

American Museum Novitates

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY
CENTRAL PARK WEST AT 79TH STREET, NEW YORK 24, N.Y.

NUMBER 2093

JUNE 13, 1962

Tree Squirrels (*Sciurus colliaei* Group) of Western Mexico

BY SYDNEY ANDERSON¹

Three nominal species of tree squirrels (*Sciurus truei* Nelson, *Sciurus sinaloensis* Nelson, and *Sciurus colliaei* Richardson) inhabit the coastal region of western Mexico. These squirrels are of small to moderate size and have relatively coarse, short hair of yellowish and blackish hue. Nelson (1899, p. 26) indicated the relationships of these species by commenting that *S. colliaei colliaei*, *S. colliaei nuchalis*, *S. sinaloensis*, and *S. truei* belong to a distinct "group" within the subgenus to which he assigned them, and that *S. sinaloensis* might eventually prove to be a subspecies of *S. colliaei*. Nelson examined 49 specimens, including 41 of *S. colliaei*, four of *S. sinaloensis*, and four of *S. truei*. The study reported here is based on 152 specimens that are listed in the accounts of subspecies.

A grant from the National Science Foundation (G 10874) helped me to compile the data reported in the present paper. I am grateful to the curators whose names follow for making specimens in their care available for study: Dr. Richard G. Van Gelder, the American Museum of Natural History (A.M.N.H.); Dr. E. Raymond Hall and Mr. J. Knox Jones, Jr., Museum of Natural History, University of Kansas, Lawrence (K.U.); Drs. Kenneth E. Stager and Charles A. McLaughlin, Los Angeles County Museum (L.A.C.M.); Miss Barbara Lawrence, Museum of Comparative Zoölogy at Harvard College (M.C.Z.); Drs. Seth B. Benson and William Z. Lidicker, Museum of Vertebrate Zoology, University of California,

¹ Assistant Curator, Department of Mammalogy, the American Museum of Natural History.

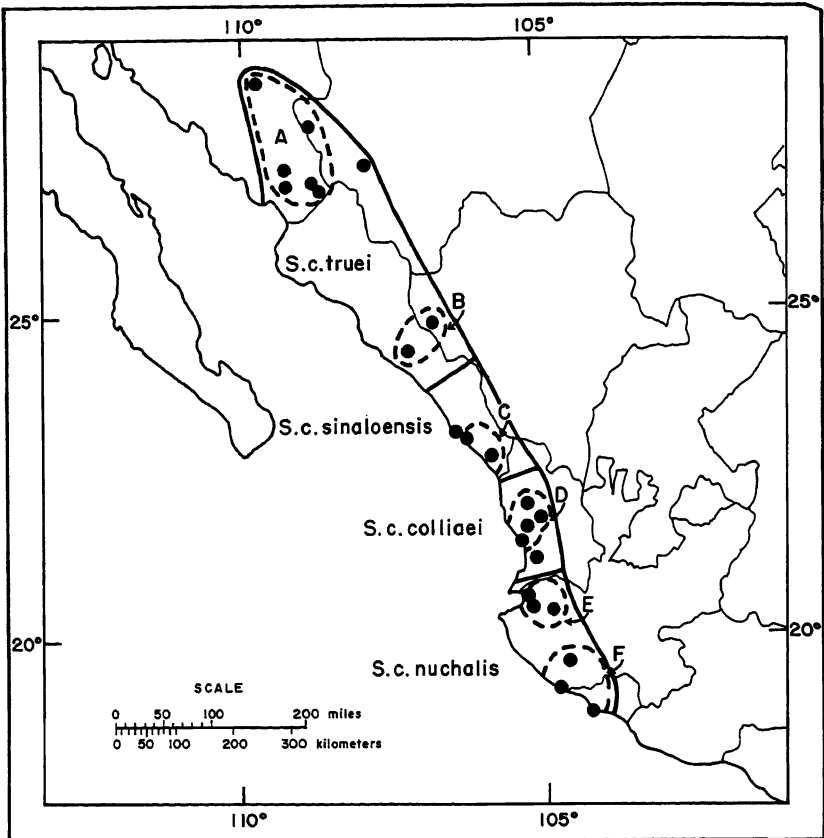


FIG. 1. Part of western Mexico, showing the range of *Sciurus coliaei*. Ranges of subspecies are labeled. Dots indicate localities from which specimens have been preserved. The letters A to F designate areas from which samples for statistical analysis were obtained.

Berkeley (M.V.Z.); Dr. George A. Bartholomew, the Donald R. Dickey Collection, University of California, Los Angeles (U.C.L.A.); Dr. Donald F. Hoffmeister, Museum of Natural History, University of Illinois, Urbana (U.I.); Drs. William H. Burt and Emmet T. Hooper, Museum of Zoology, University of Michigan, Ann Arbor (U.M.M.Z.); and Dr. David H. Johnson, United States National Museum (U.S.N.M.). The initials in the above list are used in the paragraphs concerning the specimens examined to designate the various collections.

Dr. John Edwards Hill of the British Museum (Natural History) kindly

provided (in a letter of March 28, 1961) the registration numbers of the type specimens of *S. colliaei* and *S. sinaloensis*. Dr. Joseph Curtis Moore and Dr. Karl F. Koopman read an early draft of the manuscript; their comments were helpful.

Dr. Emmet T. Hooper also read an early draft, and his comments are also appreciated. Several years ago Hooper began collecting specimens and data for a revision of *Sciurus* in Mexico. His revision, when completed, will provide additional data on the distribution, and the ecological and systematic relationships of *Sciurus colliaei* with other species occurring south of Durango and Sinaloa.

Figures 1 and 2 were prepared by Mr. Walter Holmquist. The photograph for figure 3 is by Mr. Alexander Rota, and the photographs for figures 4 and 5 are by Mr. Robert E. Logan.

The distribution of squirrels of the *Sciurus colliaei* group is shown in figure 1. In the northern part of the range, these squirrels inhabit the coastal plain and some more elevated areas such as canyons leading to the coastal plain, and no other species of tree squirrel inhabits the coastal plain. Species, the ranges of which include the adjacent Sierra Madre Occidental, occur at higher altitudes than does the *Sciurus colliaei* group where its range meets the ranges of the more montane species. In the northern part of the range of the *S. colliaei* group, the montane species are *Sciurus apache* and *Sciurus aberti*. The ranges of the three species overlap to some degree, but some altitudinal zonation is apparent, *S. apache* being most abundant in the zone of oak trees above the scrubby subtropical vegetation favored by the *S. colliaei* group, and *S. aberti* being most abundant in the zone of pine trees above the oaks. I am less familiar with the areas farther south. Perhaps altitudinal zonation in squirrel distribution occurs in the southern part of the range of the *S. colliaei* group also. The montane species there are *Sciurus poliopus* and *Sciurus nayaritensis*.

Measurements were selected after preliminary study to illustrate differences in the squirrels from different places and to test the significance of differences previously reported, or thought to be significant. Statistical significance of differences can be computed from the figures in tables 1 and 2, and taxonomic significance is reflected in the accounts of subspecies. The external measurements used are the total length, the length of the tail vertebrae, and the length of the hind foot, all as measured by the collector. All measurements are expressed here in millimeters. The cranial measurements used are the occipitonasal length, zygomatic breadth, breadth of the braincase measured at the postzygomatic notches, the interorbital breadth, and the alveolar length of the maxillary tooth row. Cranial measurements were taken with dial calipers reading to

TABLE 1

EXTERNAL MEASUREMENTS (IN MILLIMETERS) OF ADULT *Sciurus colliasi*

[For each measurement and each group (a "group" is a sample from an area shown by a corresponding letter in fig. 1) the mean and standard deviation are shown on one line; the minimum and maximum are shown, in parentheses, on a second line; and the number in each sample is shown on a third line.
Some of these data are omitted for small samples.]

Group	Total Length	Length of Tail	Length of Hind Foot
<i>S. c. truei</i>			
A	500.2±4.5 (440-534) N = 27	258.3±9.3 (203-287) N = 27	63.5±4.6 (58-67) N = 27
B	511.0 (502-520) N = 5	267.8 (259-277) N = 5	65.4 (64-66.5) N = 6
<i>S. c. sinaloensis</i>			
C	511.7 (500-524) N = 4	249.3 (241-267) N = 4	59.3 (57-60) N = 4
<i>S. c. colliasi</i>			
D	499.1±24.3 (448-537) N = 20	252.2±17.1 (215-280) N = 20	63.9±2.5 (59-67) N = 20
<i>S. c. nuchalis</i>			
E	509.2±19.2 (473-534) N = 12	256.8±11.5 (244-274) N = 12	67.5±1.7 (64-70) N = 12
F	543.6±11.9 (466-578) N = 10	267.7±20.2 (233-300) N = 10	66.6±3.3 (61-71) N = 11

tenths of millimeters. For statistical purposes I combined measurements of adult squirrels from different localities within each of the areas labeled A to F in figure 1. Statistics are presented in three tables. Statistics for three measurements are presented graphically in figure 2. All these measurements show that the squirrels become larger from north to south, and the amount of increase in size in a given distance increases progressively. Furthermore, the cline in size is paralleled by a cline in color. The squirrels become darker (more blackish) and less yellowish toward the south, as shown in figure 3. The frequency of occurrence of upper third premolar teeth increases from north to south, as is shown in table 3. The third upper premolar is absent on one side (in four individuals) or on both sides (in 13 individuals) in more than half of the Sonoran speci-

TABLE 2

CRANIAL MEASUREMENTS (IN MILLIMETERS) OF ADULT *Sciurus colliaei*

[For each measurement and each group (a "group" is a sample from an area shown by a corresponding letter in fig. 1) the mean and standard deviation are shown on one line; the minimum and maximum are shown, in parentheses, on a second line; and the number in each sample is shown on a third line.

Some of these data are omitted for small samples.]

Group	Occipito-nasal Length	Zygomatic Breadth	Breadth of Braincase	Inter-orbital Breadth	Alveolar Length of Maxillary Tooth Row
<i>S. c. truei</i>					
A	56.10±0.88 (54.4-58.6) N = 30	32.48±0.70 (30.9-33.8) N = 30	23.43±0.51 (22.2-24.4) N = 30	18.17±0.48 (17.2-18.9) N = 30	11.07±0.51 (9.8-11.5) N = 30
B	57.08 (56.2-58.2) N = 7	32.66 (31.4-33.2) N = 7	23.87 (23.7-24.1) N = 7	18.07 (17.9-18.3) N = 7	11.39 (10.9-11.9) N = 7
<i>S. c. sinaloensis</i>					
C	59.10±1.17 (56.5-62.1) N = 21	34.10±0.85 (32.3-36.1) N = 21	24.37±0.67 (23.2-25.6) N = 21	18.70±0.70 (17.7-20.1) N = 21	11.59±0.35 (10.7-12.4) N = 21
<i>S. c. colliaei</i>					
D	58.43±1.57 (56.3-63.1) N = 25	33.21±1.06 (31.5-35.1) N = 25	24.00±0.86 (22.6-26.1) N = 25	18.76±1.02 (17.1-20.6) N = 25	11.49±1.28 (10.8-12.5) N = 25
<i>S. c. nuchalis</i>					
E	59.62±1.90 (56.8-63.0) N = 12	34.50±1.43 (32.3-36.8) N = 12	24.80±0.71 (23.8-25.9) N = 12	19.11±1.19 (16.9-20.9) N = 12	11.66±0.40 (11.0-12.1) N = 12
F	61.99±2.08 (57.2-64.6) N = 11	35.41±1.69 (31.1-37.6) N = 11	25.05±1.11 (23.0-27.2) N = 11	20.54±1.06 (18.1-22.5) N = 11	11.95±0.35 (11.2-12.6) N = 11

mens. This fact supports the rejection (Moore, 1960, p. 358) of subgenera of North American *Sciurus* that are based entirely on the presence or absence of the third upper premolar.

Selected specimens were assembled at one place to permit comparisons needed to evaluate certain subtle differences reported by Nelson (1899). The results of the comparisons are reported in each subspecies account. The numbers of specimens assembled were: *Sciurus truei* (Group A, 10; Group B, five), total of 15; *Sciurus sinaloensis* (Group C), 16; *Sciurus colliaei* (Group D), six; *Sciurus colliaei nuchalis* (Group F), three. Skulls are illustrated in figures 4 and 5.

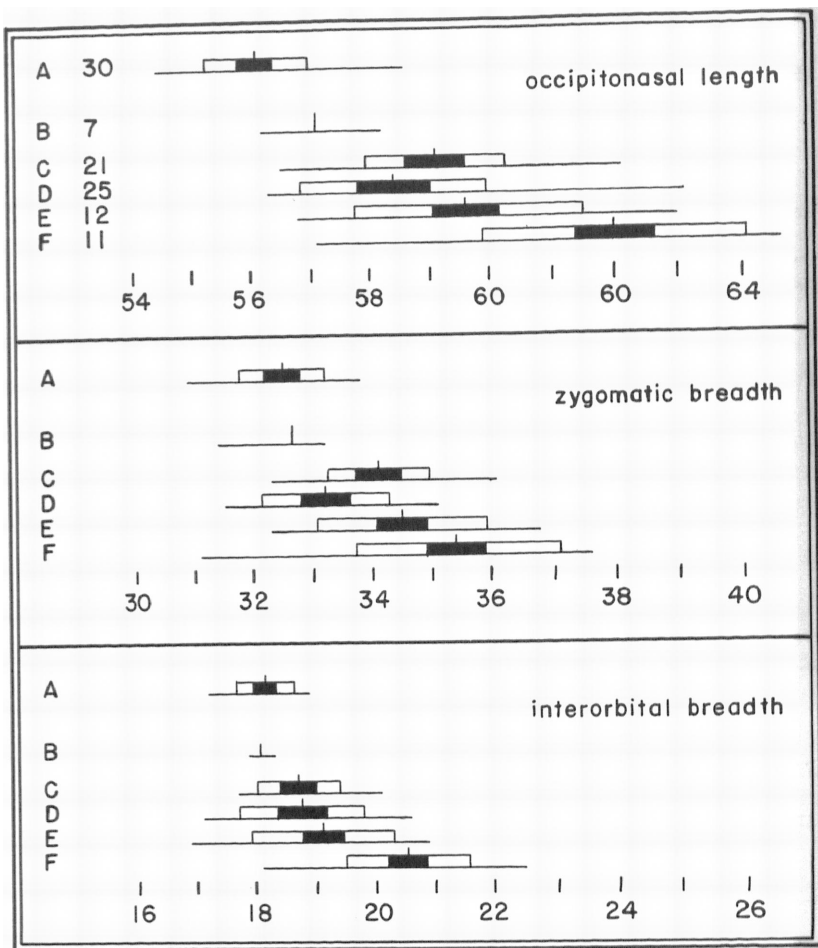


FIG. 2. Geographic variation in size in *Sciurus colliae* from north to south. Three cranial measurements are plotted. The samples labeled A to F were drawn from the areas similarly labeled in figure 1. The vertical spacing of the symbols for separate samples is proportional to the geographic distance from northwest to southeast between the places where the samples were obtained. The numerals following the sample designations A to F in the top graph are the numbers of specimens in each sample. For each sample the range is shown by a horizontal line; the mean, by a vertical line; one standard deviation each side of the mean, by boxes; and two standard errors each side of the mean are shown by a bar. The squirrels increase in size from north to south, except that *S. c. colliae* (Group D) introduces an irregularity in the cline.

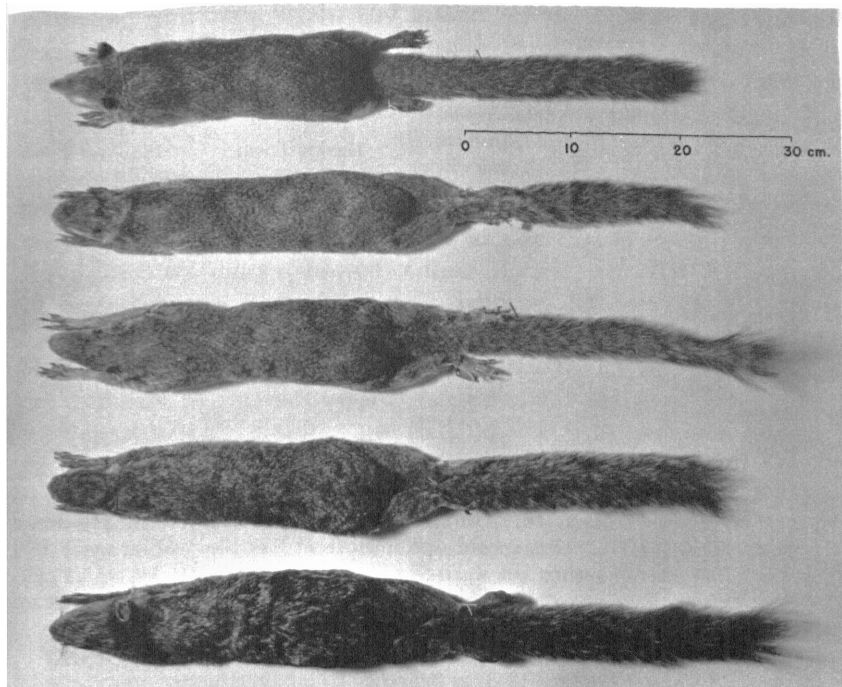


FIG. 3. Five specimens of *Sciurus colliaei*, arranged according to geographic origin from north (top) to south (bottom). In the same order the specimens are: U.C.L.A. No. 16739, from San Javier, Sonora (in Group A, fig. 1); U.S.N.M. No. 96793, from Chacala, Durango (in Group B, fig. 1); A.M.N.H. No. 24757, from Escuinapa, Sinaloa (in Group C, fig. 1); U.S.N.M. No. 88164, from San Blas, Nayarit (in Group D, fig. 1); and U.S.N.M. No. 32654, from Manzanillo, Colima (in Group F, fig. 1).

The clinal variation in size, color, and dentition (absence of third upper premolar) and the overlap in the ranges of variation of successive samples in each character studied are interpreted as evidence that squirrels of the *S. colliaei* "group" comprise one interbreeding population, more or less continuously distributed, which should be regarded as a single species. The first name proposed for the species is *Sciurus colliaei*. The systematic status of the races of *Sciurus colliaei* and the specimens examined are summarized below.

Sciurus colliaei colliaei Richardson

Sciurus colliaei RICHARDSON, 1839, in Beechey, The zoology of Capt. Beechey's voyage, p. 8, pl. 1 (*Sciurus Colliaei* Bachman, 1838, Proc. Zool. Soc. London, p. 95,

TABLE 3
OCCURRENCE OF THIRD UPPER PREMOLAR IN *Sciurus coliaei*

Group	Total Number of Individuals Examined	Number of Individuals Having Tooth on Both Sides	Percentage of Individuals Having Tooth on Both Sides
<i>S. c. truei</i>			
A	29	12	41
B	7	6	84
<i>S. c. sinaloensis</i>			
C	21	20	95
<i>S. c. coliaei</i>			
D	32	32	100
<i>S. c. nuchalis</i>			
E	19	19	100
F	11	11	100

is a *nomen nudum*). ALLEN, 1877, Monographs of North American Rodentia, no. 11, Sciuridae, p. 738 (reference to specimen from San Blas). NELSON, 1899, Proc. Washington Acad. Sci., vol. 1, p. 58.

Sciurus Coliaei, BACHMAN, 1839, Mag. Nat. Hist., vol. 3, p. 334. AUDUBON AND BACHMAN, 1854, The quadrupeds of North America, vol. 3, p. 21, pl. 114.

[*Sciurus*] *Coliaei*, BACHMAN, 1839, Amer. Jour. Sci., vol. 37, p. 307.

[*Sciurus*]. *Coliaei*, WAGNER, 1843, in Schreber, Die Säugethiere, suppl. vol. 3, p. 174.

Macroxus Coliaei, GRAY, 1867, Ann. Mag. Nat. Hist., ser. 3, vol. 20, p. 421 (part, variety 3, from Mexico).

Sciurus hypopyrrhus, ALSTON, 1878, Proc. Zool. Soc. London, p. 662 (part, cites *S. coliaei* of Richardson as synonym). ALLEN, 1878, Bull. U. S. Geol. Surv. Terr., vol. 4, p. 881 (part, follows Alston in regarding *S. coliaei* as synonym of *S. hypopyrrhus*).

Sciurus coliaei coliaei, ELLERMAN, 1940, The families and genera of living rodents, vol. 1, p. 335. HALL AND KELSON, 1959, The mammals of North America, p. 376.

The type locality is San Blas, Nayarit. The type specimen is B.M.N.H. No. 53.8.29.34 (not examined by me).

In comparison with *Sciurus c. nuchalis*, *S. c. coliaei* is smaller externally and has less blackish pelage and shorter, more delicately formed skull, with narrower and shorter rostrum, narrower jugals, and smaller bullae. The cranial differences between topotypes of *S. c. coliaei* and those of *S. c. nuchalis* seem to me to be as great as between those of *S. c. coliaei* and those of *S. c. truei*. In comparison with *S. c. sinaloensis*, *S. c. coliaei* is smaller externally and has more blackish and less orange-hued pelage, less individual variation in pelage color, and shorter skull, with narrower

rostrum, narrower jugals, and smaller bullae. In size, and in cranial features correlated with size, *S. c. colliaei* introduces an irregularity in the cline of increasing size from north to south (note Group D in fig. 2). In color *S. c. colliaei* fits in the cline of increasing blackishness from north to south.

The 52 specimens examined are listed by locality, from north to south, below. Italicized localities are not shown in figure 1, because each of them is within 10 miles of another locality that is shown in figure 1. Nayarit: Two miles southwest of Rosa Morada, two (K.U.); Platanares, 10 miles east of Ruiz, 12 (K.U.); Santiago, 200 feet, six (U.S.N.M.); 5 miles northeast of San Blas, one (U.I.); San Blas, 20 (15, U.S.N.M.; three, M.C.Z.; two, M.V.Z.); *Aticama, 10 feet*, three (K.U.); Las Varas, 800 feet, one (U.S.N.M.); 5 miles south of Las Varas, 150 feet, five (K.U.); 8 miles south-southwest of Las Varas, two (K.U.).

Sciurus colliaei nuchalis Nelson

Sciurus colliaei nuchalis NELSON, 1899 (May 9), Proc. Washington Acad. Sci., vol. 1, p. 59. ELLERMAN, 1940, The families and genera of living rodents, vol. 1, p. 335. HALL AND KELSON, 1959, The mammals of North America, p. 376.

The type locality is Manzanillo, Colima. The type specimen is U.S.N.M. No. 32657/44580.

A comparison of *Sciurus c. nuchalis* with *S. c. colliaei* is included in the account of *S. c. colliaei* above.

The 25 specimens examined are listed by locality, from north to south, below. Italicized localities are not shown in figure 1, because each is within 10 miles of another locality that is shown in figure 1. Jalisco: Four miles north-northeast of Puerto Vallarta, 50 feet, two (K.U.); *Ixtapa, 300 feet*, two (U.S.N.M.); Las Palmas, 1000 feet, one (U.S.N.M.); *San Sebastian, 3000 to 4500 feet*, seven (U.S.N.M.); Mascota, 4700 feet, one (U.S.N.M.); 5 miles south and 1 mile east of El Arado, four (K.U.); 5 miles northeast of Barra de Navidad (3 miles east of Jaluco), 200 feet, two (K.U.). Colima: *Manzanillo, 50 feet*, five (U.S.N.M.); 1 mile north-east of Santiago, 10 feet, one (K.U.).

Sciurus colliaei sinaloensis Nelson, new combination

Sciurus sinaloensis NELSON, 1899 (May 9), Proc. Washington Acad. Sci., vol. 1, p. 60. ELLERMAN, 1940, The families and genera of living rodents, vol. 1, p. 335. HALL AND KELSON, 1959, The mammals of North America, p. 376.

Sciurus colliaei, ALLEN, 1877, Monographs of North American Rodentia, no. 11, Sciuridae, p. 738 (specimen from Mazatlán).



FIG. 4. Skulls of four subspecies of *Sciurus colliaei* in dorsal view. Upper left, *S. c. nuchalis*, U.S.N.M. No. 44577, from Manzanillo, Colima; upper right, *S. c. colliaei*, U.S.N.M. No. 88172, from San Blas, Nayarit; lower left, *S. c. sinaloensis*, A.M.N.H. No. 24758, from Escuinapa, Sinaloa; lower right, *S. c. truei*, U.C.L.A. No. 18168, from Chinobampo, Sonora. Natural size.

The type locality is Mazatlán, Sinaloa. The type specimen is B.M.N.H. No. 98.3.2.168.

A comparison of *Sciurus c. sinaloensis* with *S. c. colliaei* is included in the

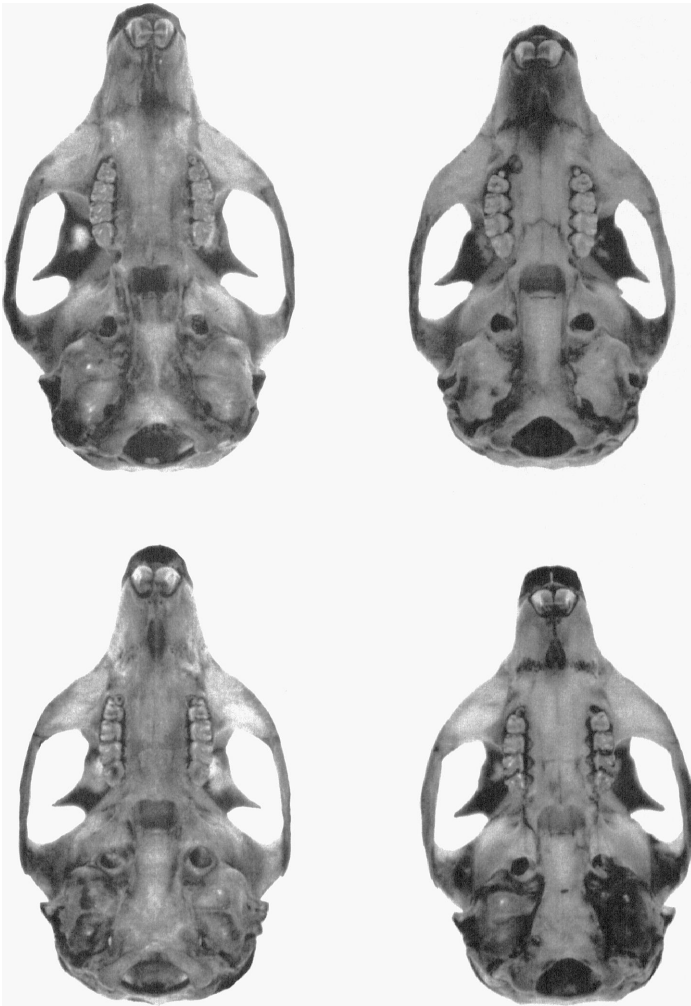


FIG. 5. Skulls of four subspecies of *Sciurus colliae* in ventral view. Upper left, *S. c. nuchalis*, U.S.N.M. No. 44577, from Manzanillo, Colima; upper right, *S. c. colliae*, U.S.N.M. No. 88172, from San Blas, Nayarit; lower left, *S. c. sinaloensis*, A.M.N.H. No. 24758, from Escuinapa, Sinaloa; lower right, *S. c. truei*, U.C.L.A. No. 18168, from Chinobampo, Sonora. Natural size.

account of *S. c. colliae* above. *Sciurus c. sinaloensis* differs from *S. c. truei* in being larger, more variable in color, generally slightly paler, orange-hued rather than yellow-hued, and in having more contrast in color of

darker, orange-washed dorsum, with grayer (paler), less colored, sides, limbs, and tail. The skulls of *S. c. sinaloensis* are larger and have correspondingly heavier zygomatic arches and rostrum and larger bullae. The variation in color in the sample of *S. c. sinaloensis* is greater than in any other sample or subspecies. Some specimens resemble *S. c. colliaei*, and some resemble *S. c. truei*. The tendency toward contrast of dorsum with sides and appendages mentioned above is greater in *S. c. sinaloensis* than in either *S. c. colliaei* or *S. c. truei*.

The 28 specimens examined and the type specimen (not examined) are listed below by locality, from north to south, except that the exact localities of italicized designations of places are unknown to me. These unknown places are not shown in figure 1. Sinaloa: Mazatlán, four [three, M.C.Z.; and the holotype, formerly A.M.N.H. No. 13753, returned to the British Museum (Natural History) in 1899, and not seen by me]; *Presidio propre Mazatlán*, one (A.M.N.H.); Escuinapa, 16 (15, A.M.N.H.; one, M.C.Z.); *Juan Lisiarraga Mountain*, three (A.M.N.H.); *Los Peiles*, three (A.M.N.H.); "*Sinaloa*," one (A.M.N.H.); *Warnales*, one (A.M.N.H.).

Sciurus colliaei truei Nelson, new combination

Sciurus truei NELSON, 1899 (May 9), Proc. Washington Acad. Sci., vol. 1, p. 61. BURT, 1938, Misc. Publs. Univ. Michigan Mus. Zool., no. 39, p. 38. BURT AND HOOPER, 1941, Occas. Papers Mus. Zool. Univ. Michigan, no. 430, p. 6. HALL AND KELSON, 1959, The mammals of North America, p. 376.

The type locality is Camoa, Río Mayo, Sonora. The type specimen is U.S.N.M. No. 96229.

A comparison of *Sciurus c. truei* with *S. c. sinaloensis* is included in the account of *S. c. sinaloensis* above. Nelson (1899, p. 62) noted that *S. c. truei* had a proportionally broader skull, more flattened braincase, broader interorbital area, shorter and heavier rostrum, shorter and posteriorly more deeply emarginate nasals, broader jugals, and larger bullae than *S. c. colliaei*. The only differences that I have been able to verify are the shorter (but not heavier) rostrum, the more deeply emarginate nasals, the broader (more vertically expanded) jugal, and the larger bullae. The shorter rostrum is correlated with the smaller size of *S. c. truei*. Intermediate shapes of the posterior border of the nasals occur in *S. c. sinaloensis*. *Sciurus c. colliaei* has narrower jugals and smaller bullae than any other subspecies. The specimens from Chacala, Durango (Group B), are slightly more orange in hue and are paler on the limbs than typical *S. c. truei*, and therefore may be regarded as intergrades

between *S. c. truei* and *S. c. sinaloensis*.

The 45 specimens examined are listed by locality, from north to south, within each state. The states are arranged alphabetically. Italicized localities are not shown in figure 1, because each of them is within 10 miles of another locality that is shown in figure 1. Chihuahua: Carimechi, four (U.M.M.Z.); Barranca de Cobre, 4300 feet, one (L.A.C.M.). Durango: Chacala, six (U.S.N.M.). Sinaloa: 32 miles south-southeast of Culiacán, three (K.U.). Sonora: San Javier, three (U.C.L.A.); Camoa, Río Mayo, 800 feet, four (U.S.N.M.); *Agua Marin, 8.3 miles west-northwest of Alamos, 1800 feet*, six (M.V.Z.); Chinobampo, three (U.C.L.A.); 8 miles southeast of Alamos, Río Cuchujaqui, one (K.U.); Guirocoba, two (U.C.L.A.); 2 miles east of Guirocoba, nine (M.V.Z.); without designation of locality, probably Sonora, three (U.C.L.A.).

Burt (1938, p. 38) recorded that these squirrels were at Baromico, Sonora. Hall and Kelson (1959, p. 376, following Burt) mapped Baromico. I know of no specimen from there. Perhaps Burt saw squirrels of this species there.

LITERATURE CITED

BURT, WILLIAM HENRY

1938. Faunal relationships and geographic distribution of mammals in Sonora, Mexico. Misc. Publ. Univ. Michigan Mus. Zool., no. 39, pp. 1-77, maps 1-26.

HALL, E. RAYMOND, AND KEITH R. KELSON

1959. The mammals of North America. New York, Ronald Press, 2 vols.

MOORE, JOSEPH CURTIS

1960. The relationships of the gray squirrel, *Sciurus carolinensis*, to its nearest relatives. Proc. 13th Ann. Conf. S. E. Assoc. Game and Fish Commissioners, 1959, pp. 356-363.

NELSON, EDWARD WILLIAM

1899. Revision of the squirrels of Mexico and Central America. Proc. Washington Acad. Sci., vol. 1, pp. 15-110, pls. 1, 2.