Wood Duck Nest Sites in an Old-growth Longleaf Pine Forest

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Abstract: We determined the density and characteristics of natural cavities suitable for wood duck (*Aix sponsa*) nest sites in an old-growth longleaf pine (*Pinus palustris*) forest in Thomas County, Georgia, in 1991 and 1992. Of 17 suitable cavities found on the 72-ha study area, 6 had been recently occupied by nesting wood ducks. Although this density (0.24 per ha) was low compared to northern hardwood forests, it was similar to the densities reported in Mississippi bottomland hardwoods and greater than the density reported for bald cypress (*Taxodium distichum*) and tupelo gum (*Nyssa aquatica*) stands in the southeastern United States. The extensive distribution of this forest type before logging in the early part of this century suggests that longleaf pine forests could have once been an important source of wood duck nest sites. Silviculture favoring or maintaining an old-growth component of these forests would benefit wood ducks and other cavity nesters and lead to a more diverse biotic community.

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Relatively few forest types have been studied to determine the density of tree cavities suitable for nesting wood ducks (Soulliere 1988). This is especially true for the southeastern Coastal Plain, with the exception of bottomland hardwood forests in Mississippi. Lowney and Hill (1989) felt that information on natural cavity occurrence by stand type and tree species was needed for the southeastern United States. Soulliere (1990) pointed out a special need for quantitative research on nest cavity abundance on upland sites in the southern states.

Longleaf pine forests once dominated extensive areas of southeastern Coastal Plain uplands (Wahlenberg 1946). Widespread cutting of longleaf pine forest began in the 1800s and peaked in the 1920s (Williams 1989). An estimated 600 ha of old-

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growth currently remains of the 27.6 million ha longleaf forest present at the time of European settlement (Hermann 1993). Today, second-growth stands of the remaining acreage of longleaf (4 million ha; Simberloff 1993) are being lost or converted to short-rotation crops of loblolly (*P. taeda*) or slash pine (*P. elliotii*) (Brown and Thompson 1988). The loss of mature trees for nest sites due to extensive logging around the turn of the century is often cited as a primary factor that dramatically reduced wood duck numbers in North America (Soulliere 1990). However, most attention has centered on hardwood forests with little mention of the habitat once provided by the pine forests that dominated much of the southeastern United States. In addition, maturing hardwoods are credited with wood duck population increases in recent decades, but the current role and potential future importance of pine forests has not been documented. The purposes of our study were to document the density of natural cavities available for wood duck nesting sites in 1 of the few remaining remnants of old-growth longleaf pine forest and to describe the characteristics of cavities actually used by wood ducks in this forest type. This information can be used to help guide forest management decisions that would affect wood ducks and other wildlife using cavities in Coastal Plain pine forests.

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Methods

The study area was a 72-ha stand of old-growth longleaf pine near Thomasville, Georgia. This privately-owned stand, the Wade Tract, is a conservation easement that has been managed for research purposes by Tall Timbers Research, Inc., since 1979. The open aspect has been maintained by frequent prescribed burning and provides visibility up to a kilometer. Forest structure is heterogeneous vertically and horizontally. Trees range in age from saplings to nearly 500 years old, and many canopy trees are more than 100 years old. Treeless gaps of up to 0.5 ha occur in several places in the stand. Longleaf pine exceeds 95% of the tree species composition >2 cm dbh. Only a limited amount of salvage cutting of lightning strikes and windthrows has occurred; the forest has never been cleared or used for agriculture (Platt et al. 1988). The groundcover is rich in herbaceous species, with wiregrass (*Aristida stricta*) being the dominant component. Over 460 species of plants have been identified within the easement (Tall Timbers Research, Inc., Herbarium List). For a detailed description of the site see Platt et al. (1988).

The Wade Tract is a part of a large private property that primarily is managed for quail hunting and timber production. The managed longleaf pine forest sur-

rounding the Wade Tract is somewhat younger and denser than old-growth except in the vicinity of red-cockaded woodpecker (*Picoides borealis*) cavity tree clusters, where old trees (200–250 years) have been maintained. Two agricultural fields (10–20 ha) and a paved road lie near the easement boundaries. One man-made semi-permanent pond (0.5 ha) lies 400 m from the center of the easement, but at least 3 limesink depressions within the easement fill with water during heavy rains. A man-made permanent pond (4 ha) is approximately 1 km from the study site.

Three observers systematically searched the study area for potential wood duck cavities by walking parallel to each other 50 m apart. After completing each 100-m swath, the observers pivoted on the lead observer's position and reversed direction. Potential cavity trees were examined from all sides with binoculars. Trees with cavities that appeared from the ground to be large enough for a wood duck to enter were marked on computer-generated maps of all trees >1.5 m in height within 1-ha gridded plots. These maps had been developed for a long-term study of longleaf pine population dynamics (Platt et al. 1988). We surveyed the entire plot between November 1991 and March 1992.

Swedish climbing ladders were used in March and April 1992 to reach each potential nesting cavity and evaluate its suitability for wood ducks. Snags with cavities were not climbed for safety reasons. We measured cavity entrance width and height; cavity interior length, width, height (above entrance) and depth (below entrance); dbh; orientation of the cavity entrance and height above ground. The distance from each tree to water was measured on aerial photographs. Tree age estimates were obtained from an age-size relationship developed by Platt et al. (1988) for the Wade Tract. The interior of each cavity and the base of the tree were examined for evidence of wood duck nesting such as egg shells or down. We classified the origin of each cavity to the best of our judgment. Tree and cavity variables measured for cavities classified as suitable (excluding those used) and those actually used by nesting wood ducks were compared in an analysis of variance. An alpha level of 0.05 was selected for defining statistical significance.

Additional data on dimensions of cavities used by nesting wood ducks in old-growth longleaf forests were collected from other nearby hunting plantations in the Tallahassee Red Hills physiographic region. We conducted a systematic search for cavities only on the Wade Tract. We classified cavities as suitable for wood duck nest sites in old-growth pine trees if they met the following minimum measurements: entrance size ≥7 x ≥7 cm (minimum dimensions observed during this study), platform size ≥13 x ≥15 cm (this study), tree dbh ≥28 cm (Gilmer et al. 1978), cavity depth <2 m, and height to nest hole from the ground ≥1.8 m (Bellrose et al. 1964).

Results

Sixteen of 25 cavities examined in living trees had suitable dimensions for wood duck nesting. One additional known nest cavity in a pine snag was not climbed or measured. Seventeen cavities (16 in live trees and 1 in a snag) suitable

for wood duck nest sites were found on the study area (0.24 per ha). This is considered a minimum number because we probably missed some cavities in live trees and we did not measure snags for suitability.

Suitable cavities occurred in living, mature longleaf pine trees with an average dbh of 51.1 ± 9.7 cm. Average cavity height above ground was 15.1 ± 3.4 m. Most cavities were oriented in a southerly or westerly direction. Fourteen of the 17 cavities were between the azimuths of 165° and 275°. Cavity interiors had an average platform size of 407.2 cm^2 and average total height of 82.9 cm. Entrance hole size averaged 102.5 cm^2. Distance to water ranged from 30 to 600 m and averaged 250 m. Based on the dbh-age relationship reported in Platt et al. (1988), we estimated that all the trees with cavities suitable for wood duck nesting on the Wade Tract were between 100 and 220 years old. Most (59%) of the suitable tree cavities were an excavation into the heartwood at the location of a broken or rotted branch. Twenty-nine percent of the tree cavities appeared to be old, enlarged red-cockaded woodpecker holes. The origin of the remaining suitable cavities (12%) was unknown. Six of the 17 suitable cavities (35%) examined showed evidence of current or recent use by nesting wood ducks. Five of these were in live trees and 1 was in a snag. This may be an under-estimate of the use rate since we stopped our search for evidence of nesting in April and probably missed some late nests.

No differences ($P > 0.25$) existed in the tree and cavity variables measured for cavities classified as suitable and those actually used by wood ducks. Four of the 6 tree cavities used by wood ducks were formed from decayed branches, 1 was an old red-cockaded woodpecker hole and 1 was of unknown origin.

Nine cavities were classified as unsuitable most often because either the entrance hole or the nest platform was too small. One cavity that otherwise would have been suitable was too deep. Like the suitable cavities, unsuitable cavities resulted mostly (67%) from broken or decayed limbs and enlarged red-cockaded woodpecker holes (22%).

Discussion and Management Implications

Few studies have documented wood duck use of old, living pine trees. Stoddard (1978) did not comment on wood duck nests in pine trees, even though he knew of many examples in the region (L. Neel, pers. commun.). Baker (1971) included wood ducks as one of the species that used inactive red-cockaded woodpecker cavities, and Almand (1965) observed wood ducks nesting in loblolly pine snags in the Piedmont of Georgia. Anecdotal literature primarily describes wood duck use of natural cavities in hardwoods and cypress for nesting in the southeastern United States (Wayne 1910; Bent 1923; Howell 1924, 1932; Lowery 1955; Oberholser 1974). The possibility seems remote that our observations are anomalous. We suspect that the paucity of reports of similar observations is a result of the lack of ornithological research done in the old-growth longleaf pine forest before it was cut extensively. Also, although wood ducks were obvious during their courtship flights on the study area, they were quite secretive around their cavities.

The density of cavities suitable for wood duck nests in this old-growth longleaf pine forest (0.24 per ha) exceeds the density (0.08 per ha) in bald cypress and tupelo stands in Mississippi, Louisiana, and Alabama (Lee 1991) and is similar to densities found in mature bottomland hardwood forests in Mississippi (0.19 and 0.23 per ha) (Lowney and Hill 1989) but lower than the 1–5 per ha found in many northern hardwood forests (Soulliere 1990). Our estimate of suitable cavities in longleaf is probably low for stands of such age because we could have missed cavities in live trees and we did not evaluate snags. In addition, a hurricane in 1985 blew down many large trees on the Wade Tract, including 25% of the red-cockaded woodpecker cavity trees (Engstrom and Evans 1988) which probably had some cavities suitable for wood ducks.

Our reported height above the ground for used cavities in longleaf ($\bar{x}$ = 14.2 m) is higher than those reported in 14 studies summarized by Soulliere (1990) but lower than the average height of 14.3 m reported by Lowney (1987). The smallest cavity entrances of used cavities that we discovered (7 cm x 7 cm) were smaller than the smallest described in Soulliere (1990).

Old-growth pine forests are essentially gone from the southeastern Coastal Plain landscape. Very old pines such as those that provided nesting cavities for wood ducks on the Wade Tract occur only as widely scattered remnants in managed forests. Although longleaf pine trees of the Wade Tract may be especially large, the open park-like aspect of the forest and the number of cavities in old diseased trees were probably characteristics of virgin stands. If the Wade Tract is representative of old-growth longleaf pine forest, the expanse of longleaf pine historically must have provided an immense amount of nesting habitat that was largely eliminated 70–100 years ago. We agree with Gilmer et al. (1978) that retaining some old-growth is essential to maintain all components of a diverse forest biotic community, and support their recommendation that "where cavity nesting wildlife is considered an important product of the forest, silvicultural prescriptions must accommodate those species associated with the old-growth condition" (Gilmer et al. 1978:295). We recommend an ecological approach to forestry such as that practiced on the hunting plantations in the Tallahassee Red Hills. This approach results in uneven-aged stands maintained through long-rotation single-tree selection, natural regeneration in patches, and frequent prescribed burning. This type of forestry has been used successfully on these private gamelands for half a century, successfully combining economic, aesthetic, and wildlife management objectives (Neel 1967).

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