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### Southern Pine Beetle: Biology, Identification, and Management



Forest Service John T. Nowak Forest Health Protection jnowak@fs.fed.us

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### Southern Pine Bark Beetle Activity: 2016



Legend  
• SPB  
• Ips  
National Forest

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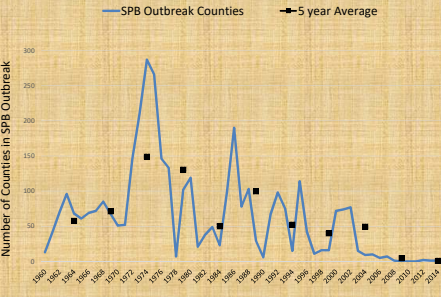
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### Prevention of Southern Pine Beetle



Number of Counties in SPB Outbreak

— SPB Outbreak Counties —■— 5 year Average

Year	Number of Counties in SPB Outbreak	5 year Average
1980	50	50
1982	100	100
1984	100	100
1986	80	80
1988	100	100
1990	100	100
1992	100	100
1994	280	150
1996	150	150
1998	100	100
2000	100	100
2002	100	100
2004	100	100
2006	100	100
2008	100	100
2010	100	100
2012	100	100

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### Field Identification

- How can I distinguish an SPB infestation from mortality associated with other bark beetles?

**Southern Pine Beetle**

- *Dendroctonus frontalis*



**Other pine bark beetles**

- "Ips" engraver beetles
  - *Ips avulsus*
  - *Ips grandicollis*
  - *Ips pini*
  - *Ips calligraphus*
- Turpentine Beetles
  - *Dendroctonus terebrans*
  - *Dendroctonus valens*

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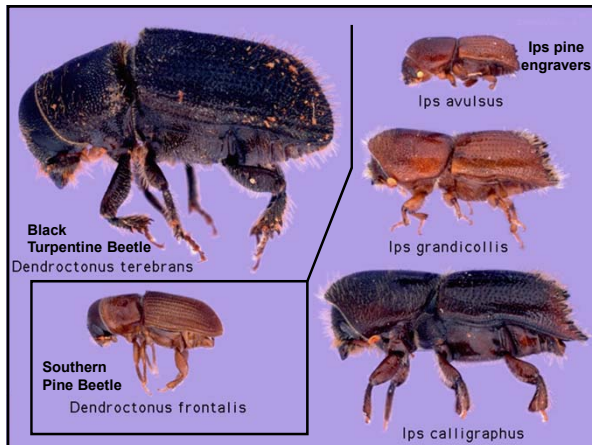
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**Black Turpentine Beetle**  
*Dendroctonus terebrans*

**Southern Pine Beetle**  
*Dendroctonus frontalis*

**Ips pine engravers**  
*Ips avulsus*

*Ips grandicollis*

*Ips calligraphus*

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### Field ID: Tree mortality patterns


**Southern Pine Beetle**

- Mortality progresses in rapidly expanding "spots"



**Other Pine bark beetles**

- Mortality often more limited, scattered, assoc. with stress



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### Field ID: SPB Tree mortality patterns



UGA0010127

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### Field ID: Pitch Tubes



**Southern Pine Beetle**

- Often located in bark crevices



**Other Pine bark beetles**

- *Ips* engravers: Often on flat face of bark plate
- Turpentine beetles: large, limited to lower trunk



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### Field ID: Galleries



**Southern Pine Beetle**

- Winding "S"-shaped galleries packed with frass



**Other Pine bark beetles**

- *Ips* engravers: H, Y, or I-shaped
- Turpentine: large, low



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### Control of SPB Infestations

- First confirm that the infestation is SPB and is “active”
  - forester assistance
- Decide on best control option for the given situation:
  - **Cut and Remove**
  - **Cut and Leave**
  - Cut, **Pile and Burn** (limited use)
  - Cut and **Spray** (limited use)



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### SPB Control: Cut & Remove

- Prompt removal of all infested trees, plus buffer of adjacent green trees
- Objectives: reduce beetle populations and halt spot expansion



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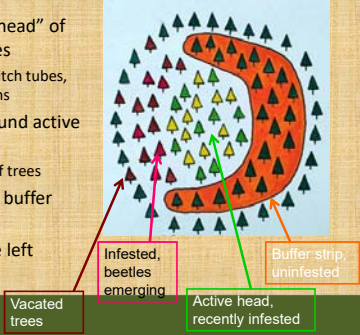
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### SPB Control: Cut and Remove

- Identify active spot “head” of recently-infested trees
  - fresh boring dust & pitch tubes, green or fading crowns
- Mark buffer strip around active head
  - Width ~ avg. height of trees
- Remove infested and buffer trees ASAP
- Vacated trees may be left standing



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### SPB Control: Cut and Remove



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Delineate final buffer strip at time of control to prevent spots from "breaking out"



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### SPB Control: Cut and Remove

- Advantages:
  - Reduces beetle population
  - Salvage harvest may provide revenue
  - Site cleared for regeneration practices
- Disadvantages
  - Requires access, entry of harvest equipment
  - Need buyer or other outlet for the wood
  - Timing



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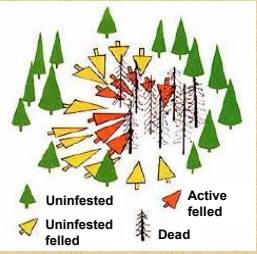
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### SPB Control: Cut and Leave

- Fell infested and buffer trees toward spot center and leave on ground
- Objectives: Disrupt pheromone biology and beetle attack behavior, halt spot expansion



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### SPB Control: Cut and Leave

- Advantages
  - Use when salvage or site access not feasible
  - Relatively inexpensive
  - Can be conducted promptly
- Disadvantages
  - No beetles removed
    - Recheck frequently
  - No revenue from felled trees
  - Not suitable for large spots (<100 trees)



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### SPB spot control priorities

- If possible, control all SPB spots with fresh attacks and/or trees with developing brood
- Otherwise, prioritize:
  - Spots with a high proportion of green/fading infested trees to red trees, and room to run
  - Spots threatening other property/resources
  - Spots threatening high value sawtimber
  - Spots threatening endangered species habitat
  - Otherwise prioritize based on accessibility, size, growth rate

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### Control of *Ips* and BTB?

- Often not implemented
- Usually recommend removal of invested trees on a limited basis (i.e. yard trees)
- Liquidate stand if losses too great
- Hope for rain

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### Sources of Landowner Assistance with SPB

- State-level Divisions of Forestry
  - County or District forester
- USDA Forest Service
  - Forest Health Protection (State and Private Forestry)
- Cooperative Extension Service
- Consulting foresters

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### Southern Pine Beetle Prevention Program

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### R8 SPB Prevention Program

#### History and Highlights

- At the request of Congress, the program started in 2003.
- This program is administered by Forest Health Protection and implemented by 12 National Forests and 13 southern states.
- Increasing forest resiliency through good forest management is a key feature of this plan. Treatments include forest thinning, prescribed fire and restoring native pine forests.
- Nearly 1.2 million acres (average \$91/acre) have been treated using program guidelines and more than 15,000 landowners and loggers have directly benefitted from state cost-share programs.

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- Appropriate species for site
- Fire is part of the equation
- Low stand density is preferable

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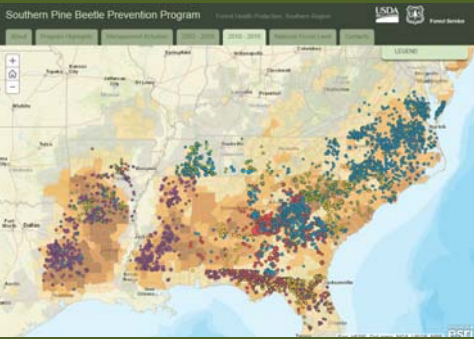
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Southern Pine Beetle Prevention Program



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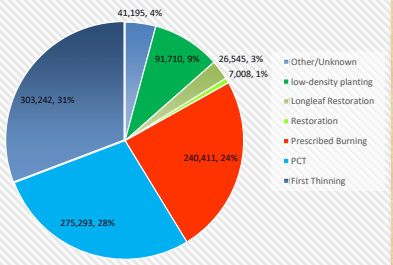
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SPB Prevention Accomplishments: Acres by Treatment Type



Treatment Type	Acres	Percentage
Other/Unknown	41,195	4%
low-density planting	91,710	9%
Longleaf Restoration	26,545	3%
Restoration	7,008	1%
Prescribed Burning	240,411	24%
PCT	275,293	28%
First Thinning	303,242	31%

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Are we certain that thinning prevents SPB?

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Nebeker (1980), Nebeker et al (1983) and Nebeker and Hodges (1983)

- Artificially introduced SPB into stands with different BA
- Followed spot expansion 4 months
- Infestations unlikely to develop with BA near 80 sq. ft.

The graph plots 'EXPECTED No. OF TREES KILLED' on the y-axis (0 to 25) against 'BA (ft<sup>2</sup>/acre)' on the x-axis (0 to 200). Two curves are shown: an upper curve representing a higher mortality rate and a lower curve representing a lower mortality rate. Both curves show an exponential increase in tree mortality as basal area increases.

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Nowak et al. 2015. Study on NF in MS  
BNF (p = 0.044) and HNF (p = 0.001)

**SPB spots (n=76)  
Bienville NF**

Legend: Unthinned (blue), Thinned (red)

**SPB spots (n=834)  
Homochitto NF**

Legend: Unthinned (blue), Thinned (red)

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## Why does thinning prevent SPB?

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Relationship between resin flow and SPB; Resin flow related to tree growth; thinning increases tree growth.



Hopkins (1899); Vite' (1961); Shopmeyer and Larson (1985); Brown et al. (1987); Nebeker/Hodges et al. (1992);

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## Tree Spacing: Gara and Coster 1968

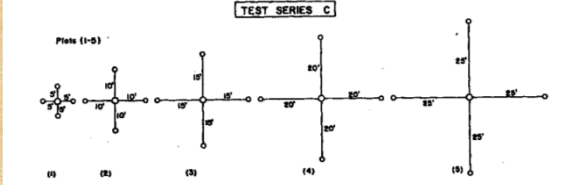


FIGURE 1. Design of field plots used to study the effects of tree spacing on the attack pattern of *D. frontalis* populations. Each plot consisted of four pine posts inserted in the ground at various distances in feet from a freshly infested center post.

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### Gara and Coster 1968 cont.

Days after Plot Established	Plot 1 (5' Radius)		Plot 2 (10' Radius)		Plot 3 (15' Radius)		Plot 4 (20' Radius)		Plot 5 (25' Radius)	
	Center	Outer	Center	Outer	Center	Outer	Center	Outer	Center	Outer
0	52	1	96	3	125	0	23	0	10	0
1	146	3	172	186	189	10	85	0	18	0
5	176	14	180	284	209	78	153	0	85	0
6	224	24	192	358	232	110	175	0	157	0
7	232	41	200	389	246	128	198	0	170	0
8	Terminated		Terminated		Terminated		200	0	178	0

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### Johnson and Coster 1978

Low to Moderate SPB Infestation Level

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### Johnson and Coster 1978

High SPB Infestation Level

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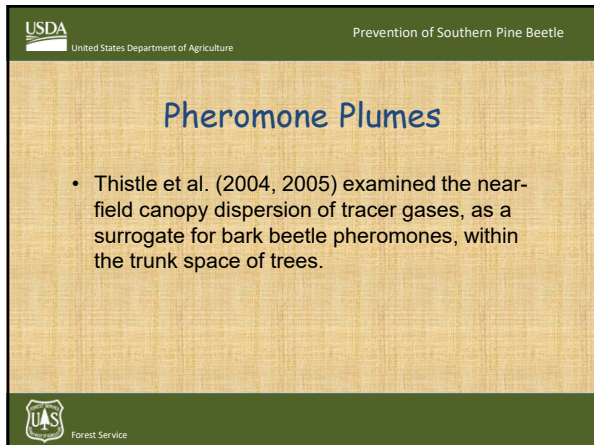
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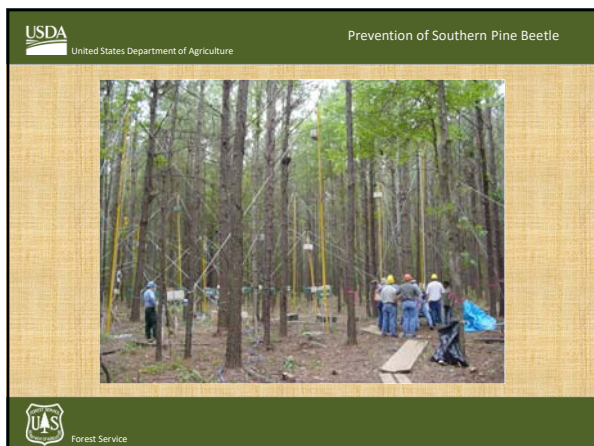
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Prevention of Southern Pine Beetle

BA 140



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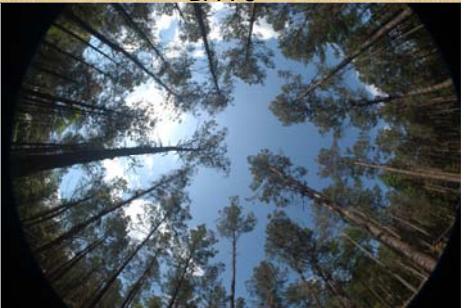
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BA 70



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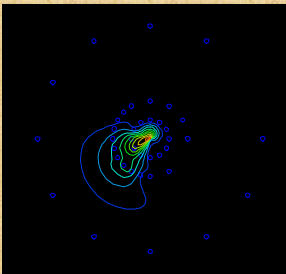
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Prevention of Southern Pine Beetle

### Experimental Design

- SF<sub>6</sub> tracer gas
  - Continuous release from plot center
  - Detectable down to 10 ppt
- Samplers
  - 50, 30 min. mean samplers @ 5, 10 & 30 m
  - 7 port, 5 min. mean sampler
  - high frequency sampler (1 Hz)
- Trials
  - 4.5 hrs each
  - 4 in unaltered stand
  - 3 at BA 140, understory removed
  - 3 at BA 100
  - 4 at BA 70



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### Conclusions

- Plumes in the thicker canopy exist in a low dispersion environment and remain more concentrated



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### Conclusions

- Thinning has a dramatic influence on ventilation, incident solar radiation and dispersive characteristics of the in-canopy environment making the plumes subject to higher velocity flows and more turbulence.



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### Thinning Recommendations

- Thinning will prevent SPB
- Thin by spacing
- Consider 20' distance between trees
- Create an open understory



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Does Prescribed Burning Prevent SPB?

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Prescribed Fire

- Can be used to reduce competing vegetation and stand basal area – reduce tree stress and change stand structure.
- Low intensity fire part of pine ecosystems.
- Caution needs to be used when used as part of bark beetle prevention.

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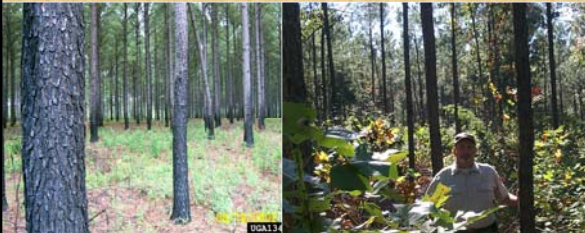
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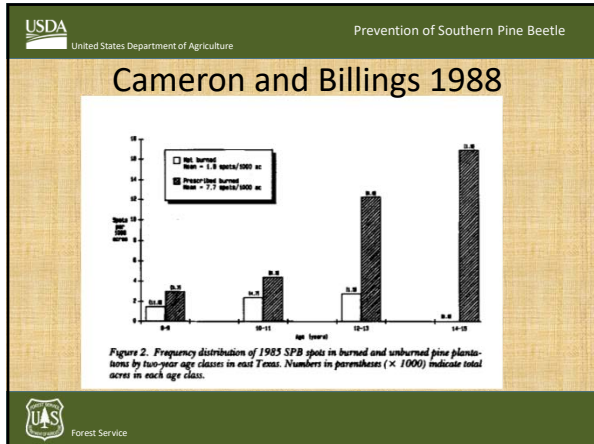
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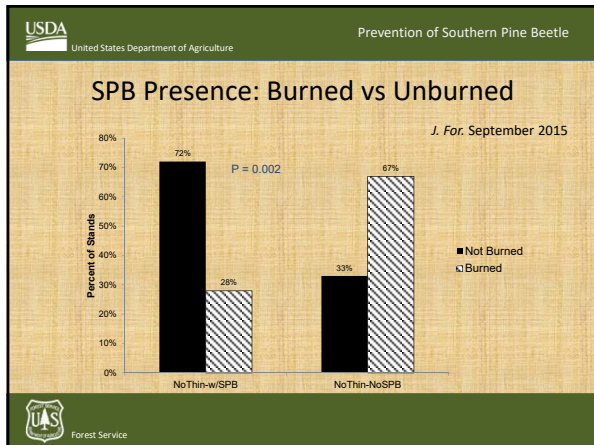
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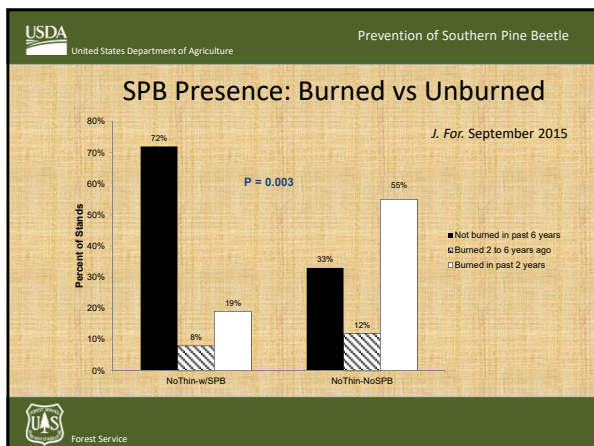
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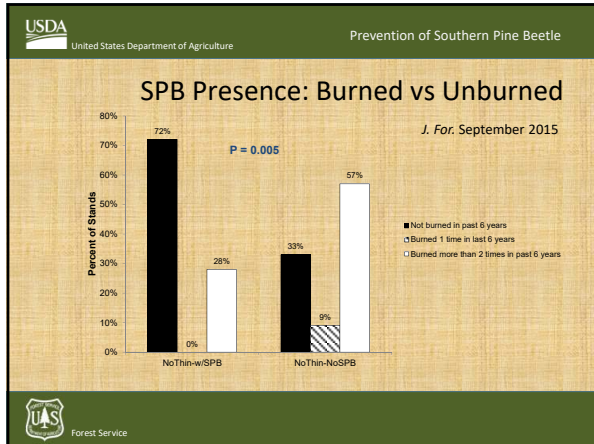
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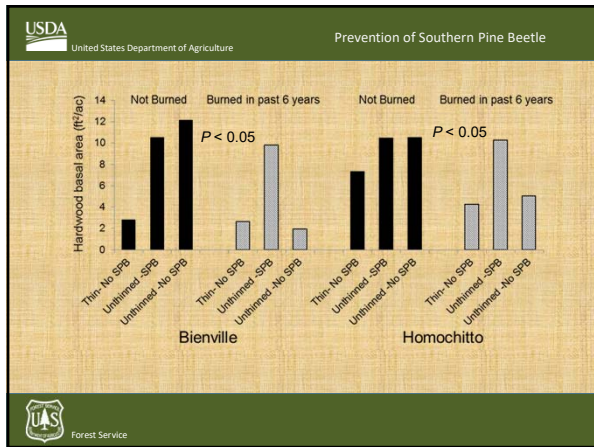
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## Should you thin or burn during an outbreak?

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### Anecdotal Case from MS



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### Negron et al. *In Press*

- Mountain pine beetle/Ponderosa pine
- All stands thinned within 2 years of MPB
- Significant MPB pressure
- Trees killed (trees/ac) Unthinned = 87.7; Thinned = 2.9;  $P < 0.0001$
- Trees did not likely have time to respond to thinning in resin production, etc.

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### Fire and Bark Beetles

- Several studies have shown a short-term increase in bark beetle (not SPB) activity following prescribed burning (Sullivan et al. 2003)
- Study in MS; thinning and burning down within 2 years of outbreak
- Have always recommended delaying thinning or burning during *Ips* activity

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Discussion to be continued....

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Thinning and SPB: 2016 Results

Homochitto NF: 2016	# of Stands With SPB (acres/# of spots)	# of Stands Without SPB (acres/# of spots)	Total # of Stands (acres/# of spots)
Unthinned Loblolly Stands <45 yrs. old	135 (6,750/264)	949 (37,237/0)	1,084 (43,987/264)
Thinned Loblolly Stands <45 yrs. old	3 (138/3)	225 (9,061/0)	228 (9,199/3)
Total Loblolly Stands <45 yrs. old	138 (6,888/267)	1,174 (46,298/0)	1,312 (53,186/267)

Fisher's exact test:  
The two-tailed P value is < 0.0001  
The association between rows (groups) and columns (outcomes) is considered to be extremely statistically significant.

Evaluation of SPB Activity

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Homochitto NF: Loblolly Pine > 45 yrs. old

- 1,340 stands (50% of all loblolly stands)
- 66,593 acres (56% of all loblolly acreage)
- 21 SPB spots in 2016 (7% of all spots in loblolly)

Homochitto NF: Loblolly Pine < 45 yrs. old

- 1,310 stands (50% of all loblolly stands)
- 53,186 acres (44% of all loblolly acreage)
- 267 SPB spots in 2016 (93% of all spots in loblolly and 74% of all spots on the Forest)

Evaluation of SPB Activity

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