Another profitable cooperative undertaking in our State is the Commission's production of bicolor lespedeza in its forest tree nurseries for the Game and Fish Commission. We have well established nursery facilities and qualified personnel for producing bicolor lespedeza and similar game plants for the Game and Fish Commission. These plants are produced at cost and this year we are producing approximately five million plants which will be packaged for the Commission as per their instructions. These plants are then delivered by the Game and Fish personnel to land owners. This cooperative endeavor has assisted the Commission to utilize its nursery facilities to mutually benefit both state agencies. We believe the cost of producing these plants is much less than would have been possible for the Game Commission to have produced inasmuch as they were grown in conjunction with our forest trees.

We also cooperate with the Game and Fish Commission in making our forest fire investigators available to help police and supervise some of the large hunting events on state and federal lands.

There is a great need for closer relationship between forest and game groups due to the changing forest land pattern in Georgia and I believe the same pattern applies equally in many other southern states due to the reduction in crop land needed for agricultural row crops. Large acreages of cultivatable land has and is being planted in pine trees. We in Georgia have planted 1½ million acres in the past five years. The forest area of Georgia now comprises of more than 24 million acres. Our commercial forest land of which 92% is in private ownership and of that amount 73% is owned by persons having less than 500 acres. The average ownership is only 113 acres.

Another factor of vital concern to forest land owners is that we have approximately 45 thousand acres of pine forest land being converted to hardwoods each year due to harvesting practices and normal reproduction tendencies. Most of these areas have only weed tree species and must receive a treatment to rid the area of the worthless trees if a commercial tree crop is to be realized. We are converting in Georgia approximately 20 thousand acres per year by means of chemical and or mechanical programs. The chemical being used is not detrimental to game and we believe that this site preparation is making much more game food available and thereby will increase game rather than the reverse. We have approximately 16 million acres in pine and 8 million in hardwood.

We have every reason to believe that the present trend is to a better understanding between game production and forest growth. We believe the trend is toward more game preservations with very little private land available for free hunters. From our mutual efforts we will have an increasing amount of game in the future.

# A THREE-YEAR STUDY OF THE FALL MIGRATION AND ROOSTING-FLIGHT HABITS OF THE WOOD DUCK IN EAST-CENTRAL NORTH CAROLINA

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## ABSTRACT

Late afternoon counts of wood ducks *(Aix sponsa)*, as they came to roost in woodland ponds, were made in the fall and early winter months of 1953, 1954, and 1960, near Wendell, North Carolina.

The numbers of wood ducks which came to roost increased rapidly during October of each year and peak numbers generally were recorded during late October and very early November, in correlation with the regular fall migration of these birds to and through the state from more northern areas. The roosting populations decreased during November and December and few wood ducks remained in the region during the winter months.

Most flights consisted of small numbers of ducks. Flocks of two birds were most common and comprised 35.5% of all 814 flocks observed. Only

a few flocks contained more than 12 birds. As the season advanced, flocks of two birds became proportionately more abundant (October, 34%; November, 36%; December, 43%; and January, 47%) possibly indicating pairing by this time. By late February some nesting had begun.

Roosting flights on clear days began about 8 minutes after sunset in mid-October and continued over a period of approximately 20 minutes. Regression lines were calculated which showed that afternoon flights began progressively later (1.9 minutes for each 10 days) as the season advanced from mid-October to early January. The times of the median and final flights showed a similar decrease (1.5 and 1.4 minutes for each 10 days, respectively) which nearly paralleled that of beginning flights. There was evidence that the afternoon flights began earlier on stormy days.

## INTRODUCTION

Wood ducks *(Aix sponsa)* characteristically gather together in woodland ponds each day at dusk for roosting. These mass congregations are generally unnoticed because the individual flocks are small, the lighting is poor, and the woodland ponds may be in remote areas. Although the gathering of these ducks for roosting has long been recognized as a characteristic of the wood duck (Bent, 1923; Kortright, 1942) very few biologists have utilized this source of information on populations and behavior.

Until the present study was undertaken in 1953, there were no published accounts of the use of afternoon roosting-flight counts as a census technique for determining relative abundance and time of migration of the wood duck. In recent years several studies have been undertaken. D. N. Martin (1957) measured flight activity in relation to sunrise and sunset in Indiana, and Smith (1958) and E. M. Martin (1959) measured roosting flights in Louisiana and Iowa, respectively, as indicators of wood duck abundance. Also E. M. Martin and Haugen (1960) measured seasonal changes in wood duck roosting flight habits in Iowa.

## MATERIALS AND METHODS

The study herein reported was begun in the fall of 1953 and was repeated in 1954 and 1960. It consisted of five sets of observations (Hester's pond, 1953 and 1960; Lake Wendell, 1954; and Tarpley's Millpond, 1954 and 1960). The wood ducks were counted as they came to roost in woodland ponds near Wendell, about 15 miles east of Raleigh, North Carolina. The three areas in which counts were made were all located within 4 miles of Wendell and were as follows:

*Hester's Pond,* owned by Dr. J. R. Hester, was an 8-acre farm pond on a tributary stream 300 yards from Little River, a small woodland stream heavily used by wood ducks. A one-acre swamp (mostly black willow, *Salix nigra,* and alder, *Alnus rugosa)* was used as a roosting site. The entire pond was surrounded by woodland and was a refuge.

*Tarpley's Millpond,* owned by Mr. J. W. Tarpley, was a millpond of about 40 acres on Little River containing interspersed areas of marsh and low swamp vegetation (mostly Carolina water ash, *Fraxinus caroliniana).* This pond was not a refuge. It was located on Little River about two miles upstream from Hester's Pond.

*Lake Wendell,* owned by 50 stockholders, was a 250-acre lake on Buffalo Creek maintained primarily for fishing. This millpond contained a margin of a few feet to several hundred feet in width composed of swamp black gum *(Nyssa sylvatica),* Carolina water ash, and bald cypress *(Taxodium distichum).* A swamp of about 85 acres at the head of the pond contained the same species of trees and was used as a roosting site. This area was not a refuge.

Afternoon counts were made from observation points about 100 or 200 yards from each roosting area. Counts were begun near sunset and continued until dark. As each flock approached the roost, the time and direction of the flight, number of wood ducks, and calling and circling behavior were recorded. Assistance rendered by other observers on two afternoons facilitated simultaneous counts on two areas.

This paper summarizes information obtained by complete counts of roosting flights on a total of 40 afternoons. On 9 additional days counts were incomplete due to late arrival of the observer or early flights by the

ducks. It was noted that the ducks came to roost earlier on stormy days, but time limitations prevented earlier observations on these days.

## RESULTS

*Fall Migration.* The 40 afternoon counts made during three fall migrations on a total of three study areas showed that the largest populations of wood ducks generally were present during late October and early November (Figures 1 and 2). At this time peak numbers of 70 to 164 wood ducks were recorded at each of the study areas. This indication of fall migration was consistent for each of the three years except for one obvious deviation which occurred at Hester's pond in 1960 (Figure 2), where wood ducks were most abundant in late November. This difference appeared to be in part due to the experimental planting of one acre of Japanese millet *(Echinochloa crusgalli* var. *frumentacea)* in Hester's pond about 50 yards from the roost. It was regarded as unusual that so many wood ducks remained in late November, especially when counts at Tarpley's millpond only two miles away were highest in mid-October (Figure 1). The wood ducks were observed feeding in the millet as late as November 24, and it appeared that the presence of this unusually abundant food supply was influential in retaining the ducks past their normal migration time.

Winter populations in December and January were usually low on all study areas and consisted of not more than 10 percent of the peak fall numbers. Similar movements were recorded by D. N. Martin (1957) who found that roosting counts reached a peak in Indiana about November 1 and that a mass departure occurred during the next two weeks, with few wood ducks remaining into December.

*Time of Flight.* In early October the afternoon flights began on all study areas soon after sunset, but they began progressively later after sunset as the season advanced into November, December and possibly early January (Figure 3). Regression lines were calculated which showed that on the average the earliest, median, and latest flights in mid-October began 8, 17 ,and 27 minutes after sunset, respectively. The calculated regression lines also showed that on the average the earliest,

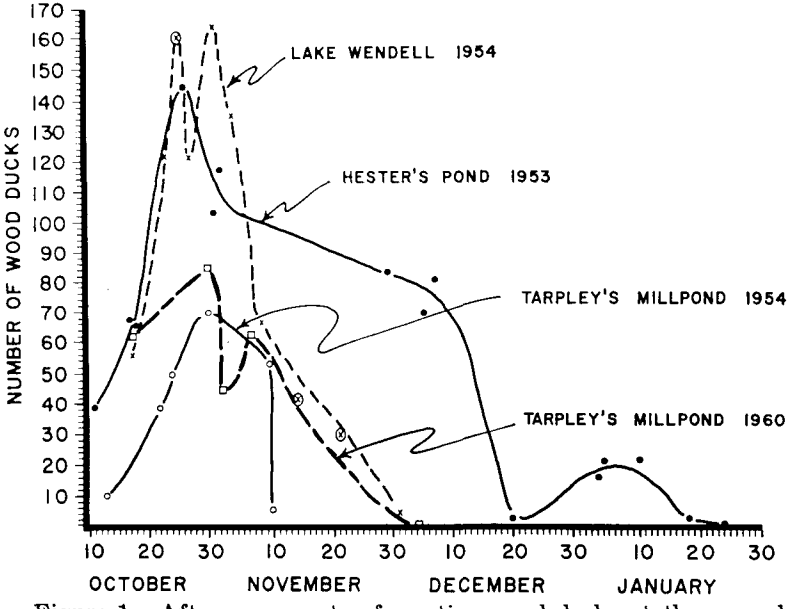


Figure 1. Afternoon counts of roosting wood ducks at three woodland ponds near Wendell, North Carolina. Each count indicated was believed to be a complete count except the three encircled observations at Lake Wendell where counts were incomplete, but were included because they provided usable information.

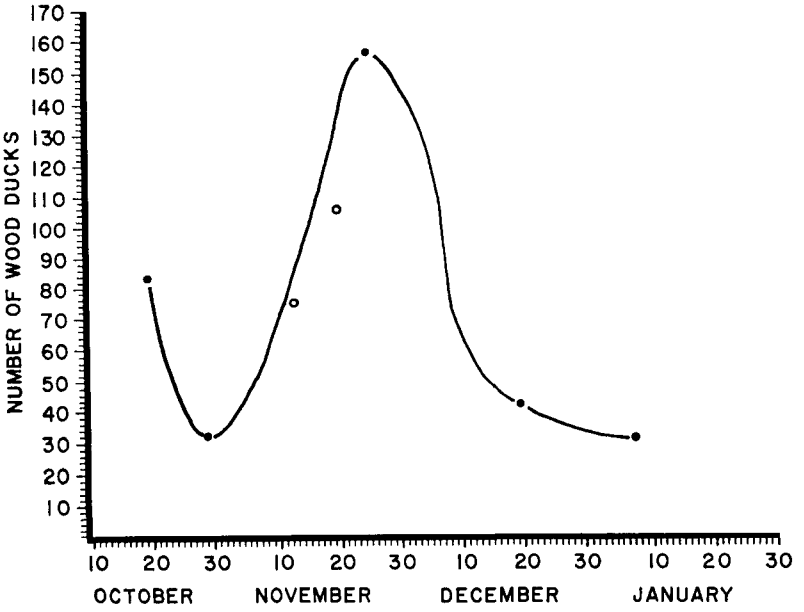


Figure 2. Afternoon counts of roosting wood ducks at Hester's pond near Wendell, North Carolina. Each solid point represents a complete count, and the open dots represent incomplete counts which provide supporting data.

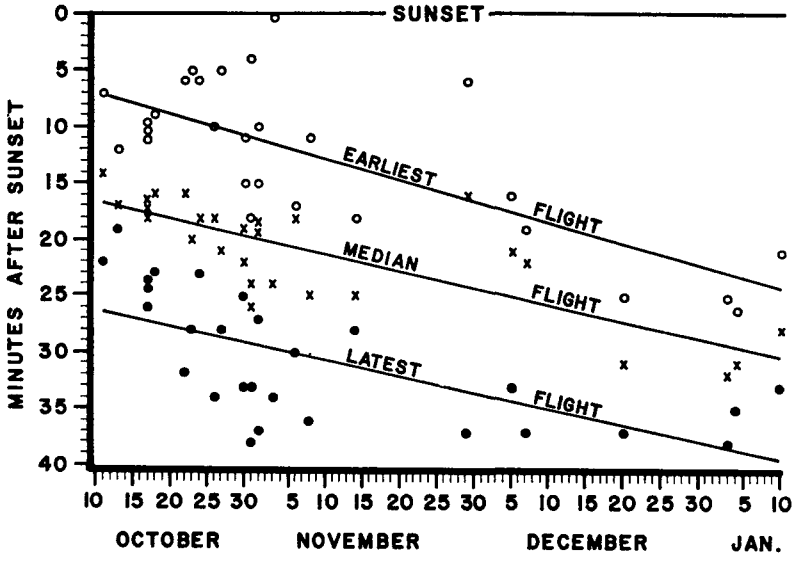


Figure 3. Change in roosting flight time in relation to sunset and time of year. Equations for the above calculated regression lines are (1) Earliest flight M=6.8+.19D, (2) Median flight M=16.7+.15D, and (3) Latest flight M=26.3+.14D, where M equals minutes after sunset and D equals days after October 10. Roosting flights from the 4 studies shown in Figure 1 are summarized above; flights at Hester's pond in 1960 were apparently complicated by feeding flights and refuge conditions and are not included in this figure.

median, and latest flights began 0.19, 0.15, and 0.14 minutes later each day, respectively. Thus the three lines were nearly parallel with the median flight averaging about 6 to 10 minutes after the earliest flight and the latest flight averaging 9 minutes after the median flight.

Martin and Haugen (1960) measured roosting flights in relation to sunset during August, September, and early October in Iowa. Their calculated regression lines showed that the starting time for afternoon flights varied from about 50 minutes before sunset in early August to 10 minutes after sunset in mid-October. Time of peak activity and the last flight also were progressively later in relation to sunset over the same period. In early August, Martin and Haugen found that peak activity occurred about 35 minutes before sunset, but by mid-October it did not occur until about 25 minutes after sunset. They also found that the time of the final flight changed from 5 minutes before sunset in early August to about 30 minutes after sunset in mid-October.

Close agreement was evident between the present study and that of Martin and Haugen in Iowa. The Iowa study began in August and continued until mid-October whereas the present study began in mid-October and continued into January. Thus only the mid-October observations may be compared for the two studies. In the present study in mid-October the earliest flight began 8 minutes after sunset (about 10 minutes for Martin and Haugen), the median flight occurred 17 minutes after sunset (about 25 minutes for Martin and Haugen) and the final flight occurred about 27 minutes after sunset (about 30 minutes for Martin and Haugen).

In the present study the entire duration of the flight period ranged from 7 to 34 minutes and averaged 18 minutes. The flight period was longest when a single flock of ducks came to roost 10 to 15 minutes early and therefore length of the flight period was not correlated with number of ducks. In fact ,the flight period during peak numbers in each of the 5 sets of observations (see Figures 1 and 2) averaged slightly less than 19 minutes.

*Flock Size.* Most flocks consisted of small numbers of ducks. Flocks of two birds were most common and comprised 35.5 percent of all 814 flocks observed, while less than 4 percent of all flocks contained more than 10 birds (Figure 4). The larger flocks appeared to be loosely held and frequently would separate into two or more smaller flocks as they reached the roosting site.

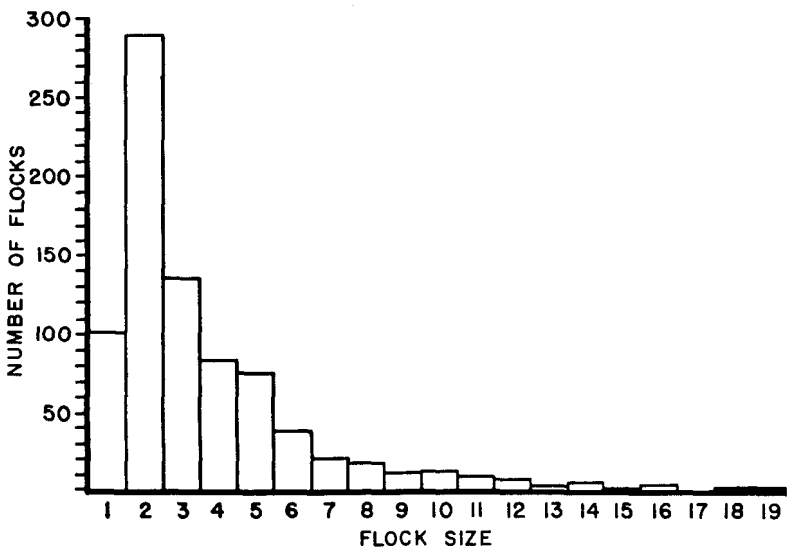


Figure 4. Flock size of 814 wood duck flocks observed over a three-year period during the months of October to January.

In some cases flocks of two birds were observed to contain male and female ducks, but poor light conditions and the rapidity of activity made it possible to determine the sex composition of only a few flocks.

Flocks of only two birds became proportionately more common as the season advanced. The percentages of total flocks which were composed of only two ducks were: October (143 of 427 flocks) 34%, November (104 of 290 flocks) 36%, December (29 of 67 flocks) 43%, and January (14 of 30 flocks) 47%. It is possible that this increase in proportionate number of flocks of two birds may indicate pairing. By late February some of the ducks which breed locally had begun nesting.

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# FOODS AVAILABLE TO WATERFOWL IN FALLOW RICEFIELDS OF SOUTHWEST LOUISIANA, 1960-1961


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According to Smith (1958-59), approximately four million ducks and geese winter in Louisiana each year. Most of these waterfowl utilize the southwest portion of the state. This wintering area covers approximately 2½ million acres and is composed of pastures, ricefields, fallow ricefields, and fresh, brackish, and salt marshes.

The quantity and kind of waterfowl food produced each year in marsh areas is known to be affected by many factors. Intrusion of salt water, drought or some other uncontrollable climatic factor, influences growth and production of food producing plants. A reduced food supply coupled with unfavorable water conditions causes some waterfowl to migrate further south and those that remain for the winter feed more heavily in ricefields. Studies have shown that even in years when marsh conditions are favorable, many ducks and geese feed at night in fields from which rice has been harvested and in fallow fields adjacent to the marsh. Feeding in these fields is more common when the waterfowl hunting season is closed.

Management of marshland by control of water levels is costly and often difficult. On the other hand, control of water levels in ricefields for waterfowl management has been simplified due to the presence of levees and drainage canals that are necessary during rice culture. Since