SQUIRREL AND RABBIT ABUNDANCES IN THE ATCHAFALAYA BASIN, LOUISIANA[1,2]

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ABSTRACT

Relative abundances of gray squirrels (Sciurus carolinensis), *fox squirrels* (Sciurus niger), *and swamp rabbits* (Sylvilagus aquaticus) *were determined in three main forest types of the Atchafalaya River Basin. Squirrel observations and rabbit fecal pellets were used to index population densities. Squirrel abundance varied by overstory type ($P<0.01$) and was highest in bottomland hardwoods* (Celtis-Fraxinus-Liquidambar-Ulmus). *A significant difference was not indicated between squirrel densities in cypress-tupelo* (Taxodium-Nyssa) *or cottonwood-willow-sycamore* (Populus-Salix-Platanus). *Rabbit abundance varied by overstory type ($P<0.01$) with highest densities in bottomland hardwoods and lowest densities in cypress-tupelo.*

Silt deposition within the levee system of the Atchafalaya River Basin has increased ground elevations and decreased the Basin's flood control capability (Hebert 1967). To remedy this situation the U. S. Army Corps of Engineers plans to increase the main channel of the Atchafalaya River to a minimum dimension of 9,290 m^2 (U. S. Army Engineer Waterways Experiment Station 1973). Channelization may have long-term effects on the forest composition and associated wildlife of the Basin. To assess possible effects of channelization, the U. S. Fish and Wildlife Service initiated a comprehensive baseline inventory of faunal and floral components of the Atchafalaya River Basin. The present study was one part of that survey.

Gray squirrels, fox squirrels, and swamp rabbits occur throughout the Atchafalaya River Basin. Soileau et al. (1975) estimated that during 1971-74 a yearly average of 146,000 man-hours of recreation were spent hunting small game animals in the Atchafalaya River Basin south of U. S. Highway 190; an estimated 23,000 rabbits and 33,000 squirrels were harvested annually. A vegetative cover map of the Atchafalaya Basin, prepared by Tabberer (1972), indicated three predominant overstory types: bottomland hardwoods (151,505 ha), cypress-tupelo (99,757 ha), and cottonwood-willow-sycamore (26,165 ha). No work had been done to associate the densities of squirrel and rabbit populations to these three forest types. This study had two primary objectives: (1) determine the relative abundances of squirrels and rabbits in each of the three overstory types, and (2) rank the three overstory types according to their degree of utilization by squirrels and rabbits.

Although tag-recapture data provide the most reliable method for estimating the total population of squirrels or rabbits on a specified area (Greathouse 1950, Flyger 1955), the time required to conduct such surveys in the Basin would necessarily limit the size of the sample area to a very small proportion of the total area. Because of the vast size of the Basin (3,370 km^2) and the diversity of habitats within overstory types, visual observations of squirrels and densities of rabbit fecal pellets were selected as the most feasible methods to index population densities.

[1] This study was part of a Master's thesis (Heuer 1976) which is on file at Louisiana State University.

[2] Louisiana State University, Louisiana Wild Life and Fisheries Commission, U. S. Fish and Wildlife Service, and Wildlife Management Institute cooperating.

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MATERIALS AND METHODS

Study Area

The Atchafalaya River Basin is in south central Louisiana. The area selected for study was that portion of the natural basin bordered by Louisiana Highway 1 to the north, U. S. Highway 90 to the south, and the Atchafalaya Basin Protection Levees to the east and west (Fig. 1). The area averages 153 km long, 22 km wide, and has a level to nearly level topography with elevations generally less than 15 m above mean sea level. The Basin is subject to frequent and prolonged flooding. Water levels and the amount of land inundated fluctuate seasonally according to flow rates of the Atchafalaya River; high flow usually occurs in April and low flow in September.

Squirrel Observations

Following range sedimentation lines of the U. S. Army Corps of Engineers (Fig. 1), McClanahan (1975) systematically established 319 points throughout the Basin. We randomly selected ten of these points in each of the three overstory types to serve as squirrel observation posts. Seasonal 1-hour observations were made at each of the 30 observation posts during fall 1974 through summer 1975. All observations commenced 30 minutes after sunrise. Observation posts were approached quietly; the observer wore camouflage clothing and remained as motionless as feasible during the observation period. Because of severe flooding during the winter and spring sampling periods, many observations were made from a pirogue. All squirrels sighted within 360° of the observation posts were recorded. The exact time of individual sightings, species of squirrels sighted, and color phase of fox squirrels were also noted.

Temperature, relative humidity, wind speed, and cloud cover were recorded at the end of each observation period. Temperature and relative humidity were measured with a sling psychrometer (Taylor Instrument Company, Rochester, N.Y.; reference to commercial products does not imply endorsement by the U.S. Government). The Beaufort Number System (a subjective rating based on leaf and twig motion) was used to index wind speed (Marshall 1964). Cloud cover was estimated to the nearest 10 percent. Counts were not conducted during inclement weather (wind in excess of 30 km/h and/or rain).

To determine if a significant difference existed between squirrel densities in the three forest types, the number of fox and gray squirrels sighted during each observation period was examined by a split-plot analysis of variance (Snedecor and Cochran 1967:369-375). Squirrel densities in different forest types were compared by orthogonal comparisons (Snedecor and Cochran 1967:308-310). Seasonal effects on the number of squirrels sighted were subdivided into linear, quadratic, and cubic components (Snedecor and Cochran 1967:349-351). Each of the 120 observation periods was divided into six 10-minute segments, and the total number of squirrels first sighted during the corresponding segments was plotted. The number of squirrels sighted (Y) was regressed on time (X) to evaluate the effect of time on the number of sightings (Snedecor and Cochran 1967:135-171). Relationships between the frequency of sightings and selected weather variables (temperature, relative humidity, wind speed, and percentage sky clouded) were examined by correlation (Snedecor and Cochran 1967:172-198).

Rabbit Log-pellet Survey

Extensive field observations in the Basin revealed that swamp rabbit fecal pellets were seldom found on the ground but often observed on logs. In an attempt to utilize this phenomenon, an examination of logs in each of the three overstory types was conducted. Other investigators have also used pellet occurrence on logs as an index to swamp rabbit densities (Martinson 1961, Terrel 1972). In this study, ten access points were randomly selected in each of the three overstory types. From each access point, we paced 40 m (east

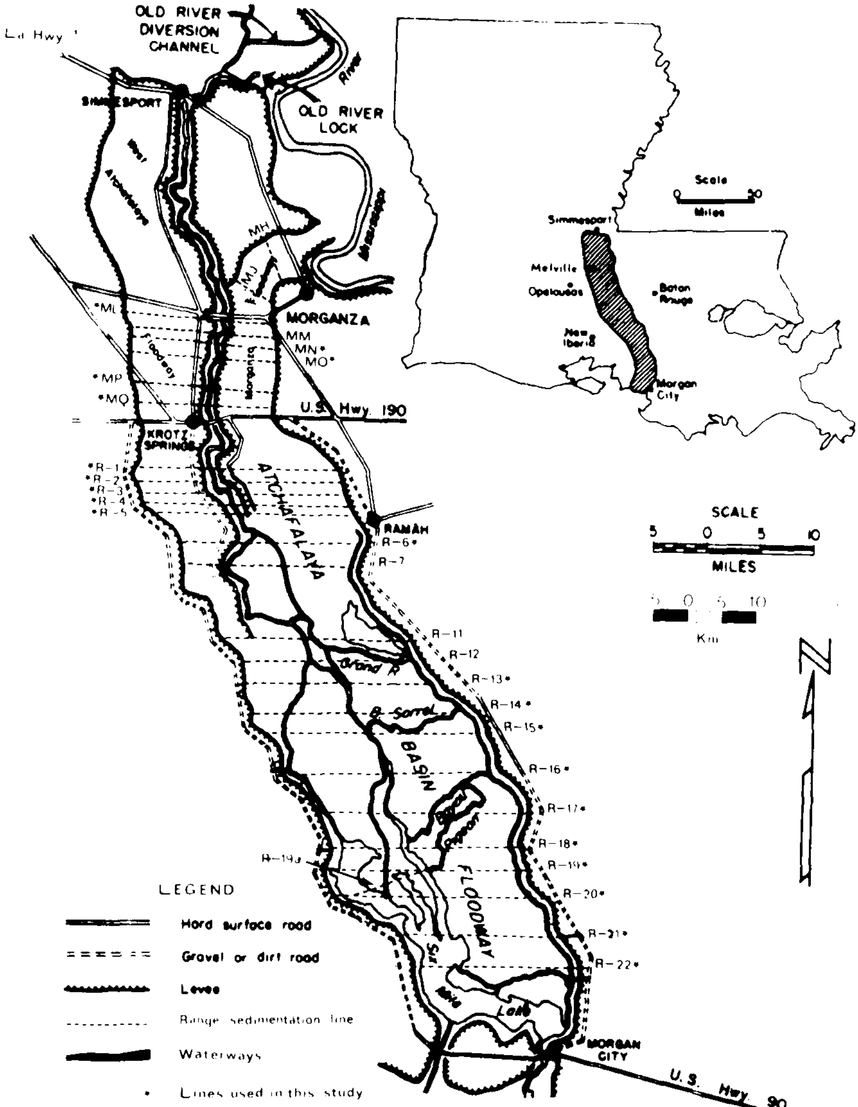

Figure 1. Location of study area, Atchafalaya River Basin, Louisiana.

or west) into the woods and then followed a transect line in the same direction for 201 m. All logs (at least 15 cm in diameter and 1 m in length) within 10 m of the transect line were examined for rabbit fecal pellets. If any part of the log was within 10 m of the transect line, the entire log was examined. The number of logs and the number of logs utilized by rabbits were recorded for each transect line. No distinction was made between logs of different diameters, lengths, or stages of decomposition. The log-pellet survey (initiated 22 November 1975 and completed 16 December 1975) was conducted when water levels in the Basin were low and the cypress-tupelo habitat was not inundated.

To determine if a significant difference existed between rabbit densities in the three forest types, the number of available logs (X) and the proportion of logs utilized by rabbits (Y) on each of the transect lines were examined by analysis of covariance (Snedecor and Cochran 1967: 419-446). Analysis of covariance was selected over analysis of variance because we suspected a relationship might exist between the number of available logs and the proportion of logs utilized by rabbits.

RESULTS

Squirrel Observations

During the 120 observation periods 26 fox squirrels and 16 gray squirrels were sighted. Four squirrels not identified to species were sighted but excluded from all analyses. Only 2 of the 26 fox squirrels were of the melanistic phase. Observation success (the mean number of squirrels seen per observation period) varied significantly ($P<0.01$) among overstory types (Table 1) and was highest in the bottomland hardwoods (0.72); cypress-tupelo was *second (0.20) and cottonwood-willow-sycamore a close third (0.12). Orthogonal* comparisons indicated no significant difference in the number of squirrels observed in the cypress-tupelo and cottonwood-willow-sycamore overstories.

Seasonal variations in the average number of squirrels observed were significant ($P<0.05$). Observation success was high (0.67) during the fall sampling period (24 September to 13 December 1974) and low (0.03) during the winter sampling period (8 January to 26 February 1975). During spring (16 April to 15 June 1975) and summer (24 June to 30 July 1975) sampling periods observation success was nearly equal, 0.36 and 0.33

Table 1. Split-plot analysis of variance for fox squirrels and gray squirrels sighted during 120 observation periods, Atchafalaya River Basin, Louisiana (fall 1974-summer 1975).

Source of variation	*df*	*SS*	*MS*	*F*
Total	239	70.65	0.30	
Overstory type[a]	2	4.28	2.14	6.29**
C-T vs C-W-S	(1)	0.06	0.06	0.17
Bhd vs C-T & C-W-S	(1)	4.22	4.22	12.41**
Season	3	3.02	1.01	2.96*
Linear	(1)	0.33	0.33	0.98
Quadratic	(1)	1.35	1.35	3.97*
Cubic	(1)	1.33	1.33	3.92[b]
Type X season	6	2.66	0.44	1.30
Error (a)	108	36.70	0.34	
Species	1	0.42	0.42	2.20
Species X type	2	0.31	0.15	0.81
Species X season	3	0.62	0.21	1.08
Species X type X season	6	2.16	0.36	1.90
Error (b)	108	20.50	0.19	

[a]C-T = cypress-tupelo; C-W-S = cottonwood-willow-sycamore; and Bhd = bottomland hardwoods.

[b]Marginally nonsignificant ($0.05<P<0.10$).

*$P<0.05$.

**$P<0.01$.

respectively. Seasonal variations in observation success exhibited a quadratic trend ($P<0.05$). There was no significant difference between the number of fox squirrels and gray squirrels sighted, nor were the various interactions of species, overstory type, and season important.

A significant ($P<0.05$) negative regression ($b = -1.26$) was computed for the number of squirrels sighted (Y) on time within the observation periods (X) (Fig. 2). A negative correlation ($P<0.05$) occurred between the number of gray squirrels sighted and temperature (Table 2). The number of fox squirrels sighted was positively correlated with wind speed ($P<0.05$) and negatively correlated with percentage sky clouded ($P<0.01$). The

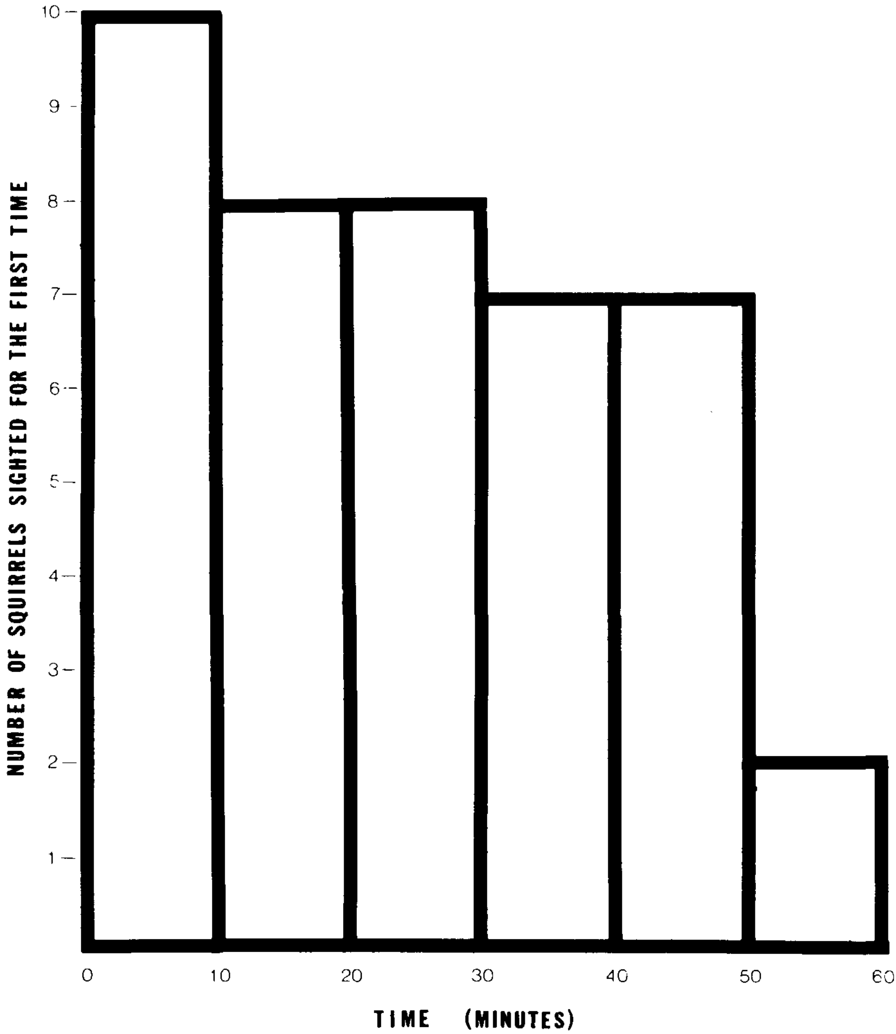

Figure 2. Number of squirrels sighted for the first time during each 10-minute segment of the 120 combined observation periods, Atchafalaya River Basin, Louisiana (fall 1974-summer 1975).

total number of squirrels sighted and percentage sky clouded were also negatively associated ($P<0.01$).

Table 2. Correlation between the frequency of squirrel sightings and selected weather variables, Atchafalaya River Basin, Louisiana (fall 1974-summer 1975).[a]

Species	*Temperature*	*Relative humidity*	*Wind speed*[b]	*Percentage sky clouded*
Gray squirrels	−0.13*/240	−0.10/240	0.06/182	−0.12[c]/240
Fox squirrels	0.04/240	−0.02/240	0.18*/182	−0.18**/240
Total squirrels	−0.05/240	−0.08/240	0.14[c]/182	−0.18**/240

[a]Correlation coefficient (r)/number of observations in the sample.
[b]Wind speed was recorded during winter, spring, summer, and 2 fall observations.
[c]Marginally nonsignificant ($0.05<P<0.10$).
*$P<0.05$.
**$P<0.01$.

Rabbit Log-pellet Survey

In the three overstory types, 891 logs were examined for rabbit fecal pellets. Although there was very little difference in the total number of logs examined in each overstory type, considerable variation occurred in the number of logs per transect line. Analysis of covariance indicated a highly significant difference ($P<0.01$) among the proportion of logs utilized by rabbits in each of the three overstory types (Table 3). Fecal pellets were found on 24 percent of the 301 logs examined in the bottomland hardwoods, 6 percent of the 296 logs examined in the cottonwood-willow-sycamore, and 0.3 percent of the 294 logs examined in the cypress-tupelo. The regression coefficient (b) was low (−0.003), but a significant negative relationship ($P<0.05$) did exist between the density of logs and the proportion of logs utilized by rabbits.

Table 3. Analysis of covariance for the number of available logs (X) and the proportion of logs utilized by rabbits (Y), Atchafalaya River Basin, Louisiana (November-December 1975).

Source of	*Sum of products*				*Y adjusted for X*			
variation	*df*	*XX*	*XY*	*YY*	*df*	*SS*	*MS*	*F*
Total	29	5282.3	−15.25	0.81				
Overstory type	2	2.6	1.12	0.48	2	0.49	0.24	23.41**
Error	27	5279.7	−16.36	0.32	26	0.27	0.01	
Regression	1				1	0.05	0.05	4.84*

*$P<0.05$.
**$P<0.01$.

DISCUSSION

Squirrel Observations

Observation success was four times as great in bottomland hardwoods as in cypress-tupelo or cottonwood-willow-sycamore, indicating that squirrel densities in the Basin were highest in bottomland hardwoods. Sightings in non-bottomland hardwoods were confined to a small number of plots. In the cypress-tupelo overstory, sightings were restricted to timber stands where the overstory or midstory was dense enough to provide a travel medium for squirrels. In the cottonwood-willow-sycamore overstory, sightings were limited to timber stands where a variety of tree species and age classes were present.

Squirrels apparently prefer a diverse habitat (Perry 1974:55) where food and cover are available during all seasons (Goodrum 1940:11). During our study no squirrels were sighted in pure even-aged stands of any one species.

Because of seasonal population trends, observation success was expected to be highest in fall and lowest in winter. However, observation success during the winter sampling period seemed disproportionately lower than success during the fall. This low rate of observation success during winter may be partly attributed to one or more factors: (1) squirrel activity is reduced during cold weather (MacClintock 1970:111, 132); (2) fall values may be inflated due to increased foraging and food storing (Barkalow and Shorten 1973:73-74); (3) during winter, daily activity peaks may occur later in the day (Bakken 1960:393); or (4) winter flooding may encourage squirrels to shift their activities to drier sites (Perry 1974:36).

Less than 10 percent of the fox squirrels sighted were of the melanistic phase. Considerable variation in the ratio of red to black fox squirrels occurs within Louisiana (Lowery 1974:182), and variations in this ratio may occur within the Atchafalaya River Basin. Since 95 percent of all squirrels sighted were recorded during the first 50 minutes of counting, and the number of squirrels sighted for the first time was negatively related to time within an observation period, it appears that observation periods could have been reduced to 50 minutes without affecting the accuracy of the data.

Doebel and McGinnes (1974) statistically examined relationships between squirrel activity and weather, and Perry (1974) correlated squirrel capture success with weather conditions. Our findings are in agreement with Doebel and McGinnes and Perry in that fairly low correlation coefficients were found between the frequency of sightings and the selected weather variables. Even though relationships may exist between squirrel activity and weather conditions, moderate weather changes (no observations were made during severe weather) accounted for little of the variation in the number of squirrels sighted. Variation in observation success is likely affected by sampling error, unknown factors which influence squirrel activity, and diversity of habitats within overstory types. Perry (1974: 27, 30) found capture success of squirrels to be dependent upon sex, age, capture status, area, and habitat.

Rabbit Log-pellet Survey

Survey data indicated that the highest rabbit densities occurred in the bottomland hardwoods, with cottonwood-willow-sycamore second, and cypress-tupelo third. Only 1 of the 294 logs examined in the cypress-tupelo overstory type had been utilized by rabbits, and that log was within 50 m of a spoil bank. Due to frequent and prolonged flooding, cypress-tupelo provided only marginal swamp rabbit habitat. Conaway et al. (1960) and Martinson et al. (1961) also noted negative effects of flooding on swamp rabbits.

Although no attempt was made to measure seasonal variation, significant seasonal fluctuations may occur in the apparent utilization of logs by swamp rabbits (Terrel 1972). Seasonal variations in pellet densities due to rabbit population fluctuations and changes in deterioration rates of fecal pellets have been noted by Krug (1960) and Cochran and Stains (1961). Since all pellet-count data in our study were collected within a 1-month period, seasonal effects should have been negligible.

Rabbit utilization and log size or stage of decomposition may have been related; Terrel (1972) found that most logs which exhibited swamp rabbit pellets were rotted on the upper surface. Fecal pellets were often concentrated in the cracks and crevices of old partially decomposed logs. On smooth logs the pellets would probably have been washed off, blown off, or kicked off by other rabbits. In this study average log size and stage of decomposition appeared approximately equal in each of the three overstory types.

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