Decline was observed in 4 percent of the area in the 0- to 10-year age class (grouped with other young stands in fig. 4). Trees of this age are not affected by oak decline, but stands in this age class often contain some large trees remaining from the previous mature stand. Decline symptoms presumably occurred in the scattered old individuals left after an earlier harvest. This condition was confirmed by comparing initial (1977) total volume and initial (1977) basal area for the youngest age classes. For affected areas, initial volume per acre and initial basal area per acre in the 0- to 10-year age class were 431 cubic feet and 52 square feet, respectively. In the 11- to 20-year age class, both total volume and basal area per acre were lower (106 cubic feet and 20 square feet), reflecting the loss of large residual overstory trees.

Old stands carried the highest risk for annual oak mortality, but the connection between increasing age and increasing risk did not appear to be as strong as it was for vulnerability (table 7). Volume losses were unexpectedly high in the < 40-year age class (again due to mortality of scattered old residuals), but they were also higher for the 51- to 60-year age class than for either the 61- to 70-year or the 71- to 80-year classes. Chronological age may not accurately reflect the physiological condition of trees that are prone to decline (Manion 1981).

Site Index/Age—Hyink and Zedaker (1987) characterized senescence as the result of changes in the efficiencies of water transport and translocation, hormone balances, and the balance between photosynthesis and respiration. They described physiological age as the progression toward critical levels of these relationships. They detailed the limitations of chronological age for characterizing senescence and suggested that a measure of physiological age would be of greater biological significance than chronological age. We created an index of physiological age by dividing SI (an indirect measure of moisture availability and stress in southern upland hardwood stands) by chronological age. Thus, 50-year-old oaks growing on poor SI 50 land (SI/age = 1.0) would be more mature physiologically than 80-year-old oaks growing on productive SI 90 land (SI/age = 1.1), despite having a lower chronological age.

The distributions of acres by SI/age classes were very different for affected and unaffected areas (fig. 5). Unaffected areas were nearly equally partitioned among the four classes, whereas affected areas were much more likely to have relatively low ratios. Nearly 60 percent of the affected acres had a ratio less than 1.0, and 84 percent had ratios less than 1.4.

Low SI/age ratios were associated not only with high vulnerability but also with high risk of mortality. Where ratios were < 1.4, annual oak mortality volume was much higher in affected than in unaffected areas (table 8). However, the greatest difference in oak mortality volume between affected and unaffected areas occurred where ratios were 1.4 – 2.0. For that SI/age class, mortality volume was 3.5 times greater in affected than in unaffected areas.

There was evidence that the low incidence of decline in the high-ratio classes was due more to young age than to high SI. Initial basal area and volume were lower for areas with ratios > 2.0 than for areas with lower ratios, especially in unaffected areas. If high site quality was the predominant influence, somewhat higher initial volumes would have been expected (see table 6).

Physiography—As expected, dry sites had higher incidence and vulnerability than did more moist sites (table 9). Forty-four percent of all decline-affected acres were classed as xeric, though these areas comprised only 30 percent of the area. Mesic landforms had about half the incidence rate of xeric sites. Mesic sites include moist mountaintops and slopes (usually coves with north-to-east aspects and relatively deep, fertile soils), floodplains, natural stream levees, and valley bottoms.

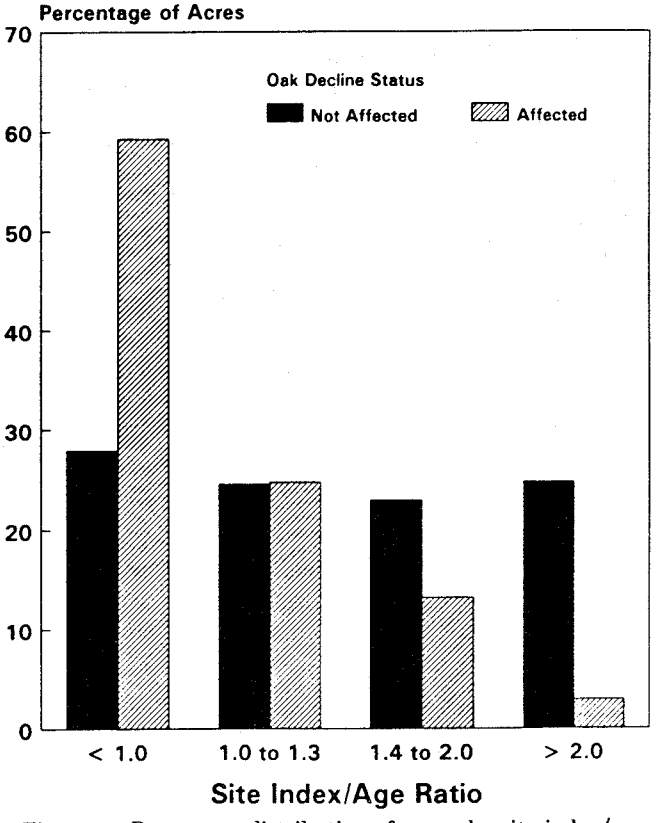

Figure 5—Percentage distribution of acres, by site index/age ratio, for oak decline-affected and-unaffected areas in the Mountain and Northern Piedmont Survey Units of Virginia, 1986.