

Southern pine beetle infestations with respect to pine species in Chickasawhay Ranger District, DeSoto National Forest, 2004.

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Introduction

As part of our studies of the relative susceptibility of different pine species to the southern pine beetle (SPB), we analyzed the patterns during 2004 of SPB infestations in the Chickasawhay Ranger District with respect to pine species. The Chickasawhay contains significant components of three native species of southern pines, loblolly pine (*Pinus taeda*), slash pine (*P. echinata*), and longleaf pine (*P. palustris*). Based on the USFS GIS database, the Chickasawhay contains 601 stands of loblolly pine (115 km²), 737 stands of slash pine (156 km²), and 1043 stands of longleaf pine (156 km²). These were mainly classified as approximately pure stands (forest types = 31, 22, and 21, respectively) but also included 120 stands of loblolly/hardwoods (forest type = 13) and 11 stands of slash/hardwood (forest type = 14). The age distributions of the three pine species were similar (Fig. 1, left), although slash pine included relatively fewer stands less than 10 years old, and longleaf pine included relatively fewer stands that were 30-40 years old. All three species contained > 150 stands that were in the 60 year age class or above. The distribution of stand sizes was also quite similar across pine species, with a median size of about 15-16 ha, a mean size of 19-22 ha, and a maximum size of about 100 ha (Fig. 1, right).

Results

Based on the SPBIS records for 2004, there were 88 discrete local infestations ("spots"), that had killed at least 9800 trees through the last recorded observations in fall of 2004 (Table 1). Of these spots, the majority were in slash pine (54), followed by loblolly (21), and longleaf (13). This corresponds to 27 spots / 100 km² of slash pine, 14 spots / 100 km² of loblolly pine, and 4 spots / 100 km² of longleaf pine (Table 1, Fig. 2; area occupied by each species excludes stands < 15 years of age because of their generally low susceptibility to SPB). Chi-square analyses indicated highly significant differences among the three pine species in the frequency of SPB spots relative to the total area occupied by each pine species or the number of stands of each pine species (chi-square = > 43, df = 2, P < 0.0005; Table 2). The higher occurrence of SPB spots in slash pine compared to loblolly was also statistically significant (chi-square > 6, df = 1, P < 0.02).

Slash pine and loblolly appeared to differ in the occurrence of SPB spots with respect to stand age (Table 3, Fig. 3). Within slash pine, SPB spots were highly concentrated in stands of about 30 years or younger, with >15% of stands in the 20-year age class being infested. In contrast, infestations of loblolly pine were relatively constant across age classes, though with a tendency for reduced numbers of infestations in the oldest stands. In longleaf pine, the highest frequency of SPB spots was within stands of about 40 years in age, but this may not be meaningful because there were few spots within longleaf stands and few longleaf stands of this age.

Discussion

The relatively low frequency of SPB spots within longleaf pine in the Chickasawhay is consistent with our analyses of SPB epidemics in the Kisatchie National Forest in Louisiana and the Oakmulgee Ranger District of the Talladega National Forest in Alabama (Whited et al., in preparation). There, spots / 100 km² of loblolly forest were 2-10x higher than in longleaf forest, compared to 3.5x higher here. Although

this pattern has not been previously quantified in the scientific literature, it has long been recognized by foresters (Wahlenberg 1946). The usual explanation for this pattern has been that longleaf pine has more effective resin defenses than loblolly pine. Our comparisons of resin flow in these pine species have failed to support this hypothesis. Furthermore, limited data from the Oakmulgee RD indicated that SPB reproductive success was as good in longleaf pine as in loblolly pine, and that longleaf pine were just as certain to die when attacked. We are presently conducting tests of alternative hypotheses that might explain the “resistance” of longleaf pine to SPB. One possibility is that spots are less likely to form in longleaf stands because beetles are less likely to disperse into, or aggregate within, longleaf stands. We solicit any other suggestions that might explain the low frequency of SPB spots in longleaf stands.

The high occurrence of SPB spots within slash pine was a surprise to us. We know of no previous attempts to quantify the susceptibility across a landscape of slash pine vs. other southern pines. The conventional wisdom seems to have been that slash pine is quite resistant to SPB, similar to longleaf pine. In fact, it contained twice as many spots / 100 km² as loblolly stands. More studies in other forests and other years are needed to determine if this pattern is as general as the low susceptibility of longleaf relative to loblolly. Our observations during 2004 seemed to indicate quite high levels of mortality in attacking adult beetles within slash pine - apparently as a result of the copious resin flow. However, the three spots that we studied in detail all grew throughout the summer, and one of them grew very rapidly (average of 1 new tree attacked per day from 23 July to 3 September; see visualization of attack progression at <http://www.dartmouth.edu/~mpayres/pubs/Chick04/AnimateSpots.htm>). So it seemed that beetle reproduction in slash pine was quite good in spite of the mortality of attacking adults. Beetle population growth during 2004 in the Chickasawhay was undoubtedly increased by very low abundances of the predator, *Thanasimus dubius*. On our sticky traps in active spots within the Chickasawhay during 2004, we captured an average of only 1 *T. dubius* / 60 SPB, compared to 1 *T. dubius* / 10 SPB during two summers using the same protocol in the Oakmulgee RD. We solicit any hypotheses that might explain why SPB spots occurred in slash pine more often than loblolly pine. During 2005, if there are continuing infestations in the Chickasawhay, we hope to quantitatively compare the reproductive success of SPB in slash pine vs. loblolly vs. longleaf. We cannot assume that host preference is correlated with reproductive performance. In the Bankhead National Forest, SPB attacked Virginia pine in preference to loblolly pine, even though it was a less suitable host for reproduction (Veysey et al. 2002, Ylioja et al., in review).

References cited

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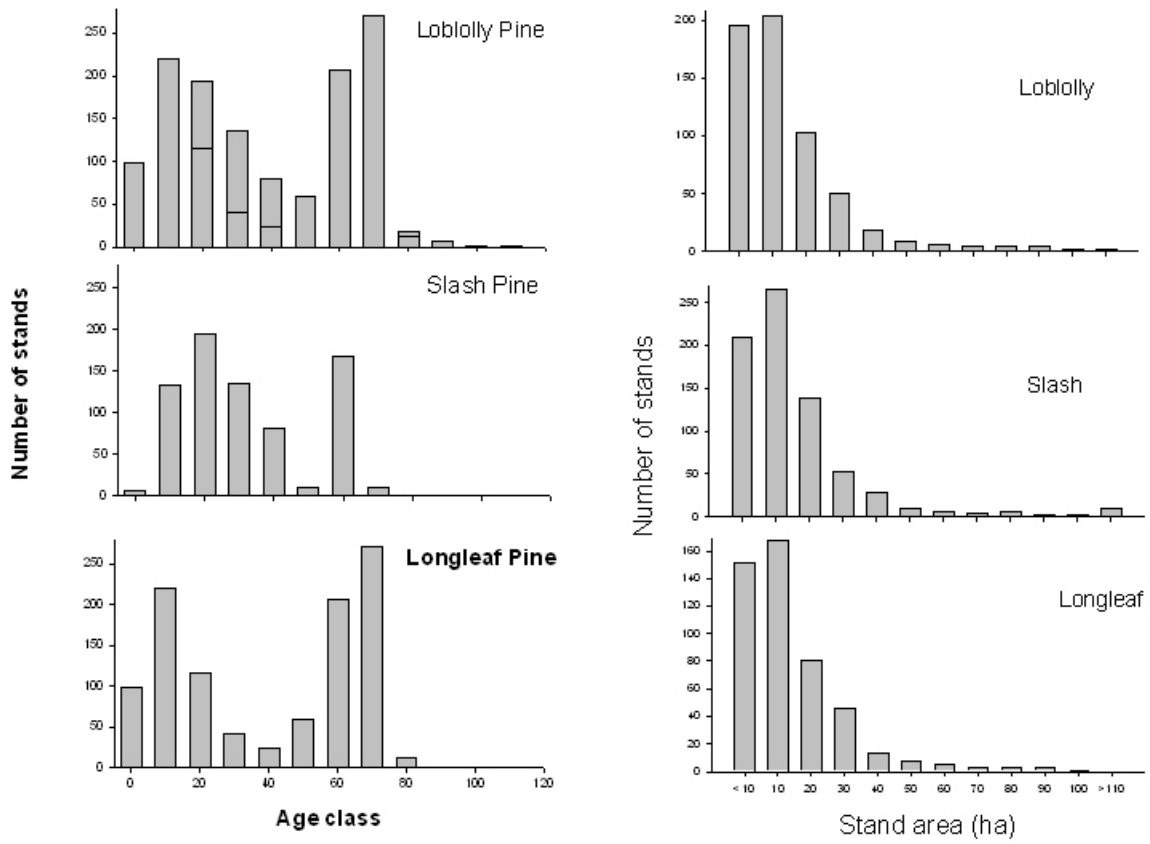


Figure 1. Frequency distributions of stand age (left) and stand area (right) of loblolly, slash, and Longleaf pine in the Chickasawhay Ranger District.

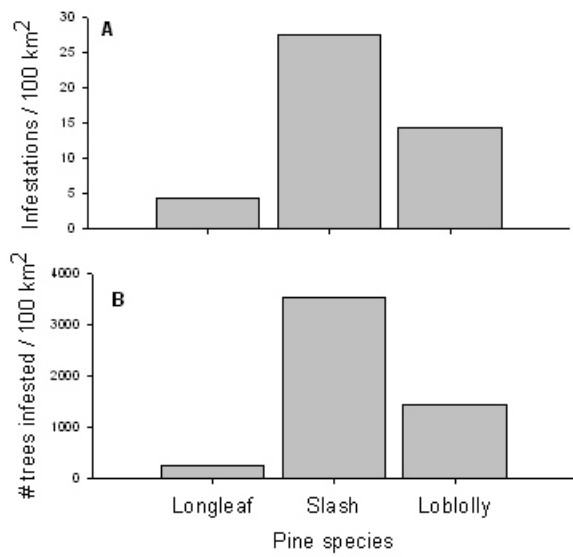


Figure 2. Comparison of pine species with respect to number of infestations per 100 km² (A) and SPBIS estimates of number of trees killed / km² (B).

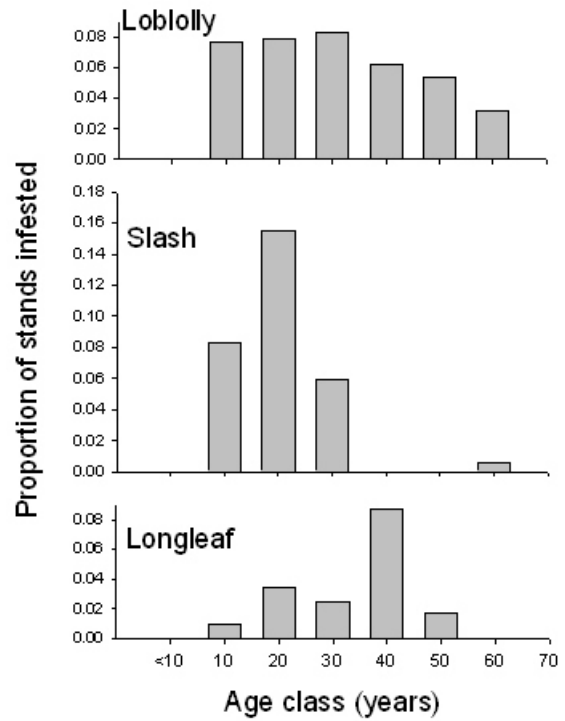


Figure 3. Proportion of stands with infestations of *D. frontalis* in each forest type in the Chickasawhay Ranger District, Summer 2004.

Table 1. Comparison of three pine species in Chickasawhay Ranger district with respect to area with stands >15 years of age, number of southern pine beetle spots, and number of infested trees (based on SPBIS records for 2004).

Tree Species	km ²	Total spots	Spots / 100 km ²	Total infested trees	Infested trees / 100km ²
Longleaf	299	13	4.4	758	254
Slash	197	54	27.4	6971	3536
Loblolly	146	21	14.4	2071	1419

Table 2. Chi-square tests for differences among pine species in the relative frequency of southern pine beetle spots. The null hypotheses of no differences among pine species (upper row) and no differences between loblolly and slash pine (lower row) were both rejected whether the expected values were based upon total area occupied by each species or total number of stands of each species.

Null hypothesis	Based on km ² of area		Based on number of stands	
	X ²	df, p	X ²	df, p
No difference among three pine species	46.04	2, <0.0005	43.29	2, <0.0005
No difference between slash and loblolly pine	6.48	1, 0.015	8.68	1, <0.005

Table 3. Comparison of pine species with respect to the age classes of stands that were infested by southern pine beetle during 2004.

Age class	Total number of stands			Percent of stands infested		
	Loblolly	Slash	Longleaf	Loblolly	Slash	Longleaf
<10	10	6	98	0	0	0
10	91	132	219	7.7	8.3	0.9
20	38	194	115	7.9	15.5	3.5
30	12	135	41	8.3	5.9	2.4
40	48	80	23	6.3	0	8.7
50	56	10	59	5.4	0	1.7
60	188	168	206	3.2	0.6	0
70	133	10	270	0	0	0
80	18	1	12	0	0	0
90	6	0	0	0	0	0
100	0	1	0	0	0	0
110	1	0	0	0	0	0