Methods

FIA crews routinely collect damage data on live trees and determine cause of mortality for dead trees. The standard FIA damage code that correlates closest with oak decline is dieback when it occurs in dominant and codominant oak (USDA Forest Service 1985). Pest management specialists provided supplemental training to field crews to ensure proper and consistent diagnosis. Normal damage coding procedures were followed, and dieback was not given priority over other concurrent damages. Determining the primary cause of mortality was often difficult in trees that had other damage in addition to dieback. If trees surrounding a dead oak displayed decline symptoms, the mortality was coded as dieback-associated.

The geographic scope of this analysis was limited to the Northern Mountain, Southern Mountain, and Northern Piedmont Survey Units. Although a complete statewide evaluation would have been desirable, the remaining Coastal Plain and Southern Piedmont Survey Units were omitted because they were surveyed during the dormant season, when identification of dieback is putatively less reliable. Nevertheless, most of Virginia's hardwood forest is found in the study area. Sixty percent of the State's merchantable hardwood volume grows there. Softwood volume comprises only one-sixth of the total inventory in the study area, compared with one-half of the total in the Southern Piedmont and Coastal Plain Units (Bechtold and others 1987).

After data collection, plots with forest types dominated by oaks were segregated from the overall data base. The type groups of interest were oak–hickory and oak–pine. The specific types included white oak–red oak–hickory, chestnut oak, yellow-poplar–white oak–northern red oak, shortleaf pine–oak, Virginia pine–southern red oak, white pine–northern red oak–white ash, and mixed hardwoods. Forest types dominated by pines and northern hardwoods, such as white pine, shortleaf pine, and maple–beech–birch, may also contain oaks subject to decline. These types were excluded from the analyses because of their relatively small proportions of oak. From the designated types, plots with damage and mortality codes attributable to oak decline were isolated. Decline symptoms were found on 273 plots. Symptoms ranged from very light (one oak on the plot with dieback) to very severe (high incidence of mortality and advanced crown decline). Decline incidence was used to determine distribution, while the volume loss associated with oak mortality was used to assess relative severity. Since subjective evaluation of dieback was considered the greatest potential source of error, Forest Pest Management specialists field-checked 10 percent of the plots with decline taken by each field crew. This field check revealed that the crews were proficient in identifying decline areas; 92 percent of the plots diagnosed as decline-affected were correctly classified.

Results

Estimates of oak decline impacts throughout Virginia would have been desirable, but our methods do not permit such estimates. Damage is reported here only for forested land in the Northern Piedmont, Northern Mountain, and Southern Mountain Survey Units of Virginia. Live-tree volume, as used in this discussion, includes the volume from a 1-foot stump to a 4-inch-diameter top (outside bark) for all living trees 5 inches d.b.h. and larger.

Distribution, Incidence, and Volume Losses

Oak forest types were widely distributed across the study area. Overall, 85 percent of the forested land was in oak forest types. The Northern Piedmont Unit had the lowest percentage of oak types (77 percent). The two Mountain Units had approximately equal proportions (89 percent in the Northern Mountains; 87 percent in the Southern Mountains). Overall, there were 6.7 million acres of oak forest types in the three Survey Units.

Oak decline occurred on an estimated 1.1 million acres in the study area, but it was not uniformally distributed (fig. 1). More than half of the plots with oak decline were in the Northern Mountains. Over 650,000 acres, or 30 percent of the area in oak forest types in this Survey Unit, had decline symptoms. The Southern Mountains had only 9 percent incidence, despite having a greater acreage of oak forest. The Northern Piedmont had the smallest oak forest area (1.8 million acres) and a decline incidence similar to the Southern Mountains (11 percent).

Annual mortality in oak forests was high for counties with concentrations of decline (fig. 2). Oak stands in Shenandoah County in the Northern Mountain Unit sustained an average annual loss of 24.9 cubic feet per acre from 1977 to 1986, the highest in the study area. Oak stands in the surrounding counties of Frederick, Warren, Page, and Rockingham had annual volume losses between 14 and 19 cubic feet per acre (fig. 2). The only county outside the Northern Mountain Unit with a similar level of mortality was Montgomery County in the Southern Mountain Unit. Mortality volume was low in oak stands in most of the Northern Piedmont Unit. Only four counties there had annual mortality volume greater than 3 cubic feet per acre, and they were all clustered in the northeastern portion of this Unit.

Affected areas differed from unaffected areas in several attributes (table 1). They had higher basal area and volume, were composed of a higher percentage of oak, and had nearly twice the annual mortality of unaffected areas. These differences were expected. High basal area and high volume in affected areas could be caused by