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Gray Squirrel (*Sciurus carolinensis*)

Description

This bushy-tailed rodent is a common resident in most of New York State. Although the usual color phase is gray, melanistic (black) squirrels are found in some localities. True albinos (white fur, pink eyes) occur rarely. Color variations of the basically gray phase are observed also, with the hair of some individuals being heavily tinged with red or brown. Individuals of various color phases can be found mixed in the same litter. Close examination of the summer pelage (fur) of the gray squirrel will reveal that the gray hairs along the back and on the shoulders are brown, with black bars and gray or silver tips. The face, flanks, feet, and rear legs tend to be rusty-brown. The underparts usually are white and often are edged with yellowish-brown. The longer, denser winter coat is much grayer. The ears are a light buff color and the soles of the feet are well furred during winter.

There are four other species of arboreal (tree climbing) squirrels in New York: fox squirrel (*Sciurus niger*)¹, red squirrel (*Tamiasciurus hudsonicus*), southern flying squirrel (*Glaucomys volans*) and northern flying squirrel (*G. sabrinus*). Some physical dimensions of each are presented in Table 1. Note that gray squirrels are slightly smaller than

¹The fox squirrel is discussed separately in this publication, beginning on page 12.

Table 1. Physical dimensions of 5 squirrel species native to New York State^a

Common Name	Length from nose to tail		Length of tail		Length of hind foot		Weight	
	cm	(in)	cm	(in)	cm	(in)	g	(oz)
Gray Squirrel ^b	46.0-53.0 (17.9-20.7)		16.5-25.0 (6.4-9.8)		6.0-7.5 (2.3-2.9)		340-680 (11.9-23.8)	
Fox Squirrel ^c	50.0-56.5 (20.0-22.6)		21.7-26.5 (8.7-10.6)		6.2-8.0 (2.5-3.2)		790 (27.6)	
Red Squirrel ^b	28.0-35.0 (10.9-13.7)		11.4-15.2 (4.4-5.9)		4.6-5.2 (1.8-2.0)		165-240 (5.8-8.4)	
Northern Flying Squirrel ^b	25.0-29.5 (9.8-11.5)		11.5-13.5 (4.5-5.3)		3.5-4.0 (1.4-1.6)		57-125 (2.0-4.4)	
Southern Flying Squirrel ^b	21.0-25.5 (8.2-10.0)		8.0-11.0 (3.1-4.3)		2.5-3.5 (1.0-1.4)		50-70 (1.8-2.5)	

- a. Average adult sizes.
b. Reference - Godin 1977.
c. Reference - Banfield 1974.

fox squirrels. Considerable overlap exists in color phases of the two species, but the fox squirrel typically has a tawny underside compared to the usual white underside of the gray, and the gray phase of the fox squirrel lacks the brown tones of the gray squirrel. The gray squirrel has a more rounded forehead and longer, more pointed ears than the fox squirrel. A nearly infallible difference between the species observable in dead or immobilized animals is the presence of one set of tiny teeth in front of the upper premolars of gray squirrels. These vestigial teeth are absent in fox squirrels. The red squirrel is markedly smaller than the gray squirrel or fox squirrel and is typically rufous (rusty-red) with a white underside. The most distinguishable characteristic of a flying squirrel is the presence of a loose membrane of furred skin which extends from the outside of the wrist on the front leg to the ankle of the rear leg.



Distribution and Abundance

Extensive stands of mature hardwoods including oak, hickory, walnut, butternut, beech, and American chestnut provided excellent habitat for gray squirrels in colonial New York. At that time squirrels were a major pest for farmers. Populations of gray squirrels would occasionally build to the point where hordes would move across the countryside, perhaps attempting to find food and uncrowded conditions. Forest clearing and the proliferation of small farms throughout the state greatly reduced squirrel habitat by the late 1800's. At the turn of the century the gray squirrel population was at its low point. Favorable habitat has since regenerated across the state following the abandonment of marginal farms during the first half of this century.

Gray squirrels are currently abundant through the state except for the central Adirondacks and the higher elevations of the Catskills. Northern New York is at the northern extreme of the gray squirrel's range, possibly because of the sporadic mast (nut) crops, extreme cold, and deep snows of this region. Five subspecies of the gray squirrel are recognized in the eastern United States; only S. c. pennsylvanicus is common in New York.

Life History

The first breeding activity begins in late January. Males readily breed with any receptive female; consequently, a female in her oestrous period has little difficulty finding mates, she need only give the characteristic vocalization indicating that she is in heat. Rival males sometimes engage in a few scuffles before the female takes off on a run followed by her suitors. Eventually the female mates with the dominant male.

Adult females in good condition often have a second breeding period, in June. Gestation requires about 44 days, so the first and second litters are born in March and August, respectively. Approximately 10 percent of the females-of-the-year breed during years of ample food supplies. Females of a spring litter commonly produce young the following spring, but seldom have a second litter that season. Females of late summer generally have their first litter one year later.

Spring litters usually are born in tree dens. These offer more protection from the elements and predators than do leaf nests. Dens are cavities within tree trunks that have been created by decay, lightning, or woodpeckers. Leaf nests are ragged spheres measuring about 45 cm (1.5 ft) in diameter and made of woven leaves and twigs. They are constructed in tree trunk forks or major limb forks of trees at least 9 m (30 ft) in height. These nest sites are often used more than one season. Pregnant females line den nests with bits of shredded bark, moss, or grass.

Food availability greatly influences litter size, which can range from 1 to 9 young. The first litters of the year generally have fewer young than those of late summer, averaging 2.5 and 3.2 young per litter, respectively. Newborn gray squirrels are completely naked, blind, and toothless. They weigh 15 to 18 grams (0.5 to 0.6 oz) and are 11 to 12 cm (4.4 to 4.8 in) long. Young squirrels do not leave the nest for the first time until they are 6 to 7 weeks old. At 8 to 10 weeks they are weaned and capable of foraging with adults. The spring litter generally stays with the female until she has her second litter, which in turn usually overwinters with her. Second litters frequently are born in leaf nests, allowing females to escape the fleas and mites of tree dens and relocate closer to seasonal food supplies. Upon leaving the family group, young squirrels often construct

their own leaf nests, but these nests often do not hold together well, probably due to the builders' inexperience. Squirrels seldom use leaf nests in winter.

Gray squirrels generally are gregarious (readily associate with each other); however, when rearing young, females defend their den or nest tree from intruders.

Local populations have a well-defined social structure in which females and juveniles are subordinate to adult males. Disputes over territories, social hierarchy, or limited food supplies, are usually settled by bluff displays. Where food is plentiful, several adults may feed peacefully side-by-side and adults may even share winter dens.

Home ranges average 0.5 ha (1.3 A) with males ranging a bit farther than females. Dense populations of 7.5 squirrels per ha (3/A) may occur in excellent habitat during peak years, but populations in good habitat average about 2.5 per ha (1/A). Local populations will readily shift their foraging a few hundred meters in the fall to adjust to food availability. A few sporadic mass migrations, covering several kilometers and involving thousands of squirrels have occurred during this century in the east. The last such migration in New York took place along the Vermont-New York border in 1951. Reasons for these large-scale movements are not known, though lack of food or overpopulation are thought to be contributing factors.

The diet of the gray squirrel changes with the seasons. In spring, preferred foods are the nutritious buds and catkins (flowers) of elms, maples and oaks, plus the inner bark and sap of maples. During early summer, maple and elm seeds are foods of major importance. Later, various seeds and fruits such as wild grapes, blueberries, wild cherry, and mushrooms, are popular food sources. Gray squirrels also will eat bird eggs and fledglings, insects, caterpillars, galls, and will gnaw on bones or antlers as part of their varied diet. An ample fall nut crop ensures squirrels of a nutritious food supply through winter. Squirrels eat a variety of mast: acorns, beechnuts, butternuts, walnuts, and hickory nuts. Corn and apples also are popular fall foods.

Squirrels cache (hide) nuts by burying them a few centimeters beneath the leaf litter on the forest floor or in crotches of trees throughout the squirrel's home range. Gray squirrels do not hibernate, but they will remain in their dens for several days during periods of severe winter weather.

During winter, squirrels randomly search for their stored nuts, locating caches by smell. Consequently, neighboring squirrels often benefit from another's industriousness. The gray squirrel's acute sense of smell allows it to detect whether or not nuts are sound, even if the nuts are buried. If all mast production in an area fails, the squirrels can make it through the winter on bark and twigs from elm, maple, and sumac, or pine seeds, but these foods are less nutritious, and spring reproduction among squirrels forced to use these foods will be reduced as a result.

Due to the gray squirrel's wariness and arboreal habits, mortality rates caused by predation are low compared to most rodents. Gray squirrels can scamper along the ground at about 24 kph (15 mph). Once in the trees, squirrels are extremely elusive, being able to climb up or down trees with equal speed and capable of leaping 2.5 meters (8 ft) or more from limb to limb.

Still, nearly every predator associated with gray squirrel habitat includes a few squirrels in its diet. Raccoons, opossums, and weasels may raid nests successfully, but usually the protective females drive off such intruders. Occasionally a squirrel, late in getting to its den or nest in the evening, will be caught by a barred or great horned owl, but because these squirrels are diurnal (move about during the day) such events are rare. Foxes, bobcat, domestic cats, mink, and large snakes will sometimes catch an unwary squirrel. Probably the most successful predators of squirrels are the forest-dwelling hawks, such as the red-shouldered hawk, goshawk, broadwinged hawk, and Cooper's hawk.

Even though gray squirrels groom themselves and maintain clean nests, they are besieged by several internal (round worms, tape worms, hook worms) and external (mites, fleas, chiggers, ticks, lice) parasites. The most common, serious disease of the gray squirrel is mange, caused by a mange mite. Squirrels with this disease lose their hair and may eventually die. Once introduced into a dense or malnourished population, diseases such as mange can take a devastating toll of squirrels.

When established in good habitat, adult gray squirrels have fairly low mortality rates and may live 8 to 10 years. The average life expectancy, however, is about 2 to 3 years.

Gray squirrels seldom go unnoticed in an area. In urban environments, squirrels usually lose much of their natural wariness and can be seen

throughout the day on lawns or in parks, searching for bits of food. In rural settings, squirrels usually limit their activity to early morning and late afternoon. People interested in observing squirrels will find the best opportunities to do so come in the fall and early winter. During these seasons, leaves are gone from most trees and squirrels concentrate around food supplies. A person who takes up a quiet vigil near a tree laden with mast will likely be rewarded with the sight of squirrels gathering their winter food supply. Food is also the key drawing card during the winter. A constant supply of seeds, nuts, apples, or corn will be visited regularly by foraging squirrels.

One does not have to see gray squirrels to know that they are present. They have several calls, but two are most distinctive. Females in heat emit an accented "bark" or chatter followed by a trill. When annoyed or aware of danger, squirrels make an alarm call consisting of a series of short barks or chattering, also heavily accented but without the trill.

Squirrels leave other evidence of their presence. Through the fall and winter, foraging gray squirrels will make small pits in the forest floor, 5 to 7 cm (1.3 to 1.8 in) in diameter and about as deep, where they have dug for stored nuts. They seldom eat their finds where they uncover them, instead they retreat to a favorite branch or stump to dine in a little more security. "Midden piles" (shells, bits of nut meats) accumulate at these feeding locations. Tracks of foraging squirrels are especially conspicuous in snow. The shape of the track varies with the speed of the squirrel: walk -- single line of superimposed tracks; short-hops -- smaller front feet come down in front of rear feet with all 4 prints present; run -- larger hind feet come down in front of front feet, with prints 0.5 to 1.5 meter (1.7 to 5.0 ft) apart. Sometimes a gray squirrel's running track is difficult to distinguish from that of a cottontail rabbit, but usually the prints of a squirrel's front feet are side-by-side rather than one behind the other. Another clue is that squirrel tracks tend to lead to and from trees, unlike the rabbit's. Red squirrels also make diggings, midden piles, and gray squirrel-like tracks, but the red's tracks are only about two-thirds the size of the gray's.

Red squirrels vigorously defend their territories from all other squirrels, including the larger gray. Unless the defense involves food supplies during times of scarcity, gray squirrels will give ground. Red

squirrels are faster and more agile than grays, so reds easily stay with the gray squirrels during running disputes through the trees. Some people mistakenly believe that red squirrels emasculate gray squirrels during such battles, thereby reducing the number of breeding males in the population. The testes of nonbreeding squirrels commonly are withdrawn into the body cavity so that at such times the males may appear to have been castrated to the casual observer. Red and gray squirrels do not interbreed in the wild. Small, reddish-colored gray squirrels observed in the fall generally are second litter individuals that have not grown their grayer winter fur.

Habitat

Stable, viable gray squirrel populations are dependent upon woodlands containing a variety of tree and shrub species with an adequate number of den trees; a water supply in the form of a stream or spring also greatly enhances squirrel habitat. As indicated earlier, gray squirrels rely on different food items at various times of the year. Should a seed, fruit, or nut crop of any one species fail in a particular season, squirrels in habitat with good plant species diversity can switch to alternate food sources. As an example, white oak acorns are an excellent squirrel food, but because this oak only sporadically produces mast, woodlots devoid of other mast species may be relatively poor squirrel habitat. Part of the diversity should include ample old trees with cavities for tree dens. Gray squirrels need tree dens for protection in winter and for rearing the first litter of the year.

Woodland management practices that encourage the production of gray squirrels consist of maintaining or establishing tree species diversity, encouraging mast-producing trees, and preserving den trees. Logging or thinning operations should spare existing den trees. Ideal den sites are mature (not decaying) hardwood nut trees having an entrance not larger than 10 cm (4 in) wide at least 6 m (20 ft) from the ground. A density of 10 to 12 active den trees per ha (4 to 5 A) is sufficient. Mast or den trees located along hedgerows or the forest edge must be associated with travel lanes of good cover if squirrels are to make use of such trees. Gray squirrels will readily use artificial nest boxes if natural den sites are not available. Woodlots should not be grazed or burned to control



understory vegetation because such practices destroy protective ground cover and important seed- or fruit-producing shrubs, brambles and vines.

Ecological Role

As herbivores (plant eaters) gray squirrels perform the vital natural function of converting plants into flesh. While gray squirrels are not the primary prey of any one predator species, because of their abundance and wide distribution they are important to many of New York's predators. The feeding habits of gray squirrels are beneficial to both plant and animal communities in their range. Since squirrels do not find all of their nut caches, the remaining nuts distributed throughout the forest are the seed source for future forests. Other rodents, such as mice and chipmunks, feed on the gray squirrel's caches and the bits of nut meats present in their midden piles.

Economic and Social Values

In a recent study of New York's metropolitan residents, the gray squirrel was rated as the most preferred mammal people would like to see around their homes. In urban situations, gray squirrels are easily

approached and make interesting wildlife to observe as they forage for food and interact with each other. They can, however, become a nuisance. They frequently plunder bird feeders in the winter, although many people tolerate this habit. Homeowners are sometimes plagued by gray squirrels using attics for shelter or storage. They also occasionally damage vegetable or flower gardens, and raid fruit trees.

Small game hunters recognize the gray squirrel as an abundant and challenging game species. Gray squirrels possess both keen hearing and sharp eyesight along with more than enough patience to sit quietly in hiding and let unskilled hunters pass by. Squirrel meat is light, flavorful, and delicious in stew or fricassee.

Control Methods

When gray squirrels have invaded an attic, garage or wall partition, control may be as simple as waiting until the offenders are outside and then covering the entry hole with planking, heavy screening or sheet metal. Napthalene flakes or moth balls can be used as a repellent for squirrels in fairly small, confined areas. Live traps work effectively on squirrels when baited with walnut meats or peanuts and placed along travel lanes.³ Captured animals should be released in suitable squirrel habitat at least 9 km (5 mi) from the trap sites to lessen the chance of their return. It may be necessary to use wooden snap-back rat traps on "trap shy" squirrels. These traps should be nailed or wired in place on a tree trunk limb to prevent squirrels from carrying off the traps. In rural areas problem individuals can be culled selectively from a population by shooting with a small calibre firearm (e.g., .22 rimfire). Local populations in rural areas can easily be kept in check by hunting during the open season. At the same time, landowners can be partially compensated with a few meals of wild game.

The best method to use with squirrel pests in vegetable or flower gardens will vary depending upon the particular case. To keep squirrels from climbing fruit trees, metal bands (stove pipe works well) at least 60

²Gray and fox squirrels are protected game animals in New York State; therefore it is necessary to contact your local Environmental Conservation Officer before trapping or shooting squirrels.

³See Caslick and Decker (1981) for more details on squirrel control.

cm (2 ft) wide and 1.5 m (5 ft) or more high above the ground or snow can be placed around the tree's trunk. Squirrels are notorious leapers, however, and will gain access to trees via low hanging branches or adjacent trees when possible. Bird feeders supported by poles can be "squirrel proofed" by fastening a 60-cm diameter metal disk on the pole.

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Fox Squirrel (*Sciurus niger*)

Description

At first glance a fox squirrel resembles a large gray squirrel. Table 1 presents some of the average physical dimensions of the squirrels of New York State. With a little practice, the relative size difference between the gray and fox squirrel is discernable in the field. As with the gray squirrel, there are various color phases of the fox squirrel (red, black, and gray), making it difficult to use overall fur color as a definite distinguishing characteristic of either species. However, the following key field characteristics generally can be used to identify the two species: the underside of the red and gray phase of the fox squirrel is much darker or colorful (tawny yellow to orange) compared to the gray's light buff to white color; the fox squirrel's tail hairs are tipped with a dark, rufous coloring and its gray body hairs are generally a solid slate gray, whereas the gray squirrel's tail is outlined in white and gray body hairs have a brownish-tint on their lower portion; the fox squirrel has the slower, less graceful, more deliberate movements of the two species. The fox squirrel's tracks are somewhat smaller and its call is briefer and lower in tone than the gray squirrel's, but only people familiar with both species can use these features as distinguishing characteristics.

Once in hand the two species can be distinguished by the straighter nose to forehead profile and the shorter, more rounded ears of the fox squirrel. The presence of a small tooth located in front of the upper premolars in the gray squirrel is a very reliable characteristic when examining dead or immobilized animals.

Distribution and Abundance

New York State is on the extreme northeastern edge of the fox squirrel's range. Limited populations occur only in the southern portions of Chautauqua, Cattaraugus, and Allegany Counties, although a few individual fox squirrels occasionally are reported in other counties through the Southern Tier.

Life History

The reproductive behavior, breeding cycle, litter size, nest utilization, and development of the young are similar to that of the gray squirrel. Varying with food availability, fox squirrels may occupy a home range of 4 ha (10 A) in a season and 16 ha (40 A) in a year. Males tend to range a bit wider than females. Population density is also dependent on food availability, with good and fair habitat holding about 2 and 1 fox squirrels per ha (0.8 and 0.4/A), respectively. As with gray squirrels, except for the female who vigorously defends her nest tree against all intruders, fox squirrels are quite tolerant of each other.

Food habits of the fox squirrel are very similar to those of the gray squirrel. They eat foods available through the year with a heavy reliance on nuts in fall and winter.

Although the fox squirrel has many of the same predators, diseases, and parasites as the gray squirrel, no single mortality factor generally has a devastating impact upon populations of these squirrels. Survival in the wild averages about 3 to 4 years.

The habitat, habits, and behavior of fox squirrels make it a fairly easy animal to observe. They prefer more open areas than grays and, although cautious, they are not particularly shy. The fox squirrel is a relatively late riser in the animal world with its peak activity periods being during mid-morning and mid-afternoon. During extremes in weather it may adjust its activity slightly. It is neither as noisy nor as agile in its aerial prowess as the gray squirrel, but its glistening black, steel-gray, or colorful rufous coat (similar to a red fox, hence the name) and mild nature make it a pleasure to watch.

Habitat

Fox squirrels and gray squirrels can occupy the same woodland, but generally fox squirrels prefer the more open edge of forests. Lightly grazed or thinned deciduous woodlots, fields, or pastures with a scattering of mast trees, and hardwood stands bordering grain fields are all prime fox squirrel habitat. Habitat management for fox squirrels consists of all of the practices outlined for gray squirrels. Because fox squirrels will inhabit relatively open areas, hedgerows are of vital importance as travel

lanes. Mast and den trees, left standing in hedgerows, will be used by these wide-ranging squirrels.

Ecological Role

The fox squirrel's ecological role is similar to that of the gray squirrel, but because of its very limited range in New York State it is not nearly as important here.

Economic and Social Values

The fox squirrel has adapted well to the environment of suburban neighborhoods and parks. Its bright coat and peaceful manner has made it a favorite of most who are interested in squirrels.

In rural habitats, the fox squirrel is every bit as crafty as a gray squirrel in eluding hunters. Its habit of foraging in the open allows patient small game hunters to stalk the squirrels away from protective cover. Its meat is tasty in stews and most hunters feel fortunate to bag one of these squirrels. Although New York is the northeastern edge of the fox squirrel's range, and as a result its distribution and abundance is limited, it is by no means rare or endangered throughout its extensive range in the U.S. As recognized game animals, both gray squirrel and fox squirrel harvests are regulated by season length and daily bag limits.

Control Methods

Control methods outlined in the preceding gray squirrel discussion are applicable for the fox squirrel.

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