

MAMMALS OF COSTA RICA

GEORGE G. GOODWIN

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DEDICATED TO CECIL F. UNDERWOOD

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PREFACE

IT SEEMS FITTING TO DEDICATE this monograph on the mammals of Costa Rica to Cecil F. Underwood as a testimonial of his contribution to mammalogy. Born in London, England, October 26, 1867, the son of George and Amelia Dodd Underwood, Cecil F. Underwood died at San José, Costa Rica, on August 19, 1943, having retained his status as a British subject until the last.

Very little is known about the early life of Mr. Underwood except that he served his apprenticeship as a taxidermist and grew up in a generation when collectors of natural history specimens were scarce. His father had a shop for the purchase and sale of objects of art in London. According to his son, Edwin G. Underwood, an industrial engineer in San José, Cecil Underwood was sent by the British Museum to America. He arrived in New York on his twenty-first birthday and on April 26, 1889, sailed for Costa Rica—apparently induced to go there through the efforts of José Zeledón. From this time on his career is not difficult to follow. Most of his early collections went to the British Museum. Very few came to this country until 1907 when Outram Bangs purchased a large collection of birds that Mr. Underwood had been building up for many years.

Life in Costa Rica must have appealed to Mr. Underwood for he rarely left the country

for almost half a century. His interests there were devoted to collecting and preserving wild life specimens. Material prepared by his hands is represented in almost every museum in the United States and in Europe. For a number of years he held a position in the National Museum of Costa Rica, and many of the exhibits there were prepared by him. In 1896 he exhibited a group of tapir at the Central American Exposition in Guatemala for which he received a gold medal. In the same year Mr. Underwood published in the *Ibis* a list of birds taken on the slope of the Volcán Miravalles. And in 1899, he published (through the Museo Nacional of Costa Rica) a list of the birds of Costa Rica.

In 1932 Mr. Underwood extended his activities to Honduras where he made extensive field trips until 1938. From this time on until the year of his death he centered his attention on collecting in Costa Rica.

During the last 10 years of his life Mr. Underwood devoted his time to mammals and collected some 3000 specimens for the American Museum of Natural History. In all he collected 42 mammal types, nine of which are named in his honor, and three are genotypes.

GEORGE G. GOODWIN

The American Museum of Natural History
September, 1945

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INTRODUCTION

WHILE MANY COLLECTIONS have come out of Costa Rica since the pioneers Drs. Frantzius, Hoffmann, and Elliot first visited the country in 1858 or 1859, the majority of the early collectors were primarily interested in birds. Type descriptions of new mammals have been published from time to time and in some instances lists of species in a particular collection given, but up to the present time no attempt has been made to cover the entire mammal fauna of Costa Rica. In this paper the author has endeavored to bring together not only all the species known to occur in Costa Rica but widely ranging forms that more or less cover this territory, and those described from the adjacent parts of Nicaragua and Panamá that have close relationships to the Costa Rican fauna.

This report is based primarily on the collections of the American Museum of Natural History, now totaling approximately 1000 specimens. However, most of Underwood's recent collections in other North American museums have also been examined. One hundred and eighty-six forms are here recorded from Costa Rica, of which 93 are types. To this are added 73 forms that have a probable range in Costa Rica or occur in neighboring parts of adjacent countries.

The life zones and physiographic features of Costa Rica were adequately worked out and published by M. A. Carriker, Jr., in the *Annals of the Carnegie Museum*, volume 6, number 1, 1909. Recent collections, however, have added some pertinent information on the origin of the Costa Rican mammals and indicated some rather unexpected boundaries. Owing to the geographic position of Costa Rica, widely ranging species of both the northern and southern halves of the Western Hemisphere broadly overlap. In general, however, the mammal fauna of the humid tropical eastern lowlands is separated from that of the arid Pacific coastal plains by species of the central mountain chain. Forms from Volcán Irazú and the Cordillera Central are typically Costa Rican, while those from the Talamanca Range show a tendency to intergrade with Panamanian species. The division here seems to follow the valley of the Reventazón.

The sharpest differentiation in the fauna occurs in the Guanacaste region and Volcania Range where the mammal fauna is definitely of a more northern origin. Some factors, more significant than the Río Grande and the valley of the San Carlos, must serve as natural boundaries.

Collections from the Caribbean coast lowlands are not large, but the species appear to be much the same as those from similar locations in Panamá. On the Pacific side of the cordillera there is some differentiation in forms east of the Río Chiriquí Viejo on the Panamá border and north of the Río Grande in the Province of Guanacaste.

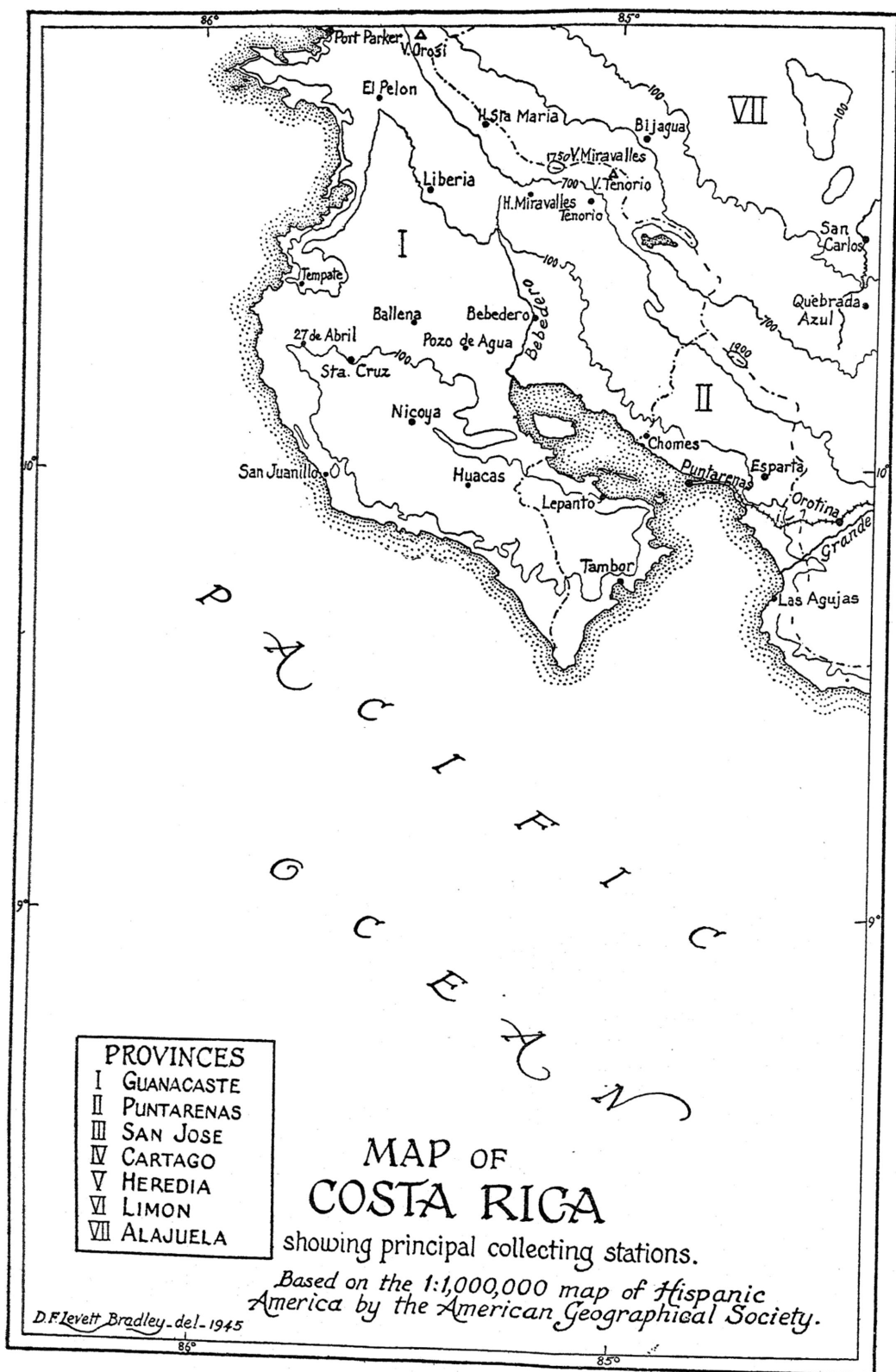
Measurements are given in millimeters unless otherwise stated. Capitalized names of colors are from Ridgway's "Color standards and color nomenclature," 1912.

Acknowledgment for the loan of material is due the United States National Museum, United States Fish and Wildlife Service, University of Michigan, Museum of Comparative Zoölogy, and the Chicago Natural History Museum.

The map of Costa Rica was drawn by Miss D. F. Levett Bradley. The line drawings of bats were made by Miss Henrietta Shaw, Miss Dorothea Kay, and Mrs. Helen Ziska. The figures of *Diclidurus*, *Dirias*, *Chrototerus*, *Choeronycteris*, *Pygoderma*, and *Protopops* were taken from Dobson (1878, "Catalogue of the Chiroptera in the collection of the British Museum"); those of *Leptononycteris*, *Vampyrops*, *Chiroderma*, *Ectophylla*, and *Dasypterus* are drawn from Elliott (1904, *Field Columbian Mus., zool. ser., vol. 4, pt. 1*).

Abbreviations in this paper referring to official catalogues are:

A.M.N.H., American Museum of Natural History
A.N.S.P., Academy of Natural Sciences of Philadelphia
B.M., British Museum
C.M., Carnegie Museum
C.N.H.M., Chicago Natural History Museum
M.B., Museum of Berlin
M.C.Z., Museum of Comparative Zoölogy
M.Z.U.M., Museum of Zoology of the University of Michigan
N.M.C.R., National Museum of Costa Rica
U.S.F.W., United States Fish and Wildlife Service
U.S.N.M., United States National Museum



GENERAL ACCOUNT OF SPECIES

CLASS MAMMALIA
SUBCLASS EUTHERIA
ORDER MARSUPIALIA
MARSUPIALS
FAMILY DIDELPHIDAE
OPOSSUMS

The American marsupials are essentially tropical in distribution, although the range of some species extends northward into the temperate zone. The opossums are the only existing representatives of this order in Central America. They have five toes on fore and hind feet. The young are born in a very incomplete stage of development. The female is usually provided with an external abdominal pouch. A true allantoic placenta is never found in American forms. The teeth are numerous and the general construction is primitive.

DIDELPHIS LINNAEUS
COMMON OPOSSUMS

Size large, fur overlaid with long coarse guard hairs, limbs short, tail long and prehensile, thumb on hind foot opposed to fingers for grasping. Geographical distribution or range of this genus extends from New Hampshire and Vermont west to Iowa and south through Mexico, Central America to Uruguay in South America.

DENTITION: Incisors, $\frac{5-5}{4-4}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{4-4}{4-4}$ = 50.

Didelphis marsupialis Linnaeus
BLACK-EARED OPOSSUM

Didelphis marsupialis LINNAEUS, 1758, *Systema naturae*, ed. 10, vol. 1, p. 54.

The type locality was fixed by Allen as Guiana.

RANGE: Coast of Texas, south through Mexico, Central America, northern South America, Amazon region and south in eastern Brazil to Rio de Janeiro, west of the Andes to Peru.

GENERAL CHARACTERS: A large opossum with long coarse pelage, occurring in either a gray or black color phase; tail long and naked, ears naked and black.

DESCRIPTION: General color grayish white, underfur white with black tips and overlaid with long white guard hairs, the guard hairs black in the dark phase, legs and feet black; side of head whitish with a black stripe across the eye; tail naked, flesh colored, becoming black on basal half. Skull with sagittal and occipital crests strongly developed with age, incisors small and canines large.

MEASUREMENTS: Adult male from San Gerónimo de Pirrís and an adult female from Palmar: Head and body, 451 mm., 500; tail vertebrae, 335, 480; hind foot, 57, 58; ear, 55, 53. Skull: condylobasal length, 100.9, 123.7; length of nasals, 49.2, 59.5; zygomatic breadth, 52.6, 68.2; postorbital constriction, 11.5, 11.2; palatal length, 62.8, 73.1; upper toothrow, c-m⁴, 36.8, 46.2; upper molar series, 20.5, 20. Weights of adult individuals range from about 8 to 12 pounds.

SPECIMENS: Prov. San José: San Gerónimo de Pirrís, 1 A.M.N.H., 3 U.S.N.M.; Pozo Azul, 2 A.M.N.H., San José, 2 A.M.N.H., San Pedro, 10 (1 male, 9 juv.) A.M.N.H. Prov. Puntarenas: Palmar, 5 A.M.N.H. Prov. Cartago: Santa Teresa Perálta, 1 A.M.N.H.

The black-eared opossum is nocturnal and primarily arboreal in his habits; the prehensile tail and grasping hind foot are especially adapted for a life in the trees. On the ground he is slow and awkward and usually favors the vicinity of streams or other water courses. A hole almost anywhere that is dry and affords a sure retreat will serve as a den for the opossum, but usually a hollow tree is preferred. Being omnivorous he will eat almost anything in the way of food, such as insects, crabs, frogs, mice, eggs, fruit, and roots of various plants, etc. This common opossum is a very prolific animal, frequently breeding twice a year and sometimes three times. Nine in a litter is not an unusual number; often there are more. The young are extremely small and underdeveloped at birth, weighing between 3 and 4 grams each, and are naked and helpless. Enemies of the opossum are numerous

and include virtually all the carnivorous animals found in its habitat, such as the cats, foxes, raccoons, weasels, hawks, owls, and probably the larger snakes.

The black-eared opossums in Central and South America have been divided into several species. The differentiating characters of specific importance, however, are rather obscure, and there may be only one. Geographical subspecies are more feasible, but even here the differences are not very apparent.

CHIRONECTES ILLIGER WATER OPOSSUMS

Size medium, hind feet webbed, fur dense and soft. Black and gray marbled dorsal markings. The range of the genus extends from El Salvador and Honduras south at least to Paraguay in South America.

DENTITION: Incisors, $\frac{5-5}{4-4}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{4-4}{4-4}$ = 50.

Chironectes panamensis Goldman PANAMANIAN WATER OPOSSUM OR YAPOK

Chironectes panamensis GOLDMAN, 1914, Smithsonian Misc. Coll., vol. 63, no. 5, p. 1.

TYPE: U.S.N.M. No. 179164, skin and skull, old male, collected at Caña in the mountains of eastern Panamá, altitude 2000 feet, March 23, 1912, by E. A. Goldman.

RANGE: From Colombia, north in Central America to Nicaragua. Replaced in El Salvador by a slightly differentiated race.

GENERAL CHARACTERS: A medium-sized opossum with marbled dorsal markings, short limbs, dense soft fur, tail long and naked except at base, moderately large, naked, rounded ears.

DESCRIPTION: Color of upperparts dark Mummy Brown; sides of body grizzled, this color extending in three light-colored bands across back, narrowly broken along mid-dorsal line by the dark color of back, a similar but less distinct band on shoulders and across forehead; scaly part of tail black except tip which is white; underparts, except tail, silvery white. Skull short and broad with large posterior palatine vacuities; sagittal and occipital crests moderately developed.

MEASUREMENTS: An adult male from Vijagual, and type in parentheses: Total

length, 685 mm. (651); tail vertebrae, 380 (386); hind foot, 70 (72); ear, 29. Skull: greatest length, 76.5 (74.2); condylobasal length, 75.3 (72.3); zygomatic breadth, 43.7 (43.8); length of nasals, 36.6 (33); interorbital breadth, 15.7 (14.1); postorbital breadth, 7.8 (8.5); palatal length, 45.5 (45.6); upper molariform toothrow, 28.3 (26.4); upper premolar series, 12.3 (11.6); upper molar series, 16.

SPECIMENS: Prov. San José: La Palma, Carillo, 2 juv. A.M.N.H.; San José, 1 U.S.N.M. Prov. Alajuela: Vijagual, 1 A.M.N.H.

The water opossum or yapok frequents fresh-water streams and lakes in suitable localities. His webbed feet, dense pelage, and streamlined body are adaptations for a life in the water. He is a good swimmer and diver and has been known to enter fish traps under water. Nocturnal in habits, he is rarely seen during the day time. Food of the water opossum consists of crustaceans, probably fish, and other forms of aquatic life. The main den is usually a hole in a river bank just above water level, but a surface nest of leaves or grasses on the ground may be used as a place to rest during the day.

PHILANDER BRISSON¹ BRISSON'S OPOSSUMS

Size medium, color dark, white patches over eyes. Skull long and narrow, four vacuities in posterior palate. The range of the genus extends from Vera Cruz, Mexico, south through Central America to Brazil.

DENTITION: Incisors, $\frac{5-5}{4-4}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{4-4}{4-4}$ = 50.

Philander opossum fuscogriseus (Allen) ALLEN'S SHORT-HAIRED OR FOUR-EYED OPOSSUM *Metachirus fuscogriseus* ALLEN, 1900, Bull. Amer. Mus. Nat. Hist., vol. 13, p. 194.

TYPE: A.M.N.H. No. 9920/8252, adult male, skin and skull, presented by Albert Smith. The specimen was found alive in a bunch of bananas being unloaded in New York from a fruit steamer arriving from a Central American port.

¹ Gilmore, R. M., 1941, Amer. Jour. Trop. Med., vol. 21, no. 2, p. 314.

The type locality was fixed by Allen as Greytown, Nicaragua.

RANGE: From the Canal Zone, Panamá, north through Costa Rica and Nicaragua to Honduras.

GENERAL CHARACTERS: A medium-sized opossum with rather short dark pelage, a small, light-colored area over each eye, and tail about equal length to head and body, naked except for a short distance at base.

DESCRIPTION: Color of upperparts finely mixed buff and black, the black predominating and darkest along middle of back and top of head, face nearly black with two conspicuous whitish areas on top of head over eyes; underparts buffy white, the hairs white to base along a narrow median line from throat to abdomen. Adult males with a pale greenish yellow patch on each side of flanks; fur lining pouch in females rusty chestnut. Skull long and narrow, sagittal and occipital crests well developed in adult specimens, interorbital constriction narrow, bullae small, canine teeth large and incisors small.

MEASUREMENTS: Adult male from San Ignacio and adult male from Palmar, type in parentheses: Head and body, 311 mm., 310 (251); tail, 292, 300 (283); hind foot, 45, 50 (39); ear, 35, 35. Skull: greatest length, 80, 78.3 (66); basal length, 79.3, 73.5 (62); zygomatic breadth, 42.2, 42.5 (32); length of nasals, 40.5, 37; least interorbital width, 9.2, 8.6 (8.5); canine to back of last molar, 32.3, 32.4 (25.5); m^1-m^4 , 15.2, 15.5.

SPECIMENS: Prov. San José: Escasú Altos, 2 A.M.N.H.; Sabanilla Pirris, 1 C.N.H.M.; San Ignacio Candelaria, 1 U.S.N.M. Prov. Alajuela: Vijagual, San Carlos, 2 A.M.N.H.; Lajas Villa Quesada, 3 A.M.N.H. Prov. Cartago: Moravia, 1 A.M.N.H.; Juan Viñas, 4 A.M.N.H. Prov. Puntarenas: Palmar, 5 A.M.N.H.; Puerto Cortez, 1 A.M.N.H.; Agua Buena, 1 A.M.N.H.

The life history of the short-haired opossum is not well known, but its habits are probably much the same as those of the larger black-eared opossum. Frequenting forested country from sea level up to about 4000 feet, he is most common at low elevations. This opossum, more or less omnivorous, feeds to a great extent on crabs and birds.

Females have been found carrying five young. A nest of one of these opossums has been found 3 feet from the ground on a fallen log and well hidden by overhanging vines. This nest, about a foot in diameter, was composed of banana leaves.

METACHIRUS BURMEISTER
BROWN OPOSSUMS

Size relatively small, general characters much as in *Philander* but smaller and color brown; the posterior palatine vacuities in the skull are only two in number, four in *Philander*. Range of the genus extends from Nicaragua south to Paraguay.

DENTITION: Incisors, $\frac{5-5}{4-4}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{4-4}{4-4}$ = 50.

Metachirus nudicaudatus dentaneus
Goldman

GOLDMAN'S BROWN OPOSSUM, ZORRO

Metachirus nudicaudatus dentaneus GOLDMAN, 1912, Smithsonian Misc. Coll., vol. 56, no. 36, p. 2.

TYPE: U.S.N.M. No. 172732, skin and skull, adult male, collected at Gatun, Canal Zone, Panamá, January 12, 1911, by E. A. Goldman.

RANGE: From the Canal Zone, Panamá, north to Chontales, Nicaragua.

GENERAL CHARACTERS: A medium-sized opossum, similar in general characters to *Philander o. fuscogriseus* but size smaller and color brown instead of dark gray.

DESCRIPTION: Color of upperparts about Wood Brown, rather darker along middle of back; sides of muzzle and ring around eye blackish; an Ochraceous-Buff area over each eye; underparts yellowish white; tail dusky except tip which is white. Skull like that of *P. o. fuscogriseus* but smaller, sagittal crest and postorbital processes undeveloped, only two posterior palatine vacuities.

MEASUREMENTS OF TYPE: Total length, 597 mm.; tail vertebrae, 332; hind foot, 48. Skull: greatest length, 63; condylobasal length, 61.7; zygomatic breadth, 31.7; nasals, 30 by 9.5; interorbital breadth, 9.3; upper molariform toothrow, 22.2.

Metachirus occurs sparingly at low elevations in Panamá but apparently becomes more numerous on the middle slopes of the

mountains. His habits are much the same as those of *Philander* except that he favors higher elevations. There appears to be no record of the brown opossum in Costa Rica up to the present time, but one was taken in western Nicaragua, thus extending the range that far north.

CALUROMYS ALLEN
MALLODELPHYS THOMAS
WOOLLY OPOSSUMS

In the Central American species the tail is very long and thickly furred from base for nearly half of its length, and the rest of the tail to tip is naked; fur long and woolly. Skull short and broad with well-developed postorbital processes; maxillary toothrows arcuate and converging anteriorly; third upper molar equal to or smaller than the first; first upper premolar very small. Range of this genus extends from Mexico south through Central America to Paraguay in South America.

DENTITION: Incisors, $\frac{5-5}{4-4}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{4-4}{4-4}$ = 50.

***Caluromys derbianus pallidus* (Thomas)**

PALE OR WHITE-EARED WOOLLY OPOSSUM

Philander laniger pallidus THOMAS, 1899, Ann. Mag. Nat. Hist., ser. 7, vol. 4, p. 286.

TYPE: British Museum specimen, skin and skull, old male, collected at Bugaba,¹ Chiriquí, Panamá, altitude 800 feet, October 12, 1898, by H. J. Watson.

RANGE: The arid Pacific coast region in western Panamá and north to central Costa Rica; exact limit of range unknown.

GENERAL CHARACTERS: A long-tailed, inornate, light-colored woolly opossum with indistinct markings; rather large whitish ears, sparsely covered with fine white hairs; typical opossum feet.

DESCRIPTION: General color of upperparts buffy gray, some extreme examples are pale gray, in others the sides of neck and mid-dorsal region are pale Rufous, scaly part of tail white, sometimes dotted with dusky spots near base; underparts white or buffy white. Skull short and broad, zygomatic arches flaring, postorbital processes broad and

shelf-like; sagittal crest developed in old individuals; canines long and slender, rest of teeth small.

MEASUREMENTS: An adult male and female from Escazú, type in parentheses: Total length, 665 mm., 760 (587); tail vertebrae, 395, 490 (398); hind foot, 45, 47 (c.u. 45); ear 35, 35 (32). Skull: greatest length, 58.7, 58.5 (61); zygomatic breadth, 35.4, 35 (35); interorbital width, 11, 11.3; length of nasals, 24.5, 24.2; upper toothrow, c-m⁴, 21.1, 22; m¹-m⁴, 9, 10; m¹-m³, 8.3, 8.5 (9).

SPECIMENS: Prov. San José: San José, 2 A.M.N.H.; Escazú, 14 ad. and 3 juv. A.M.N.H.; Fuentes, 1 C.N.H.M.; San Isidro, 1 A.M.N.H.; San Ignacio Candelaria, 1 U.S.N.M.; Piedras Negras, 2 ad. and 2 juv. A.M.N.H. Prov. Cartago: Irazú, 1 A.M.N.H. Prov. Puntarenas: Boruca, 1 A.M.N.H.; Puerto Cortez, 1 A.M.N.H.

All the central Costa Rican specimens from high elevations are very pale grayish in color with little or no infusion of Rufous shades. One example from Boruca has the upperparts pale Rufous but no brighter than the average for specimens from near the type locality. The type and two old individuals from Boqueron, Panamá, have larger skulls and higher and more strongly developed sagittal crests than any in the Costa Rican series. These differences are, however, probably no more than age characters.

***Caluromys derbianus centralis* (Hollister)**

HOLLISTER'S WHITE-EARED WOOLLY OPOSSUM

Philander centralis HOLLISTER, 1914, Proc. Biol. Soc. Washington, vol. 27, p. 103.

TYPE: U.S.N.M. No. 12218/38522, skin and skull, adult female, collected at Talamanca, Costa Rica, by William Gabb, catalogued November 19, 1874.

RANGE: Forested coastal region of eastern Costa Rica; limits of range unknown.

GENERAL CHARACTERS: A rich reddish-colored woolly opossum, contrasting with *C. d. pallidus* in its ornate instead of dull grayish appearance, and differing from typical *derbianus* from Colombia in having a deeper shade of the red markings and a buffy instead of grayish withers mark.

DESCRIPTION: In the type the muzzle, cheeks, and forehead are gray; median facial

¹ Bugaba = Bogava.

stripe, eye ring, and cheeks dark brown; upperpart of body, with the exception of large buffy stripe on withers, rich Hazel, outer sides of legs colored uniformly with back; arms and under side of body cream color, naked part of tail yellowish white, darkened or mottled at base. Skull and teeth about as in *C. derbianus* and *C. pallidus* but skull with narrower postorbital constriction.

MEASUREMENTS OF TYPE: Condylobasal length, 56 mm.; zygomatic breadth, 33.1; length of nasals, 23.1; least postorbital constriction, 8.5; toothrow, entire, 27.8.

SPECIMENS: Prov. Limón: Talamanca, 1 (type) U.S.N.M.

The woolly opossum is nocturnal in its habits and is reputed to be more arboreal than any of the other Central American opossums, spending much of his life in the lofty branches of tall forest trees. Records show that his range extends from 800 feet above sea level to an elevation of at least 4000 feet. A nest of leaves made by this opossum was found in a mass of vines at the top of a small tree near the edge of a forest. The weak dentition of the woolly opossum, probably more specialized in feeding habits than the larger and heavier built opossum, suggests a diet of fruit, insects, and probably bird eggs.

MARMOSA GRAY

MURINE OPOSSUMS

The genus *Marmosa* includes a number of small, slender, long-tailed species commonly termed "murine opossums" owing to their superficial resemblance to rats. Their small size, long tail, characteristically opossum feet, and wide mouth will serve to distinguish them from other Costa Rican mammals. The skull is small and without distinct postorbital processes, maxillary toothrows are much converged anteriorly, and the third upper molar is usually larger than the first. Range of the genus extends from central Mexico south through Central America to Patagonia in South America, vertical range from sea level to at least 8000 feet.

Marmosa alstoni alstoni (Allen)

ALSTON'S LONG-HAIRED OPOSSUM OR MARMOSA

Caluromys alstoni ALLEN, 1900. Bull. Amer. Mus. Nat. Hist., vol. 13, p. 189.

TYPE: A.M.N.H. No. 11790/16210, adult male, skin and skull, collected at Tres Rios, subtropics east of the divide, Costa Rica, by George K. Cherrie, August 17, 1893.

RANGE: Subtropics of Costa Rica, Nicaragua, and Honduras.

GENERAL CHARACTERS: A small, dusky opossum recognizable by the length and bushy appearance of the hairs at the base of its tail; ears dusky, naked, and moderately large; pelage relatively long, full, and woolly.

DESCRIPTION: Color of upperparts dusky gray, the hairs tipped with brownish, somewhat brighter than Clove Brown; face pale Cinnamon-Buff with a dark stripe from nose to behind, and encircling, the eye. Underparts buffy or buffy white, the hairs broadly dusky at base except in inguinal region and along median ventral line where in some individuals the hairs are buffy white to roots; naked part of tail dusky at base, terminal two-thirds or more creamy white. Skull stout and broad; zygomata flaring, muzzle short; supraorbital processes strongly developed and pointed; palate broad and rather short, lacking accessory posterior openings; bullae small and rounded.

MEASUREMENTS: An adult male from Cartago, female from Escazú, and type in parentheses: Total length, 430 mm., 438 (430); tail vertebrae, 250, 265 (250); hind foot, 30, 30 (s.u. 25); ear, 25, 25. Skull: greatest length, 44, 43.1; zygomatic breadth, 26.1, 25.4 (25); interorbital width, 9, 8.4 (8); length of nasals, 18.5, 18.4; length of upper toothrow, c-m⁴, 17.6, 17.6 (17.5); m¹-m⁴, 9.1, 9.2 (8.9).

SPECIMENS: Prov. San José: San José, 1 ad., 2 juv. A.M.N.H.; Escazú, 5 ad., 7 juv., 2 skulls A.M.N.H., 3 B.N.; Piedras Negras, 1 A.M.N.H. Prov. Cartago: Tres Rios, 2 ad., 3 juv. A.M.N.H.; Pozo Ancho, 1 A.M.N.H.; San Juan, 2 U.S.N.M. Prov. Limón: Cubre, 1 U.S.N.M.

Alston's opossum inhabits the subtropical forested mountain slopes in Costa Rica. He is, as are most opossums, arboreal and nocturnal in his habits. A nest of this species, composed of green leaves, has been found in the branches of a tree, and 11 young were recorded in one litter. There appears to be no fixed breeding season, and young have been

taken in June, July, August, and October. He is both frugivorous and insectivorous and especially fond of bananas. Owls are probably his most formidable enemy, but he no doubt falls prey to various arboreal carnivorous animals.

Alston's opossum is small in size when compared with opossums in general but is the largest species of the genus *Marmosa* found in Costa Rica.

***Marmosa alstoni nicaraguae* Thomas**

ALSTON'S SHORT-HAIRED OPOSSUM

Marmosa cinerea nicaraguae THOMAS, 1905, Ann. Mag. Nat. Hist., ser. 7, vol. 16, p. 313.

TYPE: B.M. No. 5.10.31.5, skin and skull, old male, collected at Bluefields, Nicaragua, sea level, January 9, 1905, by G. Palmer.

RANGE: Uncertain, probably restricted to the torrid Caribbean coastal regions of Nicaragua, Costa Rica, and Honduras.

GENERAL CHARACTERS: Similar to *M. a. alstoni* in general characters but fur shorter, especially on the furry tail base, and has much greater extension of the black down the naked part of the tail.

DESCRIPTION: Color of upperparts brownish gray, between Hair Brown and Mummy Brown; underparts light Cream-Buffer; the hairs on chest, midventral line, and inguinal region, Light Buff to roots; hands and feet grayish white; tail very long, dull blackish for about half its length, terminal half whitish. Skull similar to that of *alstoni* but palate slightly narrower, supraorbital processes more rounded, and teeth fractionally smaller.

MEASUREMENTS OF TYPE: Total length, 448 mm.; tail vertebrae, 281; hind foot, s.u., 28.5, c.u., 30; ear, 29. Skull: greatest length, 45; zygomatic breadth, 24.7; length of maxillary tooththrow, m^1-m^3 , 7.5.

SPECIMENS: Prov. Limón: Siquirres, Río Pacuare, 1 Stockholm Coll.

This opossum inhabits the low tropical forested country along the Caribbean coast of Costa Rica. In the subtropical hinterland it is replaced by the slightly larger Alston's long-haired opossum from which it is readily distinguishable by its shorter and closer pelage.

***Marmosa mexicana zeledoni* Goldman**

COSTA RICAN MURINE OPOSSUM

Marmosa zeledoni GOLDMAN, 1911, Proc. Biol. Soc. Washington, vol. 24, p. 238.

TYPE: U.S.N.M. No. 12885/37133, skin and skull, adult male, collected at Navarro, Caribbean slope between 2500 and 3000 feet, Costa Rica, March 1, 1878, by Juan Cooper for José C. Zeledón.

RANGE: Most of Costa Rica and Nicaragua.

GENERAL CHARACTERS: A small, reddish brown opossum with a moderately long tail, finely haired throughout its length, and an intensely black stripe across each eye.

DESCRIPTION: Color of upperparts nearest to Pecan Brown but richer and more vivid, this color encroaching on underparts well down along each side of belly where the fur is basally Plumbeous; throat, chest, median line along belly, inguinal region, and inside of limbs, yellowish white to roots of hair; the line of demarcation between dorsal and ventral colors sharply defined; face paler than back but not sharply differentiated, ears moderately large and dusky; tail Blackish Brown, slightly paler on under side; feet soiled whitish. Skull small and slender, without noticeable postorbital constriction, and supraorbital ridges only slightly projecting; zygomatic arches flaring, teeth small, third upper molar larger than the first; maxillary tooththrow in a straight line but converged anteriorly.

MEASUREMENTS: An adult female from San Gerónimo and a male from Aquiares, type in parentheses: Head and body, 125 mm., 162 (177, dry); tail vertebrae, 161, 177 (168); hind foot, 20, 22 (23); ear, 18, 22. Skull: greatest length, 35.3, 38 (36); zygomatic breadth, 19.6, 19.8 (19.2); postorbital constriction, 6.1, 6.3; length of nasals, 14.5, 16.5; length of upper tooththrow, canine to last molar, 14, 13.9; m^1-m^3 , 5.6, 5.5 (5.2); m^1-m^4 , 7, 6.6.

SPECIMENS: Prov. San José: San Gerónimo, 1 C.N.H.M. Prov. Cartago: Navarro, 2 U.S.N.M.; Aquiares (4000 feet), 1 A.M.N.H. Prov. Limón: Jiménez, 1 A.M.N.H.; Río Pacuare, 3 Dickey Coll. Prov. Puntarenas: Boruca, 1 A.M.N.H.; Agua Buena, 2 A.M.N.H.

Marmosa mexicana zeledoni is a geographical variety of the *mexicana* group but differs from the typical form in being of somewhat larger size and having richer color. As are most others, this opossum is nocturnal and arboreal in habits; the hands, feet, and a prehensile tail are adapted for a life in the trees. He is insectivorous and frugivorous. One individual was recorded as taken in a bird's nest in a forest tree on the slopes of Volcán Turrialba.

ORDER INSECTIVORA
INSECT EATERS

FAMILY SORICIDAE
SHREWS

Shrews are small, slender creatures with a long pointed nose, minute eyes, inconspicuous ears, tiny feet, and dense, soft, silky fur.

CRYPTOTIS POMEL
SHORT-TAILED SHREWS

Shrews of this genus are very small in size, having a short tail, and teeth pigmented with a mahogany color. Skull long and narrow; anterior teeth highly specialized, zygomatic arches wanting. Range of the genus extending from Connecticut and Ontario in the northwest to western Kansas and south through Central America and in the Andes of South America to Venezuela and southern Ecuador.

DENTITION: Incisors, $\frac{3-3}{2-2}$; canines, $\frac{1-1}{0-0}$; premolars, $\frac{2-2}{1-1}$; molars, $\frac{3-3}{3-3}$ = 30.

Cryptotis nigrescens (Allen)
IRAZÚ DUSKY SHREW

Blarina (Soriciscus) nigrescens ALLEN, 1895, Bull. Amer. Mus. Nat. Hist., vol. 7, p. 339.

TYPE: A.M.N.H. No. 9591/7952, skin and skull in fair condition, adult, collected at San Isidro (San José), about 4000 feet, by George K. Cherrie, September 5, 1891.

RANGE: Mountains of central Costa Rica and probably north to central Honduras.

GENERAL CHARACTERS: Medium-sized, uniformly colored blackish shrew with a short tail, rather long pelage, and black feet.

DESCRIPTION: Pelage relatively short and full; color of upperparts very dark Mummy

Brown, almost black; underparts not appreciably different in color from the back but showing a brownish tinge in cross lights, base of hair blackish Plumbeous; feet and tail sparsely covered with blackish hairs. Skull relatively strong and angular, the superior outline depressed in interorbital region; anteorbital foramina placed forward, the posterior border over middle of m^1 ; teeth large, the last upper premolar especially broad transversely and strongly convex on inner side; upper unicuspid teeth crowded, first two subequal and without noticeable posterior heel, third unicuspid smaller than first two, fourth unusually minute and crowded inward from the toothrow, m^3 without developed metacone and third commissure.

MEASUREMENTS: A female from Irazú, and type in parentheses: Head and body, 75 mm. (65); tail vertebrae, 22 (22); hind foot, 11.5 (12) in dried skin. Skull: condylobasal length, 18.5 (19.5); lacrimal breadth, 4.2 (4.5); zygomatic breadth 5.9 (6.5); breadth of braincase, 8.3 (9.4); length of upper toothrow, entire, 8.3 (9); breadth across m^2 - m^2 , 5.4 (5.9); length of mandible, entire, 12.1 (12.7).

SPECIMENS: Prov. San José: San Isidro, 1 A.M.N.H. (type). Prov. Cartago: Irazú, 9400 feet, 1 A.M.N.H.; Tablazo, 1 U.S.N.M. (spirit specimen, juv.).

Cryptotis nigrescens probably inhabits the rain forests in the high mountain regions of Costa Rica and is easily recognized by its uniform dark color and blackish feet.

Cryptotis orophila (Allen)
IRAZÚ GRAY SHREW

Blarina (Soriciscus) orophila ALLEN, 1895, Bull. Amer. Mus. Nat. Hist., vol. 7, p. 340.

TYPE: A.M.N.H. No. 9640/9558, skin and skull in poor condition (dried spirit specimen), collected on the Irazú Range, February, 1894, by George K. Cherrie.

GENERAL CHARACTERS: A small, brownish, short-tailed shrew. Similar to *C. micrura* from Guatemala but smaller, pelage short and close; underparts and sides of body paler than back, feet white.

DESCRIPTION: Color of upperparts about Mummy Brown, becoming lighter on side of

body; underparts Smoke Gray, the hairs tipped with buffy white, some specimens stained with Snuff Brown on throat and chest, feet grayish white, tail dusky above, distinctly paler below and well haired to tip. Skull small, short; posterior border of anteorbital foramen forward of space between m^1 - m^2 . Dentition similar to that of *nigrescens* but weaker and large upper premolar tapered anteriorly; first two upper unicuspid subequal in size; the third very small, the fourth minute and crowded inward; m^3 without developed metacone and third commissure.

MEASUREMENTS: Type in parentheses, and male from Cartago: Head and body, in dried skin, (55), 63 mm.; tail vertebrae, (21), 24; hind foot, (11), 13. Skull: length over all, (19.4), 17.6; lacrimal breadth, (4), 3.8; zygomatic breadth, (5.7) 5.5; breadth of braincase, (10), 8.3; upper tooththrow, entire, (8), 7.5; width across m^2 - m^3 , (5), 4.9; length of mandible, (9.5), 9, overall, (11.4), 10.6; mandible tooththrow entire, (6.9), 7.

SPECIMENS: Prov. Cartago: Estrella de Cartago, 2 U.S.N.M.; Irazú Range, 1 (type), A.M.N.H. Prov. Alajuela: Zarcero, 1 C.N.H.M. Prov. San José: San Pedro, Montes de Oca, 1 A.M.N.H.; San José, 1 skull, 1 alc. U.S.N.M. Prov. Limón: La Estrella, 1 A.M.N.H.

The type of *C. orophila* represents near the maximum in size and was taken probably nearer the foothills of Volcán Irazú than the upper slopes as has generally been supposed. Small individuals are indistinguishable in external and cranial characters from Allen's type of *C. olivacea* from San Rafael del Norte, Nicaragua.

Cryptotis jacksoni Goodwin

JACKSON'S SHORT-TAILED SHREW

Cryptotis jacksoni GOODWIN, 1944, Amer. Mus. Novitates, no. 1267, p. 1.

TYPE: U.S.N.M. No. 116649 (Biol. Surv. Coll.), adult female, skin and skull in good condition, collected at Volcán Irazú by M. Cary, February 27, 1902.

RANGE: The type is the only known specimen.

GENERAL CHARACTERS: A medium-sized, uniformly colored dusky shrew, larger than

C. nigrescens with pelage not quite so black; much larger and darker colored than *C. orophila*, approaching *C. gracilis* in general appearance but skull decidedly broader.

DESCRIPTION: Entire animal dark Mummy Brown, color of underparts barely differentiated from back; the fur dark Smoke Gray, heavily overlaid with Mummy Brown; tail about the color of back, scales on feet dusky but space between annulations whitish. Skull slender, the superior outline depressed behind orbits, posterior border of anteorbital foramen over space between m^1 - m^2 ; braincase broad, the lateral angles well indicated when viewed from above. Dentition: upper unicuspid teeth not crowded, inner tubercles moderately developed, the first three with a well-developed heel, second slightly larger than the first, third smaller than first, fourth very small but in line with the tooththrow; large upper premolar sharply tapered anteriorly, its posterior border about equal in length to the outer border; m^3 relatively large with a distinct metacone and third commissure.

MEASUREMENTS OF TYPE: Total length, 110 mm.; tail vertebrae, 34.5; hind foot, 14.5 (dry 13.5). Skull: condylobasal length, 19.4; zygomatic breadth, 6; distance between zygomatic root and gnathion, 8.2; breadth of braincase, 10; breadth across m^2 - m^3 , 5.5; length of mandible, 11; length of mandible entire, 12.9; maxillary tooththrow, entire, 9; mandible tooththrow, entire, 8.2.

SPECIMENS: Prov. Cartago: Volcán Irazú, 1 (type), U.S.N.M.

Cryptotis gracilis Miller

TALAMANCAN SHORT-TAILED SHREW

Cryptotis gracilis MILLER, 1911, Proc. Biol. Soc. Washington, vol. 24, p. 221.

TYPE: U.S.N.M. No. 12236/38471, skin and skull, adult, collected at head of Lari River, near base of Pico Blanco, 6000 feet elevation, Talamanca, Costa Rica, by W. M. Gabb, catalogued November 10, 1874.

RANGE: Eastern slopes of the Cordillera de Talamanca.

GENERAL CHARACTERS: A large, uniformly dusky-colored shrew, similar in size and general appearance to *C. jacksoni* but the skull is narrower and much elongated; this

peculiarity is more pronounced than in any of the other species of Costa Rican shrews.

DESCRIPTION: Pelage relatively long and full, the entire animal dark Smoke Gray, heavily washed with Blackish Brown; feet and tail Blackish Brown. Skull long and narrow with a long slender rostrum, narrow palate; braincase small and nearly circular in outline when viewed from above, the lateral angles barely indicated; upper cheek teeth compressed laterally; inner tubercle of unicuspid only faintly developed and a posterior heel well developed, fourth unicuspid in line with the tooththrow and not crowded; large upper premolar elongated, the posterior border decidedly shorter than outer; m^3 with well-developed metacone and third commissure. An adult female from Las Vueltas, 8000 feet, about 30 miles northwest of the type locality along the Cordillera de Talamanca, is here provisionally referred to *gracilis*. It is larger than the type but has a similar long narrow skull, elongated large premolars, and well-developed metacone and third commissure on m^3 .

MEASUREMENTS: Type in parentheses, and an adult female from Las Vueltas: Head and body, (70, dry), 76 mm.; tail vertebrae, (35), 34; hind foot, (13.6), 14.5. Skull: condylobasal length, (18.6), 20; lacrimal breadth, (4.2), 5; zygomatic breadth, (5.2), 5.8; breadth of braincase, (9), 9.6; upper tooththrow, entire, (8.8), 9; mandible tooththrow, entire, (7.8), 8.2; length of mandible over all, 13.3.

SPECIMENS: Prov. Limón: head of Lari River, 6000 feet elevation, 1 (type), U.S.N.M. Prov. Cartago: Las Vueltas, 8000 feet elevation, 1 M.Z.U.M.

The Costa Rican shrews are small insectivorous animals and are active both day and night. They usually frequent moist damp places near water courses where they follow runways under moss and decayed vegetation in search of food. They are very active, pugnacious creatures and will not hesitate to attack an animal twice their size, but they do not seem to be very abundant anywhere in Costa Rica.

ORDER CHIROPTERA

BATS

FAMILY EMBALLONURIDAE

SAC-WINGED BATS, WHITE BATS

Bats of this family are small, slender species with tail perforating a broad interfemoral membrane and appearing on upper surface. Most of the genera have glandular sacs in the antebrachial membrane and no noseleaf.

RHYNCHISCUS MILLER

The genus *Rhynchiscus* includes very small butterfly-like bats with whitish dorsal stripe and tufts of hair placed at intervals along the outer side of the forearm, no wing sacs. Skull

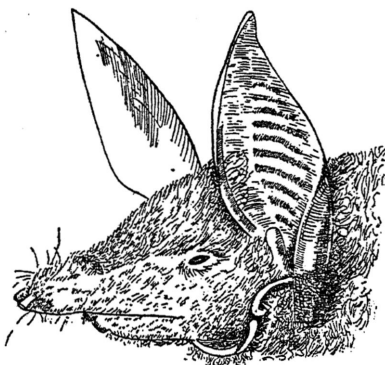


FIG. 1. *Rhynchiscus*.

small, no angle between rostrum and forehead; postorbital processes long and curved. Range of genus same as for species.

DENTITION: Incisors, $\frac{1-1}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{3-3}{3-3}$ = 32.

Rhynchiscus naso (Maximilian)

BRAZILIAN LONG-NOSED BAT

Vespertilio naso MAXIMILIAN, 1820, Reise nach Brasilien, vol. 1, p. 251 (footnote).

The type was collected on the banks of the Mucuri, near Morrow d'Arara, Minas Geraes, Brazil, by Maximilian Weid, 1815-1817.

RANGE: From southern Mexico south through Central America to northern Peru and central Brazil.

GENERAL CHARACTERS: Size small, no wing sac; forearm dotted with tufts of fur, interfemoral membrane haired to exsertion of tail, muzzle elongated, ears small.

DESCRIPTION: Color of upperparts in fresh

pelage: the hairs Blackish Brown tipped with Warm Buff, giving a buffy grizzled appearance, two curved buffy lines in a rough form of an hourglass on lower back which often do not show in worn pelage; underparts pale buffy gray, base of hairs brown. Skull short with rounded globular braincase; premaxillaries broad posteriorly and ending on upper surface of rostrum; no division between deep basisphenoid pits. First upper premolar large, triangular, with small cingulum cusps anteriorly and posteriorly. Upper incisors minute, lower incisors small, trifold.

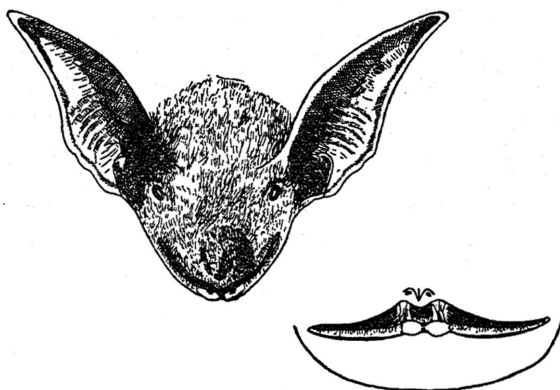


FIG. 2. *Saccopteryx*.

MEASUREMENTS (SANBORN): Forearm: males, 35.3–40.5 mm.; females, 35.8–40.7. Skull: greatest length, 11.2–12.6; condylo-basal length, 10–11.2; interorbital width, 2.3–2.8; least width of rostrum, 2.9–3.6; zygomatic width, 6.7–7.3; mastoid width, 6.3–6.8; width of braincase, 5.7–6.5; upper toothrow, c-m³, 4.3–4.7.

SPECIMENS: Costa Rica: 10 A.M.N.H., collected by G. K. Cherrie in 1894.

Rhynchiscus is an insect-eating species that is usually found in small colonies of 10 or 13 individuals. Roosting, he hangs suspended by the feet in more or less open, well-lighted caves or under bridges and has been found in the great dry curled-up leaves of the *Heliconia* tree.

Maximilian found small colonies roosting in a number of different places but usually near water courses and said that they were often seen clinging in a compact mass to the bark of a tree.

SACCOPTERYX ILLIGER

Characters of bats in the genus *Saccopteryx* include a large glandular sac situated close to the forearm near the elbow and opening on upper surface of antebrachial membrane. Skull with a slight angle between rostrum and forehead. Sagittal crest and basisphenoidal pits large, usually separated by a plate. First upper premolar (pm²) a small structureless spicule. Range of genus same as for *S. bilineata*.

DENTITION: Incisors, $\frac{1-1}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{3-3}{3-3}$ = 32.

Saccopteryx bilineata (Temminck)

TEMMINCK'S WHITE-LINED BAT

Urocryptus bilineatus TEMMINCK, 1838–1839, Van der Hoeven's Tijdschr. Nat. Gesch. en Physiol., vol. 5, p. 33.

TYPE: Museum des Pays-Bas, Leiden, skull and mounted skin, collections of M. Dieperink from Surinam, Dutch Guiana.

RANGE: From southern Mexico (Colima Guerrero and Vera Cruz) south to central Bolivia and Matto Grosso and Rio de Janeiro, Brazil.

GENERAL CHARACTERS: Size relatively large, wing sac well developed in males. Interfemoral membrane thinly haired to exertion of tail, ears moderately long and pointed, forearm naked.

DESCRIPTION: Color in fresh pelage: upperparts black with two longitudinal wavy lines of buffy white extending from behind shoulder to rump; the hairs, with the excep-

tion of the white-tipped ones forming the dorsal stripes, uniformly Blackish Brown to base; hairs on underparts dark brown from base and tipped with brownish. In worn pelage, the color becomes more brownish.

MEASUREMENTS: Two adult females from Palmar: Forearm, 44 mm., 46.7; total length, 47, 48; hind foot, 11, 11; ear, 14, 15. Skull: greatest length, 16.5, 17; condylobasal length, 15, 15; zygomatic breadth, 10.5, 10.5; interorbital breadth; 4.1, 4; upper tooththrow, c-m³, 7, 6.8.

SPECIMENS: Prov. Guanacaste: Las Huacas 3 M.Z.U.M.; Liberia, 7 M.C.Z. Prov. Alajuela: San Carlos, 4 C.N.H.M. Prov. Cartago: El Sauce Perálta, 2 U.S.F.W. Prov. Puntarenas: Palmar, 4 A.M.N.H. Prov. Limón: Jiménez, 2 A.M.N.H.

The habits of Temminck's white-lined bat are much the same as those of the long-nosed bat. Small colonies of 15 have been found roosting under arches or clinging to the bark between projecting buttresses on the trunks of large trees and in well-lighted caves.

bilineata but smaller; especially the skull and color are different.

DESCRIPTION: Upperparts uniformly brown marked by two longitudinal whitish lines extending from middle of back to rump; underparts brown but usually paler than back.

MEASUREMENTS: Forearm of males, 37.4–40 mm., females, 39.1–42.3. Skull: greatest length from front of canines, 13.1–14.4; condylobasal length, 11.8–12.7; interorbital width, 3.2–3.8; intertemporal width, 2.1–2.5; zygomatic width, 8.4–9.1; mastoid width, 7–7.5; upper tooththrow, c-m³, 5.1–5.5 (Sanborn).

Up to the present the Schreber's white-lined bat has not been recorded north of the Canal Zone in Panamá. Its range in South America is about the same as that of the larger species, and in all probability it will eventually be found in Costa Rica.

CENTRONYCTERIS GRAY

Similar in general to *Saccopteryx* but more

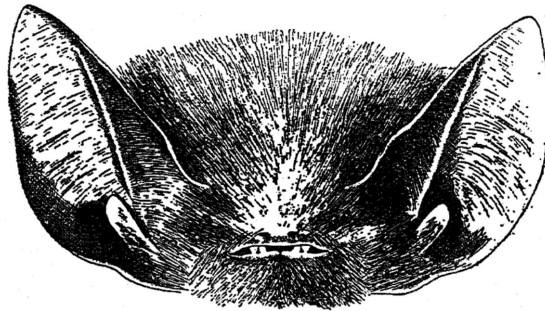


FIG. 3. *Centronycteris*.

Saccopteryx leptura (Schreber)

SCHREBER'S WHITE-LINED BAT

Vespertilio lepturus SCHREBER, 1774, Die Säugethiere, vol. 1, p. 173, pl. 57.

TYPE: Berlin Museum specimen, collected at Surinam, Dutch Guiana, about 1773, by Holfrath Rudolph.

RANGE: From southwestern Peru and northeastern Brazil, north to the Canal Zone in Panamá and possibly to southern Costa Rica.

GENERAL CHARACTERS: Similar to *S.*

slender. Fur very long and soft, back without lines. No wing sac so far as known. Skull without angle between rostrum and forehead. Range of this genus extends from Guatemala south to Ecuador and Espirito Santo, eastern Brazil.

DENTITION: Incisors, $\frac{1-1}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{3-3}{3-3} = 32$.

Centronycteris maximiliani centralis

Thomas

THOMAS' SAC-WINGED BAT

Centronycteris centralis THOMAS, 1912, Ann. Mag. Nat. Hist., ser. 8, vol. 10, p. 638.

TYPE: B.M. No. 0.7.11.3, collected at Bugaba Chiriquí, Panamá, by H. J. Watson, October 20, 1898.

RANGE: Guatemala south to Ecuador and western Brazil.

GENERAL CHARACTERS: A small slender Tawny bat, similar to typical *C. maximiliani* but slightly larger with much shorter basisphenoid pits which do not extend forward between the pterygoids.

DESCRIPTION: Color of upperparts close to Raw Umber, lighter on underparts. Hairs on interfemoral membrane reddish. Skull with angle between rostrum and forehead. Lower edge of orbit expanded so little that the edge of toothrow can be seen from above. First

dorsal stripes. Wing sac near upper edge of antebrachial membrane opening outward. Range of the genus same as for *P. macrotis*.

DENTITION: Incisors, $\frac{1}{3}$ - $\frac{1}{3}$; canines, $\frac{1}{1}$ - $\frac{1}{1}$; premolars, $\frac{2}{2}$ - $\frac{2}{2}$; molars, $\frac{3}{3}$ - $\frac{3}{3}$ = 32.

Peropteryx macrotis macrotis (Wagner)

NEOTROPICAL SAC-WINGED BAT

Emballonura macrotis WAGNER, 1843, Arch. Naturgesch., vol. 1, p. 367.

The type was collected in Matto Grosso, Brazil, by Johann Natterer of the Zoologische Staatssammlung, Munich.

RANGE: From Guatemala south to Matto Grosso, Brazil, west to Peru and east to São Paulo, Brazil.



FIG. 4. *Peropteryx*.

upper premolar with distinct anterior and posterior cusps. Basisphenoid divided by a plate.

MEASUREMENTS: One female from Vijagua, and type in parentheses: Forearm, 43 mm. (45); third finger metacarpal, 46.7 (46.5). Skull: greatest length, 15.5 (15); condylobasal length, 14.3; interorbital width, 3.4; rostral width, 6.4; zygomatic width, 9.6 (10); mastoid width, 7.8; width of braincase, 7.2; upper toothrow, 6.4 (6.1); width across m^2 - m^2 , 7.3 (6.6).

SPECIMENS: Prov. Alajuela: Vijagua, 1 M.C.Z.

Little or nothing is known about the habits of this bat. The only contribution to its life history seems to be that a specimen from Ecuador was taken from a hole in a tree.

PEROPTERYX PETERS

In general structure bats of this genus are similar to *Saccopteryx*, but the back lacks

GENERAL CHARACTERS: A small slender bat with delicate limbs and feet, rather long loose pelage, moderately large ears. No dorsal stripe. Greatest length of skull, 12 to 15 mm.

DESCRIPTION: Color of upperparts ranges from a dark Buffy Brown through grayish brown and various shades of reddish brown to a very dark Blackish Brown. Underparts slightly lighter in color. Skull small with a very sharp angle between rostrum and braincase, basisphenoidal pit not divided, rostrum much inflated.

MEASUREMENTS: Forearm, 38.3-48.2 mm. Skull: greatest length, 12-15; condylobasal length, 10.7-13.7; palatal length, 4.3-5.8; interorbital width, 2.3-3.3; width of rostrum, 5.3-6.9; zygomatic width, 7.6-8.9; width of braincase, 5.9-7.1; upper toothrow, 4.6-6.2 (Sanborn).

The habits of *Peropteryx* are probably much the same as those of *Saccopteryx*. It has been found in company with the latter,

roosting in dark recesses under the high arch of a natural bridge.

***Peropteryx kappleri* Peters**

KAPPLER'S OR DUSKY SAC-WINGED BAT

Peropteryx kappleri PETERS, 1867, Monatsber. Akad. Wiss., Berlin, p. 473.

The type was collected at Surinam, Dutch Guiana, by von Kappler for the Berlin Museum.

RANGE: From Guatemala south to Ecuador and east to Dutch Guiana.

GENERAL CHARACTERS: Similar to *P. m. macrotis* but larger throughout. Forearm, 45–53.6 mm. Greatest length of skull, 16–17.8 mm.

DESCRIPTION: There are two color phases; one is close to Mummy Brown, and the other darker than Prout's Brown; underparts slightly paler than back in both color phases.

MEASUREMENTS: Forearm, 45–53.6 mm. Skull: greatest length, 16–17.8; condylobasal length, 14.1–16.2; palatal length, 6.3–7.1; interorbital width, 2.6–3.5; width of rostrum, 7.3–8.1; zygomatic width, 9.5–10.9; width of braincase, 7.1–8; upper toothrow, 6.8–7.8.

SPECIMENS: Prov. Alajuela: Vijagual, 5 A.M.N.H.

CORMURA PETERS

Size small, feet short. Wings from metatarsus. Wing sac in center of antebrachial membrane opening outward and extending from anterior border almost to elbow.

In the absence of dorsal stripes, dark color, and small size, this genus is similar to *Peropteryx*, but the short feet and more robust structure serve to distinguish it from the latter. Range of the genus same as for species.

DENTITION: Incisors, $\frac{1}{1}$ – $\frac{1}{1}$; canines, $\frac{1}{1}$ – $\frac{1}{1}$; premolars, $\frac{2}{2}$ – $\frac{2}{2}$; molars, $\frac{3}{3}$ – $\frac{3}{3}$ = 32.

***Cormura brevirostris* (Wagner)**

WAGNER'S SAC-WINGED BAT

Emballonura brevirostris WAGNER, 1843, Arch. Naturgesch., vol. 1, p. 367.

TYPE: A Munich Museum specimen, collected at Marabitanus, Rio Negro, Amazonas, Brazil, by Johann Natterer.

RANGE: Nicaragua, south through Ecuador

and Colombia to Peru and east through Venezuela and northern Brazil.

GENERAL CHARACTERS: A small, dark-colored bat with relatively long thin pelage, short tail, and base of interfemoral membrane almost naked.

DESCRIPTION: There are two color phases, one a deep Blackish Brown and the other a reddish brown. In both phases the underparts are only slightly paler than back. Skull short and broad, rostrum very broad, rims of orbits and zygomata broad, no angle between rostrum and forehead. First upper premolar with distinct anterior and posterior cusps.

MEASUREMENTS: Adult male from Río Sixaola: Total length, 73 mm.; tail vertebrae, 13; hind foot, in dry skin, 8.2; forearm, 45. Skull: greatest length (approximate), 15; palatal length, 6.5; interorbital width, 5.2; postorbital constriction, 2.9; zygomatic width, 10.1; upper toothrow, c-m³, 6.3.

SPECIMENS: Prov. Puntarenas: El Pozo de Terraba, 2 C.N.H.M. Prov. Limón: Río Sixaola, 3 A.M.N.H.

BALANTIOPTERYX PETERS

Characters of this genus include small size, nearly uniform dark color, moderately short



FIG. 5. *Balantiopteryx*.

ears, no white lines down back, loose pelage, wing sac near center of antebrachial membrane, opening inward. Range of the genus extends from Sonora and Lower California, Mexico, south to Ecuador.

DENTITION: Incisors, $\frac{1}{1}$ – $\frac{1}{1}$; canines, $\frac{1}{1}$ – $\frac{1}{1}$; premolars, $\frac{2}{2}$ – $\frac{2}{2}$; molars, $\frac{3}{3}$ – $\frac{3}{3}$ = 32.

***Balantiopteryx plicata* Peters**

PETERS' SAC-WINGED BAT

Balantiopteryx plicata PETERS, 1867, Monatsber. Akad. Wiss., Berlin, p. 476.

The type, collected at Puntarenas, Costa

Rica, was purchased by the Berlin Museum.

RANGE: From Sonora and Lower California to Costa Rica.

GENERAL CHARACTERS: Size relatively large for this genus, base of interfemoral membrane hairy as far as exsertion of tail.

DESCRIPTION: Color uniform dark gray above and below, becoming lighter on the lower abdomen. Skull with greatly inflated rostrum and basisphenoidal pit not divided by a plate.

MEASUREMENTS: Forearm, 39–46 mm. Skull: greatest length (from front of canine), 13–14.8; condylobasal length, 11.4–12.7; intertemporal width, 2.8–3.7; width of rostrum, 6.3–7; zygomatic width, 8.3–9.3; upper tooth-row, 5–5.6.

The type is the only record of Peters' sac-winged bat in Costa Rica, but it appears to be more common farther north, especially on the west coast of Mexico. Aside from its inhabiting dark caves, little is known of its habits.

SUBFAMILY DICLIDURINAE

WHITE BATS

DICLIDURUS WIED

Bats of the genus *Diclidurus* are white, with short rounded ears, no wing sac, nose simple, eyes large; tail shorter than, and perforating, the interfemoral membrane, its extremity associated with a pouch or structure that ap-



FIG. 6. *Diclidurus*.

pears to be glandular: Skull with large braincase flattened anteriorly and descending abruptly to the rostrum; rostrum broad and depressed with elevated lateral ridges; upper incisors separated from canines and in front; first upper premolar minute; tibia with a deep longitudinal groove. Geographical distribution of the genus tropical America north to Guatemala and in South America to Espirito Santo, eastern Brazil.

DENTITION: Incisors, $\frac{1-1}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{3-3}{3-3} = 32$.

Diclidurus virgo Thomas

COSTA RICAN WHITE BAT

Diclidurus virgo THOMAS, 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 11, p. 377.

TYPE: B.M. No. 98.10.9.3, adult female, collected at Escazú, Costa Rica, November 2, 1897, by C. F. Underwood.

RANGE: From Panamá north to Guatemala.

GENERAL CHARACTERS: A relatively large white bat similar to *D. albus* but with differently shaped incisors and premolars, ears shorter than head.

DESCRIPTION: Color above pure white to roots of hair or gray-mixed, the hairs then being slaty at base. Below white, base of hairs slaty on basal half. Skull with upper incisors weak, the main cusp without secondary cusps, first small premolar well separated from the large premolar.

MEASUREMENTS: Adult from La Palma, Costa Rica, and type in parentheses: Forearm, 65 mm. (66); hind foot, in dried skin, 10.5. Skull: condylobasal length, 17; greatest length, (18); postorbital width, 5.5; zygomatic width, 12.3; width of braincase, 9.2; upper toothrow, c-m³, 8.2 (8.1).

SPECIMENS: Prov. San José: Escazú, 1 (type) B.M.; San José, 1 B.M.; La Palma, 2 A.M.N.H.

Little is known of the habits of the white bat except that it has been found between the large leaves of the coconut palm.

FAMILY NOCTILIONIDAE

BULL DOG BATS

Bats of this family are moderately large with narrow, sharp-pointed ears which, when laid forward, reach about to the end of the nose. The pelage is short and on the lower back confined to the median portion. The short tail protrudes from the upper side of the interfemoral membrane. Muzzle simple and without leaf-like outgrowths; lips full, forming distinct cheek pouches; feet large with a greatly developed bony calcar, legs excessively long.

NOCTILIO LINNAEUS

The species of the genus *Noctilio* are large with short close hair, long limbs, and large feet. The skull is strong and massive with large canine teeth; the upper incisors are very unequal and closely crowded between

FIG. 7. *Noctilio*.

canines, the inner incisors about twice as high as long; the outer pair are short, barely reaching the cingulum of the inner pair. Range of the genus includes tropical America north to Cuba and southern Mexico and south to Matto Grosso, Brazil.

DENTITION: Incisors, $\frac{2-2}{1-1}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{1-1}{2-2}$; molars, $\frac{3-3}{3-3}$ = 28.

Noctilio leporinus mexicanus Goldman

MEXICAN BULL DOG BAT

Noctilio leporinus mexicanus GOLDMAN, 1915, Proc. Biol. Soc. Washington, vol. 28, p. 136.

TYPE: U.S.N.M. No. 126672, adult male, collected at Papayo, Guerrero, Mexico, April 17, 1903, by E. W. Nelson.

RANGE: From southern Mexico south to Panamá.

GENERAL CHARACTERS: In general, same as for genus. Similar to typical *N. l. leporinus* but smaller, the difference in size most noticeable in the skull; maxillary tooththrow shorter and relatively broader than the latter.

DESCRIPTION: Color of male (type), upperparts rich dark Ochraceous-Tawny, becoming Tawny on head with a narrow stripe of paler fur along median line of back; underparts between Zinc Orange and Tawny.

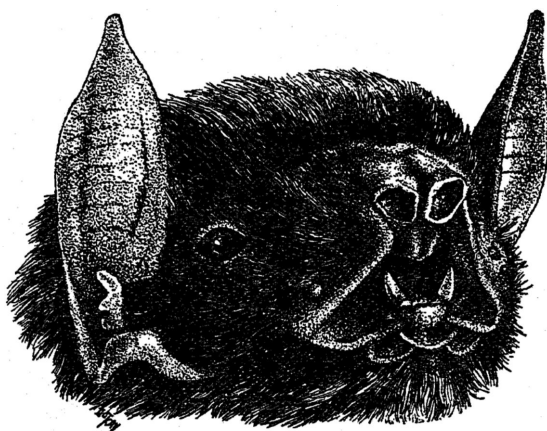
MEASUREMENTS: Type (dry skin): Forearm, 83.2 mm.; hind foot, 33.5. Skull of type and adult female: greatest length, 28.5, 26.4; condylo-incisive length, 25.2, 24.7; zygomatic

breadth, 19.8, 18.6; interorbital breadth, 7.4, 7.1; length of maxillary tooththrow, 10.7, 10.4.

This bat is noted for its alleged fish-eating habits which in some instances have proved to be correct. Its principal food, however, appears to be insects. Examination of the stomach contents of these bats shows that they devour a great many winged ants, several species of scarabeoid beetles, mole-crickets, and stinkbugs. The stomach contents of one individual from Trinidad were 100 per cent fish, an anchovy, probably *Engraulididae*. The food after it is partially masticated is deposited in the cheek pouches and later returned to the mouth, masticated and swallowed. *Noctilio* frequently roosts in dark caves; selecting the highest point, it hangs from the roof by its hind claws. It has also been found in hollow trees. Normally, it leaves the roost soon after sunset but on occasions has been seen flying in the afternoon sunshine in company with pelicans, apparently in search of dead or wounded fish. It has been seen skimming the surface of fresh-water pools and rivers, scooping water up in the interfemoral membrane to drink. They can swim well when forced. The number of young is usually one.

DIRIAS MILLER

The genus *Dirias* is like *Noctilio* in general structure but differs in being of smaller size,

FIG. 8. *Dirias*.

having darker coloration and relatively smaller feet. Skull and teeth as in *Noctilio* except

in smaller size and upper molars more closely crowded. Range of genus includes tropical America from Amazon regions north in Central America to Lake Nicaragua.

DENTITION: Incisors, $\frac{2-2}{1-1}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{1-1}{2-2}$; molars, $\frac{3-3}{3-3}$ = 28.

Dirias minor (Osgood)

LITTLE BULL DOG BAT

Noctilio minor OSGOOD, 1910, Field Mus. Nat. Hist., zool. ser., vol. 10, p. 30.

TYPE: C.N.H.M. No. 18044, adult female (in alcohol), collected at Encontrado, Zulia, Venezuela, February 15, 1908, by N. Dearborn.

RANGE: Venezuela, Panamá, and north in Central America at least to Lake Nicaragua.

GENERAL CHARACTERS: Similar to *Noctilio* but much smaller in size, richer in color, and differing in cranial details.

DESCRIPTION: Nicaraguan specimens, color of upperparts Cinnamon-Brown with a narrow yellowish white middorsal line on lower back; underparts bright Ochraceous-Tawny.

MEASUREMENTS: Two females from El Toro Rapids, Lake Nicaragua, and the type (female) in parentheses: Head and body, 79 mm., 78 (67); tail, —, — (12); hind foot from calcar, 16, 16.8 (15.6); forearm, 58.3, 56.5 (58.4). Skull: greatest length, 19.8, 19.2; condylobasal length, 17.8, 17.6; zygomatic breadth, 15.1, 14.2 (14.6); length of upper toothrow, 7.4, 7.4 (7.5).

Dirias is primarily insectivorous and gregarious. Colonies of several hundred specimens in company with *Molossus* have been found hanging from the inside of attic roofs in Panamá. They are, however, not confined to buildings but may also roost in trees, caves, or other natural retreats.

FAMILY PHYLLOSTOMIDAE

LEAF-NOSED BATS

American bats of the family Phyllostomidae are usually characterized by the presence of a "noseleaf" or naked cutaneous folds which rise prominently over the nostrils, but in the subfamily Chilonycterinae these are absent. The ears are moderately developed; three complete bony phalanges in

the third finger. Skull without postorbital processes; premaxillaries complete, fused with each other and with maxillaries. The members of this family present such a marked difference in structure, principally in the character of the teeth, that they have been divided into several subfamilies.

SUBFAMILY CHILONYCTERINAE

MUSTACHE BATS

CHILONYCTERIS GRAY

In members of this subfamily the noseleaf is absent. A well-developed tail projects through and appears on the upper surface of the interfemoral membrane; lower lip with



FIG. 9. *Chilonycteris*.

plate-like outgrowths and numerous small rounded papillae in front. Range of the genus includes the warmer parts of America north to Cuba and central Mexico and south to Matto Grosso, Brazil.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}$ = 34.

Chilonycteris personata Wagner

LITTLE MUSTACHE BAT

Chilonycteris personata WAGNER, 1843, Arch. Naturgesch., vol. 1, p. 367.

The type was collected in Matto Grosso, Brazil, probably at St. Vincent, by Johann Natterer for the Vienna Museum.

RANGE: From Matto Grosso, Brazil, to Guatemala.

GENERAL CHARACTERS: A small slender bat, occurring in two color phases; ears long with pointed tips; face well haired, elongated

tufts of hair projecting from sides of muzzle; interfemoral membrane broad.

DESCRIPTION: Color of upperparts in dark phase Mummy Brown; in light phase, bright Ochraceous-Tawny; underparts in both phases paler than back. Skull: braincase subglobose, narrowly constricted in interorbital region, rostrum depressed above near base, nasal opening circular. Upper incisors unequal, the inner twice as large as outer, cutting edge with a distinct broad notch, outer upper incisors scarcely extending beyond alveoli of inner, lower incisors trifid, forming a continuous row between canines; no distinct sagittal crest or ridges for muscle attachment present.

MEASUREMENTS: Male adult from Aroa Bolivar railroad, Venezuela: Total length, 70 mm.; tail vertebrae, 21; forearm, 44.8. Skull: greatest length, 15.5; zygomatic breadth, 8.7; interorbital constriction, 3.5; width of braincase, 7.5; width across m^2 - m^3 , 5.5; upper toothrow, canine to last molar, 6.3. "Measurements of type: body, 1' 7''; head, 7''; tail 7½''; forearm, 1' 8''."

Chilonycteris rubiginosa rubiginosa
Wagner

WAGNER'S MUSTACHE BAT

Chilonycteris rubiginosa WAGNER, 1843, Arch. Naturgesch., vol. 1, p. 367.

The type was collected at Caicara, Brazil, by Johann Natterer for the Vienna Museum.

RANGE: Upper Amazon, region of Brazil, north to Guatemala.

GENERAL CHARACTERS: A relatively large slender bat with pelage rather long and directed forward from back of neck over the head, similar in structure to *C. personata* but conspicuously larger and differing in the less elevated crown of the head.

DESCRIPTION: Color of upperparts varying from dark brown to Warm Sepia; underparts paler than back, tips of hairs buffy. In general like *personata* in characters of skull and teeth but much larger, and outer lower incisors bifid.

MEASUREMENTS: Adult male and female from Las Pavas: Head and body, 72 mm., 71; tail vertebrae, 20, 23; hind foot, 12, 12; ear, 20, 20; forearm, 61, 61.5. Skull: condylobasal

length, 21.7, 20.6; zygomatic width, 13, 12.5; interorbital constriction, 4.4, 4.2; width of braincase, 10.7, 10.8; width across m^2 - m^3 , 8.4, 8; upper toothrow, c- m^3 , 9.9, 9.4.

SPECIMENS: Prov. San José: Las Pavas, 3 A.M.N.H.

Chilonycteris frequents caves and roosts in large colonies. It is rather shy and quick to leave its roost when approached. *C. rubiginosa* is the largest known species of the genus.

PTERONOTUS GRAY

Like *Chilonycteris* but the wings are attached along the middle of the back. This genus is readily recognized among American bats by the apparently bare back, the fur of

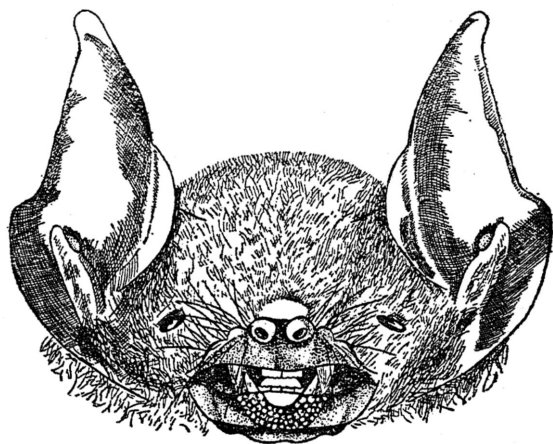


FIG. 10. *Pteronotus*.

the upper surface of the body being concealed by the wings. Range of the genus tropical America north to southern Mexico, also islands of Trinidad, Dominica, West Indies, and south to Matto Grosso, Brazil.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}$ = 34.

Pteronotus suapurensis centralis Goodwin

GREATER NAKED-BACKED BAT

Pteronotus suapurensis centralis GOODWIN, 1942, Jour. Mammal., vol. 23, no. 1, p. 88.

TYPE: A.M.N.H. No. 33193, skin and skull in fair condition, collected at Matagalpa, Nicaragua, 3000 feet elevation, November 10, 1911, by Wm. B. Richardson.

GE: The species *P. suapurensis* extends Venezuela to northern Nicaragua, but form will be found in Costa Rica has been determined.

GENERAL CHARACTERS: A medium-sized bat with pointed ears; pelage directed from back of neck over head, face haired, elongated tufts project from muzzle. Similar in general characters to *Chilonycteris* but back bare.

DESCRIPTION: Color of fur on head and ears about Prout's Brown; underparts tan back, the hairs lightly tipped with buff in inguinal region. Skull like *Chilonycteris rubiginosa* but smaller, braincase abruptly elevated above rostrum, the outer lower incisors are trilobate. The as a third accessory lower incisor on the side.

MEASUREMENTS OF TYPE: Forearm, 53.5 hind foot, in dried skin, 12. Skull: greatest length, 17.9; condylobasal length, zygomatic breadth, 10.5; interorbital width, 4.2; length of maxillary tooth-m³, 7.5.

Pteronotus suapurensis centralis is very larger than *P. davyi* from Trinidad and Mexican subspecies *fulvus*. It is even larger than the typical Venezuelan species *reusis*.

This type is the only known specimen.

Pteronotus davyi Gray

LESSER NAKED-BACKED BAT

Pteronotus davyi GRAY, 1836, Mag. Zool. and Nat. Hist., vol. 2, p. 500.

RE: An adult male; came from Trinidad being sent to Dobson. It is in the museum of the Army Medical Department at Netley, England.

ORIGIN: From Brazil northward to the island of Dominica, Lesser Antilles, and extended in southern Mexico by a smaller species. So far no specimen of the *davyi* has been recorded from the intermediate territory of Central America.

GENERAL CHARACTERS: Similar to *P. reusis* but much smaller, the skull being one and one-third smaller.

DESCRIPTION: Occurring in two colors. Brown phase has fur above Vandyke brown, below Ecru-Drab, the hair Seal

Brown basally. Rufous phase, fur above rich Tawny, below golden ochraceous, hair Cinnamon basally.

MEASUREMENTS: Five Dominican specimens of *davyi*: Forearm, 45-48 mm. (type has forearm, 1" .85¹). Skull: greatest length, 16.5-17; zygomatic width, 9-9.3; interorbital width, 4-4; width of braincase, 8.2-8.5. A series from Mexico, *Pteronotus d. fulvus* Thomas, has forearm, 42.5-46 mm. (type 43). Skull: greatest length, 15-16; zygomatic width, 8.2-9.3; interorbital constriction, 3.5-3.9; width of braincase, 7.4-8.

The American naked-backed bats of the genus *Pteronotus* are insectivorous and tropical in their habitat. It is not known why the wing membranes are not attached to the sides of the body but to the center of the back along the line of the spine, leaving the entire back naked. It is possibly advantageous in making an air pocket on the under surface of the wing to give added support. The small Mexican race has been found roosting in a very dark cave where the temperature was decidedly hot and the atmosphere close and oppressive. In the same cave were found *Mormoops*, *Natalus*, and *Chilonycteris*.

MORMOOPS LEACH

In general like *Chilonycteris*, dermal outgrowths on chin very highly developed. Skull so greatly shortened that both rostrum and braincase are broader than long; crown of head so greatly elevated above face line that the foramen magnum is above level of rostrum. Teeth essentially as in *Chilonycteris* except that the lower incisors are about equal size. Range of the genus includes warmer parts of America north to Cuba and southern border of the United States.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}$ = 34.

Mormoops megalophylla megalophylla Peters

PETERS' LEAF-CHINNED BAT

Mormops megalophylla PETERS, 1864, Monatsber. Akad. Wiss., Berlin, p. 381.

¹ Dobson, 1878, Catalogue... Chiroptera in the British Museum, p. 453.

The type, a Berlin Museum specimen, apparently preserved in spirits, was supposed to have come from Cuba, but Peters, in naming the species, shows that it came from Mexico.

RANGE: From southern Mexico and Yucatan south to Colombia, Ecuador, and Venezuela.

GENERAL CHARACTERS: A medium-sized brownish bat with moderately long fur, long

SUBFAMILY PHYLLOSTOMINAE

BIG-EARED LEAF-NOSED BATS

This subfamily contains all the leaf-nosed American bats with normal teeth.

MICRONYCTERIS GRAY

Members of the genus *Micronycteris* are small, slender bats with thin, papery membranes; large ears connected by a concealed

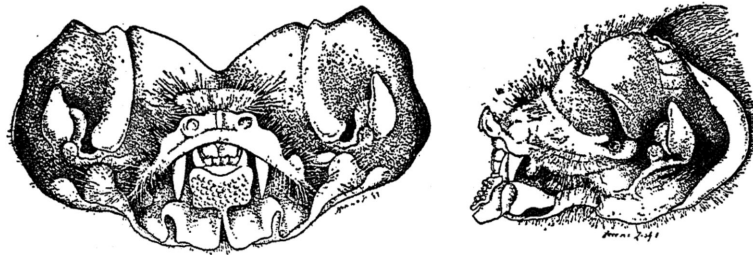


FIG. 11. *Mormoops*.

slender limbs. Tail well developed and appearing on upper side of interfemoral membrane. Ears large, not high, apex subtruncate, the internal connecting membranes rather low and only confluent at the extreme base of rostrum; eyes small, upper lip very fleshy, chin and sides of lip with well-developed cutaneous processes, continuous behind angle of mouth with outer margin of ears; a small area on crown of head devoid of hair.

DESCRIPTION: Color of upperparts about Prout's Brown, the hairs lighter basally; underparts varying from Wood Brown to Tawny-Olive. Skull greatly inflated, braincase elevated above rostrum. Middle upper incisors broad, cutting edge bilobed, outer pair small and placed in close proximity to middle incisors, lower incisors in a continuous row, trilobate and crowded between canines.

MEASUREMENTS: Head and body, 63.5 mm.; tail vertebrae, 29; hind foot, 12; forearm, 55. Skull: greatest length, 15.5; zygomatic breadth, 9.2; interorbital breadth, 5.2; upper toothrow, c-m³, 8.1.

This bat frequents dark warm caverns. It is easily disturbed and readily takes flight when approached.

band across the forehead, prominent nose-leaf; interfemoral membrane perforated by a short tail; pelage rather long and loose. Range

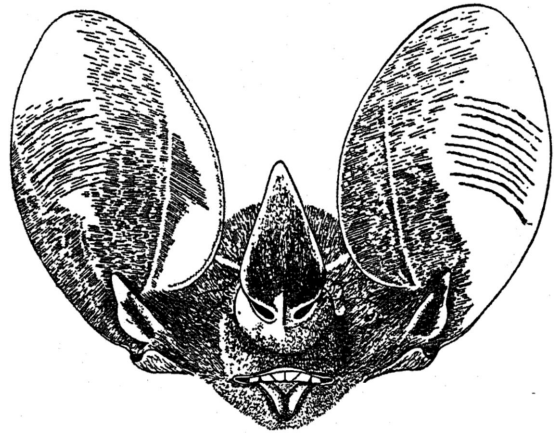


FIG. 12. *Micronycteris*.

of the genus, warmer parts of the American mainland north to central Mexico and south to the State of São Paulo, Brazil.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}$ = 34.

Micronycteris megalotis mexicana* Miller*MEXICAN BIG-EARED BAT**

Micronycteris megalotis mexicanus MILLER, 1898, Proc. Acad. Nat. Sci. Philadelphia, p. 329.

TYPE: U.S.N.M. No. 52105 (Biol. Surv. Coll.), preserved in spirits, skull not removed, collected at Plantinar, Jalisco, Mexico, April 3, 1892, by E.W. Nelson.

RANGE: From Bogota through Central America to Mexico.

GENERAL CHARACTERS: Small size, rusty brown color, prominent noseleaf, and large ears superficially distinguish this bat from other Costa Rican species except *Glyphonnycteris* and *Xenotenes*. It has larger ears, darker color, and longer forearm than *M. microtis*.

DESCRIPTION: Color in fresh pelage, above, Prout's Brown, base of hairs usually white; underparts darker. Skull slender, rostrum narrow and tapering; braincase large. Upper incisors very unequal, completely filling space between canines. The inner teeth large, cutting edges faintly divided by notch near outer side. Lower incisors small, forming a continuous row between canines, cutting edges faintly bifid.

MEASUREMENTS OF HONDURAS SPECIMEN: Forearm, 36.4 mm. Skull: greatest length, 19.4; condylobasal length, 17; interorbital constriction, 4.2; zygomatic breadth, 9.5; mastoid width, 9; width of braincase, 8; width across m^2 - m^3 , 6; upper tooththrow, c - m^3 , 7.6.

Micronycteris m. mexicana has not been recorded from Costa Rica, but its range supposedly extends from Colombia through Central America to Mexico.

Micronycteris microtis* Miller*NICARAGUAN BIG-EARED BAT**

Micronycteris microtis MILLER, 1898, Proc. Acad. Nat. Sci. Philadelphia, p. 328.

TYPE: U.S.N.M. No. 16366/23367, skin and skull, collected at Greytown, Nicaragua, by Dr. L. F. Burt, catalogued February 2, 1889.

RANGE: Nicaragua, Costa Rica, and Panamá.

GENERAL CHARACTERS: Similar to *M. m.*

mexicana but smaller with smaller ears and smaller skull.

DESCRIPTION: Color uniform Wood Brown, slightly richer on dorsal surface, hairs on body dorsally and ventrally nearly white on basal third. Skull similar to *M. megalotis* but smaller, crowns of the three lower premolars approximately the same size.

MEASUREMENTS: Two adult males from Río Sixaola: Total length, 52 mm., 51; tail, 10, 10; hind foot, in dried skin, 10, 9.5; forearm, 31.5, 31. Skull: greatest length, 17, 17.2; condylobasal length, 15.5, 15.5; interorbital width, 3.6, 3.8; width of braincase, 7.1, 7.3; zygomatic width, 8.1, 8.2; upper tooththrow, c - m^3 , 6.4, 6.5.

SPECIMENS: Prov. Limón: Río Sixaola, 6 A.M.N.H.

Micronycteris apparently does not congregate in large numbers. It has been found roosting in hollow trees and may make use of other suitable dark retreats.

XENOCTENES MILLER

Externally similar to *Micronycteris* but with connecting band between ears very low. Skull and teeth as in *Micronycteris* except in



FIG. 13. *Xenotenes*.

the character of the incisors. Inner upper incisors subtereti-conical, the crown slightly wider than long at base, the shaft convex in front, concave behind, tapering to a moderately simple point, outer upper incisors small; lower incisors crowded between canines, posterior outline of the row convex. The outer tooth wedged tightly into angle between inner incisor and canine which are

strongly in contact. Range of the genus, Costa Rica.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}$ = 34.

***Xenotenes hirsutus* (Peters)**

PETERS' BIG-EARED BAT

Schizostoma hirsutum PETERS, 1869, Monatsber. Akad. Wiss., Berlin, p. 396.

The type is in the Paris Museum, from unknown locality, here tentatively designated as Pozo Azul, Costa Rica.

RANGE: Known only from Costa Rica.

GENERAL CHARACTERS: Externally very similar to *M. megalotis* but larger, forearm about 44 mm., and well haired almost to extremity.

DESCRIPTION: General color of upperparts between Prout's Brown and Mummy Brown, the hair uniformly brown to roots on rump and sides of body; base of hairs on shoulders and middle of back white; underparts about Wood Brown washed with pale buff. Skull similar in shape to that of *M. megalotis* but much larger and braincase less elevated above facial region.

MEASUREMENTS: Adult male and female from Palmar: Head and body and tail, 65 mm., 70; hind foot, 14, 14, in dry skin from heel to end of claws, 13, 13.5; forearm, 43.7, 48.6. Skull: greatest length, 24, 24; condylo-basal length, 20.9, 21; zygomatic breadth, 11.7, 11.6; least interorbital width, 4.6, 5; width of braincase, 8.5, 8.5; upper toothrow, c-m³, 9.3, 9.3; width across m²-m², 7.4, 7.3.

SPECIMENS: Prov. Puntarenas: Palmar, 2 A.M.N.H. Prov. San José: Pozo Azul, 2 B.M.

Two of these bats were smoked out of a hollow tree at Palmar by Underwood.

GLYPHONYCTERIS THOMAS

Like *Micronycteris* but ears separated. Skull with anteorbital region distinctly inflated and basisphenoid pit deep with a sharp median dividing ridge; upper premolars with main cusp situated in front of middle of crown, the point slender and slightly recurved; lower incisor trifold. This genus, though closely related to *Micronycteris* and *Xenotenes*, is readily distinguished by the form of the upper premolars and the inflated anteorbital portion of the skull. Range of the

genus includes the mainland of tropical America from Nicaragua south to Peru and Matto Grosso, Brazil.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}$ = 34.

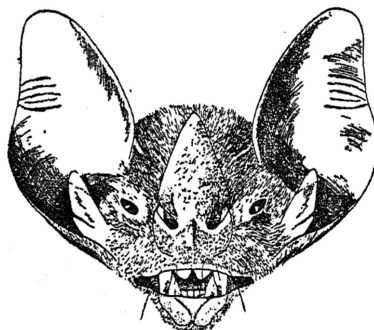


FIG. 14. *Glyphonycteris*.

***Glyphonycteris sylvestris* Thomas**

COSTA RICAN BIG-EARED BAT

Glyphonycteris sylvestris THOMAS, 1896, Ann. Mag. Nat. Hist., ser. 6, vol. 18, p. 303.

TYPE: B.M. No. 96.10.1.2, adult male, collected at Hacienda Miravalles, Guanacaste, Costa Rica, altitude 1400-2000 feet, November 8, 1895, by C. F. Underwood. The locality Imravalles given in Thomas' type description is clearly a misprint for Miravalles. Underwood was at Hacienda Miravalles from August to December, 1895.

RANGE: Costa Rica and Nicaragua.

GENERAL CHARACTERS: Same as for genus.

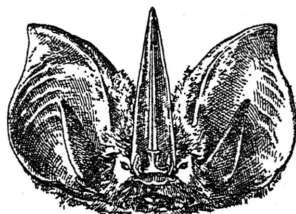
DESCRIPTION: Hair of upperparts with four alternating rings of dark brown and whitish, the extreme base of hair white, followed by a broad band of blackish brown, alternated with broad buffy ring, the hairs narrowly tipped with near Clove Brown; underparts, hair from base dark brown tipped with drab.

MEASUREMENTS OF TYPE: Forearm, 40.3; hind foot with claws, 15.5. Skull: total length, 19.8; zygomatic width, 10.2; anteorbital width, 5.8; upper toothrow, 8.2 (Anderson). As measured by Sanborn: Greatest length, 20.2 mm., zygomatic width, 9.9; upper toothrow, 7.9; lower toothrow, 8.4.

Glyphonycteris sylvestris as yet appears to be known only from the type in the British Museum, which was obtained at Miravalles, Costa Rica, and a record from Volcán de Chinandega, Nicaragua.

LONCHORHINA TOMES

The very long, sharply pointed noseleaf and large separated ears are among external characters distinctive of the genus *Lonchorhina*. The tail reaches the edge of a wide interfemoral membrane. Teeth essentially as in *Micronycteris* except that crowns of lower

FIG. 15. *Lonchorhina*.

incisors are wider, the outer upper incisor has a distinct hooked point close to the inner tooth, the second lower premolar is smaller than either of the others, and the anterior upper premolar is scarcely larger than the outer incisor; a distinct concavity at base of rostrum between the orbits. The skull shows a superficial resemblance to that of *Chilonycteris*. Range of the genus same as for the species.

DENTITION: Incisors, $\frac{2}{2}$; canines, $\frac{1}{1}$; premolars, $\frac{2}{2}$; molars, $\frac{3}{3}$ = 34.

Lonchorhina aurita Tomes

TOMES' LONG-EARED BAT

Lonchorhina aurita TOMES, 1863, Proc. Zool. Soc. London, p. 83.

The type, which came from the West Indies, is in the collection of the museum of the Army Medical Department at Netley, England.

RANGE: Venezuela, Trinidad, Bahama Islands, Panamá, and north to Guatemala.

GENERAL CHARACTERS: A rather small bat with a very long, acutely pointed noseleaf, large ears, and tail reaching the posterior border of a wide interfemoral membrane.

DESCRIPTION: General color of fur varying shades of Prout's Brown. Crown of head slightly elevated above face line, muzzle cylindrical; noseleaf about as long as the ear. Skull narrow, braincase raised above face line, frontals depressed. Middle upper incisors obliquely chisel-shaped.

MEASUREMENTS: Adult male and female from Chilibrillo, Panamá: Head and body, 60 mm., 62; tail vertebrae, 57, 58; foot, 12.6, 13; forearm, 49.6, 50; ear, from meatus, 29, 28. Skull: condylobasal length, 18.4, 19.2; zygomatic breadth, 11, 10.8; interorbital constriction, 5, 5; depth of braincase, 6.8, 6.8; maxillary toothrow, 6.6, 6.6.

This bat has been taken in a large cave at Chilibrillo, Panamá, and in the tunnel of a mine in Guatemala.

MACROPHYLLUM GRAY

A small slender bat with elongated hind limbs and corresponding posterior extension of the interfemoral membrane enclosing the

FIG. 16. *Macrophyllum*.

long tail to the border, noseleaf broad and large, ears slightly longer than head. Skull with short rostrum, its length less than breadth of braincase, nares emarginate laterally. Teeth essentially like those of *Micronycteris*, except that middle lower premolar (pm_3) is minute and crowded inward and first upper premolar (pm_1) is not much larger than outer incisor. Upper incisors completely filling space between canines, the middle pair much larger than outer. Range of the genus same as for the species.

DENTITION: Incisors, $\frac{2}{2}$; canines, $\frac{1}{1}$; premolars, $\frac{2}{2}$; molars, $\frac{3}{3}$ = 34.

Macrophyllum macrophyllum (Wied)

LONG-LEGGED BAT

Phyllostoma *macrophyllum* WIED, 1826, Beitr. Naturgesch. Brasilien, vol. 2, p. 188.

The type was collected by Maximilian,

1815-1817, on the Mucur  River, Minas Geraes, Brazil.

RANGE: From Minas Geraes, Brazil, north to Panam  City and probably southern Costa Rica.

GENERAL CHARACTERS: As for genus.

DESCRIPTION: General color Prout's Brown, the hairs becoming paler toward base, underparts about color of back or a shade paler; wings and interfemoral membrane naked.

MEASUREMENTS: An adult male, in spirits, from British Guiana: Head and body, 43 mm.; tail vertebrae, 38; hind foot, 13. Skull: greatest length, 15.7; condylobasal length, 14.5; zygomatic breadth, 9; length of upper tooththrow, $c-m^3$, 5.4.

Macrophyllum frequents dark vaulted caverns or similar places of retreat. It has been found in the cellar of ruins of old Panam  City in company with *Carollia* and *Glossophaga*.

TONATIA GRAY

Central American representatives of this genus are from medium- to rather large-sized bats with very large ears, noseleaf

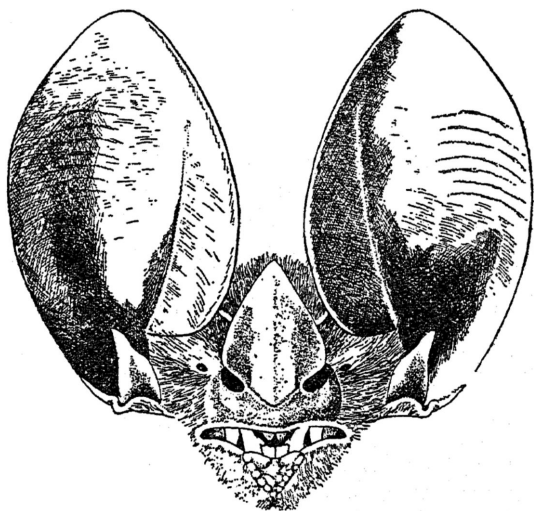


FIG. 17. *Tonatia*.

tapering to a point; tail extends to about middle of interfemoral membrane; fur rather long and loose, extending about halfway along forearm. Teeth more robust than,

though not essentially different in structure from, those of *Micronycteris*. Inner upper incisors with outer posterior border in contact with canines; outer incisors crowded forward; lower incisors higher than wide, anterior upper premolar broader than long, and middle lower premolar minute and functionless, crowded between the anterior and posterior teeth. Range of the genus includes the mainland of tropical America from Bahia on the east coast of Brazil west and north through Bolivia, Peru, Ecuador, Colombia, Guianas, Venezuela, and north to British Honduras.

DENTITION: Incisors, $\frac{2-2}{1-1}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}=32$.

Tonatia bidens (Spix)

SPIX' ROUND-EARED BAT

Vampyrus bidens SPIX, 1823, Simiarum et vespertilionum Brasiliensium, p. 65.

The type came from the Rio San Francisco, Bahia, Brazil, and was in the Brazilian Museum at Munich.

RANGE: From Bahia, Brazil, west to Peru and north, east of the Andes, to the Guianas, Venezuela, and north in Central America to Costa Rica.

GENERAL CHARACTERS: Size large, ears large but relatively short and broad when compared with other members of the genus, proximal half of forearm well haired, base of thumb and upper sides of feet hairy.

DESCRIPTION: Color of upperparts varying from Ochraceous-Tawny to blackish Mummy Brown, base of hairs behind ears and on neck more or less white, underparts paler and grayer than back, washed with pale buff. Skull large and massive, rostrum broad, flat and not constricted in orbital region; superior outline evenly elevated from front of nasals and without depression in orbital region; palate narrow, tooththrows only slightly converging anteriorly, sagittal crest present in adult specimens but undeveloped.

MEASUREMENTS: An adult male and female from Palmar: Forearm, 58.5 mm., 58.5. Skull: greatest length, 28.6, 29; condylobasal length, 25.4, 25.5; zygomatic breadth, 14.2, 14.8; interorbital constriction, 5.6, 5.6; upper tooththrow, $c-m^3$, 9.9, 10.2.

SPECIMENS: Prov. Puntarenas: Palmar, 8 A.M.N.H.

Specimens taken at Palmar were smoked out of a large hollow tree, and some of them have their ears singed.

Tonatia nicaraguae Goodwin

PYGMY ROUND-EARED BAT

Tonatia nicaraguae GOODWIN, 1942, Jour. Mammal., vol. 23, no. 2, p. 205.

TYPE: A.M.N.H. No. 41184, female adult, in spirits, skull removed, collected at Kanawa Creek, Cukra, north of Bluefields, Nicaragua, August 7, 1916, by Halter and Mannhardt.

RANGE: The type is the only known specimen.

GENERAL CHARACTERS: A small, dark-colored bat with large ears connected by a low band across forehead; lower lip with a naked V broken into wart-like protuberances, noseleaf broad and attenuated to a sharp point and not extended below nostrils as a separate leaf; forearm finely haired on basal half. Tail short and not perforating the very broad interfemoral membrane.

DESCRIPTION: General color of upperparts Mummy Brown, the hairs broadly white at base; underparts Light Drab. Skull small, evenly elevated behind nasals, rostrum parallel-sided, lower incisors small, faintly bifid; middle lower premolar minute and in the tooththrow as usual in this genus.

MEASUREMENTS OF TYPE: Forearm, 32 mm. Skull: greatest length, 17.9; interorbital width, 3.4; width of braincase, 7.8; width across canines, 3.4; width across m^2 - m^2 , 5.4; length of upper tooththrow, c - m^3 , 6.5.

The pygmy round-eared bat is about the size of *Micronycteris megalotis* and easily may be confused with the latter. Externally it can be distinguished by the wart-like outgrowths on the lower lip instead of a simple V and by the undeveloped lower portion of the noseleaf and the single pair of lower incisors.

Tonatia amblyotis (Wagner)

WAGNER'S ROUND-EARED BAT

Phyllostoma amblyotis WAGNER, 1832, Arch. Naturgesch., vol. 1, p. 365.

TYPE: A Munich Museum specimen, collected by Johann Natterer at Matto Grosso,

Brazil. Wagner published Natterer's manuscript.

RANGE: From Matto Grosso, Brazil, north on the west coast (Peru, Ecuador, Colombia) to Panamá and north in Central America to British Honduras.

GENERAL CHARACTERS: About the size of *T. bidens* but ears larger, color lighter, forearm less hairy, and differing in distinctive cranial characters.

DESCRIPTION: General color of upperparts varying from Mars Brown to Mummy Brown, the hairs lightly tipped with pale buff, base of hairs broadly white behind ears and back of neck; underparts grayer than back with a white area or collar on throat and under side of neck in some specimens. Skull narrow with a high braincase, superior outline elevated in interorbital region, rostrum relatively long and noticeably constricted in postorbital region; posterior border of palate on a line across the front of third molars, sagittal crest moderately developed.

MEASUREMENTS: Forearm, 50-55 mm.; hind foot, 15.6-16.6; ear from notch, 28-31. Skull: greatest length, 25.1-28; condylobasal length, 21-24; postorbital width, 3-5; zygomatic width, 12.2-14.2; length of upper tooththrow, c - m^3 , 8.7-10.

Up to the present time *Tonatia amblyotis* has not been recorded from Costa Rica, but it has been found in Panamá and British Honduras and no doubt occurs in Costa Rica.

MIMON GRAY

Size medium, ears large and separated; tail about as long as femur, terminating near middle of broad interfemoral membrane,

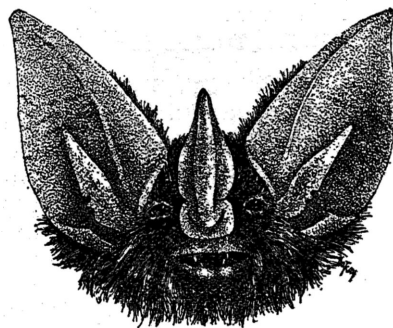


FIG. 18. *Mimon*.

noseleaf large, chin with a broad naked space, divided by a longitudinal groove. Skull slender but with rather broadly arched rostrum. Teeth like those of *Tonatia* except that the inner upper incisors are separated from canines by a distinct space occupied by well-developed outer incisor, lower canines not in contact and the middle lower premolar absent. Range of genus same as for species.

DENTITION: Incisors, $\frac{2-2}{1-1}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{3-3}{3-3}$ = 30.

Mimon bennettii (Gray)

GRAY'S SPEAR-NOSED BAT

Phyllostoma bennettii GRAY, 1838, Mag. Zool. and Bot., vol. 2, p. 488.

TYPE: A British Museum specimen in bad condition, labeled as from South America.

RANGE: Tropical America from the State of Santa Catarina, Brazil, north to southern Mexico.

GENERAL CHARACTERS: Same as for the genus.

DESCRIPTION: General color Cinnamon Brown to base of ear; underparts paler than back, fur dense and long, covering the humerus but scarcely extending on the membranes; central upper incisors moderately long and directed vertically downward; outer incisors very short. First upper premolar (pm³) much larger than outer incisor; lower incisors higher than wide.

MEASUREMENTS: A male and female (alcoholic) from Yucatan: Forearm, 55.6 mm., 56.8; third finger metacarpal, 48.1, 50; first phalanx, 19.6, 19.9; second phalanx, 26.3, 27.9; third phalanx, 12.6, 13.2; ear from meatus, 34.6, 35.7; tail, 21.5, 22.8; tibia, 23, 24.9; foot, 14.5, 14.6.

PHYLLOSTOMUS LACÉPÈDE

Members of this genus are medium- or large-sized, robust bats with a well-developed noseleaf, rather narrow pointed ears, short tail, and large interfemoral membrane, no facial stripes. Skull short and massive. Range of the genus includes tropical America north to Mexico and south to the State of Rio de Janeiro, Brazil.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{3-3}{3-3}$ = 32.

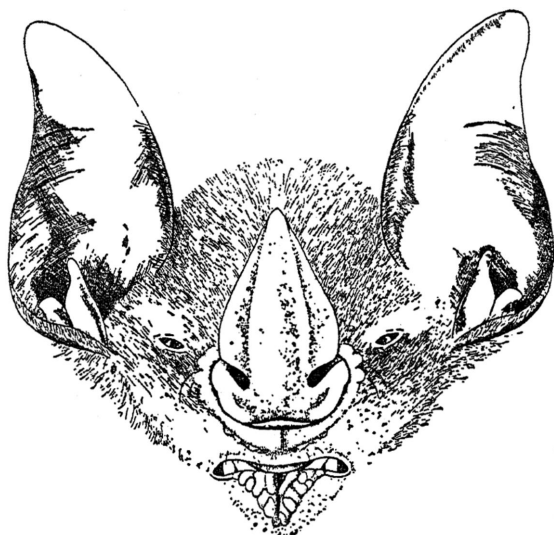


FIG. 19. *Phyllostoma*.

Phyllostomus hastatus panamensis Allen

PANAMANIAN SPEAR-NOSED BAT

Phyllostomus hastatus panamensis ALLEN, 1904, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 233.

TYPE: A.M.N.H. No. 18705, female adult, skin and skull, collected at Boquerón, Chiriquí, Panamá, by J. H. Batty, October 6, 1901.

RANGE: From Panamá north to Honduras.

GENERAL CHARACTERS: With the exception of the false vampire, *Vampyrus spectrum*, this is the largest American bat. A conspicuous gland on the under side of the neck is present in males but rudimentary in females.

DESCRIPTION: Color above dark Seal Brown, lighter and slightly varied with gray on shoulders, sides of neck, and front of head; underparts lighter brown than back, extreme tips of hairs grayish; ears, noseleaf, and membranes blackish brown. Skull heavy and robust, with broad, rather low, flattened rostrum; sagittal crest well developed; middle upper incisors simple and directed somewhat forward, outer incisors very short and broad, scarcely rising to level of cingulum of middle incisors. Lower incisors forming a continuous, nearly straight row between the cingula of the canines, the outer tooth only slightly smaller than inner; cutting edge faintly trifid.

MEASUREMENTS: An adult male from El

Sauce Perálta, and an adult female from San Gerónimo de Pirris, type in parentheses: Head and body, 128 mm., 109; tail vertebrae, 25, 28; hind foot, 22, 24; ear, 30, 33; forearm, 92.5, 88 (90). Skull: condylobasal length, 35.8, 34.2, (34); zygomatic width, 23, 20.8, (21.2); maxillary toothrow, c-m³, 14.5, 14, (14.3).

SPECIMENS: Prov. San José: San Gerónimo de Pirris, 2 U.S.F.W., 1 M.C.Z. Prov. Cartago: El Sauce Perálta, 2 U.S.F.W. Prov. Guanacaste: 27 de Abril, 4 M.Z.U.M.

This large spear-nosed bat is not uncommon at low elevations in Central America. It roosts in clusters in dimly lighted or totally dark caves. Colonies have been found numbering thousands and more than a hundred in a single spot. Their food includes various kinds of fruit, such as bananas, but they also kill and eat birds, small bats, mice, and insects.

Phyllostomus discolor verrucosus Elliot

ELLIOT'S OR LESSER SPEAR-NOSED BAT

Phyllostoma verrucosum ELLIOT, 1905, Proc. Biol. Soc. Washington, vol. 18, p. 236.

TYPE: C.N.H.M. No. 3886, collected at Niltpec, Oaxaca, Mexico, by Heller and Barber, about 1904.

RANGE: From southern Mexico south to Panamá.

GENERAL CHARACTERS: Similar in general characters to *P. h. panamensis* but much smaller, lighter colored, and fur short and close. Forearm, 57 to 65 mm.

DESCRIPTION: Color of upperparts varying from Mummy Brown to Prout's Brown, becoming almost pale Ochraceous-Tawny on head and shoulders, broad base of hairs Warm Buff; underparts Cinnamon-Buff to base of hair, this color extending well up on sides of neck and shoulders in some specimens. Skull relatively long and slender, with broad low rostrum, rounded braincase, and weak sagittal crest; zygomata well developed but not especially spreading; toothrow similar in structure to the larger species.

MEASUREMENTS: Two male skulls from Honduras: Condylobasal length, 28 mm., 28.1; width of braincase, 12.2, 12.2; width across m³-m³, 10.5, 10.1; zygomatic width, 15.7, 15.8; upper toothrow, c-m³, 10.2, 10.1.

The habits of *P. d. verrucosus* are probably much the same as those of the larger species except that it seems to favor higher elevations.

PHYLLODERMA PETERS

The genus *Phylloderma* includes large bats having a muzzle abruptly narrowed in front of the eye, large separate ears, noseleaf large and rather narrow, tail short and perforating the wide interfemoral membrane, chin with a V-shaped naked space margined by small warts. External characters are not very different from those of *Phyllostomus*. The skull has a relatively high rounded braincase,



FIG. 20. *Phylloderma*.

broad flat rostrum, rounded zygomata, and weak teeth; inner upper incisors broad, bifid; outer upper incisors very short and not rising above cingulum of canines; inner lower incisors nearly twice as wide as outer; a minute middle lower premolar (pm₃) wedged transversely between the two functional teeth. Range of the genus, tropical America from Honduras south at least to Cayenne in South America.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}$ = 34.

Phylloderma septentrionalis Goodwin

GREAT NORTHERN SPEAR-NOSED BAT

Phylloderma septentrionalis GOODWIN, 1940, Amer. Mus. Novitates, no. 1075, p. 1.

TYPE: A.M.N.H. No. 126868, female adult, skin and skull, collected at Las Pilas, department of La Paz, Honduras, March 26, 1937, by C. F. Underwood.

RANGE: The range of the genus *Phyloderma* probably extends from Honduras to South America; the species *septentrionalis* is known to occur only in Honduras and *stenops* in South America.

GENERAL CHARACTERS: As for the genus, except that *P. septentrionalis* is larger than *stenops*, and the lobes on the inner upper incisors are subequal. In *stenops* the outer cusps on the inner upper incisors are definitely longer and more slender than the inner cusps.

DESCRIPTION: Color of upperparts Prout's Brown, base of hairs Light Buff; underparts soiled Light Buff, the color of underparts extends well up on shoulders and sides of neck, wing membranes blackish brown except tips which are whitish.

MEASUREMENTS OF TYPE: Total length, 137 mm.; tail vertebrae, 15.8; hind foot, 24.5; ear from notch, 25; forearm, 80. Skull: greatest length (to front of incisors), 34.5; condylobasal length, 30.2; interorbital width, 10.5; postorbital width, 9.6; zygomatic width, 18; length of upper tooththrow, c-m³, 11.

TRACHOPS GRAY

In the genus *Trachops* the lips are conspicuously studded with conical or cylindrical wart-like protuberances; the fur is relatively long and woolly, and extends down the fore-



FIG. 21. *Trachops*.

arm for about half its length; noseleaf normal; ears large and erect; tail short and appearing on upper side of a broad interfemoral membrane. Skull more or less elongated, interorbital region smoothly rounded, braincase elevated above rostrum; outer upper incisor

very small, lower incisors small, almost subequal and forming a continuous row between cingulum of canines, middle lower premolar (pm₃) minute and crowded completely from tooththrow on inner side. Range of this genus same as for the species and north to Guatemala.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}$ = 34.

Trachops cirrhosus (Spix)

FRINGE-LIPPED BAT

Vampyrus cirrhosus SPIX, 1823, Simiarum et vespertilionum Brasiliensium, p. 64.

The type came from Brazil and was in the Brazilian Museum at Munich.

RANGE: Minas Geraes, Brazil, north to Colombia, Panamá, and probably Costa Rica.

GENERAL CHARACTERS: Same as for the genus, similar in general to *Trachops coffini* from Guatemala and Honduras but considerably larger, the upper and lower premolar teeth relatively narrower.

DESCRIPTION: Color of upperparts near Cinnamon-Brown, varying to a darker tone in some examples, base of hairs broadly whitish. Underparts dull brownish, tinged with gray brown owing to light-colored tips of hairs. Upper middle incisors large with a barely perceptible notch in the cutting edge (distinct in *coffini*).

MEASUREMENTS: An adult male from Bonda, Colombia: Forearm, 61 mm. Skull: greatest length, 28.2; condylobasal length, 25.8; zygomatic breadth, 15; interorbital breadth, 5.1; width of braincase, 11.4; upper tooththrow, canine to last molar, 10.5.

Trachops cirrhosus is known to roost in caves and probably frequents other similar retreats.

CHROTOPTERUS PETERS

Bats of this genus are large and robust, having very large though simple and separate ears, well-developed noseleaf, tail barely perceptible in the base of very wide interfemoral membrane; lips and chin nearly smooth; fur unusually long and soft and extending down the forearm for about half its length. Skull large and less angular than *Phyllostomus*; rostrum and interorbital region

subcylindrical. Maxillary teeth essentially like those of *Phyllostomus* except that the inner incisors are lower and less projecting,

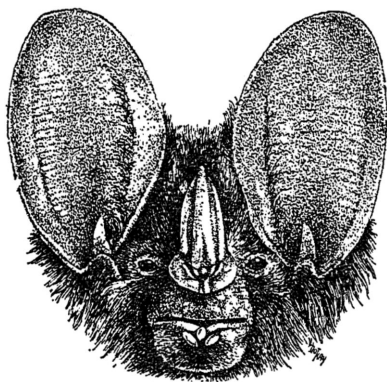


FIG. 22. *Chrotopterus*.

the anterior upper premolar is small, crowded outward from toothrow; middle lower premolar (pm_3) minute and crowded completely

The type, which came from Mexico, is probably in the Berlin Museum.

RANGE: Tropical America north to southern Mexico.

GENERAL CHARACTERS: Considerably smaller than *Vampyrum spectrum* but with similarly large ears, much longer fur, and only one pair of lower incisors. Lower lip with a small wart in the center and a narrow transverse elevation on either side.

DESCRIPTION: Color of upperparts Bister, lightly washed with Light Buff, roots of hairs whitish; underparts dusky, the tips of hairs whitish; membranes dark brown, becoming yellowish white on extreme tips of wings.

MEASUREMENTS: Adult male from Brazil, dry skin: Head and body, 104 mm.; hind foot, 25; forearm, 80. Skull: greatest length, 36; condylobasal length, 31.2; zygomatic width, 20; interorbital constriction, 6; upper toothrow, canine to last molar, 13.3.

Chrotopterus is in all probability carniv-

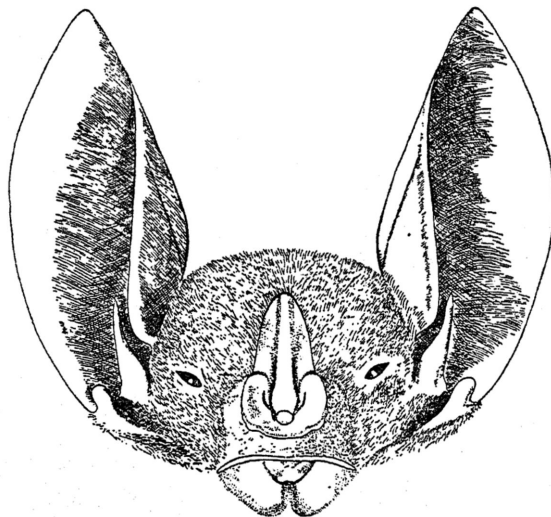


FIG. 23. *Vampyrum*.

from toothrow on inner side. Range of genus includes tropical America from Paraguay and northern Argentina north to southern Mexico.

DENTITION: Incisors, $\frac{2-2}{1-1}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}$ = 32.

Chrotopterus auritus (Peters)

PETERS' FALSE VAMPIRE

Vampyrus auritus PETERS, 1856, Monatsber. Akad. Wiss., Berlin, p. 415.

orous. In many respects it is an intermediate genera in this subfamily and connects *Vampyrum* with *Tonatia* and *Phyllostomus*.

VAMPYRUM RAFINESQUE

Very large in size, muzzle elongated, nose-leaf moderate, ears large, separate, and relatively narrow; tail absent; interfemoral membrane very wide. Skull elongate, sagittal crest well developed, middle upper incisors low and

wide, outer incisors small, pushed slightly forward out of toothrow, barely rising to level of cingulum of canine; lower incisors very small, about equal in size, forming a continuous row between canines. Range of genus includes tropical America from the State of Bahia, Brazil, north to southern Mexico and Greater Antilles.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}$ = 34.

***Vampyrus spectrum nelsoni* Goldman**

NELSON'S FALSE VAMPIRE BAT

Vampyrus spectrum nelsoni GOLDMAN, 1917, Proc. Biol. Soc. Washington, vol. 30, p. 115.

TYPE: U.S.N.M. No. 78127 (Biol. Surv. Coll.), in alcohol, male adult, skull removed, collected at Coatzacoalcas, Vera Cruz, Mexico, by E. W. Nelson, May 14, 1896.

RANGE: Panamá north to southern Mexico.

GENERAL CHARACTERS: As for the genus, the largest bat in North America, fur normal and extending down forearm for about half its length.

DESCRIPTION: Color of upperparts Bister, base of hairs buffy, broadening and more pronounced down middle of back; underparts thinly covered with pale brownish hair. The skull of *V. s. nelsoni* is smaller than that of typical *V. spectrum* from South America, zygomata less spreading posteriorly, and the sides more nearly parallel.

MEASUREMENTS: Adult male from Nicaragua, in dry skin, and type in parentheses: Forearm, 105.5 mm. (106.9); foot with claw, 29.5 (31). Skull: condylobasal length, 42.3; greatest length, 49.5 (51); zygomatic width, 24.5 (23.6); width of braincase, 15.7; interorbital constriction, 8; maxillary toothrow, canine to back of last molar, 20.3 (20.2).

The habits of this rather uncommon bat are not well known. It has been found in the hollow trunks of the giant ceiba trees in Trinidad. This bat feeds, in part at least, upon small birds, rodents, smaller bats, some fruit, and probably insects.

SUBFAMILY GLOSSOPHAGINAE

LONG-TONGUED BATS

This subfamily includes small bats with elongated muzzle, small noseleaf, short

rounded ears; short tail; long and highly extensible tongue, its surface having conspicuous, bristle-like papillae; cheek teeth narrow and elongate.

GLOSSOPHAGA GEOFFROY

Members of this genus are small bats with short pelage; short tail extending barely to middle of broad interfemoral membrane; notched lower lip. Skull with braincase large



FIG. 24. *Glossophaga*.

and elongate. Rostrum somewhat shorter than braincase, low and weak. Upper incisors well developed, projecting forward and forming an almost continuous row between canines; crowns of inner teeth longer than high, the cutting edge straight; outer teeth smaller and shorter than inner, lower incisors small but completely filling space between canines, molariform teeth small with low crowns. The range of this genus includes the warmer parts of South America, from the State of São Paulo, north to Central America and in the West Indies to Jamaica.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}$ = 34.

***Glossophaga soricina leachii* (Gray)**

LEACH'S LONG-TONGUED BAT

Monophyllus leachii GRAY, 1844, Zoology of the voyage of H.M.S. "Sulphur," vol. 1, p. 18.

The type is in the British Museum; taken April, 1837, at Realejo, Nicaragua, by collectors under Commander Belcher on the voyage of the "Sulphur."

RANGE: From Panamá north to Durango and Tamaulipas in central Mexico.

GENERAL CHARACTERS: A small brownish bat with elongate muzzle, small noseleaf, short rounded ears, notched lower lip, and short tail protruding slightly from upper side

of interfemoral membrane; length of forearm about 35 mm.

DESCRIPTION: Color uniform dark brown varying in shade from Snuff Brown to Mummy Brown, base of hairs soiled whitish, underparts slightly duller in color than back.

MEASUREMENTS: Two males from Fuentes: Head and body, 54 mm., 52; tail vertebrae, 8, 8; hind foot, without claw, 8, 7; ear, 11, 9; forearm, 36.5, 35.5. Skull: greatest length, 21.5, 21.2; zygomatic width, 9.5, 9.5; maxillary tooththrow, canine to last molar, 7.2, 7.2.

SPECIMENS: Prov. Puntarenas: Tambor, 1 M.Z.U.M.; San Francisco Esparta, 18 A.M.N.H.; Palmar, 1 A.M.N.H. Prov. San José: San Gerónimo Pirris, 1 A.M.N.H.; Escazú, 17 A.M.N.H.; San Isidro, 1 A.M.N.H.; San José, 1 A.M.N.H.; La Uruca, 56 A.M.N.H. Prov. Cartago: Tres Rios, 15 A.M.N.H.; Santa Teresa Perálta, 3 A.M.N.H. Prov. Alajuela: Grecia, 52 A.M.N.H.

Glossophaga is to some extent a nectar feeder and is known to lap up with its long tongue the honeyed liquid in the flowers of the calabash tree and night-blooming cacti. It is gregarious, roosts in colonies, and may be found in darkened rooms and abandoned buildings, but in general it prefers a retreat in dark caves.

LONCHOPHYLLA THOMAS

Externally *Lonchophylla* resembles *Glossophaga*, but the skull is longer than in the latter, with incomplete zygomatic arch,



FIG. 25. *Lonchophylla*.

inner upper incisors higher than wide and double the bulk of outer teeth; lower incisors have narrow trifid cutting edges, the outer teeth separated from the canines. Range of the genus from the State of Bahia, Brazil,

north to Panamá. Dental formula same as for *Glossophaga*.

Lonchophylla robusta Miller

RUSTY LONG-TONGUED BAT

Lonchophylla robusta MILLER, 1912, Proc. U. S. Natl. Mus., vol. 42, p. 23.

TYPE: U.S.N.M. No. 173854, in alcohol, skull removed, collected in cave on Chilibrillo River, Panamá, April 14, 1911, by August Basck.

RANGE: Panamá.

GENERAL CHARACTERS: A rusty-colored relatively large, long-nosed bat, similar to *Glossophaga* in external characters but skull longer and differing in dental characters. Size large for this genus, forearm about 45 mm.

DESCRIPTION: Color of type, upperparts between Mars Brown and Raw Umber, the hairs becoming much paler at base; underparts light Isabella Color, tinged with Raw Umber.

MEASUREMENTS: Type and adult female topotype: Head and body, 56 mm., 60; tail vertebrae,—, 10; foot, 10.4, 10.4; forearm, 43.6, 43. Skull: condylobasal length, 25.2, 25.4; interorbital constriction, 5.2, 5.4; width of braincase, 10.2, 10; maxillary tooththrow, canine to last molar, 9.8, 10.

Lonchophylla concava Goldman

PANAMANIAN LONG-TONGUED BAT

Lonchophylla concava GOLDMAN, 1914, Smithsonian Misc. Coll., vol. 63, no. 5, p. 2.

TYPE: U.S.N.M. No. 179621 (Biol. Surv. Coll.), skin and skull, adult male, collected at Cana, altitude 2000 feet, eastern Panamá, May 20, 1912, by E. A. Goldman.

RANGE: Known only from the type locality.

GENERAL CHARACTERS: In size, color, and general external appearance *Lonchophylla concava* closely resembles *Glossophaga soricina leachii* but differs in having distinctive cranial characters as shown under the genus.

DESCRIPTION: Color of upperparts near Warm Sepia, underparts and basal color of fur of upperparts somewhat paler.

MEASUREMENTS OF TYPE: Total length, 68 mm.; tail vertebrae, 10; hind foot, 11; forearm, 33.9. Skull: greatest length, 23.4; condylobasal length, 22.4; interorbital constriction, 4.6; breadth of braincase, 9.3;

maxillary tooththrow, canine to last molar, 8.

Neither species of *Lonchophylla* has been recorded north of Panamá. *L. robusta* seems to be the least rare, and it is possible that the range of one of the species includes at least part of Costa Rica. *Lonchophylla*, as are other bats of the subfamily Glossophaginae, is to some extent a nectar feeder, and uses its long tongue to lap up the honeyed liquid from the large night-blooming flowers.

ANOURA GRAY

In *Anoura* there is no tail, the calcar is very short, and the interfemoral membrane is very narrow and well haired, the hair of the body extending down the forearm for about half its length; muzzle elongated, noseleaf small, and ears small. Skull with braincase large and elongate but low, rounded, and smooth; rostrum shorter than braincase, low and weak; zygomatic arch weak and im-

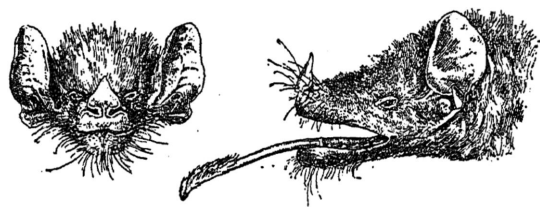


FIG. 26. *Anoura*.

perfectly ossified, upper incisors minute, the outer larger than inner, teeth close together, in pairs, the inner widely separated from each other. Range of the genus extends from southern Mexico south to Peru and Bolivia on the west coast and Santa Catarina, Brazil, on the east coast.

DENTITION: Incisors, $\frac{2-2}{0-0}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{3-3}{3-3}$ = 32.

Anoura geoffroyi Gray

GEOFFROY'S LONG-NOSED BAT

Anoura geoffroyi GRAY, 1838, Mag. Zool. and Bot., vol. 2, p. 490.

TYPE: A dried skin, in British Museum, from Brazil.

RANGE: Same as for genus.

GENERAL CHARACTERS: A small, dark-colored, long-nosed bat with short thick pelage; larger than *Glossophaga* and without external tail and very narrow interfemoral membrane.

DESCRIPTION: Color of upperparts dark Mummy Brown, base of hairs soiled whitish, underparts about color of back, the hairs dark to base and lightly tipped with buffy.

MEASUREMENTS: Adult male from Guatemala: Total length, 78 mm.; hind foot, 15; ear, 8; forearm, 41. Skull: greatest length, 23.5; width of braincase, 9.5; interorbital width, 4.5; upper tooththrow, canine to last molar, 9.

Three geographical races of *Anoura geoffroyi* are now recognized: *A. g. lasiopyga* Peters, found in southern Mexico, Guatemala, and El Salvador; *A. g. peruana* Tschudi, in Colombia, Ecuador, and Peru; and *A. g. geoffroyi* Gray, in Trinidad, Venezuela, Brazil, and eastern Bolivia. Until specimens have been taken in Costa Rica the racial characters of the form found here cannot be determined.

Anoura is in part a nectar feeder, and its long tongue is adapted for reaching into the corolla of various night-blooming tropical flowers. It is known also to visit blossoms where there is no secretion of nectar, and it may be supposed that there they are attracted by the insects drawn in by the perfume of the flowers.

CHOERONISCUS THOMAS

The genus *Choeroniscus* is recognized by its small size, uniform dark color, exceptionally long muzzle, small triangular noseleaf, small ears, and short tail. Skull small and delicate, rostrum long and slender but less than half the length of the skull, mandible very long and slender, teeth small, delicate, and distinctly spaced, upper incisors minute, no incisors in lower jaw. Range of the genus extends from Guatemala south to Peru and the State of Amazonas, Brazil.

DENTITION: Incisors, $\frac{2-2}{0-0}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{3-3}{3-3}$ = 30.

Choeroniscus godmani (Thomas)

GODMAN'S LONG-NOSED BAT

Choeronycteris godmani THOMAS, 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 11, p. 288.

TYPE: B.M. No. 79.12.24.1, adult male, in alcohol, skull removed, collected in Guatemala by G. C. Champion.

RANGE: Known from Guatemala, Honduras, and Costa Rica.

GENERAL CHARACTERS: A small, uniform, dark-colored bat, distinguished from the closely allied genus *Choeronycteris mexicana* by its smaller size and relatively shorter rostrum.

DESCRIPTION: Color of upperparts uniform Mummy Brown. The hairs brownish light drab from the base for most of their length and broadly tipped with Mummy Brown; underparts slightly paler and duller than back.

MEASUREMENTS: Male and female from San José: Head and body, 53 mm., 53; hind foot, 8, 10; forearm, 32.4, 33.5 (type, 33.5). Skull: greatest length, 19.5, 21; condylobasal length, 19.2, 19.5; interorbital width, 3.4, 3.4; width of braincase, 8.1, 8.3; width across m^3 - m^3 , 4, 4; upper toothrow, canine to last molar, 7, 7.1.

SPECIMENS: Prov. San José: San José, 5 A.M.N.H.

Choeroniscus godmani has a highly specialized elongated snout with correspondingly long narrow jaws and very long tongue, capable of being extended far beyond the lips. Tip of tongue has numerous thread-like papillae forming a brush, especially adapted for reaching the nectar at the base of the corolla in large blossoms.

CHOERONYCTERIS TSCHUDI

Similar to *Choeroniscus* but larger and rostrum relatively longer and more than half

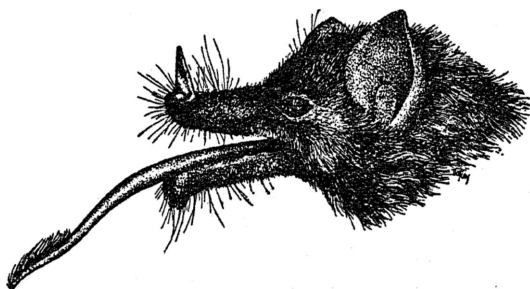


FIG. 27. *Choeronycteris*.

the length of the skull; the same dental formula. Range of the genus same as for the species.

Choeronycteris mexicana Tschudi

MEXICAN LONG-NOSED BAT

Choeronycteris mexicana TSCHUDI, 1844, Fauna Peruana, p. 72.

TYPE: A Berlin Museum specimen, obtained in Mexico by Brassart.

RANGE: From Arizona south to Guatemala; limits of range unknown.

GENERAL CHARACTERS: As for the genus.

DESCRIPTION: Similar to *Choeroniscus godmani* but larger and differing in having a relatively longer rostrum.

MEASUREMENTS: Adult from Guatemala: Total length, 72 mm.; tail, 17; hind foot, 11; ear, 12.5; forearm, 43.5. Skull: greatest length, 29; zygomatic breadth, 10.2; upper toothrow, c - m^3 , 11.

The Mexican long-nosed bat is less gregarious than most bats and seems to be disinclined to mingle with other species. Two individuals were found in separate outbuildings in Guatemala, one having two young.

With our present information on the distribution of this genus there is no good reason why it should be included in the Costa Rican fauna.

HYLONYCTERIS THOMAS

In general characters *Hylonycteris* closely resembles *Choeroniscus* except that the pterygoids are normal, not inflated, and are not extended backward to come in contact with the auditory bullae. Dental formula as in *Choeroniscus*. Range of genus same as for species.

Hylonycteris underwoodi Thomas

COSTA RICAN LONG-NOSED BAT

Hylonycteris underwoodi THOMAS, 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 11, p. 286.

TYPE: B.M. No. 3.2.1.5, collected at Rancho Redondo, Costa Rica, June 30, 1899, by C. F. Underwood.

RANGE: From Costa Rica north to Vera Cruz, Mexico.

GENERAL CHARACTERS: A small, uniformly dark-colored bat with a long muzzle, small noseleaf, small ears, and short tail which appears on upper side of the interfemoral membrane.

DESCRIPTION: General color of upperparts dark brown, crown of head darker, and underparts slightly paler than back; hairs of back tricolor, dark brown basally, and terminally with a light brown mesial ring. Skull about as in *Choeroniscus* except that the upper tooththrow is less parallel and diverges backward; pterygoids normal, and no wide space behind upper canines.

MEASUREMENTS OF TYPE: Forearm, 34.5 mm. Skull: greatest length, 23; basal length, 20.3; interorbital breadth, 4.2; breadth of braincase, 8.6; upper tooththrow, canine to back of last molar, 8.5.

SPECIMENS: Prov. San José: Rancho Redondo, 1 (type) B.M.; Tarbaca, 2 B.M.

Hylonycteris is a flower-visiting bat. It has lost its lower incisors, in correlation with its method of feeding by means of its long extensible tongue. It roosts in caves or tunnels but apparently in very small colonies.

LEPTONYCTERIS LYDEKKER

The genus *Leptonycteris* is well characterized by its unique dental formula, although externally it rather closely resembles *Anoura* and *Lonchoglossa*. The only other genus in which the third upper molar is lacking,

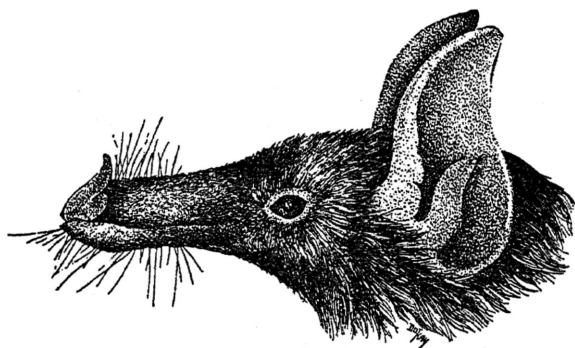


FIG. 28. *Leptonycteris*.

Lichonycteris, differs very conspicuously in the peculiar form of the upper incisors and the absence of the lower incisors. Range of the genus includes Mexico, Central America, and the island of Curaçao, Venezuela.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{2-2}{2-2}$ = 30.

Leptonycteris nivalis (Saussure)

SAUSSURE'S LONG-NOSED BAT

M[=*Ischnoglossa*] *nivalis* SAUSSURE, 1860, Rev. et Mag. Zool., ser. 2, vol. 12, p. 492.

TYPE: A Paris Museum specimen was collected by Saussure near the snow line on Mount Orizaba, Mexico.

RANGE: Mexico and Central America.

GENERAL CHARACTERS: A medium-sized brown bat with a long nose and short broad ears, noseleaf diamond-shaped, membranes thick and leathery, interfemoral membrane very narrow, tail absent, feet large and strong, fur short and dense.

DESCRIPTION: General color Cinnamon Brown, base of hairs buffy white, underparts and shoulders paler than back. Skull of the normal glossophagine type. Upper incisors rather large, projecting forward. Crowns of inner incisors about as long as high, the cutting edge straight, crown of outer incisors higher than inner and pointed. Lower incisors well developed with low flat crowns. Premolars long and narrow.

MEASUREMENTS: Adult male from Colima, Mexico: Head and body, 75 mm.; tibia, 22; foot, 14.6, without claws, 12; calcar, 6; forearm, 55; ear from meatus, 16. Skull: greatest length, 27; basal length, 25.6; zygomatic width, 11; interorbital width, 5; mastoid width, 10.8; breadth of braincase, 10; upper tooththrow (exclusive of incisors), 8.6.

LICHONYCTERIS THOMAS

This genus is similar in general external appearance to *Choeroniscus* but differs in cranial characters and dental formula. Upper



FIG. 29. *Lichonycteris*.

incisors widely spaced between canines; premolars short and not so narrow as usual; no lower incisors. Tail about half as long as femur, reaches to about middle of broad interfemoral membrane. Range of the genus same as for the species.

DENTITION: Incisors, $\frac{2-2}{0-0}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{2-2}{2-2}$ = 26.

Lichonycteris obscura Thomas

DUSKY LONG-TONGUED BAT

Lichonycteris obscura THOMAS, 1895, Ann. Mag. Nat. Hist., ser. 6, vol. 16, p. 56.

TYPE: B.M. No. 95.4.27.1, adult female, in spirits, collected at Managua, Nicaragua.

RANGE: From Dutch Guiana north through Costa Rica to Nicaragua.

GENERAL CHARACTERS: A small, dark-colored bat with rather short full pelage; small ears; small triangular noseleaf; and forearm hairy for about half its length.

DESCRIPTION: Color of upperparts uniform Mummy Brown, the hairs with a drab mesial ring; underparts slightly darker than back. Skull light, evenly elevated above rostrum; braincase large but narrow, rostrum moderately long and slender; palate extended well backward; upper premolars widely spaced and upper molars with W-pattern obsolete.

MEASUREMENTS: A female from San José, and a female from Montes de Oca, Fuentes: Head and body, 51 mm., 55; tail, 7, 10; ear, 10, 10; hind foot, 8, 8; forearm, 32.5, 33.5. Skull: greatest length, 18.5, 19.3; condylo-basal length, 17.2, 18.1; interorbital breadth, 3.9, 4.4; width of braincase, 8, 8.3; upper tooththrow, c-m³, 6, 6.2; lower tooththrow, 5.8, 6.5.

SPECIMENS: Prov. San José: San José, 1 A.M.N.H.; Fuentes, Montes de Oca, 1 C.N.H.M.

Lichonycteris is probably a nectar feeder as is indicated by its weak teeth and absence of lower incisors to give the long tongue free play. This bat, as do other genera of the subfamily Glossophaginae that have the flower-visiting habit, plays an important part in the fertilization of the night-blooming plants.

SUBFAMILY CAROLIINAE

COMMON SHORT-TAILED BATS

CAROLLIA GRAY

The bats of this genus are small or medium-sized specimens with rather short ears, small pointed noseleaf, tail reaching to about the middle of naked, moderately developed interfemoral membrane; forearm furred along outside near base. Skull strong with short rostrum. Upper incisors completely filling space between canines; inner incisors large; outer incisors minute, lower incisors small, notched, forming a slightly convex row between canines. Premolars rather narrow with



FIG. 30. *Carollia*.

well-developed main cusps; molars without W-pattern. Range of the genus includes warmer parts of America, north to southern Mexico, West Indies to Jamaica and south to Santa Catarina, Brazil.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{3-3}{3-3}$ = 32.

Carollia perspicillata azteca Saussure

AZTEC SHORT-TAILED BAT

Carollia azteca SAUSSURE, 1860, Rev. et Mag. Zool., ser. 2, vol. 12, p. 480.

No definite type locality was assigned in the original description, which implies that several specimens were examined from more than one locality. Hahn in his review of the

genus fixed the type locality as southern Mexico.

RANGE: Hot, humid regions of southern Mexico and Central America, from Panamá as far north as Orizaba.

GENERAL CHARACTERS: A medium-sized, dark-colored bat; no facial stripe; short, rather broad noseleaf; large feet; forearm from 42 to 45 mm. in length; maxillary tooth-row diverging posteriorly in two almost straight rows.

DESCRIPTION: General color varying from Mummy Brown to Rusty, the hairs blackish at base, followed by a wide band of soiled whitish, tipped with Mummy Brown and finely washed with Light Buff; underparts slightly paler than back. Skull long and heavy with rather broad braincase, teeth strong, lower incisors small, the inner notched and larger than outer.

MEASUREMENTS: Adult male from Santiago, and female from Jabillo de Pirris: Head and body, 65 mm.;—; tail vertebrae, 11,—; hind foot, 13,—; ear, 21,—; forearm, 43.6, 45.3. Skull: greatest length, 23.3, 24.6; zygomatic breadth, 11.7, 11.7; maxillary tooththrow, $c-m^3$, 8, 8.

SPECIMENS: Prov. San José: San Sebastian, 2 A.M.N.H.; La Uruca, 14 A.M.N.H.; Escazú, 28 A.M.N.H.; Jabillo de Pirris, 6 U.S.N.M., 6 U.S.F.W., 1 M.C.Z., 6 A.M.N.H.; San Gerónimo, 1 U.S.N.M.; Fuentes, Montes de Oca, 4 C.N.H.M.; Las Pavas, 26 A.M.N.H.; San Isidro, 1 A.M.N.H. Prov. Cartago: Santiago, 1 A.M.N.H.; Tres Rios, 1 A.M.N.H. Prov. Guanacaste: 27 de Abril, 1 M.Z.U.M.; Cerro de San Juan, 1 M.Z.U.M.; Las Huacas, 1 A.M.N.H. Prov. Puntarenas: Palmar, 7 A.M.N.H.; San Francisco Esparta, 62 A.M.N.H. Prov. Alajuela: Grecia, 1 A.M.N.H.; San Carlos, 2 A.M.N.H. Prov. Limón: Río Sixaola, 2 A.M.N.H.

A large series from San Francisco Esparta are somewhat smaller than the average and approach typical *perspicillata* in size. *Carollia* usually roosts in caves or subterranean tunnels and is most frequently found in large colonies. It is a fruit-eating bat. Its sense of smell is well developed, as a bunch of ripe bananas will soon be attacked by a large number of them if they are in the neighborhood.

Carollia castanea H. Allen

LEAST SHORT-TAILED BAT

Carollia castanea H. ALLEN, 1890, Proc. Amer. Phil. Soc., vol. 28, p. 19.

TYPE: U.S.N.M. No. 12914/36384, in alcohol, adult male, skull removed, collected about 1876, by José C. Zeledón in Costa Rica. Exact locality not known.

RANGE: British Guiana, Panamá, and north to Honduras.

GENERAL CHARACTERS: *Carollia castanea* resembles *C. p. azteca* in general characters but is distinguished by its much smaller size; the forearm 35 to 37 mm.

DESCRIPTION: General color about Prout's Brown, the hairs with a broad, light buffy band and finely washed with light buff. Underparts about the color of back. Skull small and relatively broad. The first upper molar projects considerably beyond the outer edge of the last premolar, making a definite break at a distinct angle in the line of the tooththrow.

MEASUREMENTS: Type in parentheses, and adult male from Río Sixaola, Talamanca: Forearm, (35 mm.), 36 mm. Skull: greatest length, (20), 20; basilar length, (16), 15.4; greatest breadth braincase, (9), 9; interorbital constriction, (5), 5.3; maxillary tooththrow, (6.5), 6.5.

SPECIMENS: Prov. Limón: Río Sixaola, Talamanca, 1 A.M.N.H. Prov. Puntarenas: Agua Buena, 2 A.M.N.H.

This small *Carollia* seems to be rare, while the larger species is probably one of the most abundant bats in Costa Rica.

SUBFAMILY STURNIRINAE

YELLOW-SHOULDERED BATS

The subfamily Sturnirinae includes medium-sized bats with short ears and noseleaf normal; no external tail; interfemoral membrane narrow and densely furred; hind limbs and feet haired to base of claws.

STURNIRA GRAY

Members of this genus have rather short full pelage; skull short and rounded, rostrum short and broad, braincase rounded, sagittal crest finely developed; inner upper incisors

small and barely extending above cingulum of canines; lower incisors small, forming a continuous row between canines; upper molariform tooththrows horseshoe-shaped in



FIG. 31. *Sturnira*.

males but sides more nearly parallel in females. Range of the genus includes tropical America from southern Mexico south to Paraguay.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{3-3}{3-3}$ = 32.

***Sturnira lilium parvidens* Goldman**

NORTHERN YELLOW-SHOULDERED BAT

Sturnira lilium parvidens GOLDMAN, 1917, Proc. Biol. Soc. Washington, vol. 30, p. 116.

TYPE: U.S.N.M. No. 126555 (Biol. Surv. Coll.), skin and skull, adult female, collected April 17, 1908, at Papayo (about 25 miles northeast of Acapulco), Guerrero, Mexico, by E. W. Nelson and E. A. Goldman.

RANGE: From Guerrero and Campeche in Mexico south to Panamá.

GENERAL CHARACTERS: Size medium, forearm from 40 to 44 mm. A conspicuous tuft of reddish hair near front of shoulders (epaulettes). All four lower incisors trilobate.

DESCRIPTION: Color of upperparts Pinkish Buff overlaid with Mummy Brown, the hairs dusky at base; underparts like back but without the brownish tip on hairs, epaulettes vary from Cinnamon-Buff to Ochraceous-Tawny or Mars Brown.

MEASUREMENTS: An adult male from Honduras: Head and body, 61 mm.; hind foot, 12; ear, 15; forearm, 40. Skull: greatest length, 22; zygomatic width, 13.3; inter-

orbital width, 5.9; maxillary tooththrow, 6.3; width across m^2 - m^2 , 8.1; width across canines, 6.1.

This species is a small, fruit-eating bat that does not appear to have been recorded from Costa Rica, although no doubt occurring in this country.

***Sturnira hondurensis* Goodwin**

HONDURAN YELLOW-SHOULDERED BAT

Sturnira hondurensis GOODWIN, 1940, Amer. Mus. Novitates, no. 1075, pp. 1-2.

TYPE: A.M.N.H. No. 126811, adult female, skin and skull, collected by C. F. Underwood at La Cruze Grande, near San José; elevation about 3000 feet, Department of La Paz, Honduras, March 17, 1937.

RANGE: Honduras to Costa Rica; limits of range unknown.

GENERAL CHARACTERS: Similar in general external appearance to *S. l. parvidens* but larger, and differing in cranial and dental characters.

DESCRIPTION: Upperparts between Mummy Brown and bister brown, the hairs pale Mummy Brown at base followed by a broad band of soiled light buff and tipped with Mummy Brown; shoulder patches in female pinkish buff to roots of hairs, in males Ochraceous-Tawny; underparts between pinkish buff and soiled light buff. Skull relatively narrow for this genus, braincase moderately high and rounded with a fairly well-developed sagittal crest in adults; pm^3 - 4 and m^1 in straight, slightly diverging lines; m^2 placed at an angle, directed inward and in line with m^3 , contrasting with the symmetrically curved tooththrows of *S. lilium parvidens*; lower incisors small, closely crowded with cutting edges bilobate; in *parvidens* the lower incisors are trilobate.

MEASUREMENTS: Male from Agua Buena, and the type, a female, in parentheses: Forearm, 42 mm. (45.5). Skull: greatest length to front of incisors, 22.9 (24.6); condylo-incisive length, 20.5 (22); palatal length, 9.8 (12.8); interorbital width, 6.2 (6.3); zygomatic width, 13.2 (13.2); width of braincase, 10.2 (10.5); width across m^2 - m^2 , 7.8 (8.2); upper tooththrow c - m^3 , 6.5 (7.7).

SPECIMENS: Prov. Puntarenas: Agua Buena, 1 ad. male and 1 juv. female A.M.N.H.

Two specimens from Agua Buena, Costa Rica, are smaller than any in the type series of *S. hondurensis*, but except for a difference in size there appear to be no characters separating them appreciably from typical *S. hondurensis*.

STURNIROPS GOODWIN

This genus is allied to *Sturnira*, which it resembles in general appearance, but it differs in having distinctive cranial characters. Skull relatively long and narrow, with short rostrum and toothrows as compared with the length of the skull; molars comparatively small; interorbital and postpalatal area elongated. Dental formula as in *Sturnira*. The type is the only known specimen.

Sturnirops mordax Goodwin

COSTA RICAN HAIRY-FOOTED BAT

Sturnirops mordax GOODWIN, 1938, Amer. Mus. Novitates, no. 976, p. 1.

TYPE: U.S.N.M. No. 250310 (Biol. Surv. Coll.), adult male, skin and skull, collected at El Sauce Perálta, Costa Rica, by C. F. Underwood, July 14, 1931.

RANGE: Known only from the type locality.

GENERAL CHARACTERS: A medium-sized, dark-colored bat with normal noseleaf and rather short pointed ears; no external tail; interfemoral membrane reduced to a narrow furred fringe; feet hairy.

DESCRIPTION: General color of upperparts light Mummy Brown, the hair dull brownish at base followed by a light dusky band and tipped with dark brown; underparts about like back. Skull long and narrow; rostrum short, about one-fourth the length of the skull; interorbital region elongated; lower incisors small, closely crowded between canines, cutting edge with terminal emargination.

MEASUREMENTS: Type: head and body, 60 mm.; hind foot, 16; ear, 18. Skull: greatest length, 24.6; condylobasal length, 22.5; least interorbital breadth, 5.2; maxillary toothrow, 6.2; upper molar series, 3.2.

SPECIMENS: Prov. Cartago: El Sauce Perálta, 1 (type) U.S.N.M.

Sturnirops mordax is similar in general external appearance to *Sturnira lilium* par-

videns but differs in having a relatively longer toothrow, peculiar elongation of the interorbital region, and shortening of the rostrum.

SUBFAMILY STENODERMINAE

SHORT-FACED BATS

This subfamily includes the small to moderately large bats with head more or less rounded, short broad rostrum, usually with one or two white facial stripes, narrow interfemoral membrane; noseleaf usually present, though sometimes rudimentary or absent.

URODERMA PETERS

In general external appearance, including the arrangement of the white facial stripes, *Uroderma* resembles *Vampyrops*, *Vampyroides*, and *Chiroderma*, but the single Central



FIG. 32. *Uroderma*.

American species of *Uroderma* may be recognized by the naked or finely haired posterior border of the interfemoral membrane, in combination with the length of the forearm. The skull is much like that of *Vampyrops*, but the upper incisors are bifid. Noseleaf well developed, lanceolate. Range of the genus same as for the species.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{3-3}{3-3}$ = 32.

Uroderma bilobatum Peters

YELLOW-EARED BAT

Uroderma bilobatum PETERS, 1866, Monatsber. Akad. Wiss., Berlin, p. 394.

The type in the Berlin Museum came from São Paulo, Brazil. In describing this species Peters also used two specimens from Cayenne and one in the Frankfurt Museum without exact locality.

RANGE: From São Paulo and Peru north at least as far as Costa Rica.

GENERAL CHARACTERS: A medium-sized bat with four white facial stripes, an indistinct narrow white middorsal line, and narrow interfemoral membrane.

DESCRIPTION: General color grayish brown, the hairs light drab from base and tipped with Bister; a pair of white facial stripes extend upward from sides of noseleaf to between ears, another pair from corners of mouth to base of ears. A narrow white dorsal line on lower back. Margins of ears yellowish white. Skull with short broad deep rostrum, last molars small but well developed both above and below; outer upper incisor small and barely reaching the cingulum of inner, all four teeth separate and bilobed; lower incisors small and completely filling space between canines.

MEASUREMENTS: Adult male from San Gerónimo and adult male from Jabillo: Head and body, 61 mm., 54; hind foot, 11, 11; ear, 17, 17; forearm, 43, 42.5; Skull: greatest length, 23.5, 22.5; zygomatic breadth, 13.5, 12.5; maxillary toothrow, 8, 8.

SPECIMENS: Prov. San José: San Gerónimo, 1 U.S.N.M.; Jabillo de Pirris, 1 C.N.H.M. Prov. Cartago: Perálta, 2 A.M.N.H. Prov. Guanacaste: Las Huacas, 3 M.Z.U.M.; Cerro de San Juan, 1 M.Z.U.M.

Various kinds of fruit form the staple diet of the yellow-eared bat. It roosts in trees which is characteristic of many of the white-lined species. The light lines giving the effect of light and dark shadows aid these bats in being passed unnoticed. They spend the day in small clusters, usually on the under side of a palm leaf which they have lined or in which they have cut out a series of small holes across the pleated surface, causing half the leaf to bend at an angle forming a shaded and protected retreat.

VAMPHYROPS PETERS

General external appearance similar to *Uroderma*, but interfemoral membrane very narrow and well furred. Forearm densely furred for most of its length; hind limbs and feet more or less haired to claws; noseleaf moderately long and pointed. White lines strongly developed. Dental formula as in *Uroderma*. Range of the genus includes

tropical America from Paraguay north to Mexico.



FIG. 33. *Vampyrops*.

Vampyrops helleri Peters

HELLER'S BAT

Vampyrops helleri PETERS, 1866, Monatsber. Akad. Wiss., Berlin, p. 392.

The type description was based on two specimens in the Vienna Museum collected by Heller in Mexico.

RANGE: Mexico and at least as far south as Panamá.

GENERAL CHARACTERS: A small brownish bat with prominent noseleaf, white facial markings, and a white dorsal line.

DESCRIPTION: General color about Snuff Brown; underparts paler than back; a pair of broad white stripes extending upward from noseleaf to between ears, a second pair of narrower white lines from corner of mouth to base of ear, a narrow white stripe from top of head down middle of back. Skull much like that of *Uroderma*. Upper incisors very unequal, the inner more than twice as high as outer, the crowns obliquely set, in contact at tip, the cutting edge entire. Lower incisors small, equal, forming a nearly complete straight line between canines, their cutting edge faintly bifid. The third upper and lower molars present.

MEASUREMENTS: Adult female from Jiménez, Costa Rica: Forearm, 39 mm. Skull: greatest length, 22; zygomatic width, 12.3; interorbital width, 5.7; maxillary toothrow, c-m³, 8.

SPECIMENS: Prov. Limón: Jiménez, 1 A.M.N.H.

Heller's bat is a fruit-eating species and probably a tree dweller with habits similar to those of *Uroderma*.

Vampyrops lineatus (E. Geoffroy)

GEOFFROY'S WHITE-LINED BAT

Phyllostoma lineatum E. GEOFFROY, 1810, Ann. Mus. Hist. Nat. Paris, p. 180.

This type was based on the description given by De Azara in his "Essais sur l'histoire naturelle des quadrupèdes de la province du Paraguay" (1801, vol. 2, p. 269).

RANGE: Paraguay (supposed to range north to Central America).

GENERAL CHARACTERS: Similar to *V. helleri* but size larger.

DESCRIPTION: General color about Snuff Brown, underparts paler than back, white line markings as in *V. helleri*.

MEASUREMENTS: Adult male from Sapacay, Paraguay: Head and body, 66 mm.; hind foot, 14; forearm, 45.5. Skull: greatest length, 24.7; zygomatic width, 14.9; interorbital width, 6.8; upper tooththrow, $c-m^3$, 9.

Vampyrops lineatus apparently has a wide range which is supposed to extend north to Central America, but until actual specimens from Costa Rica have been examined it cannot definitely be included in the fauna of this country.

Vampyrops vittatus (Peters)

GREATER WHITE-LINED BAT

Artibeus vittatus PETERS, 1859, Monatsber. Akad. Wiss., Berlin, p. 225.

The type, apparently a Berlin Museum specimen, was collected by von Appun at Puerto Cabello, Venezuela.

RANGE: Venezuela and north to Costa Rica.

GENERAL CHARACTERS: A large, white-lined bat about the size and general appearance of *Artibeus planirostris* but at once distinguished by the generic characters.

DESCRIPTION: General color about Mummy Brown, a narrow white middorsal line down back from crown of head, a pair of dusky light lines extend upward from noseleaf to between ear, lower facial stripes indistinct or absent; underparts paler than back. Forearm and hind limbs more or less hairy.

MEASUREMENTS: Adult from Valparaiso, Colombia: Head and body, 95 mm.; hind foot, in dried skin, 15.5; forearm, 58. Skull: greatest length, 31.8; zygomatic width, 19.6;

interorbital width, 7.7; upper tooththrow $c-m^3$, 12.7.

SPECIMENS: Costa Rica: 1 B.M.

VAMPYRODES THOMAS

This genus is very similar to the genus *Vampyrops* but has only two upper molars instead of three, and these conspicuously differ from each other in form, owing to the reduction of the metacone in the second to a mere trace. Known range of the genus includes Trinidad, Panamá, Costa Rica, Nicaragua, and Guatemala.

DENTITION: Incisors, $2-2$; canines, $1-1$; premolars, $2-2$; molars, $3-3=30$.

Vampyrodes major G. M. Allen

SAN PABLO BAT

Vampyrodes major G. M. ALLEN, 1908, Bull. Mus. Comp. Zool., vol. 52, no. 3, p. 38.

TYPE: M.C.Z. No. 6756, adult female, in alcohol, collected at San Pablo, Isthmus of Panamá, by Allen Lesley.

RANGE: Panamá north to Guatemala.

GENERAL CHARACTERS: A rather large robust bat with no external tail; narrow interfemoral membrane; hairy forearm, hind limbs, and feet; white facial and dorsal lines; noseleaf well developed, pointed.

DESCRIPTION: General color Mummy Brown, rather lighter on head and shoulders; a pair of broad white lines extending upward from noseleaf to between ears, a second pair extending from corner of mouth to base of ear. A white line extending from top of head down the middle of back. Margin of ears yellowish white. Skull rather large and massive, very similar in structure to that of *Vampyrops*. The absence of the last molar in conjunction with the suppression of the metacone in the second molar readily distinguishes *Vampyrodes* from its closest allied genera.

MEASUREMENTS: Type, and one from Vijagual, Nicaragua: Head and body, 76 mm., 73; hind foot, 14, 15; forearm, 55.5, 52.5. Skull: greatest length, 29, 27.5; interorbital breadth, 7, 7.2; zygomatic breadth, 18.5, 17.2; maxillary tooththrow, $c-m^2$, 10.5, 10.

SPECIMENS: Prov. San José: Cerro Santa Maria, 1 M.C.Z.

Vampyroides is a tree-roosting bat and has been found hanging from the under side of palm fronds. Like other members of the subfamily Stenoderminae it is a fruit-eating species.

VAMPYRESSA THOMAS

Bats of the genus *Vampyressa* are small, with white facial markings, no dorsal stripe, rather short rounded ears, no external tail, and narrow interfemoral membrane. The

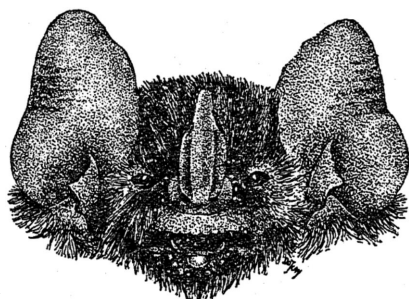


FIG. 34. *Vampyressa*.

skull in general is like that of *Vampyrops*, but there are only two upper and two lower molars, and the two middle upper incisors are distinctly bifid. Range of the genus extends from the State of São Paulo, Brazil, north to Costa Rica.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; pre-molars, $\frac{2-2}{2-2}$; molars, $\frac{2-2}{2-2}$ = 28.

Vampyressa minuta Miller

LITTLE YELLOW-EARED BAT

Vampyressa minuta MILLER, 1912, Proc. U. S. Natl. Mus., vol. 42, no. 1882, p. 25.

TYPE: U.S.N.M. No. 173832, immature female, in alcohol, collected at Cabima, Panamá, May, 1911, by August Busck.

RANGE: From the Canal Zone to Costa Rica; limit of range unknown.

GENERAL CHARACTERS: Same as for the genus. Superficially this species bears a close resemblance to small species of *Artibeus* but is smaller than any of them.

DESCRIPTION: General color Ecu-Drab, clear below, overlaid with broccoli brown above, white facial markings narrow, the lower stripe indistinct or absent; ears with a narrow yellowish margin. Skull small but

braincase large and rostrum relatively short; inner upper incisor bifid; outer incisors much smaller than inner, their cutting edge entire; lower incisors small, subequal, and completely filling space between canines.

MEASUREMENTS: Type and adult male from Agua Buena, Costa Rica: Head and body, 44 mm., 48; hind foot, 7.5, 8; forearm, 31.5, 32; ear from meatus, 12,—. Skull: condylobasal length, 16.2, 17; greatest length, 18, 18.5; zygomatic width, 10, 11; interorbital constriction, 4.4, 4.5; breadth of braincase, 8, 8.3; maxillary toothrow, 5.6, 6.

SPECIMENS: Prov. Puntarenas: Agua Buena, 2 A.M.N.H.

The little yellow-eared bat is one of the smallest species of fruit-eating bats.

CHIRODERMA PETERS

The genus *Chiroderma* resembles *Vampyrops* in general external markings, but the noseleaf is broader and the forearm and interfemoral membrane are more heavily



FIG. 35. *Chiroderma*.

haired than in that genus. Skull is similar to that of *Vampyrops*, but the dental formula is different. The most outstanding character of this genus is the apparent absence of any nasal bones; their place is occupied by an emargination extending back from the nares to between the orbits. Range of the genus includes tropical America from Mexico south to the state of Minas Geraes, Brazil.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; pre-molars, $\frac{2-2}{2-2}$; molars, $\frac{2-2}{2-2}$ = 28.

Chiroderma isthmicum Miller

ISTHMIAN BAT

Chiroderma isthmicum MILLER, 1912, Proc. U. S. Natl. Mus., vol. 42, no. 1882, p. 25.

TYPE: U.S.N.M. No. 173834, adult female, in alcohol, collected at Cabima, Panamá, May, 1911, by August Busck.

RANGE: Panamá and north to Mexico.

GENERAL CHARACTERS: A rather small brownish bat with narrow interfemoral membrane, no external tail; outer side of forearm and upper side of interfemoral membrane well haired.

DESCRIPTION: General color of upperparts Isabella Color, the individual hairs broccoli brown through basal third, then abruptly light gray tinged with Ochraceous-Buff, the extreme tips brown like base; a whitish dorsal line less conspicuous than in *C. salvini* and becoming obsolete posteriorly; underparts Ecru-Drab, finely washed with light-tipped hairs, subterminal annulation brownish. Teeth in general similar to those of *Vampyrops*, but inner upper incisors more slender and slightly less oblique.

MEASUREMENTS OF TYPE: Head and body, 65 mm.; hind foot, 10.4; forearm, 45. Skull: greatest length, 24.6; condylobasal length, 22; zygomatic breadth, 15.6; interorbital breadth, 6.2; maxillary tooththrow, 8.8.

SPECIMENS: Prov. Guanacaste: Tenorio, 1 M.C.Z.

The Isthmian *Chiroderma* is known only from about seven specimens and only one individual, a skull without skin, from Costa Rica. *C. isthmicum* may be distinguished from the following species by its smaller size, proportionately broader skull, and absence of white facial markings.

Chiroderma salvini Dobson

SALVIN'S WHITE-LINED BAT

Chiroderma salvini DOBSON, 1878, Catalogue... Chiroptera... British Museum, p. 532.

The type, in the British Museum, adult male, in alcohol, was collected in Costa Rica by O. Salvin. The exact locality is not known.

RANGE: From at least as far north as Honduras and south to Colombia.

GENERAL CHARACTERS: Similar to *C. isthmicum* but larger with well-developed white lines on face and back. Forearm measurements from 46 to 53 mm. Fur moderately long and dense.

DESCRIPTION: General color of upperparts Mummy Brown, the hairs brownish at base followed by a broad band of Pinkish Buff and tipped with Mummy Brown; underparts grayer than back, the hairs tipped with buffy white, a pair of broad white lines extend upward from base of noseleaf to between ears, a second pair from corner of mouth to base of ears, a distinct white dorsal stripe from back of neck to interfemoral membrane. Skull rather short and broad with nasal bones absent; zygomatic wide; molariform teeth heavy; inner upper incisors long and slender, the tips converge inward, the cutting edge entire; outer incisors small, barely reaching the cingulum of the canines; lower incisors small, subequal, the cutting edge indistinctly notched.

MEASUREMENTS: Two adult males from Honduras, and one from Agua Buena in parentheses: Head and body, 67 mm., 74 (77); hind foot, in dried skin, 13.5, 14 (15.5); forearm, (51.5). Skull: greatest length, 26.4, 26.6 (27); condylobasal length, 23.6, 24.4 (25); postorbital constriction, 6, 6.1 (6.3); interorbital width, 6.6, 6.6 (6.8); zygomatic width, 15.7, 16.6 (17.5); width of braincase, 11.4, 11.4 (11.4); width across m^2 - m^2 , 11.6, 11.9 (13); length of maxillary tooththrow, 9.5, 9.7 (10).

SPECIMENS: Prov. Cartago: Angostura, 1 U.S.N.M. Prov. Puntarenas: Agua Buena, 1 A.M.N.H. Costa Rica: 1 (type) B.M.

The white facial stripes are very wide and distinct in *C. salvini*, and a series from Honduras and one from Agua Buena, Costa Rica, have a pronounced dorsal stripe; the type according to Dobson has "no white line along spine." *Chiroderma* is a fruit-eating bat and is probably a tree dweller, though little is known of its habits.

ECTOPHYLLA H. ALLEN

Only the type species is known. In general external appearance *Ectophylla* resembles a small whitish *Vampyrops*. The skull is not specially modified, but in dental characters it is one of the most aberrant of the Stenoderminae. Range of the genus same as for species.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{2-2}{2-2}$ = 28.

FIG. 36. *Ectophylla*.***Ectophylla alba* H. Allen**

HONDURAN WHITE BAT

Ectophylla alba H. ALLEN, 1892, Proc. U. S. Natl. Mus., vol. 15, p. 442.

TYPE: U.S.N.M. No. 15950, skin without skull preserved in alcohol, collected on the Segovia River, Nicaragua, July 1, 1887, by C. H. Townsend. A specimen in the British Museum was collected at San Emilio, Lake Nic Nac, Nicaragua.

RANGE: Honduras, Nicaragua, limits of range unknown. Thomas places San Emilio as at the southern end of Lake Nicaragua which is on the border of Costa Rica.

GENERAL CHARACTERS: A small whitish bat, noseleaf erect, tail absent, interfemoral membrane narrow, ears moderately large and rounded, tragus moderately convex on inner margin, outer margin with two coarse serrations.

DESCRIPTION: General color of upperparts dull whitish, sides of body from shoulders to rump fawn, underparts whitish. Skull normal, upper incisors with terete-conical crowns, the inner pair larger than outer, approximating basally. Molars m^2 and m_3 basin-shaped and crossed by a distinct median longitudinal ridge.

MEASUREMENTS OF TYPE: Head and body, 36 mm.; forearm, 25; first finger metacarpal, 3, second finger metacarpal, 21, third finger metacarpal, 25, fourth finger metacarpal, 25, fifth finger metacarpal, 25; tibia, 10; foot, 8; ear, 10; tragus, 5.5.

ARTIBEUS LEACH

The genus *Artibeus* includes species varying in size from rather small to comparatively large. Normally, a pair of white facial stripes extend upward from the noseleaf to near

FIG. 37. *Artibeus*.

inner base of ears, and a shorter lateral pair from corner of mouth to base of ear; no dorsal stripe present. Ears separate and obtusely pointed; noseleaf well developed and heavy; no external tail; interfemoral membrane narrow; upper side of hind limbs, feet, and outer side of forearm on basal half thinly haired. Skull broad with a short wide rostrum, depressed in interorbital region; inner upper incisors with a distinctly bilobed cutting edge, the outer simple, hardly extending beyond base of crown of inner, the cutting edge entire, oblique. Lower incisors smaller than upper, closely crowded with slightly bilobed cutting edge. Molar teeth strong with a large crushing surface. Range of the genus includes warmer parts of America from Paraguay north to Cuba, southern Florida, and central Mexico.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{2-2}{2-2}$ or $\frac{3-3}{3-3}$ or $\frac{3-3}{3-3}$ = 28, 30, or 32.

***Artibeus planirostris planirostris* (Spix)**

FLAT-NOSED FRUIT BAT

Phyllostoma planirostre SPIX, 1823, Simiarum et vespertilionum Brasiliensium, p. 66.

TYPE: In Brazilian Museum at Munich, collected in suburbs of Bahia, Brazil.

RANGE: From central Brazil through Central America to southern Mexico.

GENERAL CHARACTERS: A large robust bat with large leathery wings and relatively short pelage. Molars, $\frac{3}{3}$. Length of forearm averages about 61.8 mm. In many instances the presence of the small m^3 is the only character by which *A. planirostris* can be safely recognized from *A. j. palmarum*.

DESCRIPTION: General color between Prout's Brown and Mummy Brown, base of

hairs Brownish Drab, underparts not much paler than back; anterior portion of upper side from shoulders forward noticeably paler, owing to the dark tips of hairs being shorter and the light basal color showing through. Supraorbital stripes from base of noseleaf to between ears Wood Brown or whitish, infraorbital stripes more or less indicated.

MEASUREMENTS: Forearm, 57.8–62.2 mm. (58.5 type); hind foot, with claws, 15–17.2. Skull: greatest length, 27–29; zygomatic width, 16.8–18.5; width of braincase, 12–13.2; maxillary tooththrow, $c-m^2$, 9.9–10.8.

Artibeus planirostris seems to be a rare bat in Central America, and so far there are no records for Costa Rica. Except that this is a fruit-eating bat, little is known of its habits.

***Artibeus jamaicensis palmarum* Allen
and Chapman**

TRINIDAD FRUIT BAT

Artibeus palmarum ALLEN AND CHAPMAN, 1897, Bull. Amer. Mus. Nat. Hist., vol. 9, p. 16.

TYPE: A.M.N.H. No. 7481/24142, adult male, in alcohol, skull removed, collected in the Botanical Gardens at Port of Spain, Trinidad, April 27, 1894, by Frank M. Chapman with the assistance of W. E. Broadway.

RANGE: Venezuela, including Trinidad and St. Vincent Islands through Central America to Vera Cruz and Jalisco, Mexico.

GENERAL CHARACTERS: Very similar in external and cranial characters to *A. planirostris* but molars $\frac{2}{3}$, the small third upper tooth being absent in *palmarum*.

DESCRIPTION: General color between Prout's Brown and Mummy Brown; hairs from base for most of their length near Wood Brown; head and shoulders distinctly lighter in color than lower back owing to the shorter dark brown tips of the hairs; underparts dull brown, the base of hairs very little lighter. A pair of white facial stripes extend from the base of noseleaf upward to between ears, and a second pair from corner of mouth to base of ear sometimes present. Tips of wings yellowish white.

MEASUREMENTS: Adult male and female from Escazú, and type in parentheses: Head and body, 91 mm., 83 (91); hind foot, in dry skin, 19, 18.5; ear from base, 20, 20 (21);

forearm, 67, 65.5 (68). Skull: greatest length, 31, 28 (31); zygomatic width, 18.3, 18.3 (19.4); width of braincase, 13.5, 12.7 (13.6); upper tooththrow, $c-m^2$, 10.7, 9.9 (10.8).

SPECIMENS: Prov. San José: San José (including Allen's type, *A. intermedius*), 15 A.M.N.H.; 3 U.S.N.M.; 3 B.M.; San Sebastian, 1 A.M.N.H.; San Pedro, 4 A.M.N.H.; 1 B.M., Escazú, 10 A.M.N.H.; Fuentes, 2 C.N.H.M.; 1 U.S.N.M. Prov. Cartago: Tres Ríos, 4 A.M.N.H. Prov. Limón: Limón, 5 (immature), A.M.N.H.

The Trinidad bat is doubtless common at lower elevations throughout Costa Rica. It is a typical fruit-eating bat and is very fond of the thin layer of pulp surrounding the fruit of palm trees. It has a habit of carrying its food to a convenient resting place to gnaw off the pulp at leisure, sometimes quite a distance, and there dropping the nut or kernel of the fruit which germinates in the ground. In this way the fruit bats serve as an important factor in the distribution of tropical fruit trees. This bat is gregarious and roosts in a variety of places. In the West Indies I have seen them clinging together in a bunch hanging from the upper branches of a tree in much the same manner as a swarm of bees. I have also found colonies of 30 to 50 individuals hanging from the roof of water cisterns, caves, and on the under side of recesses in the rocks. They leave their roosts quite early in the evening, and their flight is relatively slow and awkward, making them an easy prey for late-flying hawks and owls.

***Artibeus watsoni* Thomas**

PANAMANIAN LITTLE FRUIT BAT

Artibeus watsoni THOMAS, 1901, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 542.

TYPE: B.M. No. 0.7.11.19, male, skin and skull, collected at Bugaba, Chiriquí, Panamá, October 24, 1898, by H. J. Watson.

RANGE: From Panamá north to Guatemala.

GENERAL CHARACTERS: A small brownish bat with no external tail, white facial lines, very similar in characters to the Trinidad fruit bat but much smaller in size; forearm about 39 mm., dental formula the same, molars $\frac{2}{3}$.

DESCRIPTION: General color between Mummy Brown and Sepia, this color confined to the narrow tips of the hairs; base of hairs drab, rather lighter on head and shoulders, underparts dark gray, border of ears yellowish white, a pair of white facial lines extending from base of noseleaf to between ears and a second pair from corner of mouth to base of ear.

MEASUREMENTS: Type in parentheses: Forearm, 37.2–40.5 mm. (38); hind foot, 9.2–10. Skull: greatest length, 18.7–20.8 (19); width of braincase, 8.7–8.8; zygomatic width, 11.2–11.8 (11.7); upper toothrow, c-m², 6.5–7 (6.2).

SPECIMENS: Prov. Puntarenas: Boruca, 1 (skin only) A.M.N.H.

Artibeus watsoni is one of the smaller fruit-eating bats of Central America and is one of the few species that makes its own shelter for protection; palm leaves are cut nearly through across the pleated surface, causing the half of leaf to fold over at an angle, forming a shelter or canopy in which these bats roost during the day. It also roosts on the under side of banana leaves and similar shaded retreats.

***Artibeus toltecus toltecus* (Saussure)**

MEXICAN LITTLE FRUIT BAT

Stenoderma tolteca SAUSSURE, 1860, Rev. et Mag. Zool., ser. 2, vol. 12, p. 427.

TYPE: No more definite locality than Mexico was assigned in the original description which implies that specimens from more than one locality were examined and that an individual type was not selected.

RANGE: Central America, southern and central Mexico, as far north as Durango.

GENERAL CHARACTERS: A small, dark-colored bat with no external tail, narrow interfemoral membrane, well-developed noseleaf, moderately large ears. Very similar to *A. watsoni* but slightly larger and molars $\frac{2}{2}$, the small third lower premolar being absent in *toltecus*.

DESCRIPTION: Color Blackish Brown, the hairs white at base followed by a broad band of Drab and tipped with blackish brown; underparts very little lighter than back. White facial markings usually indistinct or absent, rarely well developed.

MEASUREMENTS: Forearm, 39.8–42 mm.; hind foot, 10–10. Skull: greatest length, 20.5–21; zygomatic width, 12.2–12.7; width of braincase, 9.8–10; maxillary toothrow, c-m², 6.8–7.2.

The habits of the Mexican little fruit bat are probably much the same as those of Panamá species. A series of 22 specimens from Honduras were all taken at an elevation of about 5000 feet.

ENCHISTHENES ANDERSEN

The type of this genus is the only species known. It is a small dark brownish bat with white facial markings, well-developed noseleaf, no external tail, narrow interfemoral membrane, allied to *Artibeus* but median upper incisors simple; m² in toothrow, as broad as the posterior margin of m²; m₃ comparatively large, about equal to one-fourth of m₂. Range of the genus same as for species.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{3-3}{3-3}$ = 32.

***Enchisthenes harti* (Thomas)**

HART'S LITTLE FRUIT BAT

Artibeus harti THOMAS, 1892, Ann. Mag. Nat. Hist., ser. 6, vol. 10, p. 409.

TYPE: A slightly immature male, in spirits, presented to the British Museum by J. H. Hart, superintendent of the Botanical Gardens, Trinidad.

RANGE: Recorded from Trinidad, Venezuela, southern Ecuador, and Honduras in Central America.

GENERAL CHARACTERS: In general much like a small *Artibeus* but upper incisors not bifid and third molar above and below well developed; forearm more or less hairy for most of its length above and below. Tragus with a pointed projection on the inner margin near tip.

DESCRIPTION: Color of upperparts dark Mummy Brown, becoming almost black on head and shoulders; underparts paler than back with darkest area on throat and chest. A pair of narrow buffy brown lines extending from base of noseleaf upward to between ears, and an indistinct pair from corner of mouth to base of ears. Skull short and broad, palate short; cutting edges of upper median

incisors simple, obtusely pointed in the center, outer upper incisors narrower and shorter than inner, lower incisors small, subequal, and filling the space between the canines.

MEASUREMENTS: An adult male from Honduras in dry skin, and type in parentheses: Head and body, 60 mm. (52); hind foot, 11.4 (9.5); ear, 11; forearm, 37.6 (38). Skull: greatest length, 20.8; basal length, (16.8); mastoid width, 10.2; width of braincase, 9.4; zygomatic width, 11.6; maxillary toothrow, $c-m^2$, 7.2 ($c-m^2$, 7).

Hart's little fruit bat is known from only three complete specimens and the skulls of 20 individuals found in owl pellets, collected by Dr. H. E. Anthony in southern Ecuador.

PYGODERMA PETERS

Members of this genus are recognizable by the excessively shortened and deepened cuboidal rostrum and short roundish palate;

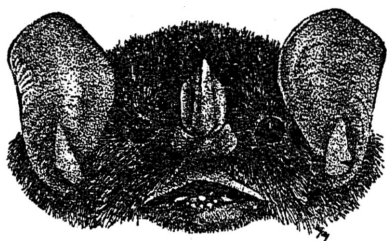


FIG. 38. *Pygoderma*.

the inner line of the toothrow forms almost a circle except where broken posteriorly. Ears moderately large, and noseleaf higher than broad. No external tail, interfemoral membrane moderately developed; lower lip with a central wart, margined by smaller warts. Range of the genus as for the following species.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{2-2}{2-2}$ = 28.

Pygoderma bilabiatum (Wagner)

IPANEMA BAT

Phyllostoma bilabiatum WAGNER, 1843, Arch. Naturgesch., vol. 1, p. 366.

The type was collected at Ipanema, São Paulo, Brazil, by Johann Natterer of the Zoologische Staatssammlung, Munich.

RANGE: From southern Brazil north to southern Mexico.

GENERAL CHARACTERS: A medium-sized bat with a short thick muzzle, fur moderately long and dense, other external characters in general essentially as in *Artibeus*. Forearm, about 38 mm.

DESCRIPTION: General color Mummy Brown, the hairs with a band of pale Buff; underparts grayish brown, a small patch of white hairs on each shoulder. Upper incisors very unequal, forming a continuous row between canines; the inner incisors large, nearly half as high as canines, conical and in contact basally, their tips wide apart; outer incisors minute, nearly flat crowned; lower incisors very small, closely crowded, subequal, their crowns deeply grooved transversely to the toothrow.

MEASUREMENTS: U.S.N.M. No. 105685, specimen from Paraguay: Head and body, 61 mm.; forearm, 28 (38, Dobson); hind foot, 11.4; ear, 17.7.

The Ipanema bat has the broad crushing surface of its molar teeth, a characteristic of the fruit-eating bats, strongly developed; its skull and jaws are especially strong and massive, and the remarkably shortened and deepened rostrum is a character not closely approached by any other known genera.

CENTURIO GRAY

Externally this genus is recognizable by the very short, broad, naked face, completely covered with wrinkled dermal outgrowths, no

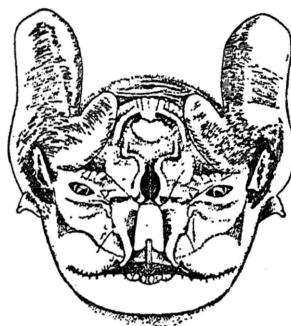


FIG. 39. *Centurio*.

true noseleaf, no external tail; interfemoral membrane moderately wide. The skull is distinguished from other short snouted bats

of the subfamily Stenoderminae by the position of the external nares which are directly over the roots of the incisors. Range of the genus same as for the following species.

DENTITION: Incisors, $\frac{2}{2}$; canines, $\frac{1}{1}$; premolars, $\frac{2}{2}$; molars, $\frac{2}{2}$ = 28.

Centurio senex Gray
WRINKLED-FACED BAT

Centurio senex GRAY, 1842, Ann. Mag. Nat. Hist., vol. 10, p. 259.

TYPE: The type is in the British Museum, an adult female, in alcohol, collected on the cruise of H.M.S. "Sulphur" under the command of E. Belcher, 1837-1838. This specimen was originally supposed to have come from "Amboyna" but it must have been collected in Mexico or Central America. Realejo, Nicaragua, seems to be the feasible place to fix the type locality.

RANGE: From Central Mexico south to Costa Rica.

DESCRIPTION: General color between Drab and broccoli brown, a white spot on shoulders; underparts paler than back. Skull with high, rounded, narrow braincase, virtually no rostrum, palate very wide and short. Upper incisors small, subequal, forming a discontinuous, nearly straight row between canines, inner teeth larger than outer, the cutting edge rising to a point at middle and slightly emarginate, outer incisors with indistinct cusp at outer edge. Lower incisors equal, low, closely crowded, their crowns transversely grooved; molars of the ordinary Stenoderminae type.

MEASUREMENTS: Twenty-four skins and skulls from Guatemala (Sanborn), and type in parentheses: Forearm, 41-43.6 mm. (52); Skull: greatest length, 17.4-18.4; condylo-basal length, 14.5-15.3; interorbital width, 4.8-5.4; zygomatic width, 14.6-15.3; width across m^2 - m^2 , 10.4-11.1.

SPECIMENS: Prov. Cartago: Cartago, 1 U.S.N.M.

Externally *Centurio* is the most specialized of the Stenoderminae fruit-eating bats; only the type species is known. Twenty-eight specimens collected by Indians in Guatemala were caught on different days, numbering two to 12 a day, indicating that they came from small colonies.

FAMILY DESMODONTIDAE
VAMPIRE BATS

The family Desmodontidae includes the true vampire bats, which subsist on the blood of animals, probably to the exclusion of other food. Teeth highly specialized for cutting, all trace of crushing surface being absent, and cheek teeth greatly reduced. Nostrils surrounded by dermal outgrowths that form a very rudimentary noseleaf; no external tail present, interfemoral membrane reduced to a narrow fringe. All the long bones of the legs and wings are deeply grooved for accommodation of muscles.

DESMODUS Wied

Characters of this genus, separating it from other vampire bats, include rather small, separate, and distinctly pointed ears;

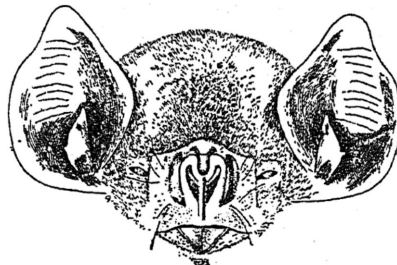


FIG. 40. *Desmodus*.

long thumb, about one-fifth as long as the third digit, its metacarpal with a short rounded pad at base and a more elongated pad under outer half. Fur short and close; forearm and limbs sparsely haired; calcar reduced to a wart-like excrescence, not connected with the interfemoral membrane. Range of the genus from central Chile and Uruguay north to Mexico.

DENTITION: Incisors, $\frac{1}{1}$; canines, $\frac{1}{1}$; premolars, $\frac{1}{1}$; molars, $\frac{1}{1}$ = 20.

Desmodus rotundus murinus Wagner
MEXICAN VAMPIRE BAT

D[esmodus] murinus WAGNER, 1840, in Schreber, Die Säugethiere, suppl. 1, p. 377.

TYPE: Description based on two specimens at the Würzburg Museum, received in a collection of Dr. Petz from Mexico, without exact locality.

RANGE: Mexico and south at least to Panamá.

GENERAL CHARACTERS: A medium-sized, dusky-colored bat with a relatively large body, long limbs, large feet, and long thumbs, virtually no interfemoral membrane, small pointed ears, moderately large hairy tragus, and no noseleaf.

DESCRIPTION: General color of upperparts dark Drab, the hairs white at base followed by a broad band of Mummy Brown, tips of hairs silvery white; underparts lighter than back, the white tips being wider. Skull with braincase large, very wide posteriorly, the rostrum reduced to a mere support of the enormous incisors and canines. Upper incisors large, almost completely filling space between canines, the two teeth with a triangular point, long and sharp. Lower incisors small, deeply bilobed, straight, in pairs, separated in middle and from canines by a wide space, canines large, long and acutely pointed, upper cheek teeth small, scarcely larger than lower incisors.

MEASUREMENTS: Adult male and female from Suiza Turrialba: Head and body, 86 mm., 80; hind foot, 19, 18.5; ear, 16, 16; forearm, 59.5, 63; thumb, 19, 20. Skull: greatest length, 25.8, 25; condylobasal length, 21.8, 21.8; interorbital width, 6, 5.3; zygomatic width, 12.7, 11.5; width of braincase, 12.2, 11.9; width across canines, 6.3, 6.4.

SPECIMENS: Prov. Cartago: Suiza Turrialba, 3 A.M.N.H.; Las Concovas, 10, in alcohol, A.M.N.H.

The vampire bat is a cave dweller. It can usually be recognized by its habit of running like a mouse along vertical walls of caves and darting in crevices to hide. With its wings folded it can walk like a four-footed animal or hop along like a toad. The bite of the vampire bat normally is almost painless and insufficient to waken a sleeping person. An incision is made with its razor sharp teeth, most frequently on the neck or withers of animals, and in the case of a sleeping person on some exposed part. The bat does not suck the blood from the wound but laps it up with its tongue as it flows. The wounds are slight, heal quickly, and usually have little ill effect. The occurrence of colonies numbering several hundred vampire bats in a vicinity where

domestic stock is little disturbed by them is an indication that the bat's main supply of blood comes from some other source. The only known sanguineous bats in the world occur in tropical America and are all in the family Desmodontidae. The term "vampire" and the legendary superstition about a blood-sucking, supernatural, bat-like creature originated in Europe long before civilized man had any knowledge of the true sanguineous bats.

DIPHYLLA SPIX

The genus *Diphylla* is externally similar to *Desmodus*, but the hind limbs are shorter and more hairy and the ears are more rounded; the thumb is short and without a pad on under side of metacarpal; a short though

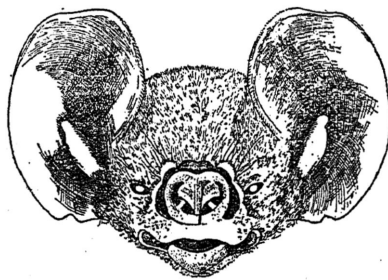


FIG. 41. *Diphylla*.

evident calcar present to which the very narrow uropatagium extends. The most distinguishing characters, however, are in the tooth formula and the fan-shaped, seven-lobed outer lower incisor. Range of the genus extends from Mexico south through Central America to São Paulo and Parana in Brazil.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{1-1}{2-2}$; molars, $\frac{2-2}{2-2}$ = 26.

Diphylla ecaudata centralis Thomas

HAIRY-LEGGED VAMPIRE BAT

Diphylla centralis THOMAS, 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 11, p. 378.

TYPE: B.M. No. 3.3.3.3., collected at Boquete, Chiriquí, Panamá, altitude 4500 feet, March 4, 1902, by H. J. Watson.

RANGE: Panamá and north through Central America to southern Mexico, replaced in South America by the typical form.

GENERAL CHARACTERS: A medium-sized bat with short rounded ears, no external tail, thick soft pelage, noseleaf rudimentary; forearms, hind limbs, and feet hairy; calcar small, interfemoral membrane narrow, thumb normal.

DESCRIPTION: General color Seal Brown, base of hairs whitish, head and shoulders lighter than back; underparts about the color of head and shoulders. Skull with braincase large, differing from that of *Desmodus* in the much higher and broader interorbital region. Inner upper incisors as in *Desmodus* but not so large. Outer incisors minute. Lower incisors much larger than in *Desmodus*, forming a continuous convex row but separated from the canines, the inner tooth about as long as high, the outer tooth decidedly longer than high. Cutting edge of inner tooth with four equal bead-like lobes, that of the outer with seven lobes. Upper cheek teeth as in *Desmodus* except for the presence of a minute m^2 ; mandible narrow and not broadened posteriorly into a wide flange as in *Desmodus*.

MEASUREMENTS: Two males from Honduras, type in parentheses: Head and body, 80 mm., 84 (87); hind foot, s.u., 15, 15; ear, 16, 18; forearm, 53, 55.4 (54). Skull: greatest length, 22.5, 23.1 (22.8); condylobasal length, 20, 20; zygomatic width, 12.5, 12.9 (12.6); width of braincase, 11, 11.8 (11.3); width across canines, 5.2, 5.2.

Characters of the fan-shaped, seven-lobed, outer incisor teeth of *Diphylla* are unique among bats, and apparently there are no teeth similar to them in any other living mammal. This is a blood-feeding bat and so far is known only from a few individuals. The wound left by the bite of the vampire is not a puncture like that made by the canine teeth of a carnivore but a shallow and clean-cut slit from which the blood will flow for a longer period.

FAMILY NATALIDAE

FUNNEL-EARED BATS

The members of the family Natalidae are small, delicately formed bats. The continental representatives of this group may be recognized by the low, somewhat funnel-shaped ears, long slender limbs, large inter-

femoral membrane, and the absence of a noseleaf. The thumb is well developed, furnished with a normal claw, and there are no adhesive disks on the thumb or foot.

NATALUS GRAY

In addition to the characters given under the family is the thread-like tail that crosses the interfemoral membrane which is naked



FIG. 42. *Natalus*.

except for a thin line of hairs along the posterior margin. Range of the genus includes warmer parts of America from Minas Geraes, Brazil, north to central Mexico, and in the West Indies to Santa Domingo.

DENTITION: Incisors, $\frac{2-2}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{3-3}{3-3}$ = 38.

Natalus mexicanus Miller

MEXICAN STRAW-COLORED BAT

Natalus mexicanus MILLER, 1902, Proc. Acad. Nat. Sci. Philadelphia, p. 399.

TYPE: U.S.N.M. No. 96496 (Biol. Surv. Coll.), adult female, in alcohol, collected at Santa Anita, Lower California, Mexico, by J. F. Abbott, July or August, 1897.

RANGE: Mexico, south to Panamá.

GENERAL CHARACTERS: A small, straw-colored, slender bat with long legs and tail, rather short pointed ears, and very thin papery flying membrane.

DESCRIPTION: Two well-defined color phases occur, a yellow and a brown. Color of light phase: upperparts uniform rich golden yellow or Cinnamon-Buff, flying membrane dark Wood Brown; underparts much paler than back. In the brown phase the fur is broccoli brown. Skull long and narrow with high globular braincase rising abruptly above level of narrow elongate rostrum, upper

incisors low and strong, subequal, the four teeth in a straight line, broken in the middle by a shallow palatal emargination; lower incisors small, trifold, the middle lobe distinctly the largest.

MEASUREMENTS: Type, female: Total length, 95 mm.; tail vertebrae, 53; forearm, 35.4; hind foot, 7.6; ear from meatus, 14. Skull: greatest length, 16; zygomatic breadth, 8; interorbital constriction, 3; maxillary toothrow, 7.

Natalus is an insect-eating bat that roosts in caves. It frequents the darkest caverns and usually in small numbers. On Anguilla, I found three individuals alone in a pitch-dark cave that was entered through a hole in the ground. They were extremely alert and it was necessary to shoot to procure the specimens.

FAMILY THYROPTERIDAE

DISK-WINGED BATS

Members of the family Thyropteridae are small, delicately formed bats with conspicuous hollow suctorial disks at the base of the thumbs and on the soles of the feet; no noseleaf; tail extending slightly beyond a broad interfemoral membrane.

THYROPTERA SPIX

Externally bats of this genus are similar to those of *Natalus* except that the legs and tail are not elongated, the soles and thumbs have adhesive disks, and the muzzle has a slight wart-like protuberance above the nostrils. Range of the genus includes tropical America from the State of São Paulo, Brazil, north to Honduras.

DENTITION: Incisors, $\frac{2}{3}$ - $\frac{2}{3}$; canines, $\frac{1}{1}$ - $\frac{1}{1}$; premolars, $\frac{3}{3}$ - $\frac{3}{3}$; molars, $\frac{3}{3}$ - $\frac{3}{3}$ = 38.

Thyroptera discifera (Lichtenstein and Peters)

HONDURAN DISK-WINGED BAT

Hyonycteris discifera LICHENSTEIN AND PETERS, 1854, Monatsber. Akad. Wiss., Berlin, p. 336.

TYPE: A Berlin Museum specimen, collected at Puerto Caballos district of Cortez, Honduras, by von Appun.

RANGE: From Honduras south to South America.

GENERAL CHARACTERS: A very small, uniformly colored, reddish brown bat with a

thin interfemoral membrane encasing a long tail; no noseleaf; feet and thumbs furnished with suctorial disks; fur long and fine, only tip of tail free.

DESCRIPTION: General color reddish brown, underparts slightly paler than back. Skull with braincase abruptly elevated anteriorly, its surface smooth and rounded; rostrum narrow, weak, and low, the upper surface nearly flat, the sides inflated; inner incisors larger than outer, both teeth well developed and both distinctly bifid, lower incisor trifid.

MEASUREMENTS: An adult female in United States National Museum, from Escondido River, Nicaragua: Total length, 66 mm.; tail, 26; forearm, 31.

Thyroptera albiventer (Tomes)

TOMES' DISK-WINGED BAT

Hyonycteris albiventer TOMES, 1856, Proc. Zool. Soc. London, p. 179.

TYPE: A British Museum specimen, collected on the Río Napo near Quito, Ecuador, by Mr. Bates, not listed by Dobson in "Catalogue of Chiroptera."

RANGE: From Ecuador north to Panamá and probably Costa Rica.

GENERAL CHARACTERS: Similar in general characters to *T. discifera* but color of back contrasting with that of belly; terminal tip of tail free, 15 per cent of its length or about 4.5 mm.

DESCRIPTION: General color of upperparts reddish brown; underparts white except for narrow stripe along the sides and chin which are reddish brown. Skull similar to that of *discifera*. Both upper incisors have a secondary cusp but that of the inner barely perceptible.

MEASUREMENTS OF TYPE: Head and body, 50.5 mm.; forearm, 38; tail vertebrae, 30.

G. M. Allen recorded two little Panamanian bats of this species caught with specimens of *Rhynchiscus* in the great, dry, curled-up leaves of the Heliconia tree, one of which escaped.

Thyroptera tricolor albigula G. M. Allen

PANAMANIAN DISK-WINGED BAT

Thyroptera tricolor albigula G. M. ALLEN, 1923, Proc. New England Zool. Club, vol. 9, p. 1.

TYPE: M.C.Z. No. 20143, adult female, in

alcohol, collected at Gutierrez, 4000 feet, in the mountains about 25 miles inland upon Chiriquito, western Panamá, August, 1923, by Emmett R. Dunn and Chester B. Duryes.

RANGE: Panamá and north in Central America to Honduras.

GENERAL CHARACTERS: Similar to *T. albiventer* but slightly smaller and white of chest extends forward to chin.

DESCRIPTION: Color of upperparts dark Cinnamon-Brown, base of hairs only slightly paler than tip; entire underparts, including chin, white except a narrow strip on side of body and a small brownish spot on each side of lower jaw. Skull essentially as in *T. albiventer* except that only the outer upper incisor has a secondary cusp, and this tooth is more distinctly bifid.

MEASUREMENTS OF TYPE: Head and body, 39 mm.; tail vertebrae, 29; free portion of tail, 7; foot, 6.5; forearm, 36.6; forearm of male and female from Esparta, respectively, 34.6, 32. Skull: greatest length, 14.6; zygomatic width, 7.5; breadth of braincase, 7.3; upper toothrow, c-m³, 6.7.

SPECIMENS: Prov. Puntarenas: Esparta, 2 C.N.H.M.

In Panamá eight of these little bats, including the type, were found inside a curled and faded banana leaf.

The remarkable round sucking disk, with a stem, beneath each wrist and a smaller one on the under side of the foot enable this bat to cling securely to the smooth, polished surface of a leaf. The suction of one disk is sufficient to support the entire weight of an individual.

The disk-winged bats are insect eaters. They are not common and not very sociable either, as rarely more than one or two individuals are found together.

FAMILY VESPERTILIONIDAE

COMMON BATS

Most of the common bats of northern latitudes are included in the family Vespertilionidae. However, the term "common" is not so appropriate in tropical America, as some species in other families are much more abundant.

Members of the family Vespertilionidae are small or medium-sized bats; muzzle without

noseleaf, tail well developed and extending to edge of a wide interfemoral membrane, ears usually separate; tragus well developed, simple; premaxillaries without palatal branches; the palate widely emarginate anteriorly.

MYOTIS KAUF

Myotis constitutes the most extensively distributed genus of any comparable group of land mammals. They are small in size, ears well developed, slender, occasionally rather



FIG. 43. *Myotis*.

large; tragus slender and nearly or quite straight. Foot variable in size but not peculiar in form. Tail about as long as outstretched leg. Interfemoral membrane large and its surface furred at base.

Bats of the genus *Myotis* have the maximum known number of teeth present in the order and are the most primitive of the Vespertilionidae. The teeth have the slightest possible degree of special modification. Range of the genus includes the entire mainland of the Eastern and Western Hemispheres to the limits of tree growth.

DENTITION: Incisors, $\frac{2}{3}$ - $\frac{2}{3}$; canines, $\frac{1}{1}$ - $\frac{1}{1}$; premolars, $\frac{3}{3}$ - $\frac{3}{3}$; molars, $\frac{3}{3}$ - $\frac{3}{3}$ = 38.

Myotis nigricans nigricans (Wied)

LITTLE BLACK BAT

[*Vespertilio*] *nigricans* WIED, 1826, Beitr. Naturgesch. Brasilien, vol. 2, p. 266.

The type was collected at Fazenda de Aga, near the Rio Iritiba, Province of Espirito Santo, eastern Brazil, about 1823, by Prince Maximilian of Wied. Its present whereabouts, if it is still in existence, is not known.

RANGE: Central and South America from Guatemala to southern Brazil and from coast to coast.

GENERAL CHARACTERS: A small bat without any unusual external specializations, no noseleaf, nostrils simple, ears well separated and rather small, tail extending to posterior border of a moderately well-developed interfemoral membrane; occurring in a dark and red color phase.

DESCRIPTION: General color of average specimens is Mars Brown or Prout's Brown, base of hairs Blackish Slate; underparts not so dark as back and often with a buffy tinge. In the red phase the color is suffused with orange, producing a brown very near to Sudan Brown or Argus Brown. Skull slender, braincase rounded and elevated above rostrum: palate deeply emarginate in front. Upper incisors well developed, subequal, closely crowded, the crowns higher than long, subterete, separated by a space from canines. Lower incisors forming a continuous row between canines, the first and second with rather narrow, trilobed cutting edge, the third much wider, subterete with three tubercles.

MEASUREMENTS: Adult male from Sipúrio: Head and body, 46.2 mm.; tail vertebrae, 37.4; foot, 6.8; forearm, 36; ear from meatus, 12.4; Skull: greatest length, 14.2; condylo-basal length, 13; interorbital constriction, 3.6; maxillary tooththrow, 5.2; breadth of braincase, 7.

The black bat *Myotis* is an insect-eating species. It is a fast and erratic flier and may be found in any dark safe retreat, such as caves and buildings, usually in the cornice or between the walls, and in hollow trees. It is gregarious and roosts in fair-sized colonies, usually the males together in one group and the females in another. Species of *Myotis* found in northern localities hibernate in caves below the frost line during the cold winter months.

SPECIMENS: Prov. Cartago: Cartago, 1 B.M. Prov. Limón: Sipúrio, 69 (alcohol) U.S.N.M.; Zent, 2 (alcohol) U.S.N.M.; 1 (alcohol) M.C.Z. Prov. Alajuela: Río Frio, 4 (alcohol) U.S.N.M.; Cataratos, San Carlos, 2 A.M.N.H.

Myotis albescens (E. Geoffroy)

PARAGUAYAN LITTLE BROWN BAT

Vespertilio albescens E. GEOFFROY, 1806, Ann. Mus. Hist. Nat. Paris, vol. 8, p. 204.

Type specimen not specified. Geoffroy's name is based on the "chauve-souris douzième" of De Azara, hence the type locality is considered to be Paraguay, perhaps near Asuncion where De Azara resided.

RANGE: Warmer parts of America from Costa Rica to Venezuela, Paraguay, and Patagonia; limits of range unknown.

GENERAL CHARACTERS: A small bat distinguishable from *M. nigricans* by its large feet, relatively short tail and tibia, globular braincase, short rostrum, and relatively weak teeth.

DESCRIPTION: Fur rather thin, of medium length, about 4 or 5 mm. at the center of back. Color: basal three-fourths of hair uniform light chocolate, nearly Rood's Brown, the tips of hairs above glistening pale buff, giving a finely peppered or frosted effect; below, the bases of hairs similar to above but the terminal portion is whitish cartridge, producing a contrasted pale ventral surface. Skull: braincase relatively large, smooth and noticeably globular, rostrum short and weak.

MEASUREMENTS: Male from Bebedero, Costa Rica: Head and body, 50 mm.; tail, 35; foot, 8.2; forearm, 36.4; ear from meatus, 13.6. Skull: greatest length, 14.4; condylo-basal length, 13.4; zygomatic width, 8.8; interorbital constriction, 3.6; breadth of braincase, 7; maxillary tooththrow, 5.2.

SPECIMENS: Prov. Guanacaste: Bebedero, 2 (alcohol) B.M.

This species may be recognized among Central and South American members of the genus by its large foot, relatively short tail, globular braincase, short rostrum, and relatively weak teeth.

EPTESICUS RAFINESQUE

Bats of this genus are medium or rather small in size with broad naked membranes, no noseleaf, nostrils simple. The general external appearance of *Eptesicus* is similar to that of *Myotis*, but the broad naked membranes combined with larger size suffice to distinguish this genus from other Costa Rican representatives of the family. Range of the genus includes Africa, Madagascar, Australia, Asia except Malay Peninsula, America from Great Slave Lake in Canada south to Rio de Janeiro and São Paulo in South America.

FIG. 44. *Eptesicus*.

DENTITION: Incisors, $\frac{2-2}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{1-1}{2-2}$; molars, $\frac{3-3}{3-3}=32$.

Eptesicus fuscus miradorensis
(H. Allen)

MIRADOR BROWN BAT

[Scotophilus] miradorensis H. ALLEN, 1866, Proc. Acad. Nat. Sci. Philadelphia, p. 287.

No type mentioned in original description. H. Allen says, "One individual, female. Museum of Smithsonian Institution. Alcohol. Mirador, Veracruz, Mexico, Doctor Sartorius." It is undoubtedly U.S.N.M. No. 5411, catalogued October 31, 1861, along with other bats that H. Allen was working on at the time. This specimen cannot be found.

RANGE: From Costa Rica north to southern Mexico.

GENERAL CHARACTERS: A rather large, nearly uniformly colored brown bat with medium-sized ears, narrower than long; tragus straight and tapering to a rounded point.

DESCRIPTION: General color about Sayal Brown, underparts slightly paler than back. Skull rather broad with flattened rostrum, sagittal crest well developed, nares and palatal emargination not especially enlarged. Both upper incisors well developed, the inner larger than the outer with a secondary cusp, the outer separated from the canine. Lower incisors subequal, trifold, and closely crowded between canines.

MEASUREMENTS: Female from San José:

Total length, 118 mm.; tail vertebrae, 49; foot, 10; forearm, 52. Skull of female from Honduras: greatest length, 21; condylobasal length, 19.5; zygomatic width, 14.2; inter-orbital constriction, 4; upper toothrow, $c-m^2$, 7.7.

SPECIMENS: Prov. San José: San José, 1 (alcohol) A.M.N.H.

The Mirador bat is strictly insectivorous and, as do most other species, drinks a great deal of water. Its habits are much the same as those of the little brown bat, *Myotis*, but apparently it does not congregate in such large colonies to roost as the latter. Northern forms of the species hibernate during the cold winter months.

***Eptesicus propinquus* (Peters)**
PETERS' BROWN BAT

Vesperus propinquus PETERS, 1872, Monatsber. Akad. Wiss., Berlin, p. 262.

TYPE: M.B. No. 2704, in the Berlin Museum, was collected at Santa Isabel, Guatemala, by J. Sivers.

RANGE: From Vera Cruz, Mexico, south to Panamá.

GENERAL CHARACTERS: A small, reddish brown bat with underparts lighter colored than back; ears small, triangular, with tips rounded; tragus constricted at base, sides parallel for two-thirds its length and attenuated to a sharp tip.

DESCRIPTION: Color of Costa Rican specimens: upperparts vary from Prout's Brown to Mummy Brown, the hair Blackish Brown from base and tipped with Prout's Brown; on underparts the hairs are Blackish Brown from base and broadly tipped with Pinkish Buff, this color varying in shade through pinkish Cinnamon-Buff to Sepia. Skull with flat rostrum and evenly elevated from back of nasal to occiput, zygomatic arches wide. Inner upper incisors well developed, with a large secondary cusp forming a distinct shallow channel down the anterior surface of the tooth; outer upper incisor very small. Lower incisor small, trifid, closely crowded and distinctly imbricated, posterior border of palate drawn out in a prominent, central, pointed process.

MEASUREMENTS: Nine specimens from Santa Teresa Perálta: Forearm, 40-42 mm.

(type, 40). Skull: greatest length, 15.8–16; condylobasal length, 15–15.4; width of braincase, 7.5–8; zygomatic width, 10.8–11; least interorbital width, 3.7–4; upper toothrow, c–m³, 5.8–6. Wing measurements of male and female: second digit metacarpal, 36.5, 38.2; third digit metacarpal, 37.4, 39, first phalanx, 15.5, 16.6, second phalanx, 12.3, 14.2; fourth digit metacarpal, 36.2, 38.9, first phalanx, 14.5, 14.8, second phalanx, 10, 10.2; fifth digit metacarpal, 35.6, 37, first phalanx, 10, 11.3.

SPECIMENS: Prov. Cartago: Santa Teresa Perálta, 9 A.M.N.H. Prov. Alajuela: Vijagual San Carlos, 1 A.M.N.H.

Peters' little brown bat is strictly insectivorous and roosts in caves, darkened attics, or in some similar secluded retreat. Colonies are apparently small and not common.

Eptesicus albigularis (Peters)
WHITE-BELLIED BROWN BAT

Vesperugo (*Marsipolaeus*) *albigularis* PETERS, 1872, Monatsber. Akad. Wiss., Berlin, p. 260.

TYPE: M.B. No. 4233, in the Berlin Museum, came from Mexico.

GENERAL CHARACTERS: A small brown bat with short rounded ears, relatively long pelage, white underparts; about the size and general proportions of *E. propinquus* but differing in color and cranial characters.

DESCRIPTION: Color of fur on upperparts dark Mummy Brown from base and tipped with light buff. Underparts pale buffy white, the hairs Blackish Brown from base for about half their length, the white wash extending well up on sides of neck behind ears, chin, and lips; face in front of eyes dark brown. Skull small with a small rounded braincase, rostrum rather narrow and not especially flattened, posterior border of palate relatively straight. Dentition similar to that of *E. propinquus* but smaller, and the inner upper incisors have a relatively smaller secondary cusp, and the first upper premolar has a more slender main shaft and conspicuous anterior and posterior cingulum cusps.

MEASUREMENTS: An adult male from Honduras, and type in parentheses: Total length, 88 mm. (105); tail vertebrae, 30 (40); hind foot, s.u., 9 (9); forearm, 40 (41.5).

Skull: greatest length to front of incisor, 15.8; condylobasal length, 14.3; least interorbital width, 3.8; zygomatic width, 10.3; width of braincase, 7.5; upper toothrow, c–m³, 5.6.

Eptesicus albigularis is included here because the specimen from Comayagua, the second on record, was discovered too late to be entered in "Mammals of Honduras."¹ Its range, however, may or may not extend to Costa Rica.

LASIURUS GRAY

This genus is well characterized by the short, deep skull, the graduated metacarpals, the furred interfemoral membrane. The only genus that it is likely to be confused with is the closely related *Dasypterus*, from which it

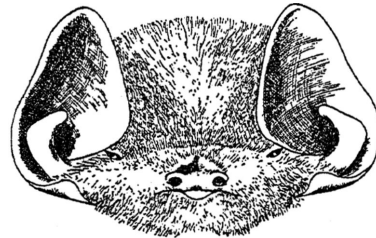


FIG. 45. *Lasiurus*.

is distinguished by the presence of the small upper premolar (pm²). Range of this genus includes North and South America to the limits of tree growth, including the Bahamas, Greater Antilles, Galápagos, and Hawaiian Islands.

DENTITION: Incisors, $\frac{1}{1}$ – $\frac{1}{1}$; canines, $\frac{1}{1}$ – $\frac{1}{1}$; premolars, $\frac{2}{2}$ – $\frac{2}{2}$; molars, $\frac{3}{3}$ – $\frac{3}{3}$ = 32.

Lasiurus borealis frantzii (Peters)

COSTA RICAN RED BAT

Atalapha frantzii PETERS, 1870, Monatsber. Akad. Wiss., Berlin, p. 908.

The type was collected in Costa Rica by von Frantzius for the Berlin Museum.

RANGE: Panamá and north to Honduras.

GENERAL CHARACTERS: A small reddish brown bat with fur covering the upper side of the hind limbs and upper side of the inter-

¹ Goodwin, G. G., 1942, Bull. Amer. Mus. Nat. Hist., vol. 79, pp. 107–195.



Mr. Cecil F. Underwood

femoral membrane and sparsely on the under side of the membrane along the forearm; ears short and rounded; tragus pointed and triangular in general outline; tail vertebrae extending full length of the broad interfemoral membrane.

DESCRIPTION: Color of upperparts bright Chestnut, the hairs blackish at base followed by a band of Light Buff and broadly tipped with Chestnut; in unworn pelage the extreme tips of hairs are lightly washed with pale buff, the hairs on interfemoral membrane dark Chestnut to base; underparts lighter colored than back, the hairs blackish from base and broadly tipped with Light Buff, with a dusky subterminal band. Skull short and broad, braincase high and rounded, rostrum very short and broad; upper incisors short, in contact with the canine, slightly triangular in outline; lower incisors small, closely imbricated, trifid; a minute upper premolar on inner side of toothrow at base of canine, nares and palatal emargination wide.

MEASUREMENTS: Adult male from San José and a spirit specimen from La Carpintera: Forearm, 39 mm., 39; second finger metacarpal, 41.5, 42; third finger metacarpal, 40.2, 41.5; fourth finger metacarpal, 38, 39.2; fifth finger metacarpal, 33.5, 35.5. Skull: condylobasal length, 11.2, zygomatic width, 8.5; width of braincase, 7.3; upper toothrow, c-m³, 4; width across m²-m³, 5.5.

SPECIMENS: Prov. San José: San José, 1 A.M.N.H. Prov. Cartago: La Carpintera, 1 (alcohol) A.M.N.H.

The Costa Rican red bat is smaller than the Mexican race: forearm, 37-39 mm., as compared with 41 mm. in the Mexican. Also the upperparts are more heavily overlaid with color and of a deeper shade than in the latter race, basal portion of the hair blacker.

In more northern latitudes, the red bat migrates spring and fall at about the same time as the swallows and certain other species of insect-eating bats. It hangs up singly in the foliage of trees or on the bark of a tree more or less in the open, never more than one being found in one place, and may easily be passed for a withered leaf. The red bat is the only species known to have more than two young in a litter; three are a frequent occurrence and occasionally four young

have been found on one female. Some of the other closely allied genera also have four mammae, and it may be that they too may have more than two young at a time.

DASYPTERUS PETERS

The genus *Dasypterus* is similar externally to *Lasiurus*, but the hind limbs and posterior part of the interfemoral membrane are naked. The skull is also similar to that of *Lasiurus*

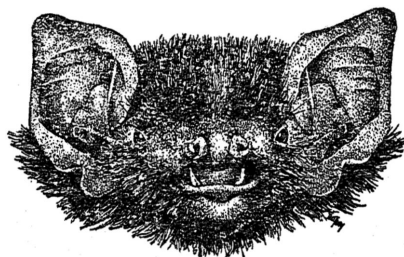


FIG. 46. *Dasypterus*.

but larger and more robust and without the small upper premolar. Range of the genus extends from Texas and Florida in the United States south to Rio Grande in southern Brazil.

DENTITION: Incisors, $\frac{1-1}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{1-1}{2-2}$; molars, $\frac{3-3}{3-3}$ = 30.

Dasypterus ega panamensis Thomas

PANAMANIAN SHORT-EARED OR YELLOW BAT

Dasypterus ega panamensis THOMAS, 1901, Ann. Mag. Nat. Hist., ser. 7, vol. 8, p. 246.

TYPE: B.M. No. 0.7.11.1, collected at Bugaba, Chiriquí, Panamá, October 8, 1898, by H. J. Watson.

RANGE: Panamá to Yucatan.

GENERAL CHARACTERS: Same as for genus.

DESCRIPTION: A medium-sized Clay Color bat with short rounded ears; tragus large, tip rounded and triangular in general outline, anterior border near tip slightly concave; tail long and supporting the gradually narrowing interfemoral membrane to a point well beyond the feet, tail haired from base for about half its length on upper side. Skull similar to that of *Lasiurus* but larger and more robust and lacking the minute upper premolar.

MEASUREMENTS: An adult male from Lajos and an adult male from San José:

Total length, 115 mm., 109; tail vertebrae, 50, 48; hind foot, 10, 9; ear, 19, 15; forearm, 44, 45.8 (type, 46.5); third finger metacarpal, 51.3, 50.1, phalanx, 16.6, 16.8, to tip, 22, 20; fourth finger metacarpal, 46.2, 46.3, first phalanx, 12.3, 12.5, to tip, 11.5, 11.5; fifth metacarpal, 40, 38.8, first phalanx, 9.2, 8.5, to tip, 7.8, 7.2. Skull: greatest length, 14.5,—; zygomatic width, 10.4,—; least interorbital width, 4.4, 5; condylobasal length, 14.2,—; width of braincase, 8.1,—; upper toothrow, $c-m^3$, 5.5, 5.5; width across canines, 5.9, 5.9; width m^3-m^3 , 6.9, 7.

SPECIMENS: Prov. San José: San José, 1 A.M.N.H. Prov. Alajuela: Lajas Villa Quesada, 1 A.M.N.H.

This bat appears to be rare in Central America. Its habits are probably much the same as those of the red bat. The only record of young appears to be that of two being found on a female in Mexico; however, since *Dasypterus* has four mammae it may have as many as four young.

RHOGEËSSA H. ALLEN

The genus *Rhogeëssa* includes vespertilionid bats of very small size, yellowish brown in color. The general external characters are similar to those of *Myotis*, but its smaller size and characteristic coloration are sufficient to distinguish it from Costa Rican representatives. The range of the genus is tropical Mexico, Central America, and probably northern South America.

DENTITION: Incisors, $\frac{1-1}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{1-1}{2-2}$; molars, $\frac{3-3}{3-3}$ = 30.

Rhogeëssa tumida H. Allen

LITTLE YELLOW BAT

Rhogeëssa tumida H. ALLEN, 1866, Proc. Acad. Nat. Sci. Philadelphia, p. 286.

TYPE: U.S.N.M. No. 84021, adult male skull, collected at Mirador, Vera Cruz, Mexico, by A. J. Grayson, catalogued March 1, 1898. The skin is said to be in alcohol but cannot be found.

RANGE: From Panamá north to southern Mexico.

GENERAL CHARACTERS: A very small slender bat with bicolored pelage, tiny feet, naked interfemoral membrane supported by a relatively long tail, ears moderately large,

tips rounded, triangular in outline, tragus rather long, point rounded and sides nearly straight; membranes from base of toes and remarkably thick.

DESCRIPTION: General color of upperparts dull yellowish brown, the hairs Pale Ochraceous-Buff from base and tipped with Prout's Brown; underparts near Cinnamon-Buff. Skull very small and slender, resembles *Eptesicus* in form, but only a single pair of upper incisors are present and outer lobe of all three lower incisors obsolete and inner lobe virtually absent in the outer incisor.

MEASUREMENTS: Three skins from Pacific coast of Costa Rica: Forearm, 28.5 mm., 28.3, 28.1. Skull of adult female from Honduras: greatest length, 12.3; zygomatic width, 8.1; upper toothrow, $c-m^3$, 4.6.

SPECIMENS: Prov. Puntarenas, Pacific coast: 3 skins containing skulls, A.M.N.H.

The habits of the little yellow bat, *Rhogeëssa*, are probably much the same as those of *Myotis* and *Eptesicus*. Goldman states that a few of these were found clinging to the rafters in a half-dark attic of an old house at San Pablo, Panamá. Underwood collected eight specimens in one day in Honduras, which would indicate that there were at least eight in one colony.

FAMILY MOLOSSIDAE

FREE-TAILED OR MASTIFF BATS

The family Molossidae includes medium- and small-sized bats with short, thick, leathery ears, broader than long, and projecting forward over the eyes; short thick muzzle, not provided with a noseleaf; tail long and projecting well beyond the posterior border of the interfemoral membrane; wing long and narrow; feet short and broad; pelage short and thick. Skull strong without post-orbital processes; premaxillaries with basal branches present or absent.

MOLOSSOPS PETERS

External characters of this genus include conspicuous lines of fur diverging from an angle in the bend of the wing along the forearm and fourth finger, occurring also in other genera. The skull has a high, broad, flattened rostrum with conspicuous, laterally projecting, lacrimal ridges, sagittal crest obsolete.

Range of the genus extends from Panamá south to Paraguay.

DENTITION: Incisors, $\frac{1-1}{1-1}$ or $\frac{1-1}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{1-1}{2-2}$; molars, $\frac{3-3}{3-3}$ = 26 or 28.

***Molossops planirostris* (Peters)**

WHITE-BELLIED MASTIFF BAT

M[olossus] planirostris PETERS, 1865, Monatsber. Akad. Wiss., Berlin, p. 575.

The type is a Berlin Museum specimen from British Guiana.

RANGE: The Guianas and Colombia north to Panamá and possibly Costa Rica in Central America.

GENERAL CHARACTERS: A small free-tailed bat with yellowish white underparts; ears separate, short and rounded; tragus small, broad, abruptly constricted at base; muzzle with a patch of stiff, short, spoon hairs below nostrils, fur of the back extending well down on base of interfemoral membrane.

DESCRIPTION: Color of upperparts Prout's Brown; underparts, chin, throat, and area down middle of abdomen to base of tail white, grading to Prout's Brown on sides of body below wings. Skull characters same as for the genus. Upper incisors strongly in contact with each other but separated from canines; middle lower incisors crowded forward from toothrow, cutting edges deeply bifid, the lobes nearly equal; outer incisors, when present, smaller than inner, bifid or faintly trifid; upper canines with a broad groove on front surface of shaft, lower canines in contact or separated by a narrow space.

MEASUREMENTS: Subadult male, in spirits, from Kartabo, British Guiana: Total length, 72.5 mm.; tail vertebrae, 23.2; hind foot, 6.5; forearm, 32. Skull: greatest length, 15.5; condylobasal length, 13.8; breadth of braincase, 8.3; interorbital constriction, 4.1; upper toothrow, c-m³, 5.5.

TADARIDA RAFINESQUE

In the members of this genus the ears are large and rounded, arising from near or at the same point on the forehead; laid forward they reach beyond the end of the muzzle; anterior border of ear conch with six or eight horny excrescences; keel well developed; tragus

small, flattened, squarely truncate above, antitragus variable, usually low and indistinct, feet and tail as usual in this family.



FIG. 47. *Tadarida*.

Range of genus extends from southern United States, through Mexico, Central America, and south to Valdivia, Chile.

DENTITION: Incisors, $\frac{1-1}{2-2}$ or $\frac{1-1}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{3-3}{3-3}$ = 30 or 32.

***Tadarida brasiliensis* (I. Geoffroy)**

GEOFFROY'S LITTLE FREE-TAILED BAT

Nyctinomus brasiliensis I. GEOFFROY, 1824, Ann. Sci. Nat., Paris, vol. 1, p. 343.

TYPE: A mounted specimen in the Paris Museum, marked Brazil, collected by M. Auguste Saint-Hilaire. Geoffroy based his description on four specimens from Curityba district of Brazil and seven from Missiones, Paraguay. Shamel fixed the type locality as Curityba.¹

RANGE: From Costa Rica south to Chile.

GENERAL CHARACTERS: A small, nearly uniform, dark-colored, free-tailed bat; ears separate; tragus quadrate above; upper lips with vertical ridges; three lower incisors; fur moderately long and dense, extending on wing membranes above and below as far as a line from middle of humerus to knee. Forearm, 42 to 46 mm.

DESCRIPTION: General color Mummy Brown, bases of hairs whitish; underparts somewhat paler than back and with less white at base of hairs. Skull with somewhat flattened braincase, rostrum broad and flat, depressed in front of occipital region, sagittal crest scarcely indicated, palate slightly arched; upper incisors simple, well developed,

¹ 1931, Proc. U. S. Natl. Mus., vol. 78, p. 4.

wide apart at base, strongly converging at tip, separated from canines. First two lower incisors equal, bifid, crowns in contact and somewhat imbricated, third lower incisors less than half the size of the others. First upper premolars (pm^2) minute and in toothrow.

MEASUREMENTS: Type, forearm, 43.8 mm. Skull of adult female from San José: greatest length, 17.2; width of braincase, 8.2; interorbital constriction, 4.2; width across m^2 - m^2 , 6.8; upper toothrow, c - m^2 , 6.2.

SPECIMENS: Prov. San José: San José, 2 A.M.N.H., 1 U.S.N.M.

Geoffroy's little free-tailed bat is an insect-eating species that roosts in crevices between the rocks or in caves and buildings. Its habits are probably much the same as those of other members of this family.

Tadarida yucatanica (Miller)

YUCATAN FREE-TAILED BAT

Nyctinomops yucatanicus MILLER, 1902, Proc. Acad. Nat. Sci. Philadelphia, p. 393.

TYPE: U.S.N.M. No. 108166 (Biol. Surv. Coll.), adult female, skin and skull, collected at Chichén-Itza, Yucatan, February 9, 1901, E. W. Nelson and E. A. Goldman.

RANGE: Yucatan and Guatemala; limits of range unknown.

GENERAL CHARACTERS: A small free-tailed bat with moderately large ears that extend well beyond tip of the muzzle when laid forward, and inner margins united about 2 mm. at base. Tragus as in *brasiliensis* but not squarely truncate, its upper posterior corner bearing a small projection. Antitragus higher than wide; lower incisors two on each side.

DESCRIPTION: General color nearly uniform Vandyke Brown, underparts tinged with Wood Brown. The fur on back does not extend onto the wing membranes as it does in other members of the American forms of the genus *Tadarida*. Skull with a relatively long narrow rostrum and rather well-developed crest.

MEASUREMENTS: Forearm, 41.8-44.6 mm.; head and body, 54-63.5; tail, 33.5-41.8; hind foot, 8-8.8. Skull (type): greatest length, 17.8; zygomatic width, 9.4; interorbital constriction, 3.6; breadth of braincase, 8.6; maxillary toothrow, c - m^2 , 6.4 (Shamel).

This species is nearest to the Brazilian

Tadarida europs, but it has a larger skull (total length, 17.6-18.2 mm. as against 16.5-17.0), a longer tibia (12.6-13.8 as against 11.2-12.0). The fur of *europs* is dark Auburn instead of Vandyke Brown as in *yucatanica*. Up to the present time there is no record for Costa Rica of a free-tailed bat of this group. It is, however, probable that either *T. europs* or *T. yucatanica* will be found here.

PROMOPS GERVAIS

The genus *Promops* is recognizable by its medium size, robust form, short rounded ears arising from the same point on the forehead, minute flattened tragus, small muzzle pad.



FIG. 48. *Promops*.

The skull has a highly domed palate and a rudimentary small upper premolar and a second lower incisor. Range of the genus extends from southern Mexico south to northern Argentina.

DENTITION: Incisors, $\frac{1-1}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$; molars, $\frac{3-3}{3-3} = 30$.

Promops centralis Thomas

DOMED-PALATE MASTIFF BAT

Promops centralis THOMAS, 1915, Ann. Mag. Nat. Hist., ser. 8, vol. 16, p. 62.

TYPE: B.M. No. 94.2.5.4, adult female, skin and skull, collected in northern Yucatan, Mexico, by G. F. Gaumer.

RANGE: Recorded from Jalisco, northern Yucatan, Mexico; Guatemala; and Honduras. Limits of range unknown.

GENERAL CHARACTERS: A medium-sized, free-tailed bat with conspicuous lines of fur diverging from the angle in the bend of the

wing along forearm and fourth finger; a small dense brush of stiff hairs below nostrils. *P. centralis* is the largest known species of the genus.

DESCRIPTION: General color varying from uniform rich Prout's Brown to glossy black, the hairs darkest at tip and white or buffy white at base. Underparts slightly paler than back. Skull short and broad, sagittal crest extending forward almost to level of lacrimal region. Upper incisors large, the shaft slender, projecting forward; lower incisors small, bifid, crowded forward in front of canines; anterior upper premolar reduced to a structureless spicule; palate highly domed.

MEASUREMENTS: Type, adult female: Forearm, 54 mm.; third finger metacarpal, 56. Skull: greatest length, from occiput to base of incisors, 20.2; condyle to front of canine, 19.3; maxillary tooththrow, 8.3; m^1 - m^2 , on outer edge, 4.5.

The geographical distribution of the genus *Promops* extends from southern Mexico south to northern Argentina and east to eastern Brazil. Five species are now recognized, four in South America. The status of the Costa Rican representation of the genus cannot be determined until specimens have been secured.

EUMOPS MILLER

Free-tailed bats of the genus *Eumops* vary from very small to large in size; the ears are large and joined at base on forehead; anti-

DENTITION: Incisors, $\frac{1-1}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{2-2}$ or $\frac{1-1}{2-2}$; molars, $\frac{3-3}{3-3}$ = 30 or 28.

Eumops abrasus milleri (Allen)

MILLER'S MASTIFF BAT

Promops milleri ALLEN, 1900, Bull. Amer. Mus. Nat. Hist., vol. 13, p. 92.

TYPE: AMNH. No. 11836/10128, female adult, skin and skull collected at Guayabamba, Peru, altitude 6000 feet, September 24, 1894, by O. T. Baton.

RANGE: Peru and from the southern border of the Amazon north to Guatemala in Central America.

GENERAL CHARACTERS: A medium-sized, dark-colored, free-tailed bat with ears connected over forehead, moderately large, extending slightly beyond nostrils when laid forward; tragus very small, proportionally smaller than in any other species of the genus; fur along margin of forearm virtually or entirely absent.

DESCRIPTION: General color very dark reddish brown, extreme base of hair buffy white; underparts only slightly paler than back. Skull relatively long, sagittal crest moderately developed, lambdoid crests well developed and projecting back beyond supra-occipital.

MEASUREMENTS: Forearm, 56-63 mm.; tibia, 16-19.5. Skull: greatest length, 23-25.1; condylobasal length, 21-23; interorbital width, 4.4-4.9; braincase, 9.8-11.6; upper



FIG. 49. *Eumops*.

tragus large, tragus small. Skull strongly built but slender, with or without sagittal crest; lambdoid crest well developed. Range of the genus extends from California and Arizona in United States south to Patagonia.

tooththrow, 9.4-10.6; across canines, 5.7-6.7; breadth across m^2 - m^3 , 9.2-10 (Sanborn).

The habits of Miller's mastiff bat are probably much the same as those of the chestnut mastiff bat. A specimen from Guatemala was

found by a woodcutter under a loose slab of bark. It differs from the following species, however, in being of slightly smaller size and in the shape of the tragus which is very small. In the skull the well-developed lambdoid crests are projected beyond the supraoccipital; in *glaucinus* the supraoccipital extends beyond the low lambdoid crest.

***Eumops glaucinus* (Wagner)**

CHESTNUT MASTIFF BAT

Dysopes glaucinus WAGNER, 1843, Arch. Naturgesch., vol. 1, p. 368.

TYPE: A Munich Museum specimen was collected at Cuyaba, Matto Grosso, Brazil, by Johann Natterer. The type description was from Natterer's notes, published by Wagner.

RANGE: Northwestern South America, West Indies, Central America, and north to southern Mexico.

GENERAL CHARACTERS: Size rather large, ears projecting forward beyond nostrils; tragus relatively well developed and square across top; glandular opening on throat; fur along forearm restricted to a narrow, inconspicuous border; premolars $\frac{2}{2}$.

DESCRIPTION: General color nearly uniform dark Cinnamon-Brown; base of hairs white, underparts duller and slightly paler than back. Skull relatively slender without sagittal crest; lambdoid crest moderately developed; the supraoccipital extends beyond the low lambdoid crest, and there are no lacrimal ridges; upper incisors long and slender, lower incisors small, subequal, bifid, and crowded in front of canines, first upper premolar small and crowded out of toothrow; basiphonoid pits well defined, nearly as broad as long.

MEASUREMENTS: Forearm, 58–61 mm.; tibia, 20.5–22. Skull: greatest length, 22.4–24.3; condylobasal length, 21.5–23.3; zygomatic breadth, 13.9–15.4; interorbital breadth, 4.8–5.2; braincase, 11.4–11.9; upper toothrow, 9.5–10.3; breadth across canines, 5.7–6.3; breadth across m^2 – m^2 , 9.6–10.2

This bat is insectivorous and, as do most other species of the family Molossidae, roosts in more or less large colonies. It has been found under the corrugated iron roofing of buildings and apparently seeks the torrid heat concentrated by the metal covering.

***Eumops bonariensis nanus* (Miller)**

DWARF MASTIFF BAT

Promops nanus MILLER, 1900, Ann. Mag. Nat. Hist., ser. 7, vol. 6, p. 470.

TYPE: B.M. No. 0.7.11.99, adult male, skin and skull, collected at Bugaba, Chiriquí, Panamá (altitude 250 meters), October 7, 1898, by H. J. Watson.

RANGE: Panamá and probably adjacent parts of Costa Rica.

GENERAL CHARACTERS: The smallest race of *Eumops* known, similar in general to *E. glaucinus* but much smaller in size, forearm about 39 mm.

DESCRIPTION: Color of upperparts dark Bister; below, brocolli brown.

MEASUREMENTS: Type, adult male: Head and body, 41 mm.; tail, 34; hind foot, 7.8; forearm, 38. Skull: greatest length, 16.4; basal length, 15; zygomatic width, 9.8; breadth of braincase, 8; maxillary toothrow c – m^2 , 6.4.

The habits of the dwarf mastiff bat are much the same as those of its larger relative. The type was "caught under the roof of a house."

MOLOSSUS GEOFFROY

Members of the genus *Molossus* are medium- or small-sized, robust, free-tailed bats with short rounded ears arising from a



FIG. 50. *Molossus*.

point on the forehead and extending barely to nostrils when laid forward; antitragus large, constricted at base; a small pad of stiff hairs below nostrils; wing membrane with a narrow border of fur along forearm. The genus *Molossus* is characterized by its short but high rounded skull with greatly de-

veloped knife-like sagittal crest, arched palate, short upper incisors, and 1-1 lower incisors. Externally the only tangible character by which it can be distinguished from *Promops* is the very minute, subterete tragus, unique in the group. Range of the genus extends from central Mexico and Cuba south to Paraguay.

DENTITION: Incisors, $\frac{1}{1}$ - $\frac{1}{1}$; canines, $\frac{1}{1}$ - $\frac{1}{1}$; premolars, $\frac{1}{2}$ - $\frac{1}{2}$; molars, $\frac{3}{3}$ - $\frac{3}{3}$ = 26.

***Molossus nigricans* Miller**

BLACK MASTIFF BAT

Molossus nigricans MILLER, 1902, Proc. Acad. Nat. Sci. Philadelphia, p. 395.

TYPE: U.S.N.M. No. 90941 (Biol. Surv. Coll.), skin and skull, collected at Acaponeta, Nayarit, Mexico, August 2, 1897, by E. W. Nelson and E. A. Goldman.

RANGE: From Tepic, Vera Cruz, and Yucatan south to Chinandega, Nicaragua, and probably Costa Rica.

GENERAL CHARACTERS: Largest of this genus found in Central America, and occurring in a red and a black color phase.

DESCRIPTION: In red phase color of upperparts uniform bright rich Russet, base of hairs whitish, underparts slightly paler than back. In dark phase glossy Blackish Brown, ears and membrane Blackish Brown. Skull large and massive, dentition normal for the genus; sagittal and lambdoidal crests very well developed, but not quite the extremes seen in the South American *Molossus rufus*.

MEASUREMENTS OF TYPE: Total length, 145 mm.; tail vertebrae, 53; hind foot, 12; forearm, 52.6. Skull: greatest length, 23.6; basal length, 19.8; interorbital constriction, 4.8; zygomatic width, 15.2; breadth of braincase, 11.4; maxillary tooththrow, c-m³, 8.8.

SPECIMENS: Prov. Puntarenas: Boruca, 1 skin A.M.N.H.

Allen labeled a large red *Molossus* from Boruca, Costa Rica, *Molossus rufus*. The forearm of this specimen measured 49 mm., and it is probably referable to *nigricans*. Unfortunately the preservation used on the skull has rendered it useless.

***Molossus sinaloae* Allen**

SINALOAN MASTIFF BAT

Molossus sinaloae ALLEN, 1906, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 236.

TYPE: A.M.N.H. No. 24524, female adult, skin and skull, collected at Escuinapa, Sinaloa, Mexico, February 15, 1904, by G. H. Batty.

RANGE: From Sinaloa, Mexico, south through Central America to western Panamá.

GENERAL CHARACTERS: Same as for the genus, size medium, forearm 45 to 47 mm.

DESCRIPTION: Color of type is Brownish Drab, base of hairs white, underparts duller and lighter colored than back. Skull strongly built, with a broad rounded braincase, short rostrum, arched palate, upper incisors short, the shafts scarcely projecting forward, lower incisors small, bifid, first lower premolars small, functional, and in the tooththrow.

MEASUREMENTS OF TYPE: Head and body, 69.5 mm.; tail, 38; hind foot, in dried skin, 12.5; forearm, 45.6. Skull: greatest length, 19.5; condylobasal length, 17.6; interorbital constriction, 4; zygomatic width, 12.2; maxillary tooththrow, 7.2.

SPECIMENS: Prov. Alajuela: La Vieja, San Carlos, 2 M.Z.U.M.

***Molossus bondae* Allen**

BONDA MASTIFF BAT

Molossus bondae ALLEN, 1904, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 228.

TYPE: A.M.N.H. No. 23661, adult female, collected at Bonda, Santa Marta, Colombia, February 10, 1900, by Herbert H. Smith.

RANGE: From northern Colombia to Honduras; limits of range unknown.

GENERAL CHARACTERS: Similar to *M. sinaloae* but size much smaller, forearm 38 to 40 mm.

DESCRIPTION: Known to occur in two color phases: one similar to *M. sinaloae* where the pelage is near Mummy Brown; the other a red phase, between rich Cinnamon-Brown and Russet, base of hairs white or buffy white; underparts lighter colored than back. Skull similar to that of *sinaloae* but much smaller in size.

MEASUREMENTS: Two male topotypes and type in parentheses: Forearm, 39.5 mm., 39.5 (39). Skull: greatest length, 17.5, 17.5 (18); condylobasal length, 15.8, 15.8 (16.3); interorbital constriction, 3.8, 3.8 (4); zygomatic width, 11.5, —(13); maxillary tooththrow, c-m³, 6.4, 6.5 (6.5).

Bats of the genus *Molossus* usually roost in large colonies. They favor metal roofings where the temperature during the day becomes excessive but they also roost in hollow trees, caves, and crevices between rocks. As are most of the free-tailed bats, they are strictly insectivorous. Their enemies include hawks and owls, and probably a number of carnivorous mammals catch them as they leave their roost.

ORDER PRIMATES

APES AND MONKEYS

Four genera of Primates are represented in Costa Rica, the capuchin or ringtailed monkey, the spider monkey, the howler, and the little titi monkey. The range of the night monkey, *Aotus*, is mainly in South America and apparently does not extend much farther north than the Canal Zone. The type of *Aotus rufipes* was said to be from San Juan del Norte, Nicaragua. This specimen was received alive in the London Zoological Gardens, and the locality is unquestionably erroneous. A specimen of *Aotus vociferans* is said to have been taken in the forest of Quindin, Costa Rica, but, according to Elliot, this record is almost certainly erroneous.

Alston (1879, p. 17) mentions examples of the little squirrel monkey *Oedipomidas geoffroyi* from Chiriquí, Panamá, which gives it a range virtually into Costa Rica. Goldman, however, states that this animal is not represented in recent collections from western Panamá and that this record is probably erroneous.

SUBORDER ANTHROPOIDEA

AMERICAN MONKEYS

FAMILY CEBIDAE

CAPUCHIN AND SPIDER MONKEYS

The family Cebidae includes the capuchin monkeys of the genus *Cebus* and the spider monkeys, *Ateles*.

CEBUS ERXLEBEN

CAPUCHIN MONKEYS

The monkeys of the genus *Cebus* are medium-sized species, readily recognized in Costa Rica by the white face, chest, and shoulders, in marked contrast to the glossy black color of the rest of the body. The tail

is long and curled under but not naked near the tip. The geographical distribution of the genus *Cebus* is imperfectly known. Paraguay seems to be the most southern district in which any South American species has been found; British Honduras is the northern limit of any Middle American species.

DENTITION: Incisors, $\frac{2}{2}$; canines, $\frac{1}{1}$; premolars, $\frac{3}{3}$; molars, $\frac{3}{3}$ = 36.

Cebus capucinus imitator Thomas

PANAMANIAN WHITE-THROATED CAPUCHIN

Cebus imitator THOMAS, 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 11, p. 376.

TYPE: B.M.No. 3.3.3.13, adult female, skin and skull, collected at Boquete, 4000 feet elevation, Chiriquí, Panamá, October 15, 1912, by H. J. Watson.

RANGE: From the Canal Zone westward and northward to Nicaragua.

GENERAL CHARACTERS: Same as for the genus.

DESCRIPTION: Color of face, forehead, sides of head including ears, throat to breast and shoulders creamy white; forearms, crown of head, neck above, tail, hind limbs, and entire upperparts of body glossy black; underparts scantily covered with buffy or blackish hairs. Skull with face foreshortened and abruptly elevated from nasals, eye sockets large and rounded, braincase elongate and well inflated; inner upper incisors broad and larger than outer, upper canines with a groove on anterior surface, inner side concave, posterior border with a sharp cutting edge; first upper premolars nearly uniform in size and shape and slightly wider than first molar; inner lower incisors narrower than outer, about the same height and virtually filling the space between the canines; first lower premolars larger than second, with a high pointed central cusp. Canines large in males, considerably smaller and shorter in females.

MEASUREMENTS: Adult male from Esparta and female from Tabarcia, type in parentheses: Total length, 835 mm., 955 (960); tail vertebrae, 450,— (510); hind foot, 135, 130 (123). Skull: greatest length,—, 94.5 (91); condylobasal length,— 69; palatal length, 31.6, 31.5; zygomatic breadth, 67.5, 62; least postorbital width, 42.6, 42.4; width

of braincase,—, 54.4; width of rostrum behind canines, 28.9, 26.1; upper molariform tooththrow, 22, 23 (22.3); width of last upper premolars, 6.3, 6.4; first upper molar, 5.7, 5.9.

SPECIMENS: Prov. San José: Tabarcia, 1 A.M.N.H.; Pozo Azul, 5 A.M.N.H. Prov. Limón: Cuábire, 4 A.M.N.H. Prov. Puntarenas: Esparta, 2 A.M.N.H.; Agua Buena, 4 A.M.N.H.; Puerto Cortez, 3 A.M.N.H. Prov. Alajuela: Vijagual San Carlos, 1 A.M.N.H.; Cataratos, San Carlos, 1 A.M.N.H.

The white-throated capuchin feeds partly on fruit but is incessantly hunting for insects. It is also fond of eggs and young birds. It favors suitable wooded localities, ranging from 1000 to 5000 feet altitude. Troops of 10 or more individuals are usually seen together.

SUBFAMILY ATELINAE SPIDER MONKEYS

The subfamily Atelinae includes rather large-sized slender monkeys of exceptional arboreal habits. Species have a very long, prehensile tail, naked on the under side near tip, used as a grasping organ, and long slender limbs, in allusion to which these animals are called spider monkeys.

ATELES E. GEOFFROY SPIDER MONKEYS

In general external appearance the spider monkeys are not very unlike the howling monkeys of the genus *Alouatta*, but forms are easily recognizable by the absence of a functional thumb on the fore feet, reducing the number of digits to four instead of five as in all other primates of the region, the fifth being usually vestigial or absent.

The genus is limited in range to the tropical forests from southern Mexico to northern Matto Grosso, Brazil, and central Bolivia in South America.

Descriptions, measurements, and characters are taken from a recent "Review of the spider monkeys" by Remington Kellogg and E. A. Goldman (1944, Proc. U. S. Natl. Mus., vol. 96, no. 3186, pp. 1-45).

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{3-3}{3-3}$ = 36.

Ateles geoffroyi frontatus (Gray) BLACK-BROWED MIRIKI OR SPIDER MONKEY

Eriodes frontatus GRAY, 1842, Ann. Mag. Nat. Hist., ser. 1, vol. 10, p. 256.

The type, a British Museum specimen, adult female with young, was shot by Captain Sir Edward Belcher on the shores of the harbor of Culebra, in the Province of Guana-caste, Costa Rica, during the voyage of the "Sulphur," 1836-1842.

RANGE: Northwestern Costa Rica and extreme western and northern Nicaragua.

GENERAL CHARACTERS: The color of upperparts except for head and shoulders in some individuals varies from Buckthorn Brown to Mars Brown, intermediate with black hairs, and belly Honey Yellow to Tawny; tail usually sharply bicolored.

DESCRIPTION: Face, forehead, top of head, and in some specimens back of neck, and shoulders black; anterior part of crown patch more or less suffused with Cinnamon-Buff, owing to light basal color of hairs, and tending to form a transverse band across forehead; side whiskers on face Light Buff to Cream-Buff; upperparts in general Buckthorn Brown to Mars Brown, sparsely or noticeably intermixed with blackish hairs (especially on midline of back in some individuals); belly Honey Yellow to Tawny, extending downward on inner surfaces of legs to ankles, and a lighter tone near Cinnamon-Buff extending downward on inner surfaces of arms to wrists; outer surfaces of arms and legs usually black (in some individuals restricted more or less to elbow and knee patches); side whiskers on face Light Buff to Cream-Buff; tail usually sharply bicolor, black or dusky above to tip and Tawny below to callosity (when otherwise, mixed light and dark hairs cover the tail above and below).

MEASUREMENTS: No external measurements available. Skull of an adult male from Peña Blanca: greatest length, 109.3 mm.; orbital breadth, 59.4; postorbital constriction, 49; width of braincase, 58.6; zygomatic breadth, 69.6; maxillary tooththrow, 28.4. Two adult females from Lavalá and Tuma, Nicaragua, respectively: greatest length, 117.3, 112; orbital width, 64.2, 60.2; postorbital constriction, 51.1, 51; width of braincase, 62.8, 59.8; zygomatic breadth, 71.4, 65; maxillary tooththrow, 29.6, 28.4.

SPECIMENS: Prov. Guanacaste: Culebra, type and 1 juv. B.M.

Ateles geoffroyi frontatus is assumed to be a recognizable subspecies, although, aside from the type in the British Museum from northwestern Costa Rica, little is definitely known of its characters or distribution. Certain specimens from Costa Rica without definite locality, and from various localities in Nicaragua, are tentatively referred to *frontatus*, although in none of these is the black on the head so restricted as in the type as figured by Gray. The color pattern in this form suggests close relationship to *geoffroyi*, which might also be expected on geographic grounds. A very young individual (U.S.N.M. No. 61208) from Costa Rica, without definite locality, closely resembles Gray's figure, just mentioned, in light coloration. A skull of an old female from Lavalá, Nicaragua (A.M.N.H. No. 28419), is one of the largest examined from anywhere in Middle America.

Ateles geoffroyi ornatus Gray

COSTA RICAN OR ORNATE SPIDER MONKEY

Ateles ornatus GRAY, 1870, Catalogue of monkeys, lemurs and fruit-eating bats in the collection of the British Museum, p. 44.

The history of the type, a British Museum specimen, is unknown. The type locality has been restricted by Kellogg and Goldman to Cuábre, Talamanca, Costa Rica.

RANGE: Eastern slope of Cordillera de Talamanca of Costa Rica; doubtless intergrading with *panamensis* on the Pacific side of the central mountain range.

GENERAL CHARACTERS: A dark golden yellowish subspecies, the upperparts in strong light having a glossy, golden yellow sheen, owing to the yellowish subterminal bands of hairs. Resembling *panamensis* of Panama and western Costa Rica but brighter, more golden yellowish in tone, the back, however, more obscured by overlying black-tipped hairs, throat lighter, under side of tail and inner side of upper arm lacking the deep "feruginous" of *panamensis*. Differs from *frontatus* of Guanacaste, northwestern Costa Rica, in having a greater extension of black area on limbs and over back of neck and shoulders, and black-tipped hairs overlying and tending to modify the golden yellowish

tones on back. Contrasting strongly in golden yellowish instead of light buffy coloration with *geoffroyi* of the coast region of southeastern Nicaragua.

DESCRIPTION: Face, top of head, forearms all around, outer sides of legs, hands, and feet black; upperparts from shoulders to hips and base of tail glossy golden yellow or Apricot Buff, varying in some specimens to Cinnamon-Rufous, more or less overlaid with blackish hairs; chest near Cinnamon-Buff, the rest of underparts and flanks becoming near Tawny or Cinnamon-Rufous, this general color extending down along inner sides of legs in some specimens nearly to ankles; throat and under side of neck near Pinkish Buff; tail black above, more or less mixed with Tawny below from base to near callosity.

MEASUREMENTS: Two adult females from San Carlos: Total length, 1160 mm., 1100; tail vertebrae, 720, 680; hind foot, 170, 163. Skull measurements of three adult males from Talamanca region, Costa Rica, respectively: greatest length, 110.2, 111.2, 113.8; orbital width, 63.3, 61.7, 62; postorbital constriction, 45.2, 45.7, 49.6; width of braincase, 61.6, 58, 61.7; zygomatic breadth, 71.5, 68.2, 71.9; maxillary tooththrow, 27.6, 30.9, 27.9.

SPECIMENS: Prov. Alajuela: Cataratos, San Carlos, 2 A.M.N.H. Prov. Limón: Cuábre, 1 A.M.N.H.; Guápiles, 1 A.M.N.H. Talamanca region: 7 skulls U.S.N.M. Prov. San José: Santa María, 3 skulls A.M.N.H.

Much confusion has existed regarding the status of this brightly colored subspecies. Specimens that apparently belong here have commonly been referred somewhat doubtfully to *A. geoffroyi* Kuhl. The description of *A. ornatus* by Gray (*op. cit.*), from an unknown locality, applies so well to specimens from eastern Costa Rica that their identity seems unmistakable. A more detailed description of the type than that published by Gray is given by Elliot ("A review of the primates," vol. 2, p. 45, June, 1913). The glossy quality as well as bright colors of the pelage suggests the propriety of the name *ornatus*. The contrast in color with plain buffy *geoffroyi* of southeastern Nicaragua is very great, but close agreement in cranial characters and other evidence indicate probable intergradation.

Ateles geoffroyi panamensis Kellogg
and Goldman

RED SPIDER MONKEY, MONO COLORADO

Ateles geoffroyi panamensis KELLOGG AND GOLDMAN, 1944, Proc. U. S. Natl. Mus., vol. 96, no. 3186, p. 40.

TYPE: U.S.N.M. No. 171489 (Biol. Surv. Coll.), adult female, skin and skull, collected at Cerro Brujo, about 15 miles southeast of Portobello, Province of Colón, Panamá, altitude 2000 feet.

RANGE: Forested regions of Panamá east of the Canal Zone (Cordillera de San Blas), and west through Chiriquí to central western Costa Rica.

GENERAL CHARACTERS: A rather large, deeply rufescent race. Very similar to *ornatus* of the Caribbean slope of Costa Rica, but reddish tone more intense, the back less obscured by overlying dusky hairs; inner side of upper arm Pinkish Cinnamon to Ferruginous. Differs from *azueroensis* of Azuero Peninsula, Panamá, in deep reddish instead of Cinnamon or Tawny general coloration.

DESCRIPTION: Upperparts of type from back of shoulders to base of tail, back of thighs, and sides of body Ferruginous, slightly obscured by black tips of hairs; outer surfaces of fore and hind limbs either black or blackish to knees and elbows; outer surfaces of limbs below knees and elbows either black or with varying admixture of black and Ferruginous hairs, the hairs banded but black at tips; underparts thinly haired, Pinkish Cinnamon on chest and along inner sides of hind limbs to ankles, becoming deep, clear Ferruginous or dark dusty reddish over abdomen; face, crown cap on head, and median streak on back of neck blackish; sides of neck covered with a mixture of Pinkish Buff, Cinnamon-Buff, and blackish hairs; chin nearly naked; throat and under side of neck thinly clothed with light Cinnamon-Drab or light brownish hairs; tail above Ferruginous heavily mixed with black on basal two-thirds, becoming clear black toward tip, below deep Ferruginous to near callosity where blackish hairs extend all around. The ground color of body in other specimens grades from dark rusty reddish to Ferruginous or Burnt Sienna, and a narrow

Ferruginous or Cinnamon-Buff streak usually extends along inner side of upper arm from armpit to elbow.

MEASUREMENTS: Type: Total length, 1280 mm.; tail vertebrae, 840; hind foot, 194. An adult male and female from Cerro Azul, respectively: total length, 1280, 1225; tail vertebrae, 786, 785; hind foot, 183, 176. Skull (type): greatest length, 112.8; orbital width, 62; postorbital constriction, 52.4; width of braincase, 61.2; zygomatic breadth, 68; maxillary toothrow, 27.3. An adult male and female from Cerro Azul, respectively: greatest length, 114.2, 109.1; orbital width, 62.7, 59.4; postorbital constriction, 53, 50.3; width of braincase, 63.2, 61.4; zygomatic width, 70.2, 69.6; maxillary toothrow, 31, 28.1.

SPECIMENS: Prov. Puntarenas: Agua Buena, 3 A.M.N.H.; El Pozo, 1 skin A.M.N.H. Prov. San José: Pozo Azul, 3 C.N.H.M., 4 skins and skulls and 5 extra skulls A.M.N.H.

This is the monkey commonly known as "mono colorado" in Panamá and western Costa Rica. It is the most intensely red of all the races of Middle America, but despite this it has been generally confused with the light buffy form, *geoffroyi*, of Nicaragua. While the ground color of most of the body appears to be Ferruginous to Burnt Sienna in ordinary light, in strong light and particularly in direct sunlight individual hairs on the upperparts are seen to have glossy subterminal bands, giving that part of the pelage a golden yellowish sheen, a peculiarity still more pronounced in *ornatus* and not shared with the more northern races. The specimens from Chiriquí and as far west as central western Costa Rica agree closely in color with those from the Canal Zone in the vicinity of the type locality. In one specimen of a series of six skins from Pozo Azul, Costa Rica, a white patch on the forehead is nearly concealed in front by longer black-tipped hairs, and the cheeks are dull whitish or pale buffy.

The spider monkey as an arboreal animal represents the highest development of the primates in the New World. Its tail is unsurpassed in its flexibility; the tip is sensitive and can grasp firmly, serving the purpose of a fifth hand. Another feature of the spider monkey is the absence of the thumb, existing

at best in only a rudimentary condition in a few individuals, and this probably is a great advantage to the animal as it travels through the forest.

The red spider monkeys are mainly frugivorous in diet. It is estimated that about 90 per cent of their food consists of fruits and nuts. "Bogamani" or wild nutmeg forms an important part of their diet. "Berba" and "berbacilla" (bean-like nuts and wild figs) are also eaten. They consume small quantities of buds and flowers and probably a few larvae and insects, but these constitute an insignificant part of their daily food. Spider monkeys begin feeding shortly after dawn. The most active period of feeding occurs between daybreak and about 10 o'clock in the morning. The middle of the day is a period of comparative rest. Feeding in the afternoon is less active and may continue until dark. Normally spider monkeys travel along the upper surface of limbs, and the tail is carried arched over the back. It is when crossing from one limb to another that the tail is brought into action. When jumping they spread all of their appendages. They frequently make long jumps outward and downward, covering at times more than 30 feet, or they may release their hold and drop straight downward for 20 feet or more to lower limbs or tree tops. The average speed of locomotion is about 4 miles an hour. Groups of spider monkeys are more or less semi-nomadic, each group inhabiting an area of the forest centering around food supplies and lodge trees. Their territory, though fairly definite, may overlap that of other groups. Spider monkeys are usually found in groups of two or three individuals, or small groups consist of one or more males and several females with their young. These small groups, however, are subdivisions of a main group that contains as many as 40 individuals.

Spider monkeys in the natural state have no distinct breeding season. For about a month after birth the young is carried on the belly of its parents, and after this interval it rides on the mother's back in the sacral and lumbar region. When the parent is in motion, the tail of the infant is coiled around that of the mother close to the base. The young

spider monkeys are dependent on their mothers until they are about 10 months old. Spider monkeys utter a terrier-like bark when approached in the wild state. Growls are given by the adult males when they are greatly aroused. The most frequently heard vocalization resembles the whinnying of a horse, with a higher pitch and less volume. This occurs when they are separated (Carpenter). When approached, spider monkeys will frequently break off and drop dead limbs of trees, attempting to let them fall on the observer. The branches sometimes weigh as much as 8 or 10 pounds.

FAMILY ALOUATTIDAE

HOWLING MONKEYS

This family has but one genus and includes the largest monkeys found in the New World. They are remarkable for the extraordinary inflation of the laryngeal apparatus and the protective vertical expansion of the angle of the lower jaw. These structural peculiarities are the means to produce the great volume of sound for which these monkeys are noted and from which the name howling monkey is derived.

ALOUATTA LACÉPÈDE

HOWLING MONKEYS

The howling monkeys are thick-set, heavy-bodied creatures. The tail is long, prehensile, partially naked, and, while used almost constantly for grasping, it does not equal the extreme usefulness of the tail of the spider monkey. The thumb of the howling monkey is well developed but is not opposable to the other digits. The face is naked, and a hairy beard hangs from the chin in adult males.

The distribution of the species of the *palliata* group as a whole extends from the southern part of Vera Cruz in Mexico to Ecuador in South America. Other branches of the genus extend to Paraguay and eastern Brazil.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{3-3}{3-3}$ = 36.

Alouatta palliata palliata (Gray)

NICARAGUAN MANTLED HOWLER

Mycetes palliatus GRAY, 1848, Proc. Zool. Soc. London, p. 138.

The type specimen was sent to the British Museum by Sallé and supposedly came from Carácas, Venezuela. Sallé later stated to Sclater that he had procured the specimen on the shores of Lake Nicaragua.

RANGE: From northwestern Panamá north through Costa Rica, Nicaragua, and Honduras.

GENERAL CHARACTERS: A large robust monkey with a rather long prehensile tail; face black, naked; general color black with long golden flank hairs.

DESCRIPTION: The color of this howler is Blackish Brown, with head, shoulders, and limbs almost black; long golden (Cinnamon-Rufous) flank hairs extend from groin to armpit, most pronounced posteriorly; the bases of these hairs are buffy, and there is a band of dark walnut just above the base. In the lower dorsal region the light-colored hairs mingle gradually with black on back. The color is variable, and most specimens from coast swamp country, near Cuábre, are nearly uniform coal black. An adult male from Santa Teresa Perálta is identically the same color as Allen's type of *A. p. matagalpae*. Skull short, broad, and massive. The zygomatic arches are short and squarely spreading; the brow ridges, temporal ridges, and ridge along the occipital suture prominent. Braincase short and broad. Males have a greatly enlarged angle of the mandible to protect the inflated hyoid bones. Canine and molar teeth large and strong, upper incisors nearly uniform in size and projecting forward, lower incisors small, the outer larger than inner.

MEASUREMENTS: An adult male and female from Santa Teresa Perálta: Total length, 1170 mm., 1125; tail vertebrae, 630, 700; hind foot, 155, 140; ear, 32, 33. Skull: greatest length, 120.8; 103.6; condylobasal length, 106.1, 89.2; palatal length, 46, 38.4; zygomatic width, 86, 72.7; mastoid width, 57.5, 50; width of braincase, 52.5, 49.5; upper toothrow, c-m³, 42, 40.5.

SPECIMENS: Prov. Limón: Cauita, 4 A.M. N.H.; Cuábre, 3 A.M.N.H. Prov. Cartago: Santa Teresa Perálta, 3 A.M.N.H.; Guayábo, 2 C.N.H.M.

Alouatta palliata aequatorialis Festa

FESTA'S MANTLED HOWLER

Alouatta aequatorialis FESTA, 1903, Boll. Mus. Zool. Anat. Comp. Univ. Torino, vol. 18, no. 11, p. 3.

Described from four cotypes, two adult males, one female, and one young (skins, Nos. 101, 102, 103, 104; skulls, Nos. 4688, 4886, 4692, 4693, Mus. Zool. Anat. Comp. Univ. Torino), from Vinces, Ecuador. Collected in September, sometime between 1895 and 1898, by Enrico Festa.

RANGE: From southwestern Costa Rica, east through Panamá and down along the Pacific coast of South America to the Bay of Guayaquil, Ecuador.

GENERAL CHARACTERS: Similar to typical *palliata*, but the long flank hairs are golden ochraceous instead of Cinnamon-Rufous, and the bases of the hairs are slightly paler.

DESCRIPTION: General color black to dark Mummy Brown with the mantle hairs ochraceous; the back is evenly sprinkled with a varying number of light-tipped hairs, and there is often a slight scattering light tip on the hairs of the tail. There is a wide range of individual color variation in this subspecies. The brightest colored specimens have the head, shoulders, and arms dark Mummy Brown with the bases of hairs walnut. The flank hairs are golden ochraceous which extend forward to the axillary region; the rump, tail, and lower parts of hind legs are a paler shade of Mummy Brown than is the anterior part of the body. From this extreme there are all degrees of color to almost pure black.

A series of 10 specimens from Puerto Cortez on the Pacific side of the cordillera, near Palmar, are referable to *aequatorialis*, thus extending the known range of this subspecies from Boquerón in Panamá across the border into Costa Rica. These have the flank hairs bright golden ochraceous, very different from the darker Rufous shades in the specimens from the Caribbean coast region.

MEASUREMENTS: An adult male and female from Puerto Cortez: Total length, 1155, 1074 mm.; tail in dry skin, 600, 550; hind foot, 150, 134; ear, 35, 30. Skull: greatest

length, 112, 102.5; condylobasal length, 100, 87.5; palatal length, 41.5, 37.2; zygomatic width, 82.5, 68.5; mastoid width, 53, 48; width of braincase, 51.8, 47; upper toothrow, c-m³, 42.5, 39.

SPECIMENS: Prov. Puntarenas: Puerto Cortez, 10 A.M.N.H.

The male howlers may be readily distinguished from the females by their somewhat larger size and by their longer mantles and beards. They are strictly arboreal and are awkward on the ground but can swim if necessary. Howlers prefer dense, tall forest trees for their habitat and apparently avoid scrub growth. They feed on the terminal twigs of trees and as a rule pull in the branches containing the food and eat directly from them. In food preference they are herbivorous and frugivorous, but primarily the former. They are gregarious in their habits, and groups number from four or five to 20 or more. They occupy a definite and limited territory which may also be shared by other clans, but they usually avoid each other. Groups travel at the average rate of 100 yards per hour and seldom more than 800 yards a day. Usually the males take the lead, and females carrying their young travel in the rear. The most active feeding period is in the mid-part of the forenoon and in the middle of the afternoon with a rest period at midday between eleven and two.

Howlers reproduce throughout the year. The females carry the newborn infants on the under side of their bodies, but later the babies climb onto the lower part of the back of the mother to ride. Partial weaning of the young occurs prior to the birth of a sibling and during late pregnancy of the mother. It is the general assumption that ocelots and other large cats are enemies of the monkeys. Ocelots occasionally do attack and kill young howlers, but it is doubtful if the other cats should be classed as enemies.

The intelligence of the howling monkey is of a very low order for the primates. Their movements are slow when compared with those of *Ateles* and *Cebus* and their tempers sullen. They are virtually untamable and soon die when held in captivity. The voice of the male howling monkey has a deep, far-reaching sound, consisting of a series of deep

growls, becoming a prolonged roar when given by several in unison that reverberates through the forest. The cries are usually uttered soon after daybreak and just before dark in the evening. There are several different patterns of vocal behavior which vary greatly. The barking or roaring utterance of the males is a means of defense and group control—the males being dominant in the clan.

FAMILY SAIMIRIDAE

TITI MONKEYS

This family is represented by the single genus, *Saimiri*, which includes small, brilliantly colored, squirrel-like monkeys with a long non-prehensile tail, tufted at tip, very short thumb, moderately large eyes and ears.

SAIMIRI VOIGT

TITI OR SQUIRREL MONKEYS

The members of the genus *Saimiri* are small in size with rather short pelage, nearly uniform in length. Head rounded and without a median frontal crest. These squirrel-like monkeys have a range that extends from western Costa Rica through Panamá and south in South America to Bolivia and Peru.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{3-3}{3-3}$ = 36

Saimiri örstedii örstedii (Reinhardt)

OERSTED'S TITI OR SQUIRREL MONKEY

Chrysotrrix örstedii REINHARDT, 1872, Vidensk. Middel. Nat. For. Kjöbenhavn, p. 157.

This species was described from an example originally obtained in Chiriquí, Panamá, and taken alive to Cartago, Costa Rica. Reinhardt named it after the Danish traveler Oersted who took this specimen back in 1849 after his visit to Central America.

RANGE: Panamá and southwestern Costa Rica.

GENERAL CHARACTERS: The titi monkey is externally recognizable by its squirrel-like appearance, together with its white face, sides of neck, and throat which contrast strongly with the black crown. Its tail is long and well haired.

DESCRIPTION: Color of hair on face, sides

of head, including ear and throat, white; top of head and nape black, the black extending forward to a point between the eyes; face flesh colored with a black patch around mouth; shoulders and outer sides of arms to elbows and legs to ankles grayish with a strong suffusion of orange; back bright Ochraceous-Tawny, tail from base for half or two-thirds its length mixed buffy and black, rather darker than shoulders; end of tail black, underparts yellowish white. Specimens from Palmar are a darker orange with the tips of the hairs uniformly darker than typical Chiriquí specimens, and there is no individual, sexual, or age variation in the color of the series. Skull elongate, braincase large, smoothly arched, prolonged posteriorly; facial portion small; middle upper incisors larger than outer; outer lower incisors slightly wider than inner and with a notch on outer side, forming a secondary cusp in unworn dentition. Canines large and pointed in males.

MEASUREMENTS: Adult male and female from Palmar: Total length, 695 mm., 612; tail vertebrae, 390, 350; hind foot, 89, 80; ear, 25, 25. Skull: greatest length, 62, 60; condylobasal length, 42.5, 40.5; palatal length, 17, 16.6; zygomatic width, 42, 36.2; least postorbital width, 28.9, 29.5; width of braincase, 33, 35.5; upper tooththrow, c-m³, 15.7, 15.

SPECIMENS: Prov. Puntarenas: Palmar, 15 A.M.N.H.; Coto, 3 M.Z.U.M.

Saimiri orstedii citrinellus Thomas
COSTA RICAN TITI MONKEY

Saimiri oerstedii citrinellus THOMAS, 1904, Ann. Mag. Nat. Hist., ser. 7, vol. 13, p. 250.

TYPE: B.M. No. 4.2.7.2, adult male, skin and skull, collected at Pozo Azul, Pirris, Costa Rica, May 31, 1902, by C. F. Underwood.

RANGE: Known only in the vicinity of Pozo Azul.

GENERAL CHARACTERS: Similar to the typical form of *S. orstedii* but head less blackened, limbs less yellowish.

DESCRIPTION: Color pattern as in *orstedii*; back, hands, and feet a similar vivid Ochraceous-Orange or slightly paler; arms, shoulders, legs, and proximal two-thirds of tail

grizzled or grayish with very little yellowish suffusion, crown of head either altogether gray like the shoulders or with tips of hairs blackish but not deeply black as in typical *S. orstedii*. Skull indistinguishable from typical form.

MEASUREMENTS: A male and female from Pozo Azul, and type in parentheses: Total length, 687 mm., 647 (765); tail vertebrae, 392, 380 (415); hind foot, 93, 84 (90). Skull: greatest length, 62.7, 59.3 (65); condylobasal length, 44.3, 40.5; length of palate, 17.5, 15.5; zygomatic width, 43.6, 37.3; width of braincase, 35.5, 35 (36); least postorbital width, 30.5, 30.5; length of upper tooththrow, c-m³, 16, 15.7.

SPECIMENS: Prov. San José: Pozo Azul, 4 A.M.N.H., 6 B.M.

The subspecies of *S. o. citrinellus* has been placed as a synonym of *S. orstedii* by some authors, and it may be a local variation of the typical form. However, four specimens from Pozo Azul in the American Museum correspond closely with the type series and are readily separable from the Palmar series by the characters given by Thomas. The squirrel-like or titi monkey is more or less local in distribution and frequents scrubby forests in suitable places in the foothills along the Pacific coast of Costa Rica. It is a sociable, curious little creature that will follow a traveler about in the underbrush. It is diurnal and arboreal in its habits but prefers low scrubby woodland growth to dense tall forest trees. Its food probably consists of insects, fruit, bird eggs, and young birds.

ORDER EDENTATA

EDENTATES

SUBORDER XENARTHRA

FAMILY DASYPODIDAE

ARMADILLOS

The armadillos are readily distinguished from all other American mammals by the bony carapace, or protective shell armor, covering the exposed parts of the body. The armadillos, as well as the sloths, another member of the order Edentata, are by no means toothless, as the appellation of the order to which they belong indicates.

SUBFAMILY CABASSOUINAE

CABASSOUS McMURTRIE

FIVE-TOED OR NAKED-TAILED ARMADILLOS

Armadillos of the genus *Cabassous* have five toes on the fore feet, head broad, ears widely separated, snout short and broad, tail shorter than the body and without heavy armored protective covering; claws on fore feet very large, and the middle claw especially large and sickle-like. The range of this genus extends from Honduras south to Paraguay.

DENTITION: $\frac{9}{8}$. All but the last one or two molars replace deciduous milk teeth.

Cabassous centralis (Miller)

CENTRAL AMERICAN FIVE-TOED OR NAKED-TAILED ARMADILLO

Tatoua (Ziphila) centralis MILLER, 1899, Proc. Biol. Soc. Washington, vol. 13, p. 4.

TYPE: U.S.N.M. No. 19464/35382, skin and skull, adult female, collected at Chamelicon, Honduras, January 8, 1891, by Erich Wiltkugel.

RANGE: Honduras to Panamá.

GENERAL CHARACTERS: A medium-sized armadillo with five toes on fore and hind feet, claws on fore feet exceptionally large, tail short and dotted with small, well-separated scales, 10 or 12 moveable transverse bands across middle of back.

DESCRIPTION: Color of upperparts, including top of head, brownish black; edges of carapace and underparts yellowish. The dark color of back extends down upper side of fore and hind limbs to claws and along tail almost to tip. Tip of tail yellowish. Skull short and broad, with a short, stout, and rapidly tapering rostrum; the jugal is broadest posteriorly, the outer surface flat; the upper tooththrow extends posteriorly well beyond the anterior place of the orbital fossa; the coronoid process of the mandible is short and exceeded in height by the condyle; teeth are small, peg-like, and in a line along each side of the jaws, but none in front.

MEASUREMENTS: Adult female (dried skin) from Suerre: Total length, 406 mm.; tail, 106; hind foot, 62.5. Skull (type female in parentheses): greatest length, 78 (80); zygomatic width, 38.5 (41); interorbital constriction, 24 (24); length of nasal, 27 (27); upper tooththrow, 28.9 (28.4). The measurements of

the upper tooththrow and mandible appear to have been transposed in Miller's original description.

SPECIMENS: Prov. Limón: Suerre, 1 A.M. N.H.

In Costa Rica the five-toed armadillo is known as "armado de zopilots" owing to its disagreeable odor. It is nocturnal in its habits and frequents open upland plateau regions where it makes its den in a burrow underground. The large claws on the fore feet are adapted for digging, and its food consists of a variety of insects, including larvae, worms, beetles, and ants, and it probably eats lizards and other small animal life. It has a small mouth and a long pointed tongue capable of being extended. Its limbs are short, and it walks on the tips of the claws of the fore feet while the soles of the hind feet are placed flat on the ground. It can run with considerable swiftness for a short distance but when frightened or attacked it burrows in the ground with surprising rapidity or rolls its body into a ball, presenting only the protected bony armor on the outside.

SUBFAMILY DASYPODINAE

DASYPUS LINNAEUS

FOUR-TOED OR NINE-BANDED ARMADILLOS

Armadillos of the genus *Dasypus* have only four toes on the fore feet. The head is narrow, the ears are close together, and the snout is long and slender. The tail is about as long as the head and body, definably ringed basally, and armored throughout its length. The range of the nine-banded armadillos extends from Texas in the United States through Middle America and south in South America to Argentina.

DENTITION: $\frac{8}{8}$ or $\frac{7}{9}$. All but the last one or two molars replace deciduous milk teeth.

Dasypus novemcinctus fenestratus

Peters

COSTA RICAN FOUR-TOED OR NINE-BANDED ARMADILLO

Dasypus fenestratus PETERS, 1864, Monatsber. Akad. Wiss., Berlin, p. 180.

Peters based this species on an old individual and a young specimen from Costa Rica, in the Berlin Museum, sent to him by Hoffmann and von Frantzius.

RANGE: Panamá and Costa Rica.

GENERAL CHARACTERS: A moderately large armadillo with nine movable transverse bands across the middle of the shell or back; head narrow; ears close together; tail long, tapered to a point and armored; four toes on fore feet and five on hind feet.

DESCRIPTION: Color of shell-like armor brownish black; underparts and edges of bands along sides of body yellowish white. Skull narrow with a long slender rostrum; jugal broadest anteriorly, the outer surface deeply furrowed; frontal outline depressed, the upper tooth series implanted well in front of the orbital fossae; the coronoid process of the mandible is long and slender and rises high over the condyle. Externally *D. n. fenestratus* is indistinguishable from typical *D. novemcinctus* from South America and *D. n. mexicanus*. In cranial characters the Costa Rican race differs from the Mexican in having a relatively longer and narrower rostrum, broader and shorter zygoma; the jugal and squamosal meet at or behind the highest point of the posterior process on the upper border of the zygoma, and the junction is wide. In *D. n. mexicanus* the junction is relatively narrow in front of the highest point. From typical *D. novemcinctus* it differs in the shortening of the palatines between the last molars and the laterally swollen condition of the maxillae in front of the lacrimals.

MEASUREMENTS: An adult male from San Carlos and a female from San Gerónimo de Pirris: Total length, 830, 704 mm.; tail vertebrae, 410, 308; hind foot, 98, 83; ear, 40, 37. Skull: greatest length, 99.8, 93.8; palatal length, 64, 63.5; zygomatic width, 42.5, 39; least interorbital width, 22.8,—; upper tooth-row, 21.5, 23.3; lower tooth-row, 24.5, 23; last upper molar to end of palate, 20.5, 19.3.

SPECIMENS: Prov. San José: San Gerónimo de Pirris, 1 U.S.N.M.; 1 U.S.F.W. Prov. Alajuela: Cataratos, San Carlos, 1 A.M.N.H. Prov. Puntarenas: Palmar, 2 A.M.N.H.

The nine-banded armadillos are not uncommon in Costa Rica but owing to their nocturnal habits are seldom seen. They favor rocky country and as a rule prefer semi-arid regions where there are low, dense thickets and coarse grass. Normally the nine-banded armadillos move in a jerky nervous fashion,

but when alarmed they can move at a considerable speed considering the short limbs and shell-like body. If they do not make cover quickly or an enemy overtakes them they will curl up in an iron-clad ball. The staple food of this armadillo is insects, and ants form the major part of its diet. Its den is a burrow about 4 feet under ground which it digs for itself. The number of young in a litter vary from four to eight but are usually four in the North American forms, and are born in the early part of the year. At first the young have a soft flexible shell that shows the pattern of the armor. The phenomenon of polyembryony in the nine-banded armadillo is not known to occur in any other mammal. It has now been established that in most species of armadillos the individual members of a litter are all derived from a single egg and therefore are all one sex. It is important to keep in mind, however, that there are species of armadillos that produce only a single offspring from one egg.

FAMILY BRADYPODIDAE

THREE-TOED SLOTHS

The three-toed sloths have three long, strongly curved, hook-like claws on the fore feet as well as on the hind feet. They are strictly arboreal animals with short rounded heads, short tails, and coarse pelage. Under side of fore and hind feet well haired to claws.

BRADYPUS LINNAEUS

THREE-TOED SLOTHS

Externally the members of this genus are best recognized by the possession of three digits on the fore feet instead of two. Males have a short haired speculum on the back between the shoulders which is brightly colored orange and black. The range of the genus *Bradypus* extends from the Patricia River in Honduras south through Central America and south to Bolivia in South America.

DENTITION: Incisors, $\frac{0-0}{0-0}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{1-1}{0-0}$; molars, $\frac{4-4}{1-1}$ = 18. The dental formula has not been definitely determined.

Bradypus griseus griseus (Gray)

GRAY'S THREE-TOED SLOTH

Arctopithecus griseus GRAY, 1871, Ann. Mag. Nat. Hist., ser. 4, vol. 7, p. 302.

The type series in the British Museum, originally described as from Costa Rica by Gray, were collected by Enrique Arce (in the employ of Godman and Salvin) on the Cordillera de Chucu, Province of Veragua, Panamá.

RANGE: From the Canal Zone in Panamá northwest to Juan Viñas and San Carlos in Costa Rica.

GENERAL CHARACTERS: A medium-sized, three-toed sloth with pelage on top of head inclined forward and forming a frontal ruff. Head, shoulders, and fore limbs darker than rest of the body. Pelage coarse, relatively short and dense, with woolly underfur.

DESCRIPTION: Color of arms to shoulders, top of head, neck, and chin drab; under side of body, rump, and hind limbs soiled yellowish white mixed with drab. Face white with separable black brown stripes across each eye and extending backward and downward to throat. A ruff of blackish brown hairs on forehead contrasting strongly with white of face. Dorsal area soiled buffy white; females with a median dark brown dorsal stripe. Males have a dorsal speculum where the hair is short and yellow, with a narrow blackish brown central streak.

The fore limbs are longer than the hind limbs; both hands and feet are very narrow, and the claws cannot be separated. Skull arched with a very short rostrum; nasals short and broad; interpterygoid fossa very broad and deep; palate narrowed posteriorly; cervical vertebrae nine, sometimes the eighth and always the ninth bear short ribs; dorsal and lumbar vertebrae 20, of which 15 to 17 bear ribs. Anterior teeth in upper jaw small, the second pair the largest in the series; first lower teeth large and broad and shear with the second pair of upper teeth. Mammae: pectoral, 1 to 1.

MEASUREMENTS: Adult female, Vijagual San Carlos: Total length, 570 mm.; tail vertebrae, 70; hind foot, 130. Skull: condylo-basal length, 72; length of nasals, 18.5; postorbital width, 23; width of braincase,

32.3; zygomatic width, 46; length of upper tooththrow, 24.2.

SPECIMENS: Prov. Alajuela: Vijagual San Carlos, 1 ad. female A.M.N.H. Prov. Puntarenas: Palmar, 1 subad. female A.M.N.H. Prov. Cartago: Juan Viñas, 1 ad. female A.M.N.H.

Bradypus griseus castaneiceps (Gray)

NICARAGUAN THREE-TOED SLOTH OR CAMALEON

Arctopithecus castaneiceps GRAY, 1871, Proc. Zool. Soc. London, p. 444.

The type is an adult male received by the British Museum in 1871 from the botanist, Dr. Berthold Seemann, who captured it in the woods surrounding the Javali gold mine in the Chontales district, Nicaragua, at about 2000 feet above sea level.

RANGE: From Jiménez, northeastern Costa Rica, north through the lowlands of Nicaragua to Patuca in eastern Honduras.

GENERAL CHARACTERS: Similar in general to typical *B. griseus* but recognized as a subspecies on the basis of color differences.

DESCRIPTION: Color of body, head, tail, fore and hind limbs soiled buffy white, females with a dark brown dorsal stripe and males with a yellow and black speculum. Face buffy white with dark brown stripes across the eyes, chin and throat dark brown.

In *B. g. griseus* the frontal region is blackish instead of grayish or pale brownish, and the short hair on the face is whiter and contrasts strongly with the coarse pelage of the ruff. The head, forearms, and shoulders are more or less drab in *B. g. griseus*; in *B. g. castaneiceps* this area is the same soiled buffy white as the rest of the body.

MEASUREMENTS: Adult male from Chontales: Total length, 660 mm.; hind foot, 120. Skull: condylo-basal length, 76.5; length of nasals, 19.5; postorbital width, 28.4; width of braincase, 34.8; zygomatic width, 50; length of upper tooththrow, 25.5.

SPECIMENS: Prov. Limón: Jiménez, 1 ad. female A.M.N.H.

The three-toed sloth is an arboreal animal and is most frequently seen in the low forest trees along river banks. Its hook-like claws are especially adapted to a slow climbing life in the tree tops. When traveling along horizontal branches and frequently when feeding

it hangs suspended by its claws, but an equal amount of time is spent climbing vertical stems. This sloth is not capable of standing in an upright position for more than a few seconds. Its life is one of slow motion. Beebe states that a female on the ground, speeded by the call of its young, made 14 feet in one minute and this is considered a fair average. In the trees this speed, he states, may be increased to 2 feet a second. The most surprising characteristic of the sloth is the readiness with which it take to water and frequently swims across rivers a mile wide. In the water the greater part of the head and much of the back are exposed. Most of the propulsion is done with the fore limbs, which swing alternately on each side. Beebe gives, as a swimming speed average, a male that swam 65 feet in two and one-half minutes. Sloths are solitary creatures and rarely, if ever, are seen together except at breeding season. They are extremely intolerant of one another when placed together on a tree, and fight if confined in a cage. The sloths are short-sighted, and their hearing is very poor. Its sense of smell is moderately good but below the average of most mammals. Its sense of touch is considered very low. The voice of the sloth, says Beebe, is characterized by silence. "When, very rarely, a sound is made, it is bird- or cicada-like and very ventriloquial." The three-toed sloth usually has a favorite roosting place, but no attempt is made to form a den or shelter as a protection against the weather other than the jungle foliage. It sleeps normally on a vertical branch or stem, taking firm hold with all four feet, and the head is rested in between the fore feet. It spends about 18 hours each day in sleep. The young are born sometime during the months of July, August, or September, and only one is in a litter. The normal position of the young after birth is flat on the mother's belly with the limbs widespread sidewise. Young sloths begin to eat leaves when about five weeks old. The enemies of the sloth include snakes, large cats, and the harpy eagle. Beebe records the skull of a three-toed sloth in the stomach of an anaconda and the remains of a small three-toed sloth in the stomach of a margay cat. One of the peculiarities of the sloth is the algae

that grow on its hair. Most individuals have an abundance of this plant life. During the dry season the algae may become a soiled brown color, but after soaking they assume a more or less green hue, giving the sloth a decided green tinge.

The three-toed sloth is a leaf-eater, and according to Beebe it feeds almost exclusively on the leaves of the Cecropia trees.

FAMILY CHOLOEPODIDAE

TWO-TOED SLOTHS

Sloths of the family Choloepodidae are similar in general appearance to those of the family Bradypodidae but differ notably in the reduction of the digits and claws on the fore feet to two, with three on the hind feet; the pelage on top of the head is inclined backward; there is no frontal ruff and no external tail; under side of fore and hind feet naked.

CHOLOEPUS ILLIGER

TWO-TOED SLOTH

Two-toed sloths of the genus *Choloepus* are large in size. Males do not have a dorsal speculum. The anterior teeth in both jaws are greatly developed, very sharp, triangular in shape, and shear together exclusively. The range of this genus extends from Matagalpa in Nicaragua south to Brazil and Ecuador.

DENTITION: $\frac{5-5}{4-4} = 18$. The anterior pair of teeth both above and below are much larger than the rest.

Choloepus hoffmanni Peters

HOFFMANN'S TWO-TOED SLOTH

Choloepus hoffmanni PETERS, 1858, Monatsber. Akad. Wiss., Berlin, p. 128.

This sloth was described by Peters from specimens collected by Hoffmann and Frantzius in Costa Rica. While the exact locality was not given, it seems logical to fix the type locality as Escazú.

RANGE: From Nicaragua south through Costa Rica and Panamá to Colombia.

GENERAL CHARACTERS: A large, long-limbed, two-toed sloth with long, loose, coarse pelage, relatively large eyes, and small ears concealed under fur.

DESCRIPTION: The Costa Rican series present a wide range of individual color varia-

tion, extremes being much lighter or darker than the average. Hair on brow and saddle white or buffy white to roots of hair; fore limbs and shoulders, hind limbs and rump Mummy Brown or Cinnamon-Brown, the hair more or less broadly tipped with buffy white; throat brownish white; underparts Mummy Brown, washed with brownish white; neck and shoulders and in some individuals the entire pelage tinged with bright green. Very young specimens are uniform pale Cinnamon-Brown. Skull arched, large and massive; first upper and lower teeth large, sharp, triangular, and separated with a wide space from the rest of the teeth which are relatively small and peg-like, all teeth growing from persistent pulp throughout life.

MEASUREMENTS: Adult male and female from Escazú: Head and body, 640 mm., 600; hind foot, 120, 110; ear, 25, 22. Skull: greatest length, 107.5, 106.5; zygomatic width, 67, 70.5; interorbital width, 29, 29.2; length of last four upper teeth, 23.5, 21.5.

SPECIMENS: Prov. Cartago: La Carpintera, 2 A.M.N.H.; Santa Teresa Perálta, 2 A.M.N.H. Prov. Limón: Cuábre, 2 A.M.N.H. Prov. Alajuela: Lajas Villa Quesada, 1 A.M.N.H. Prov. San José: Escazú, 12 A.M.N.H.

Although the movements of the two-toed sloth are slow in comparison with the actions of most other mammals, they are more than twice as fast as those of the three-toed sloth. This sloth, says Beebe, actually walks upright or on all four soles with the hind legs gathered beneath it, and the entire body clear of the ground. In eating it pulls leaf-bearing branches toward its mouth and is able to hold a broken branch in the grip of the claws against the palm. When descending a tree it turns around and comes down head first with the body free of the trunk instead of sliding backwards as does the three-toed sloth. The two-toed sloth is a leaf eater and arboreal in its habitat. It is more abundant in Costa Rica than the three-toed sloth.

FAMILY MYRMECOPHAGIDAE

ANTEATERS

The anteaters are the only toothless American members of the Order Edentata. Three genera inhabit Costa Rica that differ greatly

in size, pelage, color, and habits. Structurally they all have a conical elongate head, small mouth, long tail, and strong hooked claws.

CYCLOPES GRAY

TWO-TOED ANTEATERS

The genus *Cyclopes* includes very small species with only two claws on the fore feet, four claws on the hind feet, tail prehensile, well haired except on under side near tip, pelage soft and woolly, ears small and concealed under fur.

This genus has a range that extends from Mexico to Bolivia and southern Brazil, where the climate is sufficiently warm.

DENTITION: 0.

Cyclopes didactylus dorsalis (Gray)

COSTA RICAN TWO-TOED OR SILKY ANTEATER

Cyclothurus dorsalis GRAY, 1865, Proc. Zool. Soc. London, p. 385.

The type, a British Museum specimen, was procured by Salvin in Costa Rica. The exact locality is not known. Orosi near Cartago, where von Frantzius obtained several specimens, seems suitable to fix as the type locality.

RANGE: Central America, replaced in Mexico by an allied form, altitudinal range from sea level to 5000 feet.

GENERAL CHARACTERS: Size small, pelage glossy, very soft, thick, and woolly; tail about equal in length to head and body, tapered, prehensile; limbs short, all four claws on hind feet nearly the same length; fore feet armed with one large hooked claw and one smaller claw; under sides of fore and hind feet naked.

DESCRIPTION: General color golden yellow, tinged with Chesnut, palest on fore and hind limbs and tail; a dark dorsal stripe from head to rump. Hair on back, at base, and at subterminal band blackish; soles of feet, tip of muzzle, and naked part of tail pinkish. Skull arched, relatively short for the anteaters; greater part of the palatines and pterygoids do not meet on mid line, rostrum relatively short and slender.

MEASUREMENTS: Adult female from Palmar: Total length, 398 mm.; hind foot, 36; ear, 12. Skull: greatest length, 50.2; length

of nasals, 14; interorbital width, 9; width of braincase, 21.8.

SPECIMENS: Prov. Puntarenas: Palmar, 1 A.M.N.H.

The little two-toed or silky anteater is arboreal and nocturnal in its habits. It is strictly insectivorous and feeds principally on termites. During the day it remains motionless, completely rolled up in a ball on a shaded branch or clinging to the inside of a hollow tree. It becomes active in the evening and after dark, but even then its motions are slow and very deliberate. When climbing, this anteater does not remain in a suspended position but crawls over the branches, grasping the twigs with its strongly prehensile tail as well as with all four feet. The female probably has only one young in a litter which at first she carries around with her, clinging to her belly. When this little anteater is disturbed it rears up in a threatening attitude holding onto a branch with its tail and hind feet; the formidable front claws are laid along the side of the snout and at the least touch are slashed sharply downward. Its senses of sight and hearing are extremely dull, but the sense of touch seems moderately well developed, especially in its long extensible tongue.

TAMANDUA GRAY

THREE-TOED ANTEATERS

Anteaters of this genus are medium in size and have four claws on the fore feet (but the fourth is very small), five on hind feet; soles of feet naked; tail about equal in length to head and body, tapered and prehensile; head long and cylindrical; mouth small, pelage very coarse, ears small but not concealed by the short stiff hairs on head. The tamanduas have a wide geographical distribution, extending throughout the warmer parts of America from Paraguay to southern Mexico.

DENTITION: $\frac{0}{0}$.

Tamandua tetradactyla chiquensis Allen

CHIRIQUÍ THREE-TOED ANTEATER

Tamandua tetradactyla chiquensis ALLEN, 1904, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 395.

TYPE: A.M.N.H. No. 18883, adult female, skin and skull, collected at Boquerón, Chiri-

quí, Panamá, October 16, 1901, by J. H. Batty.

RANGE: Panamá, Costa Rica, and Nicaragua, replaced in Honduras and north to Mexico by an allied subspecies.

GENERAL CHARACTERS: A coarse-haired, black and white anteater, tail well haired at base, distal half nearly naked; middle claw on fore feet much the largest, claws on hind feet small and nearly uniform in size.

DESCRIPTION: Color of Esparta specimen: body from behind shoulders to hips girdled with black, a narrow, sharply defined white dorsal stripe terminating over hips, the black extending forward in two narrow half-moon stripes over shoulders to base of neck; chest and under side of hind limbs grizzled, snout and sides of head, back to eyes, blackish; rest of head, neck, fore and hind limbs, feet, and tail white; skin on tail white mottled with large blotches of black. In the type the black on back extends nearly 4 inches on basal portion of tail. Skull narrow and tapering, palatines and pterygoids grown together and extending the floor of the posterior nasal canal as far back as the level of the mastoids; rostral portion of skull relatively broad, frontal region flattened, nasals relatively long, correspondingly shorter parietals.

MEASUREMENTS: Female from Esparta, and type in parentheses: Head and body, 520 mm. (610); tail vertebrae, 550 (555); hind foot, 90 (100); ear, 40 (50). Skull measurements of an adult female from Agua Buena, type in parentheses: occipito-nasal length, 128 (132.5); width of braincase, 41 (42); length of nasals, 51 (55); interorbital width, 26.5 (27).

SPECIMENS: Prov. Puntarenas: Esparta, 1 A.M.N.H.; Agua Buena, 2 A.M.N.H. Prov. San José: San José, 1 skull A.M.N.H.

The tamandua or three-toed anteater is partly arboreal and partly terrestrial in its habits but seems to spend the greater part of its time in the trees. It is most active in the late evening and after dark, but it may be seen at almost any hour of the day. When walking the points of the toes on the fore feet are directed inward and the soles of the hind feet are placed flat on the ground. The habits of the tamandua are much the same as those of the little silky anteater except

that it frequently descends to the ground. Its food consists of termites and ants. Goldman records a specimen that had at least a pound of ants in its stomach including five genera. Most of these ants were in a larval condition, but some were already winged. The tamandua sleeps rolled up in a ball in a crotch of a tree or in a hollow tree trunk. When attacked it rears up on its hind feet and strikes with its fore claws.

MYRMECOPHAGA LINNAEUS

GREAT ANTEATERS

The anteaters of this genus are recognizable by their large size, very long cylindrical snout, and bushy, long-haired tail. The fore feet are armed with three large claws and one very small claw, the center claw being exceptionally long and powerful. Hind feet with five relatively small claws. The great anteaters have an extensive distribution in the warmer parts of the Americas. Formerly they ranged north to Guatemala and south in South America to Paraguay.

DENTITION: 0.

Myrmecophaga tridactyla centralis Lyon

CENTRAL AMERICAN GREAT ANTEATER OR ANT BEAR

Myrmecophaga centralis LYON, 1906, Proc. U. S. Natl. Mus., vol. 31, p. 570.

TYPE: U.S.N.M. No. 15963, skull (no skin), young adult, collected at Pacuare, Costa Rica, June, 1876, by José C. Zeledón.

RANGE: Panamá and Costa Rica.

GENERAL CHARACTERS: The bushy horse-tail and extremely long slender snout distinguish the great anteater from any other animal found in this region. Its limbs are relatively short, ears small but not concealed by the short close hair on head, mouth very small, tongue long and slender, eyes small.

DESCRIPTION: General color of upperparts grizzled, a broad black stripe or collar bordered with white extends from throat over shoulders and ends on lower back; fore limbs yellowish white, a small black area above toes and a broad black band above ankles; underparts, most of hind limbs, and tail blackish;

head sparsely covered with yellowish white, fine, bristly hair. Skull long and slender with an exceptionally long rostrum. *M. t. centralis* is similar to typical *tridactyla* from South America except that in the skull the median anterior extensions of the frontal bones are not produced farther forward than the lateral anterior extensions of the same bones, and the most anterior point of the squamosal extends forward decidedly less than halfway between the middle of the root of the zygomatic process and the most anterior point of the alisphenoid.

MEASUREMENTS: Dried skin from Costa Rica: Total length, 1860 mm.; tail vertebrae, 650; hind foot, 135. Skull of *M. t. tridactyla* from Venezuela: greatest length, 365 mm.; zygomatic width, 65; interorbital width, 43.

SPECIMENS: Prov. Limón: Pacuare, 1 (skull) U.S.N.M.; Talamanca, 2 U.S.N.M. Costa Rica: 1 skin A.M.N.H.

The great anteater ("oso real" in Costa Rica) inhabits tropical forests and swamp regions. Its food consists mainly of termites. The powerful claws on its fore feet are used to tear down the termite nests. The termites as they swarm out are drawn into the mouth of the animal in great numbers by means of the long flexible tongue. The great anteater is strictly terrestrial, though it is apparently capable of climbing park railings. When walking the outer portion of the fore feet are applied to the ground and the claws are doubled inward. Beebe saw the ant bear swimming wide rivers in British Guiana and states that it makes surprisingly good time; the head and the long hairs of the tail project above the water. On the ground it can get along at a considerable pace but can be overtaken by a man running. The great anteater makes neither nest nor burrow. It produces only a single young at a time which is carried around on the parent's back. The young remain with the mother for about a year.

The great anteater can defend itself from most of its would-be four-footed enemies unless caught unawares. Rising up on its haunches with its well-armed fore feet ready to strike, it presents a front that few animals would want to face. When injured it can utter a surprisingly loud roar for an animal with such a small mouth.

ORDER LAGOMORPHA
CONIES, HARES, AND RABBITS
FAMILY LEPORIDAE
HARES AND RABBITS

The Leporidae are virtually of world-wide distribution but are not native to Australia or to the majority of oceanic islands. Only the genus *Lepus* is circumpolar and inhabits part of both the Old World and the New World. External characters of members of the family Leporidae include a short tail, large eyes, long large ears, relatively long hind feet, and soft fur. The upper lip is cleft in the middle. They resemble typical rodents in having large chisel-like incisors on both upper and lower jaws and a wide diastema. They differ from the rodents in having an additional pair of small upper incisors placed directly behind the large one. The bony palate is reduced to a narrow bridge.

The total range of the family in America covers the entire breadth of the continents and extends from latitude 83° N., northern Greenland, south to beyond latitude 40° S. in northern Patagonia. Its vertical range extends from sea level to above timber line, reaching an elevation of more than 14,000 feet.

SYLVILAGUS GRAY
SMALL HARES

Hares of the genus *Sylvilagus* are moderately small in size with relatively small ears. The genus has a wide distribution, and in its various species ranges from the southern border of Canada throughout the United States, Mexico, Central America, and in South America at least to northern Argentina.

DENTITION: Incisors, $\frac{2-2}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{3-3}{2-2}$; molars, $\frac{3-3}{3-3}$ = 28.

SYLVILAGUS GRAY
COTTONTAIL HARES

The range of the subgenus *Sylvilagus* extends from the southern border of Canada to northwestern Costa Rica. It reaches its greatest development in the United States. Externally they are characterized by their moderately large ears and the cotton white under side of the tail. In cranial characters the long, narrow, postorbital processes normally extend along the side cranium and

leave a slit-like aperture between it and the cranium.

Sylvilagus floridanus costaricensis
Harris

COSTA RICAN COTTONTAIL HARE

Sylvilagus floridanus costaricensis HARRIS, 1933, Occas. Papers Mus. Zool. Univ. Michigan, no. 266, p. 3.

TYPE: M.Z.U.M. No. 65232, skin and skull, adult female from Hacienda Santa María, Province of Guanacaste, Costa Rica, altitude 3200 feet; collected February 1, 1932, by Austin Smith. Hacienda Santa María is a large ranch just within the cloud forest on the western slope of the Cordillera de Guanacaste, 22 miles northeast of Liberia.

RANGE: Northwestern Costa Rica.

GENERAL CHARACTERS: A medium-sized cottontail with larger ears, longer tail, and lighter color than the forest hares of the *S. gabbi* group. It is very similar to *S. f. astecus*, but the ears are grayer, the back is less black, and nape and legs are a richer Tawny. The tip of the tail is blackish on top.

DESCRIPTION: Color of type: Top of head and back light Tawny, washed with black. Hairs of back gray at base with subterminal band of light Tawny, tipped with black. Orbital ring light gray; cheeks grayish; sides and flanks gray washed with black. Color of back extends downward in a narrow area on front of thighs. Ears dark gray externally and at the base, shading to black at the tips, internally light gray, edged with white. Outside of both fore and hind legs Cinnamon-Rufous; this color extends over front feet but on toes it is mixed with gray. Upper surface of hind feet, Cartridge Buff. Nape very bright Cinnamon-Rufous; patch on throat grizzled or yellowish gray; underparts white; tail at base like back but tipped with black on top and entirely white on under side. Skull angular, evenly arched, flattened frontal region, orbits large, bullae small, nasals broad and nearly half as long as total length of skull. The first upper incisors are large and deeply grooved on inner anterior surface. The second upper incisors are small and without cutting edge; lower incisors chisel-like and without groove on anterior surface. The skull of *S. f. costaricensis* is very similar to that of

S. f. aztecus and *S. f. hondurensis* except that the bullae are slightly smaller.

MEASUREMENTS: Type, adult female: Total length, 427 mm.; hind foot to end of claws (dry skin), 84.6; ear from notch (dry skin), 51. Skull: condylopremaxillary length, 65.8; length of nasals, 34.7; breadth of rostrum above premolars, 20; depth of rostrum in front of premolars, 16.8; interorbital breadth, 19.3; diameter of bullae, 9; parietal breadth, 23.

SPECIMENS: Prov. Guanacaste: Tenorio, 1 M.C.Z.; El Pelón, 2 M.C.Z.; Hacienda Santa María, 3 M.Z.U.M.

Cottontail hares are terrestrial, mainly crepuscular and nocturnal in their habits, though they are frequently seen about at all hours of the day. They are herbivorous in diet and will eat virtually any kind of green vegetable matter. The cottontails commonly use forms in the long grass or bushes for their dens, but they also make use of burrows in the ground as a retreat from danger. The young are brought forth in a surface form. The nests, in addition to the dry grasses composing them, are lined with fur from the mother. At birth the young are blind, naked, and helpless. The number in a litter may vary from two to six or seven, but the average is about four. Cottontails have no means of defense; their only safety is in flight or concealment. Their enemies are numerous and include carnivorous mammals, hawks, owls, eagles, and large snakes. When disturbed they run with the white tail up, flashing alarm, but if pursued or stalked and they hope to sneak away unseen the tail is carried held tightly down and the white part is hidden. The cottontail is a source of food supply, and the pelts have a slight fur value.

TAPETI GRAY

TROPICAL FOREST HARES AND SWAMP HARES

Members of the subgenus *Tapeti* are distinguished by their small size, relatively small rounded ears, and very small, uniformly brownish tail. The subgenus *Tapeti*, with the greatest range of all American subgenera, extends from Dismal Swamp, Virginia, to northern Argentina and reaches its greatest development in South America.

Sylvilagus gabbi gabbi (Allen)

LITTLE COSTA RICAN FOREST HARE

Lepus brasiliensis var. *gabbi* ALLEN, 1877, in Coues, Elliott, and J. A. Allen, Monographs of North American Rodentia, p. 349.

TYPE: U.S.N.M. No. 11371/37794, skin and skull, adult male, collected in Talamanca, Costa Rica, 1872-1873, by J. C. Zeledón. Allen bases this species on three specimens, one (U.S.N.M. No. 8140) from Chiriquí, and two (U.S.N.M. Nos. 11371 and 11372) from Talamanca. No type or cotypes were designated. In order to avoid two type localities, No. 11371 is considered type, No. 11372, cotype, and No. 8140 as paratype.

RANGE: Eastern Honduras, Nicaragua, Costa Rica, and Panamá. Altitude from sea level to 5000 feet.

GENERAL CHARACTERS: A small, dark-colored hare with a very small tail, short rounded ears, and relatively short, coarse pelage.

DESCRIPTION: Color of upperparts varying from rich, deep Ochraceous-Buff to nearly Ochraceous-Rufous, heavily overlaid with black, sides of body paler, more grayish buff than back and less heavily washed with black; tail and top of fore and hind legs and feet nearly uniform reddish brown; nape rusty Rufous; under side of neck like sides of body, rest of underparts white. Skull proportionally narrow; rostrum heavy, broader at base than interorbital width; upper outline of skull arched from occiput to tip of nasals but depressed in frontal region; supraorbital processes broadly joined to frontals.

MEASUREMENTS: Adult male from Vijagual, San Carlos, and type (male) in parentheses: Total length, 360 mm.; tail, 20; hind foot, 80; ear, 45 (39 in dried skin). Skull: basilar length, 54.6 (55); length of nasals, 30 (28.3); breadth of rostrum above premolars, 18.1 (17); depth of rostrum in front of premolars, 15.3 (14.8); interorbital breadth, 16.7 (15); diameter of bullae, 8.4 (8.5).

SPECIMENS: Prov. Limón: Talamanca, 3 U.S.N.M. Prov. Cartago: Santa Teresa Perálta, 2 ad., 3 juv. A.M.N.H. Prov. Alajuela: Vijagual, San Carlos, 3 A.M.N.H.; Cataratos, San Carlos, 1 A.M.N.H.

Sylvilagus dicei Harris

GREATER COSTA RICAN FOREST HARE

Sylvilagus dicei HARRIS, 1932, Occas. Papers Mus. Zool. Univ. Michigan, no. 248, p. 1.

TYPE: M.Z.U.M. No. 64043, adult female, skin and skull, collected at El Copey de Dota, in the Cordillera de Talamanca, Costa Rica, altitude 6000 feet, May 24, 1931, by Austin Smith. El Copey de Dota is about 15 miles south of Cartago and is on the Pacific watershed on the boundary between the tropical and temperate zones.

RANGE: The mountain regions of central Costa Rica.

GENERAL CHARACTERS: Largest of the Central American forest hares of the *Sylvilagus gabbi* group. Similar in general characters to the little Costa Rican forest hare but larger and darker.

DESCRIPTION: Top and sides of head, back, and tail Ochraceous-Tawny heavily washed with black, hairs gray for basal two-thirds with subterminal band of Ochraceous-Tawny and tipped with black; orbital ring black; sides and flanks lighter than back and with less black. Postauricular patch Ochraceous-Orange; ears more blackish than head; outside of limbs and both hind and fore feet Ochraceous-Tawny, patch of Ochraceous-Tawny on under side of neck, rest of underparts white. Skull larger than that of *S. gabbi*, with heavier and broader rostrum and larger braincase; nasals flatter and less arched posteriorly than in *gabbi*. The nasals extend posteriorly beyond the premaxillae, continuous in the Cervantes specimen, supra-orbital process fused with frontals. Postorbital process joined at the posterior end to the skull; frontals very flat anteriorly.

MEASUREMENTS: Adult female from Cervantes, and type in parentheses: Total length, 413 mm. (455); tail, 18; hind foot, 86, s.u.? (100, c.u.); ear, 50 (56). Skull: condylopremaxillary length, 68.3 (68.5); length of nasals, 31.5 (33.4); breadth of rostrum, (21); zygomatic width, 36.6; depth of rostrum, (16.7); interorbital breadth, 16 (17.3); diameter of bullae, 9 (9); length of upper toothrow, 15 (15).

SPECIMENS: Prov. Cartago: El Copey de Dota, 1 M.Z.U.M.; Cervantes, 1 C.N.H.M.; Juan Viñas, 1 juv. A.M.N.H.; Rancho de

Río Jiménez, 2 juv. A.M.N.H. Prov. San José: San José, 2 juv. A.M.N.H.

The greater forest hare of Costa Rica inhabits the tropical and temperate forest zones in the mountains of central Costa Rica. Two specimens from San José, two from Río Jiménez, and one from Juan Viñas are all too young for definite identification but have all the characteristics of the larger species *dicei*.

The little forest hares live in the heavy tropical forest, usually near an opening which they visit at night. They are shy and apparently feed mainly at night. Their forms are concealed under logs or thick underbrush. They feed on virtually all kinds of green vegetable matter. These little forest hares take readily to water and swim well. The young have been taken from September to April, but they probably breed throughout the year. So far no specimens have been recorded from the Pacific side of Costa Rica, which may not be significant since during the day they keep closely hidden within the dense forest and are extremely difficult to find.

ORDER RODENTIA

RODENTS OR GNAWING MAMMALS

FAMILY SCIURIDAE

SQUIRRELS

The family Sciuridae is virtually cosmopolitan; absent only from the Australasian region, Madagascar, extreme southern South America, and desert regions of Arabia, Egypt, etc.

SCIURUS LINNAEUS

TREE OR TRUE SQUIRRELS

Squirrels of this genus are strictly arboreal members of the family Sciuridae. They are from medium to large in size and have a long bushy tail more than half the combined length of head and body. Range of the genus *Sciurus* includes Europe and Asia in the Old World and in America from Canada south to northern Argentina.

NEOSCIURUS TROUESSART

Range of the subgenus *Neosciurus* extends from the Great Lakes in Canada south to Panamá.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{2-2}{1-1}$; molars, $\frac{3-3}{3-3}$ = 22.

Sciurus variegatoides underwoodi* (Goldman)*UNDERWOOD'S SQUIRREL**

Sciurus boothiae underwoodi GOLDMAN, 1932, Jour. Washington Acad. Sci., vol. 22, no. 10, p. 275.

TYPE: U.S.N.M. No. 250219 (Biol. Surv. Coll.), adult male, skin and skull, collected at Monte Redondo, about 30 miles northwest of Tegucigalpa, Honduras, altitude 5100 feet, December 8, 1931, by C. F. Underwood.

RANGE: Highlands of central Honduras, northern Nicaragua, and extreme northwestern Costa Rica.

GENERAL CHARACTERS: A large, grizzled, long-tailed squirrel, postauricular patches buffy or white, underparts white.

DESCRIPTION: Upperparts, including back, head, sides of body, and outside of legs, and feet, mixed yellowish gray and black. The hairs black at base, followed by a buffy band and tipped with black. Postauricular patches and back of ears Ochraceous-Buff or white. Underparts and inside of legs usually white. Tail above black, washed with white, below the median line like back, bordered with black and edged with white. Skull short, broad, depressed; braincase not highly arched but expanded laterally and widening to occiput; interorbital area broad, rostrum short, broad, and heavy; nasals about equal to or shorter than interorbital width.

MEASUREMENTS OF TYPE: Total length, 513 mm.; tail vertebrae, 272; hind foot, 60. Skull: condylopremaxillary length, 55.7; zygomatic width, 34.2; interorbital width, 21.3; maxillary toothrow, 11.7.

SPECIMENS: Prov. Guanacaste: Liberia, Port Parker Bay, 1 A.M.N.H.

Sciurus v. underwoodi is considered an inhabitant of the highlands of central Honduras and northwestern Nicaragua. The coast region of northwestern Costa Rica appears to be a little out of the supposed range of this form. William Beebe reports seeing several squirrels at Port Parker. He secured one that was shot in a gully about a mile back of the Port Parker beach, which is indistinguishable from typical *underwoodi*.

Sciurus variegatoides austini* Harris*AUSTIN'S VARIEGATED SQUIRREL**

Sciurus variegatoides austini HARRIS, 1933,

Occas. Papers Mus. Zool. Univ. Michigan, no. 266, pp. 1-4.

TYPE: M.Z.U.M. No. 65118, adult male, skin and skull, collected at Las Agujas, Province of Puntarenas, Costa Rica, September 22, 1931, by Austin Smith.

RANGE: Known only from the vicinity of Las Agujas, a small settlement on a sandy peninsula with coconut palms and mangrove trees, 30 miles south of the city of Puntarenas.

GENERAL CHARACTERS: A large squirrel with head grizzled and a patch of Rufous on the forehead, underparts Rufous, postauricular patches white.

DESCRIPTION: Back from nape to base of tail with a broad band of mixed Orange-Cinnamon, black and white, widest behind ears and over lumbar region, narrow over shoulders and tapering to tail. Hairs of back black at base with a subterminal band of Orange-Cinnamon and with a sprinkling of black hairs tipped with white; head dark gray with a patch of Vinaceous-Cinnamon, back of ears gray, bordered with black; postauricular patches white; sides of body, legs, feet, and underparts Cinnamon-Rufous. Tail above black, washed with white; below with a median line like underparts, bordered with black and edged with white.

MEASUREMENTS OF TYPE: Total length, 532 mm.; tail vertebrae, 271; hind foot, 65. Skull: condylopremaxillary length, 57.8; zygomatic breadth, 33; anterior end of premaxillae to palatal notch, 30.2; interorbital breadth, 19.8.

SPECIMENS: Prov. Puntarenas: Chomes, 5 M.Z.U.M.; Las Agujas, 10 M.Z.U.M. Costa Rica; 1 C.M.

Sciurus variegatoides atrirufus* (Harris)*NICOYA PENINSULA SQUIRREL**

Sciurus adolpheii atrirufus HARRIS, 1930, Occas. Papers Mus. Zool. Univ. Michigan, no. 219, pp. 1-4.

TYPE: M.Z.U.M. No. 59842, adult male, skin and skull, collected at Tambor, Nicoya Peninsula, Costa Rica, November 28, 1928, by Austin Smith.

RANGE: Known only from the vicinity of Tambor, a small settlement at sea level on the Bay of Ballena at the southeastern extremity of the Nicoya Peninsula.

GENERAL CHARACTERS: A large squirrel

with median area of back uniform black, and underparts, sides, and ear patches Rufous.

DESCRIPTION: Back with broad band of black extending forward in stripes above the eyes, wide behind the ears and over lumbar region. Top of head, sides, postauricular patches, legs, and underparts Cinnamon-Rufous. Ears Cinnamon-Rufous bordered with black; tail above black washed with white, below median line Cinnamon-Rufous followed by a band of black and tipped with white.

MEASUREMENTS OF TYPE: Total length, 560 mm.; tail vertebrae, 275; hind foot, 63. Skull: condylobasal length, 56.3; zygomatic breadth, 34.9; anterior end of premaxillary to palatal notch, 32.5; interorbital breadth, 21.5.

SPECIMENS: Prov. Puntarenas: Tambor, 6 M.Z.U.M.

This is a well-marked form which is locally constant. The color of five specimens taken at Tambor varies only slightly in the color tones of underparts (Harris). Intergradation with *dorsalis* occurs farther north on the Nicoya Peninsula, and specimens from Oja Ancha are very similar to *atrirufus* but as a whole are referable to *dorsalis*.

Sciurus variegatoides dorsalis (Gray)

GRAY'S VARIEGATED SQUIRREL

Sciurus dorsalis GRAY, 1848, Proc. Zool. Soc. London, p. 138.

The type is in the British Museum. The type locality was fixed by Nelson as Liberia, Costa Rica. It was originally erroneously given as Carácas, Venezuela.

RANGE: Southwestern Nicaragua and northwestern Costa Rica from Lake Managua to Puntarenas, and the Pacific coast eastward to the summit of the Tileran Mountains. In Costa Rica this form is found throughout the Province of Guanacaste except in the extreme southern end of the Nicoya Peninsula, also in the northern coastal region of the Province of Puntarenas south to Chomes.

GENERAL CHARACTERS: Typical color pattern, median area of back from nape to base of tail blackish, postauricular patches white; sides, head, and legs grizzled, underparts white or Tawny.

DESCRIPTION: Broad area along middle of back from nape to base of tail blackish gray

or blackish Tawny; top of head, sides, and outside of legs and feet gray, slightly mixed with brown. Back of ears and postauricular patches white. Underparts and inside of legs white or Tawny; tail above, black washed with white, below with median line like color of underparts bordered with black and edged with white. This form shows a wide range of individual variation. Specimens from Liberia, La Cruz, El Pelón, Miravalles, and Poso del Tempisque are considered by Harris as typical.

MEASUREMENTS: Adult male from Bebedero: Total length, 500 mm.; tail, 275; hind foot, 63. Skull: condylopremaxillary length, 55.7; zygomatic breadth, 35; anterior end of premaxillary to palatal notch, 32.1; interorbital breadth, 21.6; upper molariform tooththrow, 11.3.

SPECIMENS: Prov. Guanacaste: Liberia, 3 U.S.N.M., 2 M.Z.U.M.; Miravalles, 3 C.N.H.M., 5 C.M.; El Pelón, 2 M.Z.U.M.; La Cruz, 1 M.Z.U.M.; Bebedero, 1 M.Z.U.M.; 1 A.M.N.H.; 27 de Abril, 3 M.Z.U.M.; Las Huacas, 1 M.Z.U.M.; San Juanillo, 7 M.Z.U.M.; Cerros de San Juan, 3 M.Z.U.M.; Oja Ancha, 3 M.Z.U.M.; Poso del Tempisque, 1 M.Z.U.M.; Tempate, 5 M.Z.U.M.; Ballena, 11 M.Z.U.M. Prov. Puntarenas: Chomes, 2 M.Z.U.M.

The region of Tempate and Ballena is one of intergradation between *dorsalis* and *atrirufus*. Specimens from 27 de Abril, Las Huacas, San Juanillo, Cerros de San Juan, and Oja Ancha also show intergradation between *dorsalis* and *atrirufus*. Some individual specimens from Oja Ancho are very similar to *austini*, but the series as a whole is referable to *dorsalis*.

Sciurus variegatoides rigidus Peters

PETERS' VARIEGATED SQUIRREL

Sciurus rigidus PETERS, 1863, Monatsber. Akad. Wiss., Berlin, pp. 652-653.

TYPE: A Berlin Museum specimen, collected by Hoffmann and Frantz at San José, Costa Rica.

RANGE: Mountains and valleys of central Costa Rica, from Puntarenas east to Juan Viñas, from Liberia and Zarcero in the north to Cartago in the south and possibly through-

out the Cordillera de Talamanca into Panamá.

GENERAL CHARACTERS: Color of upperparts grizzled or mixed brown and black; postauricular patches white; underparts and legs bright Rufous.

DESCRIPTION: Color of typical specimens: upperparts, including back, sides, and flanks, Ochraceous-Orange mixed with black; head paler and grayer than back; hairs of back black at base followed by a median buffy band and tipped with black; back of ears like back, bordered with black; postauricular patches white; fore and hind limbs, feet, and underparts Orange-Rufous, this color extending well up on shoulders. Many specimens show more or less white spotting on the underparts. Hairs on sides black at base and tipped with Orange-Rufous; tail above black, washed with white; below median area like underparts.

MEASUREMENTS: Adult male from Esparta: Total length, 515 mm.; tail vertebrae, 265; hind foot, 60; ear, 30. Skull: condylopremaxillary length, 52; zygomatic width, 34.5; anterior end of premaxillary to palatal notch, 29; interorbital breadth, 20.2; upper molariform toothrow, 11.5.

SPECIMENS: Prov. San José: San José, 2 U.S.N.M.; Escazú Heights, 2 A.M.N.H.; San Isidro, 1 A.M.N.H. Prov. Cartago: Cartago, 2 M.Z.U.M.; Juan Viñas, 2 U.S.F.W.; La Carpintera, 1 C.N.H.M., 3 A.M.N.H.; Agua Caliente, 1 M.Z.U.M.; San Ramón de Tres Ríos, 2 C.N.H.M. Prov. Alajuela: Alajuela, 2 U.S.N.M., 1 C.N.H.M., 1 A.M.N.H.; San Mateo, 1 U.S.N.M.; Zarcero, 6 M.Z.U.M. Prov. Puntarenas: Esparta, 3 A.M.N.H.; Puntarenas, 5 M.Z.U.M.; San Francisco Esparta, 5 A.M.N.H.

Sciurus v. rigidus intergrades with *dorsalis* when their ranges meet, but the range of *thomasi* overlaps that of *rigidus* without intergradation. Individual variation in color is noticeable and may be partly the result of age and wear, though difference in hair coloration does occur in specimens taken at the same localities and at the same seasons. Some variation is shown in the amount of Rufous on the shoulders and hind limbs which is strongly pronounced in some and entirely absent in others. One individual from La

Carpintera is referable to *thomasi*; and three others from this same locality are *rigidus*.

***Sciurus variegatoides thomasi* Nelson**
THOMAS' VARIEGATED SQUIRREL

Sciurus thomasi NELSON, 1899, Proc. Washington Acad. Sci., vol. 1, p. 71.

TYPE: U.S.N.M. No. 12044/23367, skin and skull, collected at Talamanca, Costa Rica, 1874, by W.M. Gabb.

RANGE: Humid tropical forests of eastern Costa Rica, probably from the border of Nicaragua to Panamá, westward in the south to Talamanca, and in the north to Santa Clara, Alajuela.

GENERAL CHARACTERS: A large, dark-colored squirrel with Rufous underparts and back Tawny. Similar to *belti* found in eastern Nicaragua and Honduras but much blacker above and darker and richer-colored underparts.

DESCRIPTION: Color of upperparts, including back, head, sides, outside of legs and feet, mixed Ochraceous-Orange and black, sides of body with a lighter wash of black. The hairs black at base followed by a median band of Ochraceous-Orange and tipped with black; postauricular patches Orange-Rufous or Tawny; underparts, inside of legs Orange-Rufous; tail above, black washed with white, below with median area like underparts.

MEASUREMENTS: Adult male from Cuábre, Talamanca: Total length, 475 mm.; tail, 246; hind foot, 60. Skull, type in parentheses: condylopremaxillary length, 51.6 (50); anterior end of premaxillae to palatal notch, 29.4 (26.2); zygomatic width, 32 (35.5); interorbital width, 20 (22); length of upper molar series, 11.2 (11.5).

SPECIMENS: Prov. Limón: Talamanca, 1 U.S.N.M.; Cuábre, 1 A.M.N.H.; Río Sixaola, 1 A.M.N.H.; Jiménez, 1 M.Z.U.M.; Pacuare, 1 M.Z.U.M.; Santa Clara, 2 U.S.N.M.; Guápiles, 5 C.N.H.M. Prov. Cartago: La Carpintera, 1 A.M.N.H.; Perálta, 4 A.M.N.H.; Santa Teresa Perálta, 4 A.M.N.H. Prov. Alajuela: La Vieja, 1 M.Z.U.M.; San Carlos, 3 M.Z.U.M.; Vijagual de San Carlos, 3 A.M.N.H.; Villa Quesada, 1 M.Z.U.M.

This is a well-marked form showing little individual variation. The only difference in

color appears to be a slight trace of white spotting on the underparts and in the intensity of the color. One individual from Vijagual is melanistic and totally black.

Sciurus variegatoides melania (Gray)

COSTA RICAN BLACK SQUIRREL

Macroxus melania GRAY, 1867, Ann. Mag. Nat. Hist., ser. 3, vol. 20, p. 425.

The type is in the British Museum, collected by Kellet and Wood at Point Burica, Costa Rica.

RANGE: Pacific slopes of the mountains, coastal plains, and islands of western Panamá and adjacent parts of Costa Rica.

GENERAL CHARACTERS: A large black squirrel with a long tail.

DESCRIPTION: General appearance nearly uniform black but when viewed in certain lights the pelage is a dark Seal Brown which fades with exposure and wear to Chestnut-Brown.

MEASUREMENTS: An adult male from Boquerón, Chiriquí, Panamá: Total length, 550 mm.; tail vertebrae, 280; hind foot, 62. Skull: condylopremaxillary length, 52.7; anterior end of premaxillary to palatal notch, 29.5; zygomatic width, 33.5; interorbital width, 19.2; length of upper molar series, 11.

Sciurus v. melania seems to be a black squirrel rather than a melanistic color phase. In 18 specimens from Panamá examined, the hairs are uniform blackish without any indication of banding, and there are apparently no intermediate color phases known. A black squirrel in the *S. v. thomasi* series, while coal black in general appearance, is definitely a color phase, as banding of the hairs can be detected when examined closely.

Squirrels of the *variegatoides* group are diurnal and arboreal in their habits. Their food consists of various kinds of fruits and nuts. Goldman records seeing them cutting and feeding on the ripening mangos in Panamá. Females have eight mammae, and the average number of young in a litter probably varies from four to six. The brighter-colored forms inhabit the higher and more arid regions, and the darker subspecies are found in the humid low tropical zones.

Sciurus deppei miravallensis (Harris)

GUANACASTE SQUIRREL

Sciurus miravallensis HARRIS, 1931, Occas. Papers Mus. Zool. Univ. Michigan, no. 227, p. 1.

TYPE: M.Z.U.M. No. 59882, adult male, skin and skull, collected at Volcán de Miravalles, Guanacaste, Costa Rica, January 23, 1930, by Austin Smith.

RANGE: Northwestern Costa Rica, mainly on the Cordillera del Guanacaste.

GENERAL CHARACTERS: A rather small, dark brownish squirrel with grayish underparts, closely allied to the Nicaraguan form, *S. d. matagalpae*.

DESCRIPTION: Color of upperparts, including legs and feet, mixed yellowish brown and black, slightly darker along the middle of the back and top of head, the hairs black from base for about three-fourths their length followed by a narrow band of Ochraceous-Orange and tipped with black. Some of the hairs in middorsal region are uniform black; sides of head, body, legs more yellowish than back; ring around eye and postauricular patches Ochraceous-Orange. Underparts, including inner sides of legs, gray with a slight wash of Ochraceous-Orange in lower ventral region; tail above has a general effect of hoary and has a distinct white border. Hair of tail on dorsal side black with short white tips; hairs of ventral side of tail have four black bands and three Ochraceous-Orange bands, alternating, and beginning at base with black.

MEASUREMENTS OF TYPE: Total length, 396 mm.; tail vertebrae, 182; hind foot, 51. Skull: condylobasal length, 48.8; zygomatic breadth, 31.5; interorbital breadth, 16.7; palatal length, 32.5.

SPECIMENS: Prov. Guanacaste: Volcán de Miravalles, 2 M.Z.U.M.; Hacienda Alemania, Volcán Orosi, 1 M.Z.U.M.; Hacienda Santa María, 3 M.Z.U.M. Prov. Alajuela: Vijagua, 2 M.C.Z.

Sciurus d. miravallensis is distinguished from *S. hoffmanni* in having the underparts gray in color instead of Ferruginous or Buff, and in having the hairs of the tail tipped with white instead of Ferruginous.

GUERLINGUETUS GRAY

Costa Rican representatives of *Guerlinguetus* include species of the *hoffmanni* group, rather small squirrels with ears narrow and thinly haired; tail equal to or shorter than head and body, bushy and flattened. This group ranges from the Escondido River, Nicaragua, south through Costa Rica, Panamá, and south to Ecuador. Upper premolar subcircular or quadrate in shape.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{1-1}{1-1}$; molars, $\frac{3-3}{3-3}$ = 20.

Sciurus hoffmanni hoffmanni (Peters)

HOFFMANN'S SQUIRREL

Sciurus aestuans var. *hoffmanni* PETERS, 1863, Monatsber. Akad. Wiss., Berlin, p. 654.

TYPE: A Berlin Museum specimen, collected by C. Hoffmann. The specimen on which Peters based his description was labeled "Costa Rica." Allen indicated that the type locality was somewhere in the vicinity of San José, and later Harris fixed it as Agua Caliente.

RANGE: Highlands of Costa Rica.

GENERAL CHARACTERS: A rather small, dark-colored squirrel with moderately long soft pelage, reddish tail, and rusty brown underparts.

DESCRIPTION: Entire upperparts, including top of head, outer side of fore and hind limbs, feet, and base of tail, mixed yellowish or rusty brown and black; outside of legs and feet often more yellowish or rusty; ears little darker than back with small basal patch of dingy fulvous or dull rusty; ring around eye dark buffy; underparts, including inner side of fore and hind feet and inner side of fore and hind limbs, varying dull rusty buff to deep ferruginous; tail above like back, heavily washed with bright ferruginous; below with broad median area mixed black and dark yellowish brown. Hairs on back black with narrow subterminal rings of buffy or rusty yellow, sometimes with similar subbasal rings. Skull rather broad, depressed in interorbital region; braincase arched and inflated over interparietal region and constricted posteriorly; rostrum and nasals relatively long.

MEASUREMENTS: Adult male from Irazú: Total length, 382 mm.; tail vertebrae, 180;

hind foot, 55. Skull: condylobasal length, 47.8; palatal length, 27; zygomatic width, 31.9; interorbital width, 16.5; length of upper maxillary toothrow, 9.4.

SPECIMENS: Prov. Cartago: Rancho de Río Jiménez, 3 A.M.N.H.; Volcán Irazú, 5 A.M.N.H., 1 C.N.H.M.; San Ramón Tres Ríos: 1 C.N.H.M. Prov. Alajuela: Volcán Poás, 4 A.M.N.H. Prov. San José: San José, 1 A.M.N.H., Escazú Heights, 1 A.M.N.H.

Specimens from Turrialba, San José, Volcán Poás, Irazú, and Escazú are typical. The extreme development of typical *hoffmanni* is to be found in specimens from the region of heavy rainfall on the northeastern side of the Volcán Turrialba which are darker and richer colored both above and below than specimens from San José.

Sciurus hoffmanni chiriquensis (Bangs)

CHIRIQUÍ SQUIRREL

Sciurus (Guerlinguetus) aestuans chiriquensis BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, no. 2, p. 22.

TYPE: M.C.Z. No. 10044, adult male, skin and skull, collected at Divala, Chiriquí, Panamá, altitude near sea level, November 18, 1900, by W. W. Brown, Jr.

GENERAL CHARACTERS: Similar in size and color to typical *hoffmanni* but pelage shorter and coarser and coloration slightly richer, the tone more rufescent.

DESCRIPTION: Similar to *hoffmanni* but slightly smaller. Color not appreciably different from that of the typical form except in a general tendency to a more rufous tone of the upperparts and redder underparts. The range of individual color variation in both forms is such that specimens of the two forms are often indistinguishable in coloration. The average difference in color and in the character of the pelage, however, is generally sufficient to distinguish the two forms.

MEASUREMENTS: Adult male from San Gerónimo: Total length, 398 mm.; tail vertebrae, 188; hind foot, 53; ear, 25. Skull: condylobasal length, 47.9; palatal length, 27.5; zygomatic width, 31; interorbital width, 17; length of maxillary toothrow, 8.8.

SPECIMENS: Prov. Puntarenas: Boruca, 4 A.M.N.H.; Palmar, 6 A.M.N.H.; Agua Buena, 12 A.M.N.H.; Coto, 4 M.Z.U.M.;

Punta Jiménez, 2 M.Z.U.M.; El General, 2 M.Z.U.M. Prov. Limón: Cuábre, 1 A.M.N.H.; Río Sixaola, 2 A.M.N.H.; Yarkin de Talamanca, 2 A.M.N.H. Prov. Alajuela: Cataratos, San Carlos, 1 A.M.N.H.; Lajas Villa Quesada, 2 A.M.N.H.; Zarcero, 3 M.Z.U.M. Prov. Heredia: Santa Clara, 1 A.M.N.H. Prov. Cartago: Perálta, 2 A.M.N.H.; Santa Teresa Perálta, 7 A.M.N.H.; Tuis, 1 A.M.N.H. Prov. San José: San Gerónimo Pirris, 6 A.M.N.H.; Pozo Azul Pirris, 1 A.M.N.H.

Sciurus hoffmanni chiriquensis is a rather poorly marked form differing from typical *hoffmanni* in having shorter and harsher pelage and averaging slightly richer in coloration. It inhabits the forested regions of both coasts.

SYNTHEOSCIURUS BANGS

Squirrels of this subgenus are small in size with a tail about equal to, or rather shorter than, the length of head and body and without a distinct line of demarcation between color of upperparts and underparts. Fur very thick and soft; ears greatly reduced. Skull with a relatively long and slender rostrum, nasals about equal in length to interorbital breadth. Anterior upper premolar small and peg-like; bullae relatively small; upper incisors proödont, extending beyond plane of tip of nasals; upper incisors with or without a groove on anterior surface.

Syntheosciurus has been retained as a full genus by most authors on account of the proödont grooved upper incisors. The discovery of a closely allied species in Costa Rica without grooves on the upper incisors suggests a subgeneric separation of *Syntheosciurus* from *Sciurus*.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{2-2}{1-1}$; molars, $\frac{3-3}{3-3}$ = 22.

Sciurus poasensis Goodwin

POÁS MOUNTAIN SQUIRREL

Sciurus poasensis GOODWIN, 1942, Amer. Mus. Novitates, no. 1218, p. 1.

TYPE: A.M.N.H. No. 131723, adult male, skin and skull, collected at Volcán Poás, altitude 6700 feet, Province of Alajuela, Costa Rica, May 26, 1930, by C. F. Underwood.

RANGE: Known only from the type locality.

GENERAL CHARACTERS: A small, dark, olive-colored squirrel, intermediate in size between *Microsciurus alfari* and *Sciurus deppei* and about equal in size to *Syntheosciurus brochus*; tail round and bushy, slightly shorter than length of head and body and colored similar to back; ears low, rounded, well haired inside and out to tip; pelage long, soft, and full with thick underfur; no distinct line of demarcation between colors of upperparts and underparts and no postauricular patches; pads of feet white. Incisor teeth slender, projecting forward, anterior surface smooth; upper premolars two on each side.

DESCRIPTION: Color of entire upperparts, including top of head, ears, sides of body, and outside of fore and hind limbs and feet, finely mixed Cinnamon-Buff and black, darkest on head and down middle of back; the thick underfur dark Plumbeous with a subterminal band or tipped with Cinnamon-Buff; tail similar to back, fringed along sides with rather reddish Cinnamon-Buff, the hair Ochraceous-Buff with subbasal and subterminal bands of black and mixed with a few black hairs. Ring around eye and sides of nose rich Cinnamon-Buff, a narrow area in inguinal region washed with bright Ochraceous-Tawny; inside of hind limbs similar to sides of body; feet rather browner than back. Skull small with a narrow slender rostrum; premaxillaries abruptly tapered anteriorly; postorbital processes slender; upper incisors long, slender, projecting forward, and not curved under, anterior surface smooth; molar teeth as in *Microsciurus*; a small peg-like premolar present and placed as in *S. deppei*; audital bullae small; nasals long and slender, terminating posteriorly on a line with the posterior border of the premaxillaries and constricted near base, their posterior border only slightly emarginate. Posterior palatine foramina placed well behind a line across the middle of second molars; posterior border of palate broad, evenly rounded, and without central process; sphenopalatine foramina very large.

MEASUREMENTS: Head and body, 155 mm.; tail vertebrae, 140; hind foot, s.u., 40 (in dried skin including claws, 43.7); ear, 16; basal length, 35. Skull: condylobasal length, 38.7; occipitonasal length, 43.6; palatal

length, 20.6; length of nasals, 12.7; width of nasals, 5.4; zygomatic width, 24.8; interorbital width, 12.4; width of palate across m^2 - m^2 , 10.1; length of upper molar series, 7.4.

SPECIMENS: Prov. Alajuela: Volcán Poás, 1 A.M.N.H.

Sciurus poasensis is a well-marked species characterized by definite cranial characters. Its resemblance to *S. brochus* from Boquete, Panamá, in external and most cranial characters is remarkable. The absence of a longitudinal median groove on the upper incisor, present in *S. brochus*, separates it from that species. Underwood met with this squirrel only once. He took an individual on the forested slopes of Volcán Poás.

***Sciurus brochus* (Bangs)**

BOQUETE MOUNTAIN SQUIRREL

Syntheosciurus brochus BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, p. 25.

TYPE: M.C.Z. No. 10402, adult male, skin and skull, collected at Boquete (7000 feet elevation), Chiriquí, Panamá, April 30, 1901, by W. W. Brown, Jr.

RANGE: Highlands of southwestern Panamá and probably adjacent parts of Costa Rica.

GENERAL CHARACTERS: Similar in external appearance and cranial characters to *S. poasensis*. Construction of skull fragile; upper incisors slender, projecting forward and with a well-defined median groove down the anterior surface of each (not present in *poasensis*).

DESCRIPTION OF TYPE: "Color of upperparts finely mixed Olivaceous Bistre and dull Tawny-Olive—the hairs Olivaceous Bistre tipped with dull Tawny-Olive; under fur dark Mouse Gray; orbital ring, sides of nose, and chin Tawny-Olive; tail similar to back, fringed along sides with pale rusty and slightly more reddish, less Olivaceous below; underparts, especially along middle line, strongly suffused with Orange Rufous in the type, Ferruginous in topotype" (Bangs).

MEASUREMENTS OF TYPE: Total length, 320 mm.; head and body, 170; tail vertebrae, 150; hind foot, 46; ear, 17. Skull: basal length, 35.6; occipitonasal length, 44; zygomatic width, 25.2; interorbital width, 12.6; palatal length to palatal notch, 20; to end of

pterygoid, 27.4; length of nasals, 13; width of nasals, 5.8; length of upper molar series, 7.6.

Grooved incisors are a rare development in the squirrels. In some genera a groove on upper incisors is known to appear from time to time as an individual peculiarity but never so definitely pronounced as in the only two available specimens of *S. brochus*. Additional material, however, may show an intergradation with *S. poasensis* where the grooves are entirely absent. Both species were found in a similar habitat at localities not very widely separated geographically, and without actually comparing specimens, both species apparently show a marked similarity in all characters except the groove on the upper incisor. *S. poasensis* at least forms an intermediate link between *Sciurus* and *Microsciurus* but is probably not more than subgenerically separable from *Sciurus*.

MICROSCIURUS ALLEN

PYGMY SQUIRRELS

The pygmy squirrels of the *Microsciurus* group are mainly South American in distribution, primarily the Andean region, and range from Peru, Rio Negro (Amazon), and Ecuador northward through Panamá and Costa Rica to southern Nicaragua. In this genus the tail is short and narrow, and about 40 per cent of the total length; ears small, rounded, and well haired; digits as in normal tree squirrels. The skull is short, broad, and deep, the superior outline arched but strongly depressed posteriorly; rostrum short and broad at base; interorbital space broad. Upper incisors proödont, usually extending beyond plane of tip of nasals; bullae relatively small; postorbital process situated over posterior root of zygomatic arch.

DENTITION: Incisors, $\frac{1}{1}$ - $\frac{1}{1}$; canines, $\frac{0}{0}$ - $\frac{0}{0}$; premolars, $\frac{2}{1}$ - $\frac{2}{1}$; molars, $\frac{3}{3}$ - $\frac{3}{3}$ = 22.

***Microsciurus alfari alfari* (Allen)**

ALFARO'S PYGMY SQUIRREL

Sciurus (Microsciurus) alfari ALLEN, 1895, Bull. Amer. Mus. Nat. Hist., vol. 7, p. 333.

TYPE: A.M.N.H. No. 11290/9554, female adult, skin and skull, collected at Jiménez (altitude about 600 feet), Costa Rica, January 24, 1894, by George K. Cherrie.

RANGE: Humid tropical forest regions of northeastern Costa Rica.

GENERAL CHARACTERS: A small, dark reddish brown squirrel with tail uniform in color with back, and short close pelage.

DESCRIPTION: General color of upperparts finely mixed Ochraceous-Tawny and black, the fur Plumbeous from base for most of its length, and tipped with Ochraceous-Tawny, the longer and coarser hairs black with a subterminal band of Ochraceous-Tawny, ring around eye and wash over whole front of face rich Ochraceous-Orange; underparts dull Ochraceous-Buff; hairs of tail Ochraceous-Tawny with a subbasal and a subterminal band of black, the hairs on tip of tail entirely black. Skull small, posterior border of the palate rounded and slightly in front of a line across the back of the last molars, rostrum short, broad, jugal very deep, braincase constricted in front of occiput, nasals broad, slightly emarginate, and ending posteriorly in front of the posterior border of the premaxillaries.

MEASUREMENTS: Type, in dried skin: Total length, 250 mm.; tail vertebrae, 105; hind foot, 36.5; ear from notch, 9. Skull: occipitonasal length, 36.9; condylobasal length, 32.3; palatal length, 16.2; length of nasals, 10.5; interorbital width, 12.7; width of braincase, 18.4; zygomatic width, 22.5; length of maxillary toothrow, 5.5.

SPECIMENS: Prov. Limón: Jiménez, 1 A.M.N.H.; Siquirres, 1 A.M.N.H. Prov. San José: Carrillo, 2 B.M.

Alfaro's pygmy squirrel inhabits the low humid tropical forest country of northeastern Costa Rica. Comparatively little is known about the life histories of these diminutive squirrels. Owing to their habitat and their protective coloration, they easily escape observation.

Microsciurus alfari septentrionalis
Anthony

NICARAGUAN PYGMY SQUIRREL

Microsciurus septentrionalis ANTHONY, 1920, Jour. Mammal., vol. 1, no. 2, p. 81.

TYPE: A.M.N.H. No. 41235, adult female, skin and skull, collected at Sabalos, on Río San Juan, at junction of the Río Sabalos, Nicaragua, May 12, 1917, by Wm. B. Richardson.

RANGE: Low tropical forest lands of extreme south central Nicaragua and adjacent parts of Costa Rica.

GENERAL CHARACTERS: Similar to typical *M. alfari* in general appearance but with less rufescent pelage, above and below; post-palatal region in skull noticeably longer and molar teeth smaller.

DESCRIPTION: Color of upperparts mixed Olive and black, the fur Slate-Black at base and tipped with Honey Yellow, longer and coarser guard hairs black with a subterminal band of Honey Yellow, top of head slightly more ochraceous; ring around eye and wash over front of face pale Ochraceous-Orange; underparts Warm Buff; tail Cinnamon-Rufous with a subbasal and subterminal band of black. Skull like that of *alfari* but with longer palate, the post-palatal notch not reaching to plane of last molar; jugal narrow, nasals short, truncate, and terminating posteriorly in front of the posterior border of the premaxillaries.

MEASUREMENTS OF TYPE: Total length, 240 mm.; tail vertebrae, 100; hind foot, in dried skin with claws, 37. Skull: occipitonasal length, 35.7; condylobasal length, 31; palatal length, 16.5; zygomatic breadth, 21.6; breadth of braincase, 18.4; interorbital breadth, 14; length of nasals, 10; length of maxillary toothrow, 5.4.

SPECIMENS: Prov. Alajuela: La Vieja de San Carlos, 1 M.Z.U.M.; La Vijagua, 2 M.C.Z.

Microsciurus a. septentrionalis is a short-haired race that inhabits the humid tropical lowlands in southern Nicaragua and northern Costa Rica. The pelage is about the same texture as that of *alfari*, but the color of the upperparts is decidedly more Olive and lacks the reddish brown suffusion of the typical form.

***Microsciurus alfari browni* (Bangs)**
BROWN'S PYGMY SQUIRREL

Sciurus (Microsciurus) browni BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, p. 24.

TYPE: M.C.Z. No. 10404, old male, skin and skull, collected at Bugaba (600 feet elevation), Chiriquí, Panamá, July 15, 1901, by W. W. Brown, Jr.

RANGE: Low elevations on the Pacific

slopes of the Cordillera, western Panamá, and Costa Rica.

GENERAL CHARACTERS: About the size of *M. a. alfari* but pelage much thinner, coarser, and color of upperparts decidedly more Olive, contrasting with the rusty brown shade of *alfari*.

DESCRIPTION: Color of upperparts, including back, flanks, neck, top of head and ears, outside of fore and hind limbs, feet and base of tail, Ochraceous-Tawny finely mixed with black; the hairs slate black with a subterminal band Ochraceous-Tawny; front of head, neck, and sides of head clearer Ochraceous-Tawny than back; an indistinct Ochraceous-Tawny ring around eye, hairs of tail Russet at base with alternate bands of Russet and black, tipped with Warm Buff; inside of fore limbs, chin, and throat usually washed with Pinkish Buff, the hairs broadly Plumbeous at base; hind limbs and posterior part of belly more nearly like upperparts. Skull similar to that of *M. a. alfari*, but the braincase is narrower, more rounded, and without so marked a constriction in front of occiput; molar teeth larger, the second upper premolar being noticeably larger.

MEASUREMENTS: Six Costa Rican specimens, and type in parentheses: Head and body, 121–132 mm. (140); tail vertebrae, 75–118 (120); hind foot, 33–36 (37); ear, 14–19 (13). Skull: occipitonasal length, 35–36.8 (36); condylobasal length, 30.7–32.6; zygomatic width, 20.8–22.3 (21.2); breadth of braincase, 17–18; palatal length, 13.6–14.6 (13.4); interorbital width, 11.5–12.7 (12.4); length of nasals, 9.8–10.2 (11); length of maxillary toothrow, 5.4–6 (5.8).

SPECIMENS: Prov. San José: San Gerónimo, 1 U.S.N.M., 2 C.N.H.M., 1 U.S.F.W., 1 M.C.Z.; Alto Jabillo, 1 U.S.N.M., 1 U.S.F.W., 1 C.N.H.M.; Pozo Azul, 1 U.S.N.M. Costa Rica, probably San Gerónimo: 1 M.C.Z., 1 U.S.N.M. Prov. Puntarenas: Agua Buena, 3 A.M.N.H.; Coto, 6 M.Z.U.M.; El General, 1 M.Z.U.M.; Puerto Uvita, 2 M.Z.U.M.

Brown's pygmy squirrel is known only from relatively low elevations on the Pacific slope in the western part of Costa Rica, from near sea level up to about 3000 or 4000 feet. The pelage is rather close and coarse in

specimens from the coastal regions but becomes longer and softer at higher elevations.

***Microsciurus alfari alticola* Goodwin**

MOUNTAIN PYGMY SQUIRREL

Microsciurus alfari alticola GOODWIN, 1942, Amer. Mus. Novitates, no. 1218, p. 2.

TYPE: A.M.N.H. No. 140388, male adult, skin and skull, collected at Lajas Villa Quesada, altitude 5000 feet, Province of Alajuela, Costa Rica, January 5, 1942, by C. F. Underwood.

RANGE: Highlands of central Costa Rica.

GENERAL CHARACTERS: A dull, Olive-colored pygmy squirrel with long, thick, woolly pelage, slightly larger than *M. a. alfari* with longer, softer fur and lacking the reddish brown suffusion of the typical form.

DESCRIPTION: Color of upperparts dark Olive-Brown, the fur Plumbeous from base for most of its length and tipped with Light Ochraceous-Buff, the longer hairs glossy black with a subterminal band of Ochraceous-Buff; sides of head grading to pale Ochraceous-Tawny on checks and front of face; underparts lightly washed with Warm Buff; tail Ochraceous-Tawny and black, the hairs with alternate bands of each color; tail pencil black. Skull relatively large with narrow jugal, palate long and extended posteriorly beyond the plane of the last molars; nasals relatively long and slender, posterior border emarginate and extending to the posterior border of the premaxillaries.

MEASUREMENTS: Type and topotype, both males: Total length, 248 mm., 250; tail vertebrae, 118, 113; hind foot, 39, 40; ear, 14, 14. Skull: occipitonasal length, 36.9; condylobasal length, 32.1; palatal length, 16.6; length of nasals, 10.8; zygomatic width, 21.7; width of braincase, 18.5; interorbital width, 13.9; length of maxillary toothrow, 5.45, 5.6.

SPECIMENS: Prov. Alajuela: Lajas Villa Quesada, 3 A.M.N.H.; upper San Carlos River, 1 A.M.N.H. Prov. San José: La Hondura, 1 M.Z.U.M.

Microsciurus a. alticola is a highland race with long dense fur. It is similar in color to *septentrionalis* and *browni* but differs in having the underparts more uniform with

back, and longer and more woolly pelage. In cranial characters it differs from *septentrionalis* in having longer and narrower nasals, and from *browni* in having a broader braincase and smaller teeth. *M. a. alfari* is a short-haired race and has a richer and more rufescent coloration than *alticola*. In cranial characters it differs from the latter in having a shorter palate and decidedly deeper jugal.

***Microsciurus boquetensis* (Nelson)**

CHIRIQUÍ PYGMY SQUIRREL

Sciurus (Microsciurus) boquetensis NELSON, 1903, Proc. Biol. Soc. Washington, vol. 16, p. 121.

TYPE: B.M. No. 3.3.3.38, adult female, skin and incomplete skull, collected at Boquete (altitude 6000 feet), Chiriquí, Panamá, May 7, 1903, by H. J. Watson.

RANGE: High mountain slope of north-western Panamá and probably adjacent parts of Costa Rica.

GENERAL CHARACTERS: A medium-sized pygmy squirrel of the *alfari* group with thick soft pelage, Olive-Brown upperparts, and strongly colored breast.

DESCRIPTION: (Original description.) "Upperparts including sides of body and upper surface of legs uniform olivaceous-brown with a dull yellowish shade; sides of head and neck slightly paler and more yellowish; top of feet and toes washed with rusty reddish, tail dull Tawny-Olive finely washed and tipped with black and thinly edged with pale yellowish tips of hairs; chin and throat dingy rusty; under side of neck and breast rusty Rufous shading back into dull grizzled brown; under side of tail dull Tawny-Olive narrowly bordered with black and thinly edged with pale yellowish tips of hairs." Skull of type too imperfect for description but molar series long and heavy for Central American species.

MEASUREMENTS: Type (dry skin): Total length, 257 mm.; tail vertebrae, 116; hind foot, 37. Skull: palatal length, 15.5; inter-orbital breadth, 14; length of upper molar series, 7.

The measurements of the slightly over-stuffed type show that it is about the same size as typical *alfari*. The thick soft pelage indicates that it is a resident of a comparatively cool and probably humid climate.

FAMILY HETEROMYIDAE

POCKET MICE

The family Heteromyidae includes a group of mammals widely distributed in the drier parts of western North America, central and northern South America. The range extends from British Columbia southward in the western United States to the Dakotas and Texas, through Mexico and Central America south to Ecuador, Colombia, and Venezuela. Only two genera, *Heteromys* and *Liomys*, are represented in Costa Rica. The other members of the family are the pocket mice of the genus *Perognathus* and the kangaroo rats of the genera *Dipodomys* and *Microdipodops*. The Central American representatives are distinguishable from other small rodents inhabiting this area by the deep external cheek pouches in combination with the flattened spines or bristly pelage. They overlap the other genera of the Heteromyidae in geographical range, but gradually replace them from southern Texas southward through Mexico.

HETEROMYS DESMAREST

GREATER SPINY POCKET MICE

Pocket mice of this genus closely resemble those of the genus *Liomys* but are larger and blacker in color. The pelage is usually composed of flattened, anteriorly grooved spines mixed with long slender hairs, tail longer than head and body; sole of hind foot naked at least to posterior tubercle. Second digit on hind foot with a specialized spoon-like claw. The dark color of upperparts usually extending down forearms to wrists. Skull elongate, interpterygoid fossa V-shaped. Front upper incisors without grooves. The range of this genus includes tropical and subtropical portions of continental America from southern Mexico to Ecuador, also the Island of Trinidad, West Indies.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{1-1}{1-1}$; molars, $\frac{3-3}{3-3}$ = 20.

HETEROMYS DESMAREST

Subgeneric characters with a few exceptions include: pelage hispid, tail thinly haired, sole of hind foot naked posteriorly; six-tuberculate; inner side of forearms white; braincase flat, last molars slightly narrower than premolars.

Heteromys desmarestianus repens* Bangs*BOQUETE SPINY POCKET MOUSE**

Heteromys repens BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, pp. 45-47.

TYPE: M.C.Z. No. 10356, old female, skin and skull, collected at Boquete on southern slope of Volcán de Chiriquí, Panamá (altitude 4000 feet).

RANGE: Mountains of western Panamá and probably eastern Costa Rica; limits of range undetermined.

GENERAL CHARACTERS: Size medium, ears small, about 15 mm., tail slightly longer than head and body, bicolor; general color very dark, and no buffy lateral line. Pelage very coarse and spiny.

DESCRIPTION: Color (fresh pelage): upperparts dark Mouse Gray, shaded with blackish on median dorsal area and finely mixed with pale Ochraceous-Tawny hairs; underparts and feet white; lower part of face and outer sides of legs dark Mouse Gray; ears dusky without white edging; tail brownish above, dull whitish below. Skull long and low, superior outline in nearly a straight line from nasals to occipital, rostrum long and evenly tapered, incisors long and curved under, diastema wide, molar teeth small, palate narrow, interpterygoid fossa V-shaped; nasals reaching posteriorly beyond premaxillae, supraorbital and temporal ridges well developed.

MEASUREMENTS: Type, female, and topotype, male: Total length, 282 mm., 285; tail vertebrae, 150, 145; hind foot, 33, 33; ear, 15, 15. Skull: greatest length, 35.5, 36; interorbital breadth, 9.6, 10; length of nasals, 15, 14.5; width of braincase, 15, 14; length of upper molar series, 5.1, 5.3; interparietal, —, 8.4 by 5.3.

***Heteromys desmarestianus chiriquensis*
Enders****CHIRIQUÍ SPINY POCKET MOUSE**

Heteromys desmarestianus chiriquensis ENDERS, 1938, Proc. Acad. Nat. Sci. Philadelphia, vol. 90, p. 141.

TYPE: A.N.S.P. No. 17835, adult male, skin and skull, collected at Cerro Pando, a hill 4000 feet in elevation situated between

the Río Chiriquí Viejo and its tributary, the Río Colorado, about 10 miles from the Post Office of El Volcan, Province of Chiriquí, Panamá, August 20, 1935, collected by Robert K. Enders.

RANGE: Southwestern Panamá and possibly adjacent parts of Costa Rica.

GENERAL CHARACTERS: A large, dusky-colored spiny pocket mouse, usually with a well-developed buffy lateral line. Similar in external characters to *H. d. planifrons*, but ankles dark all around in most specimens, the black hair extending to the heel; in *planifrons* a broad white line extends from the underparts to the foot. Closest in external characters to *H. d. subaffinis*, but under side of forearms and chest white and skull longer and more drawn out.

DESCRIPTION OF TYPE: Spines on upperparts blackish and mixed with light Tawny-tipped hairs, sides lighter and more buffy; lateral line light Tawny; underparts white except scrotum, inguinal region buffy due to the continuation of the lateral line along the border of demarcation on the under side of the hind limbs; suggestion of a light line down inner side of hind legs; ankles dark all around; tail brownish black above, lighter below. Skull long, with a relatively narrow braincase, narrow frontals and parietals; premaxillae extending slightly beyond posterior border of nasals; bullae small.

MEASUREMENTS: Adult male and female from Agua Buena, and type in parentheses: Total length, 300 mm., 290 (302); tail vertebrae, 166, 155 (154); hind foot, 37, 38, dry, 38, 37 (35); ear, 15, 16 (19). Skull: greatest length, 40.9, 39.7 (37.6); zygomatic width, 18, 18 (17.2); interorbital width, 10.2, 10.15 (10.1); length of nasals, 16.8, 15.5 (17); alveoli of maxillary tooththrow, 5.5, 5.7.

SPECIMENS: Prov. Puntarenas: Agua Buena, 8 A.M.N.H.

A series from Agua Buena covers a wide range of individual coloration, varying from blackish individuals in fresh pelage to specimens in which the buffy hairs are predominant. In some the hair around the ankles and well down the upper side of the foot is black, while in others a white line extends to the dorsum of foot. In some the Tawny

lateral line is well developed, and these have a decided tinge of Tawny in the inguinal region, while in others a Tawny lateral line is barely indicated and entire underparts are white.

Heteromys desmarestianus planifrons

Goldman

PIRRÍS SPINY POCKET MOUSE

Heteromys desmarestianus planifrons GOLDMAN, 1937, Jour. Washington Acad. Sci., vol. 27, no. 10, pp. 418-419.

TYPE: U.S.N.M. No. 250348 (Biol. Surv. Coll.), adult female, skin and skull, collected at San Gerónimo, Pírris, western Costa Rica, April 12, 1931, by C. F. Underwood.

RANGE: Western Costa Rica; limits of range undetermined.

GENERAL CHARACTERS: A large spiny pocket mouse, closely resembling *Heteromys desmarestianus desmarestianus* of Guatemala. Color, general size, and proportions very similar, but dusky color of forearms tending to extend farther down on wrists; pelage sparser; light Tawny lateral line usually present as in *desmarestianus*; skull usually broader and differing in other details. Similar to *Heteromys desmarestianus fuscatus* of central Nicaragua but larger; light Tawny lateral line usually present (usually absent or indistinct in *fuscatus*); cranial characters distinctive. Not very unlike *Heteromys desmarestianus repens* of the mountains of western Panamá, but larger with relatively larger ears; pelage coarser and sparser; differing otherwise in about the same characters as from *fuscatus*. Smaller than *Heteromys oresterus* of the Cordillera de Talamanca; pelage more bristly; slender hairs among bristles deeper Ochraceous-Buff; ears without white edging usual in *oresterus*.

DESCRIPTION OF TYPE: Upperparts blackish, becoming very dark brown or "mouse-gray" along flanks and outer sides of limbs, the slender light Tawny hairs present but inconspicuous among the bristles; entire underparts, feet, a line down inner side of hind legs to metatarsus white; a narrow but distinct light Tawny line of demarcation along flanks; ears blackish; tail brownish above, whitish below, becoming dusky all around at tip. Skull large, with broad brain-

case, broad frontal and parietal regions, closely resembling that of *desmarestianus* but usually broader, the lateral margins of frontals somewhat more prominent and projecting as supraorbital shelves; interparietal broader, more extended transversely, more evenly oval in outline, the anterior angle less developed; supraoccipital more produced on the median line, tending to bulge farther posteriorly over foramen magnum; dentition about the same; similar in general to that of *fuscatus* and of *repens*, but larger; interparietal relatively broader, with less evident anterior angle; supraorbital ridges more projecting and shelf-like.

MEASUREMENTS: Type, and one female adult topotype in parentheses: Total length, 303 mm. (302); tail vertebrae, 169 (174); hind foot, 35 (35). Skull (type): greatest length, 37.7; zygomatic breadth, 18.1; interorbital breadth, 9.9; length of nasals, 16.3; width across squamosals in front of auditory meatus, 16.3; interparietal, 9.9 by 4.9; alveoli of maxillary toothrow, 5.5.

SPECIMENS: Prov. San José: San Gerónimo Pírris, 5 U.S.N.M. (4 Biol. Surv. Coll.), 2 C.N.H.M., 2 M.C.Z., 1 A.M.N.H.; Jabillo, 1 M.C.Z.; Sabanilla, 1 U.S.N.M. Prov. Guanacaste: Hacienda Santa María, 3 M.Z.U.M. Prov. Puntarenas: El General, 1 M.Z.U.M. Prov. Alajuela: Cataratos, San Carlos, 1 A.M.N.H.; Vijagual San Carlos, 1 A.M.N.H.

Heteromys d. planifrons is a rather slightly differentiated form bearing a close resemblance to typical *desmarestianus*. Comparison of 13 topotypes of *Heteromys desmarestianus psakastus* of El Salvador with series of *desmarestianus*, assumed to be typical from Chipoc and other localities in the Coban region of Guatemala, indicates that the two are identical and that, therefore, *psakastus* does not have to be considered in this connection. Specimens from San Carlos River Valley suggest intergradation with *subaffinis* and *fuscatus* but are nearest to *planifrons*. An adult male and two juvenals from Santa Maria, Guanacaste, are provisionally referred to *planifrons*. They are about the color of *repens* but equal *planifrons* in external and cranial measurements and may represent an undescribed race occupying the Cordillera del Guanacaste.

Heteromys desmarestianus subaffinis

Goldman

REVENTAZÓN VALLEY SPINY POCKET MOUSE

Heteromys desmarestianus subaffinis GOLDMAN, 1937, Jour. Washington Acad. Sci., vol. 27, no. 10, p. 42.

TYPE: U.S.N.M. No. 12904/3859, adult male, skin and skull, collected at Angostura, on the southern side of Río Reventazón, opposite Turrialba, Costa Rica (altitude about 1980 feet), May, 1878, by José C. Zeledón.

RANGE: Río Reventazón and Pacuare River valleys, eastern Costa Rica; limits of range unknown.

GENERAL CHARACTERS: Similar in size and color to *Heteromys desmarestianus planifrons* of western Costa Rica, but fore limbs more or less dusky all round, and this color extending on throat and chest in some specimens. Resembling *H. d. fuscatus* of central Nicaragua, but larger, with broader, more massive skull. Larger than *H. d. repens* of the mountains of western Panamá, with ears relatively larger and skull heavier.

DESCRIPTION: Color of upperparts blackish or very dark brownish, finely mixed with light Tawny, due to the tone of the slender hairs among the dark bristles; forearms, thighs, lower part of rump, and scrotum Mouse Gray; underparts, in general including inner sides of hind limbs and feet, white; middle of chest and throat dusky in Perálta specimens; an indistinct light Tawny lateral line present in some individuals; ears brownish, tail dark brownish above, white below. Skull very similar in size and general form to that of *planifrons*, but narrower, zygomatic arches less expended and with more prominent angles; dentition about the same. Differing from those of *fuscatus* and *repens* mainly in decidedly larger size, the supraorbital ridges more strongly developed as projecting shelves.

MEASUREMENTS: Type and adult female from Perálta: Head and body,—, 137 mm.; tail,—, 154; hind foot, in dried skin, 34.5, 34; ear,—, 17. Skull: greatest length, 36.9, 37.8; zygomatic breadth, 17.3, 16.5; interorbital breadth, 10, 10; length of nasals, 15.9, 15; width across squamosals in front of auditory meatus, 15.8, 15.2; interparietal, 8.9 by 5.3, 10 by 5.7; alveoli of maxillary toothrow, 5.5, 5.1.

SPECIMENS: Prov. Cartago: Perálta, 2 A.M.N.H.; Angostura, 3 U.S.N.M., Prov. Limón: Suerre, 1 A.M.N.H.; Pacuare, 1 U.S.N.M.

Heteromys desmarestianus underwoodi

Goodwin

UNDERWOOD'S SPINY POCKET MOUSE

Heteromys desmarestianus underwoodi GOODWIN, 1943, Amer. Mus. Novitates, no. 1227, pp. 1-2.

TYPE: A.M.N.H. No. 131729, adult female, skin and skull, collected at Escazú, a small town about 7 miles southwest of San José, elevation about 3000 feet, Province of San José, Costa Rica, April 28, 1938, by C. F. Underwood.

RANGE: Highlands of central Costa Rica.

GENERAL CHARACTERS: A small spiny pocket mouse with small ears, tail longer than head and body. Closely allied to *H. d. repens* but smaller, and considerably smaller than *H. d. planifrons* and *H. d. subaffinis*.

DESCRIPTION: Color of upperparts varying from Mummy Brown to Saccardo's Umber, the spines blackish and mixed with fine Cinnamon-Buff hairs, outside of hind limbs slaty gray, outside of fore limbs buffy gray; ears dark Mummy Brown with a narrow white margin; tail Mummy Brown above, entire under side white. Underparts, including fore and hind feet to above wrists and ankles, under side of fore and hind limbs, lips to above nostrils, pure white to roots of hairs; buffy lateral line more or less distinct. Skull small and relatively broad anteriorly, supraorbital ridges strongly developed as protecting shelves; interparietal short and extended transversely; nasals conterminous with premaxillae posteriorly; rostrum evenly tapered anteriorly from zygomata; braincase narrow; bullae small but well inflated; teeth small.

MEASUREMENTS: Type (adult male), and adult male and two females from Los Higuerones, Escazú: Head and body, 129, 137, 123, 143 mm.; tail vertebrae, 148, 150, 154, 140; hind foot, 34, 35, 36, 35. Skull: greatest length, 34.5, 35.5, 35, 34.8; zygomatic breadth, 15.6, 16, 16, 16; interorbital width, 9.5, 9.4, 9,—; length of nasals, 13.8, 14.7, 14.1, 14.5; width of braincase, 13.6, 14, 13.7, 13.5; interparietal, 8.7 by 4, 9 by 5.6,

9.2 by 5, 9.5 by 4.5; alveoli of upper molar series, 5, 5, 5.1, 4.7.

SPECIMENS: Prov. San José: Escazú, 1 A.M.N.H.; Los Higuerones, 4 A.M.N.H. Prov. Cartago: San Ramón, Tres Rios, 1 U.S.F.W., 3 C.N.H.M.; Isla Nieve Irazú, 1 A.M.N.H. (skin only).

Heteromys d. underwoodi is the smallest known race of the *desmarestianus* group, much smaller than its nearest geographical neighbors, *H. a. planifrons* and *H. d. subaffinis*, of the lowlands of eastern and western Costa Rica. It is nearest in size to *H. d. repens*, but the white of the underparts extends farther up on the fore and hind limbs, and the tail is relatively longer. Cranial details, including smaller size, broader rostrum, narrower braincase, relatively shorter nasals, smaller bullae, and shorter interparietals more extended transversely, serve to distinguish this race from *repens*. Specimens from Escazú and Los Higuerones were collected at altitudes from 3000 to 5000 feet elevation in humid virgin country that is interspersed with patches of maize as well as clearings for cattle. Those from San Ramón, Tres Rios, are slightly larger than the type series but apparently referable to *underwoodi*.

XYLOMYS MERRIAM

In this subgenus the pelage is composed of soft bristles intermixed with slender hairs; sole of hind foot naked; six-tuberculate; molariform toothrows broad posteriorly, the last molar about equal to premolars.

Heteromys oresterus Harris SOFT-HAIRED POCKET MOUSE

Heteromys oresterus HARRIS, 1931, Occas. Papers Mus. Zool. Univ. Michigan, no. 248, p. 4.

TYPE: M.Z.U.M. No. 64027, adult male, skin and skull, collected May 25, 1931, by Austin Smith at El Copey de Dota in the Cordillera de Talamanca, altitude 6000 feet, Province of Cartago, Costa Rica.

RANGE: Known only from the type locality.

GENERAL CHARACTERS: A large, dusky-colored pocket mouse with relatively soft bristles and ears edged with white.

DESCRIPTION: Color of type: upperparts blackish gray, finely mixed with Ochraceous-Buff. Sides more buffy than the median area

of back and head; ears blackish with white edging; underparts and feet white; fore legs above like color of sides; hind legs above and ankles gray; tail black above and white below except at base where it is black all round, tail with white tip. Skull similar to that of *repens* but with long rostrum, more inflated anteriorly, premaxillae reaching posteriorly beyond the nasals; palate narrower; bullae less inflated.

MEASUREMENTS: Type, adult male: Total length, 357 mm.; tail vertebrae, 174; hind foot, 40; ear from crown, 16. Skull: greatest length, 39.6; zygomatic width, 16.8; interorbital width, 9.6; length of nasals, 16.2; width of braincase, 15.7; alveoli of upper molar series, 5.2.

SPECIMENS: Prov. Cartago: El Copey de Dota, 9 M.Z.U.M.; El Muñeco, 1 M.Z.U.M.

The habits of the spiny pocket mice are modified to a certain extent by the varying conditions of local environment. They are nocturnal, shy, and make a burrow into the ground under bushes, trees, and rocks. The entrances to the burrows are usually inconspicuous. They reach their greatest abundance in semi-arid, partially wooded regions and frequent suitable localities in both the mountains and plains; some species, however, inhabit humid, heavily forested areas. From three to five young are produced in a litter at birth, four being the usual number. The food of the pocket spiny mice consists largely of seeds of a great variety.

LIOMYS MERRIAM

LITTLE SPINY POCKET MICE

This genus is similar in general external characters to *Heteromys*; pelage hispid; tail haired; sole of hind foot usually hairy posteriorly; five- or six-tuberculate. Second digit on hind foot with a differentiated, specialized, spoon-like claw. Skull broad with narrow rostrum, interpterygoid fossa U-shaped. Last molars decidedly narrower than premolars. The range of the genus *Liomys* is restricted to the tropical and Sonoran zones, from southern Texas through Mexico, Guatemala, Nicaragua, Honduras, Costa Rica, and Panamá.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{1-1}{1-1}$; molars, $\frac{3-3}{3-3} = 20$.

Liomys salvini nigrescens (Thomas)

DUSKY SPINY POCKET MOUSE

Heteromys salvini nigrescens THOMAS, 1893, Ann. Mag. Nat. Hist., ser. 6, vol. 12, p. 234.

TYPE: B.M. No. 69.7.19.6, from Costa Rica, but the exact locality is not known. It seems reasonable to assume that the type came from an accessible part of Costa Rica, probably Escazú.

RANGE: Highlands of central Costa Rica, limits of range not determined, replaced on the Pacific coast and the Nicoya Peninsula by differentiated forms.

GENERAL CHARACTERS: A rather small, dark-colored spiny pocket mouse with white underparts, no buffy lateral line; fore limbs and feet white except for an occasionally narrow fringe of dusky-tipped hairs down outside of arms; tail relatively long.

DESCRIPTION: Color of specimens from Escazú: upperparts from tip of nose to base of tail, including outer sides of hind limbs to ankles, black finely mixed with Ochraceous-Buff, the black predominating; the spines grayish white with a broad black terminal band, the long slender hairs with a broad subterminal band of black and tipped with buff; underparts, including forearms, feet, inner sides of hind limbs, white; tail brownish above and white below. Skull slender with a narrow rostrum, its sides nearly parallel, relatively long narrow nasals; interorbital region slightly depressed; braincase moderately large and slightly elevated behind orbits, the ascending branches of the premaxillae extending beyond the posterior border of nasals; bullae small and relatively flat.

MEASUREMENTS: Adult male from Villa Colon, adult male from Altos Escazú, and type in parentheses: Head and body, 116 mm., 111 (127); tail vertebrae, 113, 114; hind foot, without claws, 28, 27 (25); ear, 15, 13. Skull: greatest length, 33.7, 31.5 (32.7); zygomatic breadth, 16, 14.6 (15.2); interorbital breadth, 7.7, 6.5 (6.6); length of nasals, 13.5, 12 (13.2); alveoli of upper molar series, 5.2, 5 (5).

SPECIMENS: Prov. San José: Los Higueros, Escazú, 3 A.M.N.H.; Altos Escazú, 1 A.M.N.H., 1 M.C.Z.; Villa Colon, 3 U.S.F.W., 10 C.N.H.M.

Liomys salvini aterrimus Goodwin

WESTERN COSTA RICAN SPINY POCKET MOUSE

Liomys salvini aterrimus GOODWIN, 1938, Amer. Mus. Novitates, no. 987, pp. 4-5.

TYPE: C.N.H.M. No. 35211, adult female, skin and skull, collected at Sabanilla de Pirris, a town about 3730 feet elevation, on Pacific Coast Range, 10 miles south of Puriscal, April 12, 1931, by C. F. Underwood.

RANGE: Lower slopes of the Pacific Coast Range of northwestern Costa Rica.

GENERAL CHARACTERS: A small, very dark-colored pocket mouse without yellowish lateral line; slaty gray border on outside of forearm, similar in general color to *L. s. nigrescens* but darker, tail longer, and skull larger and broader with larger bullae.

DESCRIPTION: Color of upperparts uniform brownish black, tail bicolored, like back above, white below; outside fore and hind limbs with more or less broad edging of black-tipped hairs which extend in a broad line on upper side of fore feet to base of toes in an Esparta specimen; the black of back extends down upper side of hind limbs to below ankles; underparts, including chin, inner side of limbs and toes, white. Skull similar to *L. s. nigrescens* but broader and not depressed in parietal region, braincase large and smoothly rounded, nasals long and narrow, upper incisors large; premaxillae broad, rostrum broad at base and evenly tapered forward; bullae large and well inflated.

MEASUREMENTS: Type, and adult female from Esparta: Head and body, 110, 110 mm.; tail, 132, 115; hind foot without claws, 25, 25; ear, 14, 15. Skull: greatest length, 34.2, 31; zygomatic width, 16, 15.5; interorbital width, 7.5, 7; length of nasals, 13.5, 12.2; alveoli of upper series, 4.9, 4.6.

SPECIMENS: Prov. San José: Sabanilla de Pirris, 1 (type) C.N.H.M.; Prov. Puntarenas: San Francisco, Esparta, 1 A.M.N.H.

Liomys salvini vulcani (Allen)

VOLCÁN SPINY POCKET MOUSE

Heteromys vulcani ALLEN, 1908, Bull. Amer. Mus. Nat. Hist., vol. 24, p. 652.

TYPE: A.M.N.H. No. 28315, female sub-adult, skin and skull, collected at Volcán de

Chinandega, altitude about 4000 feet, Nicaragua, May 7, 1907, by W. B. Richardson.

RANGE: Coast region of western Nicaragua and probably extreme northwestern Costa Rica.

GENERAL CHARACTERS: Similar in size to *nigrescens* but tail shorter, about equal to combined length of head and body, and general color more buffy; fore limbs and fore and hind feet nearly pure white.

DESCRIPTION: Color of upperparts finely mixed black and light Ochraceous-Buff; spines white, tipped with brownish black, the long slender hairs white from base with a broad band of black and tipped with Ochraceous-Buff, tail Blackish Brown above, white below except at tip which is more or less dusky all around; entire underparts, including fore limbs and feet, white. Skull: superior outline nearly straight, braincase flat, zygomatic arches not expanded, rostrum slender, ascending branches of premaxillae reaching posteriorly slightly beyond nasals.

MEASUREMENTS: Type, and subadult male topotype: Total length, 220 mm., 220; tail vertebrae, 110, 100; hind foot, 25, 25. Skull: greatest length, 31, 30.3; zygomatic width, —, 14.4; interorbital breadth, 6.9, 6.7; length of nasals, 11.7, 11.5; width of braincase, 11.6, 11.6; alveoli of upper molar series, 5, 5. Largest female from San Juan and an adult male from San Juanillo: Total length, 250, 225; tail vertebrae, 110, 114; hind foot 27, 24. Skull: greatest length, 33, 31; zygomatic width, 16.1, 14.9; interorbital breadth, 7, 6.3; length of nasals, 12.8, 12.2; width of braincase, 12, 11.8; alveoli of upper molar series, 5.1, 5.

SPECIMENS: Prov. Guanacaste: San Juanillo, 1 M.Z.U.M.; Tempate, 1 M.Z.U.M.; Cerro de San Juan, 4 M.Z.U.M.

Specimens from the Nicoya Peninsula are similar in color to typical *L. s. vulcani*, and relative measurements and cranial characters are much the same. They differ from the type series of *vulcani* in being of appreciably larger size and in having somewhat coarser spines. Allen's type was based on a badly prepared, rather fragmentary series of mostly "immature" specimens, and until more satisfactory material of typical *vulcani* is available the difference, if any, between it and the

Nicoya specimens cannot be determined.

The habits of the little spiny pocket mice, *Liomys*, are much the same as those of the larger *Heteromys*. They are nocturnal, terrestrial, and make their burrows in the ground usually under bushes, trees, or rocks. They are most abundant in dry, semi-arid, and partly wooded regions, both on plains and mountain slopes; some species, however, inhabit humid forested areas. They breed at all seasons of the year, and the number in a litter is usually about four. The pelage of the young at birth consists of fine hairs and anteriorly flattened, grooved bristles which are quite soft. This juvenile coat is replaced by the spiny pelage when the animal is about half grown.

The food of the spiny pocket mouse consists largely of seeds. These are of a great variety and include seeds of weeds, corn, and wheat, beans, castor beans, supplemented by fragments of leaves and twigs.

The differentiated spoon-like claw on the second digit of the hind foot is more specialized in *Liomys* than in the larger species *Heteromys*. Its development may in some way be correlated with the coarse pelage and its purpose to comb the grooved spines. It could also be used to advantage in kicking the soil out with a rear action when digging, or it may be utilized for both purposes.

FAMILY GEOMYIDAE

POCKET GOPHERS

Members of the family Geomyidae are robust, burrowing animals with very small external ears, small eyes, short hairless tail, large external cheek pouches, short limbs, fore feet with five digits bearing large strong claws. This family, represented by several genera, is confined to the North American continent where it ranges from British Columbia through western and central United States, Florida, Texas, and south through Mexico to Panamá.

MACROGEOMYS MERRIAM

CENTRAL AMERICAN POCKET GOPHERS

The members of this genus are from medium- to large-sized gophers with a well-developed naked nasal pad, large incisors with a narrow deep groove on the inner

third of the anterior surface; the face of the teeth flat on both sides of the groove. Mammary: pectoral, $\frac{1}{1}$; inguinal, $\frac{2}{2}=\frac{3}{3}$.

Three well-differentiated species are now known to occur in Costa Rica: the *heterodus* group, which includes the large, moderately soft-haired gophers, usually blackish in color without white dorsal markings and underparts paler than back, is more or less restricted to the Cordillera Central; the *cavator* group, large, uniformly colored blackish gophers with harsh woolly pelage occurs along the Cordillera Talamanca south to Chiriquí, Panamá; the *cherriei* group, which includes relatively small gophers, blackish in color with distinctive white markings on head or rump, has a known range which includes the lower mountain slopes of northern Costa Rica north to Matagalpa, Nicaragua.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{1-1}{1-1}$; molars, $\frac{3-3}{3-3}=20$.

Macrogeomys heterodus heterodus
(Peters)

CENTRAL COSTA RICAN POCKET GOPHER

Geomys heterodus PETERS, 1865, Monatsber. Akad. Wiss., Berlin, for 1864, p. 177.

The type bears the Berlin Museum number 2864. Peters did not designate an exact locality in his original description of *heterodus*. He states: "Our Museum has received through Dr. Hoffmann and Dr. v. Frantzius the skin with the perfect skull of a new species of *Geomys* from Costa Rica."

The designation of Escazú Heights, 4000 feet elevation, as the type locality seems warranted by the fact that only from here are specimens known that correspond in relative and actual measurements with those of the type as furnished by Dr. Paul Matschie.

RANGE: Western slope of the highlands in central Costa Rica, and headwaters of Río Grande de Tárcos.

GENERAL CHARACTERS: A large Blackish Brown gopher without distinctive white dorsal marking; underparts usually paler than back, pelage moderately soft and close; tail naked, males larger than females. Skull short and broad, rostrum short.

DESCRIPTION: Color of upperparts uniform Mummy Brown, muzzle and lower rump at sides of tail grayish white, underparts

Smoke Gray; tail naked, flesh-colored. Skull broad and massive, zygomatic broad and squarely spreading, the sides strongly divergent anterior; jugal large and broad, frontal broad and flat, concave along median line between orbits and deeply notched on the sides immediately in front of relatively small postorbital processes; nasals broadly wedge-shaped, their sides constricted near middle and not inflated; the ascending branches of premaxilla extending posteriorly well beyond nasals and slightly exceeding the plane of the orbits. The zygomatic breadth is considerably greater than the greatest squamosal or mastoid width; the occipital plane flat except for a vertical median ridge and sloping moderately forward; interpterygoid fossa U-shaped, heel of last molar short, broad, and about equal to half the length of the tooth.

MEASUREMENTS: Adult male and female from Escazú, and type, probably a female, in parentheses: Total length, 392, 380 mm. (325 in dry skin, tail incomplete); tail vertebrae, 80, 70; hind foot, 52, 47. Skull: condylo-basal length, 69, 61.5 (61); basal length, 64.8, 57.5 (58); basilar length, 59.7, 52.4 (51.2); breadth across squamosals, 39.5, 37 (38); zygomatic breadth, 47.2, 41.3; breadth between postglenoid notches, 31.4, 28 (27.5); interorbital width, 11.2, 11.3 (11); breadth across postorbital processes, 17, 15.7 (15.25); height of cranium above palate, 27, 24 (24); height above basin, 20, 18.4 (17); diastema, 27.5, 22.7 (22.5); alveoli of upper molar series, 15.5, 14.5 (14); breadth of rostrum in front of zygoma, 15, 14.5 (15).

SPECIMENS: Prov. San José: Escazú, 1 A.M.N.H.; Escazú Heights, 1 A.M.N.H.; Sabanilla, 1 juv. A.M.N.H.

The sex of the type of *heterodus* was not given by Peters, but judging by cranial measurements, especially the length of the diastema, it is apparently a female. An adult female with sutures fused, from Escazú Heights, agrees so closely with Peters' brief description and Matschie's measurements of the type specimen that it may be considered typical. Escazú is a small town about 7 miles southwest of San José and a probable locality for the type. While it is true that Frantzius refers to gophers as abundant on the southwest slopes of Irazú, none in the series from

this region now available is sufficiently close in cranial measurements to be considered typical. Hoffmann spent a considerable period collecting in the vicinity of San José and he must have gotten the type at Escazú.

Macrogeomys heterodus cartagoensis
Goodwin

EASTERN COSTA RICAN POCKET GOPHER

Macrogeomys heterodus cartagoensis GOODWIN, 1943, Amer. Mus. Novitates, no. 1227, pp. 2-3.

TYPE: A.M.N.H. No. 139268, adult male, skin and skull, collected at Pozo Ancho, Province of Cartago, Costa Rica, a small town between Cartago and Pacayas, elevation about 4800 feet, January 4, 1941, by C. F. Underwood.

RANGE: Upper Reventazón watershed and southern slopes of the Volcán Irazú.

GENERAL CHARACTERS: A moderately large, blackish pocket gopher, similar in general external characters to *heterodus* and *dolichocephalus* but smaller than either and differing from both in cranial characters.

DESCRIPTION: Color of type, an adult male in fresh pelage: upper parts uniform Mummy Brown, chin, wrists, and small anal patch creamy white; underparts Mummy Brown, very little paler than back; tail naked, flesh-colored. In a large series of topotypes the color of underparts varies from Mummy Brown to Smoke Gray; in worn faded pelage buffy, contrasting with the dark color of back. Skull comparatively small and relatively narrow; rostrum moderately long, shorter than in *dolichocephalus* and relatively longer than in *heterodus*; nasals evenly wedge-shaped, zygomatic arches spreading, their sides more nearly parallel than in either *heterodus* or *dolichocephalus*; the maxillary branches of the zygomatic slope strongly backwards, jugal broad, frontal depressed between the orbits and slightly inflated along margin of orbits; postorbital processes broad, the anterior border at right angles to axis of cranium, occipital plane flat, with the exception of a low, median, vertical ridge, and sloping strongly forward. Heel of last upper molar long and narrow and appreciably longer than half the total length of this tooth.

MEASUREMENTS: Type and an adult male and female topotypes: Total length, 350, 335,

360 mm.; tail, in dry skin, 76.8, 71.5, 90; hind foot, 47.5, 48, 49. Skull: condylobasal length, 65.5, 67.5, 65.5; basal length, 61.5, 63.4, 60.2; basilar length, 56.5, 58.4, 55.5; greatest width across squamosals, 38.5, 40.9, 39; zygomatic width, 39.7, 42.4, 39; width between postglenoid notches, 28.5, 29.2, 27; interorbital width, 9.1, 10, 10.9; diastema, 25.3, 27.2, 25; width of rostrum in front of zygomatic, 15.1, 16, 14.8; alveoli of upper molar series, 14.4, 14.7, 14.4.

SPECIMENS: Prov. Cartago: Pozo Ancho, 23 A.M.N.H.; San Ramón Tres Ríos, 5 C.N.H.M.; Cervantes, 3 U.S.N.M.; El Sauce Perálta, 1 U.S.F.W. Prov. San José: Rancho Redondo, Volcán Irazú, 1 U.S.N.M.

Macrogeomys heterodus dolichocephalus
Merriam

NORTHERN COSTA RICAN POCKET GOPHER

Macrogeomys dolichocephalus MERRIAM, 1895, North Amer. fauna, no. 8, p. 189.

TYPE: U.S.N.M. No. 8627/36295, adult male, skin and skull, labeled San José, Costa Rica, collected January, 1866, by José C. Zeledón. The type probably came from Zarcero or Palmira.

RANGE: Uplands of north central Costa Rica on the San Carlos River drainage; limits of range undetermined.

GENERAL CHARACTERS: A large blackish pocket gopher, similar in size and general external appearance to typical *heterodus* but skull longer and narrower with a longer rostrum.

DESCRIPTION: Color of upperparts, in fresh pelage, dark Mummy Brown with a few scattered long white hairs on lower rump; underparts varying with individuals from Smoke Gray to pale Mummy Brown; the color of underparts extends well up on sides of body and lower rump; tail naked, flesh-colored. Skull narrow and elongated, the maxillary arms of the zygomatic divergent anteriorly, sloping strongly backwards; jugal broad and broadest in the middle, frontal depressed between orbits, grooved medially and somewhat inflated along the margin of the orbits; nasals long and evenly wedge-shaped. The zygomatic width is only slightly greater than the mastoid width. Occipital plane flat except for a median vertical ridge and slop-

ing strongly forward; heel of last upper molar moderately long and broad; postorbital processes broad, rounded, the anterior border sloping backwards.

MEASUREMENTS: A subadult male from Villa Quesada; adult female and male from Tapesco; type, an adult male, in parentheses: Total length, 365, 315, 365 mm. (380); tail vertebrae, 88, 97, 95 (75); hind foot, 52, 51, 52 (48). Skull: condylobasal length, 65.2, 62, 70 (69); basal length, 61.8, 57.5, 66.5 (65); basilar length, 57.5, 53.5, 61.8 (60); greatest breadth across squamosals, 37.8, 37.5, 42.1 (39.5); breadth between postglenoid notches, 28, 28.3, 31 (29); zygomatic width, 38.5, 39.2, 43.5 (40.5); interorbital width, 10.5, 9.8, 9.5 (9.5); width across postorbital processes, 16, 16.5, 17 (17); height of cranium above palate, 26.2, 26.2, 28 (26.5); alveoli of upper molar series, 15.2, 14.8, 15.1 (15.5); diastema, 25.4, 22.3, 28.2 (27.2); breadth of muzzle in front of zygomata, 15.4, 14.3, 15, 15.5.

SPECIMENS: Prov. Alajuela: Tapesco, 4 A.M.N.H.; Lajas Villa Quesada, 2 A.M.N.H.; Palmira de Zarcero, 3 C.N.H.M., 3 M.Z.U.M.

The type of *M. dolichocephalus* was collected by Zeledón during his explorations in Costa Rica under von Frantzius and is labeled San José. A review of the present available material indicates that it may have come from somewhere on the northern slope of the Cordillera Central and probably the northern slope of Volcán Poás, instead of San José. Frantzius makes no mention of gophers found at San José but states that in addition to being abundant on the southwestern slopes of Volcán Irazú, "Gophers are also found in the hot valley of Matina and on the River Sarapiquí, where they do great damage to the roots of the cacao-trees." Headwaters of the Sarapiquí River are on the northern slopes of the Cordillera Central, and not more than 15 miles north of San José. Specimens from the San Carlos River drainage are typical *dolichocephalus* whereas those from Escazú, 7 miles southwest of San José, are typical *heterodus*. C. F. Underwood told me that he never heard of any gophers being taken in the actual vicinity of the city of San José. While Zeledón was probably careful in labeling his specimens, Frantzius labeled many specimens "San José" that were undoubtedly not collected there.

Macrogeomys cavator Bangs

CHIRIQUÍ BLACK-TAILED POCKET GOPHER

Macrogeomys cavator BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, p. 42.

TYPE: M.C.Z. No. 10381, old male, skin and skull, collected at Boquete, Chiriquí, Panamá, altitude 4800 feet, March 8, 1901, by W. W. Brown.

RANGE: In the mountains from Chiriquí, Panamá, and probably adjacent parts of Costa Rica.

GENERAL CHARACTERS: A large, uniformly colored black pocket gopher with underparts very little paler than back, and pelage moderately long and harsh and woolly; tail and hind feet naked. About the size of *heterodus* but pelage much coarser, blacker, and tail blackish brown instead of flesh color.

DESCRIPTION: Color of upperparts dark Seal Brown, almost black; underparts similar but slightly paler, the pelage sparse so that the skin shows through; a small white anal patch and sometimes small white patch under chin and on under side of wrists; tail blackish brown; fore feet more or less haired, hind feet and tail naked. Skull broad, zygomatic arches massive, broadly spreading, divergent anteriorly, the anterior border sloping backwards; jugal moderately narrow, its sides nearly parallel; rostrum broad and long, its sides parallel, nasals long and sharply wedge-shaped; interorbital area depressed with raised ridges along border of orbits; postorbital processes strongly developed, spreading squarely from axis of skull; braincase large and broad; sagittal and lambdoidal crests well developed; occipital plane bowed forward along median upper margin and sloping forward with a low vertical central ridge; last upper molar with a long broad heel.

MEASUREMENTS: From type description, an old adult male, type, and an old adult female, topotype: Total length, 375, 380 mm.; tail vertebrae, 120, 110; hind foot, 52, 49. Skull: occipitonasal length, 67.8, 63.4; basal length, 64, 61.4; zygomatic width, 45.8, 40; mastoid width, 33.4, 32; interorbital width, 11, 10; length of nasals, 28, 25.4; alveoli of upper molar series, 15.4, 15. Present measurements of two old males and two old females, topotypes: condylobasal length, 66.4, 63.5,

61.7, 61.5; tip of nasals to back of upper occipital ridges (square), 62.7, 61.8, 59.4, 58.5; diastema, 25.5, 24.5, 24, 23.4.

Macrogeomys cavator can readily be distinguished from the *heterodus* group by its nearly uniform blackish coloration, coarse pelage, and blackish feet and tail. The skull has a long rostrum similar to that of *dolichocephalus*, but the sides are straighter and the nasals longer, the interorbital area is more depressed, and the edges along the orbits are raised in narrow ridges.

***Macrogeomys cavator pansa* Bangs**

BUGABA BLACK-TAILED POCKET GOPHER

Macrogeomys pansa BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, p. 44.

TYPE: M.C.Z. No. 10364, old female, skin and skull, collected at Bugaba, Chiriquí, Panamá, altitude 600 feet, July 6, 1901, by W. W. Brown.

RANGE: Northwestern Panamá and southwestern Costa Rica; limit of range unknown.

GENERAL CHARACTERS: Similar in general character to *M. cavator* but smaller in size, colors duller and browner, pelage shorter, and underparts grayer.

DESCRIPTION: Color of type: upperparts uniform dull, dusky Chocolate brown; underparts grizzled, the belly whitish; tail yellowish brown. Skull smaller and weaker than that of *M. cavator*, with less spreading zygoma; shorter nasals and greater interorbital width; molariform teeth smaller.

MEASUREMENTS OF TYPE: Total length, 320 mm.; tail vertebrae, 110; hind foot, 48. Skull: basal length, 54; occipitonasal length, 57.6; zygomatic width, 36; mastoid width, 27.8; interorbital width, 11.8; length of nasals, 23; length of palate, to palatal notch, 37; alveoli of upper molar series, 13.

The type series consist of eight specimens from an isolated colony in the foothills of Volcán de Chiriquí, about 600 feet elevation. This species is evidently closely allied to *M. cavator*, the pocket gopher occurring at higher elevations on the slopes of the Volcán de Chiriquí.

***Macrogeomys cavator nigrescens* Goodwin**
COSTA RICAN BLACK-TAILED POCKET GOPHER

Macrogeomys cavator nigrescens GOODWIN, 1943, Amer. Mus. Novitates, no. 1227, p. 3.

TYPE: M.Z.U.M. No. 67536, adult male, skin and skull, collected at El Muñeco (Rio Navarro), 10 miles south of Cartago, Costa Rica, altitude 4000 feet, Caribbean rain forest, January 22, 1933, by Austin Smith.

RANGE: Known only from type locality.

GENERAL CHARACTERS: A large, uniformly dark-colored pocket gopher with blackish hands, feet, and tail; similar to typical *Macrogeomys cavator* but blacker in color and differing in distinct cranial characters.

DESCRIPTION: Color of upperparts dark Fuscous, the hair short, coarse, and rather woolly; entire underparts, with the exception of a small buffy anal patch and a few light-colored hairs around mouth, sparsely covered with coarse Fuscous hairs slightly paler than back. Skull resembling that of typical *cavator* but relatively longer and more slender; rostrum longer, nasals more broadly truncate posteriorly, zygomatic arches more squarely spreading anteriorly, narrower and more slender; braincase smaller, more oval and noticeably longer, resulting in a relatively longer occipitonasal length in comparison with the condylobasal length; interorbital area narrower and more sharply depressed between the raised orbital ridges.

MEASUREMENTS: Type, adult female and semi-adult male, topotypes: Total length, 390, 367, 361 mm.; tail vertebrae, 100, 104, 99; hind foot, 53, 51, 48. Skull: condylobasal length, 66.5,—, 64; basal length, 63.1,—, 60; basilar length, 57.7,—, 55.5; length of nasals, 26.5 23.3, 25.4; diastema, 26.5, 24.5, 24; interorbital width, 9.4, 8.9, 8.5; zygomatic width, 43?, 39.5, 36.9; width between postglenoid notches, 30.4?, 28.3, 27.8; width across squamosals,—, 38.3, 37; width of rostrum in front of zygoma, 15.5, 14.3, 14; alveoli of upper molar series, 15.1, 15.5, 16; tip of nasals to line across back of occipital ridges, 65.5, 61.1, 63.3.

SPECIMENS: Prov. Cartago: El Muñeco, 6 M.Z.U.M.

Macrogeomys cherriei cherriei (Allen)

SANTA CLARA WHITE-CROWNED POCKET GOPHER

Geomys cherriei ALLEN, 1893, Bull. Amer. Mus. Nat. Hist., vol. 5, p. 337.

TYPE: A.M.N.H. No. 10768/9067, immature male, skin and skull, collected at Santa Clara, Province of Limón, Costa Rica, in October, 1892, by George K. Cherrie.

RANGE: Northern foothills of the Volcán Irazú.

GENERAL CHARACTERS: A small, dark brown pocket gopher with a large symmetrical white area on top of head; feet and tail naked; a conspicuous naked nasal pad on end of nose; pelage short and soft.

DESCRIPTION: Color of upperparts Mummy Brown, top of head from between eyes to between ears pure white to roots of hairs, underparts buffy white or Smoke Gray, the line of demarcation sharply defined. Skull short and broad, zygomatic strongly bowed, the anterior border sloping strongly backward; rostrum broad, nasals broadly wedge-shaped, the posterior border truncate and more than half the width of the greatest anterior width; interpterygoid fossa U-shaped, bullae compressed, the outer side flattened. The cranium is depressed in the interorbital region and the braincase elevated behind the orbits; nasals inflated, last upper molar with a broad heel equal to about half the length of this tooth.

MEASUREMENTS: Two adult males from Santa Clara and an adult female from Jiménez: Condylbasal length, 59.2 mm., 58.4, 53; basal length, 55.8, 54.9, 49.7; basilar length, 51.4, 50.5, 46.1; width across squamosals, 33.9, 34, 30.8; width between postglenoid notches, 25.9, 25.7, 23; zygomatic width, 39.2, 40.2, 35; interorbital width, 10.1, 10, 8.6; width of rostrum in front of zygoma, 14.2, 14.7, 12.5; length of nasals, 23.3, 23, 20; width of nasals, posteriorly, 4.8, 4.9, 4, anteriorly, 8.8, 9.5, 8; diastema, 24, 23, 20.5; alveoli of upper molar series, 13.5, 13.5, 13.2.

SPECIMENS: Prov. Limón: Santa Clara, 1 (type) A.M.N.H.; Jiménez, 3 A.M.N.H., 2 C.N.H.M.

Macrogeomys cherriei is similar in general external characters to other members of the small white-crowned group but is distinguished from them by its broad rostrum,

broad wedge-shaped truncated nasals, and widely spreading, bowed zygomatic arches. All the available material of typical *cherriei* was collected around 1895. These specimens are now brownish in color because of fading or grease burn.

Macrogeomys cherriei costaricensis

Merriam

PACUARE WHITE-CROWNED POCKET GOPHER

Macrogeomys costaricensis MERRIAM, 1895, North Amer. fauna, no. 8, p. 192.

TYPE: U.S.N.M. No. 12911/2255, juvenile, sex not given, collected at Pacuare, Province of Limón, Costa Rica, in 1876 by Juan Cooper.

RANGE: Lower Río Reventazón and Pacuare River valleys, eastern Costa Rica; limits of range unknown.

GENERAL CHARACTERS: A small blackish pocket gopher with a white patch on crown of head, similar in general to typical *cherriei* but darker in color and differing in distinctive cranial characters.

DESCRIPTION: Upperparts uniform dark Mummy Brown, mixed in some individuals with a considerable number of white hairs; area between eyes and ears white, in one immature individual the white area is absent; underparts Mouse Gray or buffy white, this color extending up on outside of legs and arms in some individuals, the line of demarcation between color of upper and lower parts sharply defined; tail Blackish Brown; feet brownish or flesh-colored. Skull similar in general to that of *cherriei* but zygomatic more squared anteriorly and sides parallel, rostrum slender, nasals truncate and very broad posteriorly, their sides nearly parallel.

MEASUREMENTS: Type (immature male ?) and two adult females from Perálta: Total length, 330, 280, 263 mm.; tail, 80, 75, 70; hind foot, 37, 44, 38.5. Skull: condylbasal length, 52, 52.6, 51.8; basal length, 48.5, 49, 48.5; basilar length, 44.5, 45.3, 45; width across squamosals, 29.5, 30.8, 29; width between postglenoid notches, 23, 25, 23.7; zygomatic width, 33, 33.5, 33.5; interorbital width, 9, 8.8, 8.6; width of rostrum in front of zygoma, 14, 12.5, 12.6; nasals: length, 19.7, 20, 19.6, width anteriorly, 8.8, 7.5, 7, width posteriorly, 5, 4.5, 5.2; diastema, 20, 20.5, 19;

alveoli of upper molar series, 13, 12.5, 12.3.

SPECIMENS: Prov. Limón: Pacuare, 1 U.S.N.M. Prov. Cartago: Santa Teresa Perálta, 4 A.M.N.H.

***Macrogeomys cherriei carlosensis* Goodwin**

SAN CARLOS WHITE-CROWNED POCKET GOPHER

Macrogeomys cherriei carlosensis GOODWIN, 1943, Amer. Mus. Novitates, no. 1227, p. 3.

TYPE: A.M.N.H. No. 141944, adult male, skin and skull, collected at Cataratos, Province of Alajuela, Costa Rica, a small town on the San Carlos River about 400 feet elevation, May 4, 1942, by C. F. Underwood.

RANGE: The San Carlos River valley; limits of range unknown.

GENERAL CHARACTERS: A small Blackish Brown pocket gopher with a large symmetrical white area on top of head; tail and feet naked; underparts lighter than back; line of demarcation moderately well defined. Similar in general character to *costaricensis* but tail longer, white area on top of head larger, general color blacker, and differing in cranial characters.

DESCRIPTION: Color of upperparts uniform Mummy Brown with the exception of a white area on top of head between eyes and ears; underparts dark Mouse Gray; tail hairless, blackish brown. Skull broad with a slender rostrum; zygoma divergent anteriorly, the anterior border at right angles to axis of skull and anterior angle abruptly squared, jugal broad; occipital plane inflated, with a narrow median vertical ridge, and sloping forward; nasals long, slender, and tapered sharply backward to a narrow emarginated border, the posterior width being less than one-third of the anterior width.

MEASUREMENTS: The type, an adult male, and a subadult male?, from Villa Quesada: Total length, 323, 300 mm.; tail vertebrae, 88, 83; hind foot, 41, 40. Skull: condylobasal length, 58.5, 55; basal length, 55, 51.6; basilar length, 50, 47; width across squamosals, 33.7, 30.1; width between postglenoid notches, 26.1, 24.6; mastoid width, 39.2, 36.6; zygomatic width, 39.2, 36.6; interorbital width, 8.7, 9.5; width of rostrum in front of zygoma, 12.7, 12.6; length of nasals, 23.4, 22.5; greatest width of nasals anteriorly, 9.4, 7.9,

posteriorly, 3, 3.1; diastema, 22.7, 20.5; alveoli of upper molar series, 13, 12.1.

SPECIMENS: Prov. Alajuela: Cataratos San Carlos, 1 A.M.N.H.; Villa Quesada, 3 C.N.H.M.

Macrogeomys c. carlosensis can be distinguished from *cherriei* and *costaricensis* by its long, slender, sharply tapered nasals, narrow rostrum, and angular zygomatic arches. A specimen labeled San José in the United States National Museum is too young for positive identification.

***Macrogeomys underwoodi* Osgood**

UNDERWOOD'S WHITE-BANDED POCKET GOPHER

Macrogeomys underwoodi OSGOOD, 1931, Field Mus. Nat. Hist., zool. ser., vol. 18, no. 5, pp. 143-145.

TYPE: C.N.H.M. No. 35175, adult female, skin and skull, collected at Alto de Jabillo Pirris, between San Gerónimo and Pozo Azul, western Costa Rica, April 23, 1931, by C. F. Underwood.

RANGE: Known only from Alto de Jabillo Pirris and San Gerónimo Pirris.

GENERAL CHARACTERS: A small dark-colored pocket gopher with a broad band of pure white across lumbar region. Allied to *M. cherriei* but differing in the absence of white on the head and in having the white band across the lumbar region which extends less distinctly across the abdomen. Skull similar to *cherriei* in general characters but slightly smaller with rostrum markedly narrower.

DESCRIPTION: Color of upperparts, including head, shoulders, and middorsal region, rich dark brown, almost blackish; rump and base of tail similar but a little paler with a slight hoariness due to the presence of a varying number of exserted pale hairs; band across lumbar region sharply defined, 13 to 22 mm. in width, pure white to roots of hair, passing in front of hind legs and spreading irregularly across the abdomen; underparts abruptly paler than upperparts, except in the region of the self-colored white hairs; throat, breast, and inguinal region rather thinly haired, pale Cinnamon-Brown lightly washed with Hoary; fore and hind legs all around mainly like underparts; whiskers and a limited area at their bases whitish; tail and

feet virtually hairless, light colored; claws whitish. Skull similar to that of *M. cherriei* but slightly smaller and lighter with the rostral region conspicuously narrower; incisors weaker and narrower; maxillary tooth-row shorter; nasals much compressed behind; posterior endings of premaxillaries expanded, not pointed, behind; incisive capsule of mandible more inflated than in *cherriei*; angular process of mandible weaker and less projected laterally; maxillary-squamosal union complete above jugal.

MEASUREMENTS: Average of six adult males and females: Head and body, 189 mm. (177–199); tail, 74.6 (85–100); hind foot, 36.6 (36–38); ear, 5.6 (5–6). Skull: condylobasal length, 51.36 (48.2–57); condylobasilar length, 46.79 (44.5–52); zygomatic breadth, 33.7 (31–37.5); width between postorbital processes, 15 (14–16); interorbital constriction, 9.08 (9–9.5); width of rostrum in front of zygoma, 11.7 (11–13); length of nasals, 17.3 (17–20); diastema, 19.2 (19–21); alveolar length of upper molar series, 11.2 (10.5–12).

SPECIMENS: Prov. San José: Jabillo Pirrís, 3 C.N.H.M., 1 A.M.N.H.; San Gerónimo, 8 U.S.F.W., 1 M.C.Z., 1 U.S.N.M., 1 A.M.N.H.

The extraordinary white markings of this species are apparently not abnormal. In the 15 specimens examined there is but slight variation in the white band across the lumbar region. In some the white is continuous on the under side but slightly interrupted in the vicinity of the boundary between the upper and lower parts where it is reduced to a few scattered hairs, while in others the white band completely encircles the body. Underwood designated the exact situation of the type locality, Alto de Jabillo, as "a little *vivienda* of some half dozen shack houses between San Gerónimo and Pozo Azul. From this spot a beautiful view is secured of the Río Grande de Pirrís below and farther the Llanuras de Pirrís, and beyond, the sea coast."

Pocket gophers are subterranean in habitat; their home is a network of tunnels in the ground along the lines of which large piles of earth are pushed out at irregular intervals. They work mainly during the early mornings, evening hours, and at night. They feed on

succulent roots and stalks of various plants. Banana, sugar cane stalks, and grass are cut at the surface of the ground and are drawn gradually into the holes. The stalks of grasses are cut into sections about 3 inches in length and piled neatly along the side of the tunnel, probably for transportation to the central underground storehouse.

The pocket gophers are one of the few animals that can move almost as rapidly backwards as forward; the tail is endowed with tactile sensitivity and this function is especially useful to the gophers when they run backwards in the runway and is of great value in detecting the presence of an enemy in the rear. They are provided with extensive cheek pouches which open on the sides of the face, outside of the mouth. These cheek pouches are used exclusively in carrying food. Gophers are great hoarders and carry away to their storerooms far more than they can consume.

FAMILY CRICETIDAE

RATS AND MICE

The Cricetidae include the largest number of species of any family of American mammals. They are rat- or mouse-like rodents, or rodents derived from such forms. Most of the American forms are from small to medium in size. They have no premolars and never more than three molars in each jaw. Their range in the Americas extends from the Arctic regions, including Greenland, south to Tierra del Fuego; in the Old World, throughout Europe, Asia, Africa, and Australia, including Madagascar, Tasmania, and many islands of the Pacific.

SUBFAMILY CRICETINAE

Medium- or small-sized rodents usually with well-developed ears, long or moderately long tails. Cheek teeth cuspidate, laminate, or prismatic, rooted when cuspidate, the cusps arranged in two longitudinal rows. Skull and external form various but as a rule not extremely specialized. Distribution much the same as for the family.

REITHRODONTOMYS GIGLIOLI

HARVEST MICE

The harvest mice are small, slender rodents with a long tail, usually unicolor, and mod-

erately large ears. They are readily distinguished from other genera of small rodents inhabiting Costa Rica by the distinct longitudinal grooves on the upper incisors. Range of the genus *Reithrodontomys* extends from Washington and North Dakota in the west and Virginia in the east, south through Mexico and Central America to Ecuador.

DENTITION: Incisors, $\frac{1}{1}$; canines, $\frac{0}{0}$; premolars, $\frac{0}{0}$; molars $\frac{3-3}{3-3}$ = 16.

REITHRODONTOMYS GIGLIOLI

In this subgenus the enamel pattern of upper molars is simple, the first and second each with two outer reentrant angles, usually without accessory tubercles.

Reithrodontomys australis australis

Allen

IRAZÚ HARVEST MOUSE

Reithrodontomys australis ALLEN, 1895, Bull. Amer. Mus. Nat. Hist., vol. 7, p. 328.

TYPE: A.M.N.H. No. 11291/9553, adult male, skin and skull, collected at Volcán de Irazú, Costa Rica, June, 1892, by George K. Cherrie.

RANGE: Mountains of Costa Rica and western Panamá.

GENERAL CHARACTERS: A small, dusky, brownish-colored harvest mouse with bi-colored tail, slightly longer than combined length of head and body, and buffy white feet.

DESCRIPTION: Color of upperparts Ochraceous-Buff, varying to pale Orange-Cinnamon, rather heavily mixed with black on back; median dorsal band usually very indistinct; underparts: fur Plumbeous from base for most of its length and washed with light Pinkish Buff; area between forearms usually strongly suffused with Cinnamon-Buff; ears pale Fuscous or Fuscous-Black; tail Fuscous above, grayish white below; feet buffy white, shaded with Hair Brown; wrists and ankles Hair Brown. Skull small with slender zygomatic arches, large rounded globular braincase, bullae relatively flat, ascending branches of premaxillae extending beyond posterior border of nasals; anterior palatine foramina long and extending posteriorly to between the first molars; upper molars simple, without accessory tubercles.

MEASUREMENTS: Average of five topo-

types from Volcán de Irazú, type in parentheses: Total length, 169 (158); tail vertebrae, 84.5 (80); hind foot, 18.5 (18); ear from crown,—(10). Skull: greatest length, 22.5 (23); breadth of braincase, 10.7 (11); length of nasals, 8.2 (8); width of outer wall of anteorbital foramen, 1.8 (1.8); upper molar series, 3 (3.1).

SPECIMENS: Prov. Cartago: Volcán de Irazú, 26 A.M.N.H., 1 C.N.H.M., from 9400 feet, 8 A.M.N.H.

APORODON HOWELL

In this subgenus the upper molars have subsidiary enamel loops in the outer primary reentrant angles; these loops reach the outer border of the tooth in most species.

Reithrodontomys mexicanus cherrii

(Allen)

COSTA RICAN HARVEST MOUSE

Hesperomys (Vesperimus) cherrii ALLEN, 1891, Bull. Amer. Mus. Nat. Hist., vol. 3, p. 211.

The original type was A.M.N.H. No. 3647/2801, adult male, in spirits, skull removed, collected at La Carpintera in October or November, 1890, by George Cherrie. Unfortunately the skull erroneously associated with the skin was that of a *Peromyscus* of the *sonoriensis* group. Through this mistake this species was described as a *Hesperomys* (= *Peromyscus*) and, before the error was discovered, redescribed as *Reithrodontomys costaricensis*. Osgood, 1907, selected a second specimen from the original series and designated it the type of *Reithrodontomys cherrii*, A.M.N.H. No. 3648, adult (male?), skin without skull, collected at San José, Costa Rica, June 9, 1889, by C. F. Underwood.

RANGE: Highlands of Costa Rica and south in the mountains at least to Boquete in western Panamá.

GENERAL CHARACTERS: A medium-sized, bright, Tawny colored harvest mouse with a long unicolor tail and a broad dusky band down upper side of feet to base of toes.

DESCRIPTION: Color of upperparts varying shades of Ochraceous-Tawny, more or less mixed with black on dorsal area; ears dusky Hair Brown, scantily haired; underparts white, tail Fuscous, unicolor, clothed with

short, stiff hairs; fore feet white; hind feet white with a broad band of Fuscous down upper side of feet to base of toes. Skull large with a relatively long slender rostrum and a well-inflated braincase; ascending branches of premaxillae conterminous posteriorly with the posterior border of nasals. Anterior palatine foramina short and extending posteriorly to anterior border of first molars.

MEASUREMENTS: An adult male from La Carpintera, type series: Total length, 7.78 in.; tail, 4.55; hind foot, 0.78 (field measurements). Skull: greatest length, 24.3 mm.; breadth of braincase, 11.2; length of nasals, 9; width of outer wall of anteorbital foramina, 1.6; alveoli of upper toothrow, 3.4. Average of seven specimens from San Pedro and La Carpintera: Total length, 191 mm. (182-198); tail vertebrae, 111 (103-121); hind foot, 20 (19.5-20.5). Average of six skulls: greatest length, 23.7; breadth of braincase, 11.7; length of nasals, 8.1; width of outer wall of anteorbital foramina, 1.7; alveoli of upper molar series, 3.4.

SPECIMENS: Province Alajuela: Tapesco, 1 A.M.N.H.; Alajuela, 2 A.M.N.H. Prov. San José: San José, 2 A.M.N.H.; Tibas, 7 A.M.N.H.; Altos Escazú, 2 U.S.F.W., 1 M.C.Z., 3 A.M.N.H.; San Pedro, 10 A.M.N.H.; Sabanilla de Montes Oca, 1 A.M.N.H.; Sabanilla de San Pedro, 3 A.M.N.H.; Las Nubes, 14 A.M.N.H.; Escazú, 6 A.M.N.H.; Los Higuerones Escazú, 10 A.M.N.H. Prov. Cartago: San Indro, 1 A.M.N.H.; La Carpintera, 15 A.M.N.H., 2 in alcohol; Rancho de Río Jiménez, Irazú, 1 A.M.N.H.; slopes of Irazú, 7 C.N.H.M.

An adult female, the only specimen from Rancho de Jiménez on Volcán Irazú is much larger than any other in the present series of *R. m. cherrii*. Except in size (total length, 210 mm.; tail, 126; hind foot, 21) there seem to be no distinguishing characters separating it from *cherrii*. The teeth are worn and the skull is incomplete.

Reithrodontomys mexicanus garichensis

Enders and Pearson

ENDERS' HARVEST MOUSE

Reithrodontomys mexicanus garichensis ENDERS AND PEARSON, 1940, Notulae Nat., Philadelphia, no. 60, p. 1.

TYPE: A.N.S.P. No. 18614, young adult male, skin and skull, collected 5 miles southwest of El Volcán Post Office on the Río Gariché, Province of Chiriquí, Panamá, altitude 3200 feet, June 14, 1937, by Samuel Cresson.

RANGE: Known only from the type locality.

GENERAL CHARACTERS: About equal to *R. m. cherrii* in size but darker colored and braincase more inflated.

DESCRIPTION: Color of upperparts varying from Cinnamon-Brown on back to Ochraceous-Tawny along sides, mixed with black throughout, the black more abundant on the back; underparts white with the Slate-Gray bases of hairs showing through; ears dusky; tail unicolor; hind feet dull white above, lacking the broad white edging seen in *cherrii*. Skull lighter than *cherrii* with narrower rostrum, nasals less expanded anteriorly, braincase more inflated and expanded farther over the foramen magnum.

MEASUREMENTS OF TYPE: Total length, 191 mm.; tail vertebrae, 121; hind foot, 19; ear, 15. Skull: greatest length, 22.8; zygomatic width, 11.4; interorbital width, 3.8; width of braincase, 11.0; alveoli of maxillary toothrow, 3.5.

According to Enders and Pearson this subspecies is not a high mountain form, being cut off from the upper slopes of the volcano by the Río Chiriquí Viejo and the open llanas. The type series was taken within the great bend of the Río Chiriquí Viejo in an abandoned pasture. *R. m. cherrii* is found on the other side of the river.

***Reithrodontomys mexicanus portrero-grandei* Goodwin**

PORTRERO GRANDE HARVEST MOUSE

Reithrodontomys mexicanus portrero-grandei GOODWIN, 1945, Amer. Mus. Novitates, no. 1293, p. 1.

TYPE: A.M.N.H. No. 142464, adult male, skin and skull, collected at Agua Buena, Portrero Grande, Province of Puntarenas, Costa Rica, December 29, 1942, by C. F. Underwood.

RANGE: Known only from the type locality.

GENERAL CHARACTERS: Smallest member of the *mexicanus* group known to occur in

Costa Rica. Similar in general appearance to *cherrii* but much smaller.

DESCRIPTION: Color of upperparts bright Ochraceous-Tawny, more or less shaded with Fuscous on back; cheeks and sides of body clear Ochraceous-Tawny; underparts white; fore and hind feet dull white with a median stripe of Hair Brown; tail Fuscous, unicolor. Skull much smaller than that of *cherrii*, with a relatively higher and more rounded braincase.

MEASUREMENTS: Type, and average of six topotypes in parentheses: Total length, 175 mm. (178: 170-188); tail vertebrae, 111 (107:101-114); hind foot, 18 (18:18-18); ear, 12 (13:13-13). Skull: greatest length, 22.5 (21.6:21-22.3); zygomatic width, 10.8 (10.8:10.5-11.1); width of braincase, 10.8 (10.6:10.3-10.8); length of nasals, 8.6 (7.9:7.8-8); width of outer wall of anteorbital foramina 1.2 (1.25:1.2-1.3); width of palate across first molars, 4.5 (4.3:4.2-4.5); alveoli of upper molar series, 3 (2.9:2.8-3).

SPECIMENS: Prov. Puntarenas: Agua Buena, 15 A.M.N.H.; Francisco Esparta, 1 juv. A.M.N.H.

***Reithrodontomys brevirostris* Goodwin**
SHORT-NOSED HARVEST MOUSE

Reithrodontomys brevirostris GOODWIN, 1943, Amer. Mus. Novitates, no. 1231, p. 1.

TYPE: A.M.N.H. No. 139727, adult female, skin and skull, collected at Lajas Villa Quesada, altitude 5000 feet, Province of Alajuela, Costa Rica, September 16, 1941, by C. F. Underwood.

RANGE: Known only from the San Carlos River drainage.

GENERAL CHARACTERS: A small, dusky-colored harvest mouse with moderately long thick pelage, long unicolor tail, and white underparts. Resembling *R. m. cherrii* in general external appearance but tail longer and size smaller.

DESCRIPTION: Color of upperparts bright Ochraceous-Tawny, tips of hairs darkened in middorsal region and mixed with long black hairs, sides of body grading to clear Ochraceous-Tawny, fore and hind feet dull white with a broad median stripe of Hair Brown extending to base of toes; tail unicolor, Fuscous; ears Fuscous-Black; underparts

white, the line of demarcation well defined. Skull small, with a short rostrum; nasals short and evenly tapered posteriorly, ending on a line with premaxillae, anterior portion of frontals depressed and forming a shallow sulcus at posterior border of nasals; zygomata relatively strong and squarely spreading anteriorly from axis of skull, its sides parallel and not contracted anteriorly; braincase small, globular, well inflated, interpterygoid fossa broad; anterior palatine foramina short and ending in front of anterior border of first molars; palate narrow, molariform teeth small.

MEASUREMENTS: Type, and adult female with worn teeth: Total length, 180 mm.; tail vertebrae, 104 (dry, 114); hind foot, 17 (dry, 16.5); ear, 13. Skull: greatest length, 21.1; breadth of braincase, 10.7; length of nasals, 7.2; width of outer wall of anteorbital foramina, 1; zygomatic width, 11.3; width of palate across first molars, 4.4; alveolar length of upper molar series, 2.8.

SPECIMENS: Prov. Alajuela: Lajas Villa Quesada, 4 A.M.N.H.; Zapote Villa Quesada, 1 A.M.N.H.

Reithrodontomys brevirostris belongs to the subgenus *Aporodon* and suggests rather close relationship with the *mexicanus* group, but there are well-marked cranial differences. From *R. m. cherrii* it may be distinguished by its smaller size, longer tail, smaller skull, shorter rostrum, smaller and more globular braincase, and smaller teeth.

***Reithrodontomys rodriguezi* Goodwin**
RODRIGUEZ' HARVEST MOUSE

Reithrodontomys rodriguezi GOODWIN, 1943, Amer. Mus. Novitates, no. 1231, p. 1.

TYPE: A.M.N.H. No. 141195, adult female, skin and skull, collected at Volcán Irazú, 9400 feet, Costa Rica, August 21, 1941, by C. F. Underwood.

RANGE: Known only from the type locality.

GENERAL CHARACTERS: A moderately large harvest mouse with soft dense pelage, long unicolor tail, large ears, and white underparts, approaching *R. tenuirostris* in size and general cranial characters, but there are some well-marked differences.

DESCRIPTION: Color of upperparts Cinnamon-Buff, darkened on dorsal region with

long black hairs; head, shoulders, and sides of body clearer Cinnamon-Buff than back; ears Mummy Brown, a dusky ring around eye; tail unicolor, Dresden Brown except extreme tip which is white; fore and hind feet white with a broad wedge of dark color extending to base of toes; underparts white, the line of demarcation well defined. Skull large with a very large and highly inflated braincase; rostrum long and narrow; nasals narrowed to a point posteriorly, ending on a line with premaxillae; anterior portion of frontals depressed, forming a shallow sulcus at posterior border of nasals; zygomata slender, slightly contracted anteriorly; palatal foramina long, reaching plane of first molars; bullae small; upper molar teeth large with small but distinct accessory tubercles between the main cusps.

MEASUREMENTS OF TYPE: Total length, 190 mm.; tail vertebrae, 107 (dry, 125); hind foot, 20 (dry, 21.5); ear, 15 (from notch, dry, 13.5). Skull: greatest length, 23.6; breadth of braincase, 11.9; length of nasals, 8.4; inter-orbital width, 3.7; width of palate across first molars, 5.1; width of outer wall of anteorbital foramina, 1.2; alveolar length of upper molar series, 3.6.

SPECIMENS: Prov. Cartago: Volcán Irazú, 2 A.M.N.H.

Rodriguez' harvest mouse is known only from two individuals collected on the grasslands near the edge of the rain forest at 9400 feet on Volcán Irazú. It belongs in the *tenuirostris* group but differs from known forms by having a longer tail, being of paler color with white instead of buffy underparts, and having a smaller skull and higher and more inflated braincase.

***Reithrodontomys creper* Bangs**

CHIRIQUÍ HARVEST MOUSE

Reithrodontomys creper BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, p. 39.

TYPE: M.C.Z. No. 10284, semi-adult female, skin and skull, collected at Volcán de Chiriquí, altitude 11,000 feet, Panamá, June 2, 1901, by W. W. Brown.

RANGE: Known only from high elevations on Volcán Chiriquí and Volcán Irazú.

GENERAL CHARACTERS: A very large harvest mouse with long, dense, soft pelage, long

tail, and a large skull with a long slender rostrum and large rounded braincase.

DESCRIPTION: General color of Irazú specimens: upperparts about Prout's Brown; fur between Ochraceous-Tawny and Tawny-Olive mixed with long black hairs and grading to clearer Ochraceous-Tawny on sides of body and cheeks; ears Mummy Brown; a narrow dusky ring around eye; tail uniform Prout's Brown except tip which is white; fore and hind feet Mummy Brown, toes white; underparts Pinkish Buff without distinct line of demarcation. Skull large with a long slender rostrum and large, well-inflated braincase, narrowed posteriorly; zygomata much contracted anteriorly; palatal foramina long and extending posteriorly to anterior border of first molars.

MEASUREMENTS: Type female, and an adult male and female from Irazú: Total length, 215 mm., 237, 236; tail vertebrae, 130, 140, 140; hind foot, 23, 24, 24. Skull: greatest length, 25.4, 27.3, 26.8; breadth of braincase, 11.6, 12, 12.3; width of outer wall of anteorbital foramina, 1.9, 1.7, 1.6; length of nasals, 8.8, 10.5, 10.

SPECIMENS: Prov. Cartago: Volcán Irazú, 6 A.M.N.H.

The Chiriquí harvest mouse is found only at high elevation. Costa Rican specimens were collected at an elevation of 9400 feet on Volcán Irazú in open grassland at the edge of a rain forest. They average larger than the type, which is a single individual and not fully grown. *R. creper* is the largest of the Central American harvest mice.

***Reithrodontomys harrisi* Goodwin**

GUANACASTE HARVEST MOUSE

Reithrodontomys harrisi GOODWIN, 1945, Amer. Mus. Novitates, no. 1293, p. 2.

TYPE: M.Z.U.M. No. 65220, adult male, skin and skull, collected at Hacienda Santa María, altitude 3200 feet, 18 miles northeast of Liberia, Guanacaste, Costa Rica, January 27, 1932, by Austin Smith.

RANGE: The type is the only known specimen.

GENERAL CHARACTERS: A small harvest mouse with a relatively short, bicolored tail, feet white to ankles, light-colored ears, and underparts white to roots of hair. Similar in

general characters to *R. gracilis* Allen from Yucatan and *R. g. anthonyi* Goodwin from Guatemala but differing from both in brighter color and some cranial characters.

DESCRIPTION: Color of upperparts light Ochraceous-Tawny, sparsely mixed with dark brown hairs, paler on head and sides of body, ears Drab, tail distinctly bicolored, Fuscous above, the hairs white below; fore and hind feet white to wrists and ankles; underparts white to roots of hair except for a narrow margin along sides where the white fur is Plumbeous at base. Skull small, superior outline nearly straight; bullae small, zygomatic arches squared anteriorly, the sides parallel; rostrum slender, tapered anteriorly; braincase small and low.

MEASUREMENTS OF TYPE: Total length, 162 mm.; tail vertebrae, 92; hind foot, 18; ear from notch, 14. Skull: greatest length, 22.1; zygomatic width, 10.5; interorbital width, 3.5; width of braincase, 10.4; width of outer wall of anteorbital foramina, 1.65; length of palatine foramina, 3.35; length of nasals, 7; alveoli of upper molar series, 2.8.

Reithrodontomys harrisi may readily be distinguished from any other species known to occur in Costa Rica by its relatively short, bicolored tail and white feet. The type was caught by hand on the ground in the forest.

PEROMYSCUS GLOGER

WHITE-FOOTED MICE

The genus *Peromyscus* includes more forms than any other mammalian genus in North America. The species are all more or less woodland mice, usually with long tails, rather large ears, large eyes, and soft fur. Range of the genus extends through the North American continent from about the limits of tree growth in the north, south to Panamá.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{0-0}{0-0}$; molars, $\frac{3-3}{3-3}=16$.

PEROMYSCUS GLOGER

In the subgenus *Peromyscus* the underparts are more or less white and sharply distinguished from the upperparts; the ears are dusky and contrast with the rest of the upperparts; plantar tubercles, six; first and second upper molars with accessory tubercles present in salient angles.

MAMMAE: Inguinal, $\frac{2}{2}$; abdominal, $\frac{0}{0}$; pectoral, $\frac{1}{1}=\frac{3}{3}$.

Peromyscus nudipes nudipes (Allen)

IRAZÚ WHITE-FOOTED MOUSE

Hesperomys (Vesperimus ?) nudipes ALLEN, 1891, Bull. Amer. Mus. Nat. Hist., vol. 3, pp. 213-214.

TYPE: A.M.N.H. No. 3643/2798, adult female, in spirits, teeth worn, skull removed, collected at La Carpintera, altitude 4597 feet, Costa Rica, October, 1890, by George K. Cherrie.

RANGE: Mountains of central Costa Rica and south along the cordillera to Chiriquí, Panamá.

GENERAL CHARACTERS: A large, dark-colored, white-footed mouse; pelage long, soft, and full; ears moderate, nearly naked; tail longer than combined length of head and body, scaly with short hairs, nearly unicolor.

DESCRIPTION: General color of upperparts about Mummy Brown; sides Ochraceous-Tawny with a Russet shade, contrasting with back which is much more heavily mixed with dusky, forming a broad, blackish brown area from crown of head to base of tail; lateral line Ochraceous-Buff, underparts white with a broad pectoral spot of Ochraceous-Buff, fore and hind feet white; tail usually unicolor, occasionally under side slightly blotched with white and tip white in a few specimens; hind feet white, shaded with dusky brown halfway to base of toes. Skull short and broad, braincase smoothly rounded and thin walled; zygomatic arches slender, depressed to level of palate, narrow anteriorly, sloping sharply backward, and wide posteriorly owing to the excessive width of braincase; anterior palatine foramina long and separated by a thin bony septum. Molars rather weak and tubercular.

The type of *nudipes* is not a typical representative of the species; specimens from 9400 feet on Volcán Irazú are better examples.

MEASUREMENTS: An adult male and female from 9400 feet on Volcán Irazú, type in parentheses: Total length, 265 mm., 272 (230); tail vertebrae, 140, 140 (139); hind foot, 29, 28 (28.5); ear, 22, 22 (20). Skull: greatest length, 34, 34.5 (34.7); zygomatic width, 16.7, 17.2 (15.7); interorbital width,

5.4, 5.1 (5.1); length of nasals, 14, 14.2 (14.4); alveolar length of upper molar series, 4.9, 5.1 (5.3); width of braincase at root of zygomata, 15, 15.1 (13.8).

SPECIMENS: Prov. Cartago: San Ramón Tres Rios, 4 C.N.H.M., 1 U.S.F.W.; La Carpintera, 1 (type), A.M.N.H.; Volcán Irazú, 10 A.M.N.H.; Rancho de Río Jiménez, 5 A.M.N.H.; Isla Nievo Irazú, 1 A.M.N.H.; Volcán Irazú, 9400 feet, 20 A.M.N.H.; El Muñeco, 8 M.Z.U.M.; Estrella, 16 M.Z.U.M.; El Copey, 6 M.Z.U.M.; Vueltas, 5 M.Z.U.M. Prov. San José: San Joaquín, 1 M.Z.U.M.; Los Higuerones Escazú, 20 A.M.N.H.; San José, 1 A.M.N.H.

Peromyscus nudipes orientalis Goodwin

EASTERN COSTA RICAN WHITE-FOOTED MOUSE

Peromyscus nudipes orientalis GOODWIN, 1938, Amer. Mus. Novitates, no. 987, pp. 3-4.

TYPE: A.M.N.H. No. 123494, adult male, skin and skull, collected at El Sauce Perálta, elevation 1000 feet, Costa Rica, July 7, 1931, by C. F. Underwood.

RANGE: Lowlands of eastern Costa Rica.

GENERAL CHARACTERS: A medium-sized mouse with moderately full soft pelage; similar to typical *nudipes* but smaller in size, pelage closer, general color less ochraceous russet; tail about equal to length of head and body. Skull closely resembles that of *P. m. saxatilis* but braincase larger.

DESCRIPTION: Color of upperparts between Ochraceous-Tawny and Clay Color mixed with black, sides of body and cheeks chiefly Clay Color; tail dusky above, irregularly blotched with white below; underparts white or washed with Cinnamon-Buff; pectoral spot Clay Color. Skull narrow and relatively low; braincase smoothly rounded but not greatly enlarged; molar teeth small.

MEASUREMENTS: Type and adult male topotype: Head and body, 116, 115 mm.; tail vertebrae, dry, 114, 116; hind foot, 27, 26; ear, 21. Skull: greatest length, 33, 33; zygomatic breadth, 15.7, 16; interorbital constriction, 5.2, 4.8; length of nasals, 12.5, 13; alveolar length of upper molar series, 4.8, 4.5.

SPECIMENS: Prov. Cartago: El Sauce Perálta, 3 A.M.N.H., 7 U.S.F.W., 1 M.C.Z., 1 U.S.N.M.; Cervantes, 2 A.M.N.H., 12 U.S.F.W., 1 U.S.N.M., 3 M.C.Z.; Santa

Teresa Perálta, 8 A.M.N.H.; Juan Viñas, 4 A.M.N.H. Prov. Alajuela: Zapote, 4 A.M.N.H.; Lajas Villa Quesada, 22 A.M.N.H.; Tapesco, 1 A.M.N.H.; Zarcero, 2 M.Z.U.M.

Specimens from the San Carlos River valley appear to represent a rather extreme local variation of the *nudipes* group but are not sufficiently differentiated to be considered a geographical form. They are apparently nearest to *orientalis*. The series of 27 specimens are unusually dark in color, some are almost black, and all are without any indication of a buffy pectoral spot. In measurements they agree with *orientalis*, and the under side of the tail is blotched with white in a similar manner. The skulls, although they have a smooth, rounded braincase as in *nudipes*, are smaller than the typical form with maxillary toothrow barely exceeding 4.5 mm. and the zygomatic arches nearly parallel sided and squared anteriorly.

The type locality for *orientalis* is El Sauce Perálta in the low foothills near the Caribbean coast. Series from this region are readily distinguishable from typical *nudipes* by their smaller size, shorter tail, smaller braincase, and shorter toothrow. The similarity of specimens from Juan Viñas and Perálta to those of *P. m. saxatilis* from Matagalpa, however, is so close that there can be little doubt of the near relationship. Selected individuals from both localities are virtually indistinguishable in external and cranial characters, but on an average *orientalis* has a less angular skull and larger and more smoothly rounded braincase.

Peromyscus nudipes hesperus Harris

WESTERN COSTA RICAN WHITE-FOOTED MOUSE

Peromyscus nudipes hesperus HARRIS, 1940, Occas. Papers Mus. Zool. Univ. Michigan, no. 423, pp. 1-2.

TYPE: M.Z.U.M. No. 65201, adult female, skin and skull collected at Hacienda Santa María, altitude 3200 feet, 15 miles northwest of Liberia, Province of Guanacaste, Costa Rica, January 23, 1932, by Austin Smith.

RANGE: Northwestern Costa Rica, including the Nicoya Peninsula.

GENERAL CHARACTERS: Similar to *nudipes* but smaller and paler colored throughout.

The fulvous of sides extends over dorsal area which is only slightly darkened. Ochraceous-Buff pectoral patches obsolete.

DESCRIPTION: Color of type near Sayal Brown, darkened over back to near Snuff Brown. Middorsal region slightly darkened by presence of black-tipped guard hairs. Top of head and ears Sepia; forehead and cheeks Tawny-Olive with light buffy patch extending ventrally from just behind eye, narrow blackish eye ring; fore and hind feet white; tail nearly uniform Blackish Brown with blotches of yellowish white on ventral side. Underparts white, the basal dusky color showing through; a faint Ochraceous-Buff pectoral spot present in some individuals. Skull similar to that of *nudipes* but slightly smaller with a shorter rostrum.

MEASUREMENTS: Type, adult female: Total length, 240 mm.; tail vertebrae, 120; hind foot, 26; ear from notch, 20. Skull: greatest length, 32.3; basilar length of Hensel, 24.7; zygomatic width, 15.5; least interorbital width, 5.2; length of nasals, 12.0; alveoli of upper molar series, 5.

SPECIMENS: Prov. Guanacaste: Hacienda Santa María, 5 M.Z.U.M.; San Juan, 2 M.Z.U.M.

Peromyscus nudipes hesperus inhabits western Costa Rica where climatic conditions differ considerably from those of the area occupied by *nudipes* and *orientalis*. Without actually seeing this subspecies, I believe there may be some analogy here with *P. m. saxatilis*.

Peromyscus mexicanus saxatilis Merriam

ROCK WHITE-FOOTED MOUSE

Peromyscus mexicanus saxatilis MERRIAM, 1898, Proc. Biol. Soc. Washington, vol. 12, p. 121.

TYPE: U.S.N.M. No. 77296 (Biol. Surv. Coll.), adult male, skin and skull, collected at Jacaltenango Huehuetenango, Guatemala, altitude 5400 feet, December, 19, 1895, by E. W. Nelson and E. A. Goldman.

RANGE: Northwestern Guatemala and southeastern Chiapas, south at least to southern Nicaragua.

GENERAL CHARACTERS: A medium-sized, white-footed mouse with rather short close pelage, tail about equal to length of head and

body, color about as in *P. nudipes* but the Rufous and Tawny shades on sides usually clearer and more extensive.

DESCRIPTION: Color of upperparts: Cinnamon-Rufous mixed with dusky; middle of back darker than sides; sides from cheeks to flanks bright Russet; top of head and shoulders like back; spot at base of whiskers white and broad, orbital ring Blackish Brown; underparts white or creamy white, sometimes with a slight Cinnamon-Rufous pectoral marking, fore feet white, hind feet white with the usual wedge of Dusky Brown extending halfway to the toes, tail usually irregularly blotched with white below. Skull with moderately long rostrum and nasals; braincase full and deep but not very wide, supraorbital borders sharp-angled, usually with a low but distinct bead that extends in a low ridge across parietals; interparietal large, zygomatic arches strong and relatively broad anteriorly, the sides nearly parallel, molar teeth and bullae small.

MEASUREMENTS: Average of 10 adult topotypes: Total length, 224 mm. (233-258); tail vertebrae, 127 (120-128); hind foot, 27.6 (27-29); ear from notch, dry, 18.2 (16.6-19.5). Skull of type and topotype: greatest length, 31.8, 33.3; basilar length, 24, 25; zygomatic width, 14.9, 15.4; interorbital width, 5, 4.9; nasals, 12.2, 13.8; shelf of bony palate, 4.2, 5; postpalatal length, 11.5, 11.4; maxillary toothrow, 4.4, 4.7.

Peromyscus mexicanus saxatilis has a wide geographical range, and there is much variation in color, probably of an "ontogenetic" nature. Specimens from more humid localities are usually darker than those from more arid parts, but this does not seem to be correlated with definite areas. It is possible that unusual darkness of color may be produced by unusually wet seasons in a normally arid region. While there is considerable local individual variation, series from widely separated localities show little deviation from the typical form. Allen's name, *P. m. nicaraguae*, for the Matagalpa specimens is generally accepted and probably is a synonym of *saxatilis*. In the type series there are skulls that are indistinguishable from *saxatilis*, while others closely resemble the less-specialized skulls of *nudipes*.

MEGADONTOMYS MERRIAM

The subgeneric characters of *Megadontomys* are: large size; molar teeth large and heavy; supplementary tubercles in primary angles of both upper and lower molars well developed. The characters separating the subgenus *Megadontomys* from the subgenus *Peromyscus* are relative rather than absolute.

Peromyscus flavidus (Bangs)

BOQUETE WHITE-FOOTED MOUSE

Megadontomys flavidus BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, pp. 27-29.

TYPE: M.C.Z. No. 10331, adult male, skin and skull, collected at Boquete, 4000 feet elevation, southern slope of the Volcán de Chiriquí, Panamá, April 12, 1901, by W. W. Brown, Jr.

RANGE: Volcán de Chiriquí and probably adjacent parts of Costa Rica at elevations from 3000 feet to 5000 feet.

GENERAL CHARACTERS: A very large white-footed mouse with nearly unicolor tail, slightly longer than length of head and body; pelage long and relatively coarse; ears bare and finely haired; soles of hind feet naked to calcaneum. Skull with well-developed supra-orbital ridges.

DESCRIPTION: Color of upperparts, including head and sides of body, rich ochraceous rather coarsely mixed with dusky hairs; lower cheek and lateral line clear ochraceous, a narrow dusky orbital ring; underparts buffy white; fore feet white to wrists, hind feet white mixed with dusky to base of toes; tail brownish black, indistinctly bicolor. In worn pelage the upperparts are a richer shade of ochraceous with dusky hairs modified. Skull large and heavy and relatively narrow; palatine foramina short and wide; supra-orbital ridges well developed and extending back to occipital plane.

MEASUREMENTS: Average of 10 adult topotypes: Total length, 341.6 mm. (320-375); tail vertebrae, 181.2 (155-205); hind foot, 31.8 (31-33); ear, 22.5 (20-24); Skull of type: greatest length, 40.6; zygomatic width, 19.4; interorbital width, 6.2; length of nasals, 17.4; alveoli of upper molar series, 5.9.

Peromyscus flavidus is common in the upland forest at an altitude of 3000 to 5000 feet on Volcán de Chiriquí, Panamá, but no

specimens have been taken either above or below these elevations. *P. flavidus* or a closely allied form probably inhabits the mountains at similar elevations in the adjacent parts of Costa Rica.

The various species of white-footed mice have a widely different local habitat. All Costa Rican forms are found in woodland regions. All are habitually nocturnal. They do not use regular runways but wander widely at night. They occupy natural openings or crevices in rocks, cliffs, or hollow trees and often use underground openings or retreats formed by other animals. They climb trees to some extent and occupy deserted bird nests. White-footed mice do not hibernate but remain active throughout the year, even in northern latitudes. They prefer dry food, especially seeds and nuts, but probably feed to some extent on green food and insects.

ORYZOMYS BAIRD

RICE RATS

The genus *Oryzomys* comprises murine rodents with rather coarse, moderately long pelage; usually a long tail, varying from about three-fourths the length of head and body to one-fourth longer; ears varying from small to large; soles of hind feet naked to heels; teeth normally six-tuberculate; eight mammae: pectoral, 2-2, inguinal, 2-2. Skull relatively thin and smoothly rounded; supra-orbital and temporal ridges prominent or obsolescent; zygomatica well developed; palate reaching posteriorly beyond the plane of last molars; crowns of molars low with prominent cusps and well-developed styles, the cusps arranged in two longitudinal rows. The rice rats occupy in South America the place filled by the white-footed mice in North America. Their range extends from southern Patagonia north through Central America to southern New Jersey and the Mississippi Valley.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{0-0}{0-0}$; molars, $\frac{3-3}{3-3}$ = 16.

ORYZOMYS BAIRD

In this subgenus the color of upperparts contrasts with that of the underparts, the size ranges from medium to large, and the tail is about equal to, or longer than, head and body.

Oryzomys couesi couesi* (Alston)*COUES' RICE RAT**

Hesperomys couesi ALSTON, 1876, Proc. Zool. Soc. London, p. 756.

TYPE: In British Museum, spirit specimen, collected at Coban, Guatemala, by Osbert Salvin. The original description was based on three specimens (a), (b), (c), representing two or possibly three species. Thomas selected Alston's (a) as the logical specimen for the type.

RANGE: From Vera Cruz southeastward to northwestern Costa Rica; altitudinal range from sea level to about 5000 feet, mainly in the humid lower tropical zone.

GENERAL CHARACTERS: A medium-sized, dull brownish rice rat with coarse pelage, rather small well-haired ears; tail about equal to length of head and body, scaly and sparsely covered with fine short stiff hairs.

DESCRIPTION: Color of upperparts varying from nearly uniform Ochraceous-Buff to Ochraceous-Tawny, darkened on middorsal region with blackish hairs; underparts varying from Light Buff to Light Ochraceous-Buff, outside of ears blackish inside like back; feet white; tail brownish above, dull yellowish below. Skull short, heavy, and well arched, with a short broad rostrum, narrow braincase, temporal ridges well developed; zygomatic strong and spreading, audital bullae large; dentition moderately heavy.

MEASUREMENTS: Two adult males from La Primavera, Guatemala, and type in parentheses: Total length, 290 mm., 265 (276); tail vertebrae, 145, 122 (149); hind foot, 34, 32 (28, s.u.); ear, 18, 15. Skull: greatest length, 32.9, 31.3; zygomatic width, 17.6, 16.8; interorbital width, 5, 5.2 (5.2); width of braincase across ridges, 11.5, 11.5 (12.7); length of nasals, 12.5, 11.9 (11.1); anterior palatine foramina, 6.2, 5.5 (6.2); alveoli of upper molar series, 4.8, 4.5 (4.8).

SPECIMENS: Prov. Guanacaste: Bahía de Salinas, 1 A.M.N.H.; San Juanillo, 13 M.Z.U.M.; Hacienda Santa María, 2 M.Z.U.M.

The range of Coues' rice rat in Costa Rica is restricted to northwestern Guanacaste and the Nicoya Peninsula. Its habitat is tropical grasslands, marshes, river valleys, and bushy country at more or less low elevations.

Oryzomys alfaroi alfaroi* (Allen)*ALFARO'S RICE RAT**

Hesperomys (Oryzomys) alfaroi ALLEN, 1891, Bull. Amer. Mus. Nat. Hist., vol. 3, p. 214.

TYPE: A.M.N.H. No. 3659/2808, subadult female, skin and skull (both in poor condition), collected at San Carlos, Costa Rica, by Anastasio Alfaro, December, 1888.

RANGE: Heavily forested mountain portion of Honduras, Nicaragua, Costa Rica, and western Panamá. Altitudinal range from about 1000 to 4000 feet, mainly in the humid lower tropical zone.

GENERAL CHARACTERS: A small, dark-colored rice rat with short close pelage, ears moderately large and sparsely haired, limbs slender, tail bicolored, about equal to length of head and body.

DESCRIPTION: Color of upperparts varying from Ochraceous-Buff to dull Ochraceous-Tawny, heavily mixed with black over back and grading to more or less clear Ochraceous-Buff on cheeks and sides of body; underparts buffy white, thinly overlying the dark Plumbeous basal color; feet dull whitish with elongate silvery tufts of hair on toes projecting beyond claws, tail blackish above, soiled whitish below. Skull small with a short rostrum, braincase relatively broad and rather low; zygomatic spreading, slender, temporal ridges slightly developed; frontal region broad, the lateral margins slightly elevated; anterior palatine foramina short and wide and not reaching plane of first molars posteriorly; molariform teeth small.

MEASUREMENTS: Average of six adults from Tuis: Total length, 210 mm. (188-221); tail vertebrae, 109 (102-114); hind foot, 26.3 (26-27). Skull: greatest length, 26.7 (25.6-28.3); zygomatic width, 13.5 (13.2-14.1); interorbital width, 5.2 (5.1-5.5); width of braincase, 10.5 (10.1-10.8); length of nasals, 10.9 (10.3-11.5); anterior palatine foramina, 3.9 (3.5-4.0); upper molar series, 3.7 (3.6-3.8).

SPECIMENS: Prov. Alajuela: San Carlos, 4 A.M.N.H.; Vijagual San Carlos, 1 A.M.N.H. Prov. Cartago: Santa Teresa Perálta, 6 A.M.N.H.; El Muñeco, 2 M.Z.U.M.; Tuis, 15 A.M.N.H. Prov. Puntarenas: Agua Buena, 25 A.M.N.H. Costa Rica, exact locality unknown: 7 A.M.N.H. Prov. Guanacaste:

Cerros de San Juan, 2 M.Z.U.M.; Hacienda Santa María, 5 M.Z.U.M.

Alfaro's rice rat inhabits the heavily forested mountain slopes in the humid lower tropical zone in Costa Rica. It can generally be recognized by its rather small size, dark brownish color, short sleek pelage, and slender limbs and tail. It is larger than members of the *O. fulvescens* group and smaller than any other species of the Costa Rican rice rats.

Oryzomys talamancae talamancae Allen

TALAMANCAN RICE RAT

Oryzomys talamancae ALLEN, 1891, Proc. U. S. Natl. Mus., vol. 14, p. 193.

TYPE: U.S.N.M. No. 12222/22742, male adult, molars much worn, collected in Talamanca, Costa Rica, 1874, by W. M. Gabb. The exact locality for the type of *talamancae* is not known; Gabb, the collector, worked mainly near Sipúrio and possibly secured the specimens in the foothills there.

RANGE: Forested regions from the foothills in eastern Costa Rica to the Pacific coast eastward through Panamá to near Colombian frontier; arid and tropical zones.

GENERAL CHARACTERS: A rather large-sized, bright, Tawny colored rice rat, tail about equal to or exceeding the length of head and body, scantily haired; ears large, finely haired; pelage moderately long, rather harsh; toes of hind feet more or less webbed at base.

DESCRIPTION: General color of upperparts varying from pale Ochraceous-Tawny to bright Cinnamon-Brown or Russet, becoming lighter on cheeks, shoulders, and sides of body; underparts white, the Plumbeous basal color showing through; ears brownish; feet covered above with short glossy white hairs; tail dark brownish above, yellowish white below. Skull large, with relatively long rostrum, braincase low and somewhat flattened; supraorbital ridges well developed; maxillary arch of zygomatic heavy; nasals truncate, conterminous posteriorly with premaxillae; frontal region wide, depressed on median line; anterior palatine foramina short and wide and not reaching plane of first molars; molariform teeth moderately heavy.

MEASUREMENTS: Type (dry skin), and an adult male and female from Palmar: Total

length, 233, 250, 270 mm.; tail vertebrae, dry skin, 115, 130, 124; hind foot, 30, 30, 30. Skull: greatest length, 31.5, 31.3, 32.8; zygomatic width, 15.5, 15.8,—; interorbital width, 5.3, 5, 5; width of braincase, 11.2, 12.3, 13; nasals, 12.8, 11.8,—; anterior palatine foramina, 4.3, 4.2,—; palatine bridge, 7.1, 7,—; upper molar series, 4.6, 4.5, 4.3.

SPECIMENS: Prov. Limón: Talamanca, 2 U.S.N.M. Prov. Puntarenas: Boruca, 1 M.C.Z.; Palmar, 2 A.M.N.H.

The ranges of *talamancae* and *O. alfaro* overlap and, owing to their superficial resemblance, the two may be confused; *talamancae* is a larger animal than *alfaro*, with longer hind feet, and the skull is definitely larger and more massive.

Oryzomys talamancae carrikeri Allen

CARRIKER'S RICE RAT

Oryzomys carrikeri ALLEN, 1908, Bull. Amer. Mus. Nat. Hist., vol. 24, p. 656.

TYPE: A.M.N.H. No. 25976, adult female, skin and skull, collected on the banks of the Río Sixaola, between Cuábne and the mouth of the Río Sixaola, Province of Limón, Costa Rica, August 18, 1904, by M. A. Carriker, Jr.

RANGE: Known only from the type locality, in the low coastal regions in the Province of Limón.

GENERAL CHARACTERS: Similar in general characters to *talamancae* but darker in color, pelage finer and closer, ears smaller, tail relatively shorter, and differing in some cranial characters.

DESCRIPTION: Color of upperparts Cinnamon-Brown; cheeks and sides of body Cinnamon-Buff, fore and hind feet white; tail nearly unicolor, Mummy Brown above, slightly paler below; underparts buffy white. Skull narrow, with a small narrow braincase; supraorbital ridges well developed; interparietal short and extended transversely; nasals extended posteriorly considerably beyond posterior border of premaxillaries and terminating in a V-shaped point; anterior palatine foramina short, palate extended posteriorly.

MEASUREMENTS: Type (adult female) and two topotypes (an adult male and a subadult female): Total length, 265, 248, 240 mm.; tail

vertebrae, 133, 121, 118; hind foot, 30.5, 29.5, 30. Skull: greatest length, 31.5, 31.5, 30; zygomatic width, 14.7, 15, 14.8; interorbital width, 5, 5.3, 4.9; width of braincase, —, 12, 11.8; length of nasals, 12, 13.1, 12.5; anterior palatine foramina, —, 3.5, 3.4; palatine bridge, —, 7.6, 7.1; upper molar series, 5, 4.5, 4.5.

SPECIMENS: Prov. Limón: Río Sixaola, 3 A.M.N.H., including the type.

Oryzomys carrikeri is a dusky-colored, close-haired race of the *talamancae* group, differing from the typical form in being of darker color, having shorter and finer pelage, smaller ears, shorter and more nearly unicolor tail. In the skull the nasals extend well beyond posterior border of premaxillae (conterminous in *talamancae*), and the palate is longer with shorter anterior palatine foramina than in the latter. It is assumed that the type localities of *carrikeri* and *talamancae* are not widely separated; *carrikeri* definitely came from the low coastal region. *Talamancae*, it is assumed, came from the vicinity of Sipúrio which is also on the Río Sixaola, but the chances are that it was collected in a higher and more arid region than the type series of *carrikeri* and represents a separate geographical form.

***Oryzomys bombycinus alleni* Goldman**

COSTA RICAN LONG-HAIRED RICE RAT

Oryzomys nitidus alleni GOLDMAN, 1915, Proc. Biol. Soc. Washington, vol. 28, p. 128.

TYPE: A.M.N.H. No. 9631/7971, male, semi-adult, skin and skull, collected at Tuis, 2250 feet elevation, about 20 miles east of Cartago, Costa Rica, by George K. Cherrie, July 15, 1894.

RANGE: Forested mountainous slopes in northeastern Costa Rica; altitudinal range from 800 to 3000 feet, humid lower tropical zone.

GENERAL CHARACTERS: A medium-sized, dark-colored rice rat about the size of *Oryzomys talamancae* but pelage of upperparts very long and soft; supraorbital vibrissae 50 to 70 mm. in length; ears relatively small and finely haired; tail about equal to the combined length of head and body.

DESCRIPTION: General color of upperparts varying from Ochraceous-Tawny to Cinna-

mon-Brown or Russet, finely mixed with black; darkest on face, top of head, and back; the lighter element restricted to tips of hairs, becoming lighter and approaching Ochraceous-Buff or pale Ochraceous-Tawny on cheeks, shoulders, and sides; underparts dull white; ears black; feet yellowish white; tail dark brown above, paler below. Skull rather large with rostrum long and narrow, nasals attenuate and slightly exceeding premaxillae in posterior extent, braincase broad and moderately expanded; zygomatic slender; lateral margins of frontals rising in distinct but narrow compressed ridges; temporal ridges well developed; parietals without lateral wings extending across temporal ridges; interparietal large; anterior palatine foramina short, not reaching plane of first molars; audital bullae small, molars moderately heavy, the crowns deeply incised by reentrant angles. Similar to that of typical *O. b. bombycinus* from Cerro Azul, Panamá, but braincase higher, more arched, much more distended especially anteriorly, frontal region broader posteriorly.

MEASUREMENTS: Type, subadult male: Total length, 218 mm.; tail vertebrae, 111; hind foot, 20. Skull: greatest length, 28.2; zygomatic width, 14.3; interorbital width, 5.5; width of braincase, 11.6; length of nasals, 10.9; anterior palatine foramina, 3.5; palatal bridge, 5.5; upper molar series, 4.3.

SPECIMENS: Prov. Cartago: Tuis, 3 A.M.N.H. (type and 2 juv). Prov. Limón: Guápiles, 1 C.M.

In many important characters, especially in skull and dentition, *O. bombycinus alleni* approaches *O. talamancae*, and the two may occur in the same localities. *O. bombycinus* can be recognized externally by its very long soft pelage and in cranial characters by the slender rostrum and the absence of the lateral wings of the parietals. Its habitat is the lower heavily forested mountain slopes, apparently not above 2000 or 3000 feet elevation.

***Oryzomys devius* Bangs**

CHIRIQUÍ RICE RAT

Oryzomys devius BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, p. 34.

TYPE: M.C.Z. No. 10324, female adult, skin and skull, collected at Boquete, Volcán de Chiriquí, Panamá, altitude 5000 feet, by

W. W. Brown, Jr., January 29, 1901.

RANGE: Forested slopes of high mountains in central Costa Rica and western Panamá; altitudinal range from 4000 to at least 5000 feet, humid upper tropical zone.

GENERAL CHARACTERS: A large, dark-colored, long-haired rice rat with a tail much longer than head and body; ears large and blackish, finely haired; hind feet long and narrow.

DESCRIPTION: Color of upperparts dark Tawny, inclining toward Russet and rather heavily mixed with black along median line of back, becoming light Tawny or dark Ochraceous-Buff along lower sides; throat white, rest of underparts overlaid with Ochraceous-Buff or dull white; feet dull white or light brown; tail dark brown above, paler below. Skull large with long and heavy rostra, nasals broad and reaching posteriorly slightly beyond premaxillae; braincase moderately broad and inflated; zygomatic heavy; frontal region narrow; lateral margins of frontals smoothly rounded or rising in slightly upturned ridges; temporal ridges moderately developed, crossing lateral wings of parietals; interparietals large and extending almost across posterior parietal border; crowns of upper molars deeply incised by inner reentrant angles.

MEASUREMENTS OF TYPE: Total length, 335 mm.; tail vertebrae, 180; hind foot, 33. Two adult topotypes: Total length, 345, 360; tail vertebrae, 185, 195; hind foot, 36, 35. Skull, average of three adults, type and two topotypes: greatest length, 36.6 (35.8–37.5); zygomatic width, 18.4 (18–19); interorbital width, 5.7 (5.5–6); width of braincase, 12.6 (12.2–12.9); nasals, 14.3 (13.8–15); anterior palatine foramina, 5.4 (5.2–5.6); palatine bridge, 7.8 (7.8–7.9); upper molar series, 5.7 (5.6–5.8). Large male from Volcán Irazú: Total length, 375; tail vertebrae, 198; hind foot, 38. Skull: greatest length, 37.7; zygomatic width, 20 (?); interorbital width, 5.9; width of braincase, 13; length of nasals, 15.5; anterior palatine foramina, 6.4; palatal bridge, 8.1; upper molar series, 5.9.

SPECIMENS: Prov. Cartago: Volcán Irazú, 1 M.C.Z., 2 A.M.N.H., 1 U.S.F.W.; Estrella, 11 M.Z.U.M.; El Muñeco, 8 M.Z.U.M. Prov. Alajuela: Lajas Villa Quesada, 1 A.M.N.H.

Oryzomys aphaestus Harris

LONG-TAILED RICE RAT

Oryzomys aphaestus HARRIS, 1932, Occas. Papers Mus. Zool. Univ. Michigan, no. 248, pp. 5–6.

TYPE: M.Z.U.M. No. 62875, adult female, skin and incomplete skull, collected at San Joaquín de Dota, Costa Rica, altitude about 4000 feet, June 29, 1931, by Austin Smith.

RANGE: Mountains of central Costa Rica, in rain forest regions at elevations of from about 4000 to 5000 feet.

GENERAL CHARACTERS: A large, dark-colored rice rat with long soft fur and tail more than one and one-half times the length of head and body; feet large; vibrissae long; ears sparsely covered with fine blackish hairs.

DESCRIPTION: Color of type: upperparts between Ochraceous-Tawny and rich Ochraceous-Buff, darkened in middorsal region by a strong admixture of long dark hairs, darkest on top of head, ears black; hind feet dark Blackish Brown, base of hairs more or less dusky; tail blackish both above and below with tuft of black hairs at tip; underparts Ochraceous-Buff; chin and throat grayish white. Skull long and narrow with prominent supraorbital and temporal ridges, audital bullae small, nasals extending posteriorly slightly beyond premaxillae; zygomatic slender, not depressed to level of molars and wider posteriorly than anteriorly; molar series with prominent cusps and deep reentrant angles.

MEASUREMENTS OF TYPE: Total length, 387 mm.; tail vertebrae, 235; hind foot, 40. Skull: interorbital width, 5.6; length of nasals, 12.6; anterior palatine foramina, 4.9; palatal bridge, 7.5; upper molar series, 5.8.

SPECIMENS: Prov. San José: San Joaquín de Dota, 1 (type) M.Z.U.M.

In color, texture of pelage, and general external appearance *O. aphaestus* is not unlike large specimens of *O. devius*, but its longer tail and larger and broader feet readily distinguish it from the latter.

Oryzomys tectus tectus Thomas

BUGABA RICE RAT

Oryzomys tectus THOMAS, 1901, Ann. Mag. Nat. Hist., ser. 7, vol. 8, p. 251.

TYPE: B.M. No. 0.7.11.43, male, skin and skull, collected at Bugaba, Chiriquí, Panamá,

altitude 800 feet, September 15, 1898, by H. J. Watson.

RANGE: Pacific slope of western Panamá and southern Costa Rica at about 800 feet altitude; limits of altitudinal range unknown.

GENERAL CHARACTERS: A medium-sized, robust rice rat; tail about equal in length to head and body, scantily haired; ears small, moderately clothed with comparatively coarse hairs; pelage moderately long and coarse; hind feet short and broad, well haired above.

DESCRIPTION: Color of upperparts near Tawny, rather thinly mixed with black, general color darkest over dorsum, becoming paler and rich Ochraceous-Buff on cheeks and sides; underparts overlaid with Warm Buff; ears clothed with Tawny hairs; feet white; tail brownish above, dull white below. Skull angular and large, rostrum short, and braincase low and flattened; nasals short, ending posteriorly in the anterior plane of orbits; premaxillae conterminous with nasals posteriorly; frontals broad; temporal ridges prominent; anterior palatine foramina short, moderately broad, reaching or nearly reaching anterior planes of first molars. Molars similar to those of the *O. talamancae* group.

MEASUREMENTS: From original description of type: "Head and body, 140 mm.; tail, 142; hind foot, s.u., 27, c.u., 29.5; ear, 18. Skull, tip of nasals to back of interparietal, 33; greatest breadth, 17; nasals, 11.6×4; interorbital breadth, 6.5; palatal length, 13.8; diastema, 8.1; palatal foramina, 5×2.2; length of upper molar series, 4.9."

SPECIMENS: Prov. Puntarenas: Boruca, 2 U.S.N.M. Prov. San José: San Gerónimo de Pirris, 1 C.N.H.M.

Oryzomys tectus can usually be distinguished from most other Costa Rican rice rats by its coarse pelage, well-haired ears, and short, stout hind feet. Superficially it resembles *O. couesi*, but the tail is more finely granulated than in the latter.

OLIGORYZOMYS BANGS

The pygmy rice rats are of very small size, the hind foot usually less than 25 mm.; form slender; ears rather large and coarsely haired; tail longer than head and body, four longer toes on hind feet bearing tufts of projecting hairs. Externally they closely resemble some

species of the harvest mice, *Reithrodontomys*, from which they can be distinguished by the smooth instead of grooved upper incisors. The range of this subgenus extends from southern Mexico south through Central America to undetermined limits in South America.

As in all subspecies, there is considerable individual variation in the Central American pygmy rice rats, and not every specimen can be identified without knowing where it was collected. The large series of Costa Rican material now available, however, warrants segregation into three geographical forms: a light-colored form on the western side of Costa Rica; a dark-colored, long-tailed form in the forested central highlands; and a small form in the humid tropical forests of eastern Costa Rica.

Oryzomys fulvescens costaricensis

Allen

COSTA RICAN PYGMY RICE RAT

Oryzomys costaricensis ALLEN, 1893, Bull. Amer. Mus. Nat. Hist., vol. 5, p. 239.

TYPE: A.M.N.H. No. 9581/2925, subadult female, skin and skull, collected at El General, Costa Rica, altitude 2150 feet, February, 1891, by H. Pittier. The type skull cannot be found. The skull of a young female topotype has a type label and the number has been changed from 9582 to 9581 but this is not the type skull.

RANGE: Pacific Coast region of western Panamá and western Costa Rica, altitudinal range from near sea level to at least 3000 feet.

GENERAL CHARACTERS: A very small brownish rice rat with buffy underparts, white feet; tail relatively short but longer than the combined length of head and body, and indistinctly bicolor.

DESCRIPTION: Color of upperparts of nearly uniform light Ochraceous-Buff finely mixed with black, slightly paler on cheeks and shoulders; underparts white, suffused with light Ochraceous-Buff; feet white; tail dark brownish above, yellowish white below except at tip which is dusky all around. Skull small and delicate in structure, braincase low; supraorbital or temporal ridges absent; interorbital region relatively broad and depressed along median line; molars with small

accessory cusps present as in species of the subgenus *Oryzomys*, but reentrant angles broader.

MEASUREMENTS: Three adult specimens from Agua Buena, and type¹ in parentheses: Total length, 182 mm., 181, 185 (190); tail vertebrae, 102, 102, 105 (114); hind foot, 20, 21, 21 (dry, 21); ear, 12, 12, 11. Skull: greatest length, 22.8, 23.3, 22.9 (21); zygomatic width, 12.3, 11.3, 12.3 (11.4); interorbital breadth, 3.5, 3.5, 4 (4.3); width of braincase, 10.5, 10.3, 10.5 (10.1); length of nasals, 8, 7.7, 8; anterior palatine foramina, 3.8, 3.8, 3.6; palatal bridge, 3.8, 4.1, 4; upper molar series, 3, 3.1, 3.1.

SPECIMENS: Prov. Puntarenas: El General, 3 A.M.N.H. (including type); Buenos Aires, 2 A.M.N.H.; Boruca, 6 A.M.N.H.; Agua Buena, 25 A.M.N.H. Prov. San José: San Gerónimo Pirris, 3 A.M.N.H., 15 U.S.F.W., 1 U.S.N.M., 3 M.C.Z., 3 C.N.H.M.

The type and the series used by Allen as a basis for *costaricensis* were badly prepared and scanty. A series of 24 specimens from Agua Buena, a similar environment about 40 miles south along the cordillera, are typical. This series with the exception of one individual is uniformly light Ochraceous-Buff in color with little or no indication of a darkened dorsal region. The underparts are strongly washed with buff, and the tail length is relatively short throughout the series.

***Oryzomys fulvescens vegetus* Bangs**

VOLCÁN DE CHIRIQUÍ PYGMY RICE RAT

Oryzomys (Oligoryzomys) vegetus BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, p. 35.

TYPE: M.C.Z. No. 10298, old female, collected at Boquete, Volcán de Chiriquí, Panamá, altitude 4000 feet, April 16, 1901, by W. W. Brown, Jr.

RANGE: Volcán de Chiriquí; limit of range undetermined.

GENERAL CHARACTERS: A relatively large *Oligoryzomys*, feet larger and tail longer than in *O. f. costaricensis*.

¹ Allen's cranial measurements are referred to as those of "an adult skull," but since they do not correspond with either of the two topotypes or the Buena Vista specimen mentioned by him, they must have been taken from the missing type skull.

DESCRIPTION: Color about as in *O. f. costaricensis* but averaging darker with a stronger admixture of black hairs; underparts varying from nearly white to Ochraceous-Buff. Skull averaging larger than that of *O. f. costaricensis* but teeth about the same size.

MEASUREMENTS: Average of five specimens from Boquete, type in parentheses: Total length, 216 mm. [205-235] (210); tail vertebrae, 122 [115-130] (120); hind foot, 24.2 [24-25] (25). Skull: greatest length, 23.6 [22.7-24.3] (24.4); zygomatic width, 12.3 [11.9-12.8] (12.6); interorbital width, 3.8 [3.7-4.2] (3.4); width of braincase, 10.3 [10-10.5]; nasals, 8.7 [8.3-9.3] (9); anterior palatine foramina, 3.6 [3.4-3.9]; palatal bridge, 3.9 [3.8-4.3]; upper molar series, 3.1 [3.1-3.1] (2.8).

Larger size, longer tail, and tendency toward darker coloration usually serve to distinguish *O. f. vegetus* from *costaricensis*.

***Oryzomys fulvescens creper* Goodwin**

DUSKY PYGMY RICE RAT

Oryzomys fulvescens creper GOODWIN, 1945, Amer. Mus. Novitates, no. 1293, p. 2.

TYPE: A.M.N.H. No. 141199, adult male, skin and skull, collected at Volcán Irazú, Costa Rica, elevation 9400 feet, August 15, 1941, by C. F. Underwood.

RANGE: Highlands of central Costa Rica at elevations above 4000 feet.

GENERAL CHARACTERS: A rather small, dark-colored, long-tailed *Oligoryzomys*, smaller than *vegetus* Bangs, with noticeably smaller feet and darker color. About the size of *costaricensis* Allen but tail longer, color darker, and skull more slender than Allen's form.

DESCRIPTION: Color of type: upperparts Ochraceous-Buff grading to near Russet on rump and finely mixed with black, the black most intense on head and shoulders; cheeks and lateral line nearly clear Ochraceous-Buff; underparts white, faintly tinged with pale buff, grading to Ochraceous-Buff in other specimens, the base of hairs Plumbeous, feet soiled white; tail brownish above, yellowish white below except toward tip where it is dusky all around. Skull small and relatively narrow, rostrum slender, the sides nearly parallel in the type, slightly tapered an-

teriorly in other specimens; braincase small, smoothly rounded, and well inflated; interorbital region especially narrow and teeth small.

MEASUREMENTS: Type and adult male from Villa Quesada: Total length, 197 mm., 200; tail vertebrae, 105 (dry, 115), 120; hind foot, 22, 23; ear, 13, 13. Skull: greatest length, 22.9, 23.7; zygomatic width, 12, 12; interorbital width, 3.3, 3.3; width of braincase, 10.3, 10.5; length of nasals, 8, 9; anterior palatine foramina, 3.4, 3.6; palatal bridge, 3.8, 3.6; outer wall anteorbital foramina, 1.6, 1.8; alveoli of upper molar series, 2.5, 3.

SPECIMENS: Prov. Cartago: Volcán Irazú, 1 A.M.N.H.; Cervantes, 1 A.M.N.H.; La Carpintera, 1 A.M.N.H. Prov. Alajuela: Lajas Villa Quesada, 10 A.M.N.H.; Tapasco, 3 A.M.N.H.; Cataratos, San Carlos, 2 juv. A.M.N.H. Prov. San José: Los Higueros Escazú, 12 A.M.N.H.; Escazú 1 A.M.N.H. Prov. Puntarenas: Buena Vista, 1 A.M.N.H.

Oryzomys fulvescens reventazoni

Goodwin

REVENTAZÓN PYGMY RICE RAT

Oryzomys fulvescens reventazoni GOODWIN, 1945, Amer. Mus. Novitates, no. 1293, p. 3.

TYPE: A.M.N.H. No. 141891, skin and skull, adult male, collected at Santa Teresa Perálta, Province of Cartago, Costa Rica, a small town 3100 feet in elevation above Perálta, February 8, 1942, by C. F. Underwood.

RANGE: Caribbean side of Costa Rica at low elevation.

GENERAL CHARACTERS: A very small, dark-colored *Oligoryzomys*, similar in general appearance to *O. f. creper* but much smaller.

DESCRIPTION: Color of type very similar to that of *creper* but slightly more intense and underparts more buffy. The topotypes are paler and duller colored than the type, with underparts white. Skull smaller than that of *creper* with a shorter and more sharply tapered rostrum; anterior palatine foramina relatively long and extending posteriorly to between the first molariform teeth; in *creper* they terminate in front of a line across the anterior border of these teeth.

MEASUREMENTS: Type and semi-adult female: Total length, 182 mm., 163; tail vertebrae,

103, 90; hind foot, 22, 20; ear, 13, 11. Skull: greatest length, 21.45, 20.1; zygomatic width, 11, 10.5; interorbital width, 3.45, 3.4; width of braincase, 10.4, 9.7; anterior palatine foramina, 3.3, 3.3; palatal bridge, 3.7, 3.6; outer wall anteorbital foramina, 1.7, 1.5; nasals, 7.7, 7.5; alveoli of upper molar series, 2.8, 2.8.

SPECIMENS: Prov. Cartago: Santa Teresa Perálta, 5 A.M.N.H., including type.

Oryzomys fulvescens nicaraguae Allen

NICARAGUAN PYGMY RICE RAT

Oryzomys (Oligoryzomys) nicaraguae ALLEN, 1910, Bull. Amer. Mus. Nat. Hist., vol. 28, p. 100.

TYPE: A.M.N.H. No. 29543, male adult, skin and skull, collected at Vijagua, Nicaragua, March 24, 1909, by William B. Richardson.

RANGE: Nicaragua and north to southern Honduras and south, probably to extreme northern Costa Rica.

GENERAL CHARACTERS: About the size and general color of typical *O. f. fulvescens* but averaging paler and tail more distinctly bicolor.

DESCRIPTION: Color of upperparts pale Ochraceous-Buff, finely mixed with black; underparts white or faintly tinged with buff. Skull similar to that of *O. f. costaricensis* but smaller with smaller teeth and interorbital region narrower.

MEASUREMENTS OF TYPE: Total length, 180 mm.; tail vertebrae, 110; hind foot, 20 (dry, 21.8). Skull: greatest length, 21.5; zygomatic width, 11.2; width of braincase, 10.2; interorbital width, 3.3; length of nasals, 7.3; anterior palatine foramina, 3.4; outer wall anteorbital foramina, 1.8; alveoli of upper molar series, 2.7.

Oryzomys f. nicaraguae appears to be a recognizable geographical form. It was based on a single individual, and more material from the type locality is necessary for a satisfactory determination of its characters. Specimens from Sabana Grande, southwestern Honduras, may be referable to this form. If so they carry the pale coloration to the extreme, and the underparts in these specimens are pure white.

MELANOMYS THOMAS

Characters of the subgenus *Melanomys* in-

clude uniform blackish color, upperparts and underparts not strongly contrasted, robust form, tail about three-fourths length of head and body, hind feet broad and stout, digital bristles not projecting beyond ends of claws.

The range extends from the Andean region of northwestern South America from southern Ecuador to northern Colombia and northwest to northern Nicaragua. The altitudinal range is from sea level to about 8000 feet.

Oryzomys caliginosus chrysomelas

Allen

COSTA RICAN DUSKY RICE RAT

Oryzomys chrysomelas ALLEN, 1897, Bull. Amer. Mus. Nat. Hist., vol. 9, p. 37.

TYPE: A.M.N.H. No. 10777/9076, juvenile male, collected at Suerre, a "finca" near Jiménez, altitude 1500 feet, Province of Limón, Costa Rica, July 16, 1895, by Anastasio Alfaro.

RANGE: Western Panamá, Costa Rica, and north to northern Nicaragua; altitudinal range from near sea level to about 3000 feet, mainly in the humid lower tropical zone.

DESCRIPTION: Color of upperparts varying from Tawny to Russet, heavily mixed with black, the black tending to become predominant especially on the rump; underparts overlaid with varying shades from dark Ochraceous-Tawny to Cinnamon-Brown, the dark Plumbeous basal color showing through; vibrissae black, scarcely reaching posteriorly to ears; ears, feet, and tail thinly clothed with short blackish hairs and the epidermis blackish; claws white. Skull rotund, rostrum short, nearly straight, braincase large and inflated, frontals broad, the lateral margins projecting as supraorbital shelves; zygomatic slender but maxillary root expanded along frontal and premaxillary sutures; posterior border of anterior palatine foramina barely reaching plane of first molars.

MEASUREMENTS: Fully adult male and female from Santa Teresa Perálta, adult male from Las Vueltas, and type in parentheses: Total length, 217 mm., 202, 232 (187, dry); tail vertebrae, 88, 84, 99 (86); hind foot, 26, 26, 27 (25). Skull: greatest length, 30, 30.5, 32 (27.3); zygomatic width, 16.7, 16.5, 16.4 (14.3); interorbital width, 7.9, 6.8, 6.8 (6.3); width of braincase, 12.7, 12.3, 12.7 (12.5);

nasals, 11.4, 11.4, 12.5 (9.5); anterior palatine foramina, 4.9, 5.1, 5.3 (4.8); palatal bridge, 6.3, 6.2, 6.5 (5.5); upper molar series, 4.5, 4.5, 4.9 (4.5).

SPECIMENS: Prov. Limón: Suerre, 4 A.M.N.H. (including type); Talamanca (probably near Sipúrio), 4 U.S.N.M.; Jiménez, 1 A.M.N.H. Prov. Cartago: Santa Teresa Perálta, 17 A.M.N.H.; El Sauce Perálta, 2 U.S.F.W. Prov. Alajuela: San Carlos, 1 A.M.N.H.; Cataratos, San Carlos, 5 A.M.N.H.; Vijagual San Carlos, 2 A.M.N.H. Prov. San José: San Gerónimo Pirris, 5 A.M.N.H., 17 U.S.F.W., 4 U.S.N.M., 4 C.N.H.M. Prov. Puntarenas: Palmar, 15 A.M.N.H.; Las Vueltas, 11 A.M.N.H.; Agua Buena, 16 A.M.N.H.

Underwood wrote me that Suerre was an old name for Llanos del Tortuguero and was the principal port of entry for the early colonists. Allen stated that Suerre was probably not far from San José, at an elevation of between 3000 and 4000 feet. From what we now know of the range of this form and since we know that Alfaro collected at Jiménez in May of the same year that he secured the type, it is reasonable to assume that the type locality was the "finca" near Jiménez, known as Suerre.

Since the range of the dusky rice rat is restricted to comparatively low elevations there is no connecting link between the east and west coast representatives and some differences might be expected. A series from Perálta are probably typical, and while indistinguishable in color from the west coast specimens, they are smaller, shorter tailed than those specimens from Las Vueltas, Palmar, and San Gerónimo. The skulls also average shorter and broader with a shorter tooththrow. However, specimens from San Carlos, which is on the east coast drainage, equal those from the west coast in size and length of tail, and any difference in the series as a whole is considered local variation.

The habits of all the rice rats are somewhat similar, but they differ in details in conformity with varying environmental conditions. In general, a preference is shown for meadows or marshy areas, at rather low elevations, but some species have ascended, especially along water courses, to high elevations; others have entered the forest and become partly scan-

social. They are mostly nocturnal. Fairly well-worn runways are sometimes made along water courses. The more aquatic species readily enter the water and swim and dive freely. The nests, made of plant fibers, are placed in shallow burrows or sheltered places, usually under massed vegetation. From three to seven young are produced at birth, four or five being the usual number. There is no definite breeding season except near the extreme northern limit of the group.

Rice rats feed almost extensively on green or succulent plants but drier foods such as seed are also eaten to some extent. Owing to their nocturnal habits they are preyed upon by owls, many carnivorous mammals, and snakes.

ZYGODONTOMYS ALLEN CANE RATS

The genus *Zygodontomys* includes medium-sized, ground-inhabiting rodents that are grayish brown in general coloration, with tails shorter than head and body. Superficially, species are similar to *Oryzomys* but may be recognized by the proportionally shorter tail and shorter hind feet. Costa Rican *Zygodontomys* resemble the cotton rat, *Sigmodon*, but their smaller size, finer fur, and smaller ears serve to distinguish them externally from the cotton rats.

Range of the genus includes western Costa Rica, Panamá, Trinidad, Venezuela, Colombia, Ecuador, Peru, and part of Brazil.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{0-0}{0-0}$; molars, $\frac{3-3}{3-3} = 16$.

Zygodontomys cherriei cherriei (Allen) CHERRIE'S CANE RAT

Oryzomys cherriei ALLEN, 1895, Bull. Amer. Mus. Nat. Hist., vol. 7, p. 329.

TYPE: A.M.N.H. No. 11297/9557, male adult, collected at Boruca, Costa Rica, December 10, 1891, by G. K. Cherrie.

RANGE: Southwestern Costa Rica and northwestern Panamá, replaced in Canal Zone by a larger and paler race. Altitudinal range from sea level to about 2000 feet.

GENERAL CHARACTERS: A medium-sized brown rat with a rather short, bicolored tail; small ears; moderately coarse pelage and white feet.

DESCRIPTION: Color of upperparts about Tawny-Olive, tips of hairs varying from Pinkish Buff to Cinnamon-Buff, finely mixed with black hairs, darkest along middorsal line, ears and upper side of tail Mummy Brown; underparts, fore and hind feet, under side of tail, white or buffy white. Skull with a short, broad, tapered rostrum; frontals broad, the lateral margins projecting as supraorbital shelves, zygomatic slender, braincase large and inflated; anterior palatine foramina long and extending posteriorly to between first molars.

MEASUREMENTS: Two adult males from Palmar, and type in parentheses: Total length, 220 mm., 217 (250); tail vertebrae, 75, 84 (110); hind foot, 26, 26 (24, dry). Skull: greatest length, 30.5, 31.2 (31.2); zygomatic width, 15.5, 15.1 (15); interorbital width, 5.1, 4.9 (5); width of braincase, 12, 12.3 (12); nasals, 10.4, 11.3 (11.4); anterior palatine foramina, 6.3, 6.7 (6.5); palatal bridge, 5, 5 (5.2); upper molar series, 4.2, 4.4 (4.2).

SPECIMENS: Prov. Puntarenas: Boruca, 18 A.M.N.H. (including type); Palmar, 20 A.M.N.H.

The habits of *Zygodontomys* are very similar to those of *Melanomys* and except for the sharp differentiation in color they resemble each other in size and general characters.

TYLOMYS PETERS TREE-CLIMBING RATS

Members of the genus *Tylomys* are very large rats with a long naked tail, large ears, and relatively broad short feet. The skull is elongated, with low flat braincase, the frontals broad and extended in wide supraorbital shelves. The first upper molar is evenly rectangular with six well-developed tubercles. The known range of *Tylomys* extends from northwest Ecuador north through Central America to Chiapas, Mexico.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{0-0}{0-0}$; molars, $\frac{3-3}{3-3} = 16$.

Tylomys watsoni Thomas WATSON'S CLIMBING RAT

Tylomys watsoni THOMAS, 1899, Ann. Mag. Nat. Hist., ser. 7, vol. 4, p. 278.

TYPE: British Museum, adult female, skin

and skull, collected at Bugaba, Chiriquí, Panamá, altitude 800 feet, September 6, 1898, by H. J. Watson.

RANGE: Eastern Panamá and Costa Rica; limits of range undetermined.

GENERAL CHARACTERS: Same as for the genus. Fur moderately long and soft; underparts white. Smaller than *T. nudicaudus* from Guatemala and teeth smaller.

DESCRIPTION: Color of upperparts varying from Sayal Brown to Snuff Brown, the fur about Cinnamon-Buff mixed with longer Mummy Brown hairs; ears Mummy Brown; fore and hind feet to base of toes Mummy Brown, toes white; a dusky area around eyes; tail Mummy Brown from base for more than half its length, rest of tail white. Underparts soiled whitish, the line of demarcation not sharply defined. Skull large, elongated, with a low, rather flat braincase depressed in interorbital region; supraorbital shelves strongly developed and extended in broad ridges across parietals to occipital plane; zygomatic strong but not greatly expanded; premaxillae extending slightly beyond posterior border of nasals; bullae comparatively small.

MEASUREMENTS: Old male from Boquerón, Panamá, a subadult female from Palmar, and type in parentheses: Total length, 475 mm., 428 (493); tail, 250, 223 (243); hind foot, 35, 35 (s.u., 35; c.u., 38); ear, 30, 24. Skull: greatest length, 50.3, 47.3 (54); zygomatic width, 25.4, 24.7 (26.5); interorbital width, 9.9, 9.4 (10.5); width of braincase, 16.8, 16.7; nasals, 17.5, 16 (18); anterior palatine foramina, 8.7, 8.2; palatal bridge, 7.9, 6.8; upper molar series, 7.9, 7.8 (8.4).

SPECIMENS: Prov. Puntarenas; Palmar, 1 A.M.N.H. Prov. Cartago: La Carpintera, 1 (skin only) A.M.N.H.; El Muñeco, 1 juv. M.Z.U.M. Prov. Limón: Río Sixaola, 1 juv. A.M.N.H. Prov. San José: San Joaquín de Dota, 2 (1 ad. female, 1 juv.) M.Z.U.M.

Costa Rican *Tylomys* are here provisionally referred to *watsoni*. Additional examples are much needed in order to determine the status and relationship of the form inhabiting the Caribbean coast region and central highlands. The skulls of this animal vary considerably with age. A skin, without skull, from La Carpintera has longer and softer fur than typical *watsoni*. A young individual from the Río

Sixaola has relatively large teeth and white feet, and the adult female from San Joaquín de Dota has an exceptionally broad braincase (19 mm.), but the teeth and external characters are normal for *T. watsoni*. The type and three topotypes were all taken on the banks of a stream.

Tylomys is a tree-climbing rodent and apparently inhabits heavily forested regions. Very little is known about its habits, but it has been taken in traps baited with banana placed at the foot of palm trees and among rocks. It has also been seen climbing in palm fronds 30 feet from the ground.

OTOTYLOMYS MERRIAM LESSER CLIMBING RATS

The genus *Ototylomys* includes medium-sized rats with large, sparsely haired ears; tail about equal to, or shorter than, length of head and body, naked except for a few scattered hairs and coarsely annulated; feet small; fur moderately long, soft, and full. Except for smaller size and relatively shorter tail, members of this genus bear a strong resemblance to *Tylomys*.

Ototylomys is a genus that is virtually restricted to Central America; its range extends from Yucatan and Campeche, Mexico, south through Guatemala, Honduras, and Nicaragua to Costa Rica.

DENTITION: Incisors, $\frac{1}{1}$; canines, $\frac{0}{0}$; premolars, $\frac{0}{0}$; molars, $\frac{3}{3}$ = 16.

Ototylomys phyllotis fumeus Allen NICARAGUAN CLIMBING RAT

Ototylomys fumeus ALLEN, 1908, Bull. Amer. Mus. Nat. Hist., vol. 24, p. 658.

TYPE: A.M.N.H. No. 28291, old male, skin and skull, collected at Matagalpa, Nicaragua, March 18, 1907, by W. B. Richardson.

RANGE: Nicaragua and adjacent parts of Honduras and Costa Rica.

GENERAL CHARACTERS: A relatively large, dusky-colored climbing rat with white underparts and tail about equal to, or a little shorter than, the combined length of head and body, coarsely annulated.

DESCRIPTION: Color of upperparts a dusky gray brown, darkened on the middle of back with blackish brown, underparts pure white,

the pelage moderately long, thick, and soft; outside of limbs like back, as far as base of toes, toes white; ears dusky brown, apical three-fourths naked, a distinct white spot at base of ear; tail naked, the scales large and smooth, black, slightly lighter or blotched with white on ventral surface.

MEASUREMENTS: Adult male and female from Cerros de San Juan, and type in parentheses: Total length, 327 mm., 338 (330); tail vertebrae, 147, 159 (140); hind foot, 29, 29 (30). Skull: greatest length, 42.6, 42 (41.5); condylobasal length, 38, 37.5 (38); zygomatic width, 20.5, 21.5 (21); length of nasals, 15, 14 (13.5); mastoid width, 14.8, 14.9 (15.2); interorbital width, 6.9, 6.8 (6.7); length of bullae, 6.5, 6.5 (6.7); palatal bridge, 6, 5.8 (6.2); alveoli of upper molar series, 6.9, 7 (6.8).

SPECIMENS: Prov. Guanacaste: Cerros de San Juan, 4 M.Z.U.M.

Otodylomys phyllotis australis Osgood

PIRRÍS CLIMBING RAT

Otodylomys phyllotis australis OSGOOD, 1931, Field Mus. Nat. Hist., zool. ser., vol. 18, no. 5, p. 145.

TYPE: C.N.H.M. No. 35177, subadult male, skin and skull, collected at San Gerónimo, near Pozo Azul de Pirrís, western Costa Rica, April 17, 1931, by C. F. Underwood.

RANGE: Known only from type locality.

GENERAL CHARACTERS: A medium-sized, grayish brown tree rat with a relatively short, scaly, naked tail, large naked ears and white underparts, the line of demarcation between color of back and underparts sharply defined. Very similar in size and in external characters to *O. p. fumeus* from Matagalpa, Nicaragua, but the type skull of *australis* is broader with a wider palate, heavier rostrum, and smaller bullae than that of *fumeus*.

DESCRIPTION: Color of type: upperparts dull Hair Brown; sides of body between flanks and shoulders grayish white mixed with brownish; underparts, inner sides of legs and feet pure white to roots of hairs; ears and tail Mummy Brown. Skull long and narrow with a low flat braincase, rostrum long and slender; supraorbital shelves broadly developed and extended in raised ridges

across parietals; bullae large and rounded; molar teeth rectangular, first upper molar with six well-developed tubercles, nasals continuous posteriorly with premaxillae.

MEASUREMENTS: Subadult male, type, and an adult female, topotype: Total length, 242 mm., 351; tail vertebrae, 119, 174; hind foot, 26, 26 (dry, 28.5). Skull: greatest length, —, 42.4; basal length, 32, 35.8; zygomatic width, 18.2, 21.4; mastoid width, 13.5, 15.6; interorbital width, 6.5, 6.8; length of audital bullae, 5.5, 6.4; length of nasals, —, 14.3; alveoli of upper molar series, 6.8, 7; palatal bridge, —, 6.6.

SPECIMENS: Prov. San José: San Gerónimo, 1 C.N.H.M., type; 1 A.M.N.H.

An adult female topotype is virtually indistinguishable in external characters from typical *fumeus*. The skull is actually longer and narrower than Allen's type, with a longer toothrow, and the interparietal is longer anteriorly, but the bullae, as in the type of *australis*, are smaller than in *fumeus*.

Very little is known about the life history of *Otodylomys*. It is a forest-loving, tree-climbing rat and largely nocturnal in its habits and appears to have an altitudinal range from near sea level to at least 6000 feet. It is one of the few genera peculiar to Central America. Both *Tylomys* and *Otodylomys* are preyed on by owls as shown in owl pellets.

NECTOMYS PETERS

WATER RATS

Most Central American representatives of the genus *Nectomys* are moderately large-sized Tawny rats with a tail considerably longer than the length of head and body; feet large; fur long, full, rather coarse, and without a sharp line of differentiation between color of back and underparts. Some of the South American representatives of this genus are the largest American murine rodents. The known range of *Nectomys* in its various species extends from Nicaragua south through Costa Rica and Panamá to Colombia and south in South America to a line roughly from Ecuador on the west coast to Rio Grande do Sul, Brazil, on the east coast.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{0-0}{0-0}$; molars, $\frac{3-3}{3-3}$ = 16.

Nectomys alfari alfari (Allen)

ALLEN'S WATER RAT

Sigmodontomys alfari ALLEN, 1897, Bull. Amer. Mus. Nat. Hist., vol. 9, p. 39.

TYPE: A.M.N.H. No. 12436/10744, adult male, skin and skull, collected at Jiménez, Costa Rica, altitude 700 feet, probably in May, 1895, by Anastasio Alfaro.

RANGE: Atlantic drainage areas of Nicaragua and Costa Rica.

GENERAL CHARACTERS: A large, long-tailed rice rat; total length over 300 mm.; ears small; tail finely annulated, with short hairs growing from between the scales, unicolor; hind feet much larger than front feet.

DESCRIPTION: Color of upperparts Ochraceous-Tawny, darkened on top of head and back with Mummy Brown hairs, somewhat paler along flanks and outer side of limbs; lateral line next to belly clear Ochraceous-Buff; underparts varying from light buff to pale Ochraceous-Buff; feet and toes sparsely covered with Mummy Brown hairs; tail Cinnamon-Brown or Mummy Brown, unicolor. Skull strongly built with well-developed supraorbital shelves that extend along lateral border of parietals; rostrum short, broad, the superior outline bowed and sloping strongly downward anteriorly; nasals sharply tapered posteriorly and extending slightly beyond posterior border of premaxillae; anterior palatine foramina short and terminating well in front of first molars; auditory bullae small; dentition heavy, upper incisors large and curved strongly backward.

MEASUREMENTS: Adult male, and semi-adult male from Perálta, and type in parentheses: Total length, 315 mm., 312 (278); tail vertebrae, 185, 171 (155); hind foot, 36, 37 (37); ear, 19, 18. Skull: greatest length, 37.3, 36.5 (35.6); zygomatic width, 19.5, 19.2 (19.1?); interorbital width, 6.7, 6.7 (6.5); length of nasals, 15, 14.5 (14.5); length of anterior palatine foramina, 5.5, 5.3 (5.2); alveoli of upper molar series, 5.5, 5.5 (5.6).

SPECIMENS: Prov. Limón: Jiménez, 1, type, A.M.N.H. Prov. Cartago: Santa Teresa Perálta, 1 A.M.N.H.; El Sauce Perálta, 1 A.M.N.H., 2 U.S.F.W.

The cranial characters of *Nectomys a. alfari* are extremely variable. Typical specimens

usually have a hooked or Roman nose and a broad rostrum; in one individual from El Sauce Perálta the rostrum is relatively slender and the nasals comparatively straight, giving the skull an entirely different appearance.

Nectomys dimidiatus Thomas

NICARAGUAN WATER RAT

Nectomys dimidiatus THOMAS, 1905, Ann. Mag. Nat. Hist., ser. 7, vol. 15, p. 585.

TYPE: B.M. No. 5.3.4.2, old male, collected at Escondido River, 7 miles below Rama, Nicaragua, November, 1904, by W. G. Palmer.

RANGE: Known only from type locality.

GENERAL CHARACTERS: A small, dark-colored rat with glossy fur; tail shorter than length of head and body, finely scaled; ears small; feet large.

DESCRIPTION, FROM ORIGINAL: General color of back rather lighter than clove brown, sides of body becoming bistre; a dull buffy line edging the dark color of flanks and running down inner side of hind limbs. Belly dull clay color, deadened by the slaty bases of the hairs showing through. Outer sides of arms grayish brown; upper surface of hands and feet dull white; tail medium length, finely scaled, 15 rings to the centimeter, slaty grayish above, dull white below. Skull: supraorbital ridges little developed, the braincase broad, smooth, and rounded; zygomata widely and evenly spread. Nasals not markedly narrowed behind. Palatal foramina much longer than in any other species, narrowed in front, widely open and rounded behind and reaching the plane of the first molars.

MEASUREMENTS OF TYPE: Head and body, 125 mm.; tail vertebrae, 115; hind foot, s.u., 26, c.u., 28; ear, 13. Skull: greatest length, 30; basilar length, 23.4; zygomatic width, 17; nasals, 11.2 by 3.2; interorbital width, 4.8; breadth of braincase, 13; palate length, 12.8; diastema, 7.6; palatal foramina, 5.7 by 2.3; length of upper molar series, 4.4.

The pelage of *N. dimidiatus*, which has a thick velvety underfur, is obviously modified for an aquatic life. It is the smallest and only known member of the true glossy-furred *Nectomys* group found in Central America. *Nectomys alfari* occupies higher regions and

resembles large *Oryzomys* in pelage and general appearance.

Rats of the genus *Nectomys* are moderately specialized for a semi-aquatic life. They usually occur in the vicinity of swamps, lakes, and along the banks of streams in tropical America. Nests, so far as we know, are built under old logs and brush heaps but not necessarily with runways leading directly to water. If one can judge from the situations where the Costa Rican species have been trapped, it seems that they may be more or less independent of water. So far, this water rat has not been taken in western Costa Rica.

RHEOMYS THOMAS
WATER MICE

The members of this genus are small, dark-colored, aquatic mice with short glossy fur. They have small ears, almost concealed in the fur; feet webbed, and toes fringed with bristles. The known range of the genus *Rheomys* extends from El Salvador, probably through Honduras, Nicaragua, Costa Rica, and Panamá to Colombia.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{0-0}{0-0}$; molars, $\frac{3-3}{3-3}$ = 16.

Rheomys underwoodi Thomas
COSTA RICAN WATER MOUSE

Rheomys underwoodi THOMAS, 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 422.

TYPE: B.M., skin and skull, male, collected at Tres Rios, Costa Rica, May 5, 1905, by C. F. Underwood.

RANGE: Known only from the type locality.

GENERAL CHARACTERS: A small, dark-colored mouse with thick glossy fur overlaid with long, coarse, guard hairs; tail longer than length of head and body, well haired, underparts whitish.

DESCRIPTION: General color of upperparts Mummy Brown, darkened by the black tips of the longer hairs; rump nearly black, the tips of many of the longer hairs glossy white; whole underparts grayish white, base of hairs slaty. Head blackish, sides of muzzle and upper lip, as far back as the angle of the mouth, white; ears short, hair blackish; toes and fore feet white; hind feet well haired, dark brown above, the fringes glossy white; tail dark

brown above, slightly paler below. Skull smoothly rounded, interorbital region broad, its edges rounded, palatal foramina not extending back to level of the front of first upper molars, incisors normal, narrow, and slightly rounded in front.

MEASUREMENTS: Type male: Head and body, 130 mm.; tail, 150; hind foot, 35; ear, 5. Skull: greatest length, 30.5; basilar length, 24; zygomatic width, 15.5; length of nasals, 10.8; interorbital width, 5.6; breadth of braincase, 14.4; palatal foramina, 5; upper molar series, 4.8.

SPECIMENS: Prov. Cartago: Tres Rios, 2 B.M.

A specimen taken at El Volcán de Chiriquí was tentatively classified by Enders as *underwoodi*.

Rheomys hartmanni Enders
CHIRIQUÍ WATER MOUSE

Rheomys hartmanni ENDERS, 1938, Proc. Acad. Nat. Sci. Philadelphia, vol. 90, p. 295.

TYPE: A.N.S.P. No. 18329, female adult, skin and skull, collected on the Río Cotito, 4900 feet elevation, Chiriquí, Panamá, March 17, 1937, by R. E. Enders.

RANGE: Southwestern Panamá and probably southeastern Costa Rica but known only from type locality.

GENERAL CHARACTERS: Similar to *R. underwoodi* but ears larger; hind feet relatively smaller, tail white-tipped and not heavily haired. Pelage short, fine; fringe around toes of hind feet not conspicuous.

DESCRIPTION: Color of upperparts uniformly and finely mixed black and Cinnamon; underparts pale silvery gray; guard hairs not conspicuously longer than underfur, both Plumbeous basally; vibrissae grayish; fore and hind feet Sepia, the fringing bristles on hind feet grayish white. Skull small and flat, frontal region depressed; audital bullae heavy, narrow.

MEASUREMENTS OF TYPE: Total length, 212 mm.; tail vertebrae, 104; hind foot, 25; ear from notch to crown, 11. Skull: greatest length, 27.4; zygomatic width, 14.3; length of nasals, 11.9; interorbital width, 4.1; incisive foramina, 5.

Rheomys hartmanni is more closely related to *R. raptor* from eastern Panamá than *R.*

underwoodi. The type was taken in a meat-baited trap set in the water under a log jam; a topotype was also taken at the edge of the same stream. According to Enders, small fish were abundant here, and the animals had a strong fishy odor when caught. So far there is no conclusive evidence that *Rheomys* catches and feeds on fish. Goldman records that *R. raptor* was taken near the headwaters of the Río Limón in traps placed in the water among rocks and under logs in places where the water was trickling over the banks of a small stream. He states that there was no evidence that the species preys on fish, but that small collections of freshly emptied shells of water snails were noted near the edge of the water which suggested a probable source of food supply. Stomachs examined contained small quantities of pulp that may have been the remains of the bodies of snails.

NYCTOMYS SAUSSURE
VESPER RATS

Members of the Middle American genus *Nyctomys* are medium-sized, Tawny colored rats with hind feet modified for an arboreal life; tail well haired, tufted terminally and about equal length to head and body; pad on the fore feet representing the pollex prominent and bearing a vestigial claw; mammae four. The range of this genus extends from Vera Cruz, Mexico, south through Central America to Panamá.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{0-0}{0-0}$; molars, $\frac{3-3}{3-3}$ = 16.

Nyctomys sumichrasti costaricensis
Goldman

COSTA RICAN VESPER RAT

Nyctomys sumichrasti costaricensis GOLDMAN, 1937, Jour. Washington Acad. Sci., vol. 27, no. 10, p. 422.

TYPE: U.S.N.M. No. 250331 (Biol. Surv. Coll.), adult male, skin and skull, collected at San Gerónimo de Pirrís, a hamlet on the main road to Pirrís before one reaches Jabillo, near the west coast of Costa Rica, altitude about 100 feet, April 12, 1931, by C. F. Underwood.

RANGE: Valley of the Río Grande de Pirrís, western Costa Rica, limits of range unknown.

GENERAL CHARACTERS: A relatively large

Tawny vesper rat with rather thick pelage; large ears; long black vibrissae; short broad feet; pure white underparts, the hair white to roots, and a well-haired, unicolor tail.

DESCRIPTION: Color of upperparts near Tawny, slightly darkened on top of head and over back by a fine admixture of black-tipped hairs; cheeks, flanks, outer sides of forearms, and thighs a purer, paler Tawny; entire underparts, including lips and inner sides of limbs, white; ears Mummy Brown; forefeet white; hind feet dusky over metatarsus, toes white; tail unicolor Mummy Brown. Skull with extremely broad braincase, very broad frontals, supraorbital ridges well developed and extending over parietals to occipital; interparietal broad, completely separating parietals from supraoccipital; rostrum short; bullae small. Incisive foramina broad but scarcely reaching toothrows; cheek teeth of the *Oryzomys* type, extremely complex. Nasals pointed posteriorly and conterminous with premaxillae.

MEASUREMENTS: Adult male, the type, and an old female from Jabillo: Total length, 270 mm., 263; tail vertebrae, 139, 139; hind foot, 24, 24; Skull: greatest length, 33.3, 31.7; zygomatic width, 17.7, 18.4; interorbital width, 5.8, 6.5; greatest width between temporal ridges, 14.1, 14.3; length of nasals, 11.6, 10.5; length of palatal bridge, 5.2, 5.2; length of anterior palatine foramina, 5.3, 5.2; alveoli, maxillary tooththrow, 5, 4.9.

SPECIMENS: Prov. San José: San Gerónimo, 9 C.N.H.M., 2 M.C.Z., 3 U.S.F.W., 1 A.M.N.H.; Jabillo, 1 U.S.N.M., 4 U.S.F.W. Prov. Puntarenas: Palmar, 1 A.M.N.H. (skull, skin badly damaged in alcohol).

Nyctomys s. costaricensis is distinguished from the neighboring subspecies by its rich Tawny coloration. The skull is similar to that of *nitellinus* and of *venustulus*, but larger than either; nasals more pointed and usually about conterminous with premaxillae posteriorly; anterior palatine foramina longer, about equal in length to palatal bridge.

Nyctomys sumichrasti venustulus
Goldman

NICARAGUAN VESPER RAT

Nyctomys sumichrasti venustulus GOLDMAN, 1916, Proc. Biol. Soc. Washington, vol. 29, p. 155.

TYPE: U.S.N.M. No. 33149/45153, adult female, skin and skull, collected at Greytown, Nicaragua, February 10, 1892, by C. W. Richmond.

RANGE: East coast region of Nicaragua and the lowlands of north central and northeastern Costa Rica.

GENERAL CHARACTERS: Similar to *Nyctomys s. costaricensis* but darker in color, the Tawny element more obscured by dusky hairs.

DESCRIPTION: Color of upperparts near Tawny, finely mixed with black, general tone darkest on top of head and over back; underparts white; ears narrow, orbital borders and tail Blackish Brown; feet white with a median metapodial area dark brown. Skull similar to *N. s. costaricensis* but smaller; nasals broader posteriorly, premaxillae extending beyond the posterior border of nasals; anterior palatine foramina relatively short.

MEASUREMENTS: Type, female adult, and an adult male from San Carlos: Total length, 256 mm., 283; tail vertebrae, 125, 156; hind foot, 25.5, 25. Skull: greatest length, 31.7, 33; zygomatic width, 18.4, 18.8; interorbital width, 6.6, 6.3; greatest width between temporal ridges, 14.6, 14.4; length of nasals, 10.6, 11.2; length of anterior palatine foramina, 5.2, 5.4; length of palatal bridge, 5.2, 5.2; alveolar length of upper molar series, 4.6, 5.

SPECIMENS: Prov. Limón: Pacuare, 1 U.S.N.M. Prov. Alajuela: La Vieja, 1 M.Z.U.M.; Vijagual San Carlos, 1 A.M.N.H.; Cataratos, San Carlos, 1 A.M.N.H.

Nyctomys sumichrasti nitellinus (Bangs)

CHIRIQUÍ VESPER RAT

Nyctomys nitellinus BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, p. 30.

TYPE: M.C.Z. No. 10249, old female, collected at Boquete, Chiriquí, Panamá, altitude 4000 feet, February 8, 1901, by W. W. Brown, Jr.

RANGE: Highlands of western Panamá and eastern Costa Rica, limits of range unknown.

GENERAL CHARACTERS: Similar to *N. s. costaricensis* but somewhat smaller, upperparts duller, the general tone near Cinnamon instead of Tawny.

DESCRIPTION: Color from Bang's original

description: Upperparts yellowish Cinnamon, duller and more Isabella Color on top of head, darkened along middle of back, head, and rump by a slight admixture of brown-tipped hairs; lower sides brighter, decidedly shaded with Orange-Buff; orbital ring and space between base of whiskers and eye black, top of nose Isabella Color; underparts pure white to roots of hairs; ears, sparsely haired, dusky; tail unicolor blackish, toes and sides of tarsus white, central portion of tarsus dark brown. Skull similar to that of *N. s. costaricensis* but smaller, nasals less pointed and usually exceeded by premaxillae in posterior extension; anterior palatine foramina shorter than palatal bridge.

MEASUREMENTS OF TYPE: Total length, 260 mm.; tail vertebrae, 125; hind foot, 24; ear, 17. Skull: occipitonasal length, 32.4; zygomatic width, 18; mastoid width, 13; interorbital width, 11; length of nasals, 10.6; length of palatal slits, 4.6; length of palate, 12.4; length of upper molar series, 4.8.

SPECIMENS: Prov. Limón: Cautita, 1 A.M.N.H. Prov. Cartago: La Carpintera, 1 A.M.N.H.

A semi-adult specimen from Cautita Beach, Talamanca, is here provisionally referred to *N. s. nitellinus*. In color it is more of a Cinnamon tone than the Tawny shades of either *costaricensis* or *venustus*, though it may not be referable to any one of the three. A skin without skull from La Carpintera is nearer to *nitellinus* than either *venustus* or *costaricensis* though not typical.

The vesper rats are more or less nocturnal and arboreal in their habits. They spend the day in their nests in large trees and only occasionally come to the ground. The nests, usually prepared of fine vegetable fiber and built in the upper forks of trees, are not well hidden. They have been located in avocado trees, the fruit of which vesper rats seem to eat as well as wild figs. They appear to live in colonies and are local in distribution, being relatively common in one locality and virtually absent in others.

SIGMODON SAY AND ORD

COTTON RATS

The cotton rats are medium-sized robust rodents, with tails usually shorter than head

and body, sharply tapering to slender tips and moderately haired; short broad ears clothed with close hair. The pelage is moderately long, coarse, and generally grizzled in color. Mammae, $\frac{3-2}{3-2}=10$. The range of the cotton rats extends from the southern United States through Mexico and Central America to Venezuela and Peru in South America.

Sigmodon hispidus borucae Allen

COSTA RICAN COTTON RAT

Sigmodon borucae ALLEN, 1897, Bull. Amer. Mus. Nat. Hist., vol. 9, p. 40.

TYPE: A.M.N.H. No. 11761/10045, female adult, skin and skull, collected at Boruca, Costa Rica, December 12, 1891, by George K. Cherrie.

RANGE: Western Costa Rica at an elevation from sea level to about 3000 feet. Replaced in western Panamá by a slightly differentiated race, *S. h. chiriquensis*.

GENERAL CHARACTERS: A grayish brown cotton rat with underparts usually white but strongly suffused with buff in some individuals.

DESCRIPTION: Hair of upperparts Ochraceous-Tawny, heavily mixed with black, darkest on rump and middle of back and paler and more buffy on sides of body, top of head darker owing to a stronger admixture of black hairs; ears blackish, sparsely covered with black and buffy-tipped hairs; feet buffy or gray; tail Mummy Brown above, slightly paler below; underparts varying from nearly pure white to Cinnamon-Buff. Skull with heavy rostrum, well-developed supraorbital ridges which extend across parietals; interparietal broad, zygomatic arches strong and cut sharply backward; bullae moderate. Incisive foramina long and extending backward to between first molars; palate broad and reaching behind m^3 ; occipital plane with a high vertical median ridge; upper molar teeth heavy, flat-crowned, with narrow folds, the folds surrounded by thick enamel.

MEASUREMENTS: Type, an adult male, and a female from Palmar: Total length, 275 mm., 274, 289; tail vertebrae, 115, 110, 119; hind foot, 30, 35, 33. Skull: greatest length, 33, 37.1, 37.7; zygomatic width, 18, 19.9, 20.1; interorbital width, 6, 5, 5.4; width of braincase across ridges, 13, 13, 13.2; length of

nasals, 12, 13, 13.6; palatine foramina, 8, 8, 8; palatal bridge, —, 6.5, 7; alveoli of upper molar series, 5.5, 6.4, 6.4.

SPECIMENS: Prov. San José: San Gerónimo Pirris, 4 U.S.N.M., 12 U.S.F.W., 1 M.C.Z., 2 A.M.N.H.; Villa Colon, 19 U.S.F.W., 13 C.N.H.M., 1 M.C.Z., 4 A.M.N.H.; Sabanilla, 1 U.S.F.W., 1 M.C.Z.; Jabillo Pirris, 2 U.S.F.W., 1 M.C.Z., 2 A.M.N.H.; San José, 4 A.M.N.H.; Piedras Negras, 16 A.M.N.H. Prov. Puntarenas: San Francisco Esparta, 7 A.M.N.H.; Boruca, 19 A.M.N.H.; Palmar, 43 A.M.N.H.; Puerto Cortez, 3 A.M.N.H.; Lagartos Terreba, 1 A.M.N.H. Prov. Guanacaste: Las Huacas, 1 M.Z.U.M.; Cerros de San Juan, 10 M.Z.U.M.; San Juanillo, 7 M.Z.U.M.; Hacienda Santa María, 5 M.Z.U.M.

There are considerable individual variations even in series from one locality; some are light-colored with white underparts, while others are much darker with underparts strongly suffused with buff. Specimens from Puerto Cortez are exceptionally pale in color and suggest intergradation with *austerulus*. I have not seen the series from Guanacaste, but their subspecific classification as *borucae* listed by W. P. Harris seems acceptable.

Sigmodon hispidus chiriquensis Allen

BOQUERÓN COTTON RAT

Sigmodon borucae chiriquensis ALLEN, 1904, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 68.

TYPE: A.M.N.H. No. 18789, semi-adult male, skin and skull, collected at Boquerón, Chiriquí, Panamá, October 28, 1901, by J. H. Batty.

RANGE: Southwestern Panamá, limits of range undetermined.

GENERAL CHARACTERS: Very similar in external characters to *S. h. borucae* but color averaging darker.

DESCRIPTION: Color of upperparts Ochraceous-Tawny mixed with black, underparts varying from nearly white to Cinnamon-Buff. Skull relatively long, anterior palatine foramina long and narrow, interpterygoid fossa very wide, much wider than in *S. h. borucae*.

MEASUREMENTS OF TYPE: Total length, 280 mm.; tail vertebrae, 105; hind foot (dry), 32. Type and adult female from Talamanca: Skull: greatest length, 35.5, 37.5; zygomatic

width, 19.3, 19.5; interorbital width, 5.2, 5.5; width of braincase, 13, 13.5; length of nasals, 11.8, 13.5; palatine foramina, 8, 8.5; palatal bridge, 6.5, 7; alveoli of upper molar series, 6.2, 6.2; width across pterygoids, 3.3, 3.6.

SPECIMENS: Prov. Limón: Talamanca, 1 A.M.N.H.

An adult female labeled Talamanca, collected by Cherrie in 1890, is clearly referable to *chiriquensis*. It is not only identical in color with the type but has the wide interpterygoid fossa even more strongly accentuated. This well-marked characteristic is not approached in any other specimen of this available Costa Rican material.

***Sigmodon hispidus griseus* Allen**

NICARAGUAN OR GRAY COTTON RAT

Sigmodon hispidus griseus ALLEN, 1908, Bull. Amer. Mus. Nat. Hist., vol. 24, p. 657.

TYPE: A.M.N.H. No. 28497, adult male skin and skull, collected at Chontales (in the coastal lowlands), Nicaragua, February 20, 1908, by W. B. Richardson. The type is in good condition, but more than half the tail was lost during life.

RANGE: Nicaragua and adjacent parts of Honduras and possibly Costa Rica.

GENERAL CHARACTERS: A rather large, gray cotton rat with relatively coarse pelage; similar to *borucae* but grayer in color.

DESCRIPTION: General color of upperparts Pinkish Buff mixed with black, sides lighter and less varied with black than back, feet grayish white, tail blackish above, hair white below; underparts white or buffy white, dark basal color showing through. Skull large and broad but without any unusual peculiarities.

MEASUREMENTS: Type and adult male topotype: Head and body, 180 mm., 190; tail vertebrae, —, 110; hind foot, 30, 30. Skull: greatest length, 36.4, 37.7; zygomatic width, 21.5, —; interorbital width, 5.2, 5; width of braincase, 14, 13.2; length of nasals, 13.5, 14; palatine foramina, 8, 8.5; palatal bridge, 6.5, 6.2; alveoli of upper molar series, 6.4, 6.

***Sigmodon hispidus austerulus* Bangs**

CHIRIQUÍ COTTON RAT

Sigmodon austerulus BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, no. 2, p. 32.

TYPE: M.C.Z. No. 10288, adult male, skin and skull with slightly worn teeth and broken by trap across orbits, collected at Volcán de Chiriquí, Chiriquí, Panamá, altitude 10,000 feet, June 1, 1901, by W. W. Brown, Jr.

RANGE: Volcán Chiriquí and probably adjacent parts of Costa Rica at high elevations.

GENERAL CHARACTERS: About the size of *S. h. borucae* but tail longer, pelage more hispid, colors all much paler.

DESCRIPTION: Color of type: upperparts Cinnamon-Brown darkened along middle of back by the admixture of dark brown tipped hairs, slightly shaded with Russet on rump and flanks; underparts white washed with pale buff, sharply contrasted against color of upperparts; ears dusky with some hairs on both surfaces colored like those of back; feet and hands yellowish white, tail thickly clothed with short stiff hairs, dusky above, gray below. Skull of type too badly broken to show any specific characters.

MEASUREMENTS OF TYPE: Total length, 260 mm.; tail vertebrae, 120; hind foot, 32; ear, 7. Skull, damaged: mastoid width, 14.8; upper molar series, 6.

This species was based on an individual specimen which apparently is still unique.

Cotton rats frequent open fields, savannas, bushy places, and waste land, and usually avoid densely forested country. They make well-marked runways, radiating from their holes through the vegetation, and they are for the most part active during the day. A nest of dried grass or roots is built in a depression in the ground or in a surface excavation. The number of young varies from four or five to as many as 10, and there are several litters a year. The cotton rat feeds principally on the stems of various grasses, cutting them off in lengths of 2 or 3 inches, but varies its diet with grain and seeds.

SCOTINOMYS THOMAS

BROWN MICE

The members of the genus *Scotinomys* are small, blackish or dark reddish brown mice with soft pelage; tail sparsely haired, usually shorter than combined length of head and body, nearly unicolor blackish; ears relatively small; hind feet narrow. Cheek teeth hypodont, the molars narrow and elongated in the

anteroposterior direction, the lateral compression especially noticeable in the first upper molar. *Scotinomys* in a Middle American genus and its range extends from Chiapas in southern Mexico through Central America to Panamá.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{0-0}{0-0}$; molars, $\frac{3-3}{3-3} = 16$.

Scotinomys teguina cacabatus Goodwin

SAN CARLOS VALLEY BROWN MOUSE

Scotinomys teguina cacabatus GOODWIN, 1945, Amer. Mus. Novitates, no. 1279, pp. 1-2.

TYPE: A.M.N.H. No. 139733, adult female, teeth slightly worn, Lajas Villa Quesada, 5000 feet elevation, near Tapasco on the main road to San Carlos, September 16, 1941, collector C. F. Underwood.

RANGE: Known only from the San Carlos River drainage.

GENERAL CHARACTERS: A moderately large, dark reddish brown *Scotinomys* of the *teguina* group with glossy pelage, small ears, and relatively long tail.

DESCRIPTION: Color of upperparts about Mars Brown shaded with black, grading to Prout's Brown on head and sides of body, the fur Dark Neutral Gray from base for most of its length, tipped with reddish Cinnamon-Brown and mixed with long black hairs, the black hairs predominating over the rump; inside of ears sparsely covered with short Cinnamon-Brown hairs; outside of ears Blackish Brown; fore and hind feet and upper side of tail Blackish Brown, the epidermis on under side of tail dusky but the hairs are buffy; underparts dark Cinnamon-Buff. Skull relatively large with a slender, sharply tapered rostrum; nasals long, slender, and conterminous with premaxillae posteriorly; braincase broad, smooth, and relatively low; interparietal long anteroposteriorly; supraorbital ridges low, forming a shallow shelf over orbits and extending in a faint line across parietals. Interorbital region depressed at posterior border of nasals; anterior palatine foramina long and narrow, reaching posteriorly to a line across anterior border of first molars; palate reaching to posterior border of last molars, zygomatic arches slender; molariform teeth small but not peculiar; masseteric proc-

ess of the zygomatic plate strongly developed, extending the palate beyond the plane of first molars, a character peculiar to the *teguina* group.

MEASUREMENTS: Type and an adult female topotype: Total length, 145 mm., 145; tail vertebrae, 60, 56; hind foot, 19, 19; ear, 13, 13. Skull: greatest length, 23.75, 23.1; condylobasal length, 22, 21.2; palatal length, 11.1, 11; length of nasals, 9, 8.6; interorbital width, 4.3, 4.3; zygomatic width, 11.6, 12; width of braincase, 10.5, 10.7; width of palate across m^2-m^2 , 5.4, 5.3; alveoli of upper molar series, 3.8, 4.

SPECIMENS: Prov. Alajuela: Lajas Villa Quesada, 10 A.M.N.H.; Tapasco, 3 A.M.N.H.

Scotinomys t. cacabatus is readily distinguished from *S. irazu* by its larger size and noticeably darker and redder pelage; the skull is also larger with a broader and flatter braincase. Superficially it is similar to typical *teguina* from Coban, Guatemala, but is larger in size, tail longer, and differs in some cranial characters.

Scotinomys teguina escazuensis Goodwin

ESCAZÚ BROWN MOUSE

Scotinomys teguina escazuensis GOODWIN, 1945, Amer. Mus. Novitates, no. 1279, p. 2.

TYPE: A.M.N.H. No. 138051, adult female, teeth worn, collected at Los Higuerones, a "caserio" or community of small farms, 5000 feet elevation, in the humid tropical highlands above the town of Escazú, Costa Rica, November 1, 1940, by C. F. Underwood.

RANGE: Central Costa Rica, including the high land from Cartago directly south of the Reventazón River and west to the Cerros de Escazú; limits to the northwest and south undetermined.

GENERAL CHARACTERS: A small, dark-colored, dark reddish brown mouse of the *teguina* group without any special peculiarities. It is a rather poorly differentiated form, apparently intermediate between *cacabatus* and *irazu* but sufficiently different from both to be recognized as a geographical subspecies.

DESCRIPTION: General color of upperparts in worn pelage between Prout's Brown and Auburn shaded with black. Tail dusky above

but hairs below are buffy white for most of the length; fore and hind feet Blackish Brown; underparts Cinnamon-Buff. Specimens in unworn pelage are heavily overlaid with black over rump and middorsal region. Skull similar to that of *cacabatus* but smaller, braincase more smoothly rounded, and rostrum shorter.

MEASUREMENTS: Type, and a range of 16 largest topotypes in parentheses: Total length, 129 mm.; tail, dry skin, 46; hind foot, 16, dry skin including claws, 17; ear, 12. Skull: greatest length, 21.6 (21.4-22.3); condylobasal length, 19.8; palatal length, 10.3; length of nasals, 7.3; interorbital width, 4; zygomatic width, 11.3; width of braincase, 10; width of palate across m^2 - m^2 , 5; alveoli of upper molar series, 3.75 (3.6-3.9).

SPECIMENS: Prov. San José: Los Higuerones, 10 A.M.N.H.; Altos Escazú, 5 M.C.Z.; Escazú, 5 A.M.N.H. Prov. Cartago: San Ramón Tres Ríos, 4 C.N.H.M., 1 U.S.N.M.; La Carpintera, 3 A.M.N.H.; Cervantes, 1 U.S.N.M.; El Copey de Dota, 4 M.Z.U.M.; Estrella Cartago, 5 M.Z.U.M.; El Muñeco, 1 M.Z.U.M.

Scotinomys teguina endersi,
new subspecies

POTRERO GRANDE BROWN MOUSE

TYPE: A.M.N.H. No. 141998, adult female, skin and skull, collected at Agua Buena, locally known as Cañas Gordas but west of the real Cañas Gordas, Savanna de Potrero Grande, Province of Puntarenas, Costa Rica, elevation about 3500 feet, November 29, 1942, by C. F. Underwood.

RANGE: Known only from the vicinity of the type locality.

GENERAL CHARACTERS: A small, dark reddish brown *Scotinomys*, about the size of *S. t. leridensis* from Boquete but color slightly darker and anterior portion of skull longer and narrower.

DESCRIPTION: Color of upperparts between Mars Brown and Prout's Brown, heavily overlaid with glossy black guard hairs; face less blackish than back and cheeks lighter than face, but tip of nose almost black; lower back and rump nearly black; underparts near Buckthorn Brown; tail, feet, and

outside of ears Fuscous-Black; hair on inside of ears about color of face. Skull small and narrow, the superior outline relatively straight; rostrum long, slender, and tapered; interorbital region strongly depressed at posterior border of nasals; braincase narrow; zygomatic arches not expanded; anterior palatine foramina comparatively short; upper toothrows strongly divergent anteriorly.

MEASUREMENTS: Type, and adult female topotype in parentheses: Total length, 138 mm. (128); tail vertebrae, 58 (57); hind foot, 17, dry, 17.5 (18); ear, 11, from notch after dampening, 12 (12). Skull: greatest length, 22.4 (22.5); condylobasal length, 20.3 (20.8); palatal length, 10.2 (10.4); length of nasals, 8.5 (8.4); zygomatic width, 11.4 (11); interorbital width, 4.35 (4); width of braincase, 10 (10.7); width of palate across anterior upper molar, 5 (5); alveoli of upper molar series, 3.7 (3.7).

SPECIMENS: Prov. Puntarenas: Agua Buena, 3, including type, A.M.N.H.; Boruca, 1 A.M.N.H.

Externally *Scotinomys t. endersi* is distinguishable from other known forms of this species by its small size and very dark reddish coloration. Dr. Enders, who kindly compared this new form with the Chiriquí series at Swarthmore College, found that the Agua Buena specimens average darker than *leridensis* with the anterior portion of the skull longer and narrower; that they are smaller, shorter tailed, redder, and darker than *gari-chensis*, and the shape of the nasals is quite different; and that they are not *episcopi*, the nearest geographical ally, which is a larger and lighter colored form, and are a very different color from *apricus*. Compared with Costa Rican forms of this form, *endersi* is larger than *escazuensis*, with darker pelage, more sharply divergent toothrows, and more sharply tapered rostrum. It is smaller than *cacabatus*, with a shorter tail; the upper toothrows are noticeably more divergent, and the anterior palatine foramina considerably shorter. It is smaller and needs no comparison with *irazu*, which is a buffy-colored form with a heavier and more rounded skull. This form is named in honor of Dr. Robert K. Enders in recognition of his work on the mammals of Chiriquí.

Scotinomys teguina irazu (Allen)

IRAZÚ BROWN MOUSE

Akodon irazu ALLEN, 1904, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 46.

TYPE: A.M.N.H. No. 18128, female adult, collected on Volcán de Irazú, Costa Rica, February 23, 1902, by M. A. Carriker, Jr.

RANGE: Volcán Irazú, Costa Rica, elevation from 7000 to about 10,000 feet.

GENERAL CHARACTERS: Medium-sized brown mouse with moderately long soft pelage; smaller than *S. t. cacabatus* but the color buffy instead of Cinnamon or ochraceous.

DESCRIPTION: General color of upperparts uniform light Mummy Brown, the fur tipped with light Ochraceous-Buff and mixed with long black hairs; underparts varying from Pinkish Buff to pale Cinnamon-Buff; ears and feet Blackish Brown, tail Blackish Brown above, hairs on under side of tail light buff but not concealing the blackish epidermis. Skull small with a small, smooth, well-inflated braincase, interorbital region depressed at base of nasals and inflated over orbits, supra-orbital ridges very low and indistinct, nasals conterminous posteriorly with premaxillae, palatine slits barely reaching anterior plane of first molar.

MEASUREMENTS: Six fully adult specimens from 9400 elevation, Volcán Irazú, and type in parentheses: Total length, 128-138 (125); tail vertebrae, 53-60 (50); hind foot, dry, 17-18.6 (17); ear, 12-13. Skull: greatest length, 21.2-22.6 (22); condylobasal length, 19-20.5; palatal length, 10-10.4; length of nasal, 7.8-8.3 (8.3); interorbital width, 4-4.2 (4); zygomatic width, 11-11.5 (11.5); width of braincase, 10-10.3; width of palate across m^2 - m^2 , 4.8-5.2; alveoli of upper molar series, 3.8-4 (4).

SPECIMENS: Prov. Cartago: Volcán Irazú, 7, including type, A.M.N.H., 9400 feet, 12 A.M.N.H.; Altos de Irazú, 1 C.N.H.M.; Cartago, 4800 feet, 2 M.Z.U.M.

The range of *S. t. irazu* appears to be restricted to high, dry elevations on Volcán Irazú. The exact altitude for the type series is not known. They were collected in February and March, 1902, and are in worn pelage. A series from 9400 feet, taken in August in unworn pelage, has a heavier admixture of black hairs on the rump, giving a slightly darker

appearance than the type series, but the color is the same.

Scotinomys t. irazu is really larger than is implied in Allen's description. The type is an exceptionally small individual, choice of the only two specimens with complete skulls in the type series. The hind foot measurement of the type, 17 mm., was apparently taken without claws, as the entire foot in dry skin is 18 mm. Two specimens taken at 4800 feet at the base of Volcán Irazú, near Cartago, are referable to Allen's subspecies though not typical.

Scotinomys teguina apricus (Bangs)

BOQUETE BROWN MOUSE

Akodon teguina apricus BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, no. 2, p. 40.

TYPE: M.C.Z. No. 10236, old adult female, skin and skull, collected at Boquete, Chiriquí, Panamá, altitude 4000 feet, February 24, 1901, by W. W. Brown, Jr.

RANGE: Southwestern Panamá and possibly adjacent parts of Costa Rica, limits of range undetermined.

GENERAL CHARACTERS: A moderately large *Scotinomys*, uniformly dark brownish in color and short pelage, similar to *S. t. cacabatus* but colors not so red or so dark; the rump and thighs scarcely darker than rest of upperparts; skull heavier, rostrum broader, upper molariform toothrow more divergent than in *cacabatus*.

DESCRIPTION: Color from the original description. Upperparts Vandyke Brown, slightly more dusky on top of head and along middle of back; underparts heavily washed with dull Cinnamon-Rufous; hind feet, ears, and tail blackish. Skull similar to that of *S. t. cacabatus* but heavier throughout and toothrows more divergent. Rostrum long, broad, and not tapered anteriorly; braincase broad and relatively low and flat; anterior palatine foramina long and extending posteriorly to between anterior section of first molars; supraorbital ridges well developed.

MEASUREMENTS: From type description: Total length, 142 mm.; tail vertebrae, 58; hind foot, 18; ear, 13. Skull: occipitonasal length, 23; basal length, 20.2; zygomatic width, 12; mastoid width, 10.8; interorbital width, 4.6; length of nasals, 9; length of

palate, 9.6; upper molar series, 4; measurements of topotype: width across m^2 - m^2 , 5.1; width of braincase, 10.8.

Scotinomys teguina apricus is about the color of Honduran specimens of *S. teguina* but differs from the latter in having distinctive cranial characters, especially a broader and flatter braincase and longer and heavier rostrum. The type series were caught in open rocky places.

Scotinomys teguina episcopi

Enders and Pearson

BISHOP'S BROWN MOUSE

Scotinomys teguina episcopi ENDERS AND PEARSON, 1939, Notulae Nat. Acad. Nat. Sci. Philadelphia, no. 34, p. 1.

TYPE: A.N.S.P. No. 18454, adult male, skin and skull, collected at Siola, Río Colorado, tributary of the Río Chiriquí Viejo, 10 miles west northwest of El Volcán Post Office, Province of Chiriquí, Panamá, altitude 4100 feet, May 18, 1937, by David Bishop.

RANGE: The Pacific slopes of the continental divide, southwestern Panamá, and probably southwestern Costa Rica at altitudes from 3800 to 5600 feet. Recorded in Panamá from the valley of the Río Colorado, Río Cotito, Río Santa Clara, and the slopes of Cerro Pando where it was found abundantly around the Milpa clearings.

GENERAL CHARACTERS: Similar in color to, but slightly larger than, *S. t. apricus*, with softer and silkier pelage.

DESCRIPTION: Color very similar to that of *apricus* but averaging slightly darker over back and hips. Upper lip and forehead darker than in *apricus*; ventral surface somewhat paler. Skull narrow, higher than in *apricus*, the dorsal surface more rounded; zygomatic breadth somewhat less than in *apricus*.

MEASUREMENTS: From type description: Total length, 148 mm.; tail, 63; hind foot, 19; ear, 13. Average measurements of 10 adult topotypes: Total length, 139; tail, 60; hind foot, 18.6; ear, 13.1. Skull, type measurements: greatest length, 24.2; zygomatic width, 12.2; interorbital width, 5; width of braincase, 11.4; alveoli of upper molar series, 4.2. Average measure of three topotypes: greatest length, 23.6; zygomatic width,

12.0; interorbital width, 4.8; braincase, 10; toothrow, 4.4.

Scotinomys teguina garichensis

Enders and Pearson

ENDERS' BROWN MOUSE

Scotinomys teguina garichensis ENDERS AND PEARSON, 1939, Notulae Nat. Acad. Nat. Sci. Philadelphia, no. 34, p. 2.

TYPE: A.N.S.P. No. 18406, adult female, collected at Río Gariché, 5 miles southwest of El Volcán Post Office, Chiriquí Province, Panamá, altitude 3200 feet, June 27, 1937, by Samuel Cresson.

RANGE: Pacific slopes of the continental divide in southwestern Panamá, east of Río Chiriquí Viejo, elevations from 3200 to 5000 feet.

GENERAL CHARACTERS: Approximately the size of *S. t. apricus*, but color nearly that of *S. t. teguina*.

DESCRIPTION: Hair on back is softer, silkier, and darker than in *apricus* but lacks the dorsal darkening of *S. t. teguina*. Lips and cheeks darker than in *apricus*, color of belly less Cinnamon; hind feet darker both above and below than in *apricus*; tail slightly bicolor. Skull relatively narrow and high. Compared with *apricus* the braincase is higher and the zygomatic breadth considerably less. The skull is also higher and narrower inter-orbitally than in *episcopi*.

MEASUREMENTS: From type description: Total length, 139 mm.; tail, 58; hind foot, 19; ear, 14. Skull: greatest length, 23.2; zygomatic width, 12.3; interorbital width, 4.4; width of braincase, 11; alveoli of upper molar series, 4.3. Average measurements of adult topotypes: Total length, 140; tail, 62; hind foot, 16. Skull, average of three topotypes: greatest length, 23.5; zygomatic width, 12.1; width of braincase, 11.2; toothrow, 4.3.

The type series contained specimens taken near Llano Verde in the bottom of a ravine in dense brush, and others from the Río Garché were trapped along the edge of the woods in an abandoned coffee plantation.

Scotinomys teguina leridensis

Enders and Pearson

LERIDA BROWN MOUSE

Scotinomys teguina leridensis ENDERS AND

PEARSON, 1939, Notulae Nat. Acad. Nat. Sci. Philadelphia, no. 34, p. 3.

TYPE: A.N.S.P. No. 18483, adult female, collected at Casita Alta, Finca Lerida, Boquete, Province of Chiriquí, Panamá, altitude 7000 feet, July 13, 1937, by David Bishop.

RANGE: Known only from type locality.

GENERAL CHARACTERS: A small, dark *Scotinomys*, uniformly colored over back and hips. Considerably smaller than *S. t. apricus*.

DESCRIPTION: Color over back uniform, face less blackish with cheeks lighter than face. Compared with *apricus* the color dorsally is somewhat darker, especially over rump, but color of belly about the same as in *apricus*. Feet and ears Fuscous-Black; tail very slightly paler beneath. Skull smaller than in *apricus*, the braincase narrower and higher owing to curvature of the parietals; zygomatic breadth conspicuously less than in *apricus*; tooththrows slightly shorter, mandible smaller and lighter.

MEASUREMENTS: From type description: Total length, 129 mm.; tail, 50; hind feet, 19; ear, 13. Skull: greatest length, 22.2; zygomatic width, 12.0; interorbital width, 4.8; width of braincase, 10.8; alveoli of upper molar series, 4. Average measurements of two topotypes: greatest length, 22.6; zygomatic width, 11.8; interorbital width, 4.6; width of braincase, 11; tooththrow, 4.3.

Scotinomys xerampelinus (Bangs)

VOLCÁN DE CHIRIQUÍ BROWN MOUSE

Akodon xerampelinus BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, no. 2, p. 41.

TYPE: M.C.Z. No. 10240, old adult male, collected at Volcán de Chiriquí, Panamá, altitude 10,300 feet, May 26, 1901, by W. W. Brown, Jr.

RANGE: Volcán de Chiriquí at an elevation from 7000 to 10,300 feet.

GENERAL CHARACTERS: A medium-sized brown mouse with a relatively long tail and long pelage. The color yellowish and underparts grayish.

DESCRIPTION: Color from the original description. Upperparts uniform dark yellowish brown (a color that might perhaps be called tawny burnt-umber); underparts bro-

coli-brown; hands, feet, tail, and ears blackish (slightly grayer, less intense black than those parts in *A. t. apricus* owing to greater hairiness). Skull lighter and more delicate than that of *apricus* and *teguina*; rostrum longer, nasals narrower, palatal slits rather wider, audital bullae slightly larger, molariform teeth heavier and wider. Masseteric process of the zygomatic plate only slightly developed and the palate elevated directly in front of the first molar.

MEASUREMENTS: From type description: Total length, 145 mm.; tail vertebrae, 65; hind foot, 17; ear, 14. Skull: basal length, 19.2; occipitonasal length, 22.6; zygomatic width, 11.6; mastoid width, 10.8; interorbital width, 4.2; length of nasals, 8.6; length of palate, 9.6; alveoli of upper molar series, 4.

The type series was taken in open rocky country on the desolate top of Volcán de Chiriquí, a little below actual timber line but still where the forest had become stunted and sparse.

Scotinomys longipilosus Goodwin

LONG-FURRED BROWN MOUSE

Scotinomys longipilosus GOODWIN, 1945, Amer. Mus. Novitates, no. 1279, pp. 2-3.

TYPE: A.M.N.H. No. 141223, adult male, collected at Volcán Irazú, Costa Rica, 9400 feet elevation, August 22, 1941, by C. F. Underwood.

RANGE: Known only from the type locality.

GENERAL CHARACTERS: A dark-colored *Scotinomys* of the *xerampelinus* group with long, soft, lax pelage, relatively long tail, small ears, and underparts varying very little in color from rest of body. Skull narrow and elongate. Similar in length of pelage and general color to *xerampelinus* but underparts darker and skull relatively narrower.

DESCRIPTION: Color of upperparts nearly uniform Prout's Brown, slightly darker on rump at base of tail; fur dark Neutral Gray from base for most of its length, tipped with Cinnamon-Brown and mixed with longer, fine, black guard hairs; color of underparts slightly paler than back and without the admixture of black guard hairs; fore and hind feet, tail, and ears Mummy Brown, the inner upper anterior border of ears sparsely covered with short, coarse, Cinnamon-Brown

hairs. Skull long and slender with a long narrow rostrum and slender nasals; braincase small, smooth, moderately inflated, and constricted anteriorly; supraorbital ridges undeveloped, interorbital region narrow and inflated over orbits; zygomatic arches slender, not expanded, their sides parallel, interparietal short anteroposteriorly, anterior palatine foramina not quite reaching plane of first molars; bullae small but well inflated; nasals continuous posteriorly with premaxillae, molariform teeth normal.

MEASUREMENTS OF TYPE: Total length, 151 mm.; tail vertebrae, 70; hind foot, 18 (dry, 18.5); ear, 13. Skull: greatest length, 22.3; length of nasals, 8.5; palatal length, 10.9; palatal length, 9.8; length of palatine slits, 3.3; mastoid width, 10.3; zygomatic width, 11.2; greatest width of braincase, 10; interorbital width, 4.2; width across m^2 - m^2 , 5; alveoli of upper molar series, 4.

SPECIMENS: Prov. Cartago: Volcán Irazú, 1 (type) A.M.N.H.

Scotinomys longipilosus can readily be distinguished from *S. irazu*, which occupies the same territory, by its much longer and softer pelage, longer tail, and dusky underparts, characters that separate it from all members of the *teguina* group. The skull is especially narrow in relation to its length, and the interorbital region is extended posteriorly, resulting in a small, globular braincase and the elimination of supraorbital shelves. The type, the only known specimen, was collected at an elevation of 9400 feet at the edge of the rain forest on Volcán Irazú along with a series of *S. t. irazu*.

Scotinomys harrisi Goodwin

SAVANNA BROWN MOUSE

Scotinomys harrisi GOODWIN, 1945, Amer. Mus. Novitates, no. 1279, pp. 3-4.

TYPE: M.Z.U.M. No. 62886, adult male, skin and skull, teeth unworn, collected at Las Vueltas, Province of Cartago, Costa Rica, April 28, 1931, by Austin Smith.

RANGE: Known only from type locality, taken on the savanna at an elevation of 8000 feet.

GENERAL CHARACTERS: A relatively large, buffy-colored *Scotinomys* of the *xerampelinus*

group, with long, soft, full pelage and comparatively short tail.

DESCRIPTION: Color of upperparts light Brussels Brown with little luster. The fur is Dark Neutral Gray from base for most of its length and broadly tipped with light Ochraceous-Tawny and sparsely mixed with long black hairs; cheeks and underparts clear Ochraceous-Buff; entire ears covered with fine Ochraceous-Tawny and black hairs, the light-colored hairs predominating. Feet Mummy Brown but lightened by the presence of grayish brown hairs. The tail is exceptionally short and apparently complete. Skull large with a slender rostrum; nasals moderately long, narrow, tapered to a point posteriorly, and extending slightly beyond the posterior border of the premaxillae; braincase high and well inflated, supraorbital shelf and parietal ridges undeveloped, interparietal moderately long anteroposteriorly but not extending across parietals, bullae well inflated but not unusually large; molariform teeth large, the last upper molar with a small but distinct posterior cusp, toothrows slightly divergent anteriorly. Anterior palatine foramina reaching to a line across the front of first molariform teeth, and interpterygoid fossa extending to a line across the posterior border of last molars. Masseteric process of the zygomatic plate barely indicated, and the plate elevated at a sharp angle in front of the first molar, a character peculiar to the *xerampelinus* group.

MEASUREMENTS OF TYPE: For comparison, the measurements of the type of *xerampelinus*, an old male, are in parentheses: Total length, 141 mm. (145); head and body, 83 (80); tail, 58 (65); hind foot, 19 (17); ear from crown, 12 (from notch, 14). Skull: greatest length, 22.8 (22.6); basal length, 18.2 (19.2); palatal length, 10.9; palatal length, 9.7 (9.6); length of nasals, 8.75 (8.6); zygomatic width, 11.6 (11.6); mastoid width, 10.3 (10.8); interorbital width, 4.5 (4.2); width of braincase, 11; width of palate across first molars, 5.05; length of upper molar series, 4.2 (4); length of mandible, 12.7 (13).

SPECIMENS: Prov. Cartago: Las Vueltas, 1 (type) M.Z.U.M.

Scotinomys harrisi is larger than *S. longipilosus* with a shorter tail and color buffy

instead of Cinnamon. In cranial characters it differs from *longipilosus* in having a larger and broader skull, a noticeably larger braincase, larger teeth, and more divergent tooth-row. Compared with *S. xerampelinus*, *harrisi* is larger with shorter tail, and while the color is of a similar shade as in the latter, it is much stronger, brighter, more uniform, and strongly accentuated over the ears, whereas in *xerampelinus* the ears are blackish. In cranial characters the skull of *harrisi* is similar to that of *xerampelinus*, except that it has a more slender rostrum, higher braincase, slightly heavier teeth, and the last upper molar has a small but distinct subsidiary posterior cusp which probably disappears with wear. The two semi-adult topotypes of *xerampelinus* listed by Bangs do not have a similar cusp on this tooth.

The difference between *harrisi* and *xerampelinus* becomes more significant when the habitat and age of the two types are taken into consideration. The *harrisi* type is barely adult, with no signs of wear on the teeth, and was taken in savanna country at an elevation of 8000 feet. The *xerampelinus* type is an old male with much worn teeth and was taken on the desolate top of Volcán Chiriquí at an elevation of 10,800 feet in open rocky country, a little below timber line but where the forest had become stunted and sparse.

Scotinomys, or the little brown mice, inhabit open upland savanna and rocky places, clearings, and brush country. They appear to be more or less local in distribution, being abundant in some localities and absent or rare in others. Large series show relatively little individual variation, but local variation is evident even for short distances, so much so that some of the Costa Rican series exhibit a combination of characters that intergrade with several described forms.

FAMILY MURIDAE

SUBFAMILY MURINAE

OLD WORLD RATS AND MICE

Murinae is the largest subfamily of Old World mammals. Its members are typically rat- or mouse-like. They have no premolars, but there are three true molars on each side with transverse series of tubercles arranged in three longitudinal rows.

MUS LINNAEUS

HOUSE MICE

The genus *Mus* includes many indigenous Old World species and is represented in America by an immigrant, the common house mouse.

DENTITION: Incisors, 1-1; canines, 0-0; premolars, 0-0; molars, 3-3 = 16.

Mus musculus Linnaeus

HOUSE MOUSE

[*Mus*] *musculus* LINNAEUS, 1758, *Systema naturae*, ed. 10, vol. 1, p. 62.

TYPE LOCALITY: Uppsala, Sweden.

RANGE: Cosmopolitan, introduced, and widely established throughout the Americas.

GENERAL CHARACTERS: A small grayish brown mouse with small ears, close coarse fur, tail slightly longer than head and body, and color of underparts not contrasted with color of back.

DESCRIPTION: The fur on upperparts is Bluish Black from base for most of its length, tipped with Pinkish Buff and mixed with long black hairs, darkest on middle of back and grading to clearer buff on sides of body, head, and underparts; ears, feet, and tail Blackish Brown. Skull small and slender, braincase large, anterior palatine foramina long and extending to between the first molars; incisors, when viewed from the side, have a distinct notch on the cutting edge; molars with three longitudinal rows of tubercles, the first molar much larger than the second and the third much smaller than the second.

MEASUREMENTS: An old female from Tres Rios: Head and body, 82 mm.; tail vertebrae, 85; hind foot, 16; ear, 15. Skull: greatest length, 21.6; condylobasal length, 21; length of nasals, 8.3; length of anterior palatine foramina, 5; zygomatic width, 11.1; interorbital width, 3.9; length of upper molar series, 3.2.

SPECIMENS: Prov. San José: San José, 3 A.M.N.H.; Desamparados, 2 A.M.N.H. Prov. Cartago: Tres Rios, 4 A.M.N.H.; Volcán Irazú, 2 A.M.N.H.; Irazú, 9400 feet, 3 A.M.N.H. Prov. Alajuela: Lajas Villa Quesada, 6 A.M.N.H. Prov. Puntarenas: San Francisco, 1 A.M.N.H.

The house mouse inhabits towns and villages throughout most of Costa Rica. In

many localities these mice take to the fields where they seem to exist under the same conditions as the native mammals.

RATTUS FISCHER

COMMON RATS

This genus includes many species indigenous to the Old World and the common rats which are immigrants to America.

DENTITION: Incisors, $\frac{1}{1}$; canines, $\frac{0}{0}$; premolars, $\frac{0}{0}$; molars, $\frac{3}{3}$ = 16.

Rattus rattus rattus (Linnaeus)

BLACK RAT

[*Mus*] *rattus* LINNAEUS, 1758, *Systema naturae*, ed. 10, vol. 1, p. 61.

TYPE LOCALITY: Uppsala, Sweden.

RANGE: Cosmopolitan, introduced, and widely established in the Americas.

GENERAL CHARACTERS: A moderately large, dark-colored rat with naked, coarsely annulated tail, longer than head and body.

DESCRIPTION: General color of upperparts black or blue black; underparts Mouse Gray; ear, tail, and feet dark Mummy Brown. Skull angular, superior outline nearly straight, supraorbital ridge strongly extending across parietals, interorbital region narrow, rostrum long and slender, bullae well inflated, anterior palatine foramina long, narrow, and reaching posteriorly plane of first molars; zygomatic arches constricted anteriorly; upper molars with three longitudinal rows of tubercles.

MEASUREMENTS: Adult female from Honduras: Head and body, 160 mm.; tail vertebrae, 185; hind foot, s.u., 34. Skull: greatest length, 39.5; interorbital width, 5.6; zygomatic width, 19.5; alveolar length of upper molar series, 6.5.

SPECIMENS: Prov. Cartago: Juan Viñas, 2 A.M.N.H.; Cartago, 1 M.Z.U.M.

Rattus rattus alexandrinus (Geoffroy)

ALEXANDRIA OR ROOF RAT

Mus alexandrinus GEOFFROY, 1803, *Catalogue des mammifères du Muséum National d'Histoire Naturelle*, Paris, p. 192.

TYPE LOCALITY: Alexandria, Egypt.

RANGE: Cosmopolitan, introduced, and

widely established in southern North America, Central and South America.

GENERAL CHARACTERS: Similar to the black rat but brownish in color.

DESCRIPTION: Color of upperparts reddish brown, overlaid with long black hairs, underparts white mixed with dusky, the line of demarcation between color of back and underparts not sharply defined; tail nearly unicolor, brownish black, longer than combined length of head and body; fore and hind feet soiled white. Skull similar to that of the black rat.

MEASUREMENTS: Same as for the black rat.

SPECIMENS: Cocos Island, 1 A.M.N.H.

Rattus rattus frugivorus (Rafinesque)

FIELD RAT

Musculus frugivorus RAFINESQUE, 1814, *Précis des découvertes et travaux somnologiques*, Palermo, p. 13.

TYPE LOCALITY: Sicily.

RANGE: Cosmopolitan, introduced into the Americas.

GENERAL CHARACTERS: Similar to the Alexandria rat, but underparts white and the line of demarcation between color of back and underparts sharply defined.

DESCRIPTION: Color of upperparts reddish brown, overlaid with long black hairs, underparts white or yellowish white; tail unicolor, brownish black, and longer than combined length of head and body; fore and hind feet dusky white; skull similar to that of the black rat.

MEASUREMENTS: Adult male from El Sauce Perálta: Head and body, 165 mm.; tail vertebrae, 220; hind foot, 35. Skull measurements of male from Colombia: greatest length, 43.4; interorbital width, 5.9; zygomatic width, 20.4; alveoli of upper molar series, 7. (Total length of type, 15 inches.)

SPECIMENS: Prov. Cartago: El Sauce Perálta, 1 U.S.F.W.; Santa Teresa Perálta, 1 A.M.N.H. Prov. San José: San José, 1 A.M.N.H.

Rattus frugivorus is a field rat, while *alexandrinus* usually frequents human habitations, and may readily be distinguished from the latter by its white instead of dusky underparts.

Rattus norvegicus (Erxleben)

NORWAY RAT

[*Mus*] *norvegicus* ERXLEBEN, 1777, *Systema regni animalis*, vol. 1, p. 381.

TYPE LOCALITY: Norway.

RANGE: Introduced and widely established in North America.

GENERAL CHARACTERS: Similar in general appearance to the roof rat but tail much shorter, pelage coarser, and skull more massive, the superior outline arched in the orbital region instead of straight.

DESCRIPTION: Color of upperparts reddish brown overlaid with long black hairs, tail blackish brown, unicolor, usually less than the combined length of head and body; underparts and feet soiled white.

MEASUREMENTS: Adult female from Cocos Island (dry skin): Head and body, 180 mm.; tail, 135; hind foot, 38.5. Skull: greatest length, 44.8; length of nasals, 17; zygomatic width, 22; interorbital width, 6.5; mastoid width, 17.2; alveoli of upper molar series, 6.5.

SPECIMENS: Cocos Island, 2 A.M.N.H.

FAMILY ERETHIZONTIDAE

AMERICAN PORCUPINES

The American porcupines constitute a family of large, robust, arboreal rodents recognizable externally by the well-developed, barbed, sharp spines which are loosely attached to the skin. The range of the family extends from northern Canada through the United States, Mexico, Central America, and south to southern South America.

COENDOU LACÉPÈDE

PREHENSILE-TAILED PORCUPINES

In this genus the tail is long and prehensile. Unlike the condition in most prehensile-tailed American animals, the upper, instead of the lower side of the terminal portion of the tail is modified for direct contact in coiling about branches. The feet are highly specialized for climbing, both fore and hind feet with four functional digits armed with strong curved claws.

RANGE: Mexico through Central America to Panamá and in South America to Chile, also "said to be from West Indies."

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{1-1}{1-1}$; molars, $\frac{3-3}{3-3} = 20$.

Coendou mexicanum laenatum Thomas

CHIRIQUÍ LONG-TAILED PORCUPINE

Coendou laenatum THOMAS, 1903, *Ann. Mag. Nat. Hist.*, ser. 7, vol. 11, p. 381.

TYPE: B.M. No. 3.3.3.94, adult, not sexed, collected at Boquete, Chiriquí, Panamá, altitude 5000 feet, November 15, 1902, by H. J. Watson.

RANGE: Highlands of Costa Rica and western Panamá.

GENERAL CHARACTERS: A medium-sized porcupine with a long prehensile tail, yellow spines, and long black woolly hair, almost or entirely covering the spines. The legs are relatively short, and the body is long.

DESCRIPTION: General color of entire upperparts black, the hair more or less soiled whitish at base, the spines yellowish from base for most of their length and tipped with brownish black; underparts grizzled, the spines bristly, white and black-tipped; fore and hind feet black; upper basal four-fifths of tail with short yellow spines, rest of tail covered with stiff black hairs except upper terminal portion which is naked and modified for coiling about branches. Skull long and narrow with a short broad rostrum and broad nasals, the anterior part of the premaxillae projecting a little in front of nasals; frontal region not inflated; anterior palatine foramina ending at the premaxillo-maxillary suture; posterior edge of palate level with the back of second upper molar; bullae long and narrow; incisor teeth long and slender; molar crown pattern complex; premolar larger than the three following molars which are about subequal; supraorbital edges squared posteriorly and extending in well-defined ridges across parietals.

MEASUREMENTS: Adult male and female from Escazú, and type in parentheses: Total length, 830 mm., 750 (718); tail, —, — (256); hind foot, c.u., 85, 75, (s.u., 65; c.u., 75); Skull greatest length, 97, 84.8 (80); basilar length, 83.4, 74.3 (67); zygomatic width, 50.2, 52.8 (47); length of nasals, 29.5, 27 (24); breadth of nasals anteriorly, 22.3, 19 (16); interorbital width, 31, 32.8 (25.5);

palatilar length, 45.8, 39.7 (35.7); alveolar length of upper molar series, 20.5, 18.5 (19).

SPECIMENS: Prov. San José: Escazú, 2 A.M.N.H.; Escazú Heights, 1 A.M.N.H. Prov. Cartago: Pozo Ancho, 1 A.M.N.H.; slopes of Irazú, 2 C.N.H.M. Prov. Puntarenas: Esparta, 1 A.M.N.H.

Coendou rothschildi Thomas

ROTHSCHILD'S PORCUPINE

Coendou rothschildi THOMAS, 1902, Ann. Mag. Nat. Hist., ser. 7, vol. 10, p. 169.

TYPE: B.M. No. 723, original no., male, collected on Sevilla Island off the coast of Chiriquí, Panamá, January 24, 1902, by J. H. Batty.

RANGE: Known only from southwestern Panamá.

GENERAL CHARACTERS: A medium-sized, spiny, dark-colored porcupine speckled with white. It is readily distinguished from *C. m. laenatum* by the exposed spiny covering, the spines in the latter species being mainly covered by the long overlapping fur.

DESCRIPTION: General color of upperparts grizzled, the spines white at base followed by a broad band of Mummy Brown or black and tipped with white, the white tips absent on lower back, the spines extending down on upper side of base of tail, distal upper side of tail naked, rest of tail covered with short stiff black hairs. Underparts covered with short bristly spines, white at base followed by a broad median band of Mummy Brown and tipped with white, fore and hind feet Mummy Brown or black. Skull smaller than that of *C. m. laenatum*, frontal region inflated, nasals relatively narrow, anterior palatine foramina extending posteriorly beyond the premaxillo-maxillary suture, anterior upper cheek tooth (pm⁴) scarcely or no larger than the molars.

MEASUREMENTS: Adult male and female from Boquerón, Panamá, and type in parentheses: Head and body, 400 mm., 420 (410); tail, 280, 420 (330); hind foot, 67, 60 (68). Skull: greatest length, 84, 82.5; basilar length, 66.4, 68.5 (71); zygomatic width, 44.5, 46.2; interorbital width, 27.5, 25.5; alveolar length of upper molar series, 17.2, 16.5 (17.3).

Very little has been published on the life history of the prehensile-tailed porcupines. They are nocturnal and arboreal in their

habits, spending the greater part of the time in the tree tops and are rarely active during daylight hours. They feed on leaves and green shoots of trees and possibly some fruit. The young are born in a relatively advanced stage of development.

FAMILY DASYPROCTIDAE

AGOUTIS

External form modified for cursorial life; hind limbs lengthened, hind feet with three digits; fore feet with four functional digits, the claws hoof-like; ears short; tail rudimentary; cheek teeth semi-rooted, hypsodont. This family includes two genera, *Dasyprocta* and *Myoprocta*, the latter being restricted to South America. The geographical range of the family includes tropical America, from Mexico through Central America to Bolivia and Paraguay, Trinidad, and Lesser Antilles.

DASYPROCTA ILLIGER

AGOUTIS

The agoutis are moderately large, slender rodents with a narrow, rabbit-like head, short ears, and coarse pelage; the hair on the hinder part of the body very long and thick; the tail obsolete.

RANGE: Same as for the family.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{1-1}{1-1}$; molars, $\frac{3-3}{3-3} = 20$.

Dasyprocta punctata punctata Gray

GRAY'S AGOUTI

Dasyprocta punctata GRAY, 1842, Ann. Mag. Nat. Hist., ser. 1, vol. 10, p. 264.

The specimens forming the basis of Gray's short type description, collected by Captain Belcher, were supposed to have come from South America. Since we know that Belcher's ship, the "Sulphur," made protracted visits to Realejo and vicinity in 1837, 1838, 1839, but touched only briefly at other points on the Middle American coast, the type locality of *D. punctata* can be fixed as Realejo, Nicaragua.

RANGE: Salvador, western Honduras, western Nicaragua, and northwestern Costa Rica.

GENERAL CHARACTERS: A nearly uniformly colored, brownish agouti with long coarse

hair, alternately banded with black and brown, a decidedly Yellow Ocher shade on back and greenish on underparts.

DESCRIPTION: Color of specimens from Esparta, Costa Rica: upperparts Ochraceous-Buff mixed with black, the hairs on rump with six alternating bands of buff and black, the tips black on the head and Ochraceous-Buff on back; lower sides of body and throat pale Yellow Ocher mixed with black, the hair uniform Antimony Yellow along median line of abdomen; feet black. Skull large, long, smooth, and high; zygoma short and not expanded; nasals broad and about equal in length to parietals; a weak short sagittal crest is developed in the adult; bullae moderately large and smoothly rounded; palate straight and extending back to level of second molar; palatal foramina small and well in front of premaxillo-maxillary suture; cheek teeth strongly hypsodont, the molar crown pattern complex; incisors relatively thin, compressed.

MEASUREMENTS: Adult male and female from Esparta: Total length, 505 mm., 520; tail vertebrae, 27, 25; hind foot, 122, 110; ear, 43, 42. Skull: greatest length, 106.3, 105.2; condylobasal length, 98.2, 97.1; palatal length, 55, 54; zygomatic width, 48.5, 47; interorbital width, 29.7, 29.3; length of nasals, 42.3, 42; alveoli of upper molar series, 18.5, 20.

SPECIMENS: Prov. Puntarenas: Esparta, 2 A.M.N.H. Prov. Alajuela: Vijagua, 1 M.C.Z.

***Dasyprocta punctata richmondi* Goldman**

RICHMOND'S AGOUTI

Dasyprocta punctata richmondi GOLDMAN, 1917, Proc. Biol. Soc. Washington, vol. 30, p. 114.

TYPE: U.S.N.M. No. 51333 (Biol. Surv. Coll.), adult female, collected on the Escondido River, 50 miles above Bluefields, Nicaragua, November 16, 1892, by C. W. Richmond.

RANGE: From Talamanca north through central and eastern Costa Rica and eastern Nicaragua to south central and eastern Honduras.

GENERAL CHARACTERS: A dark, richly colored form with concolor back and rump, the pelage banded or ringed to base. Similar to *Dasyprocta p. punctata* but darker and

more reddish in color, instead of the Greenish Yellow shades in the typical form.

DESCRIPTION: Color of upperparts varying from rich Tawny to near Burnt Sienna, coarsely mixed with black, the Tawny color predominating over back; underparts in general overlaid with varying shades from Warm Buff to Ochraceous-Buff, except along median line of abdomen where the buffy color extends to roots of hair; feet black. Skull similar to that of *D. p. punctata*.

MEASUREMENTS: The type and adult female from Vijagua: Total length, 490 mm.; tail vertebrae, 35; hind foot, 123. Skull: greatest length, 110.7, 108; condylobasal length, 101.4, 98.2; zygomatic width, 49.4, 50.5; length of nasals, 44.4, 40.5; interorbital width, 28.4, 30.5; palatal length, 57.4, 53.2; alveolar length of maxillary toothrow, 17.9, 21.

SPECIMENS: Prov. Alajuela: Vijagua, 1 A.M.N.H. Prov. San José: San José, 1 U.S.F.W. Prov. Limón: Cuábre, 1 A.M.N.H.; Talamanca (probably near Sipúrio), 5 U.S.F.W.

***Dasyprocta punctata nuchalis* Goldman**

BLACK-NAPED AGOUTI

Dasyprocta punctata nuchalis GOLDMAN, 1917, Proc. Biol. Soc. Washington, vol. 30, p. 113.

TYPE: M.C.Z. No. 10081, adult female, collected at Divala, Chiriquí, Panamá, November 30, 1900, by W. W. Brown, Jr.

RANGE: Southwestern Panamá.

GENERAL CHARACTERS: An Orange-Buff and yellow race without distinctly banded pelage and readily distinguished from typical *punctata* and *richmondi* by the contrasting color of the upperparts.

DESCRIPTION: Top of head and nape strongly blackish, the nape nearly pure black in the type; sides of neck and shoulders, anterior part of back and sides mixed black and varying shades near Ochraceous-Buff or Ochraceous-Orange; posterior part of back distinctly Tawny, paling rather abruptly to Warm Buff on rump; long hairs of rump dusky with buffy tips; underparts in general Warm Buff, this color nearly pure and reaching to roots of fur on inner sides of limbs and median line of abdomen but darkened on throat, chest, and sides of abdomen where the dusky basal color shows

through; feet black. Skull closely resembling that of *D. p. punctata* and of *D. p. richmondi* but smaller than either, vertical portion of the maxillae between jugal and anteorbital vacuity narrower; nasal very broad and expanded anteriorly and teeth relatively small.

MEASUREMENTS OF TYPE: Total length, 570 mm.; tail vertebrae, 20; hind foot, 125. Skull: greatest length, 105; condylobasal length, 95; zygomatic width, 46.9; length of nasals, 39.3; interorbital width, 29.4; palatal length, 52; alveoli of maxillary tooththrow, 19.2.

***Dasyprocta punctata underwoodi* Goldman**
COSTA RICAN AGOUTI

Dasyprocta punctata underwoodi GOLDMAN, 1931, Jour. Washington Acad. Sci., vol. 21, no. 19, p. 481.

TYPE: U.S.N.M. No. 256559, male adult, collected at San Gerónimo, Pirris, western Costa Rica, June 1, 1931, by C. F. Underwood.

RANGE: Western Costa Rica.

GENERAL CHARACTERS: Similar in color and general characters to *D. p. nuchalis* from western Panamá but differing in the absence of the black nape.

DESCRIPTION: Color of type: top of head, nape, shoulders, sides of body, and outer surface of limbs coarsely mixed black and Light Orange-Yellow; middle of back heavily overlaid with rich Orange-Buff, the under color blackish; long hairs of rump blackish basally but tipped with Light Orange-Yellow in contrast with Orange-Buff on back; underparts in general mixed brownish and pale yellowish buff, the buff becoming purer along median line of abdomen and inguinal region; fore feet blackish; hind feet with short black and yellowish hairs. Skull closely resembling that of *D. p. nuchalis*.

MEASUREMENTS OF TYPE: Head and body, 511 mm.; tail vertebrae, 22; hind foot, 115. Skull: greatest length, 114.2; condylobasal length, 103.7; zygomatic width, 51.8; interorbital width, 31.3; length of nasals, 41.5; alveoli of maxillary tooththrow, 17.8.

SPECIMENS: Prov. San José: San Gerónimo Pirris, 4 U.S.F.W., 1 M.C.Z.; Altos Jabillo Pirris, 1 C.N.H.M., 1 A.M.N.H.; Pozo Pital, 1 A.M.N.H. Prov. Puntarenas: Agua Buena, 1 A.M.N.H.; Palmar, 2 A.M.N.H.

The one specimen from Agua Buena is almost black on the top of the head and nape of neck and approaches *nuchalis* in this respect. Of two specimens from Palmar, one has a black nape while the other is as light colored on the head and neck as typical *underwoodi*.

The agoutis are shy and generally nocturnal animals, though they may be about on cloudy and dull days. They are strictly terrestrial in their habits and favor savannas and tropical brush country. They live in burrows in the ground or in holes among the rocks. The young usually number two in a litter, and the probable gestation period is about 44 days. The young at birth have their eyes wide open with eyelids fully formed, the body completely covered with hair, and are able to move about easily and rapidly. Weight at birth of a male from Barro Colorado was 211 grams. Under natural conditions the agoutis feed on various kinds of wild fruit, berries, and vegetable matter. In captivity, they will eat bananas, carrots, papaya, greens, bread, cooked rice, and other similar food.

FAMILY CUNICULIDAE
PACAS

External form heavy, terrestrial, the limbs not lengthened, feet with digits of subungulate type, the claws extremely thick; hind foot with three well-developed digits, digit five and hallux present though strongly reduced; fore feet with four digits functional and a vestigial thumb bearing a small nail. Skull highly specialized, the structure very different from all other American rodents, the greater part of the maxillary and jugal expanded to form large bony cheek plates, the surface rugose; cheek teeth hypsodont, semi-rooted, characterized by deep reentrant folds.

RANGE: Tropical America from Mexico to south Brazil, Paraguay, and Peru.

CUNICULUS BRISSON
PACAS

The pacas are large, robust rodents with short, coarse hair, striped with long rows of more or less broken white spots; short limbs; obsolete tail; and small ears.

RANGE: Same as for family.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{1-1}{1-1}$; molars, $\frac{3-3}{3-3}$ = 20.

Cuniculus paca virgatus (Bangs)

PANAMANIAN PACA

Agouti paca virgatus BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, no. 2, p. 47.

TYPE: M.C.Z. No. 10079, old male, Divala, Chiriquí, Panamá, December 16, 1900, collected by W. W. Brown, Jr.

RANGE: From the Canal Zone in western Panamá to Chiriquí and in western Costa Rica to San Gerónimo; limits of range unknown.

GENERAL CHARACTERS: A large paca with the second stripe on the sides of body much less broken into spots than the Brazilian form, and all the spots above the two lateral lines smaller; differing from the Mexican form *nelsoni* in having shorter and closer pelage and a stronger dark stripe below lower lateral white stripe.

DESCRIPTION: Ground color of upperparts, including top of head, Walnut Brown or Warm Sepia; cheeks duller, paler, and shaded with Wood Brown; underparts white; on the lower sides a white stripe extending from hip to shoulder, above this another white stripe, a little shorter than first; these two bands break up on sides of neck and on flanks into series of white spots; above the white bands, two rows of small white spots, the lower one reaching from sides of neck to flanks; the upper one short, made up of only six or seven indistinct spots. Skull large, broad with zygomatic region specially modified by outgrowth from maxillary and jugal, forming a cheek plate which extends downward and conceals a large part of the mandible; nasals broad and short; palate broad, the anterior part extending beyond toothrow as a narrow shelf; palatal foramina obsolete; cheek teeth complex, upper series with two inner and three outer reëntrant folds except last molar in which the folds appear to be reversed; lower teeth with one outer and three inner folds; incisors thin and compressed.

MEASUREMENTS OF TYPE: Total length, 740 mm.; tail vertebrae, 22; hind foot, 130; ear, 43. Skull: basal length, 139.6; occipito-nasal length, 151; zygomatic width, 104;

mastoid width, 54.8; interorbital width, 47.2; length of nasals, 51.2; length of palate, 76; alveoli of upper molar series, 29.6.

SPECIMENS: Prov. San José: San Gerónimo, 1 C.N.H.M.

The pacas live in burrows in the ground, similar to those of the agoutis. The burrows are often placed on steep slopes or in rocky places. They are less cursorial and more nocturnal in their habits than the agoutis. Owing to the superior quality of their flesh, the pacas are among the most important game animals of the region and are often hunted with dogs. They are said to take readily to water when pursued.

FAMILY ECHIMYIDAE

SPINY RATS

Externally the Echimyidae are without extreme modifications, except in one case to a degree, for aquatic life; spiny covering, when present, relatively weak; feet never modified for cursorial life; digits of hind feet more than three; tail never with specialized quills or bristles in spiny genera. In general, this family includes a number of hystricoid rodents that have not become greatly specialized in any external characters. Bullae large, zygoma generally with upward directed process on posterior border or downward directed process on posterior border.

RANGE: Neotropical region, from Nicaragua southward to Patagonia, Cuba and the West Indies, Africa widely distributed south of the Sahara.

PROECHIMYS ALLEN

SPINY RATS

Rather large, rat-like rodents with grooved spines or bristles mixed with the hair, tail shorter than length of head and body, moderately haired; hind feet long and narrow, the outer digits shorter than the central three, fore feet not abnormal, the pollex rudimentary.

RANGE: From Nicaragua through Costa Rica and Panamá to Colombia and south to Bolivia and southern Brazil. Three slightly differentiated geographical forms are now recognized on the mainland of Central America, separated mainly on color differences.

DENTITION: Incisors, $\frac{1-1}{1-1}$; canines, $\frac{0-0}{0-0}$; premolars, $\frac{1-1}{1-1}$; molars, $\frac{3-3}{3-3}$ = 20.

Proechimys cayennensis centralis
(Thomas)

NICARAGUAN SPINY RAT

Echinomys centralis THOMAS, 1896, Ann. Mag. Nat. Hist., ser. 6, vol. 18, p. 312.

TYPE: British Museum specimen, adult male, collected at San Emilo, Lake Nicaragua, March 27, 1896, by W. R. Richardson.

RANGE: From the Río Grande in Nicaragua south to the Cordillera Volcanica in Costa Rica and west to Lake Nicaragua.

GENERAL CHARACTERS: A large Tawny rat with grooved spines or bristles mixed with long coarse hair on back; tail shorter than length of head and body, sharply bicolor, sparsely covered with fine hairs; hind feet large, long, and narrow.

DESCRIPTION: Color of San Carlos specimens light Tawny mixed with black down middle of back and over rump, grading to Cinnamon-Buff on sides of body and cheeks; the pelage bluish gray at base, the spines black, the coarse hair Tawny or buffy and more or less finely tipped with black; tail Mummy Brown above, white below, feet dull white or Mummy Brown; entire underparts pure white to roots of hairs, the line of demarcation sharply defined. Skull: rostrum relatively narrow and pointed; supraorbital ridges well developed, palatal foramina short but wide, toothrows rather short, divergent posteriorly and placed far forward in skull, the teeth with three outer and one inner folds each, palate short and terminating about on a line across the front of the last cheek teeth. Interparietal large.

MEASUREMENTS: Adult male from San Carlos, and type in parentheses: Total length, 420 mm.; tail vertebrae, 175; hind foot, 55 (53). Skull: basal length, 50.5 (47.5); basilar length, 42.4 (41); greatest breadth, 28.5 (26.5); nasals, 22.6 by 5.5 (21.3 by 6); interorbital breadth, 13.6 (12.5); breadth of interparietal, 13.5 (12.5); anterior palatine foramina, 6.3 by 2.6 (5 by 2.5); palatal length from henselion, 21 (20); diastema, 12.2 (12.5); length of upper molar series, 9.5 (9.2).

SPECIMENS: Prov. Alajuela: Vijagual San Carlos, 6 A.M.N.H.

Proechimys cayennensis panamensis
Thomas

PANAMANIAN SPINY RAT

Proechimys centralis panamensis THOMAS, 1900, Ann. Mag. Nat. Hist., ser. 7, vol. 5, p. 220.

TYPE: British Museum specimen, male, collected at Savanna of Panamá (near city of Panamá), Panamá, March 1, 1899, by E. André.

RANGE: Southern Panamá and western Costa Rica.

GENERAL CHARACTERS: Similar to *Proechimys c. centralis* but darker and richer in color.

DESCRIPTION: Color of upperparts Tawny mixed with black; darkest on middorsal region and top of head; underparts white; specimens from Palmar near sea level in the Pacific coast region are richer colored with whiter feet than a series taken at 2000 feet near Las Vueltas. The latter agrees closely with Thomas' original description of *P. c. chiriquinus* from Bugaba, especially in the grayish brown sides of face and the predominating black of spines over the Rufous hairs on middle of back. The darker color of the Las Vueltas specimens is no doubt due to the somewhat higher elevation, and *chiriquinus* is generally accepted as a synonym of *panamensis*. Skull indistinguishable from that of *P. c. centralis*, except that the nasals, on an average, extend slightly farther posteriorly beyond the premaxillae.

MEASUREMENTS OF TYPE: Head and body, 297 mm.; tail vertebrae, 178; hind foot, 54. Skull: basilar length, 43; greatest breadth, 29; nasals, 24 by 6.5; interorbital breadth, 13.2; length of upper molar series, 8.9.

SPECIMENS: Prov. San José: San Gerónimo Pirris, 2 C.N.H.M., 2 A.M.N.H., 1 U.S.N.M., 7 U.S.F.W., 2 M.C.Z. Prov. Puntarenas: Palmar, 22 A.M.N.H.; Las Vueltas, 11 A.M.N.H.

Proechimys cayennensis rubellus
Hollister

COSTA RICAN SPINY RAT

Proechimys rubellus HOLLISTER, 1914, Proc. Biol. Soc. Washington, vol. 27, p. 57.

TYPE: U.S.N.M. No. 12901/38587, adult male, skin and skull, collected in the Angos-

tura Valley, Costa Rica, by José C. Zeledón, catalogued June 23, 1878.

RANGE: Reventazón River and Pacuare River valleys.

GENERAL CHARACTERS: A bright reddish-colored spiny rat of the *cayennensis* group with upperparts scarcely darkened with black on middorsal region.

DESCRIPTION: Similar to *P. c. centralis* and *P. c. panamensis* but general coloration much more reddish, less dusky, with less mixture of grayish and yellowish buff and more bright Hazel on cheeks and sides, and with little blackish suffusion in color of upperparts; tail relatively short. Skull as in *P. c. centralis*.

MEASUREMENTS: Type (from dry skin): Head and body, 250 mm.; tail vertebrae, 130; hind foot, 55. Skull: greatest length, 64.7; condylobasal length, 52.3; nasals, 24.3; alveoli of upper molar series, 9.2.

SPECIMENS: Prov. Cartago: Angostura, 3 U.S.N.M.

The spiny rats of the *cayennensis* group are terrestrial in their habits. They are most abundant on the low coastal plains and foothills, rarely ascending to more than an elevation of 2000 or 3000 feet in the mountains. They live in holes in the ground, usually in the banks of streams, or beneath the roots of trees or among rocks in the forest. The young in a litter varies from two to six.

These animals have a tendency to lose their tails. Allen and Chapman, who examined tailless specimens from Trinidad, state that the amputation occurs at the second vertebra beyond the posterior border of the pelvis or just beyond the fifth caudal. They also noted that, in skinning specimens in which the tail was intact, the tail would easily break off at the fifth caudal vertebra.

HOPLOMYS ALLEN COARSE-SPINED RATS

This genus is characterized by the size and coarseness of the spines which occupy most of the back and nearly conceal the underlying fur. It differs from *Proechimys* in having notably heavier spines and shorter hair. The tail is shorter than the length of head and body, scaly, and naked; feet about as in *Proechimys*. Skull similar in general to that of *Proechimys* but larger, bullae smaller,

tooththrows nearly parallel; cheek teeth with four outer folds in the upper series, longer and stretching farther across the teeth than in *Proechimys* and placed more obliquely but isolating in the same manner. Range of the genus extends from Nicaragua south through Costa Rica and Panamá to Ecuador.

DENTITION: Incisors, $\frac{1}{1}$; canines, $\frac{0}{0}$; premolars, $\frac{1}{1}$; molars, $\frac{3}{3}$ = 20.

Hoplomys gymnurus truei (Allen) ALLEN'S SPINY RAT

Hoplomys truei ALLEN, 1908, Bull. Amer. Mus. Nat. Hist., vol. 24, p. 650.

TYPE: A.M.N.H. No. 28367, adult male, collected at Savala (Lavalá), 800 feet elevation, east slope of highlands, Nicaragua, October 5, 1907, by William B. Richardson.

GENERAL CHARACTERS: A large, mixed brown and black spiny rat, the spines grooved, especially stout and projecting conspicuously beyond the softer element of the pelage over back; vibrissae very long; ears nearly naked; hind feet large and narrow, claws long and nearly straight; tail shorter than length of head and body, scaly, nearly naked.

DESCRIPTION: Color of adult male from Perálta: spines on back broadly tipped with Blackish Brown, underfur on lower back Tawny grading to Ochraceous-Tawny on shoulder, top of head heavily overlaid with black, fore limbs and base of toes Bister, upper side of hind limbs Mummy Brown; underparts, including inner side of fore and hind limbs, hind feet, and toes white to roots of hair; ears narrow, Mummy Brown; tail absent but usually coarsely scaled, grayish brown above, whitish below. Skull long and narrow with a long slender rostrum, supra-orbital ridges strongly developed as shelves over orbits and extending across parietals with a sharp angle at corner of orbit; occipital plane with a high, knife-like, vertical, medium ridge; bullae small, palatal foramina short, tooththrows nearly parallel and placed far forward in skull, cheek teeth small; interparietal large.

MEASUREMENTS: Adult male from Perálta, and type in parentheses: Head and body, 275 mm. (380); tail vertebrae, — (170); hind foot, 61 (dry, 50). Skull: occipital nasal

length, 64.5 (55); zygomatic width, 30.2 (27); mastoid width, 23.4 (21); length of nasals, 22.4 (20); interorbital width, 14.1; alveoli upper molar series, 9.5 (10).

SPECIMENS: Prov. Cartago: Santa Teresa Perálta, 1 A.M.N.H. Prov. Limón: Suerre, 1 juv. A.M.N.H.

Like the species of *Proechimys*, this spiny rat appears to be terrestrial in habits. Specimens have been trapped under shelter of fallen trees and rocks in the forest. The tail breaks readily close to the body. The specimen from Perálta is more Tawny than the Nicaraguan specimens, the palate longer, and zygomata are more squarely spreading from the axis of skull. It is, however, an old individual, and these differences could well be age characteristics.

ORDER CARNIVORA

FLESH-EATERS

Mammals of this order vary in size from the small weasels to the large brown bears. They usually have five digits on each foot and no digit opposable to the others. The incisors are small and the canines large, pointed, and usually longer than the other teeth; on either side of the jaws are usually an opposable pair of shearing teeth with a cutting edge, termed carnassial teeth. In the upper jaw the carnassial is the posterior premolar and in the lower jaw the first true molar. Members of the Order Carnivora have a highly specialized brain and are widely distributed throughout the world.

FAMILY PROCYONIDAE

RACCOONS AND ALLIES

Members of this family are medium-sized carnivores with feet plantigrade or semi-plantigrade; the claws non-retractile; tail moderately long, more or less bushy, and usually ringed. This family, with the exception of two related Asiatic forms, is restricted to North and South America.

PROCYON STORR

RACCOONS

Raccoons are medium-sized, robust, arboreal carnivores; eyes and ears of medium size, and the face has a black mask; the tail is about one-third the length of head and body

with alternate rings of dark and light color. The carnassial teeth in this genus are undifferentiated. The range of this genus extends from southern Canada in North America south to southern Brazil in South America.

DENTITION: Incisors, $\frac{3-3}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{4-4}{4-4}$; molars, $\frac{2-2}{2-2} = 40$.

PROCYON STORR

TYPICAL RACCOONS

Range of the subgenus *Procyon* extends from southern Canada south to the Canal Zone in Panamá.

Procyon lotor crassidens Hollister

COSTA RICAN RACCOON

Procyon lotor crassidens HOLLISTER, 1914, Proc. Biol. Soc. Washington, vol. 27, p. 142.

TYPE: U.S.N.M. No. 12191/14191, adult (?male), skin and skull, collected at Talamanca, eastern Costa Rica, 1874, by William M. Gabb.

RANGE: Costa Rica, Nicaragua, El Salvador, except southwestern coast region, and probably Honduras, except western part; probably extending into western Panamá, tropical zone.

GENERAL CHARACTERS: A large raccoon with the usual bushy ringed tail and black face mask, the fur relatively short and harsh. The Costa Rican raccoon is one of the darkest known forms of the group. It closely resembles *P. l. pumilus* of Panamá and *P. l. dickeyi* of El Salvador externally, but cranial characters are distinctive.

DESCRIPTION: Face marking sharply drawn, brownish black and white. Upperparts from crown of head to base of tail blackish gray; underfur dull Prout's Brown, the hairs ringed with buff and tipped with black; a distinct narrow line of black from between ears to withers. Arms, hands, and feet buffy; legs-like back and hips. Tail ringed with black and pale orange yellow, the tip black. Skull relatively smooth and rounded, rostrum broad, tympanic bullae small; paraoccipital processes broad; molar teeth strong, brachyodont. The skull of *crassidens* is similar to that of *P. l. dickeyi* but more massive, frontal region more flattened, palate much broader,

the toothrows more widely separated, dentition heavy as in *dickeyi*. Compared with that of *P. l. pumilus* the skull is larger, relatively longer, narrower, and less extremely flattened; interorbital and postorbital regions narrower, postorbital processes of frontals shorter, broader, and more obtusely pointed; dentition similar but usually heavier.

MEASUREMENTS: Adult male from Jalapa, Nicaragua: Total length, 950 mm.; tail vertebrae, 310; hind foot, 120. Adult male from San Rafael del Norte, Nicaragua: Total length, 880; tail vertebrae, 25; hind foot, 110. Skull (type): greatest length, 125.5; condylo-basal length, 122.9; zygomatic breadth, 75.8; interorbital breadth, 25.8; width of palate between last molars, 24.1; least width of palatal shelf, 17.3; alveoli of maxillary toothrow, 47.3; upper carnassial, cross length, 10, crown width, 10.7.

SPECIMENS: Prov. Cartago: El Sauce Perálta, 1 U.S.N.M. Prov. Limón: Talamanca, 1 (type) U.S.N.M.

EUPROCYON GRAY
CRAB-EATING RACCOONS

The range of the subgenus *Euprocyon* extends from Costa Rica through Panamá and south to southern Brazil, from sea level to at least 3000 feet elevation.

Procyon cancrivorus panamensis
(Goldman)

PANAMANIAN CRAB-EATING RACCOON

Euprocyon cancrivorus panamensis GOLDMAN, 1913, Smithsonian Misc. Coll., vol. 60, no. 22, p. 15.

TYPE: U.S.N.M. No. 171669 (Biol. Surv. Coll.), adult female, collected at Gatun, Canal Zone, Panamá, by E. A. Goldman, June 21, 1911.

RANGE: Panamá and Costa Rica.

GENERAL CHARACTERS: A large raccoon with short, harsh pelage. The color pattern is much like that of *Procyon lotor*, but hair is shorter and coarser, tail less bushy, and the pelage on the nape of the neck is in reverse direction. From a hair whorl between the shoulders the hair is inclined forward, meeting the opposing pelage of the head along a V-shaped line between the ears.

DESCRIPTION: Ground color over dorsum varying from ashy gray to Ochraceous-Buff or yellowish ochraceous, heavily overlaid with black; top of head mixed black and gray, the black predominating; sides of muzzle and rather restricted supraorbital streaks white or grayish white; facial area, including orbits, interorbital space, and lower part of cheeks nearly clear black; underparts, including base of tail, pale Ochraceous-Buff; ears whitish or yellowish white; limbs blackish, feet brownish white; tail with seven or eight alternating black and grayish bands. Skull in general like that of *P. l. crassidens* but larger, broader with larger bullae and differs especially in the more rounded cusps on the molariform teeth.

MEASUREMENTS: Adult male from Agua Buena, and type in parentheses: Total length, 915 mm. (950); tail vertebrae, 300 (350); hind foot, 135 (142). Skull: greatest length, 128.5 (130); condylobasal length, 124 (125.8); zygomatic width, 83 (83.3); interorbital width, 24.5 (25.7); width of palate between last molars, 19.9; least width of palatal shelf, 17.6; alveoli of upper maxillary toothrow, 45.5 (40.3).

SPECIMENS: Prov. Puntarenas: Agua Buena, 1 A.M.N.H.

The raccoon is largely nocturnal in its habits. It is a forest-loving animal and shows a decided preference for streams, lakes, and marshes. The *P. lotor* group are first-class tree climbers and are never found very far away from trees or brush country. In diet the raccoons are omnivorous but favor frogs, fish, and creeping things usually found in wet marshes. The so-called crab-eating raccoon is apparently less arboreal in its habits than *Procyon lotor*, the Costa Rican representative which also eats crabs.

Procyon lotor has sharper claws than *Procyon cancrivorus* and is frequently found in trees, while the latter species is usually encountered on the ground. The raccoons have a habit of soaking their food or washing it in water before eating it. The number of young in a litter usually varies from two to five but is sometimes six. Races of the *lotor* group favor a den in a hollow tree but also use crevices or holes in the rocks.

NASUA STORR

COATIS

The coaties are about the size of a raccoon and have a long mobile snout which extends well forward beyond the lower lip, a long tapered tail, small ears, and short limbs. The range of the coaties extends from the warmer parts of southern Texas and Arizona through Mexico, Central America to Colombia and over the greater part of South America—at least to Paraguay and from the Atlantic coast to the Andes. The range of the white-nosed *Nasua narica* group appears to be Mexico, Central America, and northern Colombia, where it is the sole representative of the genus. The exact boundaries of the habitat of the North and South American species have not been determined.

DENTITION: Incisors, $\frac{3-3}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{4-4}{4-4}$; molars, $\frac{2-2}{2-2}$ = 40.

Nasua narica bullata Allen

COSTA RICAN COATI

Nasua narica bullata ALLEN, 1904, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 48.

TYPE: A.M.N.H. No. 19210, adult male, collected at Pozo Azul, Pirris, Costa Rica, June 23, 1902, by M. A. Carriker, Jr.

RANGE: Costa Rica; closely allied forms have been described from Nicaragua and Panamá.

GENERAL CHARACTERS: A large, dark-colored, white-nosed coati, much darker than any of the Mexican forms; tail long with only a trace of light-colored rings in most specimens; claws are long and rather straight for such an aboreal animal.

DESCRIPTION: Color of upperparts dark brownish black washed with light buff, changing gradually to Tawny from between shoulders to top of head; outer sides of forearms overlaid with buffy white, the long white tip of hairs contrasting with the general dark tone of body; underparts dark brownish black mixed with buffy; chin and muzzle white with two narrow white lines extending backward along the face and diverging gradually to enclose the eyes; ears edged with buffy white; lower limb and feet black; tail dark brownish black with a trace of buffy bands more or less developed. Skull long and comparatively

narrow, rostrum elongated and laterally compressed; braincase elevated above rostrum; constricted in postorbital region. Palate extending far beyond plane of last molar, canine compressed laterally, the points turned outward, the first three premolars single cusped; molars small; bullae large and well inflated; sagittal crest well developed in males; zygomatic arches strong and angular.

MEASUREMENTS: Adult male from Santa Teresa Perálta, and type in parentheses: Total length, 1150 mm. (1119); tail vertebrae, 550 (587); hind foot, 115 (133). Skull: occipitonasal length, 125.5 (140); basal length of Hensel, 119 (123); zygomatic width, 81 (78); interorbital width, 31.2 (28); width of braincase, 46 (45); crown length of three large upper posterior cheek teeth, 21.5 (21.5).

SPECIMENS: Prov. Puntarenas: Esparta, 1 A.M.N.H.; Palmar, 1 A.M.N.H.; Agua Buena, 1 A.M.N.H. Prov. San José: Pozo Azul, Pirris, 1 (type) A.M.N.H.; San Gerónimo, 1 C.N.H.M.; Escazú, 1 A.M.N.H.; San Joaquín de Dota, 1 M.Z.U.M. Prov. Cartago: Santa Teresa Perálta, 2 A.M.N.H.; El Copey de Dota, 1 M.Z.U.M.; Prov. Limón: Talamanca, 2 U.S.N.M.

The series of Costa Rican specimens of coaties collected by Underwood came from widely separated localities but show very little individual variation in color. They are all dark colored with large and well-inflated bullae. One adult male from Agua Buena has a smaller skull with smaller teeth than the average, but the bullae are large, well inflated, and normal for *bullata*. The type of Allen's *N. n. panamensis* from Boquerón, Panamá, is a middle-aged female, indistinguishable in color from *N. n. bullata*, but the skull is smaller with smaller bullae than the latter. Since females are noticeably smaller than males and the material available from the vicinity of Boquerón is limited, it is not possible to determine satisfactorily the exact status and relationship of *panamensis*.

The coaties are less nocturnal in their habits than the raccoons and may be seen about during the morning and early evening. They are sociable creatures and often travel in parties, numbering from five to six to a dozen or more individuals. During the heat of the day they

rest in trees. When in search of food they carry their tails high in the air and move about quickly, pausing here and there to thrust their long mobile snouts into likely places and hurrying on to catch up with the more advanced members of the group. They also ascend trees in search of food. Goldman states that stomachs examined by him contained fruit pulp only, but that coatis probably have a diversified diet. Coatis are easily tamed and are fond of fruit, especially bananas; they will also eat nuts. Betts in Nicaragua observed a solitary "pisote" climb trees in pursuit of iguanas, the large lizards of that region, but they made their escape by dropping to the ground.

BASSARICYON ALLEN
OLINGOS

The *bassaricyon* or *olingo* is a rather small member of the raccoon group, with thick soft pelage; general form elongated, head flattened; muzzle pointed; ears rather small, rounded; tail longer than head and body, non-prehensile, well haired; posterior half of soles of feet furred; claws short, sharply curved, limbs short. The general external appearance of this animal resembles the kinkajou, but the fur is longer and softer, the tail less tapered, and the face is gray. The known range of this genus appears to be from Ecuador to Nicaragua, from sea level to about 5000 feet altitude.

DENTITION: Incisors, $\frac{3-3}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{4-4}{4-4}$; molars, $\frac{2-2}{2-2}$ = 40.

***Bassaricyon gabbii gabbii* ALLEN**
GABB'S BUSHY-TAILED OLINGO

Bassaricyon gabbii ALLEN, 1876, Proc. Acad. Nat. Sci. Philadelphia, p. 21.

TYPE: U.S.N.M. No. 14214, skull only, collected at Talamanca, Costa Rica by W. M. Gabb, catalogued November 19, 1874. The skin (U.S.N.M. No. 12237) that was erroneously associated with the skull and subsequently described and figured was that of a *Nasua* or coati.

RANGE: Eastern Costa Rica; limits of range undetermined. Replaced in Nicaragua and eastern Panamá by slightly differentiated forms.

GENERAL CHARACTERS: A relatively small, buffy gray, soft-furred animal with short

limbs, elongate body, very long non-prehensile tail, and grayish face.

DESCRIPTION: Since the skin of the type was not preserved and no topotypes are available, the external appearance of this species cannot be described in detail. Skull short and broad, braincase moderately large and well rounded, rostrum short and depressed; post-orbital processes well developed; zygomatic widely expanded; orbits large; temporal ridges well defined but low, a slight sagittal crest in adult males; palate flat with shallow lateral grooves, and extending well backward beyond the toothrows; posterior half of bullae well inflated, anterior half low and flattened. Mandible with ascending ramus, long and high. Cheek teeth low crowned; first upper molar larger than second, each with three rounded cusps, canines long and slender, upper cheek teeth uninterrupted from canine to last molar.

MEASUREMENTS OF TYPE: From original description: Skull: total length, 3.1 inches; zygomatic width, 1.95 inches; mastoid width, 1.35 inches; interorbital width, 0.60 inch; breadth of rostrum, 0.67 inch; upper molar series, 0.92 inch length of last four molars, 0.47 inch.

SPECIMENS: Prov. Limón: Talamanca, 1, type, U.S.N.M.

***Bassaricyon gabbii richardsoni* (Allen)**
RICHARDSON'S BUSHY-TAILED OLINGO

Bassaricyon richardsoni ALLEN, 1908, Bull. Amer. Mus. Nat. Hist., vol. 24, p. 662.

TYPE: A.M.N.H. No. 28486, adult female, skin and skull, collected on the Rio Grande (altitude below 1000 feet), Atlantic slope, Nicaragua, April 9, 1908, by W. B. Richardson.

RANGE: Nicaragua and adjacent parts of Costa Rica.

GENERAL CHARACTERS: Apparently very similar in external characters to typical *gabbii* but differing in some cranial details.

DESCRIPTION: General color Pinkish Buff, finely mixed with black. The hair on upperparts about Mouse Gray at base with a subterminal band of Pinkish Buff tipped with black; top of head rather grayer than back; ears edged with buffy white; outer side of limbs and upper side of tail about like back;

underparts and inner sides of limbs light yellowish buff; under side of tail rather grayer than upper. Skull similar in general to the typical form. Allen, comparing the two forms, states that the teeth of *B. gabbii* and *B. richardsoni* agree essentially in relative size and form, but the skull in the two species is markedly different in contour and in details. The anterior base of the zygoma is much lower in *B. gabbii* than in *B. richardsoni* and less arched upward; the post-palatal region is shorter and broader, as are also the post-palatal fossa and pterygoid processes; the bullae are shorter and more inflated, the rostrum descends much more abruptly, and the anterior narial opening is lower and more oblique; the coronoid process is narrower, shorter, and less directed backward.

MEASUREMENTS: Adult female from Lajas Villa Quesada, and type in parentheses: Total length, 850 (950); tail vertebrae, 432 (480); hind foot, 90 (80). Skull: condylobasal length, 78.7 (80.5); zygomatic width, 53 (53); interorbital width, 17.7 (17); width of rostrum, 17.3 (17); mastoid width, 36.5 (34.3); upper toothrow, $c-m^2$, 28.4 (28); alveoli of three molariform teeth, 12.8 (12).

SPECIMENS: Prov. Alajuela: Lajas Villa Quesada, 1 A.M.N.H.

The Villa Quesada specimen is virtually indistinguishable in color and external characters from the type, and the skull also agrees with it in all essential characters.

A fully adult female from Matagalpa, Nicaragua, is a decidedly more uniformly golden color throughout than Allen's type specimen. The skull of this specimen, while smaller than the type, has actually larger molar teeth, the second from the last being especially large.

***Bassaricyon lasius* Harris**

COSTA RICAN BUSHY-TAILED OLINGO

Bassaricyon lasius HARRIS, 1932, Occas. Papers Mus. Zool. Univ. Michigan, no. 248, pp. 3-4.

TYPE: M.Z.U.M. No. 64103, adult male, skin and skull, collected at Estrella de Cartago, Costa Rica, 6 or 8 miles south of Cartago, near the source of the Río Estrella, altitude about 4500 feet, June 29, 1931, by Austin Smith.

RANGE: Known only from the type locality.

GENERAL CHARACTERS: Fur longer and thicker than is typical for the other species of the genus. Color of back mixed blackish and gray. Underparts light yellowish buff.

DESCRIPTION: Upperparts mixed black and gray. Median line of back slightly more blackish. Hairs of top of head gray at base, with subapical band of very light gray, and tipped with black. Ears gray, edged with white. Upper base of ear with black patch extending back to the neck. Yellowish buff patch below the ear, extending backward, and in contact ventrally with the black patch. Hairs of back gray at the base with subapical buffy band and tipped with black. Color of legs and feet like the back but with the flanks slightly washed with yellowish buff. Tail above like back. Edges of tail have a metallic silvery sheen. Tail below light gray. Hairs of tail light gray throughout their length but occasionally with a median black band. Underparts light yellowish buff. Skull of *lasius* closely resembles *B. g. richardsoni* Allen but has a more massive ramus, and the rostrum is wider and rises more abruptly. The zygomatic arch is higher and more arched than in *B. g. orinomus* Goldman, *B. g. richardsoni* or *B. g. gabbii* Allen. The breadth of the braincase, the depth of the skull between the palate posterior to the third molar and the frontals, and the width of the palate are greater in *lasius* than in any of the other species of the genus. There is a slight sagittal crest on the interparietal of *lasius* which is lacking in the other three species. The second premolar of *lasius* is very close to the canine with a greater space between the second and third premolars than in any of the other species. When more specimens are available, however, these skull differences may be found to be within the range of individual variation of *gabbii*.

MEASUREMENTS OF TYPE: Total length, 820 mm.; tail, 437; hind foot to end of claw, 77; ear from crown, 35. Skull: condylopremaxillary length, 78.3; zygomatic breadth, 55; breadth of braincase, 36.8; interorbital breadth, 18; breadth of rostrum, 17.7; depth of skull between palate posterior to the third molar and the frontals, 28.5.

SPECIMENS: Prov. Cartago: Estrella de Cartago, 1 (type) M.Z.U.M.

Bassaricyon pauli Enders

CHIRIQUÍ BUSHY-TAILED OLINGO

Bassaricyon pauli ENDERS, 1936, Proc. Acad. Nat. Sci. Philadelphia, vol. 88, pp. 365-367.

TYPE: A.N.S.P. No. 17911, adult male, skin and skull, collected between Río Chiriquí Viejo and Río Colorado, on a hill known locally as Cerro Pando, elevation 4800 feet, about 10 miles from El Volcán, Province of Chiriquí, Panamá, July 27, 1935, by Robert K. Enders.

RANGE: Known only from type locality.

GENERAL CHARACTERS: A robust heavy form, fur long and thick, grizzled blackish with faint dorsal stripe.

DESCRIPTION: General color of upperparts grizzled, the head gray and black, the body gray fulvous. A middorsal line extends from the shoulders to the tip of the tail. The hairs of this line are dark gray at the base, fulvous subapically and black-tipped. The hair of the back and sides is dark gray at the base with a subapical band of brownish gray tipped with black. The hairs on the top of the head are brownish at base with subapical band of very light gray tipped with black. The ears are brown, edged with white, the brown turning to black posteriorly and ventrally. A dull yellow patch below the ears changes to brighter yellow as it merges into the light-colored ventral surface. The underparts are light gray tinged with yellow, forming a rather narrow band on the ventral surface. The chin is gray. The dorsum of the tail is like the dorsal mid-line marked in addition with faint black rings. The under side of the tail is considerably darker than the ventral surface of the body. Skull more massive, rostrum wider, depth of skull between the palate and frontals greater than in other Central American members of the genus. The braincase is large, uniformly expanded. The zygomatic arch is much as in *B. gabbi*, but with the maxillary and temporal portions conspicuously heavier. There is a sagittal crest on the interparietal; the lambdoidal crest extends halfway to the mastoid process, which is heavy; the postorbital process is short. The temporal line approaches the mid-sagittal line of the parietals without forming a sagittal crest. The tympanic bullae are larger and heavier than in other members of the genus;

the glenoid fossa is wider, deeper, with well-developed post- and pre-glenoid processes; the condyle is larger and heavier.

MEASUREMENTS OF TYPE: Total length, 862 mm.; tail, 434; hind foot, to end of claw, 84; ear from crown, 38; weight, 1.58 kg. Skull: condylopremaxillary length, 80; zygomatic breadth, 57; breadth of braincase, 36.7; interorbital breadth, 20; breadth of rostrum, 20; depth of skull between palate posterior to the third molar and the frontals, 30.

The Central American species of the genus agree closely in essential characters and are probably all geographical forms of *Bassaricyon gabbi*. The olingo or *Bassaricyon* seems to be arboreal and strictly nocturnal. It frequents the upper branches of tall trees, is more or less sociable, and its principal diet is fruit. In all probability the life history of *Bassaricyon* is much like that of *Potos* or typical kinkajou. Goldman collected both genera in the same tree, and their stomach contents showed that they both had been attracted by the ripening fruit in the top of the tree.

POTOS GEOFFROY AND CUVIER

KINKAJOUS

The members of this genus have a long body, short limbs, rounded head, pointed muzzle, a long, tapered, prehensile tail, short ears, posterior half of soles of feet densely haired, claws short and sharply pointed, finger and toes partially webbed, fur relatively short and thick.

RANGE: This genus is a preëminently arboreal one and ranges from the tropical portions of southern Mexico through Middle America and south at least to Matto Grosso, Brazil.

DENTITION: Incisors, $\frac{3-3}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{2-2}{2-2}$ = 36.

Potos flavus chiriquensis Allen

CHIRIQUÍ KINKAJOU

Potos flavus chiriquensis ALLEN, 1904, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 72.

TYPE: A.M.N.H. No. 18926, male adult, collected at Boquerón, Chiriquí, Panamá, October 22, 1901, by J. H. Batty.

RANGE: Western Panamá to northwestern Costa Rica on the Pacific side of the cordil-

lera. Altitudinal range from near sea level to over 5000 feet.

GENERAL CHARACTERS: A rich golden brown kinkajou with upperparts nearly uniform in color. Externally it superficially bears a striking resemblance to *Bassaricyon* but may be distinguished by the round, tapering, short-haired, prehensile tail. The general colors of both genera are similar, but *Potos* is a larger and more robust animal, and the face is similar to the back in color whereas in *Bassaricyon* the face is grayish.

DESCRIPTION: Color of upperparts varies from rich Ochraceous-Tawny to golden Clay Color, finely overlaid with brown; middle of back rather darker than sides; underparts, including inner sides of limbs, deep Ochraceous-Buff without brownish tips to hairs, becoming darker in pectoral and inguinal regions. Feet more dusky than outer sides of limbs; tail about like back for four-fifths of its length, becoming gradually darker apically, below slightly paler. Skull short, rounded, and highly arched; rostrum short, broad; braincase large, sharply constricted in postorbital region; postorbital processes well developed from frontals, sagittal crest well developed in males, obsolete in females. Palate flat and extending posteriorly beyond last molars; bullae flattened and little inflated. Teeth, except second upper molars, larger than in *Bassaricyon*, flatter, lower crowned, and less tuberculate. Incisors heavy, broad, the outer pair the largest; canines large and strong, deeply grooved on outer sides; first upper molar about twice the size of second, subquadrate, and almost flat crowned except for outer raised rim.

MEASUREMENTS: Adult female from San Gerónimo de Pirris and the type: Head and body, 398 mm., 485; tail vertebrae, 457, 505; hind foot, 98, 80; ear, 37, 42. Skull: greatest length, 87.4, 93.7; condylobasal length, 81.5, 86; zygomatic width, 58.4, 58.8; interorbital width, 20.4, 21.4; upper tooththrow from canine to last molar inclusive, 24.3, 27. Adult female from Palmar: Total length, 975; tail vertebrae, 490; hind foot, 107. Skull: greatest length, 91.3; condylobasal length, 87.2; zygomatic width, 63.5; interorbital width, 20.5; upper tooththrow, canine to last molar inclusive, 25.4.

SPECIMENS: Prov. San José: San Gerónimo de Pirris, 1 U.S.F.W., 1 U.S.N.M.; Alto Jabillo Pirris, 1 C.N.H.M. Prov. Puntarenas: Palmar, 3 A.M.N.H.

***Potos flavus arborensis* Goodwin**

COSTA RICAN KINKAJOU

Potos flavus arborensis GOODWIN, 1938, Amer. Mus. Novitates, no. 987, p. 1.

TYPE: U.S.N.M. No. 25320 (Biol. Surv. Coll.), adult female, skin and skull, collected at El Sauce Perálta, a farm on the Atlantic railroad less than halfway from San José to Limón, Costa Rica, altitude 1000 feet, June 4, 1931, by C. F. Underwood.

RANGE: Eastern Costa Rica.

GENERAL CHARACTERS: A relatively large, light-colored kinkajou with a dark middorsal line and dusky feet; similar in general characters to *P. f. chiriquensis* but larger and paler in color and also differing in cranial characters.

DESCRIPTION: Color of upperparts in general about Clay Color, the hair Dusky Brown from base for greater part of its length, evenly covered with Cream-Buff and finely mixed with black-tipped hairs, purest on flanks and outer sides of limbs; top of head and face darker than rest of body; a narrow Blackish Brown dorsal stripe from crown of head to base of tail; underparts rich Pinkish Buff; feet and toes Mummy Brown; tail about color of back. Skull large, with a high braincase; frontal profile convex; basioccipital broad; bullae flat and elongate; postorbital processes short and peg-like; palate relatively short.

MEASUREMENTS: Head and body, 476 mm.; tail vertebrae, 496; hind foot, s.u., 98. Skull: greatest length, 93.5; condylobasal length, 87.8; zygomatic width, 62.3; interorbital width, 21.8; breadth of braincase, 40.9; upper tooththrow from canine to back of last molar, 26.4.

SPECIMENS: Prov. Cartago: El Sauce Perálta, 1 (type) U.S.F.W.; El Copey de Dota, 1 M.Z.U.M.; El Muñeco, 1 M.Z.U.M.

Potos flavus arborensis approaches *campechensis* in color but is larger with a higher and more inflated braincase, and the frontal profile of skull is more convex; the postorbital processes are shorter, the basioccipital

broader and palate shorter. Compared with *chiriquensis* it is larger and paler in color, the skull has a more inflated braincase, frontal profile more convex, bullae are more elongated, and the carnassials are relatively broader. The narrow black dorsal line may have no special significance as this feature is variable in other forms.

The kinkajous are arboreal and nocturnal in their habits. They are more or less sociable and when in search of food gather in small parties of seven or eight. They travel entirely through the tree tops and rarely descend to the ground. When disturbed, they sometimes utter a short, rather hoarse, barking sound. Fruit seems to be their principal diet, but they also eat various kinds of insects. During daylight hours they curl up and sleep in some dark shady retreat and have been found roosting in hollow trees. The exceptionally long tongue of the kinkajou is an adaptation to a frugivorous diet. The number of young in a litter is probably from two to four. A pair in the Milwaukee Zoological Gardens bred after being mated for nine years; two young were born in September. An individual in the London Zoological Gardens was alive and healthy after 19 years.

FAMILY BASSARISCIDAE CACOMISTLES

The cacomistles, while exhibiting most of the external characters of the Procyonidae, differ so greatly in nature of the teeth that they have been placed in a separate family. The dog-like premolars and molars, the rounded canines, and the evident though small secondary lobes on the incisors all show unmistakable characters of the teeth of Canidae. The range extends from Louisiana in the east and southern Oregon in the west, south through Mexico and Central America to Panamá.

JENTINKIA TROUESSART MIDDLE AMERICAN CACOMISTLES

The cacomistles of the genus *Jentinkia* are relatively large in size and have an elongate body, short limbs with strongly curved, non-retractile claws, soft long pelage. The tail is long, flattened, long haired to tip, and ringed in strongly contrasting colors. The soles of

the fore and hind feet are naked in contrast with the well-haired soles of the feet in *Bassariscus*, which is a more northern race of the cacomistles or ring-tailed cats.

RANGE: Tropical forests of Central America, from western Panamá in the south to Mexico where its range meets that of *Bassariscus* along the eastern slopes of the Mexican highlands.

DENTITION: Incisors, $\frac{3-3}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{4-4}{4-4}$; molars, $\frac{2-2}{2-2}=40$.

Jentinkia sumichrasti notinus (Thomas)

PANAMANIAN CACOMISTLE

Bassariscus sumichrasti notinus THOMAS, 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 11, p. 379.

TYPE: B.M. No. 3.3.3.22, adult male, collected at Boquete, Chiriquí, Panamá, altitude 6000 feet, August 5, 1902, by H. J. Watson.

RANGE: Western Panamá and Costa Rica, replaced in Guatemala by a slightly differentiated form.

GENERAL CHARACTERS: A dark grayish-colored cacomistle with muzzle and feet distinctly blackish, tail with light-colored rings tending to become obsolescent toward end, pelage fine, soft, and long, ears broadly rounded.

DESCRIPTION: Ground color of upperparts buffy gray overlaid with black, the black-tipped hairs most abundant on head, nape, and along median line of back; muzzle and area behind ears, ring around eye blackish, cheeks and small area over eye buffy gray; fore and hind feet blackish; ears brownish black with a more or less soiled whitish border; outer side of fore and hind limbs and upper side of tail at base about color of sides of body; tail with nine or 10 alternating rings of pale buff and black, becoming clear black on distal third in some individuals, in others the tail is distinctly banded to tip; underparts including inner sides of fore and hind limbs light Ochraceous-Buff. Skull short and broad, rostrum short and narrow; postorbital processes strongly developed from frontals, orbits large, temporal ridges forming a strong sagittal crest in males. Palate flat and not extended backward behind last molar; bullae low and only slightly inflated; braincase relatively small and narrowly constricted

behind postorbital processes. Teeth large, and all show unmistakable characters of the teeth of Canidae; canines strong and rounded; incisors with small secondary lobes, premolars and molars distinctly dog- or fox-like in general characters.

MEASUREMENTS: Adult male and female from Escazú, and type in parentheses: Head and body, 425 mm., 388 (457); tail vertebrae, 480, 403 (396); hind foot, 90, 82 (89); ear, 45, 44 (45). Skull: greatest length, 90, 82.9 (87.3); basal length, 79.5, 74.2 (77); zygomatic width, 57.5, 49 (56); nasals, 18.5, 16.2 (16.6); interorbital width, 17.2, 15 (18); breadth of braincase, 36.5, 34 (35); alveoli of upper toothrow, canine to last molar inclusive, 32.5, 30.5.

SPECIMENS: Prov. San José: Escazú, 6 A.M.N.H. Prov. Cartago: El Copey de Dota, 1 M.Z.U.M.

The cacomistles are nocturnal and expert tree climbers. The Middle American genus, *Jentinkia*, is much more arboreal in its habits than the Mexican genus *Bassariscus* which is at home along cliffs and rocky ledges and spends much time upon the ground. They are carnivorous and feed on mice, rats, and birds, but no doubt supplement their diet on a variety of edible fruit, insects, and vegetable matter. The nest is usually in a hollow tree or rocky ledge, and the number of young in a litter varies from two to four.

FAMILY MUSTELIDAE
WEASELS, OTTERS, TAYRAS,
GRISONS, SKUNKS

Members of this family vary from small to medium in size; most of them are terrestrial, but some are aquatic or semi-arboreal; all are carnivorous. Form slender, limbs short, length of tail variable, five toes on fore and hind feet. Skull with short rostrum and braincase usually large, smooth, and elongate. The last upper premolar and first lower molar especially adapted for cutting, and there are never more than one upper and two lower true molars on each side.

This family is a large one and widely distributed throughout the continents of the world, with the exception of Australia, but more especially in the northern temperate regions.

SUBFAMILY MUSTELINAE
MUSTELA LINNAEUS
WEASELS AND MINKS

This genus includes rather small, weasel-like carnivores with a long slender body, short limbs, long head, short muzzle, and three premolars in upper and lower jaws on each side.

RANGE: Widely distributed in Europe, Asia, North Africa, North and South America.

DENTITION: Incisors, $\frac{3-3}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{1-1}{2-2}$ = 34.

***Mustela frenata costaricensis* Goldman**
COSTA RICAN BRIDLED WEASEL

Mustela costaricensis GOLDMAN, 1912, Proc. Biol. Soc. Washington, vol. 25, p. 9.

TYPE: U.S.N.M. No. 13770/37149, young adult, skin and skull, collected at San José, Costa Rica, by C. H. Van Patten, catalogued June, 1883.

RANGE: Costa Rica. The species *Mustela frenata*, the only one found in Central America and Mexico, ranges northward in its various subspecific forms into Canada. In South America the range of *frenata* is limited to Venezuela, Colombia, Ecuador, and Peru.

GENERAL CHARACTERS: A large, dark brownish, long-tailed weasel with a blackish head and more or less indistinct white facial markings.

DESCRIPTION: Color of two adult males from Escazú: upperparts dull Ochraceous-Tawny overlaid with Warm Sepia, grading to glossy black on back, neck, and top of head; a small white spot between eyes on one and a narrow line of white hairs from behind eye to below ear in both; ears blackish; upper sides of fore and hind limbs and feet, base of tail about color of lower back; tip of tail black; underparts, including sides of fore limbs, varying from Cinnamon-Buff to a pale golden Ochraceous-Tawny. Skull small with a round elongated braincase; short rostrum; a low sagittal crest in adult males; bullae low and elongate. Dentition highly specialized for cutting flesh; incisors small, the outer tooth larger than the two inner teeth; canines long and rounded; carnassials well developed as shearing teeth.

MEASUREMENTS: Two adult males from Escazú: Total length, 510 mm., 455; tail vertebrae, 180, 150; hind foot (dry), 52.5, 48. Skull: condylobasal length, 53.6, 51; zygomatic width, 30, 29.5; interorbital width, 12.3, 11.8; mastoid width, 26.5, 23.5; bullae, 15 by 9, 14.3 by 8; upper molariform tooth-row, 12.3, 12; canine to last molar inclusive, 15.5, 14.7.

SPECIMENS: Prov. San José: San José, 1 (type) U.S.N.M.; Escazú, 2 A.M.N.H. Prov. Cartago: Cervantes, 1 C.N.H.M.; El Muñeco, 1 M.Z.U.M.

***Mustela frenata panamensis* Hall**
PANAMANIAN BRIDLED WEASEL

Mustela frenata panamensis HALL, 1932, Proc. Biol. Soc. Washington, vol. 45, p. 139.

TYPE: U.S.N.M. No. 170970 (Biol. Surv. Coll.), subadult female, skin and skull, collected at Río Indio, Canal Zone, near Gatun, Panamá, February 17, 1911, by E. A. Goldman.

RANGE: Upper and lower tropical zones of Panamá from sea level to 5800 feet. From Mount Pirre near the Colombian border west to Boquete in Chiriquí and probably the adjacent parts of Costa Rica.

GENERAL CHARACTERS: Similar to *Mustela frenata costaricensis* but color of upperparts darker in tone and dorsal outline of skull more convex in longitudinal axis than in any other weasel.

DESCRIPTION: General color pattern about as in *M. f. costaricensis* but the shade darker. Skull similar to that of *costaricensis* but more convex in longitudinal axis.

MEASUREMENTS OF TYPE: Total length, 408 mm.; tail vertebrae, 159; hind foot, 46.5.

According to Hall, *Mustela frenata panamensis* is one of the two darkest colored weasels; *M. f. aureoventris* Gray is the other. An adult male from Boquete, included in the *panamensis* series, is indistinguishable in color from two very dark-colored individuals from Escazú which are near topotypes of *costaricensis*.

***Mustela frenata nicaraguae* (Allen)**
NICARAGUAN WEASEL

Mustela tropicalis nicaraguae ALLEN, 1916, Bull. Amer. Mus. Nat. Hist., vol. 35, p. 100.

TYPE: A.M.N.H. No. 30754, male adult, skin and skull, collected at Matagalpa, Nicaragua, altitude 2000 feet, April 16, 1910, by Wm. B. Richardson.

RANGE: Honduras, Nicaragua, and probably extreme northern Costa Rica.

GENERAL CHARACTERS: A large, dark brown weasel with black head and extensive white marking on face. Smaller and lighter colored than *M. f. costaricensis*.

DESCRIPTION: Color of upperparts Ochraceous-Tawny overlaid with black, darker on shoulders and becoming black on head, white facial markings well developed; limbs, feet, and tail like back, with tip of tail black; underparts pale Ochraceous-Tawny becoming light Ochraceous-Buff on throat. Skull large with elongated braincase and a low sagittal crest in adult males.

MEASUREMENTS OF TYPE: Total length, 460 mm.; tail vertebrae, 180; hind foot, 50. Skull: condylobasal length, 49.5; zygomatic width, 27; interorbital breadth, 10.5; post-orbital breadth, 10; breadth of braincase, 22.4; canine to last molar, 15.

Weasels are mainly boreal in distribution and are represented in Central America by races of the *frenata* group. They are strictly carnivorous and are active during daylight hours as well as after dark. Weasels are curious, bold, and have keen senses of smell and hearing. They are relentless hunters and feed on mice, rats, gophers, rabbits, and no doubt eat a limited number of ground-inhabiting birds. Their long slender bodies and short limbs enable them to follow their prey into most subterranean burrows and retreats. The young are born blind and naked, varying from four to six or more in a litter. The nests are placed in rock piles or holes in the ground. Weasels are essentially terrestrial although they have been known to climb trees.

SUBFAMILY LUTRINAE
LUTRA BRISSON
OTTERS

The external form of the otters is highly modified for aquatic life. They are relatively large, long, slender-bodied animals with flattened head, short limbs, webbed feet with five toes on each foot and with stout

claws, long muscular tail, small eyes, and short rounded ears. Middle American species differ from the more northern *Lutra canadensis* group of otters in having the nose pad haired to near the upper border of the nostrils and the soles of the feet entirely naked.

Otters are cosmopolitan in distribution with the exception of the Australian region.

DENTITION: Incisors, $\frac{3}{3}$; canines, $\frac{1}{1}$; premolars, $\frac{4}{3}$; molars, $\frac{1}{2}$ = 36.

Lutra repanda Goldman
PANAMANIAN OTTER

Lutra repanda GOLDMAN, 1914, Smithsonian Misc. Coll., vol. 63, no. 5, p. 3.

TYPE: U.S.N.M. No. 179974, skin and skull, collected at Cana, eastern Panamá, altitude 2000 feet, May 30, 1912, by E. A. Goldman.

RANGE: Panamá and Costa Rica.

GENERAL CHARACTERS: A relatively small form with a flat skull, closely allied to *L. colombiana*, but differing in dental and slight cranial characters, especially the lesser transverse extent of the large upper molariform teeth. Differing from *L. latidens* from Nicaragua in much smaller size as well as cranial details.

DESCRIPTION: Color of entire upperparts Warm Sepia or Mars Brown; underparts grayish brown, paler on throat, pectoral and inguinal regions; lips and inner sides of fore legs soiled whitish. The skull is massive, broad, and flat; rostrum short; zygomatic arches strong and spreading; dentition heavy, the upper and lower carnassials and last upper molar especially large and heavy; bullae small and flat. Compared with *L. colombiana* the rostrum and interorbital space narrower, the palate reaching farther posteriorly beyond molars. Compared with *L. latidens*, the skull is smaller with flatter frontal region.

MEASUREMENTS: Adult female from Villa Colon, Rio Grande, and type in parentheses: Total length, 950 mm. (963); tail vertebrae, 390 (440); hind foot, s.u., 104 (c.u., 131.5). Skull: greatest length, 99 (99.6); condylo-basal length, — (95.6); zygomatic width, 66.7 (62.8); interorbital width, 19.7 (18.5); length of nasals, — (17.6); postorbital width, 16.5 (16.8); maxillary tooththrow, 34.4 (36.1);

alveolar length of upper carnassial, 11.5 (12.4); alveolar breadth of upper carnassial, 10 (10).

SPECIMENS: Prov. San José: Villa Colon, 1 C.N.H.M.

Lutra latidens Allen
NICARAGUAN OTTER

Lutra latidens ALLEN, 1908, Bull. Amer. Mus. Nat. Hist., vol. 24, p. 660.

TYPE: A.M.N.H. No. 28435, male adult, skin and fragmentary skull, collected at La-vala, Matagalpa, Nicaragua, October 28, 1907, by Wm. B. Richardson.

RANGE: Nicaragua, Honduras, and possibly northern Costa Rica.

DESCRIPTION: Color of upperparts uniform Warm Sepia or Mars Brown; underparts brownish washed with buffy white, purest on throat, pectoral and inguinal regions; lips and inner sides of fore and hind legs light buff; upper side of fore and hind feet paler and more buffy than rest of upperparts, becoming almost buffy white on toes of hind feet. Skull large, massive, and broad, with frontal region not especially flattened; bullae short and flat, differing from *L. annectens* from Rio de Tepic, Mexico, in its much larger size and relatively more massive teeth; compared with the Costa Rican and Panamanian species it is very much larger, with relatively smaller and less inflated bullae, and less flattened frontal region.

MEASUREMENTS: An adult male from Comayaguela, Honduras, and type in parentheses: Total length, 1015 mm. (1280); tail vertebrae, 465 (490); hind foot, 125; ear, 21. Skull: zygomatic breadth, 25.5; postorbital breadth, 16; maxillary tooththrow, c-m¹, 38.5 (38.3); alveolar length of upper carnassial, 13 (13.5); alveolar breadth of upper carnassial, 11 (10.5).

The otter is aquatic in its habits and rarely strays far from water. Its long and heavy body enables it to dive and swim without difficulty far beneath the surface. The head is virtually the only part of the animal visible when swimming on the surface of the water. The food of the otter consists of fish, crayfish, frogs, and shell-fish. It is never abundant in any part of its range and rarely more than a pair, or a mother and young, are seen to-

gether. It makes its home in a burrow at the edge of a stream or lake and usually has an entrance under water. The number of young in a litter may vary from one to five, but the usual number is two or three. The otter is good-tempered, playful, and tames easily when taken young.

SUBFAMILY TAYRINAE

TAYRA OKEN

TAYRAS

The genus *Tayra*, as represented in Costa Rica, is a large weasel-like animal with long slender body, broad head, short rounded ears, short limbs, short, strong, non-retractile claws, soles of feet naked, rather long hairy tail, and short coarse pelage. The general color is black, but the head is often grayish brown. The range of the tayras extends from southern Mexico through Central America to at least Paraguay, Bolivia, and Trinidad.

DENTITION: Incisors, $\frac{3}{3}$; canines, $\frac{1}{1}$; premolars, $\frac{3}{3}$; molars, $\frac{1}{2}$ = 34.

The first upper premolar and last lower molars are apt to be lost with age.

Tayra barbara biologiae (Thomas)

PANAMANIAN TAYRA

Galictis barbara biologiae THOMAS, 1900, Ann. Mag. Nat. Hist., ser. 7, vol. 5, p. 146.

TYPE: B.M. No. 69.7.19.1, collected at Calovevora, Veragua, Panamá, by E. Arcé and was received from O. Salvin.

RANGE: Panamá and Costa Rica.

GENERAL CHARACTERS: This tayra is readily recognized by its large size, long weasel-like body, blackish color, and moderately long hairy tail. The Panamanian form is closely allied to *T. b. inserta* from Nicaragua but differs in being of larger size and having a darker brownish color of the head.

DESCRIPTION: Color of some individuals entirely black; in others the head and neck are varied with buffy or brown and a small white triangular spot on throat. Skull large, low, and massive; zygomatic arches strong and spreading; sagittal crest moderately developed; braincase long and hourglass shaped; canines strong but molariform teeth relatively weak; bullae flat, palate extending posteriorly well beyond last molars.

MEASUREMENTS: Old male from Cuábre,

Talamanca: Total length, 1125 mm.; tail vertebrae, 455; hind foot, 120. Skull: condylobasal length, 120.5; zygomatic width, 80; interorbital width, 31.8; length of upper carnassial, 10; upper tooththrow, c-m¹ inclusive, 35. From type description, skull of female (probably the type), 98 mm. by 63.

SPECIMENS: Prov. Limón: Cuábre, 4 A.M.N.H.

The tayras exhibit considerable range of individual variation, especially in the color of the head and in size.

Tayra barbara inserta Allen

NICARAGUAN TAYRA

Tayra barbara inserta ALLEN, 1908, Bull. Amer. Mus. Nat. Hist., vol. 24, p. 662.

TYPE: A.M.N.H. No. 28492 (apparently inadvertently based on No. 28490), male, semi-adult, skin and skull, collected at Uluce, Matagalpa, Nicaragua, January 5, 1908, by W. B. Richardson.

RANGE: Most of Nicaragua, south central Honduras, and possibly north Costa Rica.

GENERAL CHARACTERS: A large, weasel-like animal, black in general color but with head and neck very dark brown; very similar to *T. b. biologiae* from Panamá; in the type series of *inserta* the black extends forward on the ventral surface of throat, without a trace of a white or yellowish spot on fore neck; other Nicaraguan specimens from east and south of Matagalpa have a well-pronounced white area on fore neck.

DESCRIPTION: Color of body, limbs, and tail black; head and neck dull brownish. Skull in general large and massive with a well-developed sagittal crest in old males; molariform teeth relatively small for an animal of this type; canines short and heavy.

MEASUREMENTS: Adult male from Zarcéro and topotype, type in parentheses: Skull: condylobasal length, 114 mm., 110 (115); zygomatic width, 68.8, 69 (66.5); interorbital width, 26.2, 24.5 (24.5); length of nasals, 18, — (20.4); maxillary tooththrow, c-m¹, 33.5, 33 (34.5); length of upper carnassial, 10.2, 9.5 (9.8).

SPECIMENS: Prov. Alajuela: Zarcéro, 1 skull A.M.N.H.

The skull measurements of Allen's type description were taken from a topotype,

A.M.N.H. No. 28490, an old male. The type, though a much younger specimen, has a considerably larger skull.

SUBFAMILY GRISONINAE

GRISON OKEN

GRISONS

The grisons are large, robust, weasel-like animals with a long body, short limbs, rather short hairy tail; large feet with soles naked, claws strong, non-retractable; ears short and rounded. They are smaller than the tayras and bear a superficial resemblance to a small badger. The grisons are distributed over virtually the whole of the tropical parts of North and South America, from southern Mexico to Chile and Argentina. Altitudinal range from sea level to above 3000 feet.

DENTITION: Incisors, $\frac{3-3}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{1-1}{2-2}$ = 34.

Grison canaster (Nelson)

YUCATAN GRISON

Galictis canaster NELSON, 1901, Proc. Biol. Soc. Washington, vol. 14, p. 129.

TYPE: U.S.N.M. No. 159562 (Biol. Surv. Coll.), adult male, was captured by Indians near Tunkas, Yucatan, Mexico, and was described from the living specimen while it was in the possession of General Canton, Governor of Yucatan.

RANGE: From southern Mexico, south to Panamá.

GENERAL CHARACTERS: Similar in size and general color to South American representatives but upperparts darker and grayer.

DESCRIPTION: Face and entire underparts, including feet and legs, black; the black area of face limited posteriorly by a well-defined pure white stripe extending across forehead above eyes and reaching back across cheeks to side of neck, covering front of ear, and becoming obsolete near shoulders; rest of upper side of head shading gradually from the white stripe into the grizzled color of upperparts, including tail. Underfur on back grayish white, the longer and coarser hair black from base and broadly tipped with white. Skull similar in general to that of the tayra but much smaller. Molars small but strong, upper carnassial with the inner

tubercle near the middle of the inner border of the tooth.

MEASUREMENTS: Half-grown male from Chichen Itza, Yucatan, and adult from Orizaba, Mexico: Total length, 565 mm., 720; tail vertebrae, 140, 170; hind foot, 85, —; ear, 10, —. Skull: greatest length, 83.5, —; zygomatic width, 49.5, 50; interorbital width, 20, —; length of nasals, 15.5, —; alveolar length of upper carnassial, 9, 9.

SPECIMENS: Prov. Limón: Talamanca, 1 U.S.N.M.

The grison is a more or less nocturnal, carnivorous animal. It favors the low tropical forested country and apparently is not found at elevations above 3000 feet. There is little known about the habits of the grison except that it is a ferocious killer, is easily tamed when taken young, and makes a playful pet.

SUBFAMILY MEPHITINAE

SKUNKS

SPILOGALE GRAY

SPOTTED SKUNKS

The members of this genus are small, slender skunks with rather long soft fur and extensive markings; tail bushy, shorter than length of head and body; ears rounded; limbs short; soles of feet naked. Mammary vary in number from 6 to 10, the usual arrangement being pectoral, 2-2; abdominal, 1-1; inguinal, 1-1. The range of the little spotted skunks extends from southern British Columbia in the west, northern Virginia in the east, southward through Mexico to Costa Rica.

DENTITION: Incisors, $\frac{3-3}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{1-1}{2-2}$ = 34.

Spilogale angustifrons elata Howell

HIGHLAND SPOTTED SKUNK

Spilogale angustifrons elata HOWELL, 1906, North Amer. fauna, no. 26, p. 27.

TYPE: U.S.N.M. No. 133186 (Biol. Surv. Coll.), adult male, collected at San Bartolomé, Chiapas, Mexico, March 19, 1904, by E. A. Goldman.

RANGE: Highlands of Chiapas, Mexico; Guatemala; Honduras; Nicaragua; and northern Costa Rica.

GENERAL CHARACTERS: The color pattern of this little skunk is a series of more or less

broken lines that give an impression of spots. Howell, in his review of this genus, recognized several species based on what appeared to be at that time distinctive cranial characters. A review of the present available material will probably reduce the number of full species. *S. a. elata* differs from *S. a. tropicalis*, its nearest geographical ally, in having less white at base of tail, narrower skull, and heavier dentition.

DESCRIPTION: Color of upperparts about equal amount of black and white. The marking on black background is as follows: a more or less triangular white spot on forehead between eyes; four parallel white stripes on upperparts, from between or slightly behind ears and extending to about middle of back, the outer are on each side, continued forward under and in front of ear; another white stripe on each side from just behind fore legs and running parallel with the dorsal stripes and a short distance beyond them where it curves up to the back and almost meets the median stripe on the corresponding side; between the ends of these two lateral stripes on the back are two narrow white patches in line with median dorsal stripes; a white transverse band on each side in front of hips, reaching to line of median stripes; a small white patch on each side of rump and on each side of base of tail; under side of tail and tip white. Underparts of body black. Skull flattened, with rostrum only slightly depressed below plane of upper surface; periotic region and bullae inflated, mastoid processes obsolete, post-orbital processes moderately developed, zygomatic highly arched, palate terminating on a line with last molars; upper molar roughly quadrangular, broader than long.

MEASUREMENTS: Type, adult male: Total length, 385 mm.; tail vertebrae, 123; hind foot, 45. Skull: occipitonasal length, 49.5; basilar length, 45.5; zygomatic width, 33.7; interorbital width, 14.8; mastoid breadth, 28.5.

SPECIMENS: Costa Rica, 1 N.M.C.R. (exact locality not known). This specimen was sent to the World's Fair at Chicago by the Costa Rican Commissioner. Mr. George K. Cherrie, in response to an inquiry concerning it, stated that his recollection was that it came from the neighborhood of

Alajuela, about 3000 feet altitude, on the Pacific side of the cordillera.

The little spotted skunks are mainly nocturnal in their habits. They are comparatively agile for a skunk, often climbing bushes and small trees. They live in natural crevices in rocks or burrows in the ground, made either by themselves or by some other animal. The number of young in a litter is usually four or five. They are more carnivorous than omnivorous but are especially fond of insects and make a habit of digging small holes in the ground in search of larvae. They hunt and kill rats, squirrels, and small rodents.

The fluid secreted by the anal glands and used as a means of defense possesses the same properties as that of the allied genera, and is of equally disagreeable odor.

CONEPATUS GRAY

HOG-NOSED SKUNKS

The skunks in this genus are robust, black and white animals with a rather short bushy tail, short limbs, and coarse pelage. The claws are long and stout on the forefeet and the soles of the hind feet naked. The snout is very long, projecting well beyond the lower jaw, with a large naked pad on the upper side. Range: tropical America from the United States along the Mexican border to Chile and Patagonia.

DENTITION: Incisors, $\frac{3-3}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{2-2}{3-3}$; molars, $\frac{1-1}{2-2}$ = 32.

Conepatus tropicalis trichurus Thomas

PANAMANIAN HOG-NOSED SKUNK

Conepatus tropicalis trichurus THOMAS, 1905, Ann. Mag. Nat. Hist., ser. 7, vol. 15, p. 585.

TYPE: B.M. No. 4.7.6.5, adult male, collected at Boquete, Chiriquí, Panamá, altitude 4000 feet, March 5, 1904, by H. J. Watson.

RANGE: Western Panamá and Costa Rica. The *tropicalis* group is mainly South American in distribution, but the range extends north to Vera Cruz, Mexico.

GENERAL CHARACTERS: A medium-sized black skunk with a white bushy tail and a large white area on anterior part of back, divided by a median black dorsal stripe.

DESCRIPTION: Color black with a broad

white stripe on back from crown of head to in front of hips and divided by a black dorsal stripe that extends from nape of neck backward through to black of back; tail white except at base which is black all round. Skull heavy with strong teeth, upper molar large, roughly quadrangular and about as broad as long, the first small upper premolar usually absent; bullae small or only slightly inflated; interorbital region inflated; postorbital processes undeveloped; palate terminating posteriorly about on a line with the posterior border of upper molars.

MEASUREMENTS: Adult male from Perálta, female from Escazú, type in parentheses: Head and body, 403 mm., 405 (417); tail vertebrae, 155, 175, (170); hind foot, c.u., 75, 70 (74), s.u. (67). Skull: basal length, 66.2, 66 (69); zygomatic width, 48, 46.5 (46.5); mastoid width, 39.9, 40.1 (40.5); palatal length, 30.5, 31 (32.7); length of upper molar on outer side, 9.1, 9 (9.3); length of last upper premolar, 8.3, 7.6. The Perálta specimen weighed 5 pounds.

SPECIMENS: Prov. San José: Escazú, 4 A.M.N.H.; Pozo Azul Pirris, 1 A.M.N.H.; La Hondura, 1 A.M.N.H. Prov. Cartago: Santa Teresa Perálta, 1 A.M.N.H. Prov. Limón: Jiménez, 2 A.M.N.H.

Conepatus mesoleucus nicaraguus (Allen)

NICARAGUAN HOG-NOSED SKUNK

Conepatus nicaraguae ALLEN, 1910, Bull. Amer. Mus. Nat. Hist., vol. 28, p. 106.

TYPE: A.M.N.H. No. 29282, adult male, skin and skull, collected at San Rafael del Norte, Nicaragua, January 1, 1909, by Wm. B. Richardson.

RANGE: Honduras, Nicaragua, and possibly extending to northern Costa Rica.

GENERAL CHARACTERS: A large skunk with a single white stripe down middle of back.

DESCRIPTION: Color black, with a broad white medium dorsal stripe which begins on top of head, extends down the full length of the back, and includes the entire tail except at base which is black. Snout long and with a naked pad on upper side for rooting. Soles of feet naked to heel. Skull relatively high, nasals and maxillae ending posteriorly on essentially the same plane, similar in general to that of *C. t. trichurus* but larger, superior

outline more arched, and last upper premolar smaller.

MEASUREMENTS OF TYPE: Total length, 690 mm.; tail vertebrae, 270; hind foot, 80. Skull: basal length, 67.5; zygomatic width, 46.5; mastoid width, 39.9; palatal length, 33; length of last upper premolar, 7; length of upper molar, 9.5.

The hog-nosed skunk is more or less nocturnal in its habits and prefers semi-forested broken country. It feeds principally on a variety of small animal life, such as insects, larvae, and mice. Its long mobile snout and stout claws are adapted for digging and rooting in the earth. An unmistakable character of this skunk, as in other members of the family, is its means of defense which is the secretion of a pair of anal glands that are embedded in a mass of muscle at the base of the tail. The skunk is capable of ejecting at will the fluid from these glands for a distance of 8 or 10 feet. This fluid has an extremely pungent and irritating smell. This skunk is slow-moving and deliberate in its actions, having great confidence in its power of defense.

FAMILY CANIDAE

WOLVES, FOXES, JACKALS, AND DOGS

This family includes medium-sized carnivorous mammals of a more or less long-legged cursorial type, with an elongate muzzle, long bushy tail, and long thick pelage. They are terrestrial, digitigrade, with four toes on hind feet, five toes on fore feet, and claws non-retractile. The canine teeth are long and powerful, the carnassial teeth well developed with sharp cutting edges. Members of the Canidae are found in virtually every country of the world.

UROCYON BAIRD

GRAY FOXES

Members of this genus, *Urocyon*, are typically fox-like in appearance; muzzle fairly long; ears erect; tail long, bushy, and with a concealed mane of stiff hairs; pelage relatively coarse; pupil of eye elliptical; soles of feet hairy. The range of the gray foxes extends generally throughout most of the United States, Mexico, and southward in Central America to the Canal Zone in Panamá.

DENTITION: Incisors, $\frac{3}{3}$; canines, $\frac{1}{1}$; pre-molars, $\frac{4}{4}$; molars, $\frac{2}{3}$ = 42.

Urocyon cinereoargenteus costaricensis

Goodwin

COSTA RICAN GRAY FOX

Urocyon cinereoargenteus costaricensis GOODWIN, 1938, Amer. Mus. Novitates, no. 987, p. 2.

TYPE: C.N.H.M. No. 35170, male adult, collected at Sabanilla de Pirris, a town on the Pacific coast range near Río Grande de Pirris, Province of San José, Costa Rica, altitude about 500 feet, April 2, 1931, by C. F. Underwood.

RANGE: Costa Rica.

GENERAL CHARACTERS: A relatively dark-colored gray fox, smaller and darker colored than *Urocyon c. guatemalae* but larger and darker colored than *U. c. furvus* from Panamá.

DESCRIPTION: Pelage moderately long and coarse; upperparts gray, formed by the nearly equal mixture of black tips and pale buffy subterminal bands of the coarse guard hairs, top of head like back but more finely grizzled; underfur on back varying from uniform Prout's Brown to bicolored Ochraceous-Buff tipped fur. Outside of ear and area behind ears varying from Ochraceous-Tawny to Hazel; tip of ear mixed with black; chin, under side of mouth, and muzzle Mummy Brown; lips and from each corner of mouth to throat white; upper side of fore and hind limbs and feet a mixture of black and buff; inner side of limbs Cinnamon-Buff; tail with a mane of black coarse hairs; sides of neck, under side of tail, and sides of abdomen varying from Cinnamon-Buff to Ochraceous-Tawny; throat, inguinal and pectoral regions white or buffy white. Skull relatively broad with a long palate, slender rostrum, moderately large braincase, well-developed postorbital processes; temporal ridges widely separated and lyre-shaped bullae large; palate terminating posteriorly on about a line across the posterior border of last upper molars. The longitudinal axis of the third upper premolar is not in line parallel to the first and second but the anterior edge is turned in, making a sharp angle in the tooththrow at this point.

MEASUREMENTS: Adult male from Escazú: Head and body, 580 mm.; tail vertebrae, 365; hind foot, 110; ear, 60. Skull (measurements of type in parentheses): greatest length, 109 (111.2); basal length, 99.5 (103.6); palatal length, 51.5 (55.5); zygomatic width, 61 (61.4); upper tooththrow, canine to last molar, 45 (45.7); combined length of upper molars, 13.5 (13).

SPECIMENS: Prov. San José: Escazú, 6 A.M.N.H.; Sabanilla de Pirris, 1 (type) C.N.H.M.

The gray fox is a forest-dwelling animal and favors rough rocky country in wooded sections. Its den is a hole in the ground, usually among rocks or in a hollow tree stump. Although the gray fox is primarily a night prowler, it may be seen about at almost any hour of the day. Its food consists of virtually all available small animal life that it can catch and kill. Its principal diet consists of mice, rats, reptiles, insects, ground birds, and probably fruit and berries. Its ability to climb trees is unusual for an animal that does not possess either sharp retractile claws, as do the cats, or short nails as do squirrels. It does climb trees but the progress is made by leaping from branch to branch. The usual number of young in a litter varies from about four to six. At birth the young are blind and helpless.

CANIS LINNAEUS

WOLVES, COYOTES, AND JACKALS

This genus includes large, dog-like animals that, with the exception of some domesticated strains, have large erect ears, more or less long bushy tails, long coarse guard hairs. The most conspicuous characters by which members can be distinguished from the foxes are their larger size and more robust form. The genus *Canis* has a world-wide distribution. Costa Rica is probably the extreme southern limit for the range of the coyotes.

DENTITION: Incisors, $\frac{3}{3}$; canines, $\frac{1}{1}$; pre-molars, $\frac{4}{4}$; molars, $\frac{2}{3}$ = 42.

Canis latrans dickeyi Nelson

SALVADORAN COYOTE

Canis latrans dickeyi NELSON, 1932, Proc. Biol. Soc. Washington, vol. 45, p. 224.

TYPE: No. 12260, collection of Donald R.

Dickey, adult male, collected near Cerro Mogote, 2 miles west of Rio Goascoran, District of La Union, El Salvador (latitude 18° 30' N.), December 29, 1926, by G. D. Stirton.

RANGE: West coast region of Central America; limits of range undetermined.

GENERAL CHARACTERS: *Canis latrans dickeyi* is a large, Rufous colored coyote about equal in size to *C. l. lestes* of Nevada but darker. It is larger than its nearest known geographical relatives, *C. hondurensis*, *goldmani*, *cagottis*, and *vigilis*. The characters of the Costa Rican coyote have not been described. Otto Koller (1934, p. 186) refers a specimen from Bebedero to *C. l. cagottis* and remarks, "Particularly conspicuous in the specimen from Costa Rica is the white throat which does not appear to be outstanding in the other southern forms" (translation).

DESCRIPTION: Color of type: top of nose and crown dull grizzled with a slightly rusty tinge, shading into dull rusty rufous on sides of nose and into paler, more buffy grayish on sides of head, behind and below eyes; a light dingy buffy area around eyes; nape and top of neck dull rusty rufous, washed with dusky shading posteriorly into more dingy grayish on top of lower neck and top of shoulders; rest of back and sides of body dark rusty rufous, washed with black, with black guard hairs; tail dingy, rusty buffy heavily overlaid with long black guard hairs; front and sides of legs dark rusty rufous; back of ears dull rusty rufous; chin, throat, breast, posterior part of abdomen, and inguinal region dull white. Skull large with well-developed sagittal crest and postorbital processes; zygomatic arches strong and spreading, bullae large and rounded, posterior border of palate terminating on a line with back of last upper premolar; canines large and strong; the first, second, and third upper premolars relatively small. The upper carnassial (p^4) consists of a stout blade, the middle lobe large, conical, and pointing backward; the first upper molar large, wider than long, with two outer prominent conical cusps and a low broad inward prolongation; second upper molar similar to first but considerably smaller. The lower carnassial (m_1) is a large tooth with strong, compressed, bilobed blade.

MEASUREMENTS OF TYPE: Total length, 1280 mm.; tail vertebrae, 380; hind foot, 250. Skull: greatest length, 209; condylobasal length, 193; zygomatic breadth, 101.2; length of upper canine-molariform toothrow, 87.7; outer crown length of upper carnassial, 19.8.

SPECIMENS: Prov. Guanacaste: Miravalles, 1 U.S.N.M.; Nicoya, 1 N.M.C.R.; Bebedero, 1 M.B.

The subspecific status of the Costa Rican coyote has not been determined. It could be referable to either *dickeyi* or *hondurensis* but may be distinct from both. Most records are from Guanacaste and the Nicoya Peninsula in northwest Costa Rica, indicating that its habitat is the west coast region and that it is closely allied to, if not identical with, the Salvadoran coyote.

In Central America coyotes are more or less restricted to open savanna or semi-forested, arid country, mainly along the Pacific coast region. They do not regularly occur in the unbroken forests that cover so much of the general region. Coyotes are most active between sundown and sunrise, though they may be seen about at almost any hour of the day. According to Anthony, the voice of the coyote is one of the most characteristic and distinctive mammal calls heard on the North American continent. Singly, or in twos or threes, they "tune up" at sunrise and sunset in a chorus of long howls and yapping barks that break the stillness of the air. Anastasio Alfaro recorded hearing the coyotes howling in Tamarindo and Junquillal, near the Bay of Salinas, during the year 1890. The chief food of the coyotes consists of mice, rabbits, and other forms of small animal life. Their den is usually a natural cavity among rocks or in a hollow tree or a hole in the ground. The young vary from four to six in a litter, are born blind and helpless. The period of gestation is about nine weeks.

FAMILY FELIDAE

CATS AND THEIR ALLIES

The whole structure of the animals in this family is the most highly specialized carnivorous type in the order of flesh-eating mammals. Members vary from medium to large in size; form muscular, head rounded, limbs of moderate length, feet digitigrade,

five toes on fore and four on hind feet, claws long, strongly curved, sharp and with one exception retractile; tongue with upper surface rough and rasp-like. Teeth highly specialized for cutting flesh. The family has a world-wide distribution, with the exception of the Australian region and Madagascar.

FELIS LINNAEUS
CATS

This genus includes all the true cats. Species vary considerably in size and color. The tail is usually moderately long; claws completely retractile. Eyes large, the iris very mobile and with a pupillary aperture which contracts under influence of light; tongue thickly covered with sharp-pointed recurved horny papillae. The geographical distribution is essentially the same as for the family.

DENTITION: Incisors, $\frac{3-3}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{2-2}$; molars, $\frac{1-1}{1-1}$ = 30.

Felis onca centralis Mearns
CENTRAL AMERICAN JAGUAR

Felis centralis MEARNs, 1901, Proc. Biol. Soc. Washington, vol. 14, p. 139.

TYPE: U.S.N.M. No. 14177, skull, adult male, collected at Talamanca, probably near Sipúrio, Costa Rica, by W. M. Gabb, catalogued November 19, 1874. The catalogue calls for a skin, which cannot be found.

RANGE: Central America north to El Salvador and along Pacific coast to Tehuantepec, south to Guaduas, Colombia. The jaguars in general range from Patagonia in South America north through Central America and Mexico to Texas, New Mexico, and Arizona in North America.

GENERAL CHARACTERS: The jaguar is a large, Tawny, spotted cat with tail about equal to length of body. *F. o. centralis* is a relatively small race, but it is the largest of the Central American cats.

DESCRIPTION: Color of upperparts Clay Color with a median chain of black spots bordered on each side by five longitudinal rows of black rosettes; the lateral rosettes increase in size toward the belly, and contain from one to five black spots. Crown and neck Tawny with black spots or rosettes, tail Clay Color, heavily spotted and banded with

black; underparts buffy white, more or less spotted with black. Skull short and rounded though proportionally more elongate than in the smaller cats; rostrum short and broad, zygomatic arches wide and strong, lambdoidal crest tapered to the median point of union with the sagittal crest and shelving backwards. Incisors small, canines large and strong, slightly recurved and placed wide apart. Premolars compressed and sharp pointed, anterior upper premolar small; posterior upper premolar, carnassial, a large tooth with a subcompressed blade divided into three unequal lobes. Upper true molars very small and placed more or less transversely in the toothrow. In the lower jaw the true molar, carnassial, is a compressed blade divided into two subequal lobes.

MEASUREMENTS OF TYPE SKULL: Greatest length, 250.5 mm.; condylobasal length, 219.5; width of rostrum behind canines, 63.8; zygomatic width, 169.5; interorbital constriction, 41.5; width across mastoid processes, 101; width of interpterygoid fossa, 22.3; alveoli of upper canine-premolar series, 72.5; crown length upper carnassial, 25.5; diameter upper canine (anteroposterior), 20.

SPECIMENS: Prov. Limón: Talamanca, 1 (skull), U.S.N.M. Prov. San José: Pozo Azul, 1 (skull), U.S.N.M.

The jaguar is a formidable beast of prey but rarely, if ever, attacks man unless provoked. It is wary and secretive in its habits and favors dense jungle thickets and heavy growth of vegetation. It climbs trees upon occasion but is probably not given to this as a regular habit.

The prey of the jaguars includes most of the herbivorous animals found in its habitat which are stealthily stalked through the forest and finally attacked in a short quick rush, or seized in a spring from ambush. The number of young in a litter may vary from two to four. The cubs are usually more heavily spotted with black than the adult. The call of the jaguar is a hoarse cough, made up of a repetition of guttural notes. Anastasio Alfaro, writing of the jaguar in Costa Rica in 1897, states that it is found scattered throughout the country, from both coasts to Volcán Irazú at 8000 feet. He also refers to the black jaguar or tiger as being more fre-

quently found in the north around Santa Clara and on the shores of the River San Juan.

***Felis pardalis mearnsi* (Allen)**

MEARNS' OCELOT

Felis costaricensis MEARNS, 1902, Proc. U. S. Natl. Mus., vol. 25, p. 245. Not *F. b. costaricensis* Merriam, 1901.

Felis mearnsi ALLEN, 1904, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 71 (renaming of *costaricensis* Mearns, preoccupied).

TYPE: U.S.N.M. No. 14180, old male, skull only, collected at Talamanca, Costa Rica, by W. M. Gabb, catalogued November 19, 1874. The catalogue calls for a skin, No. 12180, which cannot be found.

RANGE: Panamá, Costa Rica, and Nicaragua. The range of the ocelots in general extends from southern Texas and Arizona through Mexico, Central America, and in South America at least to Paraguay.

GENERAL CHARACTERS: A moderately large, heavily spotted cat with a relatively short tail and short close pelage. It closely resembles the long-tailed spotted cat in the spotted and lined coloration but differs in being of larger size and having a shorter tail.

DESCRIPTION: Color of an adult male from Orosi, Cartago, 3560 feet elevation: ground color of upperparts light Ochraceous-Buff, darkest on head and middle of back; five parallel black stripes on back of neck, the outer two broad; a more or less broken mid-dorsal line, rest of back and sides with evenly distributed spots and irregular rosettes, the latter elongated on shoulder. The fur inside the rosettes is strongly buffy and on the outside gray with only a slight buffy tinge; limbs and feet with smaller black spots than back, underparts with large black spots; a black transverse stripe across outside of neck and across throat; tail with irregular bands of black and pale buff. Skull and teeth typically cat-like, with heavy zygomatic arches and abruptly truncated rostrum, bullae large and well inflated.

MEASUREMENTS: An adult female from Talamanca, from Mearns' original description, and an adult male, not old, from Orosi: Total length, 1050 mm., 1320; tail vertebrae, 280, 350; hind foot, 162, 180. Skull of the

type, adult male, and male from Orosi: greatest length, 158, 144; condylobasal length, 146.3, 133.7; zygomatic width, 106.2, 92.7; interorbital width, 29.2, 23.5; length of upper carnassial (crown), 16.8, 17.5.

SPECIMENS: Prov. Limón: Talamanca, 5 skulls U.S.N.M., 1 A.N.S.P., 1 M.C.Z. Prov. Cartago: Orosi, 1 A.M.N.H.; Turrialba, 1 M.C.Z.

The ocelot is a jungle dweller and prefers heavily forested regions. Like most of the cats it is most active during the hours between sunset and sunrise. It is an apt tree climber and is occasionally seen resting during the day among the branches of trees. The Costa Rican ocelot is a large form of the *Felis pardalis* group and may be distinguished from the jaguar by much smaller size and the presence of four or five parallel black lines on the nape of neck. In color pattern the ocelot closely resembles the long-tailed spotted cat of this region but is a larger and more robust animal with a shorter tail. Its food consists of a variety of small mammals and birds as well as snakes and other reptiles.

***Felis wiedii nicaraguae* (Allen)**

**NICARAGUAN LONG-TAILED SPOTTED CAT
OR MARGAY**

Margay glaucula nicaraguae ALLEN, 1919, Bull. Amer. Mus. Nat. Hist., vol. 41, p. 357.

TYPE: A.M.N.H. No. 28957, adult male, collected at Volcán de Chinandega, Nicaragua, August 20, 1908, by W. B. Richardson.

RANGE: Western Panamá, Costa Rica, and Nicaragua.

The range of the various races of the long-tailed spotted cat or margay extends from southwestern Mexico through Central America and in South America to Paraguay and northern Argentina.

GENERAL CHARACTERS: A small spotted cat with a tail about two-thirds the length of head and body. The color pattern consists of longitudinal stripes on the head, neck, and back; on the sides of body are rosettes with black rims and centers darker than ground color. Hair on the nape of neck is usually reversed from a whorl behind the shoulders.

DESCRIPTION: Color of upperparts Cinnamon-Buff, paler on lower back and sides of

body; four distinct parallel black lines on back of neck with a narrow median stripe; a more or less broken middorsal line, rest of upperparts, including upper and outer side of limbs, with heavy black marking, linear, sharply defined, occasionally enclosing patches of color darker than ground color; the marking arranged on thighs in transverse rows, on the shoulders in more or less vertical bands; underparts white with large black spots and bands across throat and neck; tail with about seven broad black bands alternating with Cinnamon-Buff. Skull similar to that of the ocelot in most respects but much smaller, interorbital region broader, braincase more rounded, and general structure weaker and more slender.

MEASUREMENTS: Type and an adult male from Agua Buena: Total length, 1260 mm., 900; tail vertebrae, 510, 380; hind foot, 116 (dry), 130. Skull: total length, 107, 101.3; basal length, 93, 87.8; condylobasal length, 100, 95.4; zygomatic width, 72.2, 70.4; nasals, 18.7, 18.3; interorbital width, 19.2, 17.1; breadth of braincase, 43, 44.6; length of upper carnassial, 12.4, 12.3.

SPECIMENS: Prov. Puntarenas: Agua Buena, 1 A.M.N.H. Prov. Limón: Santa Clara, 1 Vienna Mus.

Felis pardinoides oncilla Thomas

COSTA RICAN TIGER CAT

Felis pardinoides oncilla THOMAS, 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 12, p. 237.

TYPE: B.M. No. 78.7.6.3, skin without skull, collected at Volcán de Irazú, Costa Rica, by Mr. Rogers and presented by F. Ducane Godman.

RANGE: Known only from Costa Rica. The species *pardinoides* is mainly South American in distribution, and its range extends south to Chile and north to Costa Rica.

GENERAL CHARACTERS: A small spotted cat with a moderately long tail; pelage soft and full, nape hairs normal instead of reversed; similar in proportions and general color pattern to *F. w. nicaraguae* but smaller in size, and color usually much richer and darker.

DESCRIPTION: Basic color of upperparts Cinnamon-Buff; four distinct black parallel lines on back of neck, rest of upperparts with

small black broken rings encircling patches of ground color; fore and hind limbs spotted with black; tail with irregular blackish rings alternating with Cinnamon-Buff; underparts white, spotted with black. Skull small, without crests, smooth and weak in structure; similar to that of the margay but smaller, dorsal outline less convex, frontal area flatter, and skull narrower in proportion to its length.

MEASUREMENTS OF TYPE: Head and body, 505 mm.; tail vertebrae, 290; hind foot, 105; ear, 39. Adult female from Pozo Azul, Pirris: Total length, 970; tail vertebrae, 276; hind foot, 101. Skull: total length, 86; basal length, 73; zygomatic width, 55; least interorbital width, 16; intertemporal width, 28; length of nasals, 18; length of upper carnassial, 10.

SPECIMENS: Prov. Cartago: Volcán Irazú, 1 (type) B.M. Prov. San José: Pozo Azul, Pirris, 1 A.M.N.H. (type of *carrikeri* Allen, apparently a melanistic specimen).

Felis concolor costaricensis (Merriam)

CENTRAL AMERICAN PUMA

Felis bangsi costaricensis MERRIAM, 1901, Proc. Washington Acad. Sci., vol. 3, p. 596.

TYPE: M.C.Z. No. 10118 (Bangs Coll.), skin and skull, adult female, collected at Boquete, Chiriquí, Panamá, April 22, 1901, by W. W. Brown, Jr.

RANGE: Panamá and Costa Rica. Nineteen forms were recognized by Nelson and Goldman in 1929, which collectively ranged from southern Patagonia to southern Canada with an altitudinal range from sea level to the upper slopes of high mountains.

GENERAL CHARACTERS: Of the Central American cats, the puma is second only to the jaguar in size. It is readily recognized by its large size, Tawny color, and absence of body marking except in the very young individual. It is distinguished from the more northern forms by its smaller size, more reddish coloration.

DESCRIPTION: Color of upperparts, including outer side of fore and hind limbs and upper side of tail, Ochraceous-Tawny, darker on top of head and along middle of back; top of tail brownish black; underparts, including under side of tail and inner side of fore and hind limbs, chin, lip, and throat, white or

buffy white. The skull is smaller and relatively shorter and broader than that of the jaguar, with a proportionately shorter rostrum, larger braincase, and more rounded bullae; it is of medium size but rather lighter than that of the average puma, and the carnassials in the females are relatively small.

MEASUREMENTS: Type, measured in the flesh: Total length, 1680 mm.; tail vertebrae, 680; hind foot, 220; ear, 75. Measurements of flat skin from Guápiles, not sexed: Total length, 2120; tail vertebrae, 710; hind foot, 22.3. Skull: basilar length, 152.5; condylo-basal length, 170; zygomatic width, 130; mastoid width, 79.4; interorbital breadth, 36.6; length of nasals along median line, 40.5; length of upper lateral tooththrow, 58.4; length of upper carnassial, crown, 23.

SPECIMENS: Prov. Limón: Guápiles, 1 A.M.N.H.; Pacuare, 1 U.S.N.M. Costa Rica, without exact locality, 2 U.S.N.M.

The favorite haunts of the puma are the rugged forested mountain slopes, but it is also found in low, flat, broken forest country where game is plentiful. It has a wide individual range and is most active between the hours of sunset and sunrise. When hunting it is a very silent animal, but during the mating season or fighting a rival it utters cries similar to those of a house cat but intensified to a scale relative to its size. The den or lair of the puma is usually a rocky ledge or a cave. The young in a litter vary in number from one to four, and at birth are covered with fine yellow hair spotted with black. The spots are usually lost when the cub is six months old. The period of gestation is about 13 weeks. The normal life of a puma appears to be about 20 years. While able to climb trees, this cat spends the greater part of its life on the ground. Its food consists of a variety of animals and birds; deer appear to be one of its principal sources of food in countries where they are plentiful.

Felis yaguarondi panamensis (Allen)

PANAMANIAN YAGUAROUNDI

Felis panamensis ALLEN, 1904, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 71.

TYPE: A.M.N.H. No. 18946, female, semi-adult, skin and skull, collected at Boquerón,

Chiriquí, Panamá, October 30, 1901, by J. H. Batty.

RANGE: Panamá and Costa Rica. The range of yaguarondi in general extends from southern Texas through Mexico, Central America, and south to Argentina in South America.

GENERAL CHARACTERS: A small, unspotted cat with a long slender body, comparatively small head, short limbs, and long tail. It is a dichromatic species presenting a gray and red color phase. The Panamá form is known only from specimens in various shades of the grayish phase.

DESCRIPTION: Color of type, upperparts dusky gray, dorsal region posteriorly, inner sides of limbs and feet, strongly blackish; sides and front of limbs lighter than back, the hairs broadly tipped with whitish, giving a grayish effect; whole head, including ears and neck, lighter than body, rusty brownish gray varied minutely with black; underparts dark gray. Skull elongate; cranium compressed laterally; rostrum sharply elevated; dorsal contour convex posteriorly, flattened in supraorbital region, with a marked declination forward from middle of nasals, interorbital region with a deep fossa continuing forward to extremity of nasals; jugal broad, bullae large and constricted laterally; occipital crests well developed, teeth normal for the family.

MEASUREMENTS OF TYPE: Total length, 985 mm.; tail vertebrae, 390; hind foot, in dry skin, 128; ear, 40. Skull of type and adult male from San José: Total length, 96, 115.5; basal length of Hensel, 80, 98; zygomatic width, 62, 74.5; interorbital width, 15.5, 20; postorbital width, 32, 30.4; width of braincase, 46, 48.3; length of nasals, 24, 26.4; upper tooththrow from front of canine, 30, 32.5; length of upper carnassial, 12.5, 12.7.

SPECIMENS: Prov. San José: Puriscal, 1 A.M.N.H.; San José, 1 skull, A.M.N.H. Prov. Guanacaste: Catalina, 1 Vienna Mus.

The yaguarondi are weasel-like cats that inhabit dense thickets and forested country. They feed on various kinds of small animal life, such as rats, mice, and birds. Very little is known about their habits. Alfaro states that in Costa Rica this animal is called "león miquero" because of its fondness for

traveling over the branches of large forest trees. Bailey, quoting a letter from F. B. Armstrong, writes "they move around a good deal in daytime, as I have often seen them come down to a pond to drink at midday, and often seen them dart through the brush in daytime."

The yaguaroundi group is poorly represented in museum collections, and the available material is insufficient for a satisfactory study of the geographical forms. There is apparently very little specific difference in external appearance of specimens from South and Central America and Mexico, but a considerable amount of individual variation is evident in available material.

ORDER PINNIPEDIA

SEALS AND WALRUSES

FAMILY PHOCIDAE

HAIR SEALS

Seals are large mammals highly modified for an aquatic habitat but which spend part of their life on coastal shores or ice floes. Species of the family Phocidae have coarse pelage and no external ear. The hind limbs are directed backward and incapable of rotation forward; the fore limbs are smaller than the hind limbs, fully haired, and provided with claws. Seals inhabit coast regions of more or less the entire world, occasionally ascending large rivers, and in some instances they are found in inland lakes.

MONACHUS FLEMING

TROPICAL SEALS

Seals of this genus are large in size with coarse stiff pelage, long whiskers, short tail, and palms and soles of feet naked. The range is restricted to the subtropical regions of the Atlantic coast region of Middle America, West Indies, Mediterranean and adjacent islands, and the Hawaiian Islands.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{4-4}{4-4}$; molars, $\frac{1-1}{1-1} = 32$.

Monachus tropicalis (Gray)

WEST INDIAN SEAL

Phoca tropicalis GRAY, 1850, Catalogue of seals in the . . . British Museum, 1850, p. 28.

TYPE: In British Museum, imperfect skin without skull, from Jamaica, brought back by Mr. Gosse.

RANGE: West Indies and probably east coast of southern Florida, Mexico, and Central America.

GENERAL CHARACTERS: A large brown seal with short coarse pelage and without underfur; no external ears, and claws short.

DESCRIPTION: Color of upperparts uniform, varying in shade from gray brown to dark brown, underparts paler and grayer than back. Skull large, broad, and low, interorbital region narrow, orbits large, rostrum short, nasals acutely tapered to a point; canines large, conical, first upper premolar in line with canine, rest of upper molariform teeth placed in a line obliquely to central line of palate, making a distinct angle in tooththrow; crowns of premolars strong, conical, compressed with a strongly lobed cingulum, especially on inner side, and slightly developed anterior and posterior cusps; the first and last molariform teeth considerably smaller than the others; the three posterior premolars, upper and lower, and the lower molar two-rooted. Upper incisors large, the middle pair smaller than outer.

MEASUREMENTS OF TYPE: Total length to end of hind limbs, 2390 mm.; length of manus, 300, of pes, 320 (Elliot). Skull of adult male from Yucatan: greatest length, 283; zygomatic width, 175; interorbital width, 30.5; alveolar length of upper tooththrow, canine to last molar, 84.2.

There appears to be no evidence that seals were ever found on the coast of Costa Rica. The West Indian seal was at one time not uncommon on the coastal islands of Yucatan and the Bay of Honduras and eastward to Jamaica, Cuba, the Bahamas, and the Florida Keys.

ORDER SIRENIA

SEA COWS

FAMILY TRICHECHIDAE

MANATEES

Members of this family are a group of herbivorous mammals, highly specialized for aquatic life. General form robust, head rounded, muzzle truncate; nostrils separate;

eyes small; fore limbs paddle-like fins; no trace of hind limbs; tail broad, flat, expanded transversely. This group inhabit bays and delta regions along the Atlantic coast of Middle America north to Florida, northern South America, west African coast, and islands of the Indian Ocean, Australia, South Pacific islands and the Red Sea.

TRICHECHUS LINNAEUS
MANATEES

The genus *Trichechus* includes the manatees which inhabit the tropical and subtropical Atlantic coast region from Florida to northern South America and west Africa. The manatee has two upper and two lower small functionless incisors that are lost at a very early stage of development. The dugongs, the Pacific and Indian ocean representatives of the Sirenia, have a pair of large, tusk-like incisors in the upper jaw, which in the males have persistent pulps and continue to grow through life.

DENTITION: Incisors, $\frac{2-2}{2-2}$; canines, $\frac{0-0}{0-0}$; premolars and molars, $\frac{6-6}{11-11} = 32-52$.

***Trichechus manatus* Linnaeus**
WEST INDIAN MANATEE

Trichechus manatus LINNAEUS, 1758, *Systema naturae*, ed. 10, vol. 1, p. 34.

TYPE LOCALITY: Fixed by Thomas (1911, March, Proc. Zool. Soc. London, p. 132) as West Indies.

RANGE: West Indies and Atlantic coast of southern Mexico, Central America, and northern South America.

GENERAL CHARACTERS: A large robust mammal with thick pendulous lips, blunt truncate muzzle, upper lip cleft medially, nostrils valve-like, external ear small, eyes small, fore limbs modified into broad flippers with rudimentary nails, no hind limbs, tail broad, flat, and outline rounded, skin virtually naked but muzzle set with stiff bristles.

DESCRIPTION: General color uniform dull grayish. Skull massive and dense; nasal bones rudimentary or absent, rostrum long and narrow; squamosal with a large and massive zygomatic process, which joins a strongly developed jugal; orbit small; incisors rudi-

mentary, concealed beneath horny plates, and disappearing before maturity. Molars number 11 in each row, but rarely more than six are functional at one time, the anterior teeth falling out as the posterior teeth come into use; the molar teeth are similar in character from beginning to the end of the series, with square enamel crowns, the grinding surface raised into tuberculate transverse ridges. The upper teeth with two ridges and three roots, the lower teeth with an additional posterior ridge and two roots.

MEASUREMENTS: Adult specimens average 7 feet in length and weigh about 430 pounds. Individuals have been recorded as measuring as much as 12 feet. Skull of adult male from Boca Lago Tejá, Amazonas, Brazil: greatest length, 350 mm.; zygomatic width, 203; interorbital width, 65; width of palate across molars, 48.

The manatee spends its whole life in the water, inhabiting bays, lagoons, estuaries, and large rivers. As a rule it prefers shallow water and is not suited to life in the open sea. Its food consists of aquatic plants on which it browses beneath the water. The manatee is slow and inactive in its movements and perfectly harmless and inoffensive.

Frantzius stated that in Costa Rica manatees were numerous along the Atlantic coast and in the San Juan River and its tributaries, the Colorado, Sarapiquí, and San Carlos.

ORDER ARTIODACTYLA
EVEN-TOED UNGULATES
FAMILY TAGASSUIDAE
PECCARIES

The family Tagassuidae includes two species of peccaries or pig-like animals. Both have short vestigial tails, coarse bristly hair, small ears, and large tusks or canine teeth. A large gland on the back gives off a strong musky odor. The fore feet have a pair of medium-sized hoofs with an outer pair of smaller lateral hoofs; the hind feet have a median pair of hoofs and one small inner lateral hoof; the outer toe is entirely absent. The range of the peccaries extends from southern Texas and Arizona south through Mexico, Central America, and in South America to the Rio Negro, Patagonia.

TAGASSU FRISCH
PECCARIES

The characters for this genus are the same as for the family. The collared and the white-lipped peccaries are treated as one genus. Range, same as for the family.

DENTITION: Incisors, $\frac{2-2}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{3-3}{3-3}$ = 38.

Tagassu tajacu crusnigrum (Bangs)
CHIRIQUÍ COLLARED PECCARY

Tayassu crusnigrum BANGS, 1902, Bull. Mus. Comp. Zool., vol. 39, no. 2, p. 20.

TYPE: M.C.Z. No. 10163, young adult male, collected at Boquete, Chiriquí, Panamá, altitude 4000 feet, April 13, 1901, by W. W. Brown, Jr.

RANGE: Highlands of western Panamá and most of Costa Rica. Probably replaced in Guanacaste by a slightly differentiated race with lighter coloring; the race to which the peccaries from this region belong has not been determined. The collared peccaries in general are found in suitable localities from Patagonia in South America, north through Central America and Mexico to Texas in the United States.

GENERAL CHARACTERS: The collared peccaries are relatively small in size and grizzled in general color. They are recognizable by the light-colored shoulder stripes forming a collar. *T. t. crusnigrum* is a dark, richly colored race with Tawny instead of whitish shoulder stripes usual in the group.

DESCRIPTION: Color of subadult male from Agua Buena nearly uniform mixed Tawny and black, the hairs over most of the back black with two light-colored bands, the band near base white, and the subterminal band Ochraceous-Tawny. Hairs of the collar are bicolored, black from base for about two-thirds their length, rest of hair to tip Ochraceous-Tawny. The long hairs on rump have three bands of light color with a long black tip; limbs, feet, chest, and mid-ventral line black. Skull evenly tapered anteriorly, rostrum elongated; the axis of the face slopes downward, frontals broad with small post-orbital processes; nasals long; palate long, narrow, and extends behind last molar; occipital crest elevated and slopes strongly

backward; canines large, directed downward, and sharp, lower canines large, directed upward and outward, and slightly curved backward; premolar and molar teeth form a continuous series, gradually increasing in size from first to last; the true molars have square quadricuspidate crowns.

MEASUREMENTS: Semi-adult female from Agua Buena and a semi-adult male from Talamanca: Total length, 900 mm., 870; hind foot, 200, 190. Skull: greatest length, 234, 235; condylobasal length, 201, 203; zygomatic width, 98, 97; interorbital width, 51, 51; palatal length, 141, 142; maxillary tooth-row, 59, 61; upper molar series, 36, 38.

SPECIMENS: Prov. Puntarenas: Agua Buena, 3 A.M.N.H. Prov. Limón: Río Sixaola, 1 A.M.N.H. Prov. Heredia: Heredia, 1 Vienna Mus. Prov. Guanacaste: Miravalles, 1 skin, Vienna Mus. (referred by Koller to *Dicotyles angulatus crassus* Merriam).

Tagassu pecari spiradens (Goldman)
COSTA RICAN WHITE-LIPPED PECCARY

Tayassu albirostris spiradens GOLDMAN, 1912, Proc. Biol. Soc. Washington, vol. 25, p. 189.

TYPE: U.S.N.M. No. 12085/14095, skin and skull, collected in Talamanca, Costa Rica (probably near Sipúrio in the valley of Río Sixaola), 1874, by William M. Gabb.

RANGE: Costa Rica and Panamá. The range of the white-lipped peccaries in general is more restricted than that of the collared peccaries and extends from southern Mexico through Central America and in South America to Paraguay.

GENERAL CHARACTERS: A large black peccary with conspicuous white areas extending from the mouth along the sides of the face. *T. p. spiradens* is similar in size and color to *T. p. ringens* from Mexico, but the white facial area is more extensive, reaching nearly to the eyes.

DESCRIPTION: General color of upperparts varying from nearly pure black to black inconspicuously mixed with Tawny; underparts blackish becoming more or less grizzled in pectoral and inguinal regions; top and sides of muzzle, chin, and a triangular area extending posteriorly from angle of mouth along cheeks, narrowing to a point nearly under ears, white or yellowish white; feet

usually whitish; young russet-colored, darkened on middorsal line with black. Skull larger than that of the collared peccary, rostrum broadly flattened above, and the maxillae expanded laterally over the first premolars; the palate lacks the distinct marginal ridge, extending in the collared peccary from the canine to the anterior premolar. In general outline the skull resembles that of *T. p. ringens*, but the zygomatics are more widely spreading, nasals broader, and the first lower premolars are smaller.

MEASUREMENTS: Type skull: greatest length, 280.5 mm.; condylobasal length, 245; zygomatic width, 120; interorbital width, 65; maxillary toothrow, 76.7. External measurements of a female from Carillo: Total length, 1040; hind foot, 190; ear, 80.

SPECIMENS: Prov. Limón: Talamanca, 14 U.S.N.M. Prov. San José: Carillo, 1 Vienna Mus.

Peccaries usually travel in bands and have the reputation of being dangerous if attacked or injured, and supposedly the whole herd will come to the aid of a wounded comrade. This, if true, would be more applicable to the white-lipped peccaries which are more gregarious and travel in larger herds. The young in a litter are usually two, and at birth are reddish in color, in contrast with the dark color of the adult. In Costa Rica the collared peccaries inhabit forested country from the coastal plains up to an elevation of 8000 feet on the central plateau country. The white-lipped peccary is found in thick forests of the warm lowlands and is only occasionally met with in the higher lying mountain woods.

FAMILY CERVIDAE DEER

The family Cervidae is composed of several subfamilies of deer-like animals; the males have deciduous solid antlers (females also in some instances) which grow from permanent bases on the frontals, no upper incisors. This family has a wide geographical distribution, ranging in the New World from the Arctic Circle as far south as Chile, and in the Old World throughout the whole of Europe and Asia.

SUBFAMILY CERVINAE TRUE DEER ODOCOILEUS RAFINESQUE WHITE-TAILED DEER

Deer of the genus *Odocoileus* are moderately large in size and possess well-developed branching antlers and a relatively long tail, conspicuously white on the under side. Distribution of this genus is throughout most of North America, with the exception of the extreme north, south through Mexico, Central America to northern South America.

DENTITION: Incisors, $\frac{0-0}{3-3}$; canines, $\frac{0-0}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{3-3}{3-3}$ = 32.

Odocoileus virginianus chiriquensis (Allen)

CHIRIQUÍ WHITE-TAILED DEER

Odocoileus rothschildi chiriquensis ALLEN, 1910, Bull. Amer. Mus. Nat. Hist., vol. 28, p. 95.

TYPE: A.M.N.H. No. 18957, skin and skull, young female with deciduous premolars still in place, collected at Boquerón, Chiriquí, Panamá, December 4, 1901, by J. H. Batty.

RANGE: Open savanna region between the coast and the mountains on the Pacific side in western Costa Rica, southwestern Panamá, and east to the Bayano River.

GENERAL CHARACTERS: A relatively small, Tawny colored deer; males with heavy rugose branched antlers, slightly lyrate and directed forward in line of face; tail relatively long and conspicuously white on the under side.

DESCRIPTION: Color of an adult, but not old, female, typotype, collected October, 1901: Top of shoulders about Cinnamon-Brown, grading to Cinnamon-Buff on lower sides of body and outer sides of limbs; upper side of tail Ochraceous-Tawny, under side of tail white. Face from nares to between ears Bister, area around eyes soiled whitish; throat, inside of fore limbs, pectoral and inguinal region white; fawns spotted with white. Skull long and narrow, zygomatic arches not expanded; postorbital processes well developed, encircling the orbit with a bony structure; bullae small; upper incisors and canines absent; anterior lower incisors broadly chisel shaped, twice as large as the second and four times the size of the third lower incisor; canines small, incisiform, and in

contact with the incisors; upper molariform teeth broad, premolars with two cusps connected by transverse ridges, molars with four cusps and transverse ridges; lower molariform teeth compressed laterally and grading in size from first to last.

MEASUREMENTS: Adult female from Boquerón, Panamá (tanned skin): Total length, 1310 mm.; tail, 92; hind foot, 295. Skull: greatest length, 207; condylobasal length, 199; median length of palate, 130; least interorbital width, 46; zygomatic width, 87; alveoli of upper toothrow, 61. Antlers of an adult male, topotype, each with four points: length of beam, 315; circumference at base, 100. Males are considerably larger than females.

SPECIMENS: Prov. Guanacaste: Bebedero, 6 Vienna Mus.

Odocoileus virginianus truei (Merriam)

TRUE'S WHITE-TAILED DEER

Cariacus clavatus TRUE, 1889, Proc. U. S. Natl. Mus., vol. 11, p. 417.

Odocoileus truei MERRIAM, 1898, Proc. Biol. Soc. Washington, vol. 12, p. 103.

TYPE: U.S.N.M. No. 16075, young adult, male, skin and skull, collected at Segovia River, northern Nicaragua, July or August, 1887, by C. H. Townsend. The type was formerly mounted but has been taken down and made into a study specimen. In the original description no type was designated. The greater part of the description was based on No. 16075, and this is the specimen that True considered most typical and on which he placed the type label.

RANGE: Caribbean slopes of the cordilleras in Costa Rica and north to Guatemala.

GENERAL CHARACTERS: Similar and probably closely allied to *O. v. chiriquensis*.

DESCRIPTION: Color of type of *costaricensis*, now considered a synonym of *truei*, from Miller's description: Upperparts a uniform, fine, but distinct grizzle, mixture of drab, black, and buff, the hair drab from base for more than half its length, rest of hair black with a broad subterminal band of light buff; sides paler than back; forehead, nape, and anterior portion of back with black tips of hair predominating but without forming a defined black marking. Underparts mostly

Wood Brown, paler on neck and darker on belly. Region between hind legs and an ill-defined median area forward on chest dull white, the white appearing indistinctly on inner sides of both front and hind legs; ears grayish externally.

MEASUREMENTS: Type of *costaricensis*, a subadult male from Talamanca: Total length, 1400 mm.; tail vertebrae, 120; hind foot, 375; ear from crown, 110. Skull: type and largest male and female from Costa Rica: greatest length, 250, 264, 217; basal length, 237, 250, —; interorbital width, 57, 64, —; zygomatic width, 94.6, 108, —; upper toothrow, 68, 68, 66.

SPECIMENS: Prov. Limón: Talamanca, 4 U.S.N.M., 1 M.C.Z. Prov. Cartago: Cartago, 1 M.C.Z. Prov. San José: Carillo, 1 Vienna Mus.

In the absence of adequate comparative material the status of, and relationship between, *Odocoileus v. chiriquensis* and *O. v. truei* cannot be definitely determined, and it seems best to treat them as subspecies of *virginianus*; *chiriquensis* is applied by Kellogg and Goldman to the form occupying the more or less open savanna country on the Pacific side of the cordillera and *truei* is restricted to specimens occurring in forested areas on the Caribbean watershed. In southern Costa Rica *truei* probably intergrades with *chiriquensis*.

The white-tailed deer is a woodland browsing animal but not necessarily an inhabitant of the deep unbroken forest. Although dense woods and thickets are essential to its existence, it chooses to live where these alternate with open savanna country and sunny forest glades. It is a shy and secretive animal. At the first sign of danger it steals silently away carrying its head down and clinging to the cover of brush or timber. It is not gregarious in the true sense of the word, though during some seasons of the year several may congregate in a small band. The number of young varies according to the age of the doe. The first year she may have one, the following year two and occasionally three. The maximum seems to be four. White-tailed deer are good swimmers and do not hesitate to take advantage of water when chased by a pack of dogs. In Costa Rica its principal

natural enemies are the big cats, such as the cougar and jaguar; eagles take a limited percentage of the young fawns. Only the bucks have antlers, which are shed annually; the does are hornless.

MAZAMA RAFINESQUE
FOREST DEER OR BROCKET

The forest deer of the genus *Mazama* are small species with simple spiked antlers about half the length of the head. The body is relatively heavy for a deer this size, and the limbs are slender. The distribution of the genus includes nearly all of tropical and subtropical America, from the State of Vera Cruz in Mexico to Paraguay; the altitudinal range extends from sea level to 16,000 feet.

DENTITION: Incisors, $\frac{0-0}{3-3}$; canines, $\frac{0-0}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{3-3}{3-3}$ = 32.

***Mazama satorii cerasina* (Hollister)**
MIDDLE AMERICAN FOREST DEER

Mazama tema cerasina HOLLISTER, 1914, Proc. Biol. Soc. Washington, vol. 27, p. 209.

TYPE: U.S.N.M. No. 12206/42206, skin and skull, young male, collected at Talamanca, Costa Rica, 1874, by William M. Gabb.

RANGE: Costa Rica, Nicaragua, Honduras, and Guatemala.

GENERAL CHARACTERS: A small, bright reddish-colored deer with head and neck dull brownish black, contrasting with the bright color of the body; *M. s. cerasina* is a richly colored form, differing from the Mexican and Canal Zone forms in its darker and more reddish coloration.

DESCRIPTION: Color above, from nose to withers, including most of outer sides of ears, dark blackish brown; sides of muzzle, region around eyes, and hairs of crown tuft mixed with reddish. Entire upperparts and sides of body, fore limbs to knees, and outer sides of hind limbs to points of hock bright reddish chestnut, almost Hay's Russet of Ridgway, darkest on back and lighter and brighter on sides, hips, and limbs. Chin and throat warm buff, the chin crossed by a band of brownish; lower neck brownish; underparts of body like sides but lighter colored, without line of demarcation; inguinal region dark buffy, scantily haired. Lower fore and hind limbs

dark brown, the feet reddish. Tail above like rump, below whitish. Two skins of older animals from the type locality are virtually like the type. The young are bright red spotted with white. Skull more strongly built, smaller and broader than that of the white-tailed deer, with a shorter rostrum and larger orbits. The maxillae are strongly inflated and overhang the outer side of the molariform teeth, the palate broad and bullae small. The teeth in general, except for smaller size, are similar to those of the white-tailed deer.

MEASUREMENTS OF TYPE: From dry skin: Head and body, 910 mm.; hind foot, 235. Skull of type and older male from the type locality: greatest length, 176, 191; condylo-basal length, 167.5, 185; zygomatic width, 80.5, 82; length of nasals, 46.5, 55.6; anterior edge of orbit to tip of premaxillary bones, 82, 94; upper molar premolar series, milk premolars in place, 58; permanent premolars in place, 54; width second upper molar, 11.3, 11.6; length of mandible, 139, 152; lower toothrow, milk premolars in place, 62; permanent premolars in place, 59.5.

SPECIMENS: Prov. San José: Pozo Azul, Pirris, 1 A.M.N.H.; La Palma, 1 U.S.N.M. Prov. Limón: Talamanca, 5 skins, 4 skulls, U.S.N.M.

The brocket, unlike the white-tailed deer, prefers dense thickets in remote parts of the unbroken forest and owing to extreme shyness is seldom seen. It is a browsing animal and feeds on leaves and green shoots of trees and brush. Like many other animals it is most active during the early hours of the morning and late evening. Its enemies include the large cats, big snakes, and eagles. The average number of young for a mature doe is two; at birth they are spotted with white and are able to stand shortly after coming into the world.

ORDER PERISSODACTYLA

ODD-TOED UNGULATES

FAMILY TAPIRIDAE

TAPIRS

The tapirs are the only indigenous odd-toed ungulates existing in America. They are stockily built animals with short stout legs and a long prehensile mobile upper lip; ears of

moderate size; tail short; skin thick and scantily covered with hair. Fore feet with four toes having distinct hoofs, the third digit the longest; hind feet with the typical Perisodactyla arrangement of three toes. The existing species of tapir inhabit suitable localities in the warm parts of Mexico, Central and South America, the Malay Peninsula, and the neighboring islands.

TAPIRELLA PALMER

CENTRAL AMERICAN TAPIR

The generic distinction of *Tapirella* is found in the different arrangement of the bony parts of the skull supporting the proboscis, as compared with the other genera of the family. The nasals are flat, triangular bones without the stout descending processes which in the genus *Tapirus* meet and overlap the maxillae; the maxillae are developed upward in thin vertical plates which embrace an anterior ossified extension of the mesethmoid, absent in *Tapirus* and in the Asiatic member of the group. The genus *Tapirella* ranges in the tropical parts of Middle America to southern Mexico.

DENTITION: Incisors, $\frac{3-3}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{4-4}{3-3}$; molars, $\frac{3-3}{3-3}$ = 42.

Tapirella bairdii (Gill)

CENTRAL AMERICAN TAPIR

Elasmognathus bairdii GILL, 1865, Proc. Acad. Nat. Sci. Philadelphia, p. 183.

TYPE: U.S.N.M. No. 6019, adult, skull only, collected at Isthmus of Panamá by W. T. White, catalogued April 9, 1863. Gill designated no type specimen. His description was based on two skulls, adult and young, but the description clearly applies to the adult specimen.

RANGE: Panamá and Costa Rica, and north to Vera Cruz, Mexico.

GENERAL CHARACTERS: Same as for the genus.

DESCRIPTION: General color nearly uniform blackish brown, lighter on head and passing into brown on the cheeks; tips of ears and edges of lips brownish white, throat and chest more or less white or dusky white. The young are usually irregularly marked with white spots and stripes. Skull elevated and

compressed. Orbit and temporal fossa widely continuous, and there is no true postorbital process. Anterior narial apertures very large and extending high on the face between the orbits; nasal bones short, elevated, triangular and pointed in front but variable in development; in some the nasals are large, each ossified from a single center, thick at base and articulated with each other for the greater part of their length; in others the nasals are small, each ossified from two centers and separated by an anterior prolongation of the frontal (characters originally ascribed to *T. dowii*). Both upper and lower cheek teeth brachyodont; canines small and conical; diastema wide; first upper molariform teeth with a triangular crown, rest of upper molariform teeth with four roots and quadrate crowns, each with four cusps connected by transverse ridges. First lower premolar compressed, the rest of lower molariform teeth with simple pair of transverse crests, first and second upper incisors nearly subequal with short crowns; the third is large and conical, considerably larger than the canines; lower incisors diminishing in size from first to third; the lower canine large and conical and working against the canine-like third upper incisor.

MEASUREMENTS: Adult from Vera Cruz, Mexico: Total length, 2020 mm.; tail vertebrae, 70; hind foot, 375; ear, 140. Skull of adult female from Tuma, Nicaragua: greatest length, 420; condylobasal length, 395; zygomatic width, 195; palatal length, 201.

SPECIMENS: Prov. Limón: Talamanca, several skulls in U.S.N.M.; Pacuare, 1 B.M., 1 U.S.N.M. Prov. San José: Carillo, 1 Vienna Mus.

TAPIRUS BRISSON

SOUTH AMERICAN TAPIRS

Tapirs of this genus, *Tapirus*, are similar in external appearance to those of the genus *Tapirella* but differ markedly in cranial characters. The skull is more elevated behind the rostrum than in *Tapirella*. Nasals are flat, triangular bones with stout descending processes which meet and overlap the maxillae, separated in *Tapirella*. The ossification of the septum does not extend farther forward than the nasal bones, and the upper surface

of the anterior arms of the maxillae is rounded off on a line with the premaxillae, whereas in *Tapirella* the maxillae are developed upward in thin vertical plates which embrace an anterior ossified extension of the mesethmoid. The range of this genus is mainly restricted to the warmer parts of South America. Goldman records the skull of *Tapirus terrestris* in the United States National Museum, labeled as collected by William M. Gabb in Talamanca, Costa Rica, along with a number of *Tapirella bairdii* from the same locality. He states that "there seems to be nothing irregular about the record of the skull, but occurrence of the species so far north lacks confirmation."

***Tapirus terrestris* Linnaeus**

BRAZILIAN TAPIR

Tapirus terrestris LINNAEUS, 1758, *Systema naturae*, ed. 10, p. 74.

TYPE LOCALITY: Brazil.

RANGE: Warmer parts of South America from sea level to about 7000 feet; may possibly occur in Costa Rica.

GENERAL CHARACTERS: Similar in external characters to *Tapirella bairdii* but differing in cranial characters.

DESCRIPTION: General color of adult uniform dark brown, paler and browner on the head and a more or less whitish area on throat and chest; young usually marked with spots and longitudinal stripes of white or fawn color on a dark background.

MEASUREMENTS: Skull of an adult (?sex) from Navanjo, Colombia, South America: greatest length, 390 mm.; condylobasal length, 380; zygomatic width, 185.

SPECIMENS: Prov. Limón: Talamanca, 1 skull, U.S.N.M.

The habits of all tapirs appear to be similar. They are solitary, nocturnal, shy, and inoffensive. They chiefly frequent the depth of shady forest country in the neighborhood of water. They feed on various vegetable substances, such as buds and shoots of trees and bushes, leaves, and long grasses. When disturbed they usually seek refuge in water either along the banks of a river or in marshes or swampy places.

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GAZETTEER OF PRINCIPAL COLLECTING LOCALITIES IN COSTA RICA

- Agua Buena, Puntarenas.** An airport, about 3000 feet elevation, on the Sabana de Potrero Grande, locally known as Cañas Gordas and 1000 feet above Las Vueltas on the Río Diquis.
- Agua Caliente, Cartago.** A small village $1\frac{1}{2}$ miles south of Cartago on the Caribbean slope, about 3000 feet elevation.
- Agujas (Las), Puntarenas.** A small settlement on a sandy peninsula 30 miles south of the city of Puntarenas.
- Alajuela, Alajuela.** Capital of the province of the same name, on a branch of the Río Grande de Térrones, which flows into the Pacific, altitude about 3100 feet.
- Alemanía (Hacienda), Guanacaste.** A hacienda about 35 miles north of Liberia and 8 miles north of Volcán Orosi, altitude 50 feet.
- Alto Jabillo, San José.** A locality above the hamlet of Jabillo de Pirrís, situated between San Gerónimo and Pozo Azul on the main road to Pirrís, altitude about 3000 feet.
- Altos de Irazú, Cartago.** Upper slopes of Volcán Irazú.
- Altos Escazú, San José.** Same as Escazú.
- Ancho, Cartago.** See Pozo Ancho.
- Angostura, Cartago.** A small valley, opposite Turrialba on the south side of the Río Reventazón, altitude about 1980 feet.
- Aquiales, Cartago.** Canton of Turrialba, small town or caserio, altitude about 2250 feet.
- Bahía de Salinas, Guanacaste.** The first bay south of Nicaraguan border on the Pacific coast.
- Ballena, Guanacaste.** On the Peninsula de Nicoya about 15 miles north of Nicoya, at the edge of tidewater, altitude sea level to 25 feet.
- Bebedero, Guanacaste.** A village at the junction of the Río Tenorio and Río Bebedero, near the upper end of the Golfo de Nicoya (altitude sea level to 15 feet). This is a collecting locality of Enrique Arcé, Underwood, Cherrie, Alfaro, Lankester, and Carriker.
- Bijagua, Alajuela.** See Vijagua.
- Boruca, Puntarenas.** Near the Río Diquis, about 12 miles from the Pacific coast, altitude 1600 feet.
- Buena Vista, Puntarenas.** A mountain peak on the divide, bordering the Province of Cartago, altitude 10,842 feet, collecting locality of H. Pittier.
- Buenos Aires, Puntarenas.** Northeast of Boruca, 20 miles from the Pacific coast, capital of the district, altitude about 1000 feet.
- Cahuita, Limón.** A village on the Caribbean coast, 22 miles southeast of Limón.
- Candelaria, San José.** A range of hills about 10 miles south of San José, altitude 4000 to 4500 feet.
- Cañas Gordas, Puntarenas.** Local name for Agua Buena, not the Cañas Gordas on the Panamá border.
- Carrillo, San José.** Same as Carrillo.
- Carpintera (La), Cartago.** On the railroad about 2 miles west of Cartago, altitude about 5000 feet.
- Carrillo, San José.** A small village 10 miles west of Guápiles on the northern slope of Volcán Irazú, altitude about 1600 feet. Cooper, Zeledón, Underwood, and Carriker did considerable collecting here.
- Cartago, Cartago.** Capital of the department, on the railroad 12 miles southeast of San José, on the Caribbean slope, altitude 4500 to 4900 feet.
- Cataratos San Carlos, Alajuela.** Rapids on the San Carlos River, about 8 miles northwest of Villa Quesada.
- Catilina (Hacienda), Guanacaste.** A town situated between the Río Tempisque and Río Bebedero about 10 miles north of the Golfo de Nicoya (sea level).
- Cauita.** See Cahuita.
- Cerro de San Juan, Guanacaste.** Mountains 10 to 15 miles southwest of Santa Cruz, Peninsula of Nicoya.
- Cerro Santa María.** Probably refers to mountains around Santa María de Cota.
- Cervantes, Cartago.** A small town, about 3 miles north of Santiago and 5 miles west of Juan Viñas. Cooper, Zeledón, and Underwood collected here.
- Chomes, Puntarenas.** On the Golfo de Nicoya, about 10 miles northwest of Puntarenas, sea level.
- Cocos Island.** An island in the Pacific Ocean, longitude $87^{\circ} 00' W.$, latitude $05^{\circ} 30' N.$
- Concovas (Las), Cartago.** A marshy district about 3 miles southwest of Cartago.
- Copey (El, de Dota), Cartago.** About 15 miles south of Cartago on the Pacific slope and at the boundary between the tropical and temperate zones. Formerly forested with large trees, mainly oaks, altitude 6000 feet.
- Coto, Puntarenas.** On the Río Coto, 8 miles from Golfo Dulce, Pacific coast, altitude 25 feet.
- Cruz (La), Guanacaste.** In northern part of the province on the Pacific slope on the Pacific coast, about 4 miles inland, altitude sea level to 350 feet.

- Cuábre, Cuabra, or Cubre, Limón. A small town about 4 miles from the Caribbean coast, 30 miles south of Limón, sea level.
- Culebra, Guanacaste. A small town on the Pacific coast, directly west of Liberia.
- Desamparados, San José. A suburb, $1\frac{1}{2}$ miles south of San José.
- El Copey de Dota. See Copey.
- El General. See General.
- El Muñeco. See Muñeco.
- El Palmar. See Palmar.
- El Pélon. See Pelón.
- El Pozo. See Pozo.
- El Pozo de Terraba. See Pozo.
- El Sauce Perálta. See Sauce.
- El Tablazo. See Tablazo.
- Escazú or Escasú, San José. A small town about 7 miles southwest of San José, altitude 3713 feet.
- Escazú Altos, San José. Above the town of Escazú, altitude 4000 feet.
- Escazú Heights. Same as Escazú Altos.
- Esparta, Puntarenas. A town 12 miles east of Puntarenas, climate exceedingly hot, altitude 700 feet.
- Estrella (de Cartago), Cartago. About 4 miles south of Cartago in the Candelaria Mountains, altitude 6000 to 7000 feet.
- Estrella (La), Limón. A small village on the Estrella River, 6 miles inland from the Caribbean coast and 18 miles south of Limón.
- Faldas de Irazú, Cartago. Slopes of Volcán Irazú.
- Francisco Esparta. See San Francisco Esparta.
- Fuentes, San José. A small town about 6 miles east of San José, altitude about 3500 feet.
- General (El), Puntarenas. A town 12 miles inland from Punta Uvita on the Pacific coast, altitude 2000 feet.
- Grecia, Alajuela. A town 8 or 10 miles northwest of Alajuela on the lower slopes of Volcán Poás, altitude 3600 feet.
- Guabito, Limón. A town on the Caribbean coast railroad, 10 miles south of Punta Mona Carreta.
- Guápiles, Limón. A town on the northern branch of the railroad and 15 miles north of Volcán Irazú, altitude 100 feet.
- Guayábo, Cartago. A station on the railroad between Turrialba and Juan Vías, altitude 2500 feet. Ridgway, accompanied by Zeledón and Alfari, collected here in 1905, but their specimens came mostly from back in the hills at an elevation of about 4000 feet.
- Hacienda Catilina. See Catilina.
- Heredia, Heredia. City between San José and Alajuela, altitude 3840 feet.
- Higuerones (Los), San José. A caserio or community of small farms on San Rafael, above the town of Escazú. Humid tropical and typical of similar elevations of Volcán Irazú, altitude 4500 feet.
- Hondura (La), San José. A hacienda about 20 miles north of Cartago in a pass between the central mesa and the tropical forest north of Volcán Irazú, altitude 4000 feet.
- Huacas (Las), Guanacaste. Near the center of the Peninsula de Nicoya, about 15 miles southeast of Nicoya, altitude 100 feet.
- Imravalles, Guanacaste. Same as Miravalles (Hacienda).
- Irazú, Cartago. Same as Volcán Irazú.
- Isla Nuevo, Cartago. Slopes of Volcán Irazú, the exact position and elevation not located on the map.
- Jabillo de Pirrís, San José. A hamlet situated between San Gerónimo and Pozo Azul on the main road to Pirrís, Pacific coast region, altitude about 1500 feet.
- Jabillo de San Carlos. Misnamed Underwood locality. Vijagual is where collections were made.
- Jiménez, Limón. A small town on the old Atlantic railroad, 3 miles east of Guápiles, altitude between 600 and 1000 feet. Alfaro, Carranza, Underwood, Cherrie, Verrill, and Carriker collected here.
- Juan Vías, Cartago. A town 12 miles northeast of Cartago, 2 miles north of the railroad, altitude 3937 feet. Visited by Zeledón, Cooper, Underwood, Boucard, and Carriker.
- La Carpintera, Cartago. See Carpintera.
- La Cruz, Guanacaste. See Cruz.
- La Estrella, Limón. See Estrella.
- La Hondura, San José. See Hondura.
- La Palma, San José. See Palma.
- Lagarto, Puntarenas. A small town on the Río Diquis, 500 feet below Boruca, altitude 1500 to 2000 feet.
- Lagartos, Terraba, Puntarenas. Evidently the same as Lagarto.
- Lajas Villa Quesada, Alajuela. Deep valleys above the town of Villa Quesada. Underwood's collections made at elevations varying from 5000 to 7600 feet.
- Lari (River), Limón. Tributary of the Río Sixaola, northeast drainage from Pico Blanco. Collection made by Gabb came from 6000 feet elevation.
- Las Concovas, Cartago. See Concovas.
- Las Huacas, Guanacaste. See Huacas.
- Las Nubes, San José. See Nubes.
- Las Parras, San José. See Parras.
- Las Pavas, Cartago. See Pavas.
- Las Vueltas, Cartago. See Vueltas.
- Liberia, Guanacaste. Capital of Guanacaste, about 35 miles northeast of the Golfo de Nicoya, altitude 300 feet.

- Limón, Limón. Main seaport on the Caribbean coast.
- Los Higuerones, San José. See Higuerones.
- Miravalles (Hacienda), Guanacaste. Fifteen miles east of Liberia. Collections were made here by Underwood in 1895, at elevations from 1400 to 2000 feet.
- Mojón, San José. See San Pedro.
- Monte Redondo, San José. A point in the Candelaria Mountains, over the crest south of San José. Altitude 4000 feet. Many of Underwood's labels bearing the locality name of Candelaria refer to this point.
- Montes de Oca. Same as vicinity of San Pedro.
- Moravia, Cartago. A name seldom used. Probably refers to a point on the headwaters of the Río Moravia. Between Pacuare and Chirripo rivers on the Caribbean watershed, altitude 2000 to 3000 feet.
- Muñeco (El), Cartago. About 5 miles southeast of Cartago on the Río Navarro, 3 miles upstream from the village of Navarro, altitude 4200 feet. Austin Smith's collecting station.
- Navarro, Cartago. A small village about 5 miles south of Cartago.
- Nubes (Las), Canton de Tilaran, probably Province of San José. A village near San Isidro, altitude 5000 to 6000 feet.
- Oja Ancha, Guanacaste. In the south central part of the Nicoya Peninsula, latitude 10° 00' N., altitude 500 to 800 feet.
- Orosi, Cartago. A small town 7 miles southeast of Cartago on the Río Grande, tributary of the Reventazón.
- Orotina, San José. On the Pacific railroad, 14 miles from coast. Collections were made on the Río Grande between Orotina and Turrubares, altitude 600 feet.
- Pacuare, Limón. A large river rising in the Chirripo Mountains and flowing northeast. It is uncertain to just what point on its course the name as used by collectors refers, but it must be some place as far down as the railroad as all species labeled Pacuare are lowland fauna. Carmical and Zeledón used the name often.
- Pacuarito, Limón. A station on the railroad, about 30 miles from Limón, between Matine and Siquirres, altitude 2000 feet. Only Cherrie collected here.
- Palma (La), San José. Five miles northeast of San Isidro.
- Palmar, (El), Puntarenas. Hamlet on the Río Diquis, 9 miles from the Pacific coast, altitude 250 feet (Underwood gives the elevation on specimens from Palmar as 2500 feet).
- Palmira (de Zarcéro), Alajuela. A hamlet about 3 miles north of Zarcéro, 5000 feet.
- Parras (Las). Probably Pavas, San José. Four miles west of San José, altitude 2600 feet.
- Pavas, Cartago. A village on the Atlantic railroad 3 miles south of Turrialba.
- Pelón (El), Guanacaste. Austin Smith's collecting station was on a line between Hacienda Santa María and Volcán Orosi, not to be confused with a town of the same name several miles to the west.
- Perálta, Cartago. A small town and station on the Atlantic railroad, 23 miles west of Cartago, altitude 1150 feet. Austin Smith's collections were made in nearby hills at 2000 to 3000 feet altitude.
- Piedras Negras, San José. Small town in the District de Mora, altitude 2056 feet. Judging by the material and association with other localities, this station should be about 5 miles south of Villa Colón.
- Pirris, Puntarenas. Pacific coast lowlands, southwest of San José.
- Point Burica, Puntarenas. Extreme southeastern Costa Rica.
- Port Parker, Guanacaste. Bay Santa Elena, Pacific coast, district of Liberia.
- Poso del Tempisque, Guanacaste. A station on the Río Tempisque about 8 miles from its mouth, altitude 100 feet.
- Pozo Ancho, Cartago. A small town between Cartago and Pacayas, altitude about 4800 feet.
- Pozo Azul, San José. Nine miles upstream from the mouth of the Río Pirris.
- Pozo Pital, San José. A point on the Río Naranjo between the Río Diquis and the Río Pirris. Only Cherrie collected here.
- Pozo (El), Puntarenas. A small town on the Río Diquis, 6 miles from the coast, near sea level.
- Pozo (El, de Terraba). Same as Pozo.
- Pucado (de Terraba), Puntarenas. A small town near Terraba.
- Puerto Cortez, Puntarenas. A small town adjoining Palmar. Underwood gives the elevation as 4000 feet.
- Puerto Uvita. See Uvita.
- Punta Jiménez, Puntarenas. Near the southern coast of the Peninsula de Osa on the Golfo Dulce, opposite the mouth of the Río Coto.
- Puntarenas, Puntarenas. A large seaport on the Golfo de Nicoya (sea level).
- Puriscal (Santiago), San José. A town 5½ miles south of Villa Colón, altitude 3737 feet.
- Quebrada Azul, Alajuela. A village about 8 miles northwest of Villa Quesada, altitude 800 feet.
- Quesada (Villa), Alajuela. About 20 miles northwest of Alajuela, on the northern slopes of Volcán Poás, altitude 2200 feet.
- Rancho de Río Jiménez, Cartago. On the Río

- Jiménez, northern slope of Volcán Turrialba, altitude 3600 feet.
- Rancho Redondo, San José. A point between Volcán Irazú and Volcán Barba, altitude about 1400 feet.
- Río Coto, Puntarenas. Empties into the Golfo Dulce.
- Río Diquis. The large river draining the Terraba Valley and emptying into the Pacific.
- Río Frio. A large river rising on the northern slope of Volcán Tenorio and Miravalles and emptying into Lake Nacaragua.
- Río Grande de Pirris. A large river rising partly in the Candelaria Mountains and emptying in the Pacific Ocean, 25 miles southeast of the Golfo de Nicoya.
- Río Grande de Terraba (Río Diquis). An old name for the Río Diquis.
- Río Lari, Limón. See Lari.
- Río Pacuare, Limón. Empties into the Caribbean Sea, 20 miles north of Limón.
- Río Reventazón. One of the largest rivers in Costa Rica, up the valley of which the railroad runs from La Junta to Cartago.
- Río Sixaola (Tarire o'Sicsaola), Limón. Empties into the Caribbean Sea, about 40 miles south of Limón.
- Sabanilla de San Pedro. Same as San Pedro, San José.
- Sabanilla de Montes Oca. Same as San Pedro, San José.
- Sabanilla, San José. A town 18 miles inland from the Pacific coast, overlooking the Río Pirris, altitude 3730 feet.
- San Carlos, Alajuela. A small settlement on the Río San Carlos, about 15 miles north of Villa Quesada, altitude 120 feet. In the past this name was sometimes used for the large tract of lowland, watered by the San Carlos River, 100 to 500 feet.
- San Carlos Guard Station, Alajuela. On the San Carlos River, altitude 533 feet.
- San Francisco Esparta, Puntarenas. A town adjoining Esparta, altitude about 1000 feet.
- San Gerónimo, San José. Eleven miles upstream from the mouth of the Río Pirris.
- San Ignacio, San José. A town 10 miles south of San José, on the Cerro Candelaria, altitude 4000 to 4500 feet.
- San Indro, San José. Same as San Isidro, San José.
- San Isidro, Cartago. On the Caribbean slope about 2 miles south of Cartago, altitude 5500 feet. Austin Smith collected here.
- San Isidro (Heredia), San José. A large town 7 miles north of San José, altitude about 3500 feet.
- San Isidro, San José. A town 8 or 10 miles northeast of San José, altitude 4733 feet.
- San Joaquín (de Dota), San José. On the Pacific slope of the Cordillera de Talamanca, about 5 miles south of Santa María de Dota, altitude 4000 feet.
- San José, San José. Capital of Costa Rica, altitude, lower part of the city, 3100 feet.
- San Juan, Guanacaste. See Cerros de San Juan.
- San Juanillo, Guanacaste. A village on the Pacific coast of the Nicoya Peninsula, about latitude 10° N., sea level.
- San Mateo, Alajuela. A town 4 miles north of Orotina and 10 miles from the Gulf of Nicoya, altitude 937 feet.
- San Pedro (Montes de Oca or del Mojón), San José. A town 2 miles east of San José, altitude 4040 feet.
- San Pedro (de Poás), Alajuela. About halfway between city of Alajuela and Volcán Poás, altitude 6000 feet.
- San Ramón (Tres Ríos), Cartago. A small town adjoining Tres Ríos, halfway between San José and Cartago.
- San Sebastian. Not definitely located. Probably in the Province of San José, near San Isidro.
- Santa Clara, Alajuela. Six miles northwest of Zarcero (Frantz station).
- Santa Clara, Heredia. A hamlet about 8 miles west of Guápiles and at a slightly higher elevation.
- Santa Clara, Limón. One mile east of Guápiles. This or the one above was Alfaro's collecting station.
- Santa María (de Cota), San José. A village on the Río Parrita about 12 miles south of Cartago.
- Santa María (Hacienda), Guanacaste. A large hacienda, the eastern part of which is within the cloud forest, 15 miles northeast of Liberia, altitude 3200 feet.
- Santa Teresa, Cartago. A small town above Perálta, altitude 3100 feet.
- Santiago, Cartago. A town on the Atlantic railroad about 5 miles northeast of Cartago, altitude 3500 feet.
- Santiago, San José. Same as Puriscal.
- Sauce (El) Perálta, Cartago. A farm on the Atlantic railroad, near Perálta, altitude 1000 feet.
- Sicola or Sixola, Limón. A village at the mouth of the Río Sixaola.
- Sipúrio, Limón. A small town in a lowland pocket, 3 miles south of Suretka.
- Siquirres, Limón. A town on the Caribbean railroad, 17 miles from the coast and just below the junction of the old branch to Guápiles and the main line to San José, altitude near sea level.
- Suerre, Limón. A "finca" near Jiménez, altitude about 1500 feet. Alfario's collecting station. Suerre was also the old name for Llanos de Tortuguero, at the mouth of the Reventazón

- and principal port of entry for the early colonists.
- Suiza (Turrialba), Cartago. A small village on the railroad, adjoining Turrialba, 14 miles east of Cartago, altitude 3000 feet.
- Suretka, Limón. A town at the northern terminus of the Caribbean coast railroad in a lowland pocket 12 miles from the coast and 30 miles south of Limón.
- Tabarcia, San José. A town 5 miles southeast of Puriscal.
- Tabasco. Same as Tapesco.
- Tablazo (El), Cartago. A small tableland in the Candelaria Mountains, about 10 miles southwest of Cartago.
- Talamanca, Limón. A large track of land extending from Limón to the Panamá border, including the coastal hills and lowlands.
- Tambor, Puntarenas. A small settlement on the Bahía de Ballena on the southeastern extremity of the Nicoya Peninsula, sea level.
- Tapesco, Alajuela. "Cacerio" on main road to San Carlos about 3 miles north of Zarcero, altitude 5000 feet.
- Tarbaca, San José. A small town 12 miles south of San José.
- Tarbarcia de Mora. Same as Tabarcia.
- Tempate, Guanacaste. A village on the Nicoya Peninsula, about 15 miles northwest of San Cruz, 4 miles from the Pacific Ocean, altitude 100 to 150 feet. Specimens sent to Gray by Salvin in 1862 were collected here by Enrique Arcé.
- Tenorio, Guanacaste. Twenty-five miles east of Liberia, altitude about 2000 feet.
- Terraba, Puntarenas. An Indian village on the Río Diquis, 18 miles from the Pacific coast, altitude about 150 feet.
- Tibas, San José. A canton near San Juan, about halfway between San José and Heredia.
- Tres Rios, Cartago. A town on the railroad 5 miles east of San José, altitude 4000 feet.
- Ŧuis, Cartago. A town 7 miles southeast of Turrialba, in the valley of the Reventazón, altitude 2250 feet.
- Turrialba, Cartago. A town on the railroad between Port Limón to San José, situated on the northern side of the Reventazón River, altitude about 2000 feet.
- 27 de Abril, Guanacaste. A village near the Pacific coast and 5 miles northwest of Santa Cruz, altitude 200 feet.
- Uruca, San José. A small town about 3 miles northwest of San José.
- Uvita (Puerto), Puntarenas. A village on the Pacific coast about 10 miles north of the mouth of the Río Diquis, altitude sea level.
- Vieja (La, de San Carlos), Alajuela. A settlement on the Río La Vieja, tributary of the San Carlos, about 5 miles northwest of Villa Quesada, altitude 350 to 1200 feet.
- Vijagua (Bijagua), Alajuela. Northern slopes of Volcán Miravalles on the headwaters of the Río Zapote, altitude 1200 to 1500 feet. (Underwood, 1908.)
- Vijagual, Alajuela. Same as Vieja.
- Villa Colón, San José. A town on the Río Grande, 12 miles west of San José, altitude 2833 feet.
- Villa Quesada, Alajuela. About 20 miles northwest of Alajuela, altitude 2200 feet.
- Viragua, Alajuela. Same as Vieja.
- Volcán Irazú, Cartago. Ten miles north of Paraiso, altitude 11,560 feet. Specimens collected by Carriker labeled Irazú came from between 8000 and 10,000 feet.
- Volcán Miravalles, Guanacaste. Twenty miles east of Liberia, altitude 5740 feet.
- Volcán Orosi, Guanacaste. Twenty-five miles north of Liberia, altitude 5237 feet.
- Volcán Poás, Alajuela. Ten miles north of Alajuela, altitude 8927 feet.
- Volcán Turrialba, Cartago. See Turrialba.
- Vueltas (Las), Cartago. A collecting station of Austin Smith, on the Cerro Vueltas in the oak forest near timber line, about 20 miles south of Cartago, altitude 11,000 to 11,300 feet.
- Vueltas (Las), Puntarenas. A village on the southern branch of the Río Diquis, 20 miles from the Pacific coast, altitude about 2000 feet.
- Yarkin, Limón. Ten miles southwest of Suretka, altitude about 500 feet.
- Zarcero, Alajuela. A town on the western slope of Volcán Poás, 6 miles south of Villa Quesada, altitude 5300 feet.
- Zapote, Alajuela. A village on the main road to San Carlos, between Zarcero and Villa Quesada, altitude 5600 feet.
- Zent, Limón. A junction of the main railroad from Limón to San José, 8 miles from the Caribbean coast, altitude near sea level.

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