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THE WOOD DUCK ROOST COUNT AS AN INDEX TO WOOD DUCK ABUNDANCE IN LOUISIANA

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INTRODUCTION

Wood duck censusing methods have been the subject to much research and discussion in recent years. The wood ducks' habitual use of secluded wooded areas with dense overhead cover precludes aerial censusing used in marsh areas. Hester (1965) stated that the elusive ways of wood ducks, together with lack of visibility in wooded bottomlands, almost completely eliminate the possibility of counting a representative sample of the wood duck population, so that the status of the population might be determined.

The roosting habit of wood ducks has been considered by many as a possible tool for censusing wood ducks. Haugen and Hein (1965) found autumn roosting flight counts useful as an index to annual changes in abundance of wood ducks in Iowa. The target date for counts in Iowa was September 20 plus or minus five days. Flight counts were found superior to float counts in Iowa (Hein 1966). Stewart (1958) states that among river float counts, brood counts, and evening flight counts, roosting flight counts were the best means of obtaining an estimate of wood duck populations in a restricted area such as a refuge. According to Stewart, counts of wood ducks on roosting flights were especially useful where a habitat island such as an isolated lake was being inventoried. Hester (1956) stated that the number of ducks using a roost would be expected to vary from year to year as the flyway population increases or decreases and correlation of changes in roosting numbers with changes in flyway populations would indicate reliability in the counts as a population index. Smith (1958) in Louisiana's vast areas of wood duck habitat, was hindered by the unknown effects of fluctuation in amounts of surface water.

A study from July to February 1971 was undertaken in Louisiana to evaluate the roosting flight count as an index to wood duck population trends in Louisiana. Attempts were made to isolate factors other than fluctuation in wood duck populations that affect numbers of roosting wood ducks.

STUDY AREA

The study was conducted at roosting sites throughout Louisiana. Ducks were observed roosting in sloughs, man made lakes, ditches, rice fields, beaver ponds, flooded stream bottoms, and natural lakes. Roosting cover was largely cypress (*Taxodium distichum*), tupelo gum (*Nyssa aquatica*, Willow (*Salix* sp.), ash (*Fraxinus* sp.) overstory with water elm (*Planera aquatica*), buttonbush, (*Cephalanthus occidentalis*), swamp privet (*Foresteria acuminata*) understory.

PROCEDURE

Ducks arriving at forty four roosts were counted from twenty minutes before sunset until thirty minutes past sunset on the first and third Thursday of each month from July through February for two consecutive years. Variables measured were cloud cover, temperature, water level fluctuation, and presence or absence of duck shooting and precipitation during the counting period.

Two of the roosts were selected by the author for concentrated study; one each year. Counts were conducted as described above and additional measurements taken were barometric pressure and realtive humidity at the beginning of the counting period. Also, light intensity was recorded at the time of arrival of the first duck, last duck and greatest concentration of ducks.

An additional study was conducted on four roosts during October 1970. Roosts 2, 5, 27 and 33 were inventoried on October 7, 8 and 9, 1970.

STATISTICAL ANALYSIS

Roosts 2, 5, 27 and 33. An analysis of variance was performed with the sources of variation roosts and days within roost obtained (Snedecor 1967). The days within roost source of variation was of particular interest as it provided an estimate of the day to day variation within roosts.

Total number of ducks seen was regressed on time intervals about sunset (T, T^2, T^3, T^4). Tests for significance of linear, quadratic, cubic and quartic effects of time on number of ducks seen in the curvilinear regression ($Y = b_0 + b_1X_1 + b_2X^2 + b_3X^3 + b_4X^4$) (Snedecor 1967) were con ducted. Non-significant terms were deleted from the equation by a backward deletion procedure.

Concentrated Study Roosts 1 and 5. Total number of ducks seen was regressed on days since July 1 (D, D^2, D^3, D^4) and on time intervals about sunset (T, T^2, T^3, T^4) for each year and over years with tests for curvilinear effects mentioned above. Mean light intensity readings at the time of arrival of the first, last and greatest concentration of ducks were calculated for each roost year and over years.

Times of arrival of the first duck and the last duck were regressed on days since July 1 (D, D^2, D^3, D^4) for Roost 1, and Roost 5 and combined roosts (over years) as described above.

Effects of temperature, barometric pressure, and relative humidity on time of arrival of the first and last duck were tested. A multiple regression was performed where time of arrival of the first and last duck was regressed on the 3 variables ($Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3$) (Snedecor 1967) for Roosts 1, 5 and combined (years 1 and 2).

All Roosts Statewide. Peak arrival time in relation to sunset was obtained for Years 1 and 2 and over Years by regressing number of ducks seen per time period on time as mentioned above. Curvilinear effects were tested. To determine the effect of cloud cover on time of arrival of ducks in relation to sunset the above procedure was repeated within each cloud cover class.

Effect of water level fluctuation on total ducks seen was determined with a curvilinear regression to total ducks on water level (W, W^2, W^3). Total ducks sighted per day was also regressed on temperature T, T^2, T^3, T^4) and wind velocity (W, W^2, W^3, W^4).

Effects of shooting, precipitation, and cloud cover on time of arrival of ducks and total ducks seen was determined by inspection of mean number of ducks seen for each of the above three factors.

A least squares analysis of variance for disproportional subclass (year by roost combination) numbers with the effect of date (linear, quadratic, cubic) removed as a covariable was used to test the year by roost interaction for total ducks seen per roost day.

Analysis of regression was used to determine peak dates of occurrence of singles, pairs, flocks, average flock size, and total ducks for each year and over years. Number of ducks seen by each class was regressed on date, as mentioned above. The same process was repeated for time of arrival of first and last duck.

RESULTS

Roosts 2, 5, 27 and 33. Results of the 1969-70 counts revealed that total number of birds seen was greatest during the first two weeks of October. It was thought that variation between days in number of birds seen was least during this time, thus early October appeared possible as the time to conduct the count in order to obtain the most reliable pre-hunting season index, provided the roost count proved to be practical.

Results indicate unreliability in the roosting flight count technique. The magnitude of the error term in the analysis of variance indicated considerable variation in numbers of birds seen due to difference between days on the same roost (Table 1). Roosts 2 and 5 were quite stable from day to day but 27 and 33 showed day to day variation.

TABLE 1. Analysis of variance for Roosts 2, 5, 27 and 33 for October 7, 8 and 9, 1970

Variance Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Corrected Total	11	12298.9167		
Roost	3	1872.9167	624.3056	0.479 NS *
Day/Roost	8	10426.0000	1303.2500	

* Not significant (P < .05).

The statewide study also indicated a lack of reliability in the roosting flight count as an index to wood duck abundance in Louisiana. The highly significant year by roost interaction (Table 2) indicates unreliability in the technique. Within roost, the number of birds observed was not stable from year to year. The greater total number of ducks over all roosts was seen during year 1. But on several roosts the mean number of ducks seen per roost day was lower in year 1 than year 2. This trend occurred frequently enough throughout the study to render the above interaction highly significant.

TABLE 2. Least squares analysis of variance for disproportional subclass numbers with the effect of date (linear, quadratic and cubic) removed as a covariable.

Source	df	SS	MS	F
Year	1	133214.057	133214.057	20.221 *
Roost	41	1560849.872	38069.509	5.779 *
Year x Roost	41	965311.853	23544.192	3.574 *
Date (Linear)	1	1044.385	1044.385	0.159
Date (Quadratic)	1	22173.261	22173.261	3.366
Date (Cubic)	1	22863.302	22863.302	3.470
Error	947	6238900.309	6588.068	

* (P < .01).

Factors other than fluctuation in population numbers obviously affected roosting numbers. Variation in amounts of surface water throughout the state affected observed roosting numbers. Water level, as measured at each roost, showed no effect on roosting numbers. The large number of "roosts" that contained water but still were not used by wood ducks partially accounts for the apparent lack of significance of the effect of water.

Total ducks seen on all roosts statewide reflects the overall effect of water level on roosting activity. During Year 1 the mean departure from mean annual precipitation for Louisiana was 6.76 inches as opposed to 5.47 inches for Year 2. During Year 1, 7,386 ducks were observed as opposed to 3,460 during Year 2. Increased surface water reduced observed numbers of roosting ducks.

Shooting ranked high as a factor affecting numbers of roosting ducks seen statewide. The count following opening of the waterfowl season showed that roosting numbers decreased 80 and 75 percent in comparison to the count preceding the waterfowl season for Years 1 and 2 respectively (Table 3). The count following closing of the season showed an increase of 65 and 66 percent for Years 1 and 2 respectively.

TABLE 3. Total ducks seen on all roosts by date

Year 1		Year 2	
Days Since July 1	No. Ducks Seen	Days Since July 1	No. Ducks Seen
17	530	15	137
38	1336	36	115
52	959	50	290
66	950	63	270
80	1788	77	278
94	2775	99	564
108	2486	106	471
129	2129	128	1776
143	400*	142	454*
157	509*	156	479
171	449*	170	537*
199	1276	198	196*
213	1504	205	574
227	1633	219	447
240	2460	233	798

* Waterfowl season in progress.

Wind direction showed no effect on numbers of roosting ducks.

Cloud cover affected the observed arrival time of wood ducks and the total number observed arriving. The total number observed arriving decreased as cloud cover increased. This was due to decreasing visibility as cloud cover increased. As there was no measure of birds not seen, the true arrival time in relation to sunset could not be determined. Observed birds arrived earlier as cloud cover increased. Time of peak arrival for clear, partly cloudy and cloudy conditions was 22, 17.5, and 12 minutes past sunset respectively.

Presence of precipitation affected observed arrival time of the ducks. The mean observed arrival times for the first and last duck respectively were 2.2 and 6.0 minutes earlier during rain than when there was no rain.

Regression analysis showed that temperature had no effect on total ducks seen per roost day.

Regression analysis revealed no effect of wind velocity on total number of ducks seen per roost day.

Barometric pressure and relative humidity, as measured in this study, showed no affect on arrival time of ducks or total ducks observed.

Time of arrival of wood ducks in relation to sunset showed an interesting trend. In all concentrated study areas peak duck arrivals occurred after sunset. Peak arrival time was 21 minutes past sunset for Roosts 1 and 5 combined. Difference between time of arrival of the last duck and sunset increased as the year progressed (Figure 1). Arrival time is then related to day length. As the days become shorter and the interval between sunset and dark becomes shorter during fall and winter, the ducks arrive at the roost nearer dark. This fact was also documented by Hein in Iowa (Hein 1965).

Shooting also affected time of arrival of the first and last duck in relation to sunset. Mean time of arrival of the first duck in absence of shooting preceded mean arrival time during shooting by 5.3, 2.1 and 4.2 minutes for Years 1 and 2 and over Years, respectively, corresponding figures for arrival time of the last duck are 1.0, 5.0 and 2.2 minutes. Inspection of the means indicate that shooting affected arrival time of the first duck to a greater extent than arrival time of the last duck. Wood ducks, when harrassed by hunters, seek a roosting site free from hunting. Such areas are numerous throughout the state.

PERCENTAGE COMPOSITION OF THE TOTAL BY SINGLES, PAIRS, AND FLOCKS

Percentage composition by date of the total number of ducks seen as to singles, pairs and flocks shows an interesting trend. During late summer and early fall, percentage of the total in singles was at its peak. This could represent unpaired young of the year. After opening of the waterfowl season frequency of singles drops and is lowest during early spring when mating is in progress.

Percentage of the total in pairs was at its peak during the last three counts in the spring. Pairing, breeding and nesting are in progress at this time and probably account for the trend. During the remainder of the season, frequency of pairs showed no particular trend.

Flocks comprised the largest percent of the total for all counts after October 1 for both years. Percentage of the total in flocks was at its peak during October and November when total peaked. These data suggest that the large buildup in total numbers of roosting ducks during October and November is due largely to arrival of flocks at the roost. The flocks could be local or migratory birds and are probably some of both.

Patterns of the relationship between flocking and pairing by season is best illustrated by Figure 2. During fall and early winter the percentage of flocks was increasing while both singles and pairs decreased. Flocks were formed at the expense of singles and pairs. Pairs were formed at the expense of flocks during the spring. The decline in flocks could also be due to departure of migrants.

MANAGEMENT IMPLICATIONS AND SUGGESTIONS FOR FUTURE STUDY

Development of the wood duck roosting flight count as a reliable population index is dependent on future research and development of the basic techniques involved in this study. If roosting flight counts are ever conducted with a statewide index as the goal, weather conditions should be as stable, calm and uniform as possible over the entire state. Counting during the waterfowl season is useless. Only total numbers should be recorded from 25 minutes before sunset until 30 minutes past sunset. All observers must conduct counts in the same manner.

Questions have been raised as well as answered by this study. Future studies should be directed at obtaining some measure of roost quality and stability. The magnitude of total number of ducks roosting is unimportant. Many roosts in this study were low in quality and stability and produced data that indicated unreliability in the technique as an index.

Location of high quality roosts, such as Roost 5 (Port Hudson) that show the most day to day stability in total roosting numbers during late October and early November would present the best tools for improvement of the roost count technique. Intensive counting of these roosts over one month's time would give better data for evaluating the reliability of the technique as an index. It is logical that increasing the number of these roosts and increasing the number of years of the study will yield a better estimate of the reliability of the roosting flight count as an index to wood duck abundance in Louisiana. More information is also

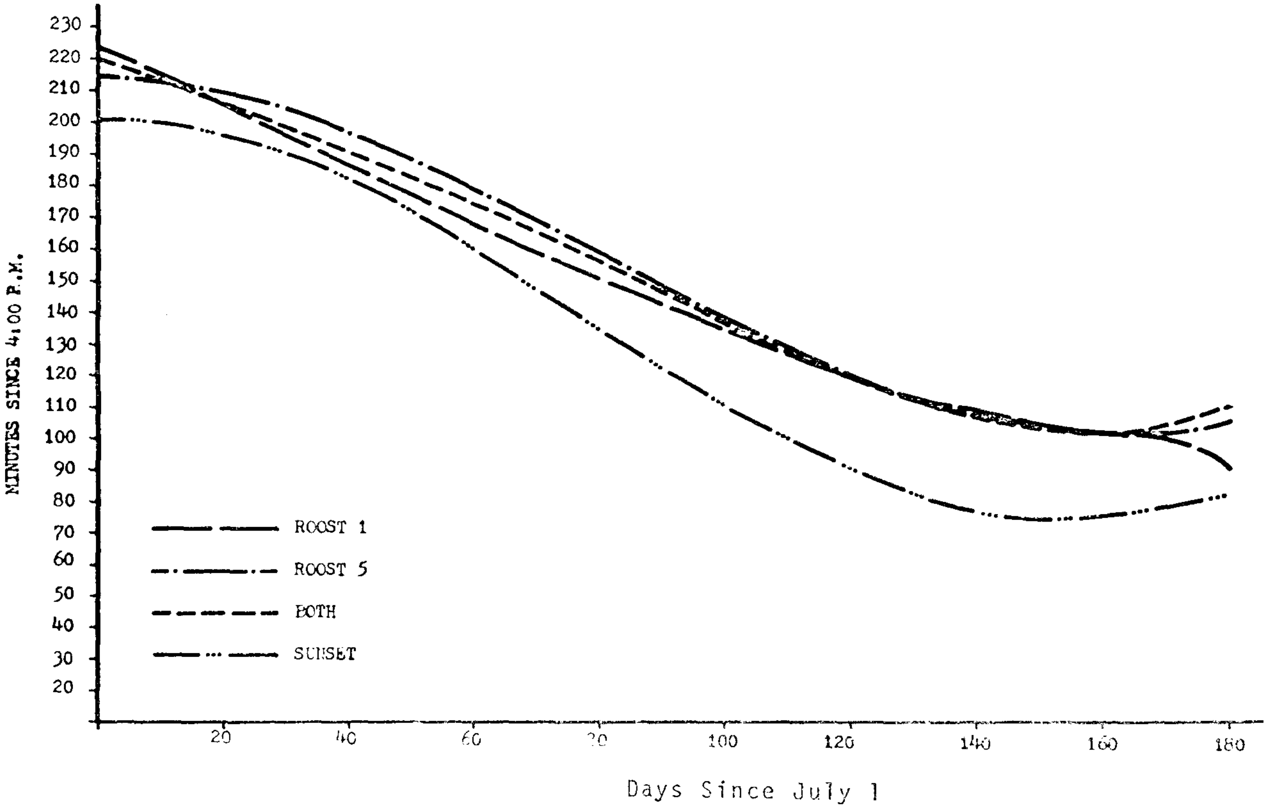

FIGURE 1. Regression of Time Last Duck Was Seen in Minutes Since 4:00 PM on Days Since July 1 for Roosts (Years) and Over Roosts

R^2	
.8955	Roost 1: $Y = 214.687 - .953\ D + .0000004377\ D^4$
.95624	Roost 5: $Y = 204.291 - .013\ D^2 + .0000534\ D^3$
.9285	Combined: $Y = 209.87 - .6655D - .0000398\ D^3 + 00000023\ D^4$

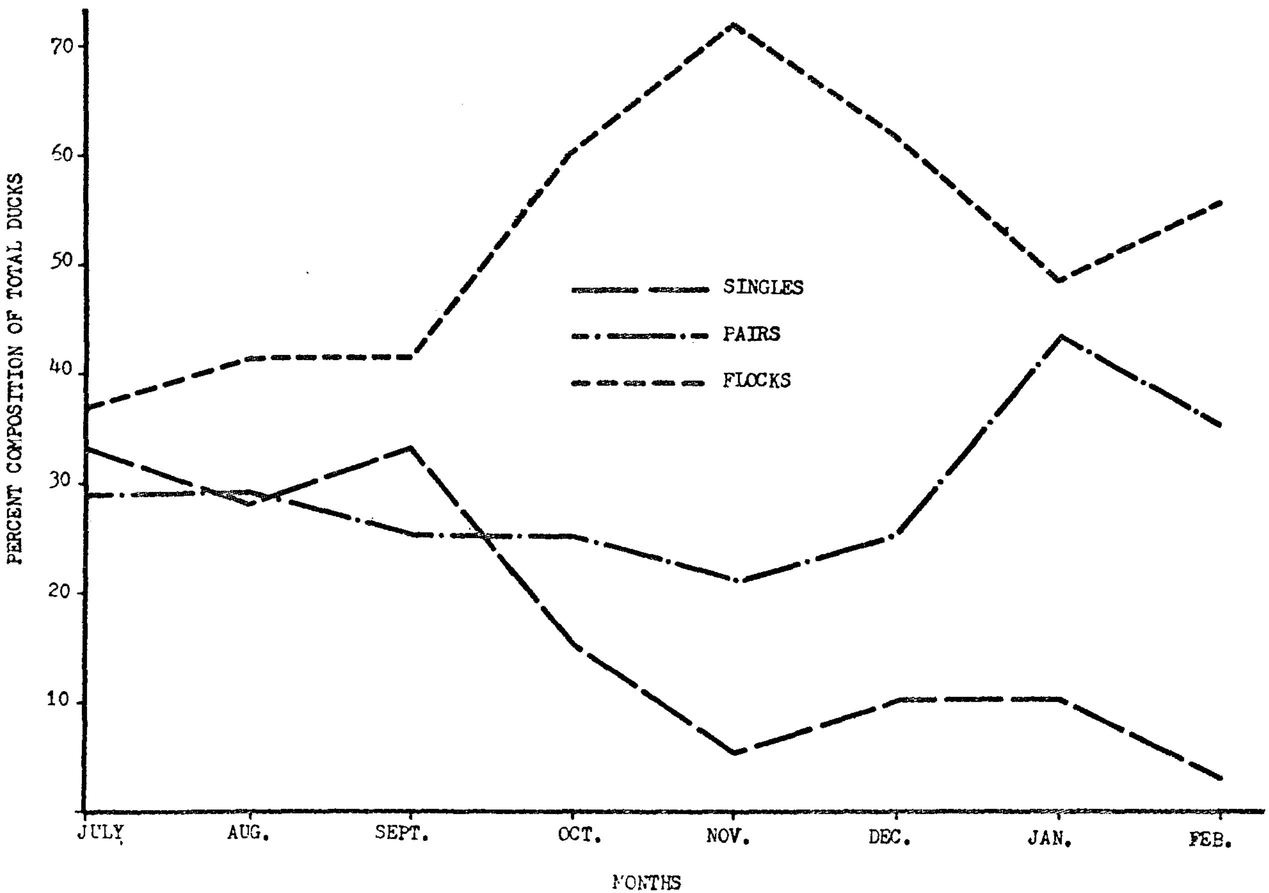

FIGURE 2. Percent Composition of Total Ducks Seen as Singles, Pairs and Flocks by Month for All Roosts over Years

needed on spatial distribution of roosts and number or roosts used by individual ducks. Are wood ducks attached to traditional roost sites and why? Do all age and sex classes make equal use of roosts?

One other management implication of consequence is the problem of shooting roosting wood ducks. It is evident that in almost all cases if a hunter hunts until wood ducks stop flying in the evening he is in violation. Attention should be given to this problem as well as the high crippling loss and unretrived kill resulting from roost shooting.

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PRODUCTIVITY OF GEORGIA COTTONTAILS [1]

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ABSTRACT

Between October, 1965 and April, 1968, 446 adult female cottontail rabbits (*Sylvilagus floridanus*) were collected from the Mountain, Piedmont, and Coastal Plain physiographic regions of Georgia. Prevalence of pregnancy and litter sizes were determined from data on dissected specimens. Although average litter size exhibited a peak of 3.53 in April, no significant differences were noted among months. Also, no significant differences in litter sizes were observed among physiographic regions. Data on prevalence of pregnancy revealed a high percentage of pregnant females in March, April, and May only. Reduced litter sizes, numbers of litters per season, and prevalence of pregnancies

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