

Species Account Paper

BIO 378 - Mammology

The Eastern GRAY SQUIRREL

(*Sciurus carolinensis*)

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Description: The Eastern Gray Squirrel (*Sciurus carolinensis*) actually falls into five subspecies of medium-sized tree squirrels that occupy the eastern part of the United States and Canada (Koprowski 1994).

Eastern Gray squirrels have no sexual dimorphism in size or coloration. They are the size of a large rat and range in length from 380-525 (tail length: 150-250) mm and weigh from 300-710 g. The dorsum of the Eastern Gray Squirrel is grizzled dark to pale gray and may be washed with cinnamon on hips, feet, and head. Ears are buff to gray (white in northern climates), and their long bushy tail is silvery gray and often brownish with long margined white hairs (Long 1970). Under parts are white to gray to buff to cinnamon.



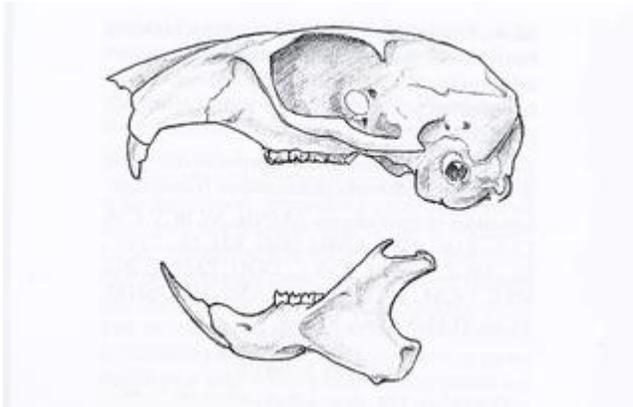
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Melanism is common in the north, and albinism is rare (some "mutant" white squirrels are found in Olney, Illinois and Missouri) (Jackson 1961).



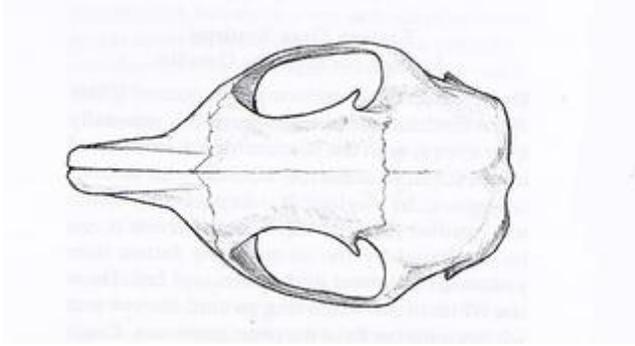
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The skull is relatively short with a broad and expanded zygomatic arch.



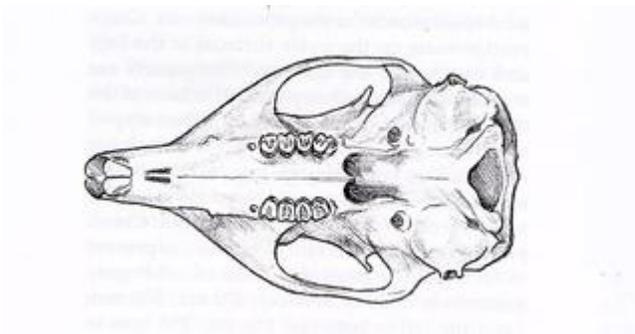
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The braincase is broad and posteriorly depressed. The rostrum is laterally compressed; the frontal area is flattened.



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Auditory bullae are moderately inflated.



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The *Sciurus carolinensis* dental formula is (I)1/1, (C)0/0, (P)2/1, (M)3/3, total 22 teeth; premolar 3 is small and peg-like. The average cranial measurements are: greatest length of skull, 60.7mm; zygomatic breadth, 34.5mm; palatal length, 17.9mm; length of nasal, 20.6mm; cranial height in vault of skull, 28.4; length of maxillary tooth row, 10.9mm (based on 32 specimens from Ark., Iowa, Kansas, and N. Carolina - McGrath, 1987) (Koprowski 1994).

Distribution: The Eastern Gray Squirrel is found in the eastern United States, with a range that extends west to the edge of the deciduous forest and north to Canada (Koprowski 1994).



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Introductions occurred in California, Montana, Oregon, and Washington in the United States; Quebec, New Brunswick, British Columbia, Manitoba, Nova Scotia, Ontario, and Saskatchewan in Canada. Eastern Gray Squirrels were introduced to Italy and England from the United States, and to Scotland, South Africa, and Ireland from England (Koprowski 1994). Introductions to Australia from England in the late 1800's proved unsuccessful. *Sciurus carolinensis* is found throughout the state of Wisconsin, and actually has its own subspecies that is native to Minnesota and Wisconsin (*Sciurus carolinensis hypophaeus* - subspecies) (Jackson 1961).

Fossil data: *Sciurus carolinensis* occurs in twenty North American Pleistocene faunas as early as the late Irvingtonian in Florida. Body size increased in the early to middle Holocene and then decreased to present size (Koprowski 1994).

Historical Distribution Info: The Eastern Gray Squirrel has been subjected to an array of land use changes since the first settlers came to America. In some cases, clearing of forested land for agriculture led to the replacement of gray squirrels by other squirrel species (i.e. red and fox squirrels) (Anderson 1981, Schorger 1982).

Ontogeny & Reproduction: *Sciurus carolinensis* has an eight-stage ontogeny. Light and temperature may be responsible for breeding behavior in *Sciurus carolinensis*. They may breed twice each year (by 27% of adult females, with a range from 0-36%) with third litters occurring during years of mild weather and good mast yields. Litter size may vary from 4 (year with abundant food) to 1 (year with scarce food). Most breeding occurs from December - March, and May to August (delayed slightly in northern latitudes). *Sciurus carolinensis* has a duplex uterus which averages approximately 81mm long and a mean clitoridis length of approximately 4mm. As many as 34 males are attracted to one estrous female. A dominance hierarchy forms among males with females demonstrating polyandry. Male gray squirrels follow females for 5 days before they go into estrous (who have the highest levels of androstenedione) and ovulation (ova are ~95um in diameter - ovaries of pregnant females weigh nearly twice those of non-pregnant females, ovarian follicles are numerous and largest in pregnancy) is induced by the presence of a fertile male. An enlarged pink vulva indicates estrus (behavioral estrus last less than 8 hours). Copulation lasts less than 30 seconds, with the male mounting dorsally and implanting a vaginal plug after fertilizing the female. Implantations are evenly distributed in the uterine horns. The paraplacental chorion allows albumin to diffuse but restricts large proteins. Placental scars (from birthing) remain for over a week (Koprowski 1994, Andersen 1981).

Females can bear young at approximately 5 months of age, but usually don't until after 1 year of age and have a reproductive longevity of approximately 8 years (even 12.5 yrs. in warmer climates). The vagina is closed in anestrus and prepubescent females. Plasma progesterone rises from less than 3nmol/l before gestation to 318nmol/l in day 35 of gestation with levels dropping after parturition. Corpora lutea regress at day 30 of pregnancy. The corpora lutea and placenta are the sources of progesterone, however pregnancy continues after ovariectomy. The number of corpora lutea is usually equal to the number of embryos. Combined ovum and embryo mortality is approximately 9% (Koprowski 1994, Andersen 1981).

Average litter sizes range from 1 to 4 with a maximum of eight. The average percentage of adults producing litters for spring is approximately 61% (with a range of 0-95%) and for summer is 66% (range 9-100%). About 90% of adults, 50-60% of yearlings, and less than 5% of sub-adults and juveniles, less than 1 year of age, reproduce each year.

Frequency of lactation in summer may fall due to mast failure. Precocious breeding by females is observed only after a good mast crop (Koprowski 1994, Andersen 1981).

Males gain sexually maturity at approximately ten or eleven months of age. They have a structure in the penis known as a baculum (~9-12.5mm long). Males undergo a semiannual cycle of testicular recrudescence and regression, with functional testes being pendant in the scrotum. Spermatogenesis usually occurs between December to February and May to July. Regressed testes without spermatogenesis usually occur in August to October and last two months per individual. Active testes weigh approximately six to seven (versus 1g. for inactive testes). Occasionally, entire breeding seasons may be skipped (especially during times of poor mast yields) (Koprowski 1994, Andersen 1981).

The interstitial cells of leydig atrophy in regressed testes result in lowered plasma androgen levels. Mean plasma testosterone levels in spermatogenically active males may be .8-7nmol/l (but less than or equal to .05nmol/l in regressed males). Testosterone levels in males vary from .4 to 20 nmol/l with declines to undetectable levels 3 weeks after a castration (with an associated fall in accessory gland weights). Progesterone is produced in the seminiferous tubules and accumulated in regressed testes. Regrowth of the prostate is preceded by mitotic activity. The prostate has either two types of secretory cells or a single type that changes function seasonally. Only 42% of germ cells become spermatozoa, resulting in relatively low numbers of spermatozoa for rodents. Epididymal spermatozoa aggregate into unique cylindrical bodies and then separate, becoming single or rouleaux(sp.) (Koprowski 1994, Andersen 1981).

Newborn (neonates) gray squirrels are naked except for whiskers (vibrissae) and weigh 13-18g. The umbilicus is attached for less than four days. The dorsum darkens at 7-10 days preceding the emergence of hair. Hair occurs on the tail dorsum by three weeks and the ventral surface by six weeks. Eyes open at 24-42 days, and ears open at 3-4 weeks. Lower incisors erupt at 19-21 days followed by upper incisors in week four and cheek teeth in week six. Weaning begins at seven weeks and is complete by ten weeks. The juvenile pelage is lost after weaning. Adult body mass is reached after 8-9 months (Koprowski 1994, Andersen 1981).

Ecology and Behavior: *Sciurus carolinensis* molt twice a year (starting with the head) and molt their tail once in summer. Their body mass gets smaller as their distribution goes south. They are mostly active in the early and latter parts of the day (bimodal). Male gray squirrels mark traditional points on trees with urine. *Sciurus carolinensis* can swim (doggy-paddle) at speeds up to 27 km/hr. They gather and bury nuts for storage during winter months (scatter hoarders) when food is not available (Koprowski 1994, Andersen 1981).

Sciurus carolinensis feeds on a variety of nuts, seeds, buds, and cultivated (i.e. corn and wheat). They have even been known to eat tree bark, fungi, bird eggs, frogs, and insects. They are typically found in hardwood forests generally greater than 40ha (oaks, hickory, and walnut), or small woodlots interspersed with farmland. They make nests in hollow trees or build leaf nests high in branches of trees. They are found throughout the state of Wisconsin (Koprowski 1994, Andersen 1981, WDNR 1998).

Because Eastern Gray Squirrels are woodland creatures, formation of den cavities requires 8-30 years with a minimum of 1 den/.8ha to maintain a density of 1 squirrel/1.6ha. Selective cutting of the basal area of trees (greater than 30cm at DBH) has little effect on densities, reproduction, or survival. Densities of *Sciurus carolinensis* are usually less than 3/ha in continuous woodlots; whereas, densities in small woodlots can be 16/ha with varying fluctuations based on the availability of tree seeds. Long term densities remain constant (Koprowski 1994, Andersen 1981).

Home ranges vary from .5-20ha with males usually having a 120% larger home range than females (based on seasonal sexual activity). Overlap of home ranges is extensive, but territorially not evidenced. Sex ratios are as follows: 1:1 in nestlings, .8:1.4 in juveniles, and .8:1.6 in adults. Survivorship of gray squirrels from less than 8 months age classes to 1 year age classes usually averages 25%. Mean mortality for adults is 40-60%. Predators (in Wisconsin) include: largemouth bass, timber rattlesnake, several hawk and owl species, weasel, mink, bobcat, coyotes and foxes (wolves too), dogs, cats, and humans. Gray squirrels rarely die from fatal falls. However, they have several types of parasites (Koprowski 1994, Andersen 1981).

Although *Sciurus carolinensis* feed on as many as 97

plant and 14 animal items, 18 plant species account for 87% of stomach volume (Koprowski 1994).

Remarks: The genus term *Sciurus* is from the ancient Greek, *skia* meaning shadow or shade, and *oura* for tail; *carolinensis* refers to the type locality of the colony of Carolina (Koprowski 1994). Additional common names for the Eastern Gray Squirrel are cat squirrel, migratory squirrel, bushy tail, black squirrel (gray squirrels are known to go through a black color phase), dark-bellied squirrel, Merriam's gray squirrel, stump ear, timber squirrel, and *ah-ji-duh-mo* ("tail in the air" - Chippewa Tribe) (Jackson 1961).



Jane Abbott - Kent State University (1986)

Popular ways of obtaining squirrels, whether for research, food, or fur, are by using live traps (baited with nuts or grains) or by several hunting methods (rifle, shotgun, bow, with or without the aid of hunting dogs) (Koprowski 1994).

With the expansion of urban America and the great demand to observe non-game wildlife, the gray squirrel is increasingly gaining the attention of natural resource personnel. Increased interest is due primarily to the expansion of America's cities into rural areas, causing a loss of wildlife habitat in some instances (Koprowski 1994).

Eastern Gray Squirrels are commonly seen in city parks and lawns and on people's birdfeeders. Some of the more rare types of gray squirrels are not gray at all, they are called melanistic gray squirrels and are a blonde, mutant, type (Long 1970). The UW-Stevens Point campus (particularly around the dormitories) is an example of where this type of blonde gray squirrel can be found.

LITERATURE CITED:

Andersen, Kenneth K. 1981. *The Density And Distribution Of Gray Squirrels In A Suburban Environment. A thesis submitted in partial fulfillment of the requirements for the degree Master of Science.* College of Natural Resources Universtiy of Wisconsin – Stevens Point.

Flyger, V. 1999. *Eastern gray squirrel.* In: D.E. Wilson, and S. Ruff (eds.). The Smithsonian Book of North American Mammals. Washington, D.C.: Smithsonian Institution Press. p451 - 453

Jackson, Hartley H.T. 1961. *Sciurus carolinensis hypophaeus Merriam.* Mammals of Wisconsin. p155-164

Koprowski, John L. 1994. *Sciurus carolinensis.* Mammalian Species (American Society of Mammologists). No. 480, p.1-9, 3 figs.

Linzey, D. W. 1998. The Mammals of Virginia. Blacksburg, Virginia: The McDonald & Woodward Publishing Company, Inc.

Long, Charles A. 1970. *Sciurus carolinensis hypophaeus Merriam.* UWSP Museum of Natural History – Reports on the Fauna and Flora of Wisconsin. No. 3, p25-26

Madson, Chris. 1978. *Squirrels on the Howard Potter Research Area.* Wisconsin Acadamey of Sciences, Arts and Letters. p284-318

Schorger, A.W. 1982. *The Gray Squirrel.* Wildlife In Early Wisconsin. p206-250

Wisconsin DNR. 1998. *Gray Squirrel.* Wisconsin Wildlife Primer. p12-13