Conclusion

Examination of nesting boxes to study gray squirrel reproduction is an efficient and rapid method for gathering data. Adults as well as nestlings are easily captured and examined.

Gray squirrels have two nesting seasons on the eastern shore of Maryland. The late summer season extends from the 27th to the 34th week, with one stray litter on the 37th week. Assuming that the last litters are born on the 34th week and that the young are dependent upon their mother for approximately 10 weeks the squirrel season should begin no earlier than the 44th week or November first if no females with dependent young are to be shot.

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NOTES ON THE LIFE HISTORY OF THE SWAMP RABBIT IN ALABAMA [1]

By EDWARD P. HILL III

ABSTRACT

A swamp rabbit life history study was conducted in Alabama during 1960-1967. Of 438 swamp rabbits taken by hunters on Wheeler National Waterfowl Refuge in northern Alabama during February, 205 (46 percent) were males. In a sample of 64 others collected statewide throughout the year, 29 (45.3 percent) were males. Late winter weights are presented for 322 swamp rabbits examined in north Alabama. Based on implantation sites or corpora lutea counts, the mean size of 95 first swamp rabbit litters of the season was 2.863. The mean size of 17 second litters of the year was 3.176. No significant differences were found between the size of litters from different latitudes or within different litter sequences.

The onset of the swamp rabbit breeding season is well defined in northern Alabama, usually starting in mid-February, and slightly preceding the onset of the cottontail breeding season. The infrequent occurrence of young animals in late winter collections of swamp rabbits from northern Alabama indicates there is little or no fall or early winter breeding by swamp rabbits in that area. A lens weight histogram representative of February age distributions is presented. Based on ages determined by lens weights, a February sample of swamp rabbits contained 58 per cent juvenile which is less than is normally found in cottontail populations, perhaps suggesting greater life expectancy in swamp rabbits.

[1] Presented at Technical Game Sessions of 21st Annual Conference of Southeastern Association of Game and Fish Commissioners, September 1967.

NOTES ON THE LIFE HISTORY OF THE SWAMP RABBIT IN ALABAMA [1]

By EDWARD P. HILL III

A life history study of the cottontail rabbit, *Sylvilagus floridanus* was conducted by the Game and Fish Division of the Alabama Department of Conservation from 1960 through 1967. This study presented numerous opportunities to examine swamp rabbits, *Sylvilagus aquaticus aquaticus* (Bachman). Since little has been published on this species from Alabama, a limited study of swamp rabbit life history was initiated. Broad objectives of the study were to determine: breeding season, litter size, sex ratios, late winter weights, and age distribution based on lens weights.

I wish to acknowledge work by biologists Reynolds W. Thrasher and Robert E. Waters, study leaders for periods 1960-1961 and 1962, respectively. Special thanks are due C. H. Conaway, University of Missouri, and W. F. Colin, Game and Fish Division, Alabama Conservation Department. I also wish to acknowledge the cooperation provided by personnel from Wheeler National Waterfowl Refuge.

Methods

Swamp rabbits were examined at checking stations during annual rabbit hunts in mid- or late-February on Wheeler National Waterfowl Refuge in northern Alabama. A few others were collected year-round throughout Alabama. They were weighed, sexed, and females were examined to determine their condition relative to reproduction. Pregnant uteri were examined grossly, and implantation sites were counted. After 1963, both ovaries were sectioned (while fresh) with a scapel. Each section was teased apart, and corpora lutea were counted to estimate ovulation rates. Commencing in 1963, one eye was removed from each swamp rabbit and processed according to Lord (1959) to provide an indication of age.

RESULTS

Sex Ratios

Of 438 swamp rabbits examined during hunter bag checks at Wheeler National Waterfowl Refuge, 205 (46 percent) were males. Of 64 swamp rabbits shot at night throughout the state, 29 (45.3 percent) were males. These data corroborate work by Hunt (1959) who found 65 males (42.7 percent) in a sample of 152 swamp rabbits collected in east-central Texas throughout the year, but differs from findings in southeastern Missouri where Holten and Toll (1960) found 107 males (56 per cent) in a sample of 191 swamp rabbits shot by hunters during January and February and where Martinson et al. (1961) found the weighted mean percentage of males shot during four hunting seasons was 55. This apparent difference is perhaps due to normal variation or sampling error, but should be considered in future work to detect regional sex ratio differences that may occur.

Late Winter Weights

Weights were taken on 180 females and 144 male swamp rabbits from mid-to-late February throughout the eight-year study period. Pregnant females were not beyond the early implanted stages of gestation. Since 90 percent of the young males and 95 percent of the young females were found by Holten and Toll (1960) to fall within adult weight ranges in January, the weight data in this study were tabulated without regard to age or condition of pregnancy.

[1] (A contribution from Federal Aid in Wildlife Restoration Project—Alabama W-35-R.)

Table 1 contains the means, ranges, and standard deviations of weights by sex and year.

TABLE 1 — MEANS, RANGE AND STANDARD DEVIATION OF WEIGHTS OF SWAMP RABBITS FROM WHEELER NATIONAL WATERFOWL REFUGE COLLECTED DURING MID- AND LATE-FEBRUARY 1960-1967.

Year	Sex	Number	Weight In Grams Mean	Range	Standard Error	Standard Deviation
1960	Female	19	2038	1608-2722	58.2	253.7
1961	Female	36	2099	1588-2495	36.6	219.8
1962	Female	36	2092	1701-2608	34.9	209.7
1963	Female	28	1938	1550-2523	50.0	264.6
1964	Female	22	2085	1474-2467	51.6	242.0
1965	Female	10	2091	1758-2580	84.7	267.8
1966	Female	14	1891	1389-2353	71.6	268.0
1967	Female	15	2047	1673-2438	53.7	208.1
Total		180				
1960	Male	9	2043	1616-2608	115.3	346.0
1961	Male	44	2122	1701-2722	38.1	252.7
1962	Male	22	2103	1701-2495	50.9	238.7
1963	Male	24	2103	1525-2495	56.5	276.7
1964	Male	22	1969	1021-2268	58.0	271.8
1965	Male	9	2023	1814-2325	57.4	172.2
1966	Male	4	1984	1701-2268	118.0	236.0
1967	Male	10	2129	1758-2523	73.3	231.9
Total		144				

The heaviest swamp rabbits (2722 grams), a nonparous female, and two males, are to my knowledge, the heaviest recorded from Alabama. The smallest (1021 grams) was a juvenile with a lens weight of 133 milligrams.

At the 95 percent level, there was no consistent difference between the mean weights of males and females or among the mean weights of the various year groups. The only significant difference found was between males in 1961 and females in 1966.

The infrequent occurrence of small swamp rabbits in these weight data indicates that fall litters are uncommon.

Litter Size

Litter size data in this study were compiled from fetus counts in 44 uteri examined through 1962 and on corpora lutea and/or fetus counts from 68 reproductive tracts examined thereafter. Means and standard deviations for first and second conceived litters of the year were calculated by standard methods on a state-wide basis and for both northern and southern Alabama. They were then tested to determine significant differences between litter sequences and between litter sequences and between geographic locations.

Means of 2.83 (n=28) and 3.7 were reported, respectively, by Hunt (1959) for east-central Texas and Svihla (1929) in southern Louisiana. Toll et al. (1960) found corpora lutea counts of Missouri swamp rabbits averaged 3.7 (n=46), but the mean of embryos 35 mm. and larger from 14 females was 2.8.

In this study mean sizes for first and second conceptions were 2.863 and 3.176, respectively. While this difference was consistent in samples from northern and southern Alabama, it was not significant at the 95 percent confidence level. Neither was there a significant difference between mean litter sizes from different latitudes.

The means, ranges, and standard deviations of swamp rabbit litter sizes are shown in Table 2.

TABLE 2 — MEAN SIZES OF FIRST AND SECOND CONCEIVED SWAMP RABBIT LITTERS COLLECTED FROM NORTHERN AND SOUTHERN ALABAMA.

Litter Sequence And Location	Number	Mean Size	Range	Standard Error	Standard Deviation
1st Concept., North Ala.	79	2.899	1-6	.108	.955
1st Concept., South Ala.	16	2.688	1-4	.176	.702
1st Concept., Statewide	95	2.863	1-6	.094	.918
2nd Concept., North Ala.	6	3.167	2-4	.400	.980
2nd Concept., South Ala.	11	3.182	2-5	.263	.872
2nd Concept., Statewide	17	3.176	2-5	.214	.884

Conaway et al. (1960) reported embryo resorption and pre-implantation loss of ovulate ova in swamp rabbits. Maximum pre-implantation losses were determined by subtracting the number of implantation sites from the number of corpora lutea. In this study, both fetus and corpora lutea counts were obtained from 34 reproductive tracts. Of the 100 ova ovulated, four intra-uterine mortalities were found. Two were pre-implantation losses, both occurring in the same specimen. The other two were resorptions, one occurring in each of two specimens.

The number of mortalities found is perhaps minimal as only gestation sacks abnormal in size or color were opened along with 1 or 2 others for taking embryo measurements. It is also possible that some corpora lutea were missed in spite of the confidence placed in the method of ovary dissection. Another factor possibly influencing a minimal number of mortalities is that most of the pregnant uteri were in early gestation and would not indicate the total mortality that may occur through term gestation.

Breeding Season

The onset of the swamp rabbit breeding season in northern Alabama is well-defined. Copulation usually starts in mid-February or occasionally in late January, slightly preceding the onset of cottontail breeding. Data for comparing commencement of swamp rabbit breeding in northern Alabama on a year-to-year basis are presented in Table 3 along with data on cottontail breeding during the same period.

TABLE 3 — IMPLANTED AND PRE-IMPLANTED PREGNANCY RATES IN ANNUAL COLLECTIONS OF SWAMP AND COTTONTAIL RABBITS FROM WHEELER NATIONAL WATERFOWL REFUGE DURING FEBRUARY 11 THROUGH 25, 1960 THROUGH 1967.

Percent of Swamp Rabbit Pregnancies			Percent of Cottontail Pregnancies			Dates of February Collection
Implanted	Pre-implanted	Total	Implanted	Pre-implanted	Total	
60.6	..	..(33)	19.1	..	..(94)	15-20, 1960
36.0	..	..(50)	9.8	..	..(102)	13-18, 1961
18.6	..	..(42)	3.1	..	..(64)	12-17, 1962
16.6*	13.4	30.0(30)	4.6	9.4	14.0(64)	11-16, 1963
13.6	27.3	40.9(22)	6.8	0.0	6.8(73)	15-19, 1964
40.0	50.0	90.0(10)	54.9	11.7**	66.6(51)	22-23, 1965
7.7	23.1	30.8(13)	3.7	35.1	38.8(54)	14-15, 1966
60.0	20.0	80.0(15)	44.1	27.9***	72.0(68)	24-25, 1967

*Includes one pre-implanted second pregnancy. **Includes one pre-implanted second pregnancy. ***Includes three pre-implanted second pregnancies. Numbers in parentheses are sample size.

If one compares the implanted pregnancy rates, the onset of breeding activity within the two species appears correlated. There also appears to be a correlation between pregnancy rates of both species and the time of collection. In an earlier report (1965) I suggested that temperature has a marked influence on the onset of cottontail breeding in northern Alabama. This may also occur in swamp rabbits and further work, including back-dating of swamp rabbit conceptions, is needed to provide a better understanding of factors influencing the onset of swamp rabbit breeding.

If temperature has a major influence on the onset of swamp rabbit breeding, it is reasonable to expect the warming influence from the Gulf of Mexico to produce an earlier and more gradual onset of breeding in its southern range, including southern Alabama, than is found further north.

Although few data are available to indicate when the breeding season starts in south Alabama, Sivhla (1929) found young rabbits *S. a. littoralis* in south Louisiana from January through September indicating breeding may occur from December through August.

Due to the difficulty of making late summer collections, few data are available which define the termination of the breeding season. The infrequent occurrence of young animals in the winter body weight and lens weight data from northern Alabama suggests that fall reproduction is minimal in that area.

Age Distribution

Dried eye lens weights have been used as an indication of age in several mammals. Histograms of lens weights showing cottontail age distributions have been reported by Edwards (1962) and Wight and Conaway (1962). Martinson et al. (1961) presented a histogram of 145 swamp rabbit lenses. They also found the mean percent of juveniles in 437 specimens taken from 1957 through 1960 was 61. Using procedures proposed by Petrides (1949), they found that the average longevity for swamp rabbits that survived until the shooting season was 1.6 years.

In this study, 116 lens weights were obtained from swamp rabbits collected in northern Alabama during February 11 through 25, 1963 through 1967. The distribution of these lens weights is shown in Figure 1. The weight ranges Martinson et al. (op. cit.) found valid for distinguishing adult from first year swamp rabbits were used as a guide in this study. Lenses weighing less than 200 mg. and those weighing more than 200 mg. were classed, respectively, as juveniles and adults. The percent of juveniles in these annual samples varied from 45.4 to 67.2 with a mean of 58.6 ($n = 99$). Following procedures proposed by Petrides (1949), an average longevity of 1.7 years was computed for swamp rabbits surviving until late February. These data corroborate the findings of Martinson et al. (1961).

When compared with cottontails whose average longevity is approximately 1.3 years for specimens surviving until December, the swamp rabbit has a greater average longevity. Factors which appear to favor its survival and life expectancy over the cottontail are its size, its readiness to take to water, and its preferred habitat which appears to afford better escape cover.

The foregoing suggest that the swamp rabbit may have a greater life expectancy than the cottontail. Such a relationship would follow the trend in the animal kingdom for an inverse correlation between life expectancy and reproductive potential; however, further work is needed to better understand these apparent differences.

SUMMARY

A swamp rabbit life history study was conducted in Alabama during 1960-1967. A sample of 438 swamp rabbits taken by hunters on Wheeler National Waterfowl Refuge in northern Alabama during February contained 205 (46 percent) males. Of 64 other rabbits collected statewide throughout the year, 29 (45.3 percent) were males.

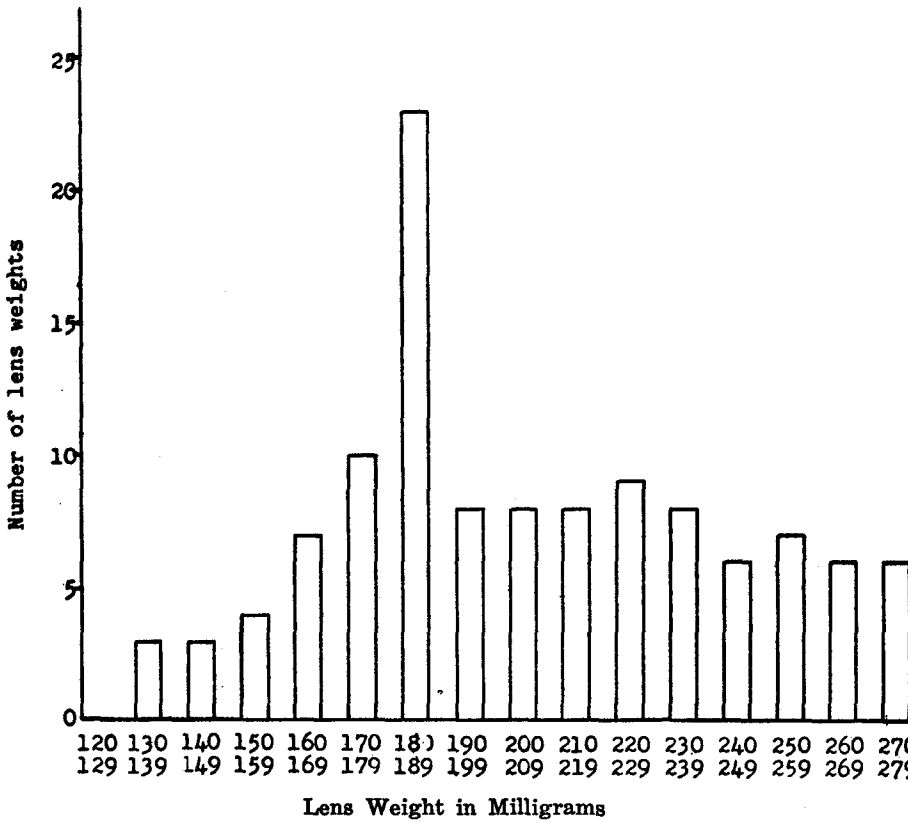

Figure 1. Lens weight distribution of 116 swamp rabbits shot by hunters during February 11-25, 1963-1967.

Late winter weights from 322 swamp rabbits are presented. There was no significant difference between weights of different sexes or among the weights of the various year groups.

Based on implantation sites or corpora lutea counts, the mean size of 95 first swamp rabbit litters of the season was 2.86. The mean size of 17 second litters of the year was 3.17. No significant differences were found between the size of litters from different latitudes or within different litter sequences.

The onset of the swamp rabbit breeding season is well defined in north Alabama, usually starting in mid-February, slightly preceding the onset of the cottontail breeding season. The infrequent occurrence of young animals in late winter collections of swamp rabbits from northern Alabama suggests that fall reproduction is minimal in that area.

Based on ages determined by lens weights, a February sample of swamp rabbits contained 58 percent juveniles which is less than is normally found in cottontail populations, perhaps suggesting greater life expectancy in swamp rabbits.

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WINTER FOOD AVAILABLE TO THE WILD TURKEY IN A HARDWOOD FOREST

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ABSTRACT

An analysis was made of 1132.5 square feet of forest litter collected during the late winter in a bottomland hardwood forest area of the Mississippi Delta. A seed cleaner and a Trier sampler were used to separate food items from litter trash and derive a quantitative estimate. Food available to the turkey averaged 135 lbs. per acre. Sugarberry seeds made up one-half of the entire amount. The next two most abundant items found were insect galls, 22.5 lbs., and grape, 19.6 lbs. The food items most commonly found in analysis of wild turkey crops and droppings were those usually appearing in the least quantity in the litter analysis. Pecan, animal matter, spice bush, and wild grape were the food items most frequently eaten by the wild turkey.

* * * * *

The main purpose of this study was to determine the quantity of food available for the wild turkey (*Meleagris gallopavo silvestris*) prior to the nesting season in a bottomland hardwood area in the Mississippi Delta. A recent study at Mississippi State University (Gardner, 1966) showed that food items utilized by the wild turkeys prior to the nesting season will significantly influence egg production even though the weights of the tested birds are not significantly influenced. Many wild turkey food habitat studies have been reported, but no published research has been found concerning the quantity and availability of food for the wild turkey during the critical pre-nesting period in the Southeastern United States. As another part of this study we investigated the choice of food items made by the turkey in the Delta area.

STUDY AREA

The study area was located on the Donaldson's Point Hunting Club, Gunnison, Bolivar County, Mississippi. The hardwood bottomland was located between the Mississippi River levee at Gunnison and the Missis-