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MAMMALS COLLECTED BY DR. W. L. ABBOTT ON THE NATUNA ISLANDS.

BY GERRIT S. MILLER, JR.

About three months during the spring and summer of 1900 were spent by Dr. W. L. Abbott in exploring the Natuna Islands in the South China Sea.^[1] Specimens were collected at the following localities: Pulo Midei, or Low Island (May 23-26), Pulo Seraia (May 29), Sirhassen Island (June 1-10), Pulo Subi (June 12-13), Pulo Lungung (June 17-19), Bunguran, or Great Natuna Island (June 24-July 31) and Pulo Laut, or North Natuna Island (August 5-13). About 265 mammals were obtained, all of which have been presented to the United States National Museum. This paper contains an account of these, and is published here by permission of the Secretary of the Smithsonian Institution.

Two extensive collections of mammals had been made on the Natuna Islands previous to Dr. Abbott's visit, the first by Mr. A. Everett during September and October, 1893, the second by Mr. Ernest Hose during July, August, September and October, 1894. These have formed, either wholly or in part, the basis of several papers,^[2] which constitute the literature relating to the mammals of the islands.^[3] Twenty-eight land mammals have been recorded as actually represented by specimens, though several others are mentioned which the collectors ascertained to occur. Dr. Abbott secured forty-four species, but failed to obtain seven^[4] of those previously taken. The total number of mammals collected on the islands thus becomes fifty-one. This increase is due, in part to the recognition of a larger number of insular forms than has been admitted by previous writers, but also to a considerable extent to the actual addition of species not hitherto taken. Species new in the latter sense are distinguished in the present paper by absence of reference to previous records.

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In regard to the faunal relationships of the Natunas, whether predominantly Bornean or Peninsular, about which much has been written,^[5] it may be said that this collection, together with much of the other work recently done by Dr. Abbott, tends to show that there is greater general uniformity in the mammalian fauna of Borneo, the Malay Peninsula, and the intervening islands than has been hitherto supposed. It seems unprofitable therefore to offer conjectures as to the probability of greater nearness of the Natuna mammals as a whole to those of Borneo or to those of the Malay Peninsula.

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MANIS JAVANICA Desmarest.

1895. *Manis javanica* THOMAS and HARTERT, Novitates Zoologicae, II, p. 492. December, 1895 (Bunguran).

An adult male was taken on Bunguran, June 24, 1900. Total length 914; head and body 508; tail 406.

TRAGULUS BUNGURANENSIS sp. nov.

Type.—Adult male (skin and skull) No. 104604 U. S. National Museum. Collected on Bunguran Island, North Natunas, July 9, 1900. Original number, 547.

Characters.—Color pattern essentially as in *Tragulus nigricans* Thomas, from Balabac. Size equal to that of *T. canescens* from the Malay Peninsula, therefore much greater than in the Balabac animal.

Color.—Back uniform ochraceous, fading to buff on sides, the hairs everywhere gray at base. Both back and sides everywhere darkened by black hair tips, but these never sufficiently abundant to produce a dark shading in excess of the ochraceous. The relative proportion of the dark wash to the light under color is precisely the same as in *Tragulus canescens* and *T. napu* (from Linga Island) but the black is less conspicuous than in the Bornean form of *T. napu*. Legs, except white area on inner side, like back but slightly brighter and less shaded with black. Entire dorsal and lateral surface of neck clear black to base of hairs, a few ochraceous specks visible on close scrutiny, particularly at sides near throat markings. On shoulders this black area fades abruptly into color of back; on head it passes forward between ears and eyes nearly to muzzle. Cheek, region between eye and ear, and line extending forward over eye to muzzle and separating black median stripe from naked loreal space, ochraceous, essentially like that of legs. Throat markings as in *Tragulus nigricans*, but white stripes apparently even more restricted. Region occupied by posterior white stripes black, continuous with that of neck, but distinctly speckled with ochraceous. Region occupied by anterior stripes ochraceous, continuous with that of cheeks and somewhat less pure and more speckled with black. White stripes as follows: (a) One on each side of naked chin area. These are about 50 mm. in length and never more than 10 mm. in breadth, but occasionally so narrow as to break up into two or more spots. They are separated from naked chin patch by an ochraceous stripe slightly broader than the white. Chin area narrowly and discontinuously bordered with white, especially in front. (b) Two posterior lateral stripes varying from 50 mm. to 80 mm. in length, and never more than 12 mm. wide. They are strongly convergent anteriorly, and sometimes nearly joined together in front by a median spot. These white stripes are always separated from the anterior stripes by an ochraceous median area varying from 10 mm. to 25 mm. in width. (c) A median stripe lying between the posterior lateral stripes. Posteriorly this stripe is as wide as the lateral stripes, but it quickly narrows and sometimes disappears at middle of latter, though usually represented again by the median spot already referred to. In none of the specimens is this stripe broad and continuous anteriorly to level of front of lateral stripes as in Nehring's figure of the throat markings of *T. nigricans*.^[6] Collar narrow, ochraceous grizzled with black. It is seldom more than 25 mm. in width; therefore much narrower than indicated by Nehring's figure. Behind the collar is a whitish gray median area continuous laterally with narrow light stripe down inner side of fore legs. This light area is sometimes divided by a dark median line joining collar with buff of belly. Belly and chest buff, essentially like that of sides, with which it forms no contrast in color. As on the sides the buff is clouded by black hair tips, but the hairs are scarcely if at all gray at base. On chest the dark hair tips tend to form a median stripe, which is sometimes sharply defined and continuous with the ochraceous line occasionally dividing white of breast. A clear whitish area slightly larger and better defined than that of breast occupies region between hind legs. It is continuous with white stripe down inner side of hind legs. This stripe is usually divided on thigh by encroachment of the surrounding ochraceous. Tail silky white below and at tip, essentially like back above.

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Skull.—The skull of *Tragulus bunguranensis* fully equals that of *T. canescens* in size, and distinctly exceeds that of the Bornean form of *T. napu*. It is much larger than that of *T. nigricans*, which proves to be a medium sized species like *T. rufulus*. In general form the skull agrees so closely with that of *Tragulus canescens* that it is only to be distinguished by its slightly greater relative breadth and smaller, less inflated audital bullæ. As compared with the skull of *Tragulus nigricans*,^[7] that of *T. bunguranensis* is much larger (distance from back of occiput to front of canine 103 instead of 92, zygomatic breadth 53 instead of 45), and the braincase is more conspicuously ridged for muscular attachment. That part of the braincase immediately above posterior root of zygoma is more conspicuously inflated. Otherwise I can detect no salient differences in the skulls of the two animals.

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Teeth.—The teeth are uniformly larger than those of *Tragulus nigricans*, but in form they present no characters of importance. As compared with *T. canescens* the premolars both above and below are conspicuously more robust, a character in which the Bunguran animal agrees with the Bornean form of *Tragulus napu*.

Measurements.—External measurements of type: total length 647; head and body 571; tail vertebræ 76; hind foot 146; hind foot without hoofs 128. Average and extremes of five adults from the type locality: total length 643 (628-673); head and body 566 (558-584); tail vertebræ 77 (70-89); hind foot 142 (140-146); hind foot without hoofs 126 (124-128).

Cranial measurements of type: greatest length 114; basal length 107; basilar length 100; occipito-nasal length 106; length of nasals 32; diastema 13 (9);^[8] zygomatic breadth 52 (46); least interorbital breadth 33 (28); greatest breadth of braincase above base of zygomata 38 (33); mandible 91 (78); maxillary tooththrow (alveoli) 38 (34); mandibular tooththrow (alveoli) 44 (39); anterior upper premolar 7 × 3.8 (6.4 × 3); middle lower premolar 7.2 × 3 (5.8 × 2.4).

Weight.—Weight of type 3.8 kg.; of two other males 3.6 kg. each. Two adult females weigh respectively 3.6 kg. and 4.2 kg.

Specimens examined.—Six, all from the type locality.

Remarks.—*Tragulus bunguranensis* is so distinct from the other known species as to require no detailed comparisons.

TRAGULUS sp.

Two specimens from Sirhassen Island are too immature for determination. Apparently they represent a member of the *napu* group, allied to that occurring in Borneo. The throat markings show no approach to those of *Tragulus bunguranensis*.

TRAGULUS JAVANICUS (Gmelin).

1894. *Tragulus javanicus* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 660. September, 1864 (Bunguran).

1895. *Tragulus javanicus* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 492. December, 1895 (part, specimens from Bunguran).

Six specimens from Bunguran.

TRAGULUS PALLIDUS sp. nov.

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1895. *Tragulus javanicus* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 492. December, 1895 (part, specimen from Pulo Laut).

Type.—Adult female (skin and skull) No. 104616 U. S. National Museum. Collected on Pulo Laut, North Natuna Islands, August 11, 1900. Original number 625.

Characters.—Smaller than *Tragulus javanicus* from Borneo or Bunguran and very pale in color. Black clouding of upper parts inconspicuous, but dark nape band well defined.

Color.—Back and sides light ochraceous-buff everywhere clouded by the blackish hair-tips, but these never in excess, except perhaps along middle of back and across lumbar region. Flanks, shoulders, neck, outer surface of legs and narrow line dividing color of sides from that of belly pale ochraceous. Nape band clear black, sharply defined from color of sides but quickly fading into that of shoulders. Top of head dull dark brown. A faint pale stripe over and in front of eye. Throat markings normal, the dark bands like neck. Collar very narrow. Under parts and inner surface of legs white. A faint yellowish shade along middle of belly. Tail white beneath and at the tip, ochraceous faintly shaded with brown above.

Skull.—The skull of the type, though fully adult and with all the teeth distinctly worn, is smaller than in Bunguran specimens so young that the posterior molars are still below the rim of the alveoli. In form, however, it shows no marked peculiarities, though in general it appears to be somewhat broader in proportion to its length than that of the Bunguran animal.

Teeth.—Teeth as in specimens of *Tragulus javanicus* from Bunguran except that the premolars, both above and below, are shorter and broader, a difference which may prove to be an individual peculiarity only.

Measurements.—External measurements of type: Total length 539; head and body 444; tail vertebræ 95; hind foot 107; hind foot without hoofs 95.

Cranial measurements of type: Greatest length 90 (94^[9]); basal length 83 (87); basilar length 78 (82); occipito-nasal length 83 (89); length of nasals 25 (29.6); diastema 9.2 (9.8); zygomatic breadth 41.4 (40); least interorbital breadth 26.4 (25); breadth of braincase over roots of zygomata 29.4 (28.4); mandible 72 (75); maxillary tooththrow (alveoli) 31.6 (34); first upper premolar 6.4 × 2.8 (7 × 2.6); mandibular tooththrow (alveoli) 35.8 (38).

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Specimens examined.—One, the type.

Remarks.—This is a pallid form of *Tragulus javanicus*, a species which apparently shows very little tendency to become differentiated into local races. The characters of the Pulo Laut animal were pointed out by Thomas and Hartert in 1895.

SUS NATUNENSIS sp. nov.

1894. *Sus* sp. THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 660. September, 1894 (Bunguran).

Type.—Adult female (skin and skull) No. 104856 U. S. National Museum. Collected on Pulo Laut, North Natuna Islands, August 6, 1900. Original number 609.

Characters.—Externally much like the Tenasserim form of *Sus cristatus*, but smaller; body brownish in marked contrast with black legs and face; skull conspicuously shorter and broader.

Fur.—The fur throughout consists of bristles with no admixture of softer hairs. The bristles are everywhere less stiff than in the Tenasserim pig, but the difference is most noticeable in the mane, which, though well developed (about 80 mm. in length), is composed of bristles very slightly coarser than those of the surrounding parts, and of not more than half the diameter of the corresponding hairs in females of *S. cristatus*. Muzzle, chest, belly and ears nearly bare.

Color.—General color black, clear and unmixed with brown on legs, throat, and face, but elsewhere heavily overlaid with brownish buff, particularly on back and sides. The brownish wash ceases abruptly just in front of ears, leaving the face and cheeks clear black. A conspicuous dull buff streak 100 mm. long and about half as wide at middle extends back from angle of mouth to level of posterior canthus of eye. It is sharply outlined above by black of cheeks, and below by that of chin. A faint buffy mark beneath eye. Tail like back.

Skull.—The skull while much shorter than that of *Sus cristatus* from Tenasserim is actually broader. As a result the width across postorbital processes is contained only about three times in occipito-nasal length, as opposed to nearly four times in the related species. Similarly the zygomatic breadth slightly exceeds one half of the basilar length, while in *Sus cristatus* it is less than half. Width of palate between middle molars almost exactly one sixth distance from posterior edge of palate to front of premaxillaries (measured along median line). In *Sus cristatus* the palatal width is contained nearly seven times in the same distance. Dorsal profile of skull slightly concave near base of nasals. Zygomata heavier and deeper than in *Sus cristatus*. Audital bullæ noticeably smaller and less inflated than in the Tenasserim pig. Mandible shorter and much more robust than that of *Sus cristatus*, the outward bulge of the ramus a little behind middle of toothrow greatly accentuated. [118]

Teeth.—As the teeth of the two specimens of *Sus natunensis* are much worn, while those of the only skulls of *Sus cristatus* at hand are not fully grown, it is impossible to make any accurate comparisons. The smaller size of the Natuna pig's teeth is, however, evident for the length of the entire upper toothrow does not equal that of *S. cristatus* without the posterior molar. The crown of the middle upper molar appears to be more nearly square in outline than that of the Tenasserim pig, but in the very different condition of the specimens it would be unsafe to assume that this character is constant.

Measurements.—External measurements of type; total length 1294; head and body 1117; tail vertebræ 177; height at shoulder 558; hind foot 220 (170); ear from meatus 100; width of ear 75.

Cranial measurement of type: greatest length 295 (332^[10]); occipito-nasal length 282 (316); basal length 245 (275); basilar length 235 (263); length of nasals 135 (157); width of both nasals together posteriorly 34 (33); median length of bony palate 168 (183); width of bony palate at middle of second molar 30 (29); breadth between tips of postorbital processes 87 (87); least interorbital breadth 64 (65); zygomatic breadth 130 (133); occipital breadth 58 (62); occipital depth 100 (103); least depth of rostrum between canine and incisor 33 (39); mandible 225 (232); depth of mandible through coronoid process 104 (110); depth of ramus at front of first molar 40 (41); maxillary toothrow to front of canine (alveoli) 113 (131^[11]); mandibular toothrow to front of canine (alveoli) 120 (138); crown of first upper molar 12 × 13 (18 × 16); crown of second upper molar 18 × 18 (22 × 16).

Weight.—Weight of type, 40 kg.; weight of adult female from Pulo Lingung, 35 kg.

Specimens examined.—Two, one from Pulo Laut, the other from Pulo Lingung.

Remarks.—While the two specimens agree in all essential characters they differ in numerous minor details. The skin from Pulo Lingung is somewhat darker than the type, but the difference is due to the shade of the brown wash, not to any extension of the black. The skull of this specimen is more rounded posteriorly than that of the type, and the rostrum is shorter. Both specimens show conclusively that their relationships are with the *Sus cristatus* of the Malay Peninsula and not with the *S. longirostris* of Borneo, a case which finds an exact parallel in the giant squirrels. [119]

MUS INTEGER sp. nov.

Type.—Adult male (skin and skull) No. 104837 U. S. National Museum. Collected on Sirhassen Island, South Natunas, June 7, 1900. Original number 455.

Characters.—A large robust species with coarse but not spinous fur. Relationships with *Mus validus* Miller, from Trong, Lower Siam, and *Mus mülleri* Jentink from Sumatra. Differs from the former in smaller size and in the absence of the anterior outer tubercle of the last upper molar, and from the latter in larger size, and yellowish brown (not white) underparts.

Color.—Back and sides a fine grizzle of black and dull ochraceous (the exact shade intermediate between the ochraceous and ochraceous-buff of Ridgway), the two colors nearly equally mixed on back, but the ochraceous in excess on sides. Underparts and inner surface of legs buff. An ill defined drab-gray median line from throat to pubic region. Head darker and more glossy than

back, the cheeks distinctly washed with gray. Lips and chin drab-gray. Feet an indefinite brown, darker on metapodials. Ears essentially naked, dark brown. Tail dark brown throughout. Underfur gray (Ridgway, pl. II, No. 8), becoming paler on under parts where it fades irregularly into the general buff.

Fur.—The fur is exactly as in *Mus validus*, that is the grooved bristles are so slender that their true nature is not apparent without use of lens. On middle of back the mass of the fur is about 17 mm. in length, the long terete hairs scattered through it reaching about 30 mm. On rump the fur is longer but not conspicuously so, and there is no noticeable increase in length or abundance of the terete black hairs.

Tail, feet and mammae.—Tail slightly more coarsely scaled than in *Mus validus*; 9 rings to the centimeter at middle. Hairs scarcely noticeable except toward tip, where they somewhat exceed the breadth of the rings.

Feet heavy and robust. Thumb short, with a flat blunt nail. Soles and palms naked, the former with six well developed tubercles, the latter with five. [120]

Mammæ, p. 2—2, i. 2—2 = 8.

Skull.—In general appearance the skull of *Mus integer* resembles that of *Mus validus*.^[12] It is shorter (greatest length about 51 instead of 55) and the rostrum is relatively broader and deeper. Audital bullæ similar in form to those of *Mus validus*, but the surface less irregular. Region between anterior bases of zygomata broader than in *Mus validus* so that the arches are more nearly parallel.

Teeth.—The teeth are relatively as well as actually smaller than in *Mus validus* and the enamel pattern is normal, that is, the posterior upper molar consists of two transverse folds, and an anterior internal tubercle. There is no trace of the supplementary outer tubercles of the corresponding tooth of *Mus validus*.

Measurements.—External measurements of type: total length 463; head and body 235^[13] tail vertebræ 228;^[13] hind foot 48 (45); ear from meatus 19; ear from crown 15; width of ear 15. In adult male topotype: total length 462; head and body 234;^[13] tail vertebræ 228;^[13] hind foot 46 (44); ear from meatus 21; ear from crown 16; width of ear 16.

Cranial measurements of type: greatest length 52 (55);^[14] basal length 45 (48.6); basilar length 41.6 (45.6); palatal length 23 (26); least width of palate between anterior molars 5 (5); diastema 14 (14.6);^[15] length of incisive foramen 8 (9); combined breadth of incisive foramina 3 (3.6); length of nasals 21 (22.6); combined breadth of nasals 6 (6.2); zygomatic breadth 25 (28); interorbital breadth 8 (8); mastoid breadth 19 (19); breadth of braincase above roots of zygomata 18.8 (20); depth of braincase at anterior border of basi-occipital 12.8 (15); frontopalatal depth at posterior extremity of nasals 12.8 (13.4); least depth of rostrum immediately behind incisors 10 (10); maxillary toothrow (alveoli) 9.6 (11); width of front upper molar 3 (3); mandible 30 (31); mandibular toothrow (alveoli) 9 (10).

Specimens examined.—Four, three from the type locality, and one from Pulo Lingung.

Remarks.—This rat is probably a near relative of the Bornean *Mus mülleri* of Thomas.^[16] The specimen from Pulo Lingung does not differ appreciably from the others.

MUS SABANUS Thomas.

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1887. *Mus sabanus* THOMAS, Ann. and Mag. Nat. Hist., 5th ser., XX, p. 270. October, 1887 (Mt. Kina Balu, Borneo).

1894. *Mus sabanus* THOMAS and HARTERT, Novitates Zoologicæ, I, p. 658. September, 1894 (Bunguran).

Thirteen skins and one extra skull, all from Bunguran. There is little probability that this rat is the same as the true *Mus sabanus* of Borneo.

MUS RAJAH Thomas.

1894. *Mus hellwaldi* THOMAS and HARTERT, Novitates Zoologicæ, I, p. 658. September, 1894 (Bunguran).

1894. *Mus rajah* THOMAS, Ann. and Mag. Nat. Hist., 6th ser., XIV, p. 451. December, 1894 (Mount Batu Song, Borneo).

1895. *Mus rajah* THOMAS, Novitates Zoologicæ, II, p. 26. February, 1895 (Revised determination of Bunguran specimens).

Six specimens (one in alcohol) from Bunguran, two from Pulo Lingung, one from Pulo Laut, four (one in alcohol) from Sirhassen, and one (in alcohol) from Pulo Midei. It is doubtful whether these series are referable to one species or whether any of them are the true Bornean *Mus rajah*. The material is not wholly satisfactory, and I have been unable to examine specimens from Borneo.

MUS NEGLECTUS Jentink.

1894. *Mus rattus* var. THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 658. September, 1894 (Bunguran).

1895. *Mus neglectus* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 492. December, 1895 (Bunguran).

Five specimens from Pulo Lingung, one from Pulo Midei, and nine from Sirhassen. In the absence of Bornean material, I follow Thomas and Hartert in referring the Natuna rats of the '*alexandrinus*' type to *Mus neglectus*.

SCIUROPTERUS EVERETTI Thomas.

1894. *Sciuropterus phayrei* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 660. September, 1894 (Bunguran).

1895. *Sciuropterus everetti* THOMAS, *Novitates Zoologicæ*, II, p. 27. February, 1895 (Revised determination of Bunguran specimens).

1895. *Sciuropterus everetti* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 490. December, 1895 (Bunguran).

Two specimens, both from Bunguran; an immature male taken July 4, and an adult female taken July 21, 1900.

PETAURISTA NITIDULA Thomas.

1894. *Pteromys nitidus* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 660. September, 1894 (Bunguran).

1895. *Pteromys nitidus* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 490. December, 1895 (Bunguran).

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1900. *Petaurista nitidula* THOMAS, *Novitates Zoologicæ*, VII, p. 592. December 8, 1900 (Bunguran).

Seven specimens from Bunguran.

SCIURUS PROCERUS sp. nov.

1894. *Sciurus tenuis* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 659. September, 1894 (Bunguran).

1895. *Sciurus tenuis* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 492. December, 1895 (Bunguran).

Type.—Adult male (skin and skull) No. 104698 U. S. National Museum. Collected on Bunguran Island, North Natunas, July 18, 1900. Original number 574.

Characters.—Externally similar to *Sciurus tenuis* though somewhat smaller. Skull very much smaller and relatively broader than in the related species.

Color.—The color is exactly like that of *Sciurus tenuis* from Singapore.

Skull and teeth.—Except that it appears to be broader throughout, relatively to its length, the skull of *Sciurus procerus* is essentially a miniature of that of *S. tenuis*, as the braincase shows none of the tendency to increased depth characteristic of the Bornean animal. Ratio of rostral depth to distance between middle of interparietal and lower rim of audital bulla, 50. This ratio is 49 in *S. tenuis*.

Measurements.—External measurements of type: total length 235; head and body 140; tail vertebræ 95; hind foot 35 (33). Average and extremes of four specimens from the type locality: total length 239.5 (235-247); head and body 140; tail vertebræ 99.5 (95-107); hind foot 35.2 (34-36.5); hind foot without claws 32.9 (31.8-34).

Cranial measurements of type: greatest length 34 (38);^[17] basal length 28.6 (32); basilar length 26 (29); palatal length 14.6 (16); diastema, 7.6 (8.8); length of nasals 10.4 (11.4); greatest breadth of nasals 4.8 (5.6); interorbital breadth 12 (12.6); zygomatic breadth 20.8 (21); greatest breadth of braincase 17 (17.6); cranial depth from middle of interparietal to lower rim of audital bulla 14 (15); least depth of rostrum 7 (7.2); mandible, 20 (21); maxillary tooththrow (alveoli) 6 (7); mandibular tooththrow (alveoli), 6 (7).

Specimens examined.—Six, all from the type locality.

Remarks.—This species is immediately distinguishable from its allies by its small skull, scarcely larger than that of *Funambulus macclellandi*.

[123]

SCIURUS NATUNENSIS (Thomas).

1894. *Sciurus lowi* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 659. September,

1894 (Sirhassen).

1895. *Sciurus lowi natunensis* THOMAS, Novitates Zoologicae, II, p. 26. February, 1895 (Revised determination of Sirhassen specimen).

1895. ? *Sciurus lowi natunensis* THOMAS and HARTERT, Novitates Zoologicae, II, p. 491. (Bunguran and Pulo Laut.)

Four specimens from Sirhassen. The average and extreme measurements are as follows: total length 222 (215-229); head and body 135 (133-140); tail vertebræ 86 (82-89); hind foot 33.6 (33-35); hind foot without claw 31.5 (30.5-32).

SCIURUS LINGUNGENSIS sp. nov.

1895. ? *Sciurus lowi natunensis* THOMAS and HARTERT, Novitates Zoologicae, II, p. 491. (Bunguran and Pulo Laut.)

Type.—Adult male (skin and skull) No. 104693 U. S. National Museum. Collected on Pulo Lingung off southern extremity of Bunguran, North Natuna Islands, June 19, 1900. Original number 494.

Characters.—Externally similar to *Sciurus natunensis* (Thomas), but slightly larger (hind foot with claws 36 instead of 33.6). Skull larger than that of *S. natunensis*, the audital bullæ much broader anteriorly.

Color.—The color is precisely as in *Sciurus natunensis*, and therefore requires no detailed description.

Skull.—Skull larger than that of *Sciurus natunensis* (see measurements) but not different in general form. The audital bullæ are, however, readily distinguishable by the much greater development of the anterior inner lobe. In *Sciurus natunensis* this lobe is so small as scarcely to form any part of the general contour of the bulla. In *S. lingungensis* it is nearly equal to the anterior outer lobe, together with which it imparts a distinctly triangular outline to the ventral aspect of the bulla.

Measurements.—External measurements of type: total length 229; head and body 140; tail vertebræ 89; hind foot 36 (33.7); ear from meatus 12; ear from crown 7. A second specimen from the type locality gives precisely the same measurements.

Cranial measurements of type: greatest length 38 (36);^[18] basal length 33 (31); basilar length 30 (29); palatal length 17 (16); greatest length of nasals 11 (10); greatest width of both nasals together 5 (5); interorbital breadth 12 (11.4); zygomatic breadth 22.4 (20); mastoid breadth 17 (16.6); depth of braincase at anterior edge of basi-occipital 13.6 (13); mandible 23 (22); maxillary tooththrow (alveoli) 6.4 (7); mandibular tooththrow (alveoli) 7 (7).

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Specimens examined.—Two, both from the type locality.

Remarks.—While *Sciurus lingungensis* is scarcely distinguishable from *S. natunensis* by external characters alone, size of the skull and form of the audital bullæ are clearly diagnostic. Both species from the Natunas are separated from the Bornean *S. lowi* Thomas by their well developed ears, and shorter broader rostral portion of skull.

SCIURUS LUTESCENS sp. nov.

1894. *Sciurus notatus* THOMAS and HARTERT, Novitates Zoologicae, I, p. 659. September, 1894 (part, specimens from Sirhassen).

Type.—Adult male (skin and skull) No. 104668 U. S. National Museum. Collected on Sirhassen Island, South Natunas, June 3, 1900. Original number 429.

Characters.—Allied to *Sciurus notatus*, but considerably smaller than the Bornean representative of the species. Colors very pale, the under parts buff or cream-buff (Ridgway, pl. v, nos. 13 and 11) irregularly tinged with gray.

Color.—Entire dorsal surface of body and tail a fine grizzle of black and cream-buff, the individual hairs black with two or three cream buff rings. On tail the grizzle is less fine than on back, and it shows a faint tendency to resolve itself into obscure cross bands. On sides of body and on head the cream-buff brightens to buff. Cheeks and muzzle buff, scarcely grizzled. Feet slightly yellower than sides, under parts and inner surface of legs pale buff, palest anteriorly and laterally (where it about matches the cream-buff of Ridgway) brightest along median line. Under side of tail dull ochraceous-buff slightly grizzled with black. Pencil not different from rest of tail. Between the colors of sides and belly are the usual longitudinal stripes. The outer of these is about 5 mm. in width, and cream-buff in color. The inner is about twice as wide, and black, but much obscured by a thick sprinkling of bluish gray hairs. Outer surface of ears concolor with neck, inner surface like cheeks. The sprinkling of bluish gray hairs on sides of belly extends irregularly forward to axilla and inner side of front leg, occasionally to throat and chin.

Skull.—As compared with the Bornean form of *Sciurus notatus*, the skull of *S. lutescens* is much smaller (greatest length about 45 instead of 50) the rostrum is relatively shorter and broader, and the audital bullæ are less elongate antero-posteriorly. Teeth as in *Sciurus notatus* except that they are uniformly smaller.

[125]

Measurements.—External measurements of type: total length 355; head and body 177; tail vertebræ, 177; hind foot 45 (41). Average and extremes of six specimens from the type locality: total length 356 (329-375); head and body 186 (177-196); tail vertebræ 170 (152-178); hind foot 43.8 (41-45); hind foot without claws 40.7 (39-42).

Cranial measurements of type: greatest length 45.4 (50.4)^[19]; basal length 39 (43); basilar length 36.4 (41); palatal length 20 (23); palatal width between middle molars 6 (6); greatest length of nasals 13 (14.8); greatest width of both nasals together 6.6 (7); interorbital breadth 15.4 (17); mastoid breadth 21 (21); zygomatic breadth 26 (29); depth of braincase at anterior edge of basioccipital 16 (16.8); mandible 28 (30); maxillary tooththrow (alveoli) 8 (9); mandibular tooththrow (alveoli) 8 (9).

Specimens examined.—Seven (one in alcohol), all from the type locality.

Remarks.—This squirrel is recognizable among the members of the *S. notatus* group by its light colors, and particularly by the pallor of the under parts. In the latter characteristic it is approached by the form inhabiting Pulo Laut, but with this exception it is unique among the fulvous bellied species. The six specimens show no variation worthy of note.

SCIURUS SERAIÆ sp. nov.

Type.—Adult male (skin and skull) No. 104660 U. S. National Museum. Collected on Pulo Seraia, South Natuna Islands, May 29, 1900. Original number 415.

Characters.—Most nearly related to the small, pallid, *Sciurus lutescens* from Sirhassen Island, but upper parts slightly less pale, and under parts and pale side stripe buff-yellow, the former without admixture of gray.

Color.—Upper parts as in *Sciurus lutescens* except that the pale bands on the hairs are more nearly buff than cream-buff. Tail essentially as in *S. lutescens* but a shade less pale. Under parts buff-yellow darkening irregularly to dull orange-buff. Dark side stripe broad and well defined.

Skull.—The skull closely agrees with that of *Sciurus lutescens* in both size and form, though it is perhaps even broader in proportion to its length. Teeth as in *S. lutescens*. [126]

Measurements.—External measurements of type: total length 368; head and body 197; tail vertebræ 171; hind foot 44 (40). Average and extremes of four specimens from the type locality: total length 347 (323-368); head and body 184 (171-197); tail vertebræ 163 (152-171); hind foot 43.7 (43-45); hind foot without claws 40.1 (39.5-41).

Cranial measurements of type: greatest length 45; basal length 38.6; basilar length 36; zygomatic breadth 26.4; least interorbital breadth 17; mandible 28; maxillary tooththrow (alveoli) 8.6; mandibular tooththrow (alveoli) 8.6.

Specimens examined.—Four, all from the type locality.

Remarks.—As might be expected from the geographic position of the island it inhabits, *Sciurus seraiæ* differs from the Bornean *S. notatus* in much the same way as the Sirhassen representative of the group. It is readily distinguishable from the Sirhassen animal by the different color of the under parts. In color *Sciurus seraiæ* closely resembles *S. abbottii* of the Tambelan Islands. The latter is, however, a much larger animal, with a longer and relatively narrower skull.

SCIURUS RUTILIVENTRIS sp. nov.

Type.—Adult male (skin and skull) No. 104658 U. S. National Museum. Collected on Pulo Midei (Low Island), South Natuna Islands, May 24, 1900. Original number 405.

Characters.—Size slightly greater than that of *Sciurus lutescens* and *S. seraiæ*, but not equal to that of the Bornean or Bunguran representatives of *S. notatus*. Color above as in *S. seraiæ*. Under parts bright clear orange-rufous.

Color.—Color exactly as in *Sciurus seraiæ* except that the pale side stripe is light cream-buff and the under parts are bright orange rufous. Tail without trace of red suffusion.

Skull and teeth.—The skull and teeth are a trifle larger than in *Sciurus lutescens* and *S. seraiæ*, but the difference is scarcely a tangible one.

Measurements.—External measurements of type: Total length 368; head and body 190; tail vertebræ 178; hind foot 45 (41). Average and extremes of seven specimens from the type locality: total length 356 (330-368); head and body 186 (178-190); tail vertebræ 173 (165-184); hind foot 45.5 (43-48); hind foot without claws 42.2 (39.5-45).

Specimens examined.—Seven, all from the type locality. [127]

Remarks.—This squirrel is remarkable among the Natuna members of the *S. notatus* group for the brilliant color of its under parts. In this respect it surpasses all of the related forms with which I am acquainted. The red color is, however, strictly confined to the body, showing no tendency to spread to the tail as in *S. miniatus* of the Malay Peninsula.

SCIURUS RUBIDIVENTRIS sp. nov.

1894 (part, specimens from Bunguran).

1895. *Sciurus notatus* THOMAS and HARTERT, *Novitates Zoologicae*, II, p. 491. December, 1895 (part, specimens from Bunguran).

Type.—Adult female (skin and skull) No. 104671 U. S. National Museum. Collected on Bunguran Island, North Natunas, June 22, 1900. Original number 498.

Characters.—Size and general appearance both above and below as in the Bornean form of *Sciurus notatus*, but red of under parts brighter, and cheeks and chin distinctly less fulvous than surrounding parts. Skull with broader, deeper braincase than in the Bornean animal.

Color.—The color so closely resembles that of the Bornean *Sciurus notatus* that no detailed description is necessary. Under parts ochraceous-rufous, fading to tawny on throat, everywhere lighter and more tinged with red than in the Bornean animal. In the latter the color of the under parts extends forward to lips and also strongly suffuses the cheeks and sides of head which are only a shade browner than the throat and conspicuously more fulvous than top of head and sides of neck. In *Sciurus rubidiventris* the cheeks and lips are noticeably suffused with gray so that they form a distinct contrast with both throat, top of head and sides of neck.

Skull.—The skull agrees in general size with that of the Bornean animal, and is therefore much larger than in the three species from the South Natunas. It is distinguishable by greater general breadth and by the depth of the braincase, which perceptibly exceeds that of *S. notatus*.

Measurements.—External measurements of type: total length 380; head and body 209; tail vertebræ 171; hind foot 49 (44.5). Averages and extremes of seven specimens from the type locality: total length 378 (368-393); head and body 208 (203-222); tail vertebræ 173 (165-184); hind foot 49.3 (48-50); hind foot without claws 45.7 (44.5-47).

Cranial measurements of type: greatest length 52.4 (50.4);^[20] basal length 44 (43); basilar length 41 (41); palatal length 23 (23); palatal width between middle molars 6 (6); greatest length of nasals 15 (14.8); greatest width of both nasals together 7.2 (7); interorbital breadth 18.2 (17); mastoid breadth 23 (21); breadth of braincase above roots of zygomata 24 (22); zygomatic breadth 30.4 (29); depth of braincase at anterior edge of basi-occipital 17.8 (16.8); mandible 29 (30); maxillary tooththrow (alveoli) 9 (9); mandibular tooththrow (alveoli) 9 (9).

[128]

Specimens examined.—Seven, all from the type locality.

Remarks.—In both size and general color this squirrel more closely resembles the Bornean representative of the group than it does either of the three forms from the South Natunas. Its relationships, however, appear to be rather with the race inhabiting Singapore Island than with any of its near geographic allies, *Sciurus lautensis* excepted.

SCIURUS LAUTENSIS sp. nov.

1895. *Sciurus notatus* THOMAS and HARTERT, *Novitates Zoologicae*, II, p. 491. December, 1895 (part, specimens from Pulo Laut).

Type.—Adult female (skin and skull) No. 104683 U. S. National Museum. Collected on Pulo Laut, North Natuna Islands, August 6, 1900. Original number 612.

Characters.—Size slightly less than that of *Sciurus rubidiventris* and color conspicuously pallid. Upper parts as in *S. lutescens*; lower parts nearly as in *S. seraiæ* but rather less dull; pale side stripe much less yellow than belly. Skull as in *Sciurus rubidiventris*.

Color.—Upper parts and tail as in *Sciurus lutescens*. Cheeks faintly washed with ochraceous-buff. Under parts and inner surface of legs bright ochraceous-buff (distinctly more yellow than Ridgway's pl. V, No. 10). Lateral stripes as in *S. lutescens* (not distinctly yellowish as in *S. seraiæ*), but black band usually less sprinkled with gray. Scarcely a trace of gray in axillary region or on sides of neck.

Skull.—The skull in all respects closely resembles that of *S. rubidiventris* except that it is slightly smaller. Its large size and the correspondingly large teeth readily distinguish it from that of the South Natuna species.

Measurements.—External measurements of type: total length 375; head and body 195; tail vertebræ 180; hind foot 44 (41). Average and extremes of nine specimens from the type locality: total length 363 (355-379); head and body 189 (171-196); tail vertebræ 170 (165-183); hind foot 45 (44-46); hind foot without claws 42 (41-43).

Specimens examined.—Ten (one in alcohol), all from the type locality.

[129]

Remarks.—Though suggesting two of the small South Natuna squirrels in color, *Sciurus lautensis* is obviously related to the dark colored Bunguran form, with which it more nearly agrees in size.

SCIURUS NAVIGATOR (Bonhote).

1894. *Sciurus prevostii* THOMAS and HARTERT, *Novitates Zoologicae*, I, p. 656. September, 1894 (Sirhassen).

1901. *Sciurus prevostii navigator* BONHOTE, *Ann. and Mag. Nat. Hist.*, 7th ser., VII, p. 171. February, 1901 (Sirhassen).

Nine specimens, three from Sirhassen Island and six from Pulo Subi.

Those from Pulo Subi, while agreeing with the topotypes in color, appear to average a trifle smaller, though the series is hardly extensive enough to prove that this is constant.

RATUFA SIRHASSENENSIS (Bonhote).

1894. *Sciurus bicolor albiceps* THOMAS and HARTERT, *Novitates Zoologicae*, I, p. 659. September, 1894 (Sirhassen).

1900. *Ratufa ephippium sirhassenensis* BONHOTE, *Ann. and Mag. Nat. Hist.*, 7th ser., V, p. 498. June, 1900 (Sirhassen).

Two specimens, Sirhassen, June 8, 1900.

This species, though related to *Ratufa ephippium*, with which it agrees in color-scheme, is sharply differentiated by its small size and cranial peculiarities. It is in no way closely allied to *Ratufa bunguranensis* and *R. nanogigas*.

As compared with that of *Ratufa ephippium sandakanensis* Bonhote, the skull in addition to its small size (greatest length 57 instead of 65) differs in general narrowness, in the relatively greater breadth of the nasal branches of the premaxillaries, and in the form of the audital bullæ. When the skull is held upside down and viewed from behind the bullæ are seen to be narrower than in the Bornean animal and to rise to a much greater height above the surface of the basi-occipital.

RATUFA BUNGURANENSIS (Thomas and Hartert).

1894. *Sciurus bicolor bunguranensis* THOMAS and HARTERT, *Novitates Zoologicae*, I, p. 658. September, 1894 (Bunguran).

1895. *Sciurus bicolor bunguranensis* THOMAS and HARTERT, *Novitates Zoologicae*, II, p. 491. December, 1895 (Bunguran).

1900. *Ratufa ephippium bunguranensis* BONHOTE, *Ann. and Mag. Nat. Hist.*, 7th ser., V, p. 497. June, 1900.

Thirteen specimens from Bunguran, all in various stages of the change from the bleached winter coat to the summer pelage. In the latter there is some color variation, mostly due to the greater or less distinctness of the drab wash overlying the Prouts-brown or 'chocolate' of the upper parts. Not only does the drab vary in amount in different individuals, but on every specimen it is more noticeable when the animal is viewed from in front. The drab wash is of the same character as that in *Ratufa affinis*, though less conspicuous. [130]

As Mr. Thomas has pointed out to me, after examining a specimen of the latter, *Ratufa bunguranensis* is closely allied to *R. pyrsonota*. Indeed its relationship to the Siamese species is much closer than to the *R. ephippium* of Borneo. Together with *R. pyrsonota* the Bunguran giant squirrel differs conspicuously from that of Borneo in its narrow skull, lengthened audital bullæ, dark feet, dark median line on under surface of tail, and entirely brown back. From *R. pyrsonota*, however, it is readily separable by its darker, less ochraceous color both above and below, drab washed back, and by the much less distinct annulation of the hairs of the dorsal surface.

RATUFA NANOGIGAS (Thomas and Hartert).

1895. *Sciurus bicolor nanogigas* THOMAS and HARTERT, *Novitates Zoologicae*, II, p. 491. December, 1895 (Pulo Laut).

1900. *Ratufa ephippium nanogigas* BONHOTE, *Ann. and Mag. Nat. Hist.*, 7th ser., V, p. 498. June, 1900 (Pulo Laut).

Four specimens, all from Pulo Laut, the type locality.

This strongly characterized dwarf species is allied to *Ratufa pyrsonota* and *R. bunguranensis* with which it agrees in color scheme. It is in no way closely related to the large Bornean *R. ephippium*.

RATUFA ANGUSTICEPS sp. nov.

Type.—Adult male (skin and skull) No. 104646 U. S. National Museum. Collected on Pulo Lingung, off south coast of Bunguran, June 17, 1900. Original number 481.

Characters.—Externally like *Ratufa anambæ* and *R. melanopepla*. Skull about equal to that of latter in length, but conspicuously narrower.

Color.—As the color is precisely like that of *Ratufa anambæ* and *R. melanopepla* it requires no description.

Skull and teeth.—The skull is immediately recognizable by its general narrowness, but particularly in the region of the anterior zygomatic roots. Ratio of lachrymal breadth to greatest length, 39. In the other black backed species it is about 42. Audital bullæ narrower and more

elongate than in *R. melanopepla*, and more elevated above level of basi-occipital (when skull is held upside down). Lateral processes of basi-occipital obsolete.

Teeth as in the related species.

[131]

Measurements.—External measurements of type: total length 748; head and body 342; tail vertebræ 406; hind foot 79 (74).

Cranial measurements of type: greatest length 48.6 (70);^[21] basal length 57 (59); basilar length 52 (53); diastema 15.6 (16); length of nasals 22 (23.4); breadth of nasals anteriorly 12 (13); breadth of nasals posteriorly 6 (7); interorbital breadth 27 (28); lachrymal breadth 28.4 (31); breadth between tips of postorbital processes 38 (41); zygomatic breadth 41 (44); mastoid breadth 31 (32.6); mandible 40 (41.6); maxillary tooththrow (alveoli) 14 (14); mandibular tooththrow (alveoli) 14.6 (14.4).

Specimens examined.—One, the type.

Remarks.—While this squirrel exactly resembles the other black backed species with untufted ears, so far as external characters are concerned, it seems to be well differentiated in cranial peculiarities. No black backed *Ratufa* has hitherto been recorded from the Natunas.

RHINOSCIURUS sp.

An immature long-nosed squirrel was taken on Sirhassen Island, June 4, 1900. In the absence of material for comparison I am unable to determine the species. The genus is new to the islands.

ARCTOGALIDIA INORNATA sp. nov.

Type.—Adult^[22] male (skin and skull) No. 104859 U. S. National Museum. Collected on Bunguran Island, North Natunas, June 23, 1900. Original number 502.

Characters.—Much smaller than *Arctogalidia leucotis* from the Malay Peninsula or *A. stigmatica* from Borneo (greatest length of skull about 100 instead of 115) and in color paler than either, the dark dorsal stripes obsolete in adult.

Color.—General color of back and sides light silvery gray irregularly suffused with buff and slightly darkened by blackish hair-tips and by appearance at surface of hair-brown basal portion of fur. The buff suffusion is least noticeable on back, slightly more apparent on sides and flanks, and most evident on sides of neck, where it usually brightens almost to buff-yellow in distinct contrast with surrounding parts. On middle of back there is a trace of the middle dark stripe of the three normally present in members of the genus. Head essentially like back though somewhat more gray. Muzzle and ill-defined eye ring blackish. Cheeks and short median stripe on forehead dull whitish gray. Under parts essentially like back, but buff tinge more diffuse. Feet and ears dark brown. Tail like back but darkening to uniform brown beyond middle.

[132]

Newly born young are clear bluish gray, with scarcely a tinge of buff. The three black dorsal stripes are clearly defined and normal in extent.

Skull.—In addition to its smaller size the skull differs from that of the Bornean *Arctogalidia stigmatica* in the relatively larger braincase, and less prominent audital bullæ. The braincase is nearly as broad as in the Bornean species, but the zygomatic width is distinctly less. Audital bullæ less raised above level of basi-occipital when skull is held upside down and viewed from behind. The sagittal crest, though of normal development in very old individuals, is absent at an age when it is well grown in the larger species. In *Arctogalidia leucotis* and *A. stigmatica*, even in animals so young that the teeth are unworn and all the sutures of the rostrum plainly visible, the sagittal crest is a knife-like ridge extending from proencephalon to lambdoid suture, and rising to a height of about 4 mm. over middle of braincase. In much older individuals of *A. inornata*, with worn teeth and nearly obliterated rostral sutures, the crest is represented by a low ridge about 5 mm. wide over middle of braincase and flat or grooved on top. At this stage it rises very inconspicuously above level of the adjacent surface, from which it is distinguished more by the texture of the bone than by actual form.

Teeth.—The teeth are uniformly much smaller than in *Arctogalidia leucotis* and *A. stigmatica*, but I can detect no important differences in form.

Measurements.—External measurements of type: total length 1027; head and body 469; tail vertebræ 558; hind foot 78 (73.) External measurements of an adult female: total length 911; head and body 431; tail vertebræ 480; hind foot 77 (72).

Cranial measurements of type: greatest length 102 (115);^[23] basal length 96 (106); basilar length 92 (103); median palatal length 53 (60); palatal breadth between anterior molars 13 (15.4); zygomatic breadth 55 (60); breadth between tips of postorbital processes 41 (39); constriction in front of postorbital processes 19 (18); constriction behind postorbital processes 13 (12); breadth of braincase above roots of zygomata 32 (33); mastoid breadth 36 (38); mandible 76 (86); maxillary tooththrow (exclusive of incisors) 34^[24] (41); mandibular tooththrow (exclusive of incisors) 39 (44); crown of first upper molar 5.4 × 5 (5.4 × 5.6); crown of second upper molar 4 × 5 (5.4 × 6.4); crown of second lower molar 7 × 4.2 (8.4 × 5.4).

[133]

Specimens examined.—Seven (two young in alcohol and one skull without skin), all from the type locality.

Remarks.—*Arctogalidia inornata* is so distinct from the previously described species as to require no special comparisons. It is common on Bunguran where it frequents the coconut trees, living for the most part in the tops among the leaf stalks.

VIVERRA TANGALUNGA Gray.

1895. *Viverra tangalunga* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 490. December, 1895 (Bunguran).

Nine specimens from Bunguran. These agree in all respects with the Bornean animal.

TUPAIA SPLENDIDULA Gray.

1894. *Tupaia splendidula* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 656. September, 1894 (Bunguran).

1893. *Tupaia splendidula typica* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 489. December, 1895 (Bunguran).

Two specimens from Bunguran.

TUPAIA LUCIDA (Thomas and Hartert).

1895. *Tupaia splendidula lucida* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 490. December, 1895 (Pulo Laut).

Seven specimens (two in alcohol) from Pulo Laut.

TUPAIA SIRHASSENENSIS sp. nov.

1894. *Tupaia tana* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 657. September, 1894 (Sirhassen).

Type.—Adult male (skin and skull) No. 104712 U. S. National Museum. Collected on Sirhassen Island, South Natunas, June 5, 1900. Original number 442.

Characters.—In general similar to Bornean specimens of *Tupaia tana*, but smaller (hind foot 47 instead of 52, greatest length of skull 55 instead of 60), gray markings on head and shoulders less distinct, and red of tail brighter. Rostral portion of skull less attenuate than in *Tupaia tana*.

Color.—The color so exactly resembles that of the common Bornean *Tupaia tana* as to need no detailed description. Gray of head darker than in the Bornean animal and light shoulder markings less distinct and sharply defined. Under side of tail light orange-rufous, darkening to ferruginous toward edge. (In *T. tana* these colors are replaced by dull ferruginous and hazel respectively.)

[134]

Skull and teeth.—The skull is throughout much smaller than in specimens of *Tupaia tana* from Borneo. In form it differs from that of *T. tana* in less slender and elongate rostrum, narrower braincase and slightly shorter audital bullæ. Suborbital vacuity much broader than in *T. tana*. Teeth as in the Bornean animal.

Measurements.—External measurements of type: Total length 355; head and body 203; tail vertebræ 152; hind foot 46.4 (44). Average and extremes of four adults from the type locality: total length 367 (365-371); head and body 203; tail vertebræ 163 (162-168); hind foot 45.4 (44-46.6); hind foot without claws 42.5 (41-44).

Cranial measurements of type: greatest length 54.6 (61);^[25] basal length 49 (54); basilar length 46.4 (51); median palatal length 48 (53); distance from lachrymal notch to tip of premaxillary 27.6 (31); least interorbital breadth 14.4 (16); zygomatic breadth 25 (28.4); mandible 38 (41); maxillary tooththrow (behind diastema) 20 (21.4); mandibular tooththrow (behind diastema) 17 (18).

Specimens examined.—Five, all from the type locality.

GALEOPITHECUS VOLANS (Linnæus).

1894. *Galeopithecus volans* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 657. September, 1894 (Bunguran and Sirhassen).

Two specimens from Sirhassen and two (one young in alcohol), from Bunguran. Also foetus of one of the Sirhassen specimens.

EMBALLONURA ANAMBENSIS Miller.

Four specimens from Bunguran. These agree essentially with the Anamba animal, but show some slight cranial peculiarities.

PIPISTRELLUS SUBULIDENS sp. nov.

Type.—Adult female (in alcohol) No. 104758 U. S. National Museum. Collected on Sirhassen Island, South Natunas, June 3, 1900.

Characters.—Similar to *Pipistrellus pipistrellus* (Schreber) in size, color and external form, but skull with broader rostrum, and inner upper incisor without supplemental cusp.

Skull.—The skull is of the same size as that of *Pipistrellus pipistrellus*, but the braincase is narrower and more elongate, and the rostrum is very markedly shorter and broader. The great breadth of the anterior portion of the skull involves also the palate and interpterygoid space, both of which are noticeably wider than in *Pipistrellus pipistrellus*. Audital bullæ slightly smaller than in the European species. [135]

Teeth.—The teeth are essentially as in *Pipistrellus pipistrellus*, except that the inner upper incisor lacks the small supplemental cusp. Mandibular teeth wider than those of *P. pipistrellus*.

Measurements.—External measurements of type: total length 76; head and body 41; tail 33; tibia 14; foot 6; calcar 10; forearm 32.4; thumb 6; second digit 30; third digit 60; fourth digit 53; fifth digit 43; ear from meatus 11; ear from crown 9; width of ear 9.6; tragus (measured in front) 4.

Cranial measurements of type: greatest length 12.4 (12);^[26] basal length 11.8 (11.6); basilar length 9 (9); zygomatic breadth 8.4 (8); least interorbital breadth 3.2 (3.2); greatest length of braincase 8 (7.6); greatest breadth of braincase above roots of zygomata 6.6 (6.6); mandible 8.8 (8.4); maxillary tooththrow (exclusive of incisors) 4.2 (4.2); mandibular tooththrow (exclusive of incisors) 4.8 (4.8).

Specimens examined.—Six (in alcohol), all from the type locality.

Remarks.—I am unable to identify this bat with any described species. Externally it is practically identical with *Pipistrellus pipistrellus* except that the color, so far as can be judged from specimens preserved in alcohol, is more blackish. Internally it is readily distinguished by the characters of the skull and teeth. From *Pipistrellus abramus* it differs externally in smaller size, narrower ears, and in the absence of any unusual development of the penis. The incisors differ from those of *P. abramus* in the same manner as from those of *P. pipistrellus*.

HIPPOSIDEROS LARVATUS (Horsfield).

Two specimens (one in alcohol) were collected on Sirhassen Island, June 6 and 7, 1900.

RHINOLOPHUS AFFINIS (Horsfield).

One badly damaged specimen from Bunguran appears to be referable to typical *Rhinolophus affinis*. The forearm cannot be measured, but the third finger is 75 mm. in length. Tibia 21, foot 10.4, ear from meatus 21. Ridge on muzzle beneath edge of nose leaf low, broad and hairy, not in the least suggesting a supplementary leaflet. [136]

RHINOLOPHUS SPADIX sp. nov.

1894. *Rhinolophus affinis* THOMAS and HARTERT, Novitates Zoologicæ, II, p. 656. December, 1895 (Sirhassen).

Type.—Adult female (in alcohol) No. 104752 U. S. National Museum. Collected on Sirhassen Island, South Natunas, June, 1900.

Characters.—In general like *Rhinolophus affinis* but much smaller. Color uniform tawny brown. Muzzle with distinct supplemental leaflets.

Muzzle.—Muzzle and noseleaf precisely as in *Rhinolophus affinis*, except that the ridge on muzzle beneath edge of horseshoe is developed into a distinct supplemental leaflet resembling those present in *Hipposideros*. In this respect *Rhinolophus spadix* resembles the animal from Burmah referred by Thomas to *Rhinolophus rouxii*;^[27] but the terminal erect portion of the noseleaf is not shortened or in any way peculiar in form.

Ears.—The ears resemble those of *Rhinolophus affinis*, except that they are not as large.

Color.—Fur everywhere russet, slightly paler on ventral surface, darker and somewhat tinged with hazel above. Ears and membranes dark brown.

Skull and teeth.—The skull and teeth exactly resemble those of mainland specimens of *Rhinolophus affinis* except for their uniformly smaller size.

Measurements.—External measurements of type: total length, 70 (85^[28]); tail 21 (23); tibia 17.6 (24); foot 8 (10); calcar 12 (13); forearm 43 (51); thumb 8 (8.6); second digit 32 (40); third digit 64 (77); fourth digit 53 (61); fifth digit 54 (63); ear from meatus 17 (20); ear from crown 14 (17); length of noseleaf from lip 13 (16); greatest width of noseleaf 8 (9).

Cranial measurements of type: greatest length 18 (23); basal length 16 (20.4); basilar length 14.6 (18); zygomatic breadth 9 (11); least interorbital breadth 2.4 (2.4); greatest length of braincase 10.4 (13); greatest breadth of braincase above roots of zygomata 8 (9.4); frontopalatal depth (at

middle of molar series) 4 (4.8); depth of braincase 6 (7); mandible 11.8 (15); maxillary tooththrow (exclusive of incisor) 6.8 (9); mandibular tooththrow (exclusive of incisors) 7 (9.8).

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Specimens examined.—Three (one skin), all from the type locality.

Remarks.—*Rhinolophus spadix* is so readily distinguished from its relatives of the *R. affinis* group that it needs no special comparisons. It is a much smaller animal than the species from the Anambas that I recently referred to *R. rouxii*.^[29] In color the latter is a dull brown not in the least resembling the russet of *R. spadix*.

CYNOPTERUS MONTANOI Robin.

1894. *Cynopterus marginatus* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 655. September, 1894 (Sirhassen and Bunguran).

1899. *Cynopterus montanoi* MATSCHIE, *Die Fledermäuse des Berliner Museums für Naturkunde*, p. 75. August, 1899. (Natuna record of *C. marginatus* placed in synonymy of *C. montanoi*.)

Five specimens (three skins) from Sirhassen. These agree so closely with a skin and two bleached alcoholic specimens from Singapore, which I suppose to be the same as the Malaccan *Cynopterus montanoi*, that without more material it is impossible to distinguish the Natuna animal from that of the southern extremity of the Malay Peninsula. *Cynopterus montanoi* as thus understood differs from *C. angulatus* Miller^[30] of Lower Siam in its more slender skull and in the absence of the white border of the ear, and from *C. titthæcheilus* (Temminck) of Sumatra and Java in its conspicuously smaller size.

PTEROPUS VAMPYRUS (Linnæus).

1894. *Pteropus vampyrus* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 655. September, 1894 (Bunguran).

1895. *Pteropus vampyrus* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 489. December, 1895 (Bunguran).

Six skins from Bunguran.

? PTEROPUS HYPOMELANUS Temminck.

1894. *Pteropus hypomelanus* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 655. September, 1894 (Sirhassen).

1895. *Pteropus hypomelanus* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 489. December, 1895 (Pulo Pandak, Pulo Panjang and Pulo Laut).

Eight (one in alcohol) from Sirhassen and seven (one in alcohol) Pulo Laut. It is highly probable that these specimens represent a species distinct from the true *Pteropus hypomelanus* of Ternate.

NYCTICEBUS TARDIGRADUS (Linnæus).

[138]

1894. *Nycticebus tardigradus* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 655. September, 1894 (Bunguran).

1895. *Nycticebus tardigradus* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 489 (Bunguran).

One specimen from Bunguran.

MACACUS 'CYNOMOLGUS' Auct.

1894. *Macacus cynomolgus* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 654. September, 1894 (Bunguran).

1895. *Macacus cynomolgus* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 489. December, 1895 (Bunguran).

A specimen from each of the following islands: Sirhassen, Pulo Lingung and Pulo Laut.

SEMNOPIITHECUS CRISTATUS (Raffles).

Two monkeys from Sirhassen appear to be referable to this species.

SEMNOPIITHECUS NATUNÆ Thomas and Hartert.

1894. *Semnopithecus natunæ* THOMAS and HARTERT, *Novitates Zoologicæ*, I, p. 652. September, 1894 (Bunguran).

1895. *Semnopithecus natunæ* THOMAS and HARTERT, *Novitates Zoologicæ*, II, p. 489. (Bunguran.)

Ten specimens from Bunguran.

FOOTNOTES:

- [1] For location of the Natuna Islands see Proc. Washington Acad. Sci., II, p. 204. August 20, 1900.
- [2] Thomas (O.) and Hartert (E.). List of the first collection of mammals from the Natuna Islands. *Novitates Zoologicæ*, I, pp. 652-660. September, 1894.
Thomas (O.). Revised determinations of three of the Natuna rodents. *Novitates Zoologicæ*, II, pp. 26-28. February, 1895.
Thomas (O.) and Hartert (E.). On a second collection of mammals from the Natuna Islands. *Novitates Zoologicæ*, II, pp. 489-492. December, 1895.
Bonhote (J. Lewis). On the squirrels of the Ratufa (*Sciurus*) bicolor group. *Ann. and Mag. Nat. Hist.*, 7th ser., V, pp. 490-499. June, 1900.
Thomas (O.). The red flying squirrel of the Natuna Islands. *Novitates Zoologicæ*, VII, p. 592. December 8, 1900.
Bonhote (J. Lewis). On the Squirrels of the *Sciurus Prevostii* Group. *Ann. and Mag. Nat. Hist.*, 7th ser., VII, pp. 167-177. February, 1901.
- [3] Gray's "Notice of a species of *Tupaia* from Borneo, in the collection of the British Museum" in the Proceedings of the Zoological Society of London for 1865 (p. 322) may be added to the bibliography of Natuna mammals, as the animal described, though supposed to have been taken in Borneo, is apparently confined to Bunguran Island, the largest of the Natunas.
- [4] *Megaderma spasma*, *Myotis muricola*, *Taphozous melanopogon*, *Mydaus meliceps*, *Paradoxurus hermaphroditus*, *Lutra sumatrana* and *Mus ephippium*.
- [5] See papers already cited, also *Novitates Zoologicæ*, I, p. 468 (letter from Mr. Everett); *ibid.*, I, p. 483 (note on land shells by Mr. E. Smith), *ibid.*, II, p. 478 (Birds); *ibid.*, II, p. 499 (Reptiles).
- [6] Sitz.-Berich. der Gesellsch. Naturforschender Freunde zu Berlin, 1893, p. 224.
- [7] For the opportunity of examining the skull of an adult male from Balabac I am indebted to the courtesy of Mr. D. G. Elliot. A photograph (slightly reduced) of this specimen was published by Mr. Elliot in 1896 (*Field Columbian Museum, Publication II, Zoological Series, I, No. 3, pl. XI, May, 1896*).
- [8] Measurements in parentheses are those of an adult male topotype of *Tragulus nigricans*.
- [9] Measurements in parentheses are those of a less mature specimen from Bunguran.
- [10] Measurements in parentheses are those of a Tenasserim specimen (female) of *Sus cristatus* so young that the posterior molar is not fully in place.
- [11] Last molar not fully grown.
- [12] See Proc. Biol. Soc. Washington, XIII, pl. III and IV.
- [13] Collector's measurement.
- [14] Measurements in parentheses are those of the type of *Mus validus*.
- [15] In the type of *Mus mülleri* the diastema is 12 mm.
- [16] *Ann. and Mag. Nat. Hist.*, 6th ser., XIV, p. 450. December, 1894.
- [17] Measurements in parentheses are those of an adult male topotype of *Sciurus tenuis*.
- [18] Measurements in parentheses are those of an older specimen of *Sciurus natunensis* from Sirhassen.
- [19] Measurements in parentheses are those of an adult *Sciurus notatus* from Borneo.
- [20] Measurements in parentheses are those of an adult Bornean *Sciurus notatus*.
- [21] Measurements in parentheses are those of the type of *Ratufa melanopepla*.
- [22] Teeth very much worn and many of them absent.
- [23] Measurements in parentheses are those of a young adult *A. stigmatica* from British North Borneo.
- [24] Tooth measurements are from a younger specimen (male) with perfect dentition.
- [25] Measurements in parentheses are those of an adult male Bornean *Tupaia tana*.
- [26] Measurements in parentheses are those of an adult skull of *Pipistrellus pipistrellus* from Switzerland.
- [27] *Ann. Mus. Civ. di Storia Nat. di Genova, Ser. 2, X, p. 923, pl. XI, 1892.*
- [28] Measurements in parentheses are those of an adult female *Rhinolophus affinis* from Trong, Lower Siam.
- [29] Proc. Washington Acad. Sci., II, p. 234. August 20, 1900.
- [30] Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 316. July, 1898.

Transcriber's Note:

Obvious typographical errors have been repaired.

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