# BIRD POPULATIONS IN EVEN-AGED LOBLOLLY PINE FORESTS OF SOUTHEASTERN LOUISIANA[1]

*by*
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## ABSTRACT

Wintering and breeding-bird populations were determined for even-aged loblolly pine stands 6 years, 20 years, and 46 years old in Livingston Parish, Louisiana. Comparative data were collected in a natural stand. These stands supported bird populations lower in density and species diversity than the natural forest. As vegetative strata increased in a stand, the number and kinds of birds present, also increased.

## INTRODUCTION

In uplands of Louisiana and throughout the Coastal Plain clear-cutting, reducing the site to mineral soil, and planting pine is often practiced. The pine species planted most commonly are loblolly pine *(Pinus taeda)*, slash pine *(Pinus elliottii)*, and longleaf pine *(Pinus palustris)*.

There are presently about 1,400,000 acres of monoculture pine in Louisiana. This represents 10% of the total forest in the state. Acres in pine plantations will increase appreciably in the future. The demand for southern pine lumber is expected to double in the next 10 years. The first recommendation of the Southern Resources Analysis Committee, formed to study forest demand in the South, was to add at least 10 million acres planted with genetically improved pine seedlings by 1985, and to replace 20 million acres of low quality upland hardwood with pine (Wheeler 1970).

Clear-cutting, and especially clear-cutting with artifical regeneration, is a controversial issue (Bultena and Hendee 1972, Ellefson 1972a and 1972b, Glasgow and Noble 1971). Part of the controversy stems from a lack of knowledge of what wildlife populations use even-aged pine stands.

Millions of acres in the Southeast will be in pure, even-aged pine stands by 1990. These stands are frequently managed intensively to reduce ground cover and competition. Reduction or elimination of lesser vegetation in pine stands will almost surely reduce the number of niches available, and therefore the number of avian species using the stand and avian species diversity could be reduced (see MacArthur and MacArthur 1961).

It is important to determine, as soon as possible, the wildlife species, and the density of each, which occur in pure, even-aged pine stands of different ages. We cannot evaluate the total environmental impact of pine monoculture until we have such information. This study was designed to provide data on density and diversity of avian species in even-aged, loblolly pine stands of three age-classes in Livingston Parish, Louisiana. Identical data were collected in a "control" stand for comparative purposes.

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## MATERIALS AND METHODS

A 30-acre, square study plot was selected within each of four stand types such that the plot was surrounded on all sides for at least 150 feet by forest identical to that represented in the plot. An exception was the 20-year plot where about ¼ of the north boundary borders a young hardwood forest.

The study plots are located within 5 miles of one another in Livingston Parish, Louisiana. The plots were cruised using 0.2 acre circular plots.

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*6-year Loblolly Pine Plantation*

The 6-year old loblolly pine plot is in the E1/2 S1, T6S, R4E (30°33'N, 90°45'W). Approximately 350 acres in this area were clear-cut, then chopped with a tree-crusher in late 1968. The prepared site was direct seeded from a helicopter in February 1969.

The natural stand that this replaced was a mixed hardwood-pine forest very similar to the "control" used in this study.

A 10% systematic cruise of the plot in April 1975 gave the following results (dbh = diameter at breast height, in inches):

| *Species* | *Number of Stems Per Acre* | *Average dbh* | *Basal Area Per Acre in ft²* |
|---|---|---|---|
| Loblolly Pine | 831 | 2.1 | 20.0 |
| Sweetgum | 89 | 0.9 | 0.9 |
| Other Hardwoods | 24 | 1.3 | 1.3 |
| Totals | 944 | | 22.2 |

The loblolly pines averaged 13 feet in height (range 9.5-19.0 ft.). All hardwoods were below this average height (range 8-11 ft.).

The site has numerous, small (less than 0.5 acre), low areas which remain wet throughout the winter. The loblolly pine did not establish on these areas. For that reason the study plot has many small openings in the form of low, wet sites where scattered shrubs such as waxmyrtle *(Myrica cerifera)*, winterwillow *(Baccharis halimifolia)*, horsesugar *(Symplocos tinctoria)* and starbush *(Illicium floridanum)* occur. The plot is dissected by several firelanes 4 feet wide.

*20-year Old Loblolly Pine Plantation*

The 20-year old loblolly pine plot is situated in E1/2 S26, T5S, R4E (30°35'N, 90°46'W). The 30-acre study plot is part of about 200 acres which were first clear-cut to remove all merchantable trees, then cleared with a dozer. The site was hand-planted with 1-year old loblolly pine seedlings in January and February 1956.

A 10% systematic cruise of the study plot in March 1975 indicated that the plot was a pure, even-aged, stand of loblolly pine having 320 trees per acre with an average dbh of 8.6 inches and a stand height of 62 feet. The basal area was 129 ft²/acre.

This 20-year plot has a closed canopy. In the winter of 1975 the understory vegetative cover between the ground and 6 feet high was 10%. The remaining 90% of the ground surface was covered only by pine needle litter. No cover existed between a maximum of 6 feet above ground and the lowest portion of the tree canopy (a vertical distance of 36 feet).

The common understory plants in winter are waxmyrtle, smilax *(Smilax rotundifolia)*, crossvine *(Anisostichus capreolata)*, poison ivy *(Rhus radicans)*, Japanese honeysuckle *(Lonicera japonica)*, and several grasses and sedges. Only 20% of understory vegetative cover exists in the stand in spring and summer. This cover consists of, in addition to the winter understory plants, French mulberry *(Callicarpa americana)* and southern crabapple *(Malus angustifolia)*.

The plot has been prescribed burned at two to three year intervals since 1969.

*46-year Old Loblolly Pine Stand*

The 46-year old loblolly pine plot occurs in W1/2 S11, T5S, R4E (30°38'N, 90°47'W). The plot is located within a stand of about 200 acres. The land was farmed for many years but rowcropping was discontinued in the late 1920's. The abandoned fields soon seeded into loblolly pine, sweetgum *(Liquidambar styraciflua)*, southern red oak *(Quercus falcata)*, blackgum *(Nyssa sylvatica)*, water oak *(Q. nigra)*, winged elm *(Ulmus alata)*, persimmon *(Diospyros virginiana)* and other less abundant hardwoods. In the early 1950's all commercial hardwoods were harvested, and those hardwoods remaining were girdled and poisoned, thereby converting the stand into a pure, even-age loblolly pine forest. Since then the pines have been periodically thinned to maintain good spacing among the stems. The stand was prescribed burned "as needed" until 1973 but for the last three years it has been controlled burned annually (February 1973; March 5, 1974; and March 6, 1975).

A 10% systematic cruise of the study plot in April 1975 indicated 58 trees per acre with an average dbh of 15 inches and an average tree height of 92 feet. The basal area was 62 ft²/acre which illustrates the openness of the stand.

The only canopy tree was loblolly pine. Three small patches of about 1000 ft² each have somehow escaped the fires, and these support a heavy undergrowth plus hardwood saplings up to 18 feet tall. The remainder of the study plot supports a sparse winter understory cover (below 6 feet) of waxmyrtle, dewberry (*Rubus* sp.) and several grasses. Other than the three "patches" mentioned above no cover exists from a maximum of 6 feet above ground to the lowest portion of the tree canopy (a "naked" area of about 50 vertical feet).

The spring and summer understory cover (below 6 feet) is about 80% because the stand is quite open thus permitting much sunlight through the canopy. Therefore, a relatively heavy spring and summer understory cover of hardwood sprouts, French mulberry, waxmyrtle, other shrubs, grasses and numerous forbs develops following the late winter prescribed fire, but this understory never develops beyond the first year because of annual burning in late winter.

Fifteen dead standing trees and snags occur scattered over the plot.

*Control*

The "control" plot is an uneven-aged (mature to overly mature trees), mixed pine-hardwood stand with no recent fire history. Some trees were selectively harvested from the stand in the late 1940's, but since that time it has remained undisturbed. Vegetation occurs from ground level into the canopy of dominant trees.

This "natural" forest type is rapidly disappearing throughout southeastern Louisiana and in much of the coastal Plain of the southeastern United States as intensive modern day forestry converts the stands into even-aged monocultures.

A 13% stratified cruise of the plot in May 1975 gave the following results:

| *Species* | *Number of Stems Per Acre (4 inches dbh and above)* | *Average dbh (inches)* | *Basal Area Per Acre in ft²* |
|---|---|---|---|
| Yellow-poplar *(Liriodendron tulipifera)* | 22 | 15.1 | 30.5 |
| Sweetgum | 27 | 11.2 | 22.3 |
| Southern Magnolia *(Magnolia grandiflora)* | 23 | 11.4 | 20.4 |
| Blue beech *(Carpinus caroliniana)* | 36 | 5.7 | 6.9 |
| Blackgum | 10 | 6.6 | 2.2 |
| Spruce Pine *(Pinus glabra)* | 9 | 8.9 | 5.4 |
| Cow oak *(Quercus michauxii)* | 4 | 14.3 | 5.8 |
| Water oak | 4 | 13.7 | 6.5 |
| Sourwood *(Oxydendrum arboreum)* | 4 | 6.0 | 1.1 |
| 16 other species | 12 | 11.0 | 8.0 |
| Totals | 151 | | 109.1 |

*Breeding-bird Census*

Territorial mapping was used to census breeding birds (Kendeigh 1944 and Svensson 1970). Each study plot was subdivided and conspicuously marked into squares of equal size. The number of subdivisions in each plot depended upon the thickness of the understory and/or the canopy vegetation. The 6-year, 20-year, 46-year, and "control" plots were subdivided into 14, 40, 25, and 40 subdivisions, respectively. It was possible, therefore, for us to know our position and to estimate the position of a bird contacted, anywhere within the plot.

Outline maps of each plot were prepared, and one of these maps was used for each visit to the plot. Eight visits were made to each pine stand, and 10 visits to the control stand. The heterogeneity of the control stand was the reason for more visits to that plot. Visits for the breeding-bird census were made between May 16, 1974 and June 21, 1974.

On each visit, beginning at official sunrise, one or two observers, using binoculars, covered a plot by walking quietly and slowly, with frequent stops, through the plot, making sure that all points within the plot were approached within about 150 feet during the count period. The observer(s) recorded on the visit map the location of all birds, by species, seen or heard. At the end of the breeding-bird counts (visits) data on the 8 or 10 visit maps were used to construct a species map for each individual species.

The clusters on a species map were an indication of the territories of that particular species on the plots. Since only males sing and establish territories, the male population of a species on a plot was doubled to estimate total population of that species. The assumption is that all singing males defending an established territory over a period of several weeks had a mate.

Visits were made between 0615 and 1115 CDT. We spent 26 manhours in the 6-year plantation for the breeding-bird census, 27 manhours in the 20-year stand, 27.5 manhours in the 46-year plot and 57 manhours were spent in the "control."

*Winter Bird Counts*

The same plots used for the breeding-bird census were used for the wintering-bird counts. An observer traversed the plot in such a way that all parts of it came under observation with a minimum of duplication. As birds were noted they were recorded and their approximate location noted. Only those birds actually foraging on the plot were included in the count.

Eight visits were made to each pine plot and 9 visits to the control plot between January 9, 1975 and March 6, 1975. At the conclusion of the winter's visits, the numbers of individuals of each species were totaled for all visits and the sum divided by the number of visits. These calculations gave an estimate of the number of individuals, by species, wintering on the 30-acre plots.

During the wintering-bird counts we spent 17 manhours in the 6-year plot, 18 manhours in the 20-year, 16 in the 46-year, and 31 in the "control." Visits were made between 0800 and 1620 CDT.

*Bird Species Diversity Index*

Bird species diversity of each plot was calculated with the Shannon-Weaver formula (Shannon and Weaver 1949):

$$H' = -\sum_{i} \frac{Ni}{N} \ln \frac{Ni}{N}$$

where $H'$ = species diversity index
$N$ = total number of individuals of all species
$Ni$ = number of individuals of the $i^{th}$ species

This index is affected by both the number of species present and the distribution of indiviudals between species. It equals 0 when only one species is present and increases as the number of species and the evenness of their distribution increases.

## RESULTS AND DISCUSSION

Bird species diversity for the winter population was greatest in the "control" plot (2.71), slightly less in the 6-year stand (2.65) and the 20-year stand (2.56), and lowest in the 46-year plot (2.38).

Species diversity in the breeding-bird population was lowest in the 6-year stand (2.14) and 20-year stand (2.19), highest in the 46-year plot (2.77), and intermediate in the "control" (2.41).

Table 1. Species diversity index by bird population and forest type. Livingston Parish, Louisiana 1974-1975.

| *Stand* | *Diversity Index* | |
|---|---|---|
| | *Winter population* | *Breeding population* |
| 6-year | 2.6459 | 2.1360 |
| 20-year | 2.5634 | 2.1869 |
| 46-year | 2.3750 | 2.7746 |
| "Control" | 2.7121 | 2.4133 |

*Bird Populations*

Birds show not only a horizontal distribution over the earth's surface but also a vertical distribution in available vegetation strata. Dunlavy (1935) proposed the term *phyto-vertical distribution* to designate the local vertical distribution of birds in any vegetational formation with reference to distance from the ground.

MacArthur and MacArthur (1961) showed that avian species diversity increases as foilage height diversity increases. Foilage height diversity increases as the number of levels of vegetation increases. MacArthur and MacArthur (1961) found that analyzing the vegetation in three layers (roughly corresponding to ground cover, understory and canopy) was sufficient to explain trends in avian species diversity.

Table 2. Winter bird population and breeding bird population by species and forest type. Livingston Parish, Louisiana, 1974-75. (Populations expressed as birds per 100 acres.)

| | *Winter January–March 1975* | | | | *Breeding May–June 1974* | | | |
|---|---|---|---|---|---|---|---|---|
| | *6-yr* | *20-yr* | *46-yr* | *control* | *6-yr* | *20-yr* | *46-yr* | *control* |
| Yellow-rumped Warbler *(Dendroica coronata)* | 50 | 9 | 5 | 124 | | | | |
| Swamp Sparrow *(Melospiza georgiana)* | 49 | | 2 | | | | | |
| Short-billed Marsh Wren *(Cistothorus platensis)* | 32 | | | | | | | |
| Ruby-crowned Kinglet *(Regulus calendula)* | 26 | 34 | 10 | 92 | | | | |
| Carolina Wren *(Thryothorus ludovicianus)* | 24 | 7 | 4 | 21 | 6 | 14 | 14 | 60 |
| Northern Cardinal *(Cardinalis cardinalis)* | 22 | 4 | 2 | 48 | 40 | 34 | 20 | 200 |
| Rufous-sided Towhee *(Pipilo erythrophthalmus)* | 18 | | | 1 | 26 | 6 | 14 | 2 |
| Blue Jay *(Cyanocitta cristata)* | 11 | 15 | 10 | 60 | | 6 | 6 | 6 |
| American Robin *(Turdus migratorius)* | 10 | 4 | 1 | 87 | | | | |
| Song Sparrow *(Melospiza melodia)* | 6 | | | | | | | |
| Northern Mockingbird *(Mimus polyglottos)* | 5 | | | | 4 | | | |
| White-throated Sparrow *(Zonotrichia albicollis)* | 4 | 2 | 2 | 32 | | | | |
| Common Flicker *(Colaptes auratus)* | 4 | | 1 | 7 | | | | |
| Winter Wren *(Troglodytes troglodytes)* | 3 | | | | | | | |
| White-eyed Vireo *(Vireo griseus)* | 3 | | | 2 | 14 | 14 | | 240 |
| Common Yellowthroat *(Geothlypis trichas)* | 3 | | | | 20 | | | |
| Mourning Dove *(Zenaida macroura)* | 2 | | | | | | | |
| House Wren *(Troglodytes aedon)* | 2 | | 3 | 1 | | | | |
| American Goldfinch *(Spinus tristis)* | 2 | 2 | 5 | 3 | | | | |

| | Winter January–March 1975 | | | | Breeding May–June 1974 | | | |
|---|---|---|---|---|---|---|---|---|
| | 6-yr | 20-yr | 46-yr | control | 6-yr | 20-yr | 46-yr | control |
| Tufted Titmouse *(Parus bicolor)* | 2 | | 1 | 13 | | 4 | 4 | 14 |
| American Woodcock *(Philohela minor)* | 1 | | | | | | | |
| Orange-crowned Warbler *(Vermivora celata)* | 1 | 1 | | 5 | | | | |
| Field Sparrow *(Spizella pusilla)* | 1 | | | | | | | |
| American Bittern *(Botaurus lentiginosus)* | 1 | | | | | | | |
| Turkey Vulture *(Cathartes aura)* | 1 | | | 1 | | | | |
| Black Vulture *(Coragyps atratus)* | 1 | | | | | | | |
| Red-shouldered Hawk *(Buteo lineatus)* | 1 | 1 | | 9 | | | | 4 |
| Carolina Chickadee *(Parus carolinensis)* | 1 | 5 | | 24 | | 14 | | 14 |
| Long-billed Marsh Wren *(Telmatodytes palustris)* | 1 | | | | | | | |
| Eastern Bluebird *(Sialia sialis)* | 1 | | 8 | | 2 | | 4 | |
| Dark-eyed Junco *(Junco hyemalis)* | 1 | | 2 | | | | | |
| Pine Warbler *(Dendroica pinus)* | | 25 | 55 | 36 | | 20 | 46 | 4 |
| Hermit Thrush *(Catharus guttatus)* | | 14 | 2 | 28 | | | | |
| Red-bellied Woodpecker *(Centurus carolinus)* | | 9 | 7 | 24 | | | 14 | 14 |
| Golden-crowned Kinglet *(Regulus satrapa)* | | 6 | | 14 | | | | |
| Pileated Woodpecker *(Dryocopus pileatus)* | | 4 | | 3 | | | | 6 |
| Solitary Vireo *(Vireo solitarius)* | | 4 | | 3 | | | | |
| Downy Woodpecker *(Dendrocopos pubescens)* | | 3 | 2 | 5 | | | 6 | 2 |
| Eastern Phoebe *(Sayornis phoebe)* | | 2 | 2 | 4 | | | | |
| Barred Owl *(Strix varia)* | | 2 | 2 | 4 | | | | 2 |
| Common Crow *(Corvus brachyrhynchos)* | | 1 | | | | | | |
| Brown-headed Nuthatch *(Sitta pusilla)* | | | 10 | | | | 26 | |
| Bachman's Sparrow *(Aimophila aestivalis)* | | | 1 | | | | 14 | |
| American Kestrel *(Falco sparverius)* | | | 1 | | | | | |
| Henslow's Sparrow *(Ammodramus henslowii)* | | | 1 | | | | | |
| Brown Thrasher *(Toxostoma rufum)* | | | | 25 | | | | |

| | Winter January–March 1975 | | | | Breeding May–June 1974 | | | |
|---|---|---|---|---|---|---|---|---|
| | 6-yr | 20-yr | 46-yr | control | 6-yr | 20-yr | 46-yr | control |
| Yellow-bellied Sapsucker *(Sphyrapicus varius)* | | | | 7 | | | | |
| Hairy Woodpecker *(Dendrocopos villosus)* | | | | 1 | | | 2 | 2 |
| Fox Sparrow *(Passerella iliaca)* | | | | 1 | | | | |
| Cedar Waxwing *(Bombycilla cedrorum)* | | | | 1 | | | | |
| Yellow-breasted Chat *(Icteria virens)* | | | | | 74 | | | |
| Prairie Warbler *(Dendroica discolor)* | | | | | 54 | | 14 | |
| Painted Bunting *(Passerina ciris)* | | | | | 20 | | | |
| Bobwhite *(Colinus virginianus)* | | | | | 14 | | | |
| Orchard Oriole *(Icterus spurius)* | | | | | 4 | | | |
| Indigo Bunting *(Passerina cyanea)* | | | | | 4 | | 6 | |
| Acadian Flycatcher *(Empidonax virescens)* | | | | | | 20 | 6 | 18 |
| Great Crested Flycatcher *(Myiarchus crinitus)* | | | | | | 20 | 2 | 2 |
| Red-headed Woodpecker *(Melanerpes erythrocephalus)* | | | | | | | 14 | |
| Eastern Wood Pewee *(Contopus virens)* | | | | | | | 14 | |
| Yellow-throated Vireo *(Vireo flavifrons)* | | | | | | | 14 | 20 |
| Summer Tanager *(Piranga rubra)* | | | | | | | 6 | 2 |
| Ruby-throated Hummingbird *(Archilochus colubris)* | | | | | | | 2 | |
| Red-cockaded Woodpecker *(Dendrocopos borealis)* | | | | | | | 2 | |
| American Redstart *(Setophaga ruticilla)* | | | | | | | | 414 |
| Red-eyed Vireo *(Vireo olivaceus)* | | | | | | | | 214 |
| Northern Parula Warbler *(Parula americana)* | | | | | | | | 120 |
| Yellow-billed Cuckoo *(Coccyzus americanus)* | | | | | 2 | | | 40 |
| Prothonotary Warbler *(Protonotaria citrea)* | | | | | | | | 34 |
| Hooded Warbler *(Wilsonia citrina)* | | | | | | | | 32 |
| Swainson's Warbler *(Limnothlypis swainsonii)* | | | | | | | | 26 |
| Worm-eating Warbler *(Helmitheros vermivorus)* | | | | | | | | 26 |
| Louisiana Waterthrush *(Seiurus motacilla)* | | | | | | | | 20 |

| | Winter January–March 1975 | | | | Breeding May–June 1974 | | | |
|---|---|---|---|---|---|---|---|---|
| | *6-yr* | *20-yr* | *46-yr* | *control* | *6-yr* | *20-yr* | *46-yr* | *control* |
| Blue-gray Gnatcatcher *(Polioptila caerulea)* | | | | | | | | 14 |
| Wood Thrush *(Hylocichla mustelina)* | | | | | | | | 6 |
| Black-and-white Warbler *(Mniotilta varia)* | | | | | | | | 6 |
| Kentucky Warbler *(Oporornis formosus)* | | | | | | | | 4 |
| Green Heron *(Butorides virescens)* | | | | | | | | 2 |
| Yellow-crowned Night Heron *(Nyctanassa violacea)* | | | | | | | | 2 |
| Totals | 289 | 154 | 139 | 686 | 282 | 154 | 250 | 1572 |
| Total Species | 31 | 21 | 24 | 31 | 13 | 13 | 22 | 33 |

Bird populations by species, season, and stand type are presented in Table 2.

The 6-year loblolly pine plantation supports about the same number of birds, per 100 acres, in winter (289) as during the nesting season (282). Vegetative strata in the 6-year plantation are limited because the average height of the stand is 13 feet. Consequently little habitat diversity, as determined by different vegetative strata, occurs in the 6-year plantation from winter through summer.

The same situation holds for the 20-year stand. The only real vegetative stratum is the closed canopy. Consequently, as one might suspect, the wintering-bird population (154) and the breeding-bird population (154), per 100 acres, are about the same even though the avian species composition of the two populations differ considerably.

The breeding-bird population of the 46-year old plantation (250), per 100 acres, is 80% higher than the wintering-bird population (139). During winter only the open tree canopy exists since periodic fire has eliminated or drastically reduced many of the shrubs (both evergreen and deciduous) and other plants that would ordinarily occur under this open pine canopy. Only a sparse understory cover and three small patches of good cover exist in winter. Not surprisingly, the Carolina Wrens *(Thryothorus ludovicianus)*, House Wrens *(Troglodyates aedon)*, Hermit Thrushes *(Catharus guttatus)*, White-throated Sparrows *(Zonotrichia albicollis)*, Northern Cardinals *(Cardinalis cardinalis)*, Dark-eyed Juncos *(Junco hyemalis)*, Swamp Sparrows *(Melospiza georgiana)*, Bachman's Sparrow *(Aimophila aestivalis)*, and Henslow's Sparrow *(Ammodramus henslowii)* reported here as part of the wintering-population (based on 100 acres) in our 46-year plantation were all associated with the three patches of good cover and the very sparse understory cover on our study plot.

In spring and summer numerous grasses and forbs grow under the open canopy, hardwood sprouts appear and grow vigorously from established root systems (these sprouts are killed back each year by prescribed fire). By May 15th the ground cover is well-established and in some instances several feet high. Therefore, during the breeding season the 46-year plantation offers not one vegetative stratum as in winter, but two distinct strata; one from ground level to several feet high and a second stratum in the tree canopy. The hiatus between these two strata represents a vertical distance of about 50 feet in which no vegetation other than tree trunks exist.

The "control" plot, an uneven-aged (with many mature trees), mixed hardwood-pine stand with numerous deciduous and evergreen shrubs, offers at least some vegetative cover in winter from ground level to the top of the highest trees. The "control" plot had a wintering-bird density (686) 2.4 times higher than that in the 6-year plantation, 4.5 times higher than the 20-year stand, and 4.9 times higher than the 46-year plot.

By mid-spring the deciduous trees and shrubs in the "control" plot have leafed out and the vegetative cover from ground level to tree-top height is even more developed. Numerous deciduous vines (e.g., *Vitis* spp., *Campsis radicans*, *Rhus radicans*, and *Parthenocissus quinquefolia* add to this vegetative diversity in spring. The staircase appearance of the vegetation is conspicuous. There is no dominating tree canopy *per se*.

The breeding-bird population per 100 acres in the "control" plot was 1,572 individuals; 5.6 times more than in the 6-year stand, 10.2 times greater than the 20-year plantation, and 6.3 times higher than the breeding-bird population in the 46-year old plantation.

Of the 50 birds species found wintering in the four forest types (at populations of at least 1 individual per 100 acres) only 8 occurred in all four types while 21 species were restricted to one of the specific forest types. Forty-four bird species nested in the four types. Only three of these, Carolina Wren, Rufous-sided Towhee *(Pipilo erythrophthalmus)* and Northern Cardinal, nested in all four types while 26 species nested in only one type; 17 of these in the "control" only (see Table 2).

## MANAGEMENT IMPLICATIONS

More and more emphasis is being placed on managing nongame birds (Noble 1974). This was well borne out at a recent national symposium on managing nongame birds in forest and range habitats (U. S. Forest Service 1975).

The findings of this study show that even intensively managed, pure, even-aged pine plantations support bird populations. Indeed, if one were managing land mainly for Pine Warblers we would recommend a situation such as our 46-year plot. The Swamp Sparrow and Short-billed Marsh Wren *(Cistothorus platensis)* (wintering-birds only on our study area) occur most abundantly in our patchy, in places wet, 6-year plantation.

However, we believe that both the kinds of birds and the density of birds can be increased on any area by permitting more vegetative strata to develop.

Nothing can be presently done with our 6-year plot. It already has many openings in the form of firelanes and areas too wet to support loblolly pine. Because of these openings there are more birds, both in kind and density, than would occur if the stand was completely stocked.

Direct seeding, especially from a helicopter or fixed-wing aircraft, is preferable to hand planting of seedlings because the aerial seeding frequently results in a patchy distribution of trees thereby creating, by default, small openings in the stand. These openings increase the number and kind of birds that can live in the plantation.

Such openings of one-half acre or less should be planned for plantations hand-planted with seedlings and created in plantations of any age.

Bird populations in our 20-year old plot could be increased by thinning the stand to permit some sunlight to strike the forest floor, providing two or three "openings" of about one-half acre each, and using prescribed fire sparingly and judiciously.

There is little reason to burn the 46-year stand annually. The same results, from a forest management standpoint, could be achieved with a carefully applied fire once every three or four years.

Our "control" plot supported very high bird populations, much higher populations than occurred in any of the pine plantations. If one desires the maximum number of nongame birds in both species and numbers, then one must provide a diversified habitat with all vegetative strata from ground level to tree-top height represented variously throughout the forest stand.

Dead trees and snags are important to some birds. In our plots some bird species were largely associated with, and concentrated around, dead trees and snags. This was true for all woodpeckers (except the Red-cockaded, *Dendrocopos borealis)*, Eastern bluebird *(Sialia sialis)*, Brown-headed Nuthatch *(Sitta pusillus)*, Tufted Titmouse *(Parus bicolor)*, Barred Owl *(Strix varia)*, Great-crested Flycatcher *(Myiarchus crinitus)*, and Prothonotary Warbler *(Protonotaria citrea)*, and to a lesser extent for the Eastern Wood Pewee *(Contopus virens)*, Carolina Chickadee *(Parus carolinensis)*, and American Kestrel *(Falco sparverius)*.

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# AVERSIVE CONDITIONING BLACK BEAR TO HONEY UTILIZING LITHIUM CHLORIDE

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## ABSTRACT

Seven caged black bear *(Ursus americanus)* were fed granular lithium chloride mixed in honey. At the maximum dosage (80g dissolved in .9 l of honey) and minimum dosage (20g/.9 l) ingestation resulted in sickness. A single treatment resulted in six of the treated bears being conditioned to refuse to eat pure honey for periods varying from 15 to 220 days. One bear continued to relish pure honey and exhibited no aversion

## INTRODUCTION

A major management problem with the remaining black bear *(Ursus americanus)* population in Georgia exists because much of the beekeeping and honey industry in the state is located in the remaining bear habitat and because of the strong attraction that bear have for honey. Many beekeepers who maintain bee yards in bear territory utilize protective devices such as electric fences, blinking lights, transistor radios and guard dogs to minimize attacks of bear on hives; however, the most efficient device is the bear proof beehive platform (Whisenhunt, 1958); however, the platform is not used extensively in Georgia due to initial construction cost and working inconvenience.

Serious conflicts arise between game managers and beekeepers when a few beekeepers revert to protection of their hives by killing bears with honey containing strychnine or the aid of steel traps and "catch-and-tree" dogs. The problem is exemplified by a bill introduced in 1975 into the Georgia House of Representives making the State of Georgia liable for bear damage to beehives under certain conditions and giving the beekeeper the right to destroy bears under certain conditions (Georgia, 1975). The bill is still pending.

The purpose of this research project was to determine if lithium chloride could be used effectively and safely to cause aversive reaction of bear to honey at prescribed dosage levels. Gustavson and Garcia (1974) used this material to avert coyote *(Canis latrans)* predation of sheep and mountain lion *(Felis concolor)* taste for "deer-burger".

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