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A REVISION OF THE FOX SQUIRRELS OF THE LOWER
MISSISSIPPI VALLEY AND TEXAS

By GEORGE H. LOWERY, JR. AND WILLIAM B. DAVIS

Few North American species of mammals include geographical variants so pronounced as those which occur in the Fox Squirrel (*Sciurus niger*). The superficial external differences between certain geographical races are in many cases far greater than those between many time-honored species of mammals, the family Sciuridae not excepted. It is hardly conceivable, for example, that *S. n. niger*, *S. n. limitis* and *S. n. rufiventer* are conspecific. While in these, as well as in other races of fox squirrels, the more trenchant specific characteristics are discernible, there is great dissimilarity between the forms in color patterns, size, and cranial characters. Populations within the races are remarkably constant and do not usually demonstrate gradient tendencies. Where the ranges of two races meet, complete and clear-cut intergradation takes place and as a rule the region of overlapping is narrow.

In spite of these interesting features, the group seems to have attracted surprisingly little attention from the systematist, particularly as to the populations occupying the Lower Mississippi River Valley and the general Gulf Coast region.

Thirty-five years ago, Wilfred H. Osgood published¹ a brief treatment of the subject. Particularly notable, among other things, was his application of the name *S. n. texianus* Bachman which led to its subsequent use for the Fox Squirrel occupying the middle Gulf Coast region east of the Mississippi River. However, Dr. Osgood's careful treatment

¹ *Proc. Biol. Soc. of Wash.*, 20, 1907: 46-47.

of the subject notwithstanding, we are of the considered opinion that he was in error in using Bachman's name for this race of Fox Squirrel. Consequently, we have been obliged to recommend certain alterations in the nomenclature of the group as henceforth explained.

The present study began several years ago as a result of our routine curatorial attempts to identify subspecifically the Fox Squirrels in the two collections under our care. According to the best available literature, the Fox Squirrels of the Lower Mississippi River Valley and eastern Texas were referable to *S. n. rufiventer* (Geoffroy) which, however, was by no means compatible with the evidence at hand based on what doubtless constitutes the largest assemblage of specimens yet examined from this geographical area. While we did not then, nor later, seek to describe additional races, it became evident that the Fox Squirrels of this area fell into three separate and distinct categories. One proved to be the form to which Osgood misapplied the name *S. n. texianus* Bachman, and which now proves to be a synonym of *Sciurus n. ludovicianus*. This leaves the squirrels of the middle Gulf Coast area unnamed. Neither of the other two forms agreed with *rufiventer*. To have called them such would have necessitated blinding ourselves to deep-rooted, well-defined characters that clearly set them apart from other races. Accordingly, we find it proper to resurrect from the copious synonymy of *S. niger*, names which are applicable to both forms. Each has long deserved nomenclatural recognition but there has not been until now sufficient museum material at hand for them to be understood properly.

Generally speaking, all Fox Squirrels fall into two separate categories: the *niger* group and the *rufiventer* group. The former includes *niger*, *avicennia*, *bryanti*, and *neglectus*. These without exception are distinguished by the presence of white on the nose and toes and in some cases on the ears and tip of the tail. The predominant color pattern is gray or buff, suffused on the upper parts with black. The *rufiventer* group includes *rufiventer*, *limitis*, *ludovicianus* and *subauratus*. The predominant color pattern in this group is yellowish or yellowish brown, suffused in varying degrees with black. The color of the under parts is yellowish or orange-cinnamon, but never white or buff-colored except in *limitis*. *Sciurus niger bachmani* (*nobis*) is somewhat intermediate between the two groups in that it has white on the nose, toes, ears, and tail, as characteristic of the *niger* group, but its general coloration agrees more closely with the *rufiventer* group.

All of the races occupying this area are naturally interrelated. For this reason we are including in the following summary a brief analysis of the currently recognized races that occur within the scope of the present work. Furthermore, specimens at our disposal tend to clarify distributional limits as well as taxonomic characteristics. Material referred to in this paper is in the collection of the Louisiana State University Museum of Zoölogy unless otherwise indicated.

We wish to acknowledge assistance from the following persons and institutions: Miss Fannye A. Cooke, the Mississippi Game and Fish Commission and the Mississippi WPA Animal and Plant Survey Project; C. H. Everett and the Mississippi Sunflower Junior College; H. T. Jackson and the Fish and Wildlife Service; David H. Johnson and the United States National Museum. Horace Hays of Provencal, Louisiana, secured for us an excellent series of specimens from northwestern Louisiana, Ted O'Neil of the Louisiana Department of Conservation obtained the series from Allen Parish, Louisiana, and E. A. McIlhenny of Avery Island, Louisiana, assisted greatly in gathering other pertinent material. Lowery is especially grateful to his good friend Jas. Hy. Bruns of New Orleans, Louisiana, for his helpful suggestions and for the use of his indispensable natural history library.

SCIURUS NIGER NIGER LINNAEUS.

SOUTHERN FOX SQUIRREL

[*Sciurus*] *niger* Linnaeus, Syst. Nat., ed. 10, vol. 1, 1758: 64 (based on Catesby's Black Fox Squirrel).

Sciurus cinereus Linnaeus, Syst. Nat., ed. 10, vol. 1, 1758: 64 (in part) (gray phase of *S. n. niger* Linnaeus).

Sciurus vulpinus Gmelin, Syst. Nat., 1, 1788: 147.

Sciurus capistratus Bosc, Ann. du Mus., 1, 1802: 181.—Harlan, Faun. Amer., 1825: 175.—Bachman, Proc. Zool. Soc. London, 1838: 85.—Audubon and Bachman, Viv. Quad. N. America, 1846, Plate 68; text in letterpress, vol. 2, 1851: 132.

Sciurus cinereus var. *niger* J. A. Allen, Proc. Bost. Soc. Nat. Hist., 16, 1874: 13.

Type locality.—Probably southern South Carolina.

Distribution.—South Carolina, southern Georgia, southeastern Alabama and northern Florida.

Diagnosis.—The largest of the races of the Fox Squirrel, occurring in three color phases—gray, buff, and black or melanistic. In the extreme form of the gray phase, it is smoke gray above strongly suffused

with black; white below; nose and ears, always white. In the buff phase, the general tone of the upper parts is pinkish buff; the under parts, feet, and under side of the tail cinnamon-buff to clay color. In the black phase, the coloration is wholly black or brown except the nose and ears, which are white.

Comparisons.—This form is not to be confused with any other races of *Sciurus niger* in the Gulf Coast region, as its affinities are with *avicennia*, of southern Florida, *bryanti* of Maryland, and *neglectus* of the Middle Atlantic States. The color pattern is similar to *bachmani*, but it lacks the distinct ferruginous color characteristic of that race. It is larger than *bachmani* and the skull is more massive and less angular.

Measurements.—Three specimens from Thomasville, Georgia (body measurements in millimeters from dried skins): total length, 692 (685-698); tail, 323 (317-330); hind foot, 79 (76-82); basilar length of Hensel, 56.7 (54.8-58.2); zygomatic breadth, 41.5 (40.6-42.1); length of nasals, 27.0 (26.0-27.7); alveolar length of maxillary tooth row, 13.1 (12.8-13.6); width of rostrum, 11.6 (11.2-12.4); width across posterior tongues of the premaxillae, 19.6 (18.2-21.4).

Remarks.—Insofar as this region is concerned, *S. n. niger* is readily distinguishable from all other races as neither the gray nor the buff phase has a counterpart in any of the other races herein under consideration. Its somewhat larger size and the gray or buff coloration set it apart from even *S. n. bachmani*.

This is, of course, the *Sciurus capistratus* of Bosc, Bachman, Harlan, and authors in general.

SCIURUS NIGER BACHMANI new subspecies

BACHMAN FOX SQUIRREL

Type.—Male, adult, skin and skull; number 1565, Louisiana State University Museum of Zoölogy; 10 mi. NW Enon, Washington Parish, Louisiana; collected December 28, 1939, by Ted O'Neil; original number 48.

Distribution.—Northern Georgia (possibly a small portion of western South Carolina), all of Alabama (except the southeastern part), eastern Tennessee, Mississippi (except the extreme western part), and eastern Louisiana east of the Mississippi River and north of Lake Pontchartrain.

Diagnosis.—A large Fox Squirrel that possesses a deep ferruginous coloration throughout, suffused on the upper parts with black. The top

of the head is nearly wholly black and the *nose, ears, and toes* are white; the end of the tail is often extensively tipped with white. In the melanistic phase, it is seldom wholly black, although frequently individuals appear that are normal except for the black under parts.

Comparisons.—In size and color *bachmani* is most similar to *niger*. It is, however, clearly separable on the basis of external characters by its somewhat smaller size and by its rich ferruginous coloration. The skull is smaller than that of *niger* in every detail: basilar length of Hensel, 53.9 mm. as opposed to 56.7; zygomatic breadth, 39.6 as compared to 41.5; length of nasals, 21.2 as opposed to 27.0; alveolar length of maxillary tooth row, 11.7 as opposed to 13.1. In *bachmani* the supra-occipital crest is somewhat more pronounced and the brain case is larger than in other races.

Measurements.—Two typical adult specimens from extreme southeastern Louisiana (body measurements in millimeters from dried skins): total length, 629, 635; tail, 279, 305; hind foot, 71, 64; basilar length of Hensel, 53.4, 54.5; zygomatic breadth, 39.2, 39.9; length of nasals, 21.2, 21.2; alveolar length of maxillary tooth row, 11.6, 11.8; width of rostrum, 11.1, 12.4; width across posterior tongues of premaxillae, 18.7, 19.0.

Remarks.—Osgood (*op. cit.*) attempted to show that Bachman's name *texianus*² pertains to the Fox Squirrel of extreme southeastern Louisiana, southern Mississippi, south-central Alabama, and parts of Tennessee and Georgia, which is distinguished by *white on the nose and ears in combination with its more ferruginous coloration*. Osgood reached these conclusions on the basis of his examination in European museums of two of the three specimens mentioned by Dr. Bachman, and his opinion that one of these specimens is to be considered the type which, incidentally, is not the one so labeled. As a matter of fact, the specimen actually designated as the type was labeled long after Bachman's description appeared. However, along with the original citation of the name as it appeared in the *Proceedings of the Zoological Society of London*, the following statement is made: "This name is proposed by Dr. Bachman for an apparently undescribed species which he saw in the Museum at Paris." This specimen is now labeled "*Sciurus texianus* (Back.) Type, M. Price, Texas." If the Paris Museum specimen is not to be accepted as the type (as according to Osgood), the

² *Sciurus texianus* Bachman, Proc. Zool. Soc. London, 1838: 86.

alternative course seems to be that of considering the type material composite. In reality, little is to be gained by attempting to choose at this late date which specimen Dr. Bachman himself considered the type.

It is significant, however, that Bachman gave a specific locality and outlines a range for *texianus* in the original description, as follows: "... a specimen received from a friend from the south-western parts of Louisiana, . . ." and "... this species has a tolerably extensive range extending perhaps from south-western portions of Louisiana, through Texas, into Mexico." The range of a totally distinct race (*subauratus*) intervenes between the range of *texianus* as outlined by Bachman and the range of the race to which Osgood maintains the name should apply.

The cardinal point in Bachman's description of *S. texianus* and the one which makes it absolutely incompatible with the race of Fox Squirrel in southeastern Louisiana, southern Mississippi, etc., is his statement:³ "The Texian Squirrel bears some resemblance to the *Sciurus capistratus* [= *S. niger niger*]. The latter species, however, in all the varieties hitherto examined by Dr. Bachman, has uniformly the white ears and nose." This clearly denotes *S. texianus* as a form *without* the white ears and nose, yet the squirrel to which Osgood has given this name *always* possesses this characteristic. Osgood inexplicably omits this paragraph or any reference thereto!

Bachman's somewhat contradictory statement in a previous paragraph to the effect that the nose and lips of *texianus* are "brownish white," cannot be interpreted as descriptive of these same parts in the race of Fox Squirrels occurring in the area now being discussed. Only the colors *black*, *rusty brown*, and *immaculate white* are found on the forehead of this form. Conclusive, however, is his statement describing the ears of *texianus*; he gives their color as being "yellow" on both surfaces, and while he adds that they are "interspersed with white hairs," this could by no means apply to the ears of any of the squirrels inhabiting the southeastern states. In the individuals occupying this area, the ears are *black at the base and wholly white on the tips*.

Added proof that Bachman could not have been describing the squirrels of the middle Gulf Coast region is furnished by the colored plates in Audubon and Bachman's original Imperial Folio Edition of the "Viviparous Quadrupeds of North America" (vol. 2, 1846). Plate 68 contains a magnificent portrait (the middle figure) of a squirrel

³ *Op. cit.*, p. 87, paragraph 3.

drawn by John J. Audubon and labeled "*Sciurus capistratus*." The plate was reproduced in the Octavo Edition of "The Quadrupeds of North America," as Plate 68, vol. 2, 1851. This figure and the accompanying text⁴ demonstrate beautifully the color and color pattern of the squirrel ranging from eastern Louisiana, eastward through most of Mississippi, parts of Tennessee and Alabama and a small portion of Georgia. If Osgood is correct in stating that Bachman had this variety in mind when he described *texianus* in his earlier monograph in 1838, why then should Audubon and Bachman have failed to use the name *texianus* for the squirrel which they picture and describe in "The Viviparous Quadrupeds" in 1846. The figure is labeled *Sciurus capistratus* instead. As a matter of fact, Audubon and Bachman were no doubt referring to the type of squirrel pictured in the middle figure on Plate 68 when they wrote (*op. cit.*), as follows:

"There is a fourth variety which is very common in Alabama, and also occasionally seen in the upper districts of South Carolina and Georgia; which has on several occasions been sent to us as a distinct species. The ears and nose, as in all other varieties, are white. This, indeed, is a permanent mark, running through all the varieties, by which this species can be easily distinguished. Head and neck, black; back, a rusty blackish brown; neck, thighs, and belly, bright rusty colour; tail annulated with black and red."

Moreover, the name *texianus* is omitted entirely from all editions of "The Quadrupeds," a comprehensive work which is supposed to contain all of the forms known to either Audubon or Bachman. It therefore is obvious that Bachman himself did not consider *texianus* valid.

Bachman proposed the name *S. texianus* before a meeting of the Zoological Society of London on August 14, 1838. His data were subsequently published in the Proceedings of that Society. The complete reference to that form, as published, is as follows:

"*Sciurus Texianus*. Texian Squirrel. This name is proposed by Dr. Bachman for an apparently undescribed species which he saw in the Museum at Paris. It was said to have been received from Mexico. In the Museums of Berlin and Zurich, he also found what he con-

⁴ The letterpress to the Imperial Folio Edition of plates of the "Viviparous Quadrupeds of North America," vol. 2, 1851, p. 134. (See also: "The Quadrupeds of North America," vol. 2, 1851, p. 134). The letterpress to the Imperial Folio Edition and the Octavo Edition, are, in the present instance, the same. Attention is called to this in view of the fact that all readers will not have access to the Imperial Edition, while many will find it possible to consult the smaller one.

ceives to be the same species; and in the British Museum there is a specimen obtained at Texas by Mr. Douglas, agreeing with the other in almost every particular. Dr. Bachman also states that, among his notes there is a description of a specimen received by a friend from the south-western parts of Louisiana, which, on a comparison with memoranda taken from the other specimens, does not appear to differ in any important particular. Hence, he thinks it probable that this species has a tolerably extensive range extending perhaps from the south-western portions of Louisiana, through Texas, into Mexico.

"The Texian Squirrel is about the size of the Fox Squirrel. On the upper surface there is a mixture of black and yellow, and on the under parts deep yellow. The under sides of the limbs, and also the parts of the body contiguous, are whitish. Fore-legs externally, and the feet, rich yellow: ears, on both surfaces, yellow, with interspersed white hairs: nose and lips, brownish white: hairs of tail, rich rusty yellow at base, with a broad black space near the extremity, and finally tipped with yellow.

DIMENSIONS

	inches	lines
Length of body.....	13	6
Tail to end of hair.....	15	0
Tarsus.....	3	0
Height of ears to end of fur.....	0	6½

"The Texian Squirrel bears some resemblance to the *Sciurus capistratus*. The latter species, however, in all the varieties hitherto examined by Dr. Bachman, has uniformly the white ears and nose.

"This species would appear to replace the *Capistratus* in the south-western parts of America."

In this description there is no statement which would exclude its application to the squirrels occupying southwestern Louisiana or portions of Texas, and as Bachman mentioned specimens from both places, and stated that it replaced *capistratus* in the southwestern United States, the name *S. texianus* should justifiably be relegated to the synonymy of *S. ludovicianus* Custis, a much older name for the squirrel occupying southwestern Louisiana and eastern Texas. Bachman refers to a specimen of *texianus* from Mexico, and area from whence *S. n. limitis* might be obtained. However, as pointed out by Bailey,⁵ it is necessary only to read Bachman's description, with specimens of both races in hand, to be convinced that his *texianus* is the same as the large dark-colored *ludovicianus* and not the small, pale *limitis*. We have accordingly placed *S. texianus* Bachman in the synonymy of *S. n. ludovicianus* Custis.

⁵ *North American Fauna*, no. 25, 1905: 77.

For the sake of clarity, we summarize our arguments for rejecting the name *texianus* for the Fox Squirrels of southeastern Louisiana and portions of Mississippi, Tennessee, Alabama, and Georgia:

(1) Bachman's original description obviously does not apply to the race of squirrel occupying this area, but does apply to *ludovicianus* of western Louisiana and eastern Texas. Since Bachman examined specimens from Texas and western Louisiana, and since his description of *texianus* applies to a race now known to occur in that geographical area, the name *texianus* should therefore be considered in connection with that race.

(2) Bachman separates *texianus* from *capistratus* [= *niger*] by the absence of white on the ears and nose in the former. The race to which Osgood applied the name *texianus* always has white on the ears and nose. Hence, *texianus* of Bachman must apply to some race other than *texianus* of Osgood. In like manner, Bachman describes the ears of *texianus* as being yellow on both surfaces, but in the form to which Osgood applies this name the ears are black at the base and broadly tipped with white.

(3) Although Bachman described a form of the Fox Squirrel which he called *texianus* in 1838, he apparently did not consider it valid, for it is not mentioned in his and Audubon's "Quadrupeds" (1846-1854). However, Osgood assigns the name *texianus* to the large, white-nosed, white-eared squirrel inhabiting eastern Louisiana and parts of Mississippi, Alabama, Tennessee, and Georgia. The middle figure in Audubon's Plate 68 in the "Quadrupeds" demonstrates beautifully the characters of the squirrel whose range is the above-mentioned area. The figured squirrel is labeled *Sciurus capistratus*, but is not given the name *texianus* or any other subspecific name. If this squirrel is *texianus*, as Osgood contends, then Bachman, who described *texianus* would surely have labeled the figure as such. This is especially significant in view of the fact that Dr. Bachman (intro., vol. 1, p. viii) assumed responsibility for the designation of species and the text of the "Quadrupeds."

(4) Bachman examined specimens allegedly from Texas, Mexico, and western Louisiana, and even though some doubt exists as to the correctness of these localities, there is definitely no evidence to indicate that any of the type material came from anywhere east of the Mississippi River. Nevertheless, Osgood applies the name *texianus* to a race of Fox Squirrel which *only* occurs east of that river.

In view of Dr. Bachman's contribution over a hundred years ago to our knowledge of the Sciuridae, it is befitting that we dedicate this hitherto unnamed squirrel to him. The common appellation, "Bachman Fox Squirrel," by which it has been known can be therefore conveniently retained.

The name *S. capistratus* Bosc has no status of availability in the present connection. It is clearly a synonym of *Sciurus niger niger*. Likewise, there is no evidence whatsoever to indicate that *S. vulpinus* Gmelin or any of the other names variously applied to southern Fox Squirrels were based directly on specimens from within the range of the present form.

Our material indicates that *bachmani* occurs near the Louisiana coast only in the extreme southeastern section of the state along the Pearl River delta of the Louisiana-Mississippi state boundary westward almost to Baton Rouge. This squirrel enters Louisiana from the Gulf Coast region of southern Mississippi and follows the northern shores of Lake Pontchartrain, inhabiting the pine-oak association of that section. Typical specimens have been examined by us from Mandeville, Nott, Chipola, and Enon, Louisiana, and from Saucier, Mississippi. Louisiana specimens from West Feliciana Parish and a portion of East Baton Rouge Parish are intermediate between *bachmani* and *subauratus* but much closer to the former. Mississippi specimens from Wilkinson County are likewise not wholly typical of *bachmani* in that some of them average smaller and others are not as richly ferruginous in color.

Specimens examined.—Total number, 17, as follows:

LOUISIANA.—*East Feliciana Parish*: Clinton, 8. *St. Helena Parish*: Chipola, 1. *St. Tammany Parish*: Nott, 1. *Washington Parish*: Enon, 1 (type). *East Baton Rouge Parish*: 10 miles E Baton Rouge, 2.

MISSISSIPPI.—*Wilkinson County*: Centreville, 1; 5 miles N Woodville, 1; unspecified, 1. *Noxubee County*: Brooksville, 1.

SCIURUS NIGER RUFIVENTER (Geoffroy)

WESTERN FOX SQUIRREL

Sciurus rufiventer Geoffroy, Catal. Mamm. Mus. Nat. Hist., Paris, 1803: 176.

Sciurus ruber Rafinesque, Ann. of Nat., 1820: 4 (Missouri Territory).

Sciurus macroura Say, Long's Exped. to Rocky Mts., 1, 1823: 115 (northeastern Kansas).

Sciurus magnicaudatus Harlan, Fauna Americana, 1825: 178.

Sciurus rubicaudatus Audubon and Bachman, Vivi. Quad. N. Amer., 2, 1846, Plate 55; text in letterpress, vol. 2, 1851: 30-31 (type locality Kentucky, not Illinois as stated by Osgood).

Sciurus sayi Audubon and Bachman, Vivi. Quad. N. Amer., 2, Plate 89, 1846; text in letterpress, vol. 2, 1851: 274-276.

Type locality.—Mississippi Valley, exact locality not known but certainly north of Tennessee (Cf. Osgood, *op. cit.*).

Distribution.—The northern Mississippi Valley from northern Arkansas to southern Wisconsin.

Diagnosis.—A fairly large Fox Squirrel; color pattern usually tawny brown, grizzled with gray and pale yellowish; black above and pale cinnamon below. The nose, ears, toes, and tip of tail never white; the tail is cinnamon suffused with black; the feet are likewise cinnamon colored.

Comparisons.—This race is clearly separable from either *bachmani* or *niger* on the basis of its inferior size and its yellowish-brown coloration and the total absence of white on the nose, ears, toes, etc. Its affinities are with races hereinafter described, notably *ludovicianus*.

Measurements.—Eighteen specimens from Wisconsin, Iowa, Indiana, and Ohio: total length, 522 (489-594); tail, 245 (225-280); hind foot, 72 (69-74); basilar length of Hensel, 50.1 (47.8-52.6); zygomatic breadth, 36.5 (35.3-38.3); length of nasals, 22.3 (20.8-23.4); alveolar length of maxillary tooth row, 11.8 (11.1-12.6); width of rostrum, 10.0 (9.4-11.5); width across the posterior tongues of the premaxillae, 16.7 (15.9-17.7).

Remarks.—Although this squirrel doubtless intergrades with the larger *ludovicianus* in southern Arkansas, and northeastern Texas, sufficient specimens are not available to demonstrate this clearly.

Specimens examined.—Total number, 17, as follows:⁶

WISCONSIN.—*Walworth County*: Delavan, 1; *Dodge County*: Beaver Dam, 2; Burnett, 1. *Rock County*: Janesville, 3.

ILLINOIS.—*Cass County*: 1.

IOWA.—*Mills County*: Pacific Junction, 1. *Henry County*: Hillsboro, 1. *Hancock County*: Duncan, 1.

INDIANA.—*Marshall County*: Lake Maxinkuckee, 5.

ARKANSAS.—*Crawford County*: Van Buren, 1.

⁶ Material borrowed from the U. S. National Museum.

SCIURUS NIGER LUDOVICIANUS Custis

PINE WOODS FOX SQUIRREL

Sciurus ludovicianus Custis, Barton's Med. and Phys. Jour., vol. 2, 1806: 47.

Sciurus texianus Bachman, Proc. Zool. Soc. Lond., 1838: 86-87.

Sciurus niger var. *ludovicianus* Allen, Monog. N. Amer. Sciuridae, 1877: 720.

Type locality.—Red River of Louisiana (herein restricted to Natchitoches Parish, Louisiana).

Distribution.—Western Louisiana in the pine flats, prairies, and wooded uplands; probably also typical in parts of Arkansas and in eastern Texas in the counties adjacent to the Sabine River. Complete extent of range imperfectly known.

Diagnosis.—A very large, robust Fox Squirrel; grayish above, strongly suffused with black; pale ochraceous-buff to pinkish cinnamon below, rarely with tawny tinge; feet frequently strongly suffused with black; skull very large.

Comparisons.—Externally similar to *rufiventer* from which it differs in being much larger (especially discernible in body bulk); upper parts grayer (less tawny) and more strongly suffused with black; tail decidedly blacker. From *S. n. limitis* Baird it differs in being much larger and in being darker above and below. From *niger* and *bachmani* it is distinguished by the absence of white on the nose, ears, etc., and the lack of any concentration of black on the head. It is similar to *bachmani* in body size. Skull also similar to *bachmani* but somewhat larger and more massive, nasals less expanded distally; rostrum slightly deeper; jugal and entire zygomatic arch somewhat heavier and brain case larger; temporal ridge usually more distinct and convergent farther anteriorly. The skull of *ludovicianus* differs from *rufiventer* in being somewhat larger, the brain case more expanded, broader across the zygomata and the rostrum wider.

Measurements.—Fourteen adult specimens from western Louisiana: total length, 560 (525-612); tail, 259 (230-290); hind foot, 68 (60-73); ear, 25.7 (22.0-31.0); basilar length of Hensel, 51.1 (50.0-52.6); zygomatic breadth, 37.5 (35.8-39.0); length of nasals, 22.2 (21.0-23.0); alveolar length of maxillary tooth row, 11.8 (11.5-12.3); width of rostrum, 10.3 (9.7-11.0); width across posterior tongues of the premaxillae, 18.2 (18.0-18.9).

Remarks.—This race comes into geographical contact with *rufiventer* to the north, and with *limitis* to the west and *subauratus* to the east,

from which two later races its larger size and general coloration make it easily discernible. Specimens from south-central (Acadia Parish) and central Louisiana (Rapides Parish) are somewhat intermediate in size and color between *ludovicianus* and *subauratus*. The Acadia Parish specimens are, however, closer to *ludovicianus*. The series from eastern Texas (Walker and Trinity County) are clearly referable to *ludovicianus*; specimens from Brazos County approach *limitis*.

A careful review of the synonymy of *Sciurus niger* reveals that this name is applicable to the present form. We have not examined any of Custis' specimens upon which he based his description; in fact, he does not mention having saved specimens. However, we have a good series from various points along the Red River in northwestern Louisiana.

The basis for the name *S. ludovicianus* is contained in a letter written by Dr. Peter Custis to his teacher, Dr. Benjamin S. Barton, and published by the latter in 1806.⁷ The pertinent material from this letter, as published by Barton, is as follows:

"There is a Squirrel, in this country, not described by Linnaeus. Its body and the upper parts of the tail are dark grey: the belly, inside of the legs and thighs, and under parts of the tail, are of a reddish brown: ears not bearded. Tail longer than the body, and very broad. About the size of *Sciurus vulpinus*. I have called it *Sciurus Ludovicianus*, until we know it to be a new species."

It is conceivable that Custis could have gained his impression of *S. ludovicianus* from specimens along the Red River of Avoyelles or Concordia Parishes, as he traveled by boat from Natchez, Mississippi, up the Red River to Natchitoches. In Avoyelles and Concordia Parishes, *subauratus* is encountered. Since, however, Custis wrote his letter to Barton from Natchitoches and said, "There is a squirrel in *this country* . . ." we are justified in restricting the type locality to the Red River region of Natchitoches Parish. We would have preferred to name Allen Parish, in southwestern Louisiana, the restricted type locality, for there *ludovicianus* reaches its maximum development, but the Red River does not pass through this particular area. Since Custis specifically cited the Red River, the type locality should properly remain somewhere in its vicinity.

Specimens examined.—Total number, 57, as follows:⁸

LOUISIANA.—*Natchitoches Parish*: Ashland, 2; Lotus, 1; Cypress, 3;

⁷Loc. cit.

⁸The Texas specimens are in the Texas Cooperative Wildlife Collection.

Provencal, 1; Bellwood, 1; Kisatchie, 1. *Allen Parish*: Oberlin, 8 miles W on Whiskey Chitto Creek, 7. *Acadia Parish*: Egan, 4 (intergrades); Crowley, 1. *Lincoln Parish*: Ruston, 1.

TEXAS.—*Brazos County*: 3 mi. W Bryon, 1; 3 mi. E College Station, 1; 16 mi. SW College Station, 2. *Burleson County*: 4 mi. SW Caldwell, 1; 3 mi. NW Caldwell, 1; 5 mi. N Caldwell, 1. *Robertson County*: 6 mi. E Hearne, 1. *Leon County*: Normangee, 1. *Walker County*: 11 mi. SSW Huntsville, 1; 3 mi. E Riverside, 3. *Trinity County*: 12 mi. E Trinity, 3; 17 mi. SW Trinity, 2; 14 mi. SW Trinity, 3; 3 mi. SW Trinity, 1; Trinity, 1. *Harris County*: 6 mi. E Katy, 2; 2 mi. E Sheldon, 1. *Polk County*: 4 mi. W Segno, 1. *Hardin County*: Nona, 1 (white). *Limestone County*: Groesbeck, 2.

ARKANSAS.—*Pike County*: Delight, 4.

SCIURUS NIGER SUBAURATUS Bachman

GOLDEN-BELLIED FOX SQUIRREL

Sciurus subauratus Bachman, Proc. Zool. Soc. London, 1838: 87.

Sciurus auduboni Bachman, Proc. Zool. Soc. London, 1838: 97 (New Orleans; melanistic example of *S. n. subauratus*).

Type locality.—Herein restricted to Iberville Parish, Louisiana. Name based on two specimens secured by John J. Audubon from New Orleans market, hence possibly from anywhere in the lower delta region. By restricting the type locality to Iberville Parish, this will avoid possible confusion with races lying to the east and west of the New Orleans area.

Distribution.—Lower alluvial valley of the Mississippi River north through the alluvial swamp region of the Mississippi, Atchafalaya, and Tensas River systems into southern Arkansas and the Yazoo River delta of the state of Mississippi.

Diagnosis.—An extremely small Fox Squirrel although not quite so small as *limitis* of central Texas. General coloration similar to *rufiventer* but decidedly more reddish (vinaceous-rufous) below and distinctly buff brown above. The grayish suffusion of the upper parts of *rufiventer* and *ludovicianus* is totally lacking. The nose, ears, toes, etc., lack all traces of white and are reddish like the tail; there is no appreciable concentration of black on the head.

Comparisons.—Compared with *ludovicianus*, *subauratus* is conspicu-

ously smaller in body size and cranial measurements. Comparison of eight topotypes with seven specimens of *ludovicianus* from Allen Parish, Louisiana: basilar length of Hensel, 45.5 mm as opposed to 51.4; zygomatic breadth, 33.7 mm as opposed to 37.7; length of nasals, 19.9 mm as opposed to 22.5; width of rostrum, 9.2 mm as opposed to 10.4; width across posterior tongues of the premaxilla, 15.4 mm as opposed to 18.0. Compared with *rufiventer* and *bachmani*, the same marked differences in skull proportions are to be noted (see measurements under these races). In color, *subauratus* differs from *rufiventer*, *ludovicianus*, and *limitis* in being decidedly more reddish on the under parts, tail, upper surfaces of the feet, furred portion of the ears, and on the sides of the head. The suffusion of black in the upper parts and tail is more extensive.

Measurements.—Eighteen adults from south-central and central Louisiana: total length, 505 (460-590); tail, 246 (217-295); hind foot, 60.1 (51-67); ear, 23.6 (22-29); basilar length of Hensel, 45.8 (42.6-46.6); zygomatic breadth, 33.4 (32.3-34.9); length of nasals, 19.9 (19.3-20.5); alveolar length of maxillary tooth row, 10.9 (10.0-11.9); width of rostrum, 9.1 (8.8-9.7); width of the posterior tongues of the premaxillae, 15.4 (14.1-15.9).

Remarks.—The name *Sciurus subauratus* which Bachman applied to the two small squirrels obtained by John J. Audubon in the New Orleans market has been treated with considerable uncertainty by various subsequent authors. This confusion has been primarily a result of both Audubon and Bachman having considered *subauratus* a type of gray squirrel, in spite of its dental formula and other features characteristic of *Sciurus niger*. Ever since we began to gather the first specimens of the small, reddish Fox Squirrels of the Mississippi, Atchafalaya, and Yazoo river valleys, we have considered it a perfectly valid and easily recognizable race. However, until we had carefully scrutinized John J. Audubon's fine painting of the squirrels which he had sent to Dr. Bachman, and upon which the latter based the name *subauratus*, we had not realized the connection between *subauratus* and the supposedly unnamed race which we were studying at the time.

A comparison of Audubon's plate⁹ of *Sciurus subauratus* with that of

⁹ "The Viviparous Quadrupeds of North America" (Imperial Folio Edition), vol. 2, Plate 58, 1846; text in vol. 2, pp. 67-70 of the letterpress. See also: "The Quadrupeds of North America," vol. 2, 1851: 67-70; Plate 58.

his *S. capistratus* reveals possibly why both he and Bachman considered *subauratus* a type of gray squirrel. Bachman, living in South Carolina, was most familiar with the exceedingly large, gray, white-eared, white-nosed squirrel (typical *niger*) of the southeastern United States. Audubon was equally familiar with the large ferruginous colored, white-eared, white nosed squirrel (*S. n. bachmani*) of eastern Louisiana, in the area north of Lake Pontchartrain. Hence, when Audubon secured the small dark colored, reddish-bellied squirrels at New Orleans, it was logical, he not being aware of the reliability of the dental formulæ in distinguishing the two species, that both he and Bachman should have considered this new squirrel related to the Carolina Gray Squirrel. Its size is about that of *S. carolinensis* and hence decidedly smaller than any race of *S. niger* except *limitis* of Texas. Even today, were it not for intergradation between *subauratus* and *bachmani* being fully established, these two races of Fox Squirrel might well be considered distinct species, as they are totally dissimilar.

The name *S. auduboni* Bachman¹⁰ is nothing more than a melanistic example of *S. subauratus* and was first described in the same paper; the latter has page priority. *S. auduboni* was pictured by Audubon in one of the supplementary plates accompanying the letterpress to the Imperial Folio Edition of "The Viviparous Quadrupeds of North America"¹¹ and this plate was not included in the Imperial Folio Edition published in 1846. Bachman's *S. subauratus* was included in the Folio Edition.

The range of *subauratus* seems to coincide with the alluvial bottom lands of the lower Mississippi, Atchafalaya, Tensas, and Yazoo river valleys. This race is bounded on all sides by races that are larger both in body size and in cranial measurements. At Baton Rouge, *subauratus* occurs on the eastern side of the Mississippi but is confined, as to be expected, to the bottom lands. In at least one place the pine woods of the Florida Parishes (those parishes in Louisiana east of the Mississippi River, south of the Mississippi state line, and north of lakes Pontchartrain and Maurepas) extend to within three miles of the Mississippi River itself. Extremely interesting from the ecological viewpoint is the

¹⁰ *Lit. cit.*, p. 97.

¹¹ Vol. 3, 1854: 260-261; plate 152. (See also: "The Quadrupeds of North America," vol. 3, 1854: 260-261; Plate 152.) John Woodhouse Audubon collected the specimen and made the drawing of this squirrel and it was for him that Bachman named it.

fact that *bachmani* extends through the pine woodlands to the very edges thereof where they join the alluvial swamps. There *subauratus* and *bachmani* come into contact with one another and intergradation takes place. Some specimens have the general color of *bachmani* but lack the white on the nose, ears, toes and tips of the tail. The tremendous skull differences between typical *subauratus* and *bachmani* are bridged by these intergrades.

In the Yazoo Valley of northwestern Mississippi, specimens tend to resemble *rufiventer* in that they are more yellowish beneath. Skull measurements, while somewhat large for the average of *subauratus*, fall closest to that form. A gradient tendency toward *rufiventer* northward through the Mississippi River Valley, however, is to be expected. Just where complete intergradation between *rufiventer* and *subauratus*, as well as between *subauratus* and *bachmani*, takes place in the central Mississippi River Valley is not yet clearly demonstrated due to the lack of specimens from critical areas.

Melanism possibly is more prevalent in *subauratus* than in any other race of *Sciurus niger*. In north Louisiana, for example, an interesting contrast is to be noted. At Ruston and Minden, in the hill parishes where *ludovicianus* occurs, melanism is exceedingly rare. In contrast to this, melanism is very common seventy-five miles to the east in the Tensas and Mississippi River swamps. There any given population is likely to average fifty per cent. melanistic. Specimens in this color phase are usually totally black, but one specimen is at hand which is of the "agouti" pattern.

Specimens examined.—Total number, 40, as follows:

LOUISIANA.—*Pointe Coupee Parish*: Lakeland, 1; unspecified, 1; Racourci Island, 2; Lottie, 7. *Iberville Parish*: Indian Village, 2. *St. Bernard Parish*: Toca Village, 1. *Plaquemine Parish*: Fannye, 2. *Iberia Parish*: New Iberia, 2. *West Baton Rouge Parish*: Erwinville, 1; Cinclaire, 2. *East Baton Rouge Parish*: 5 mi. S University, 1 (intergrade). *West Feliciana Parish*: unspecified, 4 (intergrades). *West Carroll Parish*: Oakgrove, 1. *Madison Parish*: Tallulah, 1. *St. Landry Parish*: unspecified, 1. *LaSalle Parish*: Jena, 1. *Catahoula Parish*: Jonesville, 1. *Rapides Parish*: Valentine Lake, 1.

MISSISSIPPI.—*Sunflower County*: Moorhead, 8.

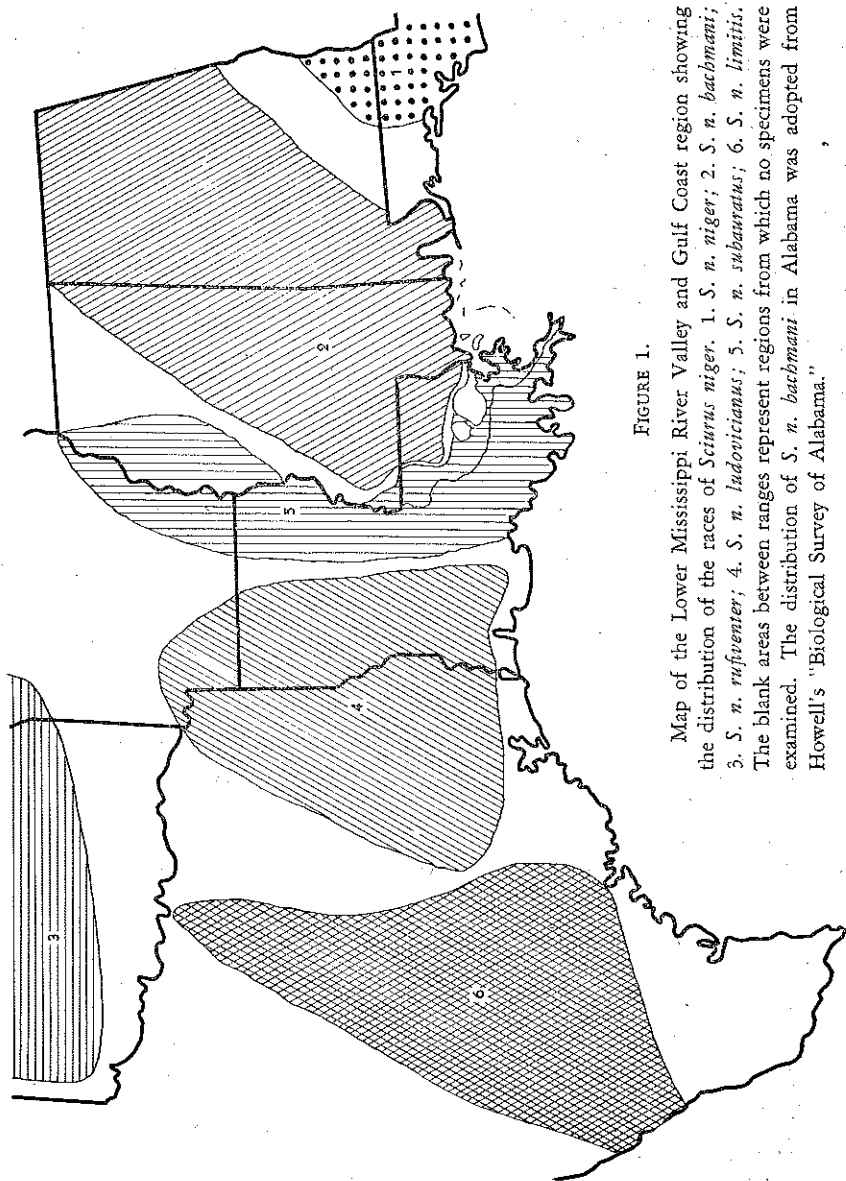


FIGURE 1.

Map of the Lower Mississippi River Valley and Gulf Coast region showing the distribution of the races of *Sciurus niger*. 1. *S. n. niger*; 2. *S. n. bachmani*; 3. *S. n. rufiventer*; 4. *S. n. ludovicianus*; 5. *S. n. subauratus*; 6. *S. n. limitis*. The blank areas between ranges represent regions from which no specimens were examined. The distribution of *S. n. bachmani* in Alabama was adopted from Howell's "Biological Survey of Alabama."

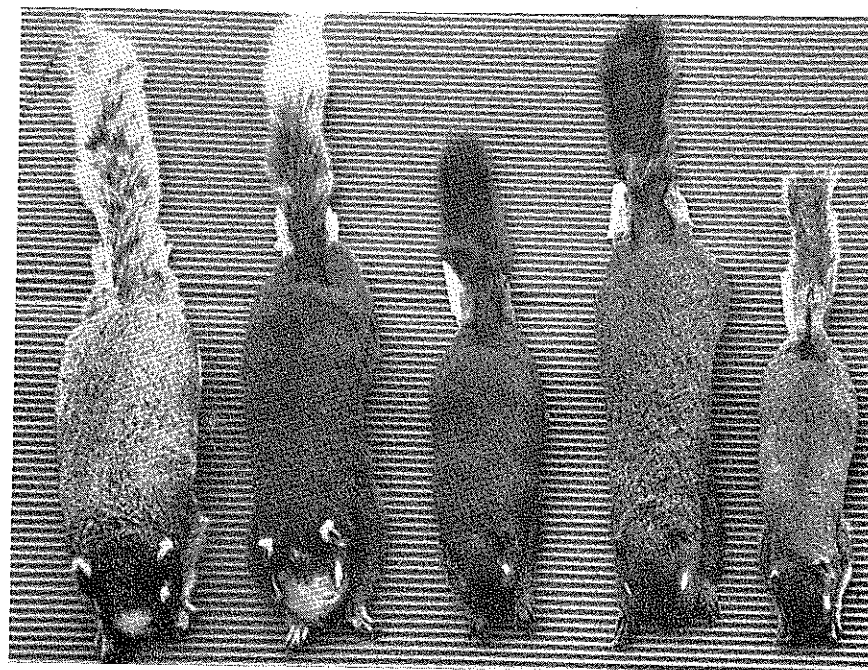


FIGURE 2.

Photograph of typical adult specimens of five of the geographical races of *Sciurus niger* discussed in this paper. (Left to right) *S. n. niger* from McClellanville, South Carolina; *S. n. bachmani* from Chipola, Louisiana; *S. n. subauratus* from Lakeland, Louisiana; *S. n. ludovicianus* from 10 mi. W Oberlin, Louisiana; *S. n. limitis* from Johnson City, Texas. Made in daylight with Finopan (no filters) by J. Harvey Roberts.

SCIURUS NIGER LIMITIS Baird

TEXAS FOX SQUIRREL

Sciurus limitis Baird, Proc. Acad. Nat. Sci. Philadelphia, 7, 1835: 331.

Sciurus ludovicianus limitis Bangs, Proc. Biol. Soc. Washington, 10, 1896: 149.

S[ciurus] n[iger] limitis Osgood, Proc. Biol. Soc. Washington, 20, 1907: 47.

Type locality.—Devil's River, Valverde County, Texas.

Diagnosis.—The smallest of the Fox Squirrels; similar in color to *rufiventer*, but decidedly paler and with less suffusion of black on the upper parts.

Distribution.—Central Texas, from Colorado and Comanche Counties westward to the Pecos River.

Comparison.—As compared with *ludovicianus*, the race geographically adjacent to the east, *limitis* is much smaller and paler. The skull is considerably smaller in all respects (basilar length of Hensel 46.4 as compared with 51.1).

Measurements.—Seven adult specimens from the "hill country" of Texas: total length 470 (454-493); length of tail, 223 (200-280); length of hind foot, 61 (59-63); basilar length of Hensel, 46.4 (45.2-48.8); zygomatic breadth, 34.6 (33.4-36.1); length of nasals, 20.9 (19.2-22.0); alveolar length of maxillary tooth row, 10.7 (10.3-11.1); width across posterior tongues of premaxillae, 16.6 (15.9-17.5).

Remarks.—Specimens from Marysville, Lamkin, and Eagle Lake are intermediate in most respects between *ludovicianus* and *limitis*.

Specimens examined.—Total number, 27, as follows:¹²

TEXAS.—*Bexar County*: 5 mi. E San Antonio, 1. *Cooke County*: 2 mi. S Marysville, 3 (intergrades). *Lee County*: Giddings, 1. *Blanco County*: 9 mi. E Blanco, 1; Johnson City, 1. *Kimble County*: 7 mi. S Segovia, 1. *Kerr County*: 20 mi. W Mountain Home, 2; 2 mi. W Kerrville, 4; 4 mi. NE Center Point, 1; 5 mi. W Hunt, 1. *Edwards County*: 28 mi. N Rocksprings, 1. *Comanche County*: Lamkin, 1. *Colorado County*: 30 mi. SW Eagle Lake, 2. *Aransas County*: Aransas Refuge, 2. *Maverick County*: Eagle Pass, 2. *LaSalle County*: 8 mi. E Encinal, 2. *Hamilton County*: 1 mi. E Lamkin, 1. *Atascosa County*: 7 mi. SW Somerset, 3 (A. J. Kirn coll.).

¹² The Johnson City specimen is in the Louisiana State University Museum of Zoology; the remainder are in the Texas Cooperative Wildlife Collection.