KENTUCKY SQUIRRELS

E. COOPER BETRAM, Department of Fish and Wildlife Resources, Frankfort, Kentucky
WILLIAM L. GAULT, Department of Fish and Wildlife Resources, Frankfort, Kentucky

Proc. Annu. Conf. Southeast. Assoc. Game & Fish Comm. 6:591-605

Pittman-Robertson Project W-26-R, "Squirrel and Rabbit Investigations in Kentucky," was initiated on January 1, 1950. Mr. E. Cooper Bertram was assigned as Project Leader for the Squirrel Phase and Mr. Joe Bruna for the Rabbit Phase. Mr. Bertram carried on the research for this phase of the project through June, 1952, at which time he resigned to enter private business. In June of 1951, Mr. Gault was employed as part time aid while attending the University of Kentucky and advanced to the job of full-time assistant in March, 1952. Mr. Gault prepared this paper from the final project report prepared and submitted by Mr. Bertram.

The primary objectives of this study were to determine the major breeding season, or seasons, and to try to determine the environmental requirements conducive to a high population.

Both the northern *(Sciurus carolinensis leucotis)* and southern *(Sciurus carolinensis carolinensis)* gray squirrels are known to occur in Kentucky, along with the southern fox squirrel *(Sciurus niger rufiventer).* This paper deals with these races of gray squirrels, except where otherwise indicated.

STATE-WIDE AREAS WORKED ON

The squirrel investigation project functioned on a state-wide basis. Listed below are the five geographical divisions of the state with a brief description of each.

Bluegrass

This region is characterized by rich limestone soil, with a high percentage of the land under cultivation. There are few stands of mature timber, with the majority being small farm wood lots. Predominant trees are: ash *(Fraxinus* sp.), oak *(Quercus* sp.), walnut *(Juglans nigra),* sugar maple *(Acer saccharum),* hackberry *(Celtis occidentalis),* and hickories *(Carya* sp.).

Mountains

This division is a portion of the Allegheny and Cumberland Mountain chains. Principal soil type is sandy shale. There are few climax stands of timber and the second growth stands are badly slashed. Much of the timber was, and still is used for supports in the many coal mines of the region. Principal trees are: pine *(Pinus virginia),* hemlock *(Tsuga canadensis),* oaks *(Quercus* sp.), beech *(Fagus grandiflora),* and hickories *(Carya* sp.).

Midland Knob and Barren Region

Principal soil is limestone, with mixed sandstone and shale. Forest cover is largely mixed hardwoods with oak and hickory on the ridges and beech, ash, maple *(Acer* sp.) associations on the slopes.

Pennyroyal

The soil type ranges from deep, well drained, naturally fertile bottom land to low grade limestone, to acid hard pan soils of low fertility. Hardwoods predominate in the uplands and gum *(Liquidambar* sp.), poplar *(Populus* sp.), beech and maple predominate in the lowlands.

Jackson Purchase

The soil is composed of alluvial deposits of sand, gravel, and clay. Forest types found are oaks, gums *(Liquidambar* and *Nyssa* sp.), red cedar *(Juniperus virginiana)* and sugar maple.

Intensive research was centered on two study areas of 50 acres each in Midland Knob and Barren Regions. Originally, four areas were established. However, two were abandoned because the timber was sold from them.

INTENSIVE STUDY AREAS

Coburg Refuge

This area comprises a 50-acre woodlot situated on rather low, poorly drained land, near Coburg, Kentucky, in northern Adair County. Much of the timber in the woodlot has reached the post climax stage of succession. Along the very low ridges and on the better drained land, white oak *(Quercus alba),* black oak *(Quercus veluntina),* and red oak *(Quercus borealis),* predominate with beech, yellow poplar *(Liriodendron tulipifera),* shagbark hickory *(Carya glabra),* mockernut hickory *(Carya tomentosa),* ash, maple *(Acer saccharum* and *saccharinum),* and black gum *(Nyssa sylvatica)* as associates. The only other predominant type present is beech, with associates sugar and silver maples, sweet gum *(Liquidambar styraciflua),* red oak, American elm *(Ulmus americana),* white oak, mockernut and pignut hickories.

Pittman Creek Management Area

Includes all of a 542-acre farm located near Mac, Kentucky, in northeast Green County. A fifty-acre wood lot on gently rolling, well drained land was chosen for the study plot. Some mature poplars, oak, and hickories have been removed in recent years; but many mature trees were left in the stand. Oak-hickory is the predominant cover type found on the area. Included in association with the dominant white, black, and red oaks are the shagbark and bitternut hickories, white ash *(Fraxinus americana),* sugar maple, poplar, beech, black gum, sweet gum, and an understory of dogwoods *(Cornus florida).*

METHODS OF STUDY

Life history data were obtained through live-trapping, hunter bag checks, hunter questionnaires, personal interviews with hunters and farmers, examinations of nests and dens and direct observations.

Trapping

For live-trapping operations, Baumgartner type live traps were used. This is a simple box 26 inches long, 6.75 inches wide and 5 inches deep, with a glass back and a door in front. The door swings up to the top of the inside of the trap and is secured by means of a wire attached to a treadle on the floor. A hole was bored in the top of the trap, centered about 2 inches behind the top of the swinging door. A twenty penny nail was placed in the hole after setting the trap. When the trap is tripped, the spike falls and prevents the door from being pulled up from the inside.

It is suggested, that in the future, 0.25 inch wire mesh be used instead of glass for the back of the traps. Glass is easily broken and often necessitates repairs. It would also be easier to prod squirrels, that are reluctant to enter the cone, through the wire mesh back, than to remove the top of the trap or forceably eject the squirrel by hand.

Metal coverings for the top of the treadle and the inside of the front are also recommended since they suffer greatly from gnawing by trapped squirrels.

Traps were spaced over a 26 acre plot on the Coburg Refuge. No definite plan of placing the traps was followed other than trying to spot them in suitable locations. The number of traps used ranged from 32 to 160.

Yellow field corn proved to be the best all-around bait. Cracked walnuts, peanuts, pecans, hickory nuts, acorns, and white field corn were all used with varying degrees of success. Yellow corn, however, was much more effective.

The traps were visited between 8:00 and 10:00 in the morning, and 4:00 and 6:00 in the afternoon regardless of weather conditions.

Handling Squirrels

A wire cone made of 1 inch poultry netting evolved by Stuever of Michigan was used to hold the trapped squirrels for examinations. The mouth of the cone was placed into the trap and by tapping on the rear of the trap, the squirrel was made to enter the cone. The mouth of the cone was then squeezed together and the squirrel tagged, weighed, sexed, and examined for ectoparasites and external condition.

Diagnosis of Breeding Condition

Male gray squirrels were assumed to be in breeding condition if the testes were descended, and the scrotum black and shiny.

Breeding females were determined by the condition of the mammae, appearance of the hair around the mammae, noticeable weight increase which could be attributed to pregnancy, and examination for swelling of the vulva. Feeling for uterine swellings was also tried, but with no success.

Tagging

The first 25 squirrels taken were ear tagged with a number 3 mammal tag made by the National Band and Tag Company, Newport, Kentucky. They were also tagged with a number one fingerling tag in the same manner as used by J. P. Linduska in Michigan. Ear tags were discontinued after the first 25 squirrels were trapped as a high percentage were tearing the tags from their ear when entering the wire cone after having been recaught.

Only one squirrel was known to retain the ear tag for one year and it dropped from her ear while being rehandled in 1951. Several records show that squirrels toe-tagged in May, 1950, were still wearing the tags in June, 1952.

Census Techniques

Leaf nest counts were made on the 26 acre trapping area. These counts were made in June of 1950, and simply involved counting all of the leaf nests on the area.

Time area counts were made by the observer stationing himself in a selected spot for a designated length of time. During this time a count of all squirrels seen was made. The area of visibility was then measured and the number of squirrels seen in that area used as an index to the total population.

The live trapping method has been explained previously.

LIFE HISTORY

Reproduction

The term "breeding season" as used in this paper is defined as that period, starting with premating behavior and extending throughout pregnancy.

Mating chases were used as an index to the beginning of the breeding season.

In 1950, mating chases were observed to extend into mid-January. Seven mating chases were recorded between June 20 and June 25 of the same year. Chases were also recorded from mid-December, 1950 through January of 1951. A particularly heavy incidence of mating behavior was noted in late June and the first half of July, 1951 and again during Christmas week.

Trapping data show that males in breeding condition were taken from April 30 through October 13 (Table 1).

Females in oestrus were trapped from May 3 through June 28. Those showing evidence of having weaned a recent litter were taken from May 11 through May 22, and October 10, through November 15 (Table 2).

Biologists' counts made during the 1951 hunting season (Table 3), show that pregnant or lactating squirrels were checked between August 20, and October 14, with 97.2% of them being pregnant or lactating between August 20 and September 30.

Since both biologists' check and the hunter kill are limited by the opening date of the squirrel season (August 20 in 1950 and 1951), the significant date derived from these data is September 30, the latest period for taking suckling or pregnant squirrels.

Table 1. Data taken from trap records concerning male gray squirrels in breeding condition 1950 - 1951.

Year	Months examined	Number examined	In breeding condition Number	Percent
1950	May	3	2	66.6
	June	7	1	14.3
	July	11	2	18.2
	August	10	1	10.0
Totals		31	6	19.3
1951	April	3	1	33.3
	May	14	6	42.9
	June	16	6	37.5
	July	20	4	20.0
	August	5	3	60.0
	September	4	3	75.0
	October	1	1	100.0
Totals		63	24	38.1

Table 2. Data pertaining to females in oestrus and those showing evidence of having weaned a recent litter, 1950 - 1952.

Date Examined	No.	Condition
May 11, 1950	1	Recently weaned a litter
May 12, 1950	1	Recently weaned a litter
May 13, 1950	1	Recently weaned a litter
May 15, 1950	2	Recently weaned a litter
June 25, 1950	1	In oestrus
June 27, 1950	1	In oestrus
June 28, 1950	1	In oestrus
June 30, 1950	1	In oestrus
October 17, 1950	1	Recently weaned a litter
May 3, 1951	1	In oestrus
May 22, 1951	1	Recently weaned a litter
October 10, 1951	1	Recently weaned a litter
November 2, 1951	1	Recently weaned a litter
November 15, 1951	1	Recently weaned a litter
March 25, 1952	1	Nursing

By allowing for a nine week rearing period, which is a medium for the eight to ten week period given by Brown and Yeager (1945), the trapped squirrels showing evidence of having weaned a recent litter, dropped their young from February 21 through March 4, and August 23 through September 27. These dates coincide very closely with the periods determined by Hibbard (1935), who found the two annual rearing seasons to be August 3 through September 24, and February 14 through March 3.

Table 3. Data on lactating and pregnant females taken from biologists check sheets during 1951 hunting season, August 20 through November 5.

Date	No. of adult female gray squirrels examined	No. lactating or pregnant	Percentage of breeding females
8/20 to 8/26	42	26	61.9
8/27 to 9/2	28	12	42.9
9/3 to 9/9	21	12	57.1
9/11 to 9/16	10	8	80.0
9/17 to 9/23	4	2	50.0
9/24 to 9/30	14	11	78.6
10/1 to 10/7	4	0	0.0
10/8 to 10/14	8	2	25.0
10/15 to 10/21	3	0	0.0
10/22 to 10/28	1	0	0.0
10/29 to 11/5	1	0	0.0
Total	136	73	53.7

In view of the foregoing observations, it is apparent that there are two annual breeding seasons for Kentucky gray squirrels, one occurring from mid-December through early March and the other between June and late September. By allowing a nine week nursing period, the months, February - April and March - May become important as well as the months August - October and September - November, since the young squirrels are unable to take care of themselves during these periods. Naturally, any gunning pressure before the end of the rearing season would result in a loss of litters, and the full benefit of the fall rearing season would not be realized.

Records kept of one adult female gray squirrel taken on the Coburg Study Area showed evidence of this squirrel having raised three litters during four breeding seasons (2 years).

This female was first taken May 15, 1950, at which time she was lactating. During July 1950, she was recaught and found to be pregnant. She was taken frequently during February, March and April of 1951, but showed no evidence of being pregnant, nor was she lactating. She was again caught in December 1951, and showed evidence of having raised a fall litter. This particular squirrel was handled 74 times.

It is interesting to note that this squirrel failed to produce a litter in the spring of 1951. By referring to Fig. 2 it appears that no spring litters were produced on the study area during 1951.

A cursory survey of the mast in the general vicinity of the study area during the fall of 1950, revealed a poor crop. In March of 1951, one flying squirrel and 13 gray squirrels were found dead on the study area. Autopsy reports attributed their death to a combination of malnutrition and coccidiosis.

During the winter of 1950 - 51, Kentucky experienced severe intermittent ice and snow storms with temperatures as low as -20° Fahrenheit. Available squirrel food was covered by a coating of ice for periods ranging up to two weeks at a time.

With the above incidents in mind, it is a reasonable assumption that a lack of food during the severe winter of 1950, along with disease, could have been responsible for a failure of spring litters.

Seven litters of gray squirrels were examined between April 13, and July 13, 1950. Each of these litters contained three young. Nine litters were examined from June through September 1951. A total of 32 young were in the nine litters, for an average of 3.55 young per litter. The overall average for the litters examined is 3.31.

Embryo counts of 3 gray squirrels, made in September 1950 revealed nine embryos for an average of 3 per litter. Counts made of 15 squirrels, between August 21, and September 18, 1951, showed an average of 3.4 young per litter for an overall average of 3.33 young per litter (Table 4.)

Table 4. Embryo count of gray squirrels in 1951.[a]

Date Examined	No. Exam	No. Embryos
8/21/51	1	3
8/22/51	1	3
8/23/51	3	3-4-5
8/25/51	5	3-4-4-3-5
8/30/51	1	1
9/08/51	1	3
9/13/51	1	1
9/15/51	1	5
9/18/51	1	4

[a] The above table represents the results of 15 female pregnant squirrels examined during the hunting season. An average of 3.4 embryos were found per pregnant squirrel.

Five adult females were collected between September 5 and December 5, 1951. A placental scar count was made, and 16 scars were found indicating an average of 3.2 young per litter (Table 5).

Table 5. Placental scar count of gray squirrels in 1951.[a]

Date Collected	No. Exam	No. Scars
9/05/51	1	2
9/27/51	2	4-3
9/28/51	1	4
11/05/51	1	3

[a] The above table is based on a total of 16 indicating an average of 3.2 young per female.

Kentucky, with respect to geography and climate, is considered a border state — neither north nor south. The weather during the spring breeding season is generally severe enough to confine the rearing of litters to den cavities. Rearing of summer litters however, is not confined to dens and may also take place in leaf nests. In Kentucky, the predominant sites for both leaf nests and dens, are beech and oak.

Sex Ratios (Hunter Kill)

The sex of 8,826 gray squirrels and 1,228 fox squirrels was determined through hunter kill and live-trapping during the course of this study. These data are presented in Table 6.

Table 6. Sex ratio in Kentucky squirrels as determined from live trapping and hunter kill, 1950 - 1952.

	Number		Total	Percent		Sex ratio
Data taken from	Male	Female	number	Male	Female	male:female
Gray Squirrels						
Live-trapping	90	162	252	36	64	55:100
Hunter questionnaire	4,923	3,903	8,826	55	45	126:100
Fox Squirrels						
Hunter questionnaire	676	552	1,228	55	45	122:100

Range

Only four tags were recovered during this study. One of these tags was taken from a squirrel that was approximately 5 miles from the trapping area when shot. The other three tags were returned from points about three-fourths of a mile from the trapping area. As yet, no work has been done on the study area concerning movements or home range.

Average Seasonal Weights of Adults and Juveniles

The average weights, by months, of the 252 squirrels live-trapped on the Coburg Study Area, have been computed and are presented in Table 7.

Table 7. Average weight in ounces of live trapped gray squirrels, 1950 - 1952.

	Males		Females		Spring Juveniles		Summer Juveniles	
Month	Number	Average weight	Number	Average weight	Number	Average weight	Number	Average weight
January	1	13.0	1	21.0	0		7	12.7
February	1	14.0	16	14.6	0		9	13.3
March	8	15.0	27	14.3	0		5	14.2
April	6	16.7	13	5.6	7	8.0	10	14.7
May	17	16.5	52	16.6	36	10.4	4	15.2
June	19	16.2	40	16.8	12	9.3	3	13.8
July	21	16.4	31	17.1	6	9.8	5	13.2
August	7	16.2	8	17.1	1	12.0	0	
September	3	15.8	0		0		1	16.0
October	2	17.5	4	17.0	0		2	8.5
November	0		3	17.3	1	20.0	14	9.6
December	1	14.0	0		0		3	11.0

It is apparent that the average weight of adult gray squirrels during December, January, February, and March is significantly lower than the average during the rest of the year.

A poor mast crop in the fall of 1950, and an outbreak of coccidiosis during the early spring of 1951 could well be the cause of this difference.

Diseases and Parasites

In 1950, five tagged juvenile squirrels were found dead on the trapping area. They showed a reduction in weight (taken from previous weight records), and in death a discharging of the bladder. All of these animals were taken to the University of Kentucky Animal Pathology Department and were autopsied by Dr. R. G. Brown. Cultures made from contents of the intestines showed that these squirrels were infected with coccidiosis *(Eimeria* sp.).

In March 1951, one flying squirrel and 13 gray squirrels were found dead in or near the traps. In addition, two were found dead on this area in April and another in May. According to Dr. Brown, these squirrels were infected with coccidia, and death was attributed to a combination of malnutrition and coccidiosis.

It is believed that the incidence of coccidiosis was extremely high on the trapping area during 1951. Undoubtedly, other squirrels died in inaccessable places and were not found. This is further substantiated by weight records which showed that other squirrels were experiencing a considerable weight loss and when handled were definitely in a weakened and emaciated condition. Many of these squirrels were never recaught and it is assumed that they too succumbed to the aforementioned disorders.

A mange, attributed to *Sarcoptes* sp., was observed on several squirrels during the course of this study. The incidence of infection was not high enough to be considered a limiting factor.

TRAPPING RESULTS

From 32 to 160 traps were utilized for trapping squirrels on a 26 acre plot on the Coburg Refuge. Trapping in 1950 was carried on from May 1 through August 28. In an effort to secure further life history data, the Coburg Refuge plot was continuously trapped from February 22, 1951 through June 30, 1952. During the periods mentioned above, a total of 252 squirrels were tagged. Table 8 shows the original catch with reference to dates and age classes.

Table 8. Original catch.

	Adult		Juvenile		
Date	Male	Female	Male	Female	Total
5/11/50 to 6/30/50	7	49	15	12	83
7/01/50 to 8/28/50	11	13	2	2	28
2/22/51 to 3/10/51	6	15			21
3/11/51 to 6/10/51	15	21			36
6/11/51 to 8/10/51	2	12			14
8/11/51 to 11/30/51	4	5	7	10	26
12/01/51 to 3/10/52	1	1	3	1	6
3/11/52 to 6/06/52	1	2	15	10	28
Totals	47	118	42	35	242

Figure 1 illustrates the higher trapping incidence of adults through the month of May 1950. After that date, the juveniles appear in larger numbers (due to retakes) and are apparently less trap shy.

Figure 2 illustrates the complete absence of juvenile squirrels throughout the spring breeding season of 1951. Summer and fall young did not make an appearence in the traps until October 10. After that date they were taken with increasing frequency.

Figure 3 illustrates the period November 31, 1951, through June 30, 1952. Juveniles of the fall litter were trapped more frequently than adults. Juveniles of the 1952 spring litter made their initial appearance during the first week in May.

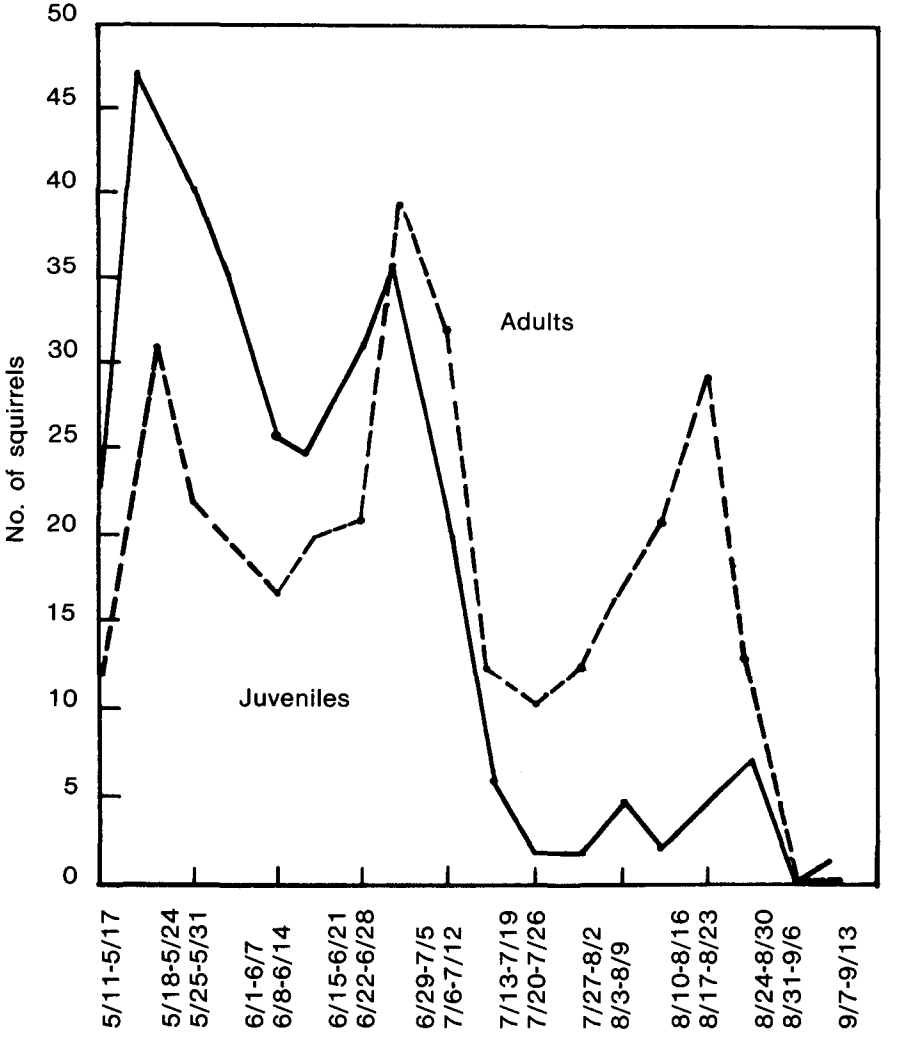

Fig. 1. 1950 catch comparing adults with juveniles.

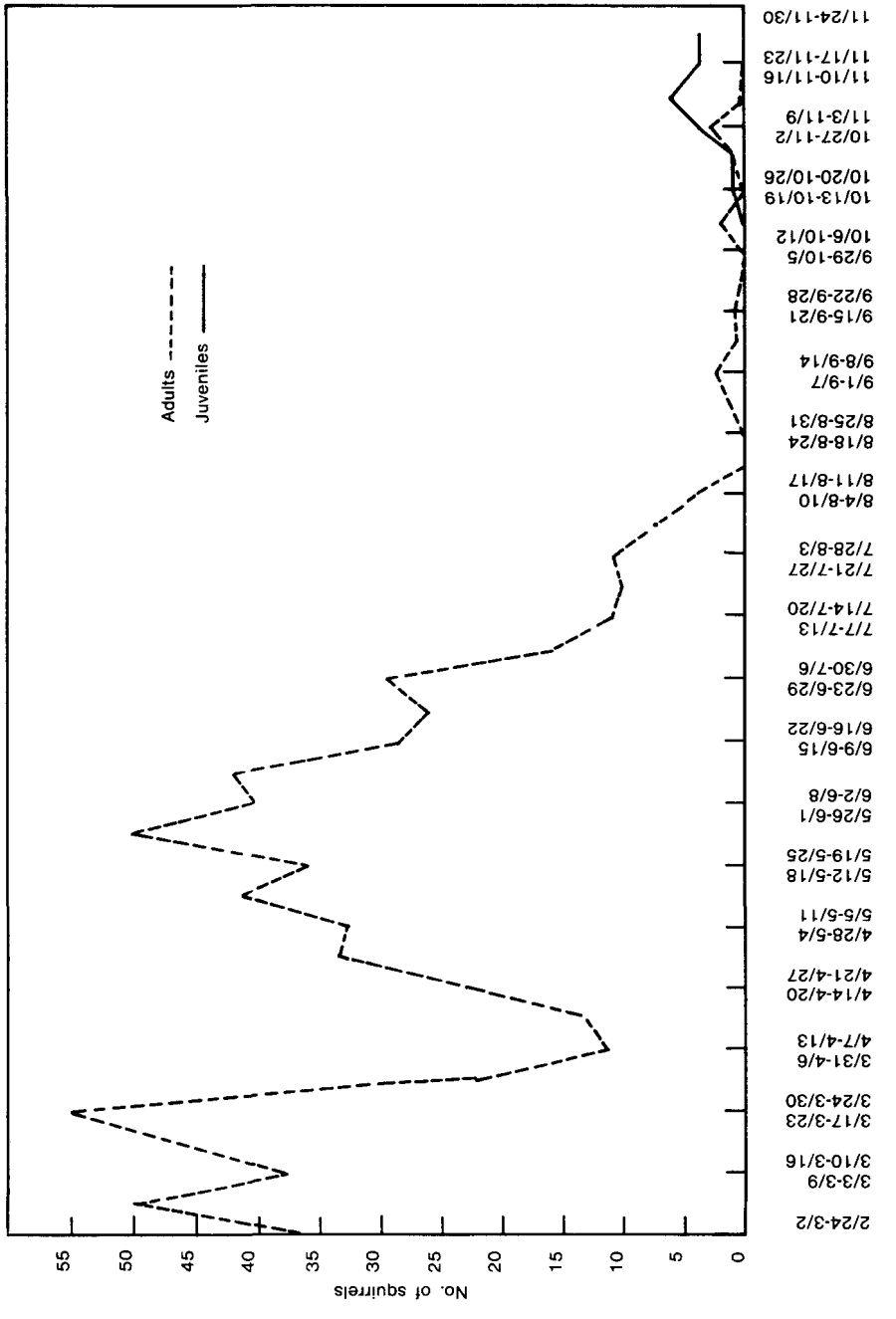

Fig. 2. 1951 catch comparing adults with juveniles.

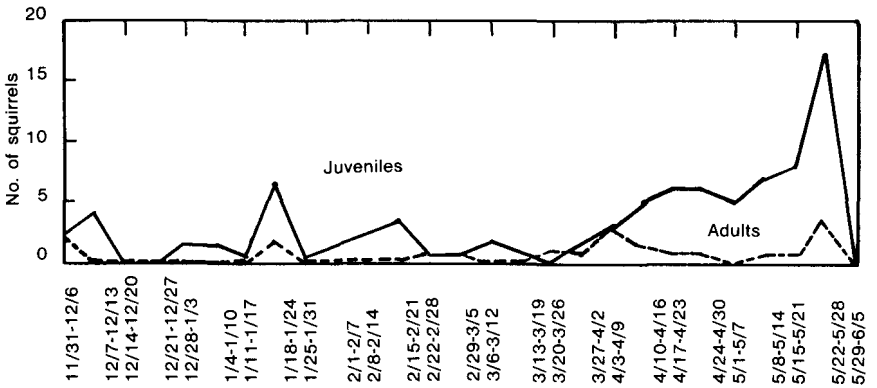

Fig. 3. Total catch for November 31, 1951 through June 5, 1952, comparing adults with juveniles.

CENSUS RESULTS

Figures from the three census methods used were in disagreement. Leaf nest counts made during November, 1951, showed 18 active nests. Cruise counts, however, indicated a population of 48 squirrels. Trapping figures for the period December 15, 1951 - March 1952, revealed a population of only 17 squirrels, thirteen of which were juveniles.

KILL DATA

Hunter Questionnaires

By means of questionnaires distributed by conservation officers, approximately 2% of the hunters were sampled during the 1949 - 50 hunting season. The calculated state-wide squirrel kill was 2,427,100 gray squirrels, and 344,500 fox squirrels. During this season, more gray squirrels were killed than any other Kentucky mammal.

During the 1950 - 51 hunting season, 2.2% of the total number of hunters were sampled (Table 9). The squirrel kill was calculated at 2,538,900 gray squirrels and 259,100 fox squirrels. Returns from approximately 2.3% of the hunters at the close of the 1951 - 52 hunting season showed the state-wide kill of gray squirrels to be an estimated 2,203,100 and that of fox squirrels 286,400.

A total of 3,195 hunter questionnaires were distributed over the state by the Project Leader during the 1950 squirrel hunting season (August 20 - November 5). The return was 9.73%. The following information was obtained from these questionnaires.

Average number of hunts per hunter	6.98
Average length of hunt	3 hours, 22 minutes
Average time taken to bag a squirrel	1 hour, 10 minutes
Average number of squirrels killed per hunt	2.91

Prior to the 1951 squirrel hunting season, 6,000 questionnaires were mailed. A return of 11.25% (675 was realized), however 34.22% of the returns were incomplete, leaving 7.73% of the number mailed, containing pertinent information as follows:

Average number of hunts per hunter	5.66
Average length of hunt	3 hours, 24 minutes
Average time taken to bag a squirrel	1 hour, 20 minutes
Average number of squirrels killed per hunt	2.59

Age Class Kill Ratios

Give below are the ratios of squirrels killed during the 1950 - 51 and 1951 - 52 hunting season, taken from hunter questionnaires distributed by the Project Leader. The questionnaires were not mailed until the season opened.

Ratios of 1950 squirrel kill figured from returns of 286 hunters.
529 fox squirrels
3,346 gray squirrels

Fox squirrel:	(age) 65.7% adult	34.3 juvenile		
	(sex) 45.7% male	33.5% female	20.8% unknown	
Gray squirrel:	(age) 53.1% adult	46.9% juvenile		
	(sex) 51.9% male	37.1% female	11% unknown	

Ratios of 1951 squirrel kill figured from returns of 464 hunters.
894 fox squirrels
5,886 gray squirrels

Fox squirrel:	(age) 68.3% adult	31.7% juvenile
	(sex) 58.6% male	41.4% female
Gray squirrel:	(age) 64.4% adult	35.6% juvenile
	(sex) 54.6% male	45.4% female

SUMMARY

1. Data collected during 1951 - 1952 indicated two annual breeding seasons, one from December through early March and the other between late June and late September.
2. Data indicate that gray squirrel young are nursed during the periods February - May and August - November.
3. One adult gray squirrel showed evidence of having raised three litters in two years.
4. Litter sizes during 1950 - 1951 averaged 3.3 young per litter.
5. Embryo counts made during 1950 - 1951 showed an average of 3.3 young per litter.
6. Placental scar counts made in 1951 indicated an average of 3.2 young per litter.
7. One squirrel tag was returned from a point five miles from the trapping area.
8. 252 gray squirrels were tagged on the trapping area.
9. Most litters are born in dens.

Table 9. Kill data taken from hunter questionnaires for 1951 and 1952 hunting season (August 20 - November 5).

	Fox Squirrels						Gray Squirrels										
	Adults			Juveniles			Adults						Juveniles				
										Lact. or Preg.							
Hours Hunted	M[a]	F[b]	UNK[c]	M	F	UNK	M	F	UNK	No.	%	% adults	M	F	UNK	% juvenile	Total kill
1950																	
4662	186	126	36	56	51	74	883	622	271	3	.48	53.07	855	618	97	46.93	3872
1951																	
2077	355	256		169	114		1997	1765		139	7.87	64.22	1188	908		35.78	6811

[a] M = Male.
[b] F = Female.
[c] UNK = Unknown.

10. Oak and beech are predominant sites of dens and leaf nests.
11. Sex ratio obtained from hunter kill showed a gray squirrel ratio of 126 males:100 females.
12. Sex ratios taken from trapping data showed a ratio of 55:100.
13. A high incidence of coccidiosis occurred in the gray squirrel population on the trapping area.
14. A sarcoptic mange was found on several gray squirrels.
15. Census method figures were in disagreement.
16. The 1950 hunters' questionnaires showed an increased kill of 111,800 gray squirrels over the 1949 season.
17. Hunter questionnaires indicated that 335,800 fewer gray squirrels were killed in 1951 than in 1950.

LITERATURE CITED

Allen, Durward L. 1942. Populations and Habits of the Fox Squirrel in Allegan County, Michigan. Am. Midland Nat. 27(2): 338-379.

Brown, Louis G. and Lee E. Yeager. 1945. Fox Squirrels and Gray Squirrels in Illinois. Illinois Natr. Hist. Surv., Bull. 23(5): 449-536.