

GRAY AND FOX SQUIRREL FOOD HABITS INVESTIGATIONS

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Proc. Annu. Conf. Southeast. Assoc. Game & Fish Comm. 8:191-197

The desirability of some knowledge regarding the important squirrel foods became evident during the early stages of Kentucky's statewide squirrel research. The first endeavor to conduct a statewide mast production survey was especially instrumental in calling attention to the lack of information regarding squirrel feeding habits. Knowledge was lacking as to which of the state's fruit-producing trees were important as squirrel foods, and as to which species among the more than one hundred likely ones to include on the mast study list.

A knowledge of the staple and preferred squirrel foods during periods of food shortage was, furthermore, believed to be knowledge essential for efficient squirrel management.

The food habits study was begun in July, 1952, and is still in progress. The current report covers data collected through September 30, 1954. Objectives have been to determine the important species of squirrel foods, the relative importance of each, and the degree to which certain foods are utilized during each of the annual seasons.

METHODS

The two methods of obtaining squirrel food habits data which were considered were analysis of stomach contents and observations of food utilization. The latter method was selected as offering the most usable means of obtaining a satisfactory quantity of data on foods the year around.

Most food habits studies have previously been conducted by the logical method of stomach collection and analysis. The stomach analysis method possesses the advantage of revealing the exact quantity of each food species by volume; however, the method also possesses certain disadvantages. The observational technique seems especially well adapted for use in squirrel study, and appears to possess the following advantages over other techniques.

1. Squirrels are easier to observe in the act of feeding than are most wild animals, thus making it possible to obtain a significant quantity of data.

2. Squirrels masticate foods so thoroughly that species identification from stomach contents requires expert laboratory study.

3. The observational technique determines foods the year around, while stomach collections usually are made during the hunting season and therefore present a true picture for only a short period of the year. The stomach analysis method often fails to provide data on foods used during seasons of critical food shortage.

Observations made on squirrels actually in the act of feeding have provided all data used during the study. Signs of evidence of feeding have been ignored, because signs of feeding always leave doubt as to the identity of the feeding

animal. Flying squirrels, mice, and certain birds also feed on mast, and leave "cuttings" similar to those left by squirrels.

Approximately twenty-four biologist, in all of Kentucky's twelve P-R Districts, have contributed to the collection of data. No limit has been in effect on areas of observation, and feeding records have been obtained at random over the state. A record was made during routine field work whenever a squirrel was seen feeding, while special attention was given to the job during all squirrel research work. In addition, scheduled field trips were conducted for three mornings during each of the months of January, April, July, and October for the specific purpose of observing feeding squirrels.

Standardized forms on 3" × 5" cards were used for recording data. Squirrels were identified as to whether gray or fox; and, when possible, as to whether adult or juvenile. Information was also recorded pertaining to habitat and time of day. Foods were carefully identified as to the exact plant species, and as to the plant portions being eaten. Binoculars and keys to identification of fruits materially aided in observation and identification of food species.

RESULTS

The foods of gray and fox squirrels were first listed separately, but a comparison showed no apparent difference in food preference, so the foods of both species have been combined. Fox squirrel diet reflected food supply in the Bluegrass region where the state's heaviest fox squirrel population occurs. Gray squirrels accounted for approximately eighty-eight percent of the total squirrel-feeding observations, and gray squirrels have comprised a similar percent of the annual hunting seasons squirrel kill.

Sight identification of feeding squirrels as adult or juvenile was usually uncertain; therefore, no attempt has been made to differentiate food preference by age groups. A large percentage of the squirrels seen eating mushrooms, bark, and sprouted beechnuts were identified as juveniles, but no other difference was discernible in food preference.

Table 1 shows the most heavily used food species, listed in order of frequency of use. Forty-five different plant species have occurred on the list of observed usage; however, twenty-four of those species comprised approximately ninety-five percent of the total records. Each of the twenty-one miscellaneous foods not listed in Table 1 accounted for less than one-half of one percent of the total squirrel diet. Only one instance of utilization of animal food occurred among the 840 records of squirrels observed feeding. One squirrel was seen robbing a songbird's nest and eating the eggs.

Food Utilization in Relation to Availability

Table 2 reveals the percent of the total annual diet accounted for by each of the major food species. Utilization of a given species was high in a year of high mast production and low in a year of low mast production. American beech was the most heavily used species in 1952, but beech received only moderate usage in 1953 and 1954. The mast survey revealed that the year 1952 produced a very heavy crop of beechnuts, while in 1953 and 1954 production was only moderate.

Table 1. Total gray and fox squirrel feeding observations July 1, 1952 through September 30, 1954.

Common name	Plant species		Total records of use
		Scientific name	
American Beech		<i>Fagus grandifolia</i>	121
Black Oak		<i>Quercus velutina</i>	88
Shagbark Hickory		<i>Carya ovata</i>	87
Black Walnut		<i>Juglans nigra</i>	72
Pignut Hickory		<i>Carya glabra</i>	53
Yellow-poplar		<i>Liriodendron tulipifera</i>	51
White Oak		<i>Quercus alba</i>	38
Mockernut Hickory		<i>Carya tomentosa</i>	31
Mulberry		<i>Morus</i> sp.	31
Blackgum		<i>Nyssa sylvatica</i>	23
Unidentified Oak		<i>Quercus</i> sp.	22
Red Hickory		<i>Carya ovalis</i>	19
Silver Maple		<i>Acer saccharinum</i>	19
Bitternut Hickory		<i>Carya cordiformis</i>	15
Flowering Dogwood		<i>Cornus florida</i>	15
Red Maple		<i>Acer rubrum</i>	14
Scarlet Oak		<i>Quercus coccinea</i>	14
Unidentified Hickory		<i>Carya</i> sp.	14
Shellbark Hickory		<i>Carya laciniosa</i>	14
Northern Red Oak		<i>Quercus borealis</i>	10
Chestnut Oak		<i>Quercus montana</i>	8
Corn		<i>Zea mays</i>	8
Blackberry		<i>Rubus</i> sp.	6
Pin Oak		<i>Quercus palustris</i>	6
Chinquapin		<i>Castanea pumila</i>	5
Mushrooms			5
Others (21 species)			51
Total			840

The same similarity of food supply and food utilization was observed in the other important species. Black oak and yellow-poplar were the two leading foods in 1953, a year when fruits of those species were abundant, and when beechnuts and hickory nuts were scarce. White oak was of importance in 1954; the first year that white oak mast has been produced in heavy quantity. Hickory nut production has been low during each of the three years; however, that favorite food annually ranked high in usage. Walnuts have also been consistent in annual use.

As a part of the first annual mast study, information was recorded on the degree of abundance of the various mast species. It was found that a listing of food species in order of their abundance followed the same general sequence as did a listing of the food species in order of their frequency of use. Some notable exceptions were found in fruit-producing trees that were common within the state, yet absent from or low on the records of squirrel foods. As a result, three main categories of food plants have been tentatively designated according to the type and degree of squirrel utilization.

Table 2. Percent of total squirrel diet computed for each plant species.

Plant species	Percent of total diet				Average for all years
	July 1, 1952 to May 20, 1953	May 21, 1953 to May 31, 1954	June 1, 1954 to Sept. 30, 1954		
American Beech	30	7	5	14	
Black Oak	3	19	1	10	
Shagbark Hickory	14	9	7	10	
Black Walnut	7	8	12	9	
Pignut Hickory	5	6	9	6	
Yellow-poplar	0	13	1	6	
White Oak	2	4	11	5	
Mockernut Hickory	5	1	8	4	
Mulberry	0	3	12	4	
Blackgum	0	2	11	3	
Unidentified Oak	4	3	0	3	
Red Hickory	5	2	0	2	
Silver Maple	4	2	0	2	
Bitternut Hickory	0	2	4	2	
Flowering Dogwood	3	1	0	2	
Red Maple	2	2	0	2	
Scarlet Oak	2	2	0	2	
Unidentified Hickory	1	2	3	2	
Shellbark Hickory	1	0	8	2	
Northern Red Oak	1	1	3	1	
Chestnut Oak	0	1	3	1	
Corn	2	1	0	1	
Blackberry	0	2	0	1	
Pin Oak	1	1	0	1	
Chinquapin	2	0	0	1	
Mushrooms	2	0	0	1	
Other (21 species)	6	7	4	6	
Total %	102	101	102	103	

1. Plant species that were common, but low in palatability, and therefore not used as food except during periods of extreme food shortage. Among the plants in this group were the elms, black cherry, the ashes, black locust, sweetgum, osage-orange, and honey locust.

2. Plant species that were common, but normally found growing in shrubby or second growth areas, and believed low in usage because of growth habitat — since such habitats usually did not support a high squirrel population. Members of this group were redbud, sassafras, dewberry, grape, persimon, greenbrier, sumac, raspberry, and hawthorn.

3. Plant species that received a moderate-to-high degree of usage in relation to their abundance. The species ranking highest in this group were, in the order named, American beech, shagbark hickory, red hickory, black oak, pignut hickory, black walnut, yellow-poplar, mockernut hickory, and mulberry. These species when available, apparently comprised almost the entire squirrel diet.

Seasonal and Monthly Use of the Important Foods

Table 3 reveals the significant foods during each of the annual seasons. Only the more important foods have been included in Table 3, and those have been grouped taxonomically by genera. Feeding records were heaviest during the months of scheduled study and during the hunting season months.

Acorns, beechnuts, and walnuts ranked almost equally high as year around foods, with hickory nuts and vegetative plant portions being next in order of importance. The most reliable late winter and early spring foods were walnuts, acorns, vegetative parts, hickory nuts, and beechnuts.

The various species of hickory nuts supplied twenty-eight percent of the total annual diet on the three-year average. Hickory nuts comprised almost the entire August diet, accounting for sixty-eight percent of that month's feeding records. Squirrels apparently preferred hickory nuts over all other foods, and subsisted largely on nuts until the supply was exhausted.

Combined species of acorns made up twenty-three percent of the three-year diet, while beechnuts accounted for fourteen percent and walnuts nine percent.

The chief plant species on which vegetative portions were eaten were, in order of descending frequency, the maples, the oaks, yellow-poplar, and the hickories.

DISCUSSION

The facts learned from the food habits study have been especially useful in application to the mast study. The first statewide mast study was conducted through observations of 106 plant species. That list was obviously long and unwieldy. The mast survey list now in use consists of twenty-one plant species which, based on the 840 feeding observations, are all of the tree species that supply a significant portion of the annual squirrel fare. The mast rating has increased in validity because each species that goes to make up the rating is a species known to be used as squirrel food. The shorter list also permits greater accuracy through more careful study of individual species.

A knowledge of which foods are used and which foods are not used seems essential in advance of any valid mast study.

Table 3. Degree of utilization, by month, of the most important food groups. Average of data from July 1, 1952 through September 30, 1954.

Type of food	Usage by months											
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Hickory Nuts	**	***	**	**	**	***	***	*****	*	*		*
Acorns	****	***		**	**	*****	*****	*	**	*****		
Beechnuts	*		**	**	***	**			****	**	***	*****
Walnuts	*	****	***	*	*	*				*	*****	**
Yellow-poplar fruits								**	**			
Maple seeds	*			*	*							
Mulberry fruits						****						
Blackgum fruits							*				*	
Dogwood fruits	**											
Buds and other vegetative parts		***	**	***	**	*						
Total food record for month	52	10 ^b	12 ^b	103	57	58	79	253	143	59	4 ^b	10 ^b

^a Each * represents approximately ten percent of the total squirrel foods for that month.

^b The quantity of data for the months of February, March, November, and December is too small to be conclusive.

The annual trend in food use is a reliable supplement to the mast study and provides a check on the accuracy of the mast rating, since species production and species utilization follow a similar annual trend. The food habits study may dictate future changes in the mast study list and may eventually permit a weighted mast rating that rates each species to the extent of its importance as a squirrel food.

A knowledge of preferred foods is desirable in advance of any attempt at squirrel management. Few landowners care to plant trees for squirrel food and wait for the trees to mature; however, many landowners can manage woodlots for better squirrel habitat through selective cutting. Most woodlots can be greatly improved by thinning out the trees that are of no value as food producers and giving more room to the better mast species. Timber harvest often favors squirrels accidentally, because the hickory and beech trees are usually passed up by lumbermen.

Squirrel studies increasingly indicate that food supply is the chief factor limiting squirrel population levels.

SUMMARY

Investigations regarding the food habits of gray and fox squirrels were conducted in Kentucky from July 1, 1952, through September 30, 1954. Studies were observational in nature. Data were recorded on exact food species and on other pertinent factors whenever a squirrel was seen in the act of feeding. Records were obtained on a statewide basis by approximately twenty-four P-R personnel.

No difference was discernable in food species preference between gray and fox squirrels, or between adult and juvenile squirrels. In 840 observed instances of squirrel feeding, only one usage of animal food was recorded.

Forty-five different plant species occurred on the list of known usage; however, twenty-four of those species accounted for approximately ninety-five percent of the total squirrel diet.

Three tables are presented: a listing of plant species in order of their frequency of use; a computation of percent of the total foods by species and year; and a table of monthly and seasonal usage of the important food groups.

Comparison of food availability with food utilization indicated three categories of squirrel foods: 1) plant species that were common, but low in usage because of unpalatability; 2) plant species that were common, but low in usage because of growth habitat; and 3) plant species that received a moderate to high degree of usage in relation to their availability.

Mast production and food utilization followed similar annual trends.

The most important genera of squirrel foods were hickory nuts, acorns, beechnuts, and walnuts; those four groups combined supplying seventy-four percent of the total three-year diet.

The food habits information has been especially applicable to the mast study, and is believed to be applicable for use in woodland management, since food supply is apparently the chief limiting factor in squirrel population levels.