THE EFFECT OF THINNING AND PRESCIRBED FIRE ON FUEL LOADING IN THE CENTRAL HARDWOOD REGION OF MISSOURI

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What is the importance of fuel loading information in the Central Hardwood Region?

1. Historic land use and agency policy has changed fuel loading and vegetative structure.
2. Little to no fuel loading information exist for the area.
3. Managers use treatments that concern or affect fuel loading on a regular basis.

Pre-Settlement (circa 1820)

- **This open pine and oak/pine forest structure was the result of an anthropogenic fire regime, dominated by light surface fires.**

- **Dendrochronological derived Mean Fire Interval (MFI)** (Guyette 1997)**:**
  - **17.7 years (1580-1700)**
  - **12.4 years (1701-1820)**

Today's Forest

- **Comprised mostly of dense oak forests.**
- **Reduction in relative pine abundance from historic levels by 66%** (Guyette 1997)**.**
- **Shortleaf pine range reduced from an estimated 6.6 million acres to only 400,000 acres in 1976** (Essex and Spencer 1976)**.**
- **All indications suggest fuel loading has increased, unchecked by periodic fire.**

The Cause

- **During settlement, 1821-1940, the MFI decreased to 3.1 years** (Guyette 1997).
- **By the early 1900's, the Missouri Ozarks had been completely cut over with little regard to the regeneration of future forest.**
- **In the 1930's wildfire suppression began increasing the statewide fire rotation length (1970 to 1989) increased to 326 years** (Westin 1996)**.**
- **With suppression, conditions were favorable to the development of dense oak forest.**

Management Today

- **Prescribed fire, harvesting, thinning, or combinations of the these treatments are commonly used management tools.**
- **Treatments are often used in the restoration of habitat and biodiversity.**
- **In 2002 state/fed/private organizations applied prescribed fire to greater than 60,000 acres in Missouri.**
- **However, the effects of management activities on fuels are poorly understood.**

Purpose

1. **Determine existing fuel loads.**

2. **Determine whether aspect has an effect on fuel loading in stands that received thinning, prescribed fire, or thinning and prescribed fire.**

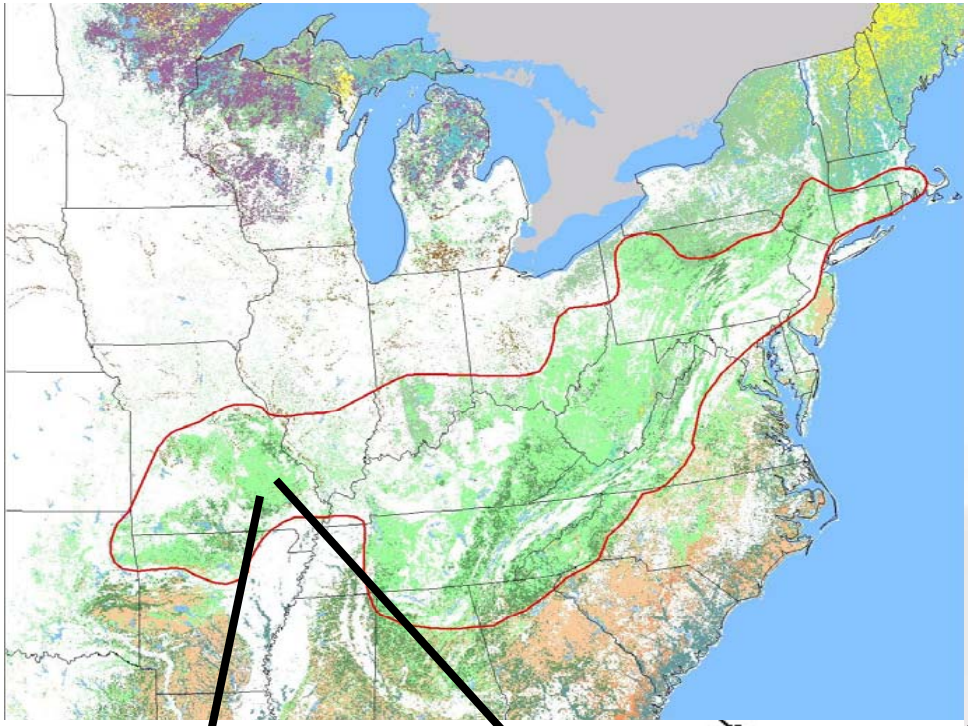
   - **Exposed Slopes: south/west aspects**
   - **Protected Slopes: north/east aspects**
   - **Ridge: no aspect**

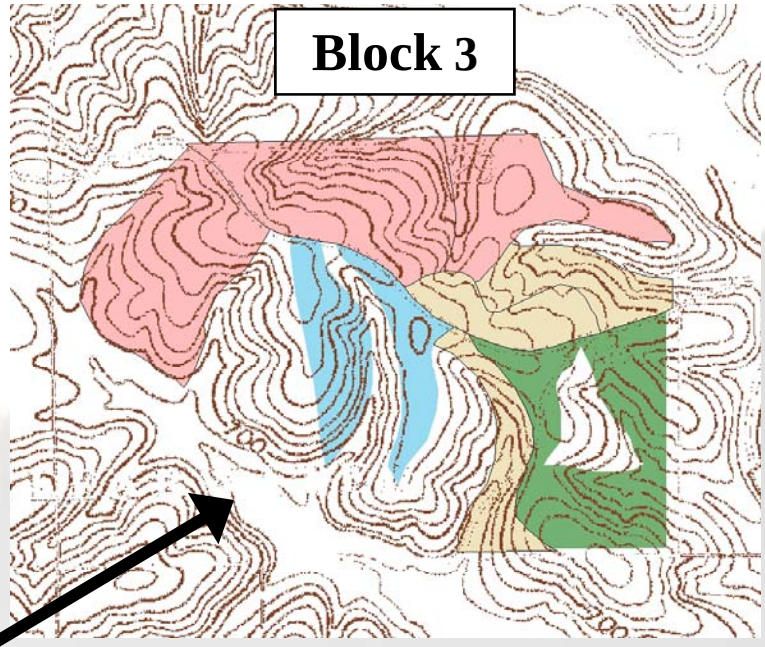
Study Area

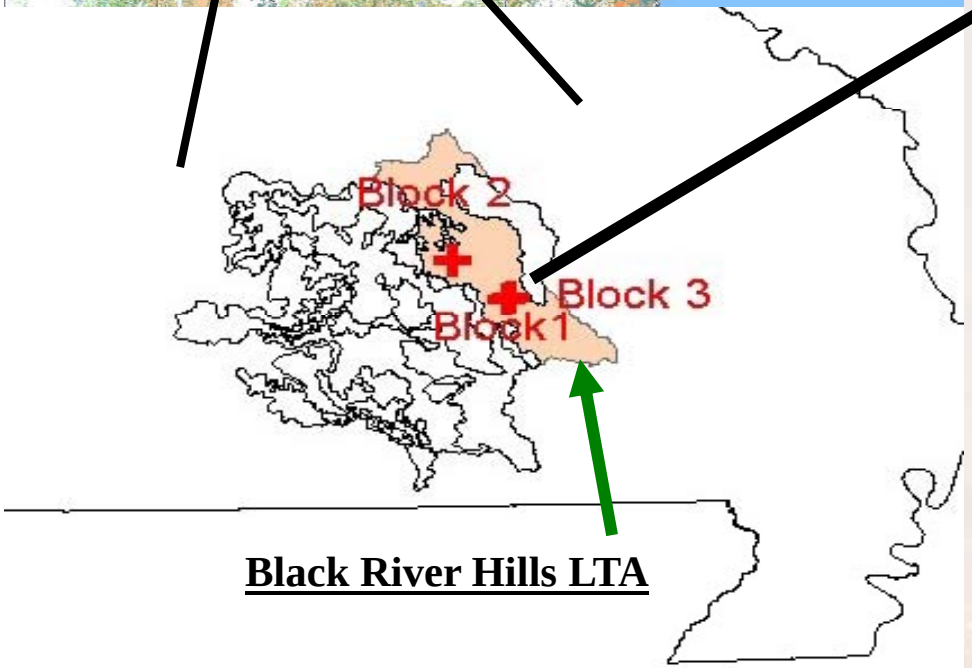
- **Located in the southeastern Missouri Ozarks on land managed by the Missouri Department of Conservation.**

- **Stands had no management or fire for 30 years.**

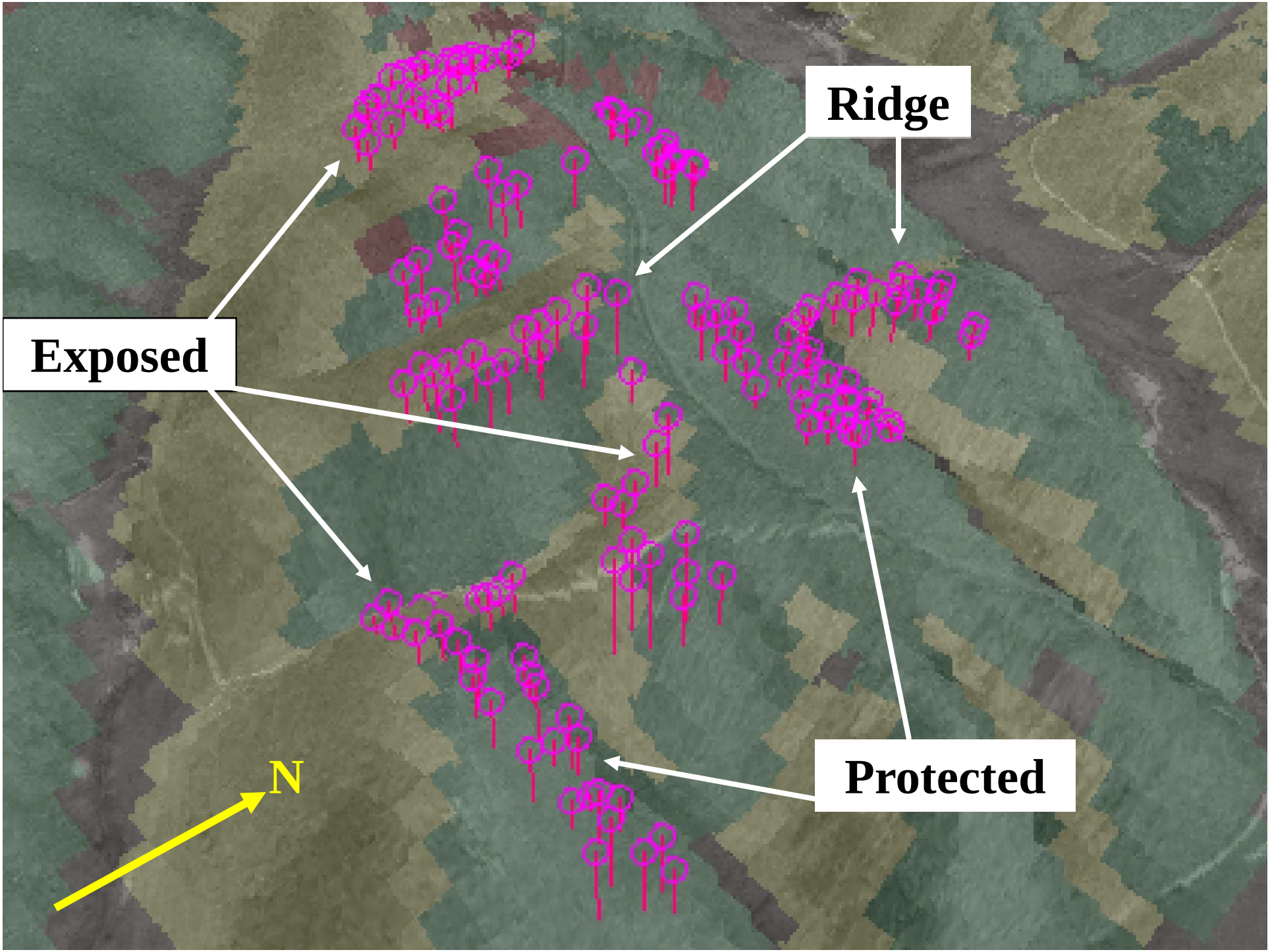
- **Stands were fully stocked oak-hickory and oak-pine forest types.**







Replicated across three complete blocks of twelve stands each (3 aspect classes X 4 treatments) making each stand an aspect/treatment unit.

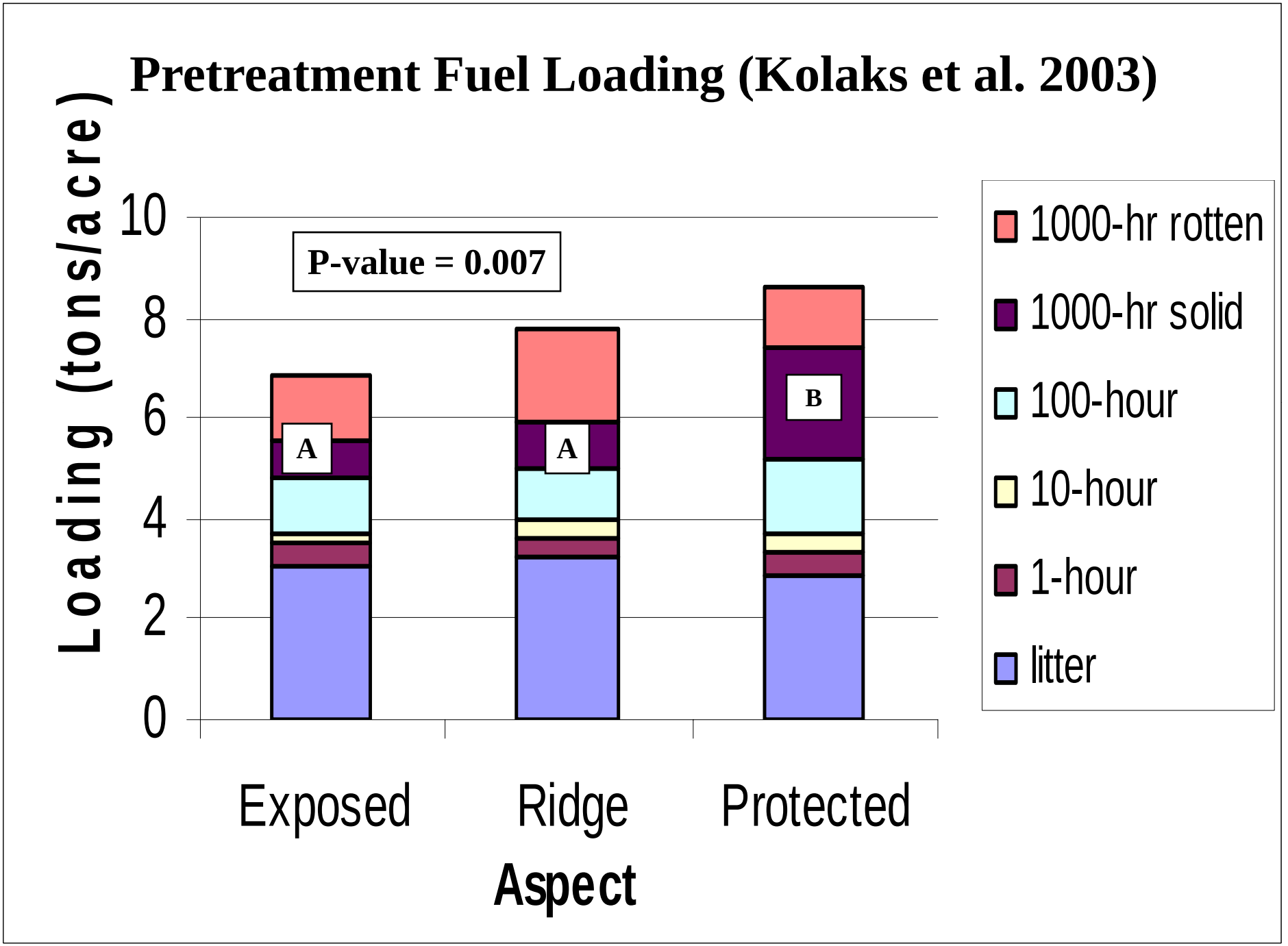

Ridge
Exposed
Protected
N

Data Collection

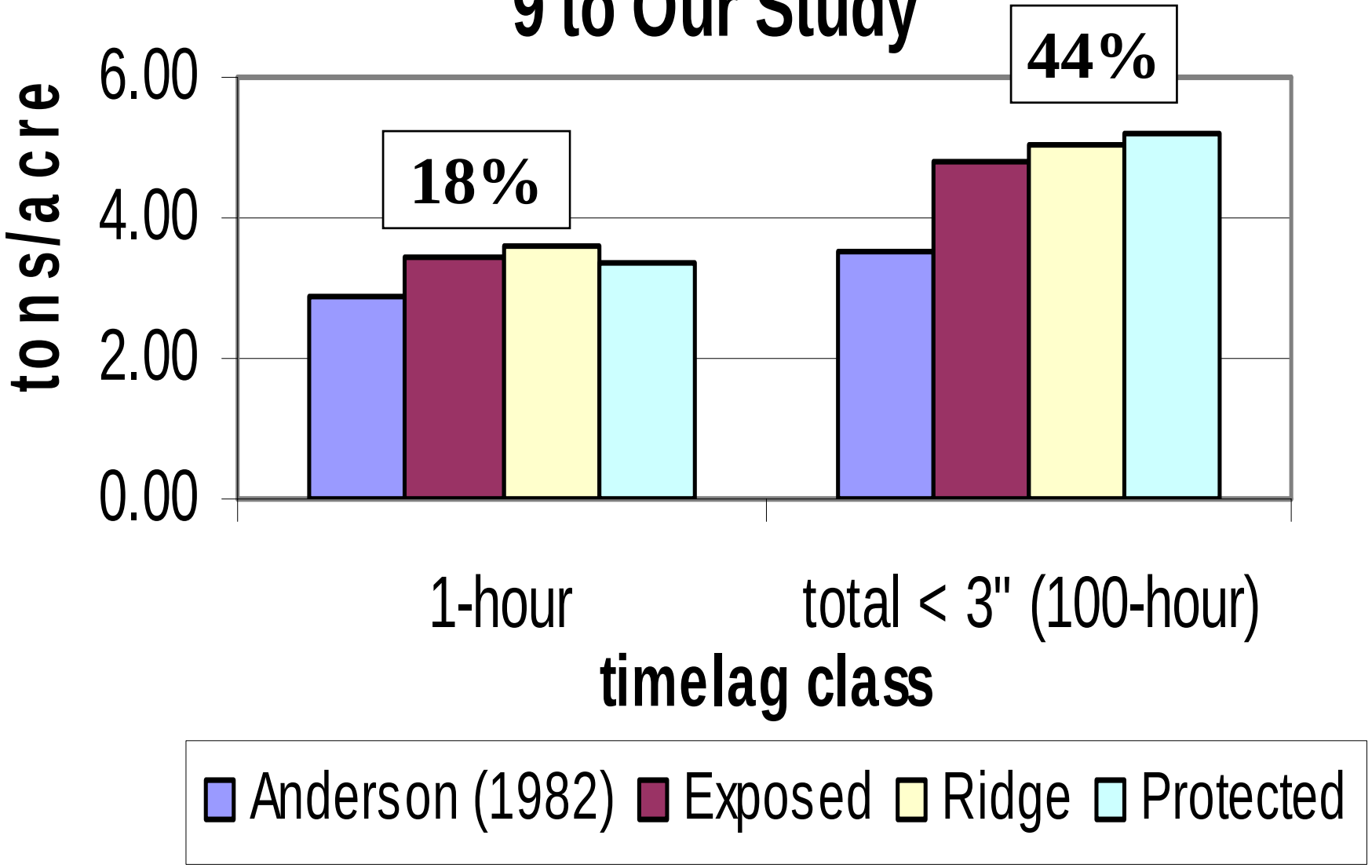
- **A modified transect intercept method was used to collect data from 15 randomly chosen points in each stand.**
- **Downed dead and woody fuel size classes: 1, 10, 100, 1000-hour solid, and 1000-hour rotten fuels.**
- **Litter collected from 2 ft^2 clip plots located at the end of each transect.**
- **Fuel height, litter depth, and duff depth were also measured.**

Timeline of Events

- **Pretreatment sampling: Winter 2002**
- **Commercial thinning: Summer and Fall 2002**
- **Post-thinning and pre-burn sampling: Winter 2003**
- **Prescribed burn: Spring 2003**
- **Post-burn sampling: Spring 2003**


Pretreatment Fuel Loading (Kolaks et al. 2003)
Loading (tons/acre)
10
8
6
4
2
0
P-value = 0.007
A
A
B
1000-hr rotten
1000-hr solid
100-hour
10-hour
1-hour
litter
Exposed
Ridge
Protected
Aspect

Compairison of Fire Behavior Fuel Model 9 to Our Study



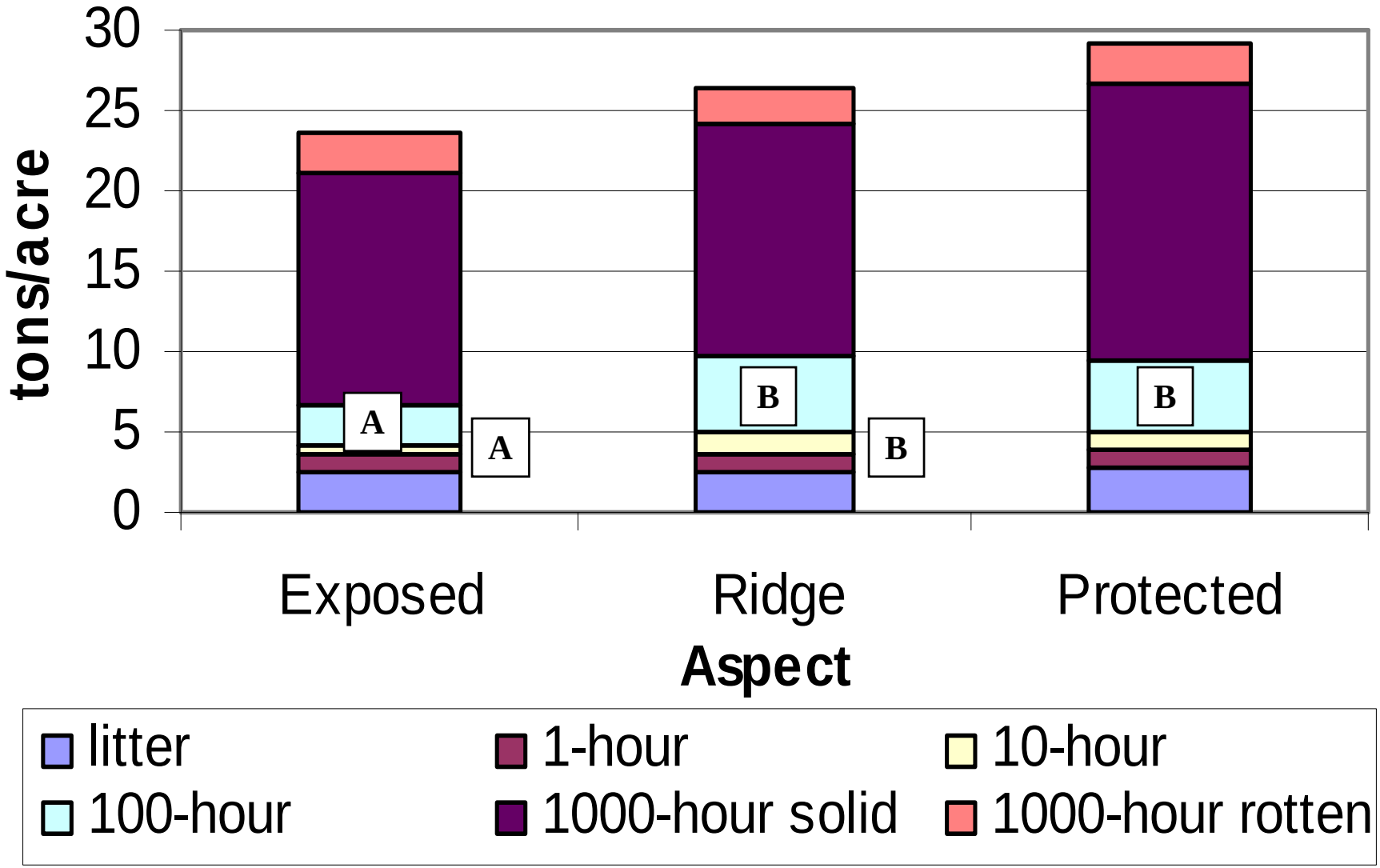
Conclusions (Kolaks et al. 2003)

- **Aspect does not significantly affect total fuel loading.**
- **Aspect significantly affected 1000-hour solid fuels under fully-stocked forested conditions in the Central Hardwoods of Missouri.**
- **Differences in fuel loading due to landscape position may be more prominent at smaller levels of ecological classification.**
- **With exception of 1000-hour solid fuels, a single fuel loading value may be reliably used to predict fire behavior on any slope.**

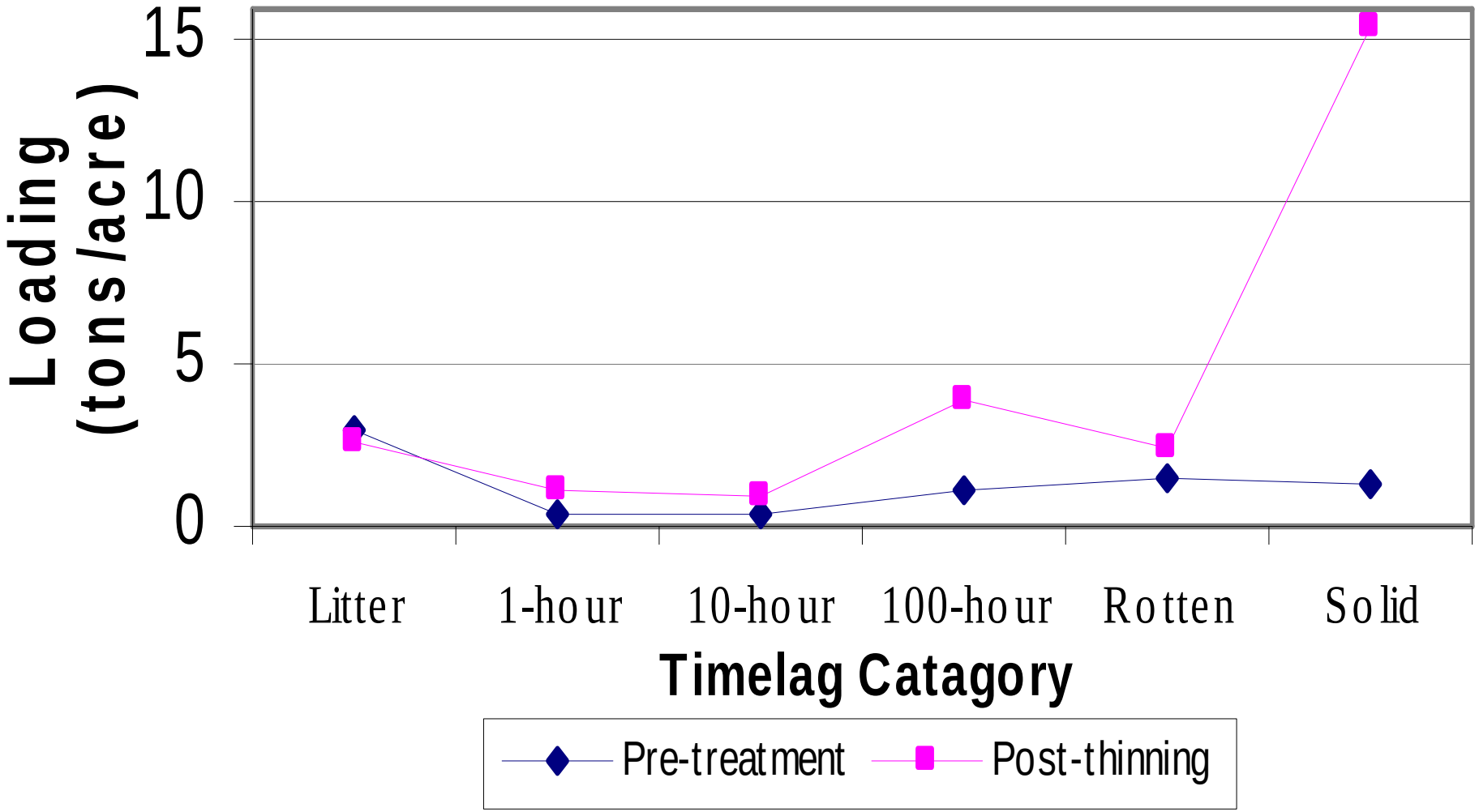
Thinning

- **Reduced stocking to 60%**
- **Preference was given to individuals having fire tolerance, good form, and canopy dominance.**
- **This stocking level is commonly used in intermediate cuttings, shelterwood systems, and savanna/woodland restoration (Johnson et al. 2002).**

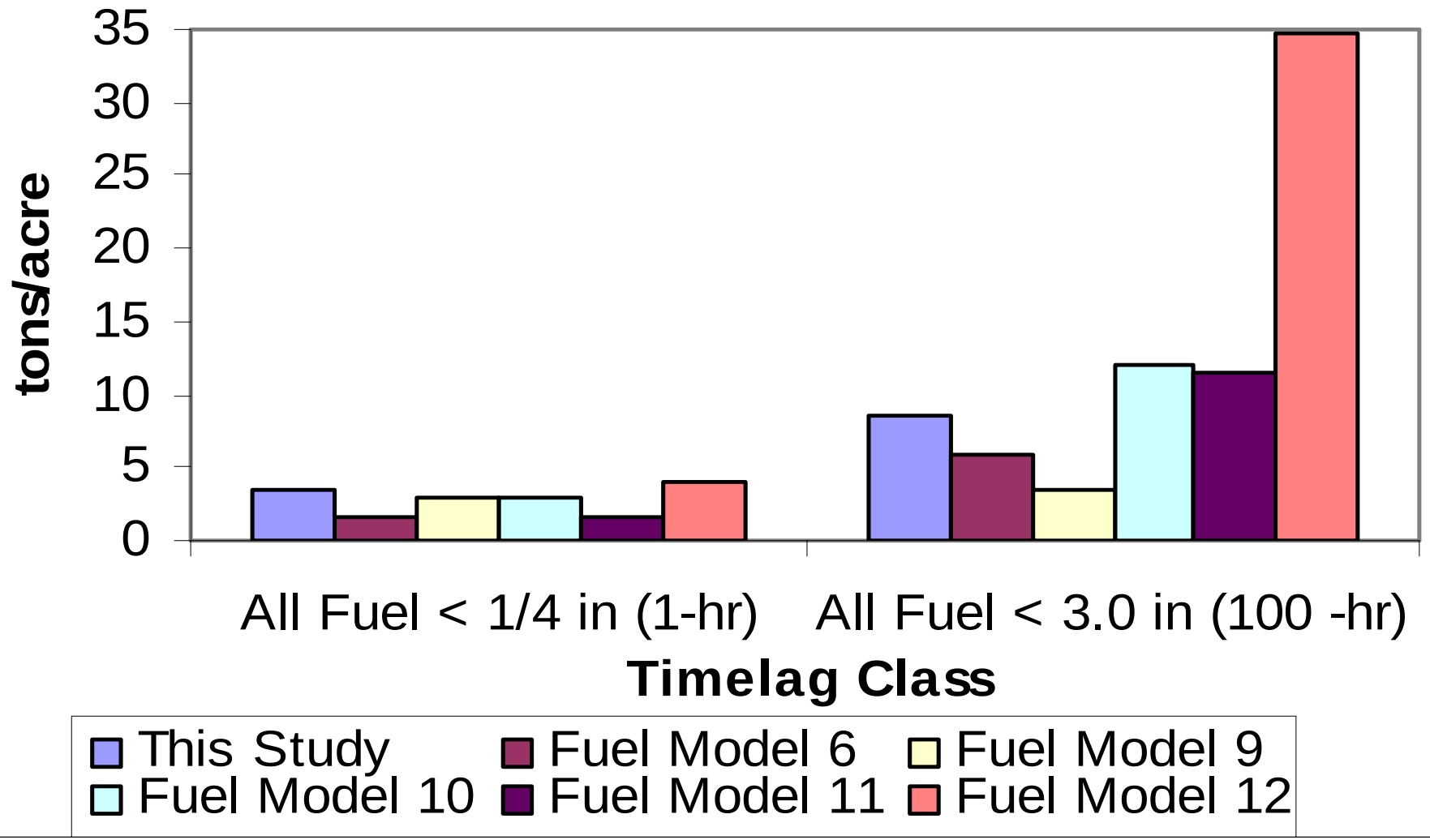
Post-Thin Fuel Loading



Pre vs. Post-thinning Average Fuel Loading



Comparison of Post-thin Fuel Loading and BEHAVE Fuel Models



Thinning Conclusions

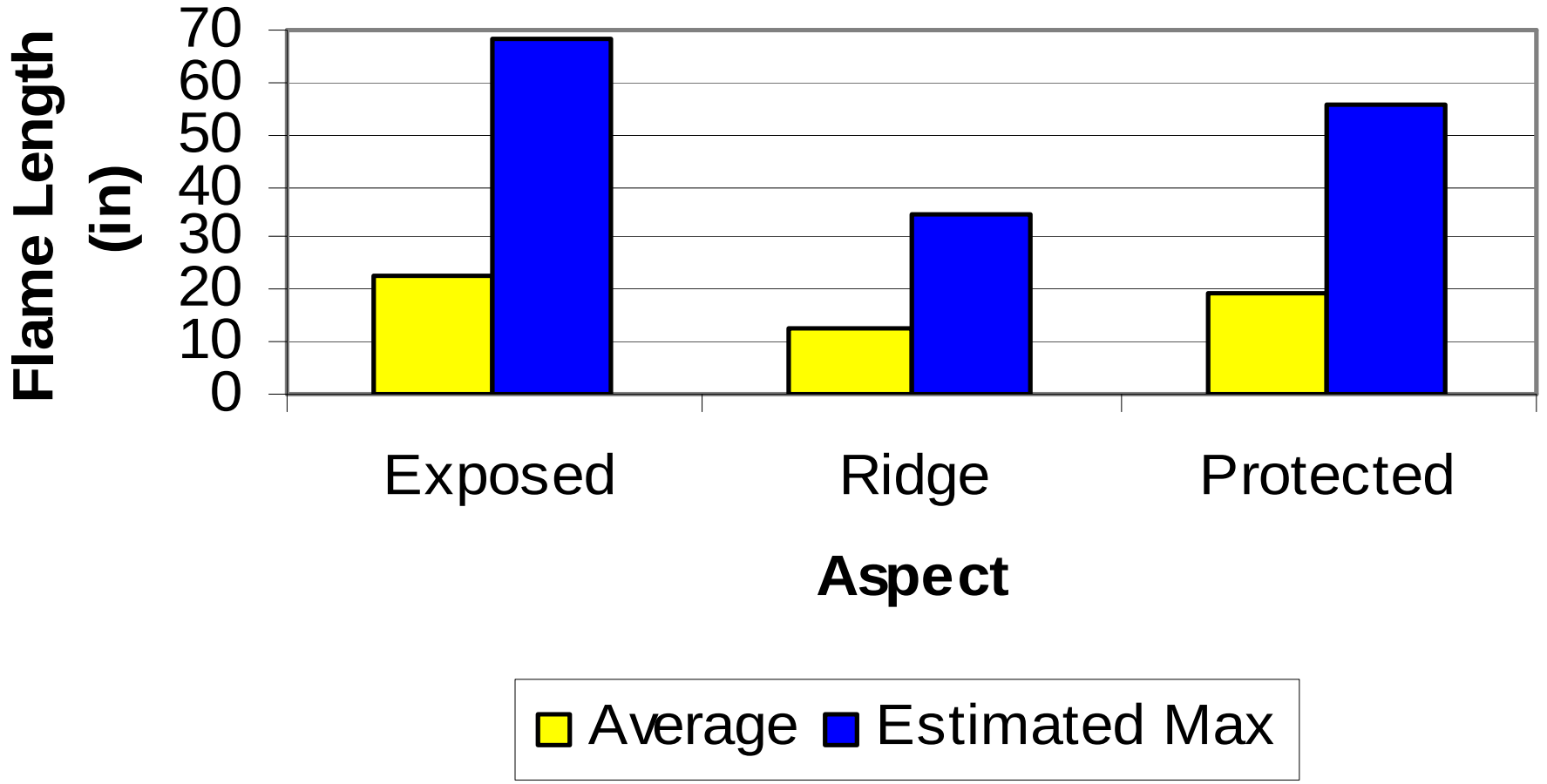
- **Thinning increased fuel loading by 300%; significantly altering 1, 10, 100-hour, and 1000-hour solid fuel loading while not affecting litter.**
- **In both thinned and unthinned stands there is a progression in fuel loading from exposed slopes, < ridge, < protected slopes.**
- **Significant changes in fuel loading due to position in the landscape could be more prevalent at smaller scales of ecological classification.**
- **Further research is also needed in developing constants for calculating fuel loadings in the Central Hardwood Region.**

Consumption

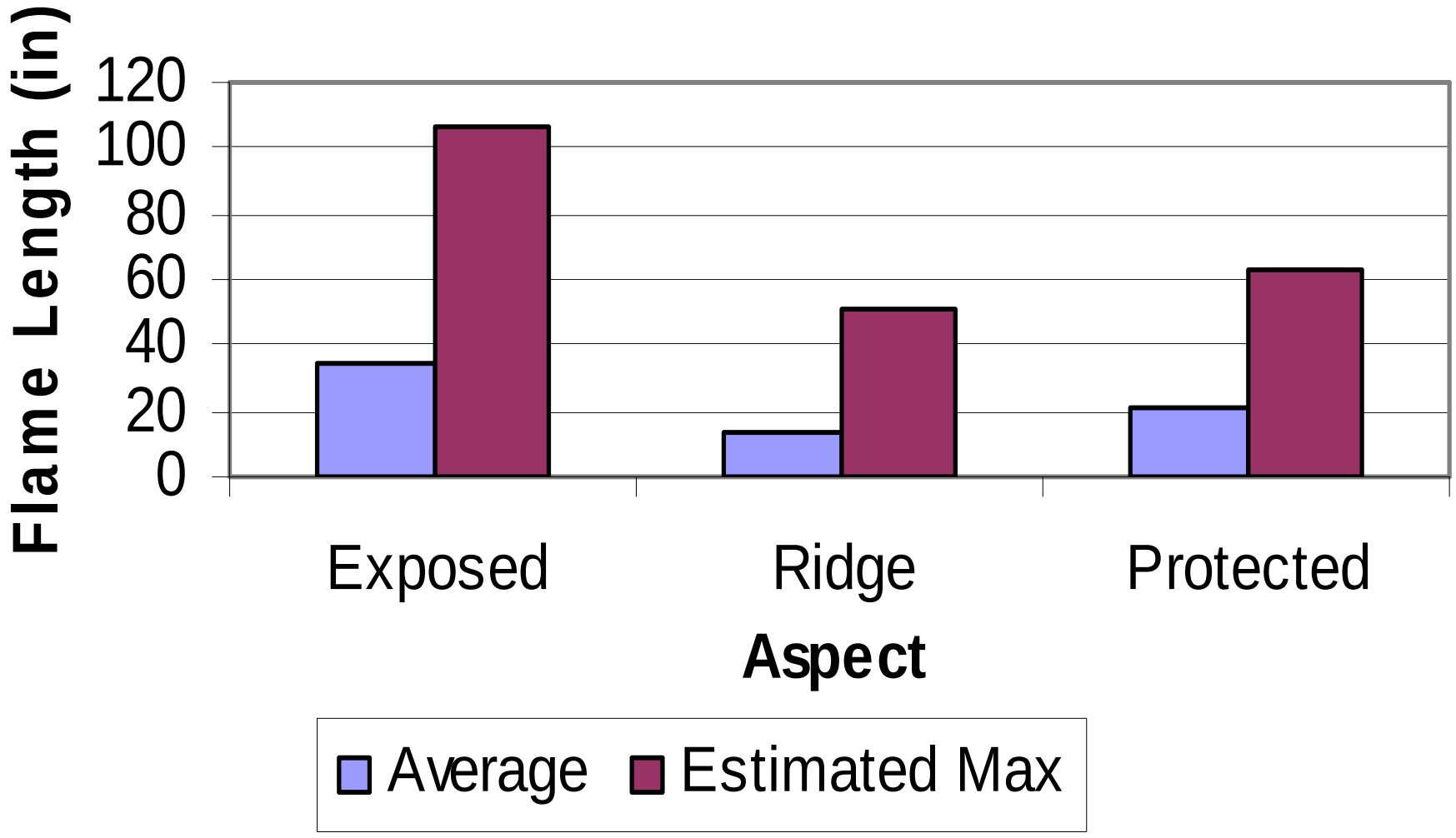
Weather and Fuel Moisture

Attribute	Perscription	Observed Average	Observed Range
Temp (F)	45-65	64	45-74
Mid Flame Wind (mph)	0-7	2.5	0-7.5
Rel. Humidity (%)	25-45	22.4	9-46
Fuel Moisture:			
1-hr.	5-10	5.4	
10-hr.	8-15	9.8	
100-hr.	12-18	13.7	
1000-hr.	> 20	17.6	

Average and Maximum Flame Lenght by Aspect in Unthinned Stands

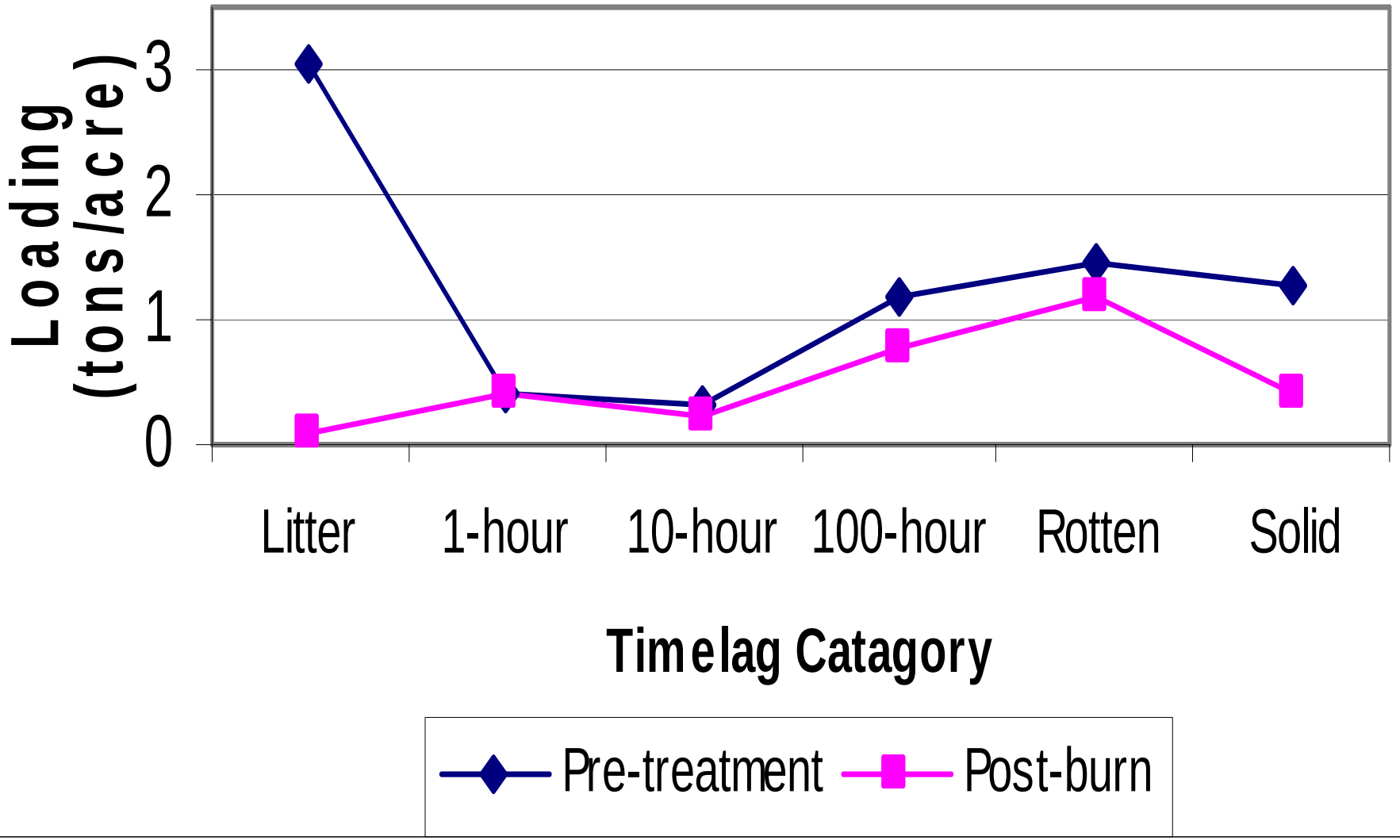


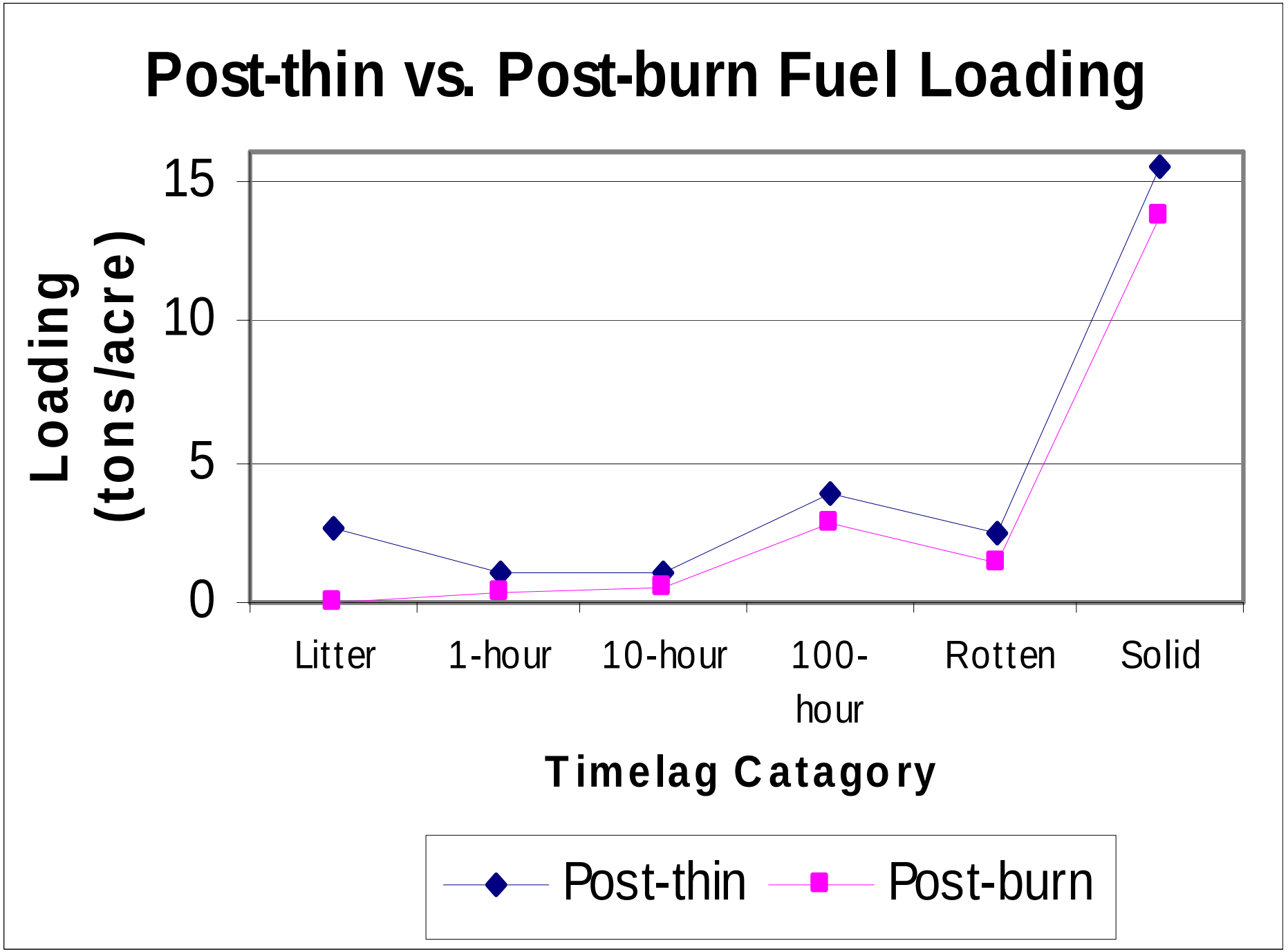
Average and Maximum Flame Length by Aspect in Thinned Stands



Flame lengths off of slash piles averaged 14 ft with maximums of 50 ft being not so uncommon.

Pre-treatment vs. Post-burn Average Fuel Loading (Unthinned)




Post-thin vs. Post-burn Fuel Loading
Loading (tons/acre)
15
10
5
0
Litter
1-hour
10-hour
100-hour
Rotten
Solid
Timelag Catagory
Post-thin
Post-burn

Duff Consumption

- **A layer of duff about ½ in thick remained after the burn on all aspects and in both treatments.**
- **This could possibly inhibit the establishment of pine seedlings from natural regeneration or direct seeding.**
- **Prescribed fire site prep for pine regeneration may require multiple applications.**

Burning Conclusions

- **Consumption during prescribed fires was not significantly affected by aspect despite increased fire behavior on the slopes.**

- **Post-burn aspect differences were almost identical to pre-burn differences found primarily in heavy fuels not significantly affected by burning.**

- **50% of litter will return in 2.5 years (Guyette 1999). With litter making up 50% or greater of all fuels < 3", prescribed burning will only temporarily reduce wildfire threat.**

In Review

- **Pretreatment: Fuel loading is greater than that assumed by BEHAVE an is affected by aspect in larger timelag classes.**
- **Thinning increases total fuel loading by 300% with aspect significantly affecting 10 and 100-hour fuel loading.**
- **Both pre and post-thin fuel loading exhibit a trend in increasing fuel loading from exposed < ridge < protected.**
- **Consumption does not vary by aspect and does not completely consume the duff layer.**

Thanks

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