 - Black oak
 - White oak



Tag Search Area



- Each supplied with 100-200 tagged white and black oak acorns (see below)
- Tag type corresponded to exclosure type and species

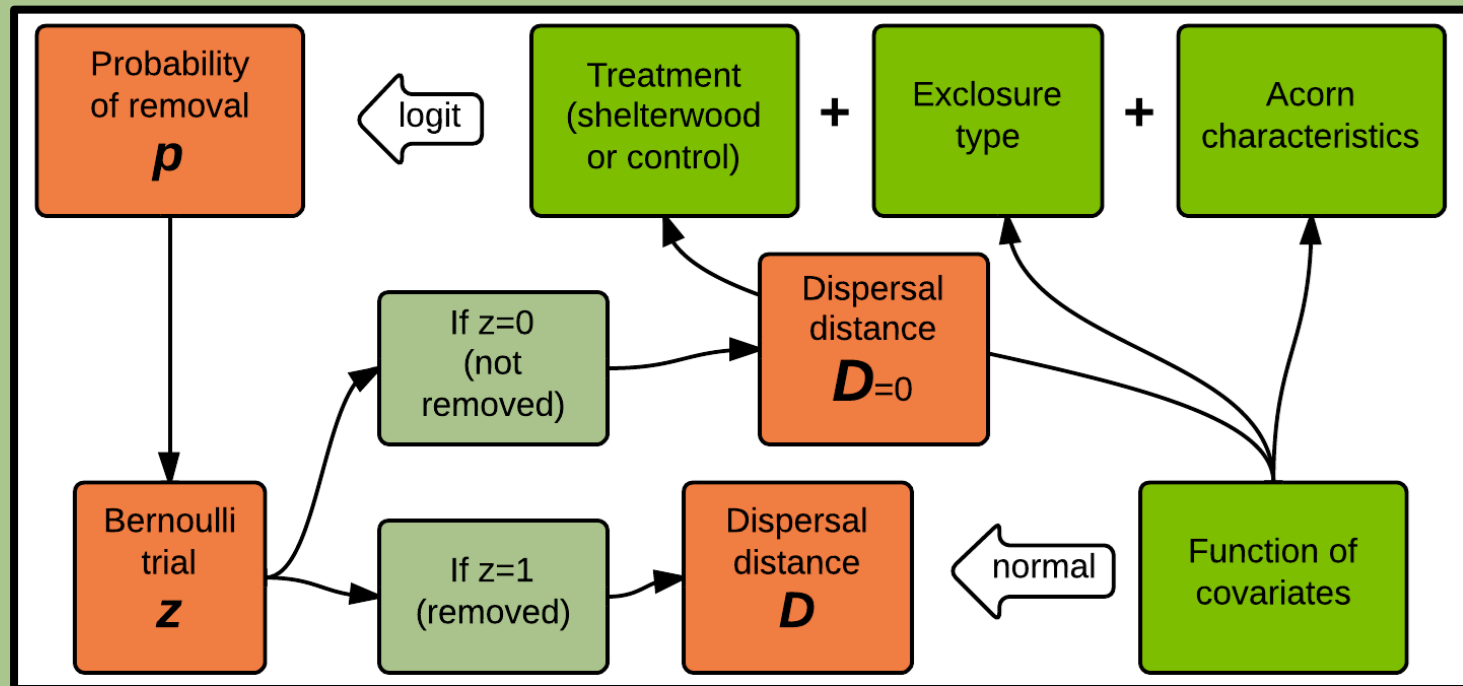
Methods - Searches

- Search area divided into 10x10 m cells
- Searched thoroughly with metal detector
- Tags / tagged acorns recovered and fate determined

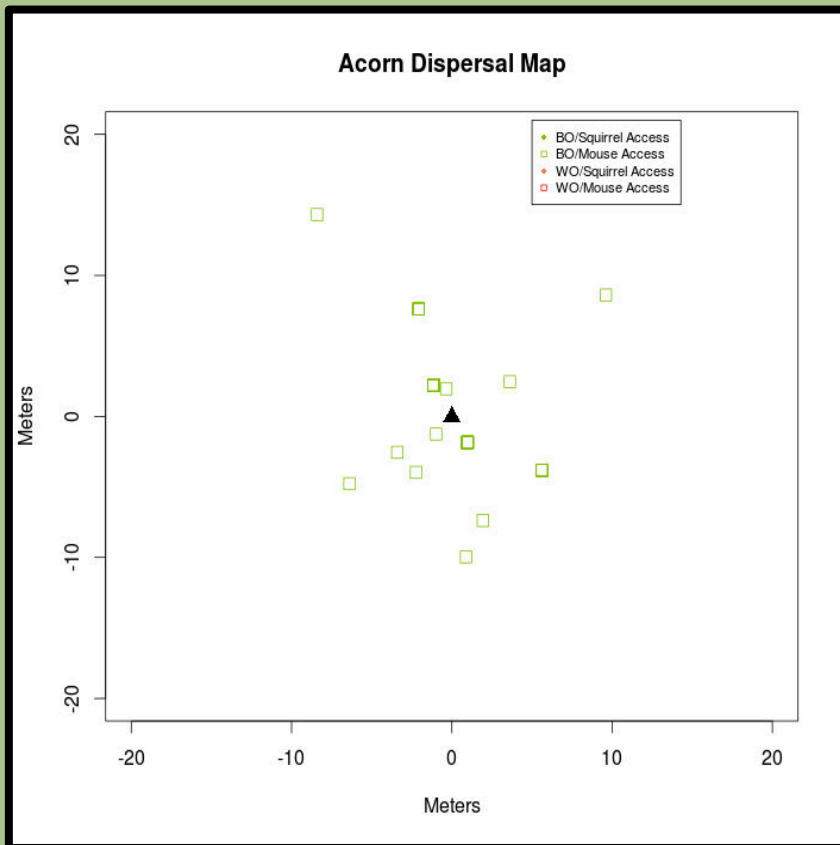


Methods - Analysis

- Simultaneous modeling of removal and dispersal
- Covariates: harvest treatment, species, enclosure type

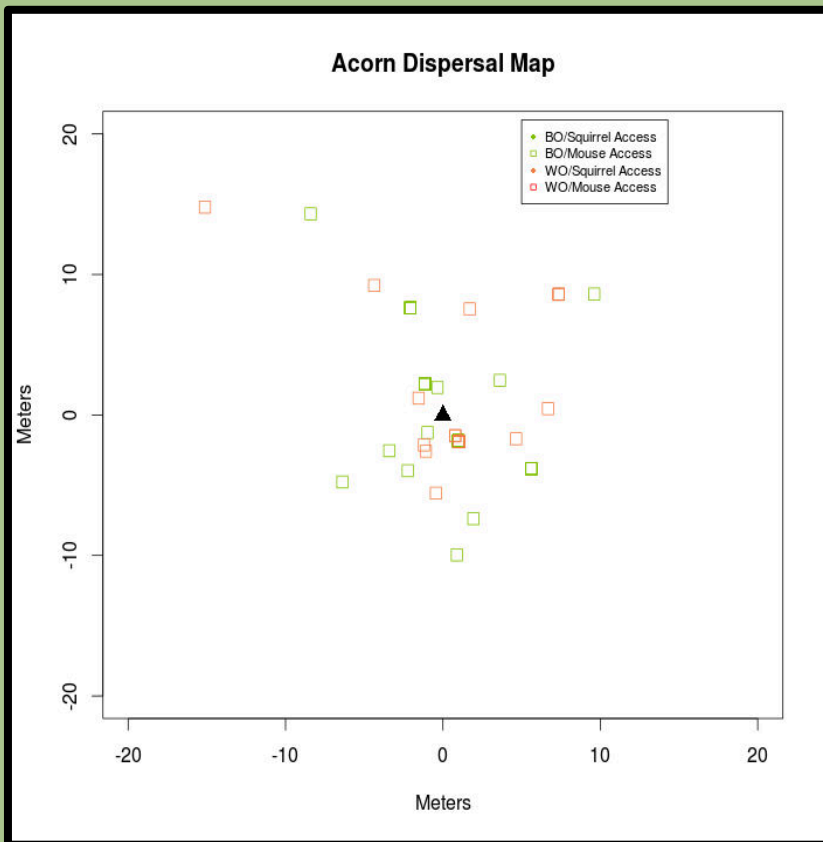


Results - Recovery



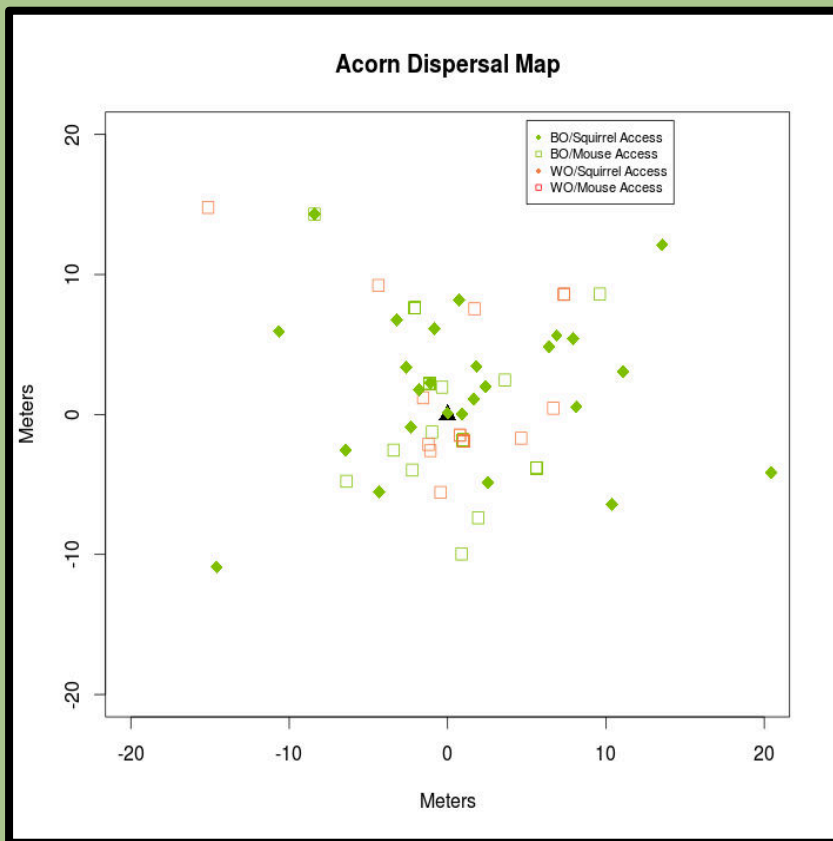
- 6000 seeds released; 1912 recovered (32%)
- $p(\text{detection}) = 0.40$ and not significantly different based on tag type
- Undetectable seeds in trees, burrows, or outside search area

Results - Recovery



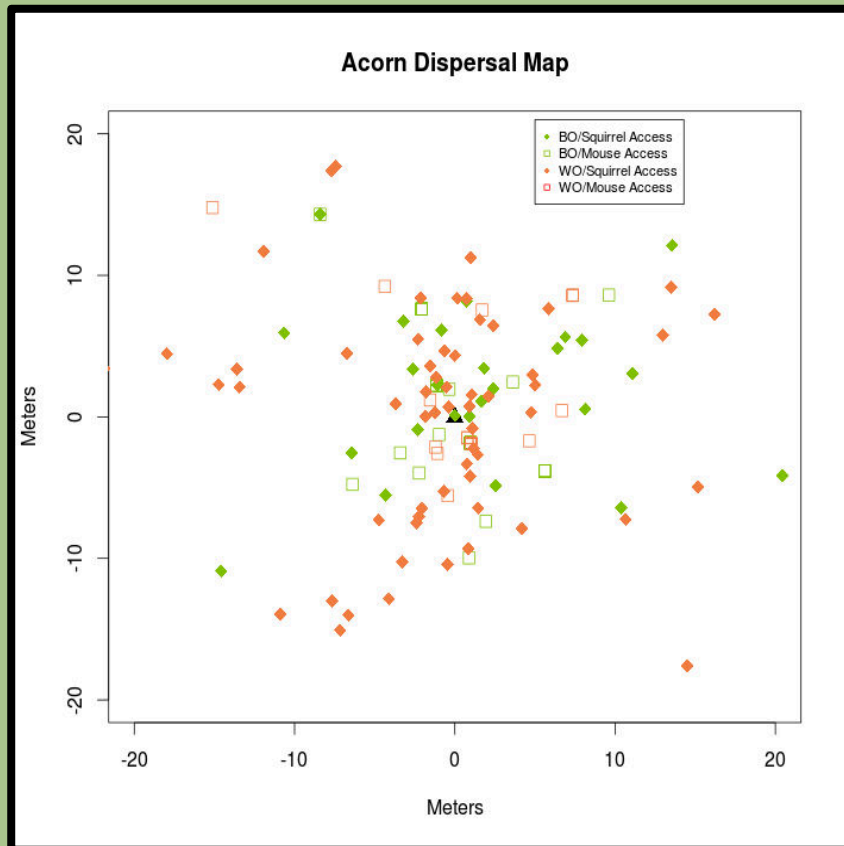
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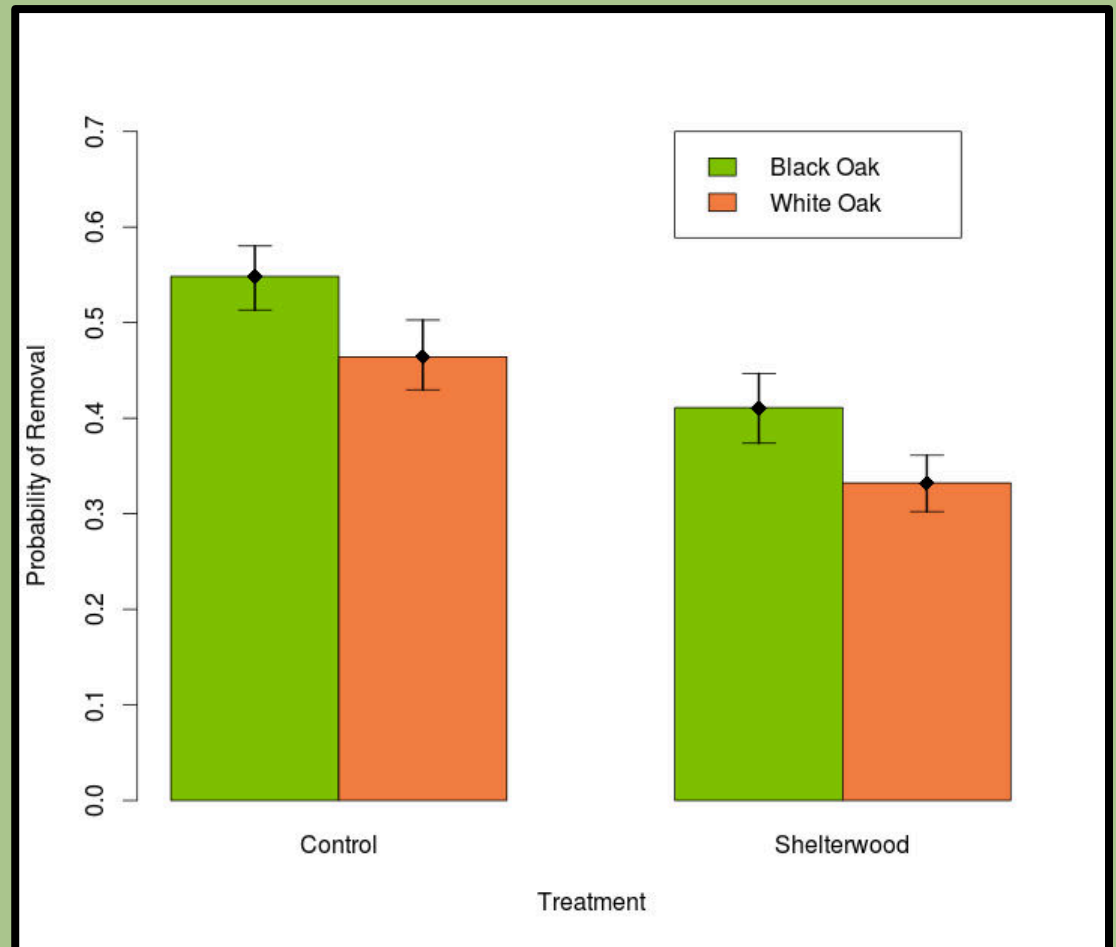
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Results

Parameter	Mean	SE	2.5%	97.5%
Probability of Removal Covariates				
Black Oak	1.37	0.14	1.10	1.63
Squirrel Access	1.48	0.11	1.26	1.69
2012 Effect	1.82	0.18	1.47	1.94
2013 Effect	2.15	0.19	1.81	2.50
Shelterwood	-0.37	0.11	-0.58	-0.15
Dispersal Distance Covariates				
Black Oak	0.15	0.07	0.01	0.28
Squirrel Access	0.15	0.07	0.04	0.27
Acorn Cached	0.27	0.08	0.12	0.43
2012 Effect	0.83	0.09	0.65	1.00
2013 Effect	0.71	0.09	0.54	0.88
Shelterwood	0.31	0.06	0.19	0.36

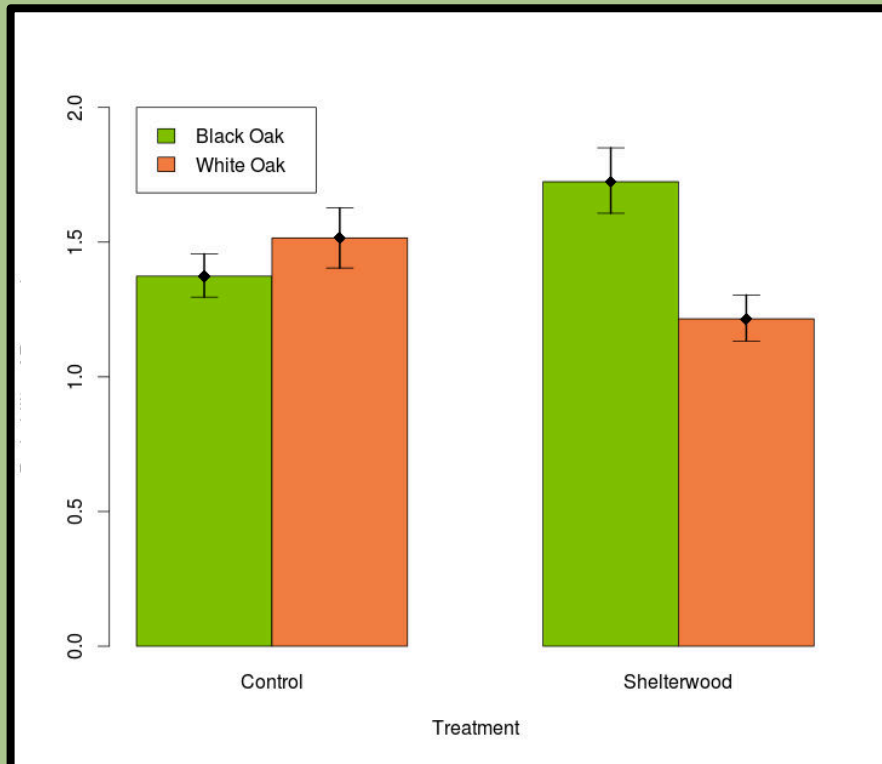
Results - Removal

- $p(\text{removal})$ higher for black oak
- Removal less likely in shelterwood treatment

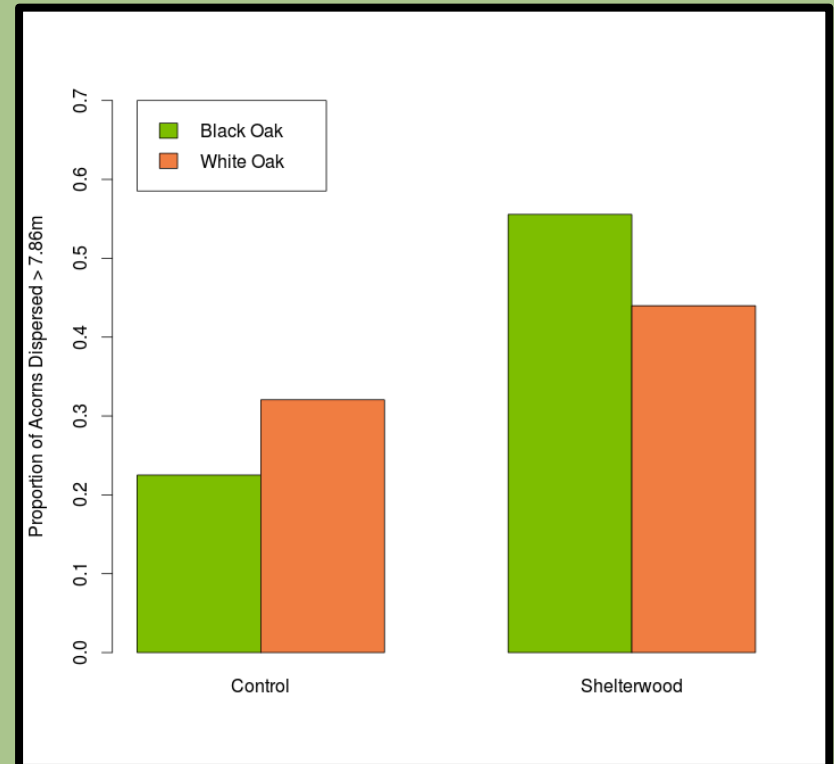


Results - Dispersal

Mean dispersal distance (m)

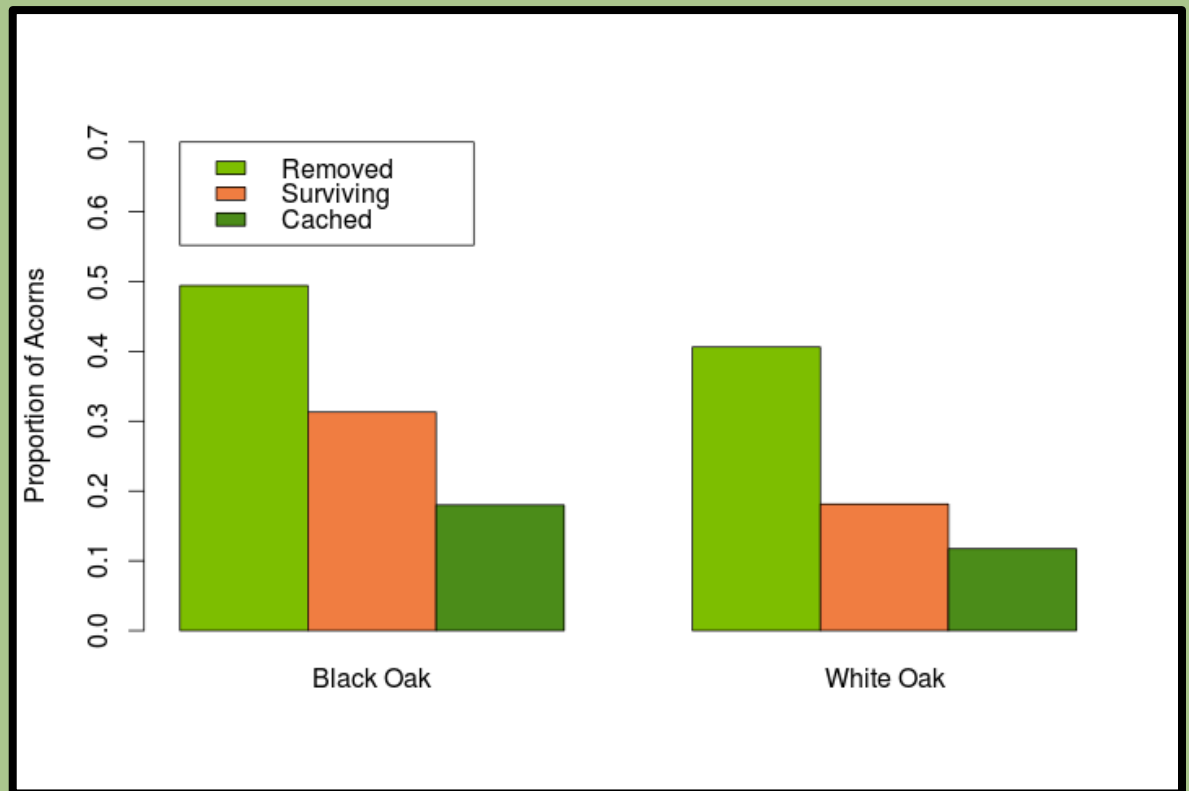


Proportion dispersed outside canopy



Results - Acorn fate

- Roughly half of the acorns removed
- However, a substantial percentage survived
- Cached = best outcome

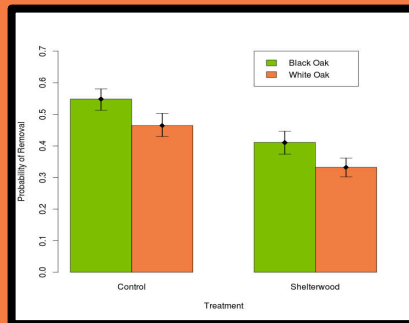


Discussion

1. Acorns in shelterwood harvests are **less likely** to be removed by predators due to reduced cover



Evidence:



Shelterwood

-0.37

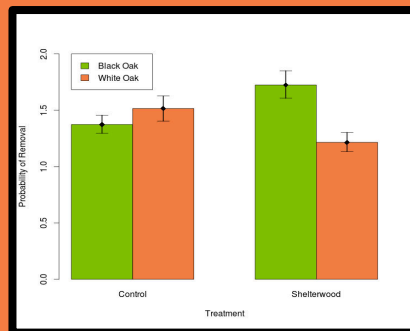
- Acorns less likely to be removed at shelterwood sites
- Potentially due to reduced overstory cover -> mammals perceive higher predation risk
- Note: removal does not equal seed predation (often conflated)

Discussion

2. Dispersal distances will differ between treatments



Evidence:



Shelterwood

+0.31

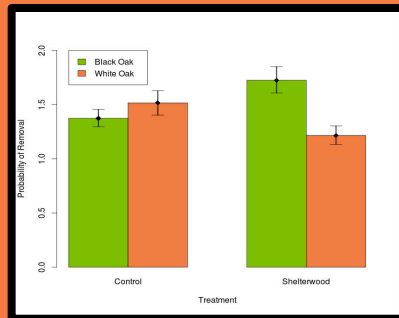
- Overall, acorns dispersed farther in shelterwood treatment
- Harder to find safe place to consume/cache?
- Differences between species likely related to seed characteristics
- Greater range of dispersal distance favor germination / regeneration

Discussion

3. Removal, dispersal, and caching of acorns will differ between oak species



Evidence:



Black oak

+0.15

- Overall, BO dispersed further and more likely to be removed/cached
- Difference minimal at control (unharvested) sites but pronounced at shelterwood sites
- Reflects reduced perishability relative to white oak (germination schedule)

Future directions

- Additional data collection
- Expand analysis to relate treatment to seed fate (eaten/surviving/cached)
- Account for seed detection probability (incorporate pilot data)
- Shelterwood/burn method - even great changes in disperser behavior?

Acknowledgments

- Technicians: Jessica Rodkey, Nick Grady, Annie Spikes, Mikko Moy, Joni Willits, Christian Houser
- Lab group: Nate Lichti, Harmony Dalglish, Rita Blythe, Mekala Sundaram
- HEE: Jeff Riegel, Rebecca Kalb, Andy Meier
- Funding: Indiana DNR, Purdue Dept. of Forestry and Natural Resources, Purdue Graduate School

Questions?

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