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U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 15

[Actual date of publication, August 8, 1899]



REVISION OF THE JUMPING MICE OF THE GENUS ZAPUS

BY

EDWARD A. PREBLE
ASSISTANT IN BIOLOGICAL SURVEY

Prepared under the direction of
Dr. C. HART MERRIAM
CHIEF OF DIVISION OF BIOLOGICAL SURVEY



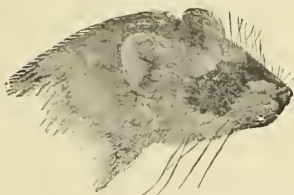
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., June 15, 1899.

SIR: I have the honor to transmit herewith for publication, as No. 15 of North American Fauna, a 'Revision of the Jumping Mice of the Genus *Zapus*.' by Edward A. Preble, assistant in the Biological Survey.

Respectfully,

T. S. PALMER,
Acting Chief, Biological Survey.

Hon. JAMES WILSON,
Secretary of Agriculture.

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REVISION OF THE JUMPING MICE OF THE GENUS ZAPUS.

BY EDWARD A. PREBLE.

INTRODUCTION.

History and material.—The Jumping Mice of North America early attracted the attention of naturalists, but their true status and relationships long remained in obscurity. The first reference to any of the species seems to have been made by Thomas Pennant, in the latter part of the last century, who mentioned the animal under the name of the ‘Long-legged Mouse of Hudson’s Bay.’ In 1780 Zimmermann, basing his description on that of Pennant, and supposing the animal to be congeneric with the jerboas of the Old World, named it *Dipus hudsonius*. Subsequent authors, recognizing the inapplicability of *Dipus*, referred the species successively to *Gerbillus*, *Meriones*, and *Jaculus*, until finally Dr. Elliott Coues, in 1875, after showing that all the generic names previously used were untenable, proposed *Zapus*.

Previous to 1857 a number of specific names were used for members of this genus (see pp. 10–13), but were applied mainly to specimens from the eastern United States and Canada. Suffice it to say that Baird, in 1857, and Coues, in 1877, recognized but one species, having a range nearly coincident with the present geographic distribution of the genus in North America. This resulted mainly from two causes—poor quality of existing material and the prevailing tendency of the times to lump distinct species having a superficial resemblance to one another. The material consisted mainly of poorly preserved alcoholic specimens, or skins badly made (in most cases with the skulls inside), and without satisfactory measurements. The characters distinguishing the species, therefore, were not apparent or were considered as being due merely to individual variation. In failing to examine skulls, both Baird and Coues referred specimens of the animal since described as

Zapus insignis to *Z. hudsonius*, though *insignis* has a different number of teeth and is now considered subgenerically distinct from the latter. Under the improved methods of collecting and preserving mammals now in vogue large series of well-prepared specimens have been brought together during the past few years, and several new forms have been described, mainly from the west and northwest.

The following revision of the genus *Zapus* is based on a study of more than 900 specimens, mainly in the collections of the Biological Survey of the U. S. Department of Agriculture, the U. S. National Museum, and several private individuals.¹ To the custodians and owners of these collections my thanks are cordially extended. For kind assistance and advice my thanks are also especially due to Dr. C. Hart Merriam, Dr. T. S. Palmer, and Mr. Gerrit S. Miller, jr. Through the courtesy of Mr. Miller I have had an opportunity of examining the types of *Zapus setchuanus* Pousargues, temporarily placed in his hands for comparison, and am thus able to present a complete account of the genus, including a description of this very interesting Asiatic species, the only one known from the Old World.

The National Museum collection of *Zapus*, though not extensive, contains many specimens of unusual interest from widely separated localities; that of the Biological Survey is especially rich in western specimens; and those of Miller and Bangs contain good series of eastern species. These collections, comprising many large suites of well-prepared skins, nearly all accompanied by perfect skulls and by measurements taken in the flesh, have afforded facilities for comparison never before enjoyed. Much additional material is needed, however, before certain questions concerning relationship and seasonal variation can be satisfactorily settled.

Distribution.—*Zapus* is a Boreal genus, and, with the exception of a single species, is confined to North America. The exact northern limits of its range are not well known, but are indicated by specimens from Hamilton Inlet, Labrador; Fort Churchill, on Hudson Bay; Fort Rae, on Great Slave Lake; and the Yukon River (probably Fort Yukon, just below the Arctic Circle). Southward it extends as far as Raleigh, N. C.; Wheeling, W. Va.; Jackson County, Mo.; Santa Fe, N. Mex.; and Kern River, California. Within the region thus roughly outlined there are probably no large areas where at least one member of the genus is not found. In regions where there is little or no woodland its distribution is more or less local, and is confined almost exclusively to the borders of streams. Of course, the arid deserts of the West do not offer a congenial environment.

¹ These specimens are as follows: Biological Survey, 378; U. S. National Museum, 85; Merriam Collection, 60; Bangs Collection, 132; Miller Collection, 200; and a few from each of the following collections, American Museum of Natural History, New York; Academy of Natural Sciences, Philadelphia; Carnegie Museum, Pittsburg, Pa.; Field Columbian Museum, Chicago; and the collections of Samuel N. Rhoads and Charles F. Batchelder.

Very little is known of the geological history of *Zapus*, except that the genus dates back to the Postpliocene. In 1871 Prof. E. D. Cope recorded a mandibular ramus with incisor and second molar of a Jumping Mouse from the Port Kennedy Bone Cave in Pennsylvania.¹ On account of lack of recent specimens for direct comparison he was somewhat in doubt as to the specific identity of the remains, but referred them to *Jaculus* (= *Zapus*) *hudsonius*.²

External characters.—The external and cranial characters of *Zapus* have been so exhaustively treated by Baird, Cones, and others that a brief reference to them here will be sufficient. The body is considerably enlarged posteriorly, the hind legs and tail greatly developed, the forelegs rather short, and the ears somewhat longer than the surrounding fur. All the species agree closely in color and markings. A broad dorsal stripe of some shade of yellowish brown, quite thickly flecked with black-tipped hairs, is bordered by a slightly narrower lateral stripe of a lighter color and usually with less black. The fur of the entire upper parts is uniform plumbeous at base, only the tips of the hairs affecting the external appearance of the animal. Between the darker color of the sides and the white of the lower parts is a narrow stripe of clear yellowish orange, unmixed with black, and with the base of the hairs white. The lower parts are white, sometimes suffused with the color of the sides, and one species, *Z. setchuanus*, from China, has a well-defined brown ventral stripe. The tail is very long, usually about 60 per cent of the total length, and more or less distinctly bicolor, brownish above and whitish below. It is thinly covered with short hairs, which are longer on the terminal part and form a short pencil. In two of the three subgenera the tail is conspicuously tipped with white. The spring and early fall pelages differ noticeably, except in members of the subgenus *Napaozapus*, the bright color of the spring and early summer pelage becoming duller in the fall, and the dark dorsal area partially obliterated. In some species, however, the dorsal area is darker and more sharply defined in late summer and early fall than in spring and early summer.

The teats are normally 8, and arranged in pairs at regular intervals. The pectoral pair is situated just back of the forelegs, the inguinal pair far back at the base of the thighs, and the remaining pairs between. Sometimes the anterior or posterior pair remains undeveloped.

Habits.—In general but one species occurs in a given locality, but *Zapus hudsonius*, which has the widest range of all, seems to be always present throughout the range of the subgenus *Napaozapus*, the members of which are almost invariably found in deep woods near streams. All the other species delight in meadows, shrubby fields, and thickets along

¹ Preliminary report on the Vertebrata discovered in the Port Kennedy Bone Cave <Proc. Am. Philos. Soc., XII, p. 86, 1871.

Vertebrate Remains from Port Kennedy Bone Deposit <Journ. Acad. Nat. Sci. Phila., 2d ser., XI, p. 200, 1899.

² Spelled *hudsonianus* by Zittel, Handbuch der Paläontologie, IV, p. 527, 1893.

the edges of woods, and show a marked preference for moist locations. During the summer Jumping Mice are often seen in meadows and fields, and are more readily detected during the haying season than at other times, when they are driven from their hiding places while the grass is being cut. When disturbed they move off by a series of frog like leaps, and often remain motionless after a jump or two, especially when frightened from a nest. In leaping they are greatly assisted by their long tails, which aid in preserving their balance as in the case of other animals similarly endowed. If, by any accident, a portion of the tail is lost, the power of balancing is greatly impaired, and the animal, if startled, seems unable to pursue a direct course because of failure to land properly on its feet. Some of the earlier writers ascribe to the animal the power of leaping 4 or 5 yards. Such statements are probably exaggerated, but it is certain that *Zapus* does possess remarkable leaping powers, and when disturbed will jump 6 or 8 feet, and under some circumstances perhaps much farther. In their chosen haunts these mice do not follow beaten paths or runways like many small mammals, notably meadow mice, but seem to wander rather indiscriminately, availing themselves to some extent of natural pathways or open places.

The birth of the young (five or six in number) which occurs in a nest, ordinarily underground but sometimes placed in a hollow tree, usually takes place in May or June. Sometimes, however, it occurs as late as September; from which it seems probable that a second litter is raised, or that the breeding season continues throughout the summer. Three specimens obtained by my brother at Wilmington, Mass., September 25, 1897, which with their parents were turned up by a plow, were so young that the posterior upper molars had just appeared.

During the latter part of summer *Zapus* makes a globular nest of grass about 4 inches in diameter, with a small entrance at the side. All that I have seen were on the ground in meadows among thick grass or small bushes. One that I examined was made entirely of the straight narrow leaves of grass, and was a very beautiful little home; but though seemingly compact, it was so frail that it was impossible to preserve it. These nests are usually occupied by two individuals, presumably a pair, and seem to be used only at the close of the breeding season.

The hibernation of *Zapus* has been frequently noticed and several interesting articles have appeared mainly on this habit.¹ All the species, so far as known, hibernate during winter, though in one, at least, hibernation is not always complete—that is, individuals may awake and come out during warm intervals, after the manner of the common skunk. Dr. Merriam mentions having seen Jumping Mice abroad in northern New York on several occasions during the unusually mild winter of 1881–82. Messrs. H. H. and C. S. Brimley report that they have no positive evidence of the hibernation of *Zapus hudsonius americanus* at Raleigh, N. C., although they add that the animal is too rare to enable them to

¹Davies, Trans. Linn. Soc. London, IV, p. 155, 1798; Barton, Trans. Am. Philos. Soc., VI, p. 143, 1804; Tenney, Am. Nat., VI, p. 330, 1872.

find out much about it. Hibernation varies with the locality, but usually begins about the time of the first heavy frosts and lasts until spring. The fall pelage is usually assumed and the animals become exceedingly fat before entering winter quarters. Although they often lay up stores of food in nests or burrows during summer, it is not known that they use this food during winter. The animals are generally found singly (sometimes in pairs) in nests in holes at a depth varying from a few inches to 2 or 3 feet below the surface. They lie rolled up like a ball with the feet close together and tail curled about them. If removed from the nest and subjected to a moderate degree of heat they revive and in the course of a few hours move about freely, but generally resume their lethargic state if again exposed to cold. The pulse and respiration are very slow.

Hibernation sometimes takes place in a nest above ground. Dr. A. K. Fisher tells me that some years ago a *Zapus* was brought to him at Lake George, New York, which some men at work in the woods had found hibernating in an elaborate nest of grass and moss, exposed by moving a log. This nest was destroyed, but when the animal was given material it constructed another, in which it resumed its interrupted sleep. It was occasionally awakened, and observations were taken on its weight, respiration, and heart beats, after which it would relapse into its state of lethargy.

NOMENCLATURE.

Five generic and 30 specific and subspecific names have been applied to various forms of Jumping Mice now included in the genus *Zapus*. In order to discuss the different species and subspecies intelligently it becomes necessary to separately consider each of these names, which may be taken up alphabetically.

GENERIC NAMES.

Dipus Zimmermann, Geog. Geschichte des Menschen u. vierfüßigen Thiere, II, p. 358, 1780. The original description of the genus *Dipus* included six species: *D. jaculus*, *D. sagitta*, *Yerbua capensis* (= *Mus cafer*), *D. longipes*, *D. tamaricinus* and *D. hudsonius*. The name was subsequently restricted to the Old World jerboas.

Gerbillus Desmarest, Nonv. Dict. d'Hist. Nat., XXIV, p. 222, 1804. A genus of Old World rodents allied to *Meriones*. Four nominal species of American Jumping Mice were referred to this genus by Rafinesque in 'Précis des Découv. somiologiques' (p. 14, 1814), and Am. Monthly Magazine (III, p. 446, Oct., 1818).

Meriones Illiger, Prod. Syst. Mamm. et Avium, p. 82, 1811. The name was originally proposed by Illiger for a group including *Dipus tamaricinus* and *D. meridianus*. Cuvier apparently proposed it independently, twelve years later, for the American Jumping Mouse (*Dents des Mamm.*, pp. 187, 256, 1823).

Jaculus Erxleben, Syst. Nat., p. 404, 1777. A genus of Old World jerboas. The name was first used for North American species by Wagler (Nat. Syst. Amphibien, p. 23, 1830).

Zapus Coues, Bull. U. S. Geol. Surv. Terr., I, 2d ser., No. 5, p. 253, 1875. The first tenable generic name based on a North American Jumping Mouse.

SPECIFIC AND SUBSPECIFIC NAMES.

Acadicus (*Meriones*) Dawson, Edinburgh New Philos. Journ., new series, III, p. 2, 1856. Dawson, after unmistakably referring the animal since described as *Zapus insignis* to the *Meriones labradorius* of Richardson's Fauna Boreali-Americana (i. e., *Z. hudsonius*), goes on to describe *Z. hudsonius* from Nova Scotia, calling it provisionally *Meriones acadicus*.

Alascensis (*Zapus*) Merriam, Proc. Biol. Soc. Wash., XI, p. 223, July 15, 1897. Dr. C. Hart Merriam has described a subspecies of *Z. hudsonius* under this name, from specimens collected at Yakutat Bay, Alaska.

Alleni (*Zapus*) Elliot, Field Columbian Mus., Pub. 27, Zool. Ser., I, No. 10, pp. 212-213, March, 1898. Under this name Mr. D. G. Elliot described the form of *Zapus* inhabiting the Sierra Nevada in California.

Americanus (*Dipus*) Barton, Trans. Am. Philos. Soc., IV, No. XII, p. 115, 1799. Under this name Benjamin Smith Barton described specimens from the vicinity of Philadelphia, Pa. Later (ibid, VI, 1804) he discussed the habit of hibernation and presented a figure of the animal. Mr. C. F. Batchelder has recently revived *americanus* for the form of *Z. hudsonius* inhabiting the Upper Austral zone in the Eastern States. (Proc. New Eng. Zool. Club, I, p. 6, 1899.)

Brachyurus (*Gerbillus*) 'Rafinesque.' A name referred to by Fischer (Syn. Mamm., p. 340, 1829) without reference, and included in the synonymy of *Zapus* by Coues (Mon. N. Am. Rodentia, p. 468, 1877). I have been unable to find the original reference, but the inapplicability of the name is self-evident.

Canadensis (*Dipus*) Davies, Trans. Linn. Soc. London, IV, p. 157, 1798. Maj. Gen. Thomas Davies described specimens which he had procured in the vicinity of Quebec, Canada. He undoubtedly referred to an animal of the *hudsonius* type, and as specimens from that region do not deserve separation from the typical form, the name becomes a synonym of *hudsonius*.

Daviesii (*Gerbillus*) Rafinesque, 'Precis des Découv. somiologiques, p. 14, 1814.' Rafinesque is said to have renamed *Dipus canadensis* after its describer.

Hardyi (*Zapus*) Batchelder, Proc. New. Eng. Zool. Club, I, p. 5, February 8, 1899. Mr. C. F. Batchelder has recently applied this name to specimens from Mount Desert Island, Maine. From a careful study of the material at present accessible, I can find no characters of importance to separate this form from *hudsonius* as here restricted.

Hudsonius (*Dipus*) Zimmermann, Geog. Geschichte des Menschen u. vierfüßigen Thiere, II, p. 358, 1780. This is the first specific name proposed for any species of Jumping Mouse in America, and undoubtedly refers to the common eastern species which has so long borne the name. It is the only species thus far known to occur about Hudson Bay—the locality of Pennant's 'long-legged mouse,' to which Zimmermann referred.

Imperator (*Zapus*) Elliot, Field Columbian Mus., Pub. 30, Zool. Ser., I, No. 11, p. 228, February 1, 1899. Mr. D. G. Elliot has recently described a *Zapus* from the Olympic Mountains of Washington, but specimens from that region not being considered separable from typical *Z. trinotatus*, the name becomes a synonym.

Insignis (*Zapus*) Miller, Am. Naturalist, XXV, p. 472, August, 1891. Mr. Gerrit S. Miller, jr., described the species erroneously referred to *M. labradorius* (*Z. hudsonius*) by Dawson, from specimens collected on the Restigouche River, New Brunswick.

Labradorius (*Dipus*) Kerr, Animal Kingdom, p. 276, 1792. Based on the 'Labradore Jerboid Rat' of Pennant's History of Quadrupeds, 1781. Kerr says, "Inhabits Hudson's Bay and Labradore. This species was sent over from Hudson's Bay by Mr. Graham." Although Labrador is mentioned in the habitat of the species, the specimen came from Hudson Bay, and consequently the name should be restricted to the animal from that region, thus becoming a synonym of *hudsonius*.

Ladas (*Zapus*) Bangs, Proc. New Eng. Zool. Club, I, p. 10, February 28, 1899. Under this name Mr. Outram Bangs has described, as a subspecies, the form of *hudsonius* inhabiting the Labrador Peninsula.

Leonurus (*Gerbillus*) Rafinesque, Am. Monthly Mag., III, p. 446, October, 1818. From the description—"body fallow, ears very long, white inside, tail as long as body, black with a fallow tuft at end, length 6 inches, body 3"—the animal is plainly not referable to *Zapus*.

Longipes (*Mus*) Zimmermann, in Pennant's Arkt. Zool. I, p. 131, 1787.* Zimmermann erroneously identified a Jumping Mouse in spirits, sent from Hudson Bay by Mr. Graham, as *Mus longipes* of Pallas, an animal from the deserts about the Caspian Sea.

Macrourus (*Gerbillus*) 'Rafinesque,' a name referred to by Fischer (Syn. Mamm., p. 340, 1829), without reference, and included in the synonymy of *Zapus* by Dr. Coues (Mon. N. Am. Rodentia, p. 468, 1877). I have been unable to find the original reference.

Megalops (*Gerbillus*) Rafinesque, Am. Monthly Mag., III, p. 446, October, 1818. This animal he describes as follows: "Body gray, belly white." * * * "Total length 5 inches, body only 2. From the barrens of Kentucky." This can not apply to any species of Jumping Mouse.

Mellivorus (*Dipus*) Barton, Trans. Am. Philos. Soc., VI, p. 143, 1804.

* Fide Coues, Mon. N. Am. Rodentia, p. 467, 1877. I have not seen this edition of Pennant.

This name occurs incidentally in the text, being applied to a supposed new species, with remarks on its reputed habit of passing the winter in beehives and living on the honey.

Microcephalus (**Meriones**) Harlan, Proc. Zool. Soc. London, p. 1, 1839. Under this name Dr. Harlan described specimens from the vicinity of Philadelphia, Pa. The name, being antedated by *americanus* Barton, becomes a synonym.

Montanus (**Zapus**) Merriam, Proc. Biol. Soc. Wash., XI, p. 104, April 26, 1897. Dr. C. Hart Merriam described the form inhabiting the Cascade Range in Oregon, under the name *Zapus trinotatus montanus*, but the characters seem to warrant its recognition as a full species.

Nemoralis (**Meriones**) Geoffroy St. Hilaire, Dict. Classique d'Hist. Nat., VII, p. 323, Fev., 1825. Under this name Geoffroy published a careful description of two specimens (without locality), in the Museum d'Histoire Naturelle of Paris, which were figured by F. Cuvier and served as the basis of Cuvier's genus *Meriouxes*. There is nothing in the description of *nemoralis* that gives any clue to the specific identity of the animal.

Niger (**Gerbillus**) Rafinesque, Am. Monthly Mag., IV, p. 106, December, 1818. A *nomen nudum* used by Rafinesque in an article entitled 'General Account of the Discoveries made in the Zoology of the Western States.'

Pacificus (**Zapus**) Merriam, Proc. Biol. Soc. Wash., XI, p. 104, April 26, 1897. Under this name Dr. C. Hart Merriam described a form represented in the Biological Survey collection by specimens collected in upper Rogue River Valley, Oregon.

Princeps (**Zapus**) Allen, Bull. Am. Mus. Nat. Hist., V, pp. 71-73, April 28, 1893. Dr. J. A. Allen described under this name a large species from Florida, La Plata County, Colo., which proves to be a very distinct form inhabiting the Rocky Mountain region of the United States.

Saltator (**Zapus**) Allen, Bull. Am. Mus. Nat. Hist., N. Y., XII, p. 3, March 4, 1899. Dr. J. A. Allen has recently described under this name a well-marked form inhabiting northern British Columbia and the adjacent region.

Setchuanus (**Zapus**) Pousargues, Ann. Sci. Nat., 8e sér., I, No. 4, p. 220, Avril, 1896. The only name based on the single Old World species of *Zapus*.

Soricinus (**Gerbillus**) Rafinesque, 'Précis des Découv. somiologiques p. 14, 1814.' I have not seen the original reference.

Sylvaticus (**Gerbillus**) Rafinesque, Am. Monthly Mag., III, p. 354, September, 1818. A *nomen nudum* used by Rafinesque in a letter addressed to "Samuel L. Mitchill, president, and the other members of the Lyceum of Natural History, * * * dated at Louisville, Falls of Ohio, 20 July, 1818."

Tenellus (**Zapus**) Merriam, Proc. Biol. Soc. Wash., XI, p. 103, April 26, 1897. Under this name Dr. C. Hart Merriam has described a form from Kamloops, British Columbia.

Trinotatus (**Zapus**) Rhoads, Proc. Acad. Nat. Sci., Phila., 1849, p. 421 (January 15, 1895). Under this name Mr. S. N. Rhoads described, from

specimens taken on Lulu Island, near the mouth of Fraser River, a well marked form inhabiting the Pacific coast region from Fraser River, British Columbia, to Humboldt Bay, Calif.

Genus ZÁPUS Coues.

Dipus Zimmermann, Geog. Geschichte d. Menschen u. vierfüssigen Thiere, II, p. 358, 1780.

Gerbillus Rafinesque, 'Précis des Découv. somnologiques, p. 14, 1814'. (Not *Gerbillus* Desmarest, 1804.)

Meriones F. Cuvier, Dents des Mamm., pp. 187, 256, 1823. (Not *Meriones* Illiger, 1811.)

Jaculus Wagler, Nat. Syst. Amphibien, p. 23, 1830. (Not *Jaculus* Erxleben, 1777.)

Zapus Coues, Bull. U. S. Geol. Surv. Terr., I, 2d ser., No. 5, p. 253, 1875.

Characters.—Skull not massive; brain case rather high and rounded; antorbital foramen large and oval; zygomata not widely spreading, broadly expanded anteriorly where the malar extends upward to the lachrymal. Teeth 16 or 18 (upper premolar present or wanting); enamel much folded; upper incisors compressed, much curved, deeply sulcate, and deep orange.

Body enlarged posteriorly; hind legs and tail greatly developed, the latter much exceeding length of head and body. Tail slender, uniformly tapering. Toes of hind foot five, each with separate metatarsal. Upper parts ochraceous; median dorsal band dark. Under parts white (often suffused with ochraceous); one species with brown ventral stripe.

KEY TO THE SUBGENERA OF ZAPUS.

Premolar present:

Enamel folds closely crowded; tail not tipped with white; ears rather long; lower parts white or ochraceous *Zapus*

Enamel folds not crowded; tail tipped with white; ears rather short; lower parts white with brown ventral stripe. *Eozapus*

Premolar absent:

Enamel folds closely crowded; tail tipped with white; ears rather long; lower parts white *Napaeozapus*

LIST OF SPECIES AND SUBSPECIES, WITH TYPE LOCALITIES.

Subgenus *Zapus*.

<i>Zapus alascensis</i> .	Yakutat, Alaska.
<i>alleui</i> .	Pyramid Peak, Lake Tahoe, California.
<i>americanus</i> .	Philadelphia, Pennsylvania.
<i>campestris</i> nob.	Bear Lodge Mountains, Wyoming.
<i>hudsonius</i> .	Hudson Bay.
<i>ladas</i> .	Rigoulette, Hamilton Inlet, Labrador.
<i>major</i> nob.	Warner Mountains, Oregon.
<i>minor</i> nob.	Wingard, Saskatchewan.
<i>montanus</i> .	Crater Lake, Mount Mazama, Oregon.
<i>nevadensis</i> nob.	Ruby Mountains, Nevada.
<i>orarius</i> nob.	Point Reyes, California.
<i>oregonus</i> nob.	Elgin, Oregon.
<i>pacificus</i> .	Prospect, Rogue River Valley, Oregon.
<i>princeps</i> .	Florida, La Plata County, Colorado.
<i>saltator</i> .	Telegraph Creek, Northwest Territory.
<i>tenellus</i> .	Kamloops, British Columbia.
<i>trinitatus</i> .	Lulu Island (mouth Fraser River), British Columbia.

Subgenus *Napaozapus*.

- abietorum* nob. Peninsula Harbor, Ontario.
- insignis*. Restigouche River, New Brunswick.
- roanensis* nob. Magnetic City, Roan Mountain, North Carolina.

Subgenus *Eozapus*.

- setchuanus*. Ta-tsien-lou, Szechuen, China.

Subgenus ZAPUS Coues.

Type Zapus hudsonius (Zimmermann), from Hudson Bay.

Subgeneric characters.—Teeth: *i.* $\frac{1-1}{1-1}$, *p.* $\frac{1-1}{0-0}$, *m.* $\frac{3-3}{3-3}$ = 18. Upper pre-molar very small, nearly cylindrical; anterior upper molar large, broadly oval; *m* 2 similar, but noticeably smaller; *m* 3 considerably smaller and nearly circular. Lower molars similar in shape and relative size (fig. 1). Enamel folds closely crowded. Interorbital constriction of medium width; frontal region moderately swollen; brain case rather high; rostrum slender and somewhat attenuated.

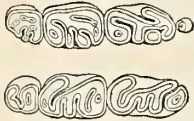


FIG. 1.—Molar teeth of *Zapus hudsonius* from Tower, Minnesota (No. 72695, U. S. Nat. Mus.) × 6.

Upper parts as in entire genus; lower parts white, sometimes suffused with color of sides; tail more or less distinctly bicolor, normally without white tip.

KEY TO SPECIES OF THE SUBGENUS ZAPUS.

- Lower parts much suffused with color of sides *orarius*.
- Lower parts not much suffused with color of sides.
 - Size, large; hind foot usually more than 32 mm.
 - Ears never conspicuously bordered with whitish.
 - Larger; pencil of tail never normally white; lower parts often suffused with ochraceous *trinotatus*.
 - Smaller; pencil of tail usually white; lower parts never suffused with ochraceous *alleni*.
 - Ears usually conspicuously bordered with whitish.
 - Sides light ochraceous buff *nevadensis*.
 - Sides not light ochraceous buff.
 - Skull narrow; incisive foramina very large *saltator*.
 - Skull broad; incisive foramina not very large.
 - Hind foot about 35 mm *major*.
 - Hind foot about 32 to 34 mm.
 - Incisive foramina broad posteriorly *oregonus*.
 - Incisive foramina narrow posteriorly *princeps*.
 - Size medium or small; hind foot usually below 32 mm.
 - Size medium; hind foot 30 to 32 mm.; total length of adults more than 215 mm.
 - Skull rather heavy; brain case broad; incisive foramina rather large.
 - Dorsal area not very distinct *pacificus*.
 - Dorsal area distinct.
 - Rostrum considerably deflected *minor*.
 - Rostrum not much deflected *montanus*.

Skull rather light; brain case narrow; incisive foramina small.

Coloration dark and dull.

Larger; basilar length of skull usually more than 18 mm.

alascensis.

Smaller; basilar length of skull usually under 17.5 mm. *tenellus.*

Coloration not dark and dull.

Dorsal area very much flecked with color of sides; fall pelage with dorsal area nearly black *campestris.*

Dorsal area not much flecked with color of sides; fall pelage with dorsal area not very dark.

Larger; hind foot about 32 mm.; tail usually more than 140 mm. *ladas.*

Smaller; hind foot usually 30 or 31 mm.; tail usually below 135 mm. *hudsonius.*

Size small; hind foot usually below 30 mm.; total length of adults usually under 215 mm. *americanus.*

ZAPUS HUDSONIUS (Zimmermann). Hudson Bay Jumping Mouse.

(Pl. I, figs. 3, 3a.)

- 1780. *Dipus hudsonius* Zimmermann, Geog. Geschichte d. Menschen u. vierfüßigen Thiere, II, p. 358.
- 1792. *Dipus labradorius* Kerr, Animal Kingdom, p. 276 (based on the 'Labradore Jerbooid Rat of Pennant').
- 1798. *Dipus canadensis* Davies, Trans. Linn. Soc. London, IV, p. 157.
- 1822. *Gerbillus canadensis* Desmarest, Mammalogie, II, p. 321.
- 1825. *Gerbillus labradorius* Harlan, Fauna Am., p. 157 (in part).
- 1829. *Meriones labradorius* Richardson, Fauna Boreali-Americana, I, p. 144. (Not *M. labradorius* Dawson, 1856.)
- 1830. *Jaculus americanus* Wagler, Nat. Syst. Amphibien, p. 23.
- 1839. *Meriones microcephalus* Harlan, Proc. Zool. Soc. London, 1839, p. 1.
- 1843. *Jaculus labradorius* Wagner, Suppl. Schreber's Säugthiere, III, p. 294.
- 1856. *Meriones acadicus* Dawson, Edinburgh New Philos. Journ., new ser., III, p. 2.
- 1857. *Jaculus hudsonius* Baird, Mamn. N. Am., p. 430 (in part).
- 1875. *Zapus hudsonius* Coues, Bull. U. S. Geol. Surv. Terr., 2d Ser., No. 5, p. 253; Mon. N. Am. Rodentia, p. 467, 1877 (in part), and recent authors (in part).
- 1899. *Zapus hudsonius canadensis* Batchelder, Proc. New Eng. Zool. Club, I, p. 4.
- 1899. *Zapus hudsonius hardyi* Batchelder, Proc. New Eng. Zool. Club, I, p. 5. (Mount Desert Island, Maine.)

Type locality.—Hudson Bay.

Geographic distribution.—As restricted in the present paper, this species is found from the southern shores of Hudson Bay south to New Jersey, and in the mountains to North Carolina, west to Iowa and Missouri, and northwest to Alaska. It intergrades with *Z. americanus* in the upper part of the Carolinian zone in the Eastern States; with *campestris* along the edge of the Great Plains, and probably with *alascensis* somewhere in northern British America.

General characters.—Size medium, smaller than *Z. insignis*, *Z. trinotatus*, or *Z. princeps*. Skull less massive, with small molars and incisive foramina.

¹ "Inhabits Hudson's Bay and Labradore. This species was sent over from Hudson's Bay by Mr. Graham."—Kerr.

Color.—*Summer pelage:* Fur of entire upper parts plumbeous at base, with tips of hairs ranging from yellowish fawn to rather dark ochraceous, rather thickly flecked with black-tipped hairs; broad dorsal stripe reaching from upper part of face to base of tail much darker than remainder of upper parts, the black-tipped hairs predominating; tail rather sharply bicolor, grayish brown above and whitish beneath; lower parts white, sometimes suffused with color of sides; feet white. *Fall pelage:* Ochraceous of sides duller and more yellowish, encroaching more on the dark dorsal area, which is sometimes almost obliterated. *Young of the year* with more ochraceous in fall pelage than the adults, and a greater tendency to fulvous wash on lower parts.

Cranial characters.—Skull rather lightly built, with rather narrow brain case, small incisive foramina, and small molars; zygomata not widely spreading; rostrum not appreciably deflected.

Measurements.—Two specimens from James Bay, Canada, measured from alcohol, average: Total length, 209; tail vertebrae, 124; hind foot, 30.5. Eleven from Tower, Minn., average: Total length, 218; tail vertebrae, 133; hind foot, 30.2. Thirty-four adults from Keene Valley, Essex County, N. Y., average:¹ Total length, 216.6; tail vertebrae, 129.25; hind foot, 31.25. *Skull:* An adult skull from James Bay measures: Basilar length, 18.5; zygomatic breadth, 11; mastoid breadth, 10; interorbital constriction, 4.2; incisor to postpalatal notch, 8.5; foramen magnum to postpalatal notch, 8; fronto-palatal depth at middle of molar series, 6.5. An adult ♀ from Ossipee, N. H., measures: Basilar length, 18.8; zygomatic breadth, 11.6; mastoid breadth, 10; interorbital constriction, 4.3; incisor to postpalatal notch, 8.6; foramen magnum to postpalatal notch, 8.2; fronto-palatal depth at middle of molar series, 6.2.

General remarks.—*Zapus hudsonius*, the type of the genus, was until recently the only well established species. The foregoing list of synonyms indicates that it attracted the attention of many naturalists during the early part of the century, all the names published previous to 1856 referring almost exclusively to it. *Jaculus hudsonius* of Baird (= *Zapus hudsonius* Coues) is a composite species including nearly a dozen forms now recognized as distinct. The distribution of *hudsonius*, including its four well-marked subspecies, is by far the most extensive in the genus, few North American rodents equaling it in this respect.

The only specimens of *Zapus* from Hudson Bay at present available are four alcoholic examples, in rather poor condition, from James Bay, and a part of a skin from Fort Churchill, Northwest Territory. This skin has evidently been in alcohol, and hence its color can not be depended upon. I have removed several skulls from the James Bay specimens, including one perfect adult. Since this skull agrees essentially with skulls from Tower, Minn., from which place the Biological Survey has a large series, these specimens have been assumed to be

¹ Fide Batchelder.

fairly typical and have been used for comparison in most instances. It is quite possible, however, that a series of skins from Hudson Bay would measure slightly more than the Minnesota specimens, and would perhaps differ in color. While this material, taken in connection with what is available from the type locality is sufficient for comparison with the subspecies here recognized, it will not permit the recognition of other nominal forms which may eventually prove to be well founded. A skull from Saint Catharines, Ontario, however, which may be considered a topotype of *canadensis*, is identical in appearance with one from James Bay.

Specimens examined.—Total number, 319, from the following localities:

Northwest Territory: James Bay, 4; Fort Churchill, 1; Fort Rae, 1; Fort Resolution, 1.

Ontario: Nepigon, 7; North Bay, 6; Mount Forest, 3; Michipicoten, 1; Saint Catharines, 6.

New Brunswick: Oak Bay, 30.

Nova Scotia: Halifax, 6; James River, 2; Digby, 4.

Maine: Walker Pond, 4; Mount Desert Island, 4.

New Hampshire: Ossipee, 1; Fabyans, 1.

Vermont: Brandon, 1; Mount Mansfield, 1; St. Johnsbury, 2.

Massachusetts: Wareham, 70; North Truro, 6; Middleboro, 2; Wilmington, 3; Lunenburg, 2; Belmont, 2; Ipswich, 1; Concord, 4; Lexington, 1; Dighton, 1; Wellesley, 1; Barnstable Neck, 5.

Connecticut: East Hartford, 1 (not typical); Wethersfield, 2 (not typical).

New York: Peterboro, 39; Catskills, 8; Elizabethtown, 2; Waterville, 1; Patten Mills, 1; Loenst Grove, 7; Lake George, 5.

New Jersey: Lake Hopatcong, 5.

Pennsylvania: Leasuresville, 3.

Maryland: Cumberland, 1; Finzel, Garrett County (6 miles north of Frostburg), 1.

West Virginia: Wheeling, 1.

North Carolina: Roan Mountain, 1; Magnetic City, 1.

Ohio: Portland Station, 1.

Indiana: Terre Haute, 1.

Wisconsin: Racine, 1.

Michigan: Seney, 1.

Minnesota: Lac qui Parle, 1; Elk River, 25; Tower, 26.

ZAPUS HUDSONIUS LADAS Bangs. Labrador Jumping Mouse.

Zapus hudsonius ladas Bangs, Proc. New Eng. Zool. Club, 1, p. 10, Feb. 28, 1899.

Type locality.—Rigoulette, Hamilton Inlet, Labrador.

Geographic distribution.—Eastern Quebec north to Hamilton Inlet, Labrador; limits of range unknown.

General characters.—Larger than typical *Zapus hudsonius* with longer tail and hind foot; coloration darker; differing also in cranial characters.

Color.—*Summer pelage*: Sides rather dark, bright ochraceous buff, moderately lined with blackish-tipped hairs; dorsal area usually less distinct than in typical *hudsonius*, much flecked with ochraceous. Lower parts white, usually more or less suffused with color of sides.

Tail quite sharply bicolored, dusky above and whitish beneath; ears usually edged with ochraceous (whitish in *hudsonius*). Feet white. *Fall pelage*: Dorsal area usually even less distinct than in summer, with the general tinge of entire upper parts yellowish instead of ochraceous.

Cranial characters.—Skull longer than that of typical *hudsonius*; zygomata considerably longer; zygomatic breadth about the same as in largest skulls of *hudsonius*; interorbital constriction slightly wider; brain case higher and averaging slightly longer; rostrum and nasals longer; bullæ considerably larger; molar series averaging slightly longer.

Measurements.—Type No. 4169 ♀ ad., collection of E. A. and O. Bangs: Total length, 238; tail vertebræ, 153; hind foot, 32. Average of five adults from Black Bay, Labrador: Total length, 228; tail vertebræ, 142; hind foot, 32. *Skull*: Average of four adults from Black Bay, Labrador: Basilar length, 18.8; zygomatic breadth, 11.4; mastoid breadth, 10.2; interorbital constriction, 4.5; incisor to postpalatal notch, 8.9; foramen magnum to postpalatal notch, 8.5; fronto-palatal depth at middle of molar series, 6.3.

General remarks.—*Zapus h. ladas* is a fairly well-marked subspecies represented by 23 specimens in the collection of E. A. and O. Bangs, and 5 in the Biological Survey collection. The best characters separating this form from typical *hudsonius*, as here restricted, are the longer tail, larger hind foot, and longer skull, with larger audital bullæ. This latter character is very evident, even in young skulls.

Specimens examined.—Total number, 28, from the following localities:

Labrador: Hamilton Inlet (type locality), 3; Black Bay, 20.

Quebec: Godbout, 5.

ZAPUS HUDSONIUS ALASCENSIS Merriam. Alaska Jumping Mouse.

Zapus hudsonius alascensis Merriam, Proc. Biol. Soc. Wash., XI, p. 223, 1897.

Type locality.—Yakutat, Alaska.

Geographic distribution.—Yakutat Bay, north to Yukon River; limits of range unknown.

General characters.—Similar to *Zapus hudsonius*, but slightly larger and darker.

Color.—Sides dull, dark ochraceous, with many black-tipped hairs; dorsal area quite distinct, but thickly flecked with brownish; beneath pure white; tail rather sharply bicolor.

Cranial characters.—Skull similar to that of typical *hudsonius*, but slightly longer and narrower; zygomata less bowed outward and slightly longer; brain case narrower; molar series longer; crown of last lower molar longer.

Measurements.—Average of four specimens from type locality: Total length, 218; tail vertebræ, 132; hind foot, 31.5. *Skull*: Average of two adults from type locality: Basilar length, 18.2; zygomatic breadth,

10.7; mastoid breadth, 10.2; interorbital constriction, 4.2; incisor to postpalatal notch, 8.5; foramen magnum to postpalatal notch, 8; fronto-palatal depth at middle of molar series, 6.2.

General remarks.—*Zapus h. alascensis* is a fairly well-marked subspecies based on four specimens collected at Yakutat Bay, Alaska. Four additional specimens in the National Museum from Alaska have been examined, but are in such poor condition as to furnish no additional characters. This form undoubtedly intergrades with true *hudsonius* somewhere in northern British America.

Specimens examined.—Total number, 8, from the following localities:

Alaska: Nushagak, 2; Yakutat Bay, 4; Yukon River, 2.

ZAPUS HUDSONIUS AMERICANUS (Barton). Carolinian Jumping Mouse.

Dipus americanus Barton, Trans. Am. Philos. Soc., IV, No. XII, p. 115, 1799.

Zapus hudsonius americanus Batchelder, Proc. New Eng. Zool. Club, I, p. 6, 1899.

Type locality.—Philadelphia, Pa.

Geographic distribution.—From vicinity of Raleigh, N. C., north through Upper Austral zone along coastal plain to southern Connecticut and lower Hudson Valley, intergrading in upper edge of its range with *Z. hudsonius*.

General characters.—Similar to *Zapus hudsonius*, but smaller; dorsal area less distinct; skull and teeth smaller.

Color.—Description of specimens in summer pelage from Raleigh, N. C.: Entire upper parts deep dull ochraceous, the dorsal area very indistinct and but slightly mixed with black-tipped hairs; sides of head much lighter than remainder of upper parts; ears very dark, nearly black; under parts whitish, suffused with ochraceous. In the fall the dorsal area is indistinct and very thickly flecked with yellowish-tipped hairs; sides dull yellowish.

Cranial characters.—Skull considerably smaller than in *Z. hudsonius*, with zygomata more arched and brain case shorter; incisive foramina shorter and relatively broader; interorbital breadth about the same; rostrum relatively deeper and shorter; molar series shorter.

Measurements.—Average of 7 adults from Raleigh, N. C.: Total length, 191.3; tail vertebrae, 115.4; hind foot, 28.3.¹ Two from Washington, D. C., average: Total length, 198.5; tail vertebrae, 117.5; hind foot, 28. *Skull*: Average of two from Raleigh, N. C.: Basilar length, 17; zygomatic breadth, 10.3; mastoid breadth, 9.2; interorbital constriction, 3.9; incisor to postpalatal notch, 8.2; foramen magnum to postpalatal notch, 7.5; fronto-palatal depth at middle of molar series, 6.

General remarks.—It is unfortunate that the name *americanus* must be adopted for this subspecies, since it was based on specimens clearly intermediate between the extremes of this form and true *hudsonius*.

¹ Fide Batchelder.

Specimens examined.—Total number, 54, from the following localities:

New York: Long Island, 3; Montauk Point, 8; Raynor Beach, 1; Roslyn, 3; Sing Sing (not typical), 1.

New Jersey: Chatham, 1; Englewood, 1; Mount Holly, 2; 'New Jersey', 1; Phillipsburg, 1.

Pennsylvania: Chester County, 1; Culver Lake, 2; Delaware County, 2; Marple (Delaware County), 1; Schuylkill, 1; Tinicum (Delaware County), 1; Upper Darby, 1.

Maryland: Kensington, 1; Laurel, 4; Prince George County, 5; Sandy Spring, 1.

District of Columbia: Washington, 2.

Virginia: Accotink, 1; Falls Church, 1.

North Carolina: Raleigh, 7; Weaverville, 1.

ZAPUS HUDSONIUS CAMPESTRIS subsp. nov. Prairie Jumping Mouse.

Type from Bear Lodge Mountains, Wyoming, No. 65872, ♂ ad., U. S. Nat. Museum, Biological Survey Coll. Collected June 12, 1894, by B. H. Dutcher. Original No. 600.

Geographic distribution.—Great Plains from Manitoba southward to Nebraska and westward to Colorado and Wyoming.

General characters.—Similar to *Z. hudsonius*, but slightly larger and brighter in color; differing also in cranial characters.

Color.—*Summer pelage:* Sides bright ochraceous-buff, similar to brightest specimens of *hudsonius* from Eastern States, moderately lined with black-tipped hairs; dorsal area distinct, strongly suffused with color of sides; tail yellowish white below, dark grayish above. *Fall pelage:* Sides dull yellowish instead of ochraceous; dorsal area nearly black, very slightly flecked with yellowish-tipped hairs; dorsal surface of tail much darker than in summer; ears darker, conspicuously bordered with whitish.

Cranial characters.—Skull slightly larger than in *Z. hudsonius*. Skulls from the type locality, compared with those of *Z. hudsonius* from Tower, Minn., agree in interorbital breadth; brain case about as wide but higher; incisive foramina slightly larger; process on lower border of maxillary portion of zygoma more pronounced; viewed in profile, the cranium is more evenly curved.

Measurements.—Average of 4 adults from type locality: Total length, 222; tail vertebrae, 135; hind foot, 30.5. *Skull:* Average of 4 adult skulls from type locality: Basilar length, 18.7; zygomatic breadth, 11.4; mastoid breadth, 10.4; interorbital constriction, 4.2; incisor to postpalatal notch, 8.9; foramen magnum to postpalatal notch, 7.9; frontopalatal depth at middle of molar series, 6.3.

General remarks.—The present well-marked form replaces *Z. hudsonius* over the northern and more elevated portions of the plains west of Minnesota and Iowa to the base of the Rocky Mountains. The characters of this form remain remarkably constant throughout its known range. While no good intergrades have been examined, it doubtless

does intergrade with true *hudsonius* in western Minnesota. The difference between summer and early fall pelage is very great, apparently greater than in any other species.

Specimens examined.—Total number, 35, from the following localities:

Manitoba: Carberry, 2; Portage la Prairie, 1; Red River settlement, 4; Selkirk settlement, 1.

North Dakota: Devils Lake, 1; Fort Sisseton, 1; Fort Wadsworth, 1; Pembina, 2.

Montana: Little Big Horn River, 1.

South Dakota: Custer, 4.

Wyoming: Bear Lodge Mountains (type locality), 6; Cheyenne, 1; Devils Tower, 1; Sherman, 1; Sundance, 1

Nebraska: Columbus, 1.

Colorado: Loveland, 5.

Missouri: Jackson County, 1.

ZAPUS TENELLUS Merriam. Kamloops Jumping Mouse.

Zapus tenellus Merriam, Proc. Biol. Soc. Wash., XI, p. 103, April 26, 1897.

Type locality.—Kamloops, British Columbia.

Geographic distribution.—Known only from vicinity of type locality.

General characters.—Size rather small; ears rather large; coloration dark.

Color.—*Early fall pelage*: Somewhat similar to *Zapus hudsonius* in corresponding pelage but much darker; sides olive yellowish, heavily intermixed with black-tipped hairs; dorsal area somewhat as in *hudsonius*, but not well defined, contrasting less with sides; tail sharply bicolor, darker above and at tip than in *hudsonius*; nose, ears, and outer sides of thigh and forearm dusky, much darker than in *hudsonius*; fore and hind feet soiled whitish.

Cranial characters.—Skull similar to that of *Zapus hudsonius*, but less swollen in frontal region; border of ascending portion of jugal straighter; cranium more arched.

Measurements.—Average of four specimens from type locality: Total length, 208; tail vertebrae, 128; hind foot, 30.5. *Skull*: Average of 3 skulls from type locality: Basilar length, 16.5; zygomatic breadth, 10.6; mastoid breadth, 9.6; interorbital constriction, 4.2; incisor to postpalatal notch, 7.6; foramen magnum to postpalatal notch, 6.9; frontopalatal depth at middle of molar series, 5.7.

General remarks.—*Zapus tenellus* is a well-marked form requiring comparison only with *Z. hudsonius* and its subspecies *alascensis*. In color it resembles *alascensis*, but in cranial characters it departs from *hudsonius* in another direction. There is a possibility that it may be found to intergrade with one of them to the northward, but until such intergradation is proved, it seems best to allow it full specific rank.

Specimens examined.—Total number, 7, from the following localities:

British Columbia: Ducks, 2; Kamloops, 5.

ZAPUS PRINCEPS Allen. Rocky Mountain Jumping Mouse.

(Pl. I, figs. 6, 6a.)

Zapus princeps J. A. Allen, Bull. Am. Mus. Nat. Hist., N. Y., V, p. 71, April 28, 1893.*Type locality*.—Florida, La Plata County, Colo.*Geographic distribution*.—Rocky Mountain region from northern New Mexico northward to Henry House, Alberta.*General characters*.—Size large; skull broad and heavy, much as in *Z. hudsonius*, but much larger.*Color*.—*Summer pelage*: "Above with the middle of the dorsal region pale yellowish brown, profusely mixed with blackish, so that sometimes the blackish color, sometimes the pale yellowish brown, predominates; sides of the body, forming a band on either side about equal to the dark dorsal area, yellowish brown, slightly mixed with blackish, except over a narrow lateral line, adjoining the white of lower parts, which is a clear, strong yellowish brown; lower parts white to the base of the hairs, varying in some specimens to strong ochraceous; tail indistinctly bicolor—grayish white below and pale brown above, and very thinly haired; hind feet grayish white above like the lower surface of the tail; ears narrowly edged with yellowish white."¹ In *fall pelage* adults have the dorsal area with more black and sides more yellowish than in summer; under parts pure white; immature in same pelage similar, but with dorsal area more suffused with yellowish; under parts somewhat suffused with color of sides.*Cranial characters*.—Skull large and heavy, with rather heavy dentition. In some specimens the premolar is very small, occasionally being flattened against the adjacent tooth and scarcely functional. Immature skull short and broad, with large brain case. The incisive foramina in this and closely related species much larger than in those more nearly related to *Z. hudsonius*.*Measurements*.—Average of 7 specimens from Fort Garland, Colo.: Total length, 245; tail vertebræ, 147; hind foot, 32. Average of 4 from La Barge Creek, Wyo.: Total length, 239; tail vertebræ, 150; hind foot, 32. Average of 6 from St. Mary Lake, Mont.: Total length, 232; tail vertebræ, 139; hind foot, 32. *Skull*: Average of 2 adult skulls from Fort Garland, Colo.: Basilar length, 20.7; zygomatic breadth, 12.5; mastoid breadth, 11; interorbital constriction, 4.5; incisor to postpalatal notch, 9.8; foramen magnum to postpalatal notch, 8.8; fronto-palatal depth at middle of molar series, 6.6. One from Preuss Mountains, Idaho: Basilar length, 20.5; zygomatic breadth, 13.2; mastoid breadth, 11; interorbital constriction, 4.8; incisor to postpalatal notch, 9.8; foramen magnum to postpalatal notch, 8.8; fronto-palatal depth at middle of molar series, 6.5.*General remarks*.—*Zapus princeps* is one of the largest species of the genus and has the widest range of any except *Z. hudsonius*. It is mostly confined to mountains, though northward its range extends¹ From original description in Bull. Am. Mus. Nat. Hist., N. Y., V, p. 71, 1893.

over the plains of Assiniboia and Saskatchewan, where it grades into the form here described as subspecies *minor*.

Specimens examined.—Total number, 101, from the following localities:

Alberta: Crow Nest Pass (Rocky Mountains near forty-ninth parallel), 1; Henry House, 2; 15 miles south of Henry House, 3.

British Columbia: Field, 3; Glacier, 1.

Montana: Bear Paw Mountains, 6; Big Snowy Mountains, 12; Blackfoot Agency, 2; Fort Ellis, 1; Paola, 1; Pryor Mountains, 1; St. Marys Lake, 13; Summit, 5; Upper Stillwater Lake, 2.

Idaho: Preuss Mountains, 8; Salmon River Mountains, 5.

Wyoming: Clark Fork, 1; La Barge Creek, 11; Yellowstone Lake, 1.

Colorado: Cochetope Pass, 1; Florida (type locality), 5; Fort Garland, 10; Gold Hill, 2; Rocky Mountains (39°), 1.

New Mexico: Camp Burgwyn, 2; Santa Fe, 1.

ZAPUS PRINCEPS MINOR subsp. nov. Saskatchewan Jumping Mouse.

Type from Wingard, near Carlton House, Saskatchewan, No. 73673, ♀ ad., U. S. Nat. Museum, Biological Survey Coll. Collected July 23, 1895, by J. Alden Loring. Original No. 3123.

Geographic distribution.—Plains of Saskatchewan; limits of range unknown.

General characters.—Similar to *Zapus princeps*, but smaller and differing in color and cranial characters.

Color.—*Summer pelage*: Similar to *Z. princeps*, but dorsal area darker; lower parts suffused with salmon. *Fall pelage* with dorsal area thickly flecked with yellowish and sides yellowish olive; lower parts much as in summer.

Cranial characters.—Skulls of the present form from Osler and Wingard, Saskatchewan, compared with those of *Z. princeps* from Colorado, differ as follows: Smaller; rostrum shorter and more deflected; nasals much narrower anteriorly; brain case relatively higher; interpterygoid fossa shallower.

Measurements.—Average of 10 specimens from Osler, Saskatchewan: Total length, 219; tail vertebrae, 131; hind foot, 29.9. Average of 2 from type locality: Total length, 220; tail vertebrae, 131.5; hind foot, 28. *Skull*: Average of 3 skulls from Osler, Saskatchewan: Basilar length, 18.7; zygomatic breadth, 12.2; mastoid breadth, 10.7; interorbital constriction, 4.4; incisor to postpalatal notch, 9; foramen magnum to postpalatal notch, 8.3; fronto-palatal depth at middle of molar series, 6.7.

General remarks.—*Z. minor* is a well-marked subspecies requiring comparison only with *Z. princeps*. It is evidently the northern plains representative of that species, probably intergrading with it in Assiniboia and eastern Alberta near the United States boundary and along the eastern base of the Canadian Rockies. Lack of specimens from this region makes it impossible to conclusively settle this point.

Specimens examined.—Total number, 21, from the following localities:

Saskatchewan: Osler, 15; Wingard (type locality), 3.

Assiniboia: Indian Head, 3.

ZAPUS PRINCEPS OREGONUS subsp. nov. Blue Mountains Jumping Mouse.

Type from Elgin, Blue Mountains, Oregon, No. 78156, ♂ ad., U. S. Nat. Museum, Biological Survey Coll. Collected May 29, 1896, by Edward A. Preble. Original No. 959.

Geographic distribution.—Blue Mountains of Oregon.

General characters.—Similar to *Zapus princeps*, but differing in color and in cranial characters.

Color.—*Early summer pelage*: Very similar to *Z. princeps*, but slightly lighter on sides, especially anteriorly; dorsal area and head more finely flecked with color of sides, the head especially presenting a grayish appearance; beneath pure white; whitish edging of ears very indistinct.

Cranial characters.—Compared with *Z. princeps* from Colorado, the skull of the present form differs as follows: Brain case more rounded, especially shorter and more rounded behind; zygomata shorter; incisive foramina larger and very much broader behind; audital bullæ slightly smaller.

Measurements.—*Type*: Total length, 250; tail vertebræ, 154; hind foot, 33. Average of 3 adults from Strawberry Butte, Oregon: Total length, 243; tail vertebræ, 146; hind foot, 32. *Skull*: Average of 3 adult skulls from type locality: Basilar length, 20.1; zygomatic breadth, 12.9; mastoid breadth, 11; interorbital constriction, 4.4; incisor to postpalatal notch, 9.7; foramen magnum to postpalatal notch, 8.5; frontopalatal depth at middle of molar series, 6.5.

General remarks.—The present form seems to replace *Z. princeps* throughout the Blue Mountains region of northeastern Oregon. Specimens from this region agree very constantly with each other and differ from typical *Z. princeps* as above indicated. It is much larger than and not at all closely related to *Z. montanus*, its relative on the west. A specimen from Mountain City, Nev., in the Brunneau Mountains, though differing in many details, is doubtfully referred to this form. Externally it differs considerably from *Z. oregonus* and agrees with *Z. nevadensis*, from the Ruby Mountains, Nev., though the skull shows that it is not closely related to that form. The skull of the Mountain City specimen also differs somewhat from that of typical *Z. oregonus*, and additional material will doubtless show it to represent a form which merits separation.

Specimens examined.—Total number, 9, from the following localities:

Oregon: Elgin, 3; Harney (10 miles north), 2; Strawberry Butte, 3.

Nevada: Mountain City (not typical), 1.

ZAPUS MAJOR sp. nov. Warner Mountain Jumping Mouse.

Type from Warner Mountains, Oregon, No. 79983, ♀ ad., U. S. Nat. Museum, Biological Survey Coll. Collected August 4, 1896, by C. Hart Merriam and Vernon Bailey. Original No. 5720.

Geographic distribution.—Known only from the type locality.

General characters.—Similar externally to *Zapus princeps*, but larger; skull closely resembling that of *Z. trinotatus*.

Color.—*Type in summer pelage:* Sides ochraceous-buff, moderately lined with black-tipped hairs; back slightly darker, thickly flecked with black; tail not sharply bicolored; beneath, dull white; feet soiled white.

Cranial characters.—Skull massive; brain case high and broad; zygomata rather short; palate broad and long; interpterygoid fossa broad and shallow, with bordering edge of palate much excavated. Maxillary portion of zygomata heavy and nearly perpendicular to main axis of skull; incisive foramina large and elliptical. The skull of *Z. major* differs from those of *Z. trinotatus* taken near type locality and from northern Washington, as follows: Rostrum larger and nasals broader; brain case higher; ascending portion of jugal steeper.

Measurements.—*Type:* Total length, 255; tail vertebrae, 155; hind foot, 35. *Skull (type):* Basilar length, 20.4; zygomatic breadth, 13; mastoid breadth, 11.2; interorbital constriction, 4.7; incisor to post-palatal notch, 10; foramen magnum to postpalatal notch, 8.6; fronto-palatal depth at middle of molar series, 6.5.

General remarks.—The present form is based on a single adult specimen from the Warner Mountains, in southern Oregon. The skull bears some resemblance, especially in the form of the brain case, to those of *Z. trinotatus* and its subspecies *alleni*. It is apparently shut off by natural barriers from all of the forms surrounding it, with the possible exception of *Z. montanus*, and has no close affinities with them. From *Z. montanus* it differs to such an extent that intergradation is out of the question.

Specimens examined.—The type.

ZAPUS NEVADENSIS sp. nov. Nevada Jumping Mouse.

Type from Ruby Mountains, Nevada, No. 94185, ♀ ad., U. S. Nat. Museum, Biological Survey Coll. Collected June 21, 1898, by Vernon Bailey. Original No. 6581.

Geographic distribution.—Known only from type locality.

General characters.—Size rather large; color light; molar series long and rather narrow.

Color.—Dorsal area about as in *Z. princeps*, pale yellowish-brown, profusely mixed with black-tipped hairs; sides light ochraceous-buff, becoming almost white on cheeks, moderately lined with black-tipped hairs, the basal portion of fur cinereous, noticeably lighter in color than in *Z. princeps*, with a few white hairs intermixed; beneath, pure white.

Cranial characters.—The skull of the type and only known specimen is large, but rather lightly built. Compared with skulls of *Z. princeps* from Colorado it is smaller and flatter; brain case shorter and more rounded; incisive foramina small and elliptical; bullae smaller; molars rather narrow, but molar series long; zygomata short and not broadly spreading. Compared with skulls of *Z. trinotatus alleni* from the Sierra Nevada, Calif., it differs as follows: Smaller, but with molar series longer; incisive foramina smaller and narrower posteriorly; zygomata

shorter and less spreading; brain case flatter; rostrum shorter. Compared with the skull of the specimen from Mountain City, Nev., doubtfully referred to *Z. oregonus*, the type differs as follows: Slightly smaller and younger; zygomata shorter and zygomatic breadth slightly less; shape of brain case not strikingly different; molar series decidedly longer; incisive foramina very much smaller and narrower posteriorly; postpalatal notch indenting palate farther, nearly to middle of posterior molars; bullæ slightly smaller. Mandible slighter, but lower molar series longer.

Measurements.—Type: Total length, 242; tail vertebræ, 150; hind foot, 33. *Skull* (type): Basilar length, 19.4; zygomatic breadth, 12; mastoid breadth, 11; interorbital constriction, 4.6; incisor to postpalatal notch, 9.5; foramen magnum to postpalatal notch, 8; fronto-palatal depth at middle of molar series, 6.

General remarks.—The present form is based on a single adult specimen collected in the Ruby Mountains in east-central Nevada. It does not seem to be closely related to any of the forms whose ranges partially surround its habitat. While it is probably most nearly related to *Z. princeps*, it seems to differ enough to warrant specific separation.

Specimens examined.—The type.

ZAPUS TRINOTATUS Rhoads. Northwest Jumping Mouse.

(Pl. I, figs. 5, 5a.)

Zapus trinotatus Rhoads, Proc. Acad. Nat. Sci. Phila., 1894, p. 421, Jan. 15, 1895.

Zapus imperator Elliot, Field Columbian Mus., Pub. 30, Zool. Ser., I, No. 11, p. 228, Feb. 1, 1899; *ibid.*, No. 13, pp. 260-261, 1 fig. in text, March, 1899. (Type from Sieg's ranch, Elwah River, Clallam County, Wash.)

Type locality.—Lulu Island, mouth of Fraser River, British Columbia.

Geographic distribution.—Coast region of southern British Columbia, Washington (including Cascades), Oregon (west of western base of Cascades), and northern California, south to Humboldt Bay.

General characters.—Size large; color bright; skull large and broad.

Color.—*Summer pelage:* Sides dark ochraceous-buff, rather heavily lined with black-tipped hairs; dorsal area very distinct, moderately flecked with color of sides; beneath white, frequently suffused or blotched with fulvous, especially in young; outer surface of forearm and legs dusky; tail quite strongly bicolored, in dried skins dusky brown above and yellowish-white below. In *early fall pelage* the sides are dull yellowish instead of ochraceous; dorsal area duller than in summer, much more thickly flecked with yellowish hairs. In immature individuals the dorsal area is especially indistinct.

Cranial characters.—Skull large and rather heavily built, about the size of that of *Z. princeps*. Brain case broader and more globular; zygomatic breadth greater; palate shorter; molars more lightly built than in that species.

Measurements.—Average of 4 adults from Neah Bay, Wash.: Total length, 248; tail vertebra, 153; hind foot, 33.5. Four specimens from Lake Washington, Wash., average: Total length, 240; tail vertebra, 147.5; hind foot, 34.2. Ten specimens from Lake Cushman, Wash., average: Total length, 239.5; tail vertebra, 144.5; hind foot, 32.5. *Skull*: Six adult skulls from five localities in Washington, average: Basilar length, 20.2; zygomatic breadth, 13; mastoid breadth, 10.9; interorbital constriction, 4.3; incisor to postpalatal notch, 9.6; foramen magnum to postpalatal notch, 8.8; fronto-palatal depth at middle of molar series, 6.7.

General remarks.—*Zapus trinotatus* is one of the largest, and in early summer pelage one of the most showy species in the genus. In the absence of specimens from the exact type locality, specimens from Port Moody, British Columbia, a few miles distant on the mainland, are assumed to be typical.¹ The species is remarkably constant in characters throughout its range, examples from near the type locality not differing much from specimens from Yaquina Bay, Oregon. In the Sierra Nevada of California this species is replaced by the closely related subspecies *alleni*. In a recent paper entitled 'Preliminary descriptions of New Rodents from the Olympic Mountains,' Mr. D. G. Elliot has described the *Zapus* from that region under the name *Zapus imperator*, but in making his comparisons he ignores *Z. trinotatus*, contrasting *imperator* only with *Z. princeps*. Through the courtesy of the author I have been able to examine the type and a topotype of *imperator*. They do not differ sufficiently from *Z. trinotatus*, from the contiguous coast region and from the type locality, to admit of even subspecific separation.

Specimens examined.—Total number, 99, from the following localities:

British Columbia: Lulu Island (type locality), 2; Mount Baker Range, 4; Mount Lehman, 1; Port Moody, 3; Sumas, 3.

California: Crescent City, 1; Mad River (Carson's Camp), 1.

Oregon: Astoria, 1; Beaverton, 3; Elk Head, 1; Glendale, 1; Lincoln County, 1; Marshfield, 1; Salem, 1; Yaquina Bay, 9.

Washington: Cascade River (head), 2; Easton, 3; Granville, 1; Fort Steilacoom, 1; Kichelos Lake, 1; Lake Cushman, 15; Lake Washington, 4; Lapush, 2; Mount Rainier, 12; Mount St. Helens, 3; Neah Bay, 5; Nisqually River, 4; Olympic Mountains (head Elwah River), 2; Olympic Mountains (head Soleduc River), 2; Pacific County, 5; Puget Sound, 3; 'Washington,' 1.

ZAPUS TRINOTATUS ALLENI Elliot. Allen's Jumping Mouse.

Zapus alleni Elliot, Field Columbian Mus., Pub. 27, Zool. Ser., I, No. 10, pp. 212-213, March, 1898.

Type locality.—Pyramid Peak, Lake Tahoe, California.

Geographic distribution.—Mount Shasta and southward in the Sierra Nevada to Mammoth and North Fork of Kern River, California.

¹ Since the above was written the type and a topotype have been examined and found to agree with the specimens from Port Moody.

² Type and topotype of *Zapus imperator*.

General characters.—Similar to *Z. trinotatus*; differing slightly in external and cranial characters.

Color.—*Early summer pelage*: Sides rather pale ochraceous-buff, only moderately lined with black-tipped hairs; dark dorsal area well defined, rather lighter than in *Z. trinotatus*; under parts pure white; never marked with fulvous, except that rarely young specimens are slightly suffused with this color beneath; tail in dried skins rather light grayish-brown above and yellowish-white below; tail lighter toward tip, the pencil often white. Compared with *Z. trinotatus*, adults of this species have dorsal area less flecked with color of sides and fewer black-tipped hairs on sides. Upper surface of tail, ears, head, and outer surface of thighs lighter than in *Z. trinotatus*. Immature individuals in late summer pelage have dorsal area very indistinct and much mixed with ochraceous. *Fall pelage*: An adult taken at Cassel, Calif., August 29 (very fat and doubtless about to hibernate), is in a pelage quite similar to that worn in early summer, but the sides are lighter ochraceous, especially anteriorly, and the dorsal area is more thickly flecked with color of sides. *Z. alleni* apparently does not assume the dull yellowish fall pelage of *Z. trinotatus*.

Cranial characters.—Skulls similar to those of *Z. trinotatus*, but smaller, with much smaller bullæ. From that of *Z. montanus* of the Cascade Range the skull of the present species differs so much as not to require comparison.

Measurements.—Eight adults from Emerald Bay, Lake Tahoe, average: Total length, 234.6; tail vertebrae, 143.6; hind foot, 32.5. Two adults from Mount Shasta, Calif., average: Total length, 249.5; tail vertebrae, 152.5; hind foot, 32.5. *Skull*: Eight skulls from Emerald Bay, Lake Tahoe, average: Basilar length, 19.7; zygomatic breadth, 12.6; mastoid breadth, 10.5; interorbital constriction, 4.5; incisor to postpalatal notch, 9.3; foramen magnum to postpalatal notch, 8.2; fronto-palatal depth at middle of molar series, 6.5.

General remarks.—*Zapus t. alleni* is a fairly well-marked subspecies occupying the Sierra Nevada of California, from Mount Shasta south to the region about the head of the North Fork of Kern River. It is a very beautiful species and differs from all others of this subgenus in often having the pencil, and occasionally more of the tail, white.

Specimens examined.—Total number, 61, from the following localities:

California: Big Trees, 1; Cassel, 1; East Fork Kaweah River, 2; Emerald Bay, Lake Tahoe, 19; Kern River (North Fork—'Kern Lakes'), 1; Lassen Peak, 14; Mammoth, 1; Mount Shasta, 20; Summit, 1; Upper Bear Creek, 1.

ZAPUS MONTANUS (Merriam). Mountain Jumping Mouse.

Zapus trinotatus montanus Merriam, Proc. Biol. Soc. Wash., XI, p. 104, April 26, 1897.

Type locality.—Crater Lake, Mount Mazama, Oregon.

Geographic distribution.—Cascade Range in Oregon.

General characters.—Smaller and duller in color than *Z. trinotatus*; also differing in cranial characters.

Color.—*Summer pelage* Sides rather dark, ochraceous-buff, heavily lined with black-tipped hairs; dorsal area quite sharply defined, grizzled dusky and yellowish; outer side of legs dusky to heel; tail sharply bicolor, dark gray above and whitish beneath; fore and hind feet soiled white; immature, suffused beneath with yellowish. *Fall pelage:* Dorsal area darker than in summer, thickly flecked with light yellowish, presenting a pepper-and-salt appearance; sides yellowish-olive, heavily lined with black-tipped hairs.

Cranial characters.—Skull smaller than those of *Z. trinotatus* and *Z. princeps oregonus* and much narrower throughout; incisive foramina much narrower posteriorly; bullae smaller.

Measurements.—Eight specimens from type locality average: Total length, 228; tail vertebrae, 135; hind foot, 31. *Skull:* Three skulls from type locality average: Basilar length, 19.5; zygomatic breadth, 12.4; mastoid breadth, 10.1; interorbital constriction, 4.5; incisor to postpalatal notch, 9; foramen magnum to postpalatal notch, 8.3; fronto-palatal depth at middle of molar series, 6.4.

General remarks.—*Zapus montanus* is a very well-marked form inhabiting the entire Cascade Range in Oregon. It is apparently totally distinct from all of the species whose ranges surround its habitat. The type series was taken in August, 1896, near Crater Lake at the head of a tributary of Anna Creek, on Mount Mazama, Oregon. The species was quite abundant in the meadows and the shrubbery of the wet hill-sides, and nearly a dozen were taken within a few days. Several of their summer nests were found. A week or two later other specimens were taken in the same valley a few miles below. These had begun to assume the fall pelage, being slightly more olivaceous.

Two specimens taken September 9, at Fort Klamath, at the base of the mountains, had assumed the complete fall pelage. They were excessively fat, and were doubtless nearly ready to hibernate.

Specimens examined.—Total number, 16, from the following localities:

Oregon: Crater Lake (type locality), 9; Diamond Lake, 1; Fort Klamath, 2; Mount Mazama (Anna Creek), 2; Mount Hood, 2.

ZAPUS ORARIUS sp. nov. Coast Jumping Mouse.

(Pl. I. figs 4, 4a).

Type from Point Reyes, Calif., No. 250, ♂ ad., collection of E. A. and O. Bangs. Collected May 14, 1893, by Charles A. Allen. Original No. 618.

Geographic distribution.—Coast of California from Point Reyes north to Mad River, Humboldt County; limits of range unknown.

General characters.—Size, medium; dorsal area and lower parts strongly suffused with color of sides. Skull rather small and peculiar in shape.

Color.—*Type in rather worn spring pelage:* Sides of body and head rather dark ochraceous, moderately lined with black-tipped hairs; dorsal area not sharply defined and strongly suffused with color of

sides. White of lower parts so strongly suffused with ochraceous that the white is almost obsolete, appearing only on lower parts of forelegs and between thighs; hind legs ochraceous all around; sides of throat deeper ochraceous than remainder of lower parts; feet yellowish white; tail yellowish-white below and grayish above. A specimen from Point Reyes, in the collection of Dr. C. Hart Merriam, about one-fourth grown, "has the upper parts almost uniform deep ochraceous yellow, with only the faintest trace of the dorsal area."

Cranial characters.—Skull rather small; rostrum short and considerably deflected; nasals very narrow anteriorly; greatest zygomatic breadth on plane of middle molars; zygomata rather light, the maxillary portion meeting nearly at right angles to main axis of skull; process on lower border of maxillary arm of zygoma very pronounced and nearer antorbital foramen than in any other species. Brain case high and rather globular in shape; interorbital constriction narrow; interpterygoid fossa narrow and shallow; incisive foramina rather small and evenly elliptical in shape; auditory bullæ small and rather near together; upper incisors slender and more projecting than usual; mandibular symphysis short.

Measurements.—The type measures: Total length, 220; tail vertebrae, 127; hind foot (dry), 30. *Skull* (type): Basilar length, 19; zygomatic breadth, 12; mastoid breadth, 10.6; interorbital constriction, 4; incisor to postpalatal notch, 8.5; foramen magnum to postpalatal notch, 7.9; fronto-palatal depth at middle of molar series, 6.2.

General remarks.—*Zapus orarius* appears to be a very well-marked species requiring close comparison with no other known form. The type has the lower parts more intensely suffused with the color of the sides than any other specimen of the genus that I have seen. A specimen from Mad River, Humboldt County, resembles the type very closely, and another from Eureka, without a skull, undoubtedly belongs to this species. The latter is suffused beneath with ochraceous, though to a lesser extent than the type. The skull of the type bears a slight resemblance in some respects to that of *Z. pacificus*, but the differences are so great that unless the type specimen is abnormal *orarius* can not be considered closely related to *pacificus*. Much additional material is needed to clear up satisfactorily the relationships of these and other forms from this region.

Specimens examined.—Total number, 4, from the following localities:

California: Eureka, 1; Mad River (Carson's Camp), 1; Point Reyes (type locality), 2.

ZAPUS PACIFICUS Merriam. Pacific Jumping Mouse.

Zapus pacificus Merriam, Proc. Biol. Soc. Wash., XI, p. 104, April 26, 1897.

Type locality.—Prospect, Rogue River Valley, Oregon.

Geographic distribution.—Interior valleys of southwestern Oregon and northwestern California; limits of range unknown.

Color.—"Dorsal area not sharply defined, but so strongly suffused with yellowish that the yellow predominates over the black; sides buffy-yellow, moderately lined with black hairs; inner side of legs only slightly darkened; tail sharply bicolor; grayish above, white beneath; fore and hind feet soiled white."¹ A toptype, younger than the type from which the above description was taken, "has the dorsal area even less distinct, the entire upper parts being ochraceous yellow."

Cranial characters.—Compared with that of *Z. montanus* (its nearest relative geographically) the skull of *Z. pacificus* is smaller; the rostrum and nasals shorter; audital bullæ smaller; basi-occipital broader between bullæ; interpterygoid fossa shorter; upper molar series more divaricating posteriorly.

Measurements.—The type measures: Total length, 225; tail vertebrae, 141; hind foot, 31. *Skull*: Basilar length, 17.5; zygomatic breadth, 12; mastoid breadth, 10; interorbital constriction, 4.5; incisor to postpalatal notch, 8.4; foramen magnum to postpalatal notch, 7.2; frontopalatal depth at middle of molar series, 6.

General remarks.—Owing to the small number of specimens available from the immediate region, it is impossible to discuss satisfactorily the true relationship of *Zapus pacificus* to the surrounding species. The type and a toptype taken at the same time are in a peculiar washed-out, almost albinistic, pelage, and may possibly be abnormal, especially as the locality is well within the humid, heavily forested area, where most of the animals are darker in color than their congeners to the eastward. The species, however, has fairly well marked skull characters and is undoubtedly a good form. An immature specimen from Siskiyou, Oreg., taken September 28, doubtless referable to this form, has dorsal area more distinct; sides brighter ochraceous and with more black hairs; upper surface of tail darker and fur of upper parts darker at base than specimens from the type locality. Another, from Little Shasta, Calif., taken September 20, also provisionally referred to this form, resembles the Siskiyou specimen, but has dorsal area finely flecked with yellowish instead of ochraceous.

Specimens examined.—Total number, 4, from the following localities:

- Oregon: Prospect, Rogue River Valley (type locality), 2; Siskiyou, 1 (not typical).
- California: Little Shasta, 1 (not typical).

ZAPUS SALTATOR Allen. Stickeen Jumping Mouse.

Zapus saltator Allen, Bull. Am. Mus. Nat. Hist., N. Y., XII, p. 3, Mar. 4, 1899.

Type locality.—Telegraph Creek, Northwest Territory, Canada.

Geographic distribution.—Telegraph Creek south to mouth of Skeena River and Tschimshian Peninsula; limits of range unknown.

General characters.—Similar in early fall pelage to *Z. trinotatus*, but smaller and differing in cranial characters.

¹ From original description.

Color.—*Fall pelage:* Sides yellowish, moderately lined with black-tipped hairs; dorsal area well-defined, rather dark, and thickly flecked with yellowish; ears like back, narrowly edged with yellowish; beneath, pure white; tail dusky above and gray beneath. Compared with *Z. trinotatus* in corresponding pelage, the back is slightly darker, the tail darker above, and gray, instead of yellowish-white beneath.

Cranial characters.—Compared with *Z. trinotatus*, the skull of *Z. saltator* differs as follows: Brain case narrower; zygomatic breadth considerably less; nasals broader posteriorly. Compared with skulls of *Z. princeps* from Field and Glacier, British Columbia, and Henry House, Alberta, the skull of *Z. saltator* has the rostrum longer; palate from incisive foramina to postpalatal notch shorter; and molars, especially last upper, smaller. All of the skulls of *Z. saltator* examined agree very well among themselves, and all have the incisive foramina very large and broad posteriorly. The zygomatic expansion is small and the brain case high and narrow.

Measurements.—An adult from Port Simpson, British Columbia, measures: Total length, 245; tail vertebrae, 145; hind foot, 32. Average of five young adults from same locality: Total length, 234; tail vertebrae, 151; hind foot, 32. *Skull:* An adult skull from Port Simpson, British Columbia, measures: Basilar length, 20; zygomatic breadth, 11.8; mastoid breadth, 10.5; interorbital constriction, 4.5; ineisor to postpalatal notch, 9.4; foramen magnum to postpalatal notch, 8; frontopalatal depth at middle of molar series, 6.4.

General remarks.—*Zapus saltator* is a well-marked form, differing considerably from its relatives to the southward. With *Z. hudsonius alascensis*, which probably meets it on the north, it requires no comparison, the immensely larger incisive foramina and larger molars of the present species distinguishing the two forms at a glance. A small series of *Z. saltator*, which forms the basis of the present description, was taken by the writer at Port Simpson, British Columbia, in August, 1897. Some of these were taken in a grassy thicket near the edge of the forest, a few feet above high-water mark, and the remainder in a garden in the village. *Z. saltator* may be found to intergrade with either *Z. trinotatus* or *Z. princeps* (it seems nearer the latter), but until its true relationship is proved it seems best to allow it full specific rank. The tail is longer and the hind foot shorter, relatively, than in *Z. trinotatus*. Through the kindness of Dr. J. A. Allen, I have been enabled to examine the type of *Z. saltator*. The skull of the type being imperfect, the cranial characters given above are taken from Port Simpson specimens.

Specimens examined.—Total number, 8, from the following localities:

Northwest Territory: Telegraph Creek, 1 (the type).

British Columbia: Inverness (mouth of Skeena River), 1; Port Simpson, 6.

NAPÆOZAPUS¹ subgenus novum.

Type *Zapus insignis* Miller, from Restigouche River, New Brunswick.

Subgeneric characters.—Teeth: $i. \begin{smallmatrix} 1-1 \\ 1-1 \end{smallmatrix}, p. \begin{smallmatrix} 0-0 \\ 0-0 \end{smallmatrix}, m. \begin{smallmatrix} 3-3 \\ 3-3 \end{smallmatrix} = 16$. Skull stouter than in other subgenera; interorbital constriction greater; frontal region more swollen; middle molars equalling first in size. Enamel pattern of molars not essentially different from *Zapus*, but sulcus on inner side of upper molars deeper and persisting longer in the wearing tooth (fig. 2). General color pattern as usual in the genus, but tail tipped with white.



FIG. 2.—Molar teeth of *Zapus (Napæozapus) insignis* (topotype), from Restigouche River, N. B. (No. 2333, coll. E. A. and O. Bangs) × 6.

KEY TO SPECIES OF THE SUBGENUS NAPÆOZAPUS.

- Hind foot less than 33 mm.; interorbital constriction usually more than 4.5 mm.
 Larger and lighter in color; hind foot usually more than 30 mm.; skull broader and stouter..... *insignis*.
 Smaller and darker; hind foot about 30 mm. or less; skull rather slender.
roanensis.
 Hind foot about 33 mm.; interorbital constriction narrow, usually less than 4.5 mm.;
 size large..... *abietorum*.

ZAPUS (NAPÆOZAPUS) INSIGNIS Miller. Woodland Jumping Mouse.

(Pl. I, figs 1, 1a.)

1856. *Meriones labradorius* Dawson, Edinburgh New Philos. Journ., new ser., III, p. 2.
 1857. *Jaculus hudsonius* Baird, Mamm. N. Am., p. 430 (in part—specimen from Nova Scotia).
 1877. *Zapus hudsonius* Coles, Mon. N. Am. Rodentia, p. 467 (in part).
 1891. *Zapus insignis* Miller, Am. Naturalist, XXV, p. 472, August, 1891.

Type locality.—Restigouche River, New Brunswick.

Geographic distribution.—Canadian Zone in eastern Canada and south to western Maryland.

General characters.—Size rather large, larger than *Zapus hudsonius*, with longer ears and paler, more fulvous coloration. Tail tipped with white.

Color.—“Adult male No. $\frac{1}{15} \frac{6}{2}$, collection of G. S. Miller, jr., Peterboro, N. Y., August 22, 1892; length, 250; tail vertebrae, 154; hind foot, 31.6; ear from notch, 18.6. Tip of tail for 23 mm., dorsum of manus and pes, and entire ventral surface pure white to base of hairs. Sides buff-yellow, tinged with clay color, except on cheeks, fore neck, and a narrow line bordering white of belly, where the yellow is noticeably purer; the fur plumbeous-gray at base and a trifle sprinkled with black, bristly hairs. These black hairs predominate on the back, where they form a sharply

¹ *Napæozapus*: *ναπέαιος*, belonging to a wooded vale or dell; + *Zapus*. This name was suggested to me by Mr. Gerrit S. Miller, jr.

defined dorsal stripe slightly mixed with the color of the sides, broadest just back of the shoulders, tapering gradually to base of tail, and becoming indistinct on the head after passing between the ears. Ears externally concolor with back, internally buff-yellow; muzzle grayish-brown; whiskers mixed brownish and whitish, the longest hairs reaching beyond shoulders; tail thinly haired, so that the annulation shows distinctly, sharply bicolor, dark brown, except ventrally and at tip.¹ There is very little seasonal variation in this species, and the white of lower parts is never suffused with the color of sides.

Cranial characters.—Skull rather broad and stout; frontal region much swollen; brain case broad and rather flat; interorbital constriction broad as compared with that of all other species of the genus.

Measurements.—Nine specimens from Nova Scotia average: Total length, 238; tail vertebrae, 146.7; hind foot, 31.1. Sixteen from Peterboro, N. Y., average: Total length, 236; tail vertebrae, 147; hind foot, 30.25. One from Pocono Mountain, Pennsylvania: Total length, 224; tail vertebrae, 140; hind foot, 31. Two from Lake Hopatcong, New Jersey, average: Total length, 231; tail vertebrae, 140; hind foot, 31.5. *Skull:* Two skulls from type locality average: Basilar length, 18.7; zygomatic breadth, 12.3; mastoid breadth, 10.2; interorbital constriction, 4.9; incisor to postpalatal notch, 8.8; foramen magnum to postpalatal notch, 7.8; fronto-palatal depth at middle of molar series, 6. Four skulls from New York average: Basilar length, 19.6; zygomatic breadth, 12.9; mastoid breadth, 10.8; interorbital constriction, 5; incisor to postpalatal notch, 9; foramen magnum to postpalatal notch, 8.6; fronto-palatal depth at middle of molar series, 6.1.

General remarks.—Apparently the first published record which refers unmistakably to this species is that of Prof. J. W. Dawson, who, in 1856, in the Edinburgh New Philosophical Journal, called attention to the fact that two distinct species of Jumping Mice inhabited Nova Scotia. The present species he wrongly referred to *Meriones labradorius* (= *Zapus hudsonius*), and described true *Z. hudsonius* as a new species, calling it, provisionally, *Meriones aeadicus*. In the National Museum are two specimens of *Zapus* deposited by Dawson; though mounted, they are in good condition for examination and are plainly referable respectively to *Z. insignis* and *Z. hudsonius*. Both Baird and Coues examined them, or at least similar specimens received from Dawson, but did not consider the two animals specifically distinct. *Zapus hudsonius* also occurs throughout the range of the present species, but the two prefer different situations—*Z. hudsonius*, shrubby fields and meadows, and *Z. insignis*, deep woods near streams.

This species presents remarkably little variation throughout its range. Specimens from central Pennsylvania, in the collection of Mr. S. N. Rhoads, are practically indistinguishable from examples taken near the type locality. Three specimens from Lake Hopatcong, N. J., have

¹ G. S. Miller, jr., Proc. Biol. Soc. Wash., VIII, p. 2, 1893.

slightly smaller skulls than usual, but are otherwise perfectly typical. I have also examined two specimens from western Pennsylvania, collected by Mr. W. E. Clyde Todd, and have myself collected a specimen in the mountains at Finzel, in Garrett County, Md. None of these show any approach to *Z. insignis roanensis* from Roan Mountain, North Carolina. Mr. S. N. Rhoads writes me that he has also taken the species at Summit, Cambria County, Pa.

Specimens examined.—Total number, 107, from the following localities:

- New Brunswick:** Restigouche River (type locality), 3.
Nova Scotia: Halifax, 3; James River, 4.
Ontario: North Bay, 6.
New Hampshire: Antrim, 1; Chocorua, 8; Dublin, 3; Fabyans, 1; Franconia, 4; Profile Lake, 10.
Vermont: Mount Mansfield, 4.
Massachusetts: Mount Greylock, 1.
New York: Cascadeville, 4; Catskills, 4; Elizabethtown, 10; Glenville, 1; Lake George, 1; Peterboro, 30.
New Jersey: Lake Hopatcong, 3.
Pennsylvania: Cherry Spring, Potter County, 1; Eaglesmere, 2; Kingston, Westmoreland County, 1; Mount Pocono, 1.
Maryland: Finzel, Garrett County (6 miles north of Frostburg), 1.

ZAPUS (NAPLEOZAPUS) INSIGNIS ROANENSIS subsp. nov. Roan Mountain
 Jumping Mouse.

Type from Magnetic City, foot of Roan Mountain, North Carolina, No. 66283, ♂ ad., U. S. Nat. Museum, Biological Survey Coll. Collected May 22, 1894, by A. G. Wetherby.

Geographic distribution.—Known only from Roan Mountain, North Carolina.

General characters.—Smaller and darker than typical *Z. insignis*, with smaller, narrower skull.

Color.—Sides bright tawny ochraceous; entire upper parts, including ears, considerably darker than in typical *Z. insignis*. Beneath, pure white; amount of white on tail averaging less than in *Z. insignis*.

Cranial characters.—Skull similar to that of *Z. insignis*, but smaller and more slender throughout; mandible much more slender, especially in region of molars; interorbital constriction very slightly less; frontal region much less swollen; brain case narrower; fronto-palatal depth about the same.

Measurements.—Sixteen specimens from Roan Mountain average: Total length, 220; tail vertebrae, 131; hind foot (dry), 29.5. *Skull:* Six adult skulls from Roan Mountain average: Basilar length, 18.8; zygomatic breadth, 11.7; mastoid breadth, 10.1; interorbital constriction, 4.7; incisor to postpalatal notch, 8.8; foramen magnum to postpalatal notch, 8; fronto-palatal depth at middle of molar series, 6.2.

General remarks.—The collection of the Biological Survey contains 24 specimens of this form, collected from May to September. As in typical *Z. insignis*, there is very little seasonal variation. A young individual, about one-third grown, collected at the type locality September 11, 1892, by Dr. C. Hart Merriam, resembles adults in color,

except that the dorsal area is very indistinct and the nose is white. Several of the type series, including this young one, have the white on the tip of tail reduced to the merest trace. While the material examined from Maryland and Pennsylvania shows no indication of intergradation existing between typical *Z. insignis* and the present form, I have thought best to give it a trinomial name in the belief that intergradation does exist.

Specimens examined.—Total number, 24, all from Roan Mountain, North Carolina.

ZAPUS (NAPÆOZAPUS) INSIGNIS ABIETORUM subsp. nov.
Northern Woodland Jumping Mouse.

Type from Peninsula Harbor, north shore of Lake Superior, Ontario, No. 4268, ♀ ad., collection of Gerrit S. Miller, jr. Collected Sept. 27, 1896, by Gerrit S. Miller, jr.

Geographic distribution.—Probably throughout Hudsonian zone in eastern Canada; limits of range unknown.

General characters.—Larger than typical *Z. insignis*, with shorter ears and peculiar skull.

Color.—Apparently not distinguishable from *Z. insignis*.

Cranial characters.—Compared with typical *Z. insignis* the skull of the type has molar series longer and heavier; interorbital constriction narrower than in any specimen of *insignis* examined; ventral border of pterygoids nearly on plane of palate; maxillary process of zygomata shorter and zygomata much less curved than in typical *insignis*; mandible much heavier.

Measurements.—Type: Total length, 255; tail vertebræ, 160; hind foot, 33; ear from meatus, 16.6. An adult male from Godbout, Quebec, measures: Total length, 250; tail vertebræ, 160; hind foot, 32.5. *Skull* (type): Basilar length, 19.4; zygomatic breadth, 12.2; mastoid breadth, 10.5; interorbital constriction, 4.3; incisor to postpalatal notch, 9.6; foramen magnum to postpalatal notch, 8.4; fronto-palatal depth at middle of molar series, 6.

General remarks.—This form is based mainly on a single specimen, collected at Peninsula Harbor, Ontario, on the north shore of Lake Superior, in the Hudsonian zone, by Gerrit S. Miller, jr. Mr. Miller recorded this specimen¹ and described its peculiarities in some detail. A specimen in the Bangs collection, from Lake Edward, Quebec, and two from Godbout, Quebec, in Dr. Merriam's collection, while not perfectly typical, agree with the type in large size, narrow interorbital constriction, and in other peculiarities. This makes it probable that this form will be found to occur throughout the Hudsonian zone, in eastern Canada. The specimen of *Z. insignis*, recently recorded from Labrador by Mr. Outram Bangs,² which he thinks is not typical, may

¹ Notes on the Mammals of Ontario <Proc. Boston Soc. Nat. Hist., XXVIII, No. 1, p. 10, April, 1897.

² Am. Naturalist, XXXII, No. 379, p. 493, July, 1898.

belong to this form. The type of *abictorum* is slightly larger than the largest specimens examined of the typical form, while the ear is slightly shorter than usual.

Specimens examined.—Total number, 4, from the following localities:

Ontario: Peninsula Harbor, 1 (type).

Quebec: Godbout, 2; Lake Edward, 1.

EOZAPUS¹ subgenus novum.

Type *Zapus setchuanus* Pousargues, from Szechuen, China.

Subgeneric characters.—Teeth: $i. \frac{2}{2}, p. \frac{1-1}{0-0}, m. \frac{3-3}{3-3} = 18$. Skull similar to those of the subgenera *Zapus* and *Napaeozapus*, but differing as follows: Skull relatively broader, shorter, and lower; nasals broad, distinctly forked posteriorly; antorbital foramina rather large; incisive foramina medium; posterior palatine foramina midway between incisive foramina and postpalatal notch, the latter barely reaching posterior plane of molars. Rostrum relatively shorter and broader; zygomata relatively shorter, with jugal portion almost perfectly straight, frontal region less swollen. Enamel pattern of molars somewhat similar, but enamel folds not closely crowded; last lower molar relatively larger (fig. 3). Color pattern differing from that of other subgenera in having a brown ventral stripe; tail tipped with white, as in *Napaeozapus*.

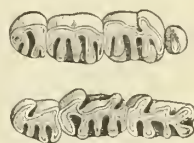


FIG. 3.—Molar teeth of *Zapus (Eozapus) setchuanus* (cotype), from Ta-t sien-lou, Szechuen, China. $\times 6$.

ZAPUS (EOZAPUS) SETCHUANUS Pousargues. Szechuen Jumping Mouse.

(Pl. I, figs. 2, 2a.)

Zapus setchuanus Pousargues, Ann. Sci. Nat., 8^e sér., I, No. 4, p. 220, Avril, 1896; Bull. Mus. d'Hist. Nat., Paris, II, p. 13, figs. 1-3, 1896.

Type locality.—Ta-t sien-lou, Szechuen, China.

Geographic distribution.—Known only from the type locality.

General characters.—Differing from all other known members of the genus in having a ventral stripe of brown.

Color.—Upper parts dark, tawny ochraceous; dorsal area sharply defined and very thickly flecked with black-tipped hairs, the sides moderately lined with same. Pattern of color above as in the American species. Beneath white, suffused with ochraceous, the white nearly obsolete on fore breast; a brownish stripe about 5 mm. wide extends the entire length of breast and belly; feet, chin, and lips white; tail strongly bicolored; brownish above and whitish beneath, with about 15 mm. of the tip pure white; ears dusky.

Cranial characters.—Compared with *Z. hudsonius* the skull of *setchuanus* differs as follows: Interorbital constriction relatively narrower;

¹ Eozapus: ἠώς, dawn, *i. e.* eastern; + *Zapus*.

frontal region less swollen; rostrum shorter and less attenuated; zygomatic shorter, the maxillary portion more nearly perpendicular to main axis of skull, the jugal portion heavier and nearly straight; palate longer, the postpalatal notch not quite reaching posterior plane of molars (in American species commonly exceeding that point); nasals prolonged farther posteriorly and forking (in American species generally irregularly truncated); bullæ larger; the coronoid process of mandible not ascending so high, but longer, broader, and straighter, and the coronoid notch deeper and less rounded than in *Z. hudsonius* (fig. 4).



FIG. 4.—Skull of *Zapus (Eozapus) setchuanus* (co-type) from Ta-t sien-lou, Szechuen, China. $\times 1\frac{1}{2}$.

Measurements.—The following measurements from Pousargues will serve for comparison with other species: ‘Vieux,’ head and body, 100; tail, 120; foot, 31; ‘adulte,’ head and body, 80; tail, 103; foot, 30; ‘semiadulte,’ head and body, 70; tail, 95; foot, 28. Skull No. 2:¹ Zygomatic breadth, 11.6; interorbital constriction, 3.6; incisor to postpalatal notch, 8.5; fronto-palatal depth at middle of molar series, 5.5. No. 3: Zygomatic breadth, 11.5; interorbital constriction, 3.8; incisor to postpalatal notch, 8.2; fronto-palatal depth at middle of molar series, 5.6.

General remarks.—This very interesting species was described from three skins in alcohol accompanied by imperfect skulls. Its describer, M. E. De Pousargues, discusses its color and other peculiarities in considerable detail, and presents a table showing the measurements of the three specimens, together with the corresponding measurements of a specimen of *Z. hudsonius*, taken from Coues. These measurements of *hudsonius* (head and body, 85; tail, 135; foot, 27), if all from one individual, must have been taken from a distorted specimen and do not give a fair idea of the proportions, the foot measurement, 27 mm., being evidently too small for an animal with the tail measuring 135. On this account the proportional differences between *setchuanus* and *hudsonius* are exaggerated. Through the courtesy of Mr. Gerrit S. Miller, jr., I have been able to examine two of these skins and the skulls, generously loaned to him by M. Pousargues. The color of these skins is apparently not much changed by the action of alcohol. The brown ventral stripe and comparatively short, hairy tail with its white tip, constitute the most striking peculiarities. The hind foot is about the same size as in *hudsonius*; the ear shorter and broader than in the American species.² As already stated, the skulls are all imperfect.

¹ These numbers are provisional, and owing to the imperfect condition of the skulls only these measurements could be taken.

² The following table will serve to show the approximate ratio of width to height of ear in *Zapus insignis*, *Z. hudsonius*, and *Z. setchuanus* (alcoholic specimens):

	<i>Z. insignis</i> . Two specimens.		<i>Z. hudsonius</i> . Two specimens.		<i>Z. setchuanus</i> . Two specimens.	
	Male.	Female.	Male.	Female.	Larger.	Smaller.
Height of ear from notch.....	15.5	15.5	14	14	12.5	11
Greatest width of ear.....	9	9	9	9	10	9

The largest is so badly crushed as to be almost worthless, and the two smaller ones lack the occipital portion of the cranium and the posterior parts of the mandibles, the shape of the angular process, therefore, being unknown. This species has the small upper premolar as in the subgenus *Zapus*, that tooth being larger than in *Z. hudsonius*. The last lower molar is also proportionately larger. All the molars differ from those of any American species in having the enamel folds not closely crowded, the resulting wide and deep sulci giving the teeth a very different appearance, though the general pattern of enamel folding is perhaps not essentially different. The incisors are lighter in color than in the American species.

Specimens examined.—Two skins and three skulls, from the type locality.

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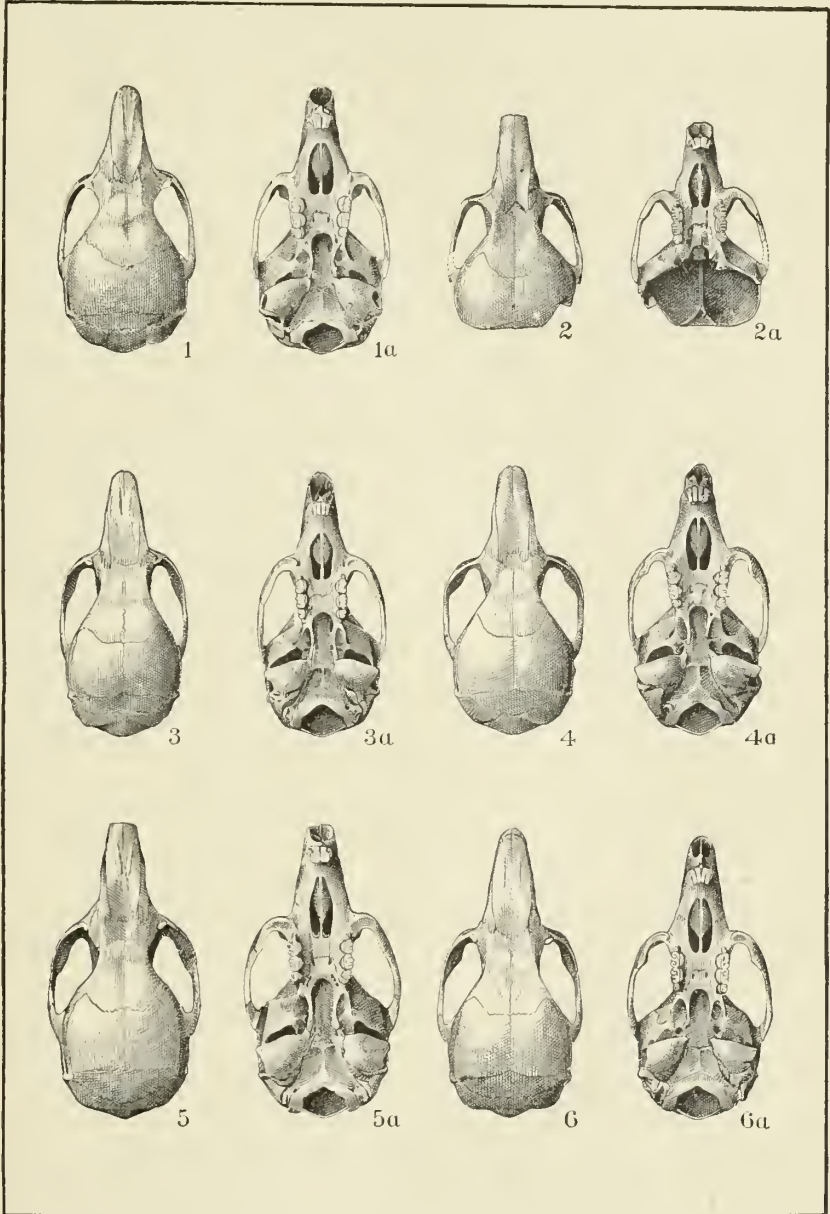
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PLATE I.

(One and one-half times natural size.)

- FIG. 1. *Zapus (Napaeozapus) insignis* Miller (Type). Restigouche River, New Brunswick.
(Type $\frac{3.87}{4.64}$, Miller collection.)
2. *Zapus (Eozapus) setchuunus* Pousargues (Cotype). Ta-tsien-lou, Szechuen, China.
 3. *Zapus (Zapus) hudsonius* (Zimmermann). James Bay, Canada.
(No. 60588, U. S. Nat. Mus.)
 4. *Zapus (Zapus) orarius* Preble (Type). Point Reyes, Calif.
(No. 250, Collection E. A. & O. Bangs.)
 5. *Zapus (Zapus) trinotatus* Rhoads. Port Moody, British Columbia.
(No. 66928, U. S. Nat. Mus.)
 6. *Zapus (Zapus) princeps* Allen (Topotype). Florida, La Plata County, Colo.
(No. 4139, Am. Mus. Nat. Hist.)

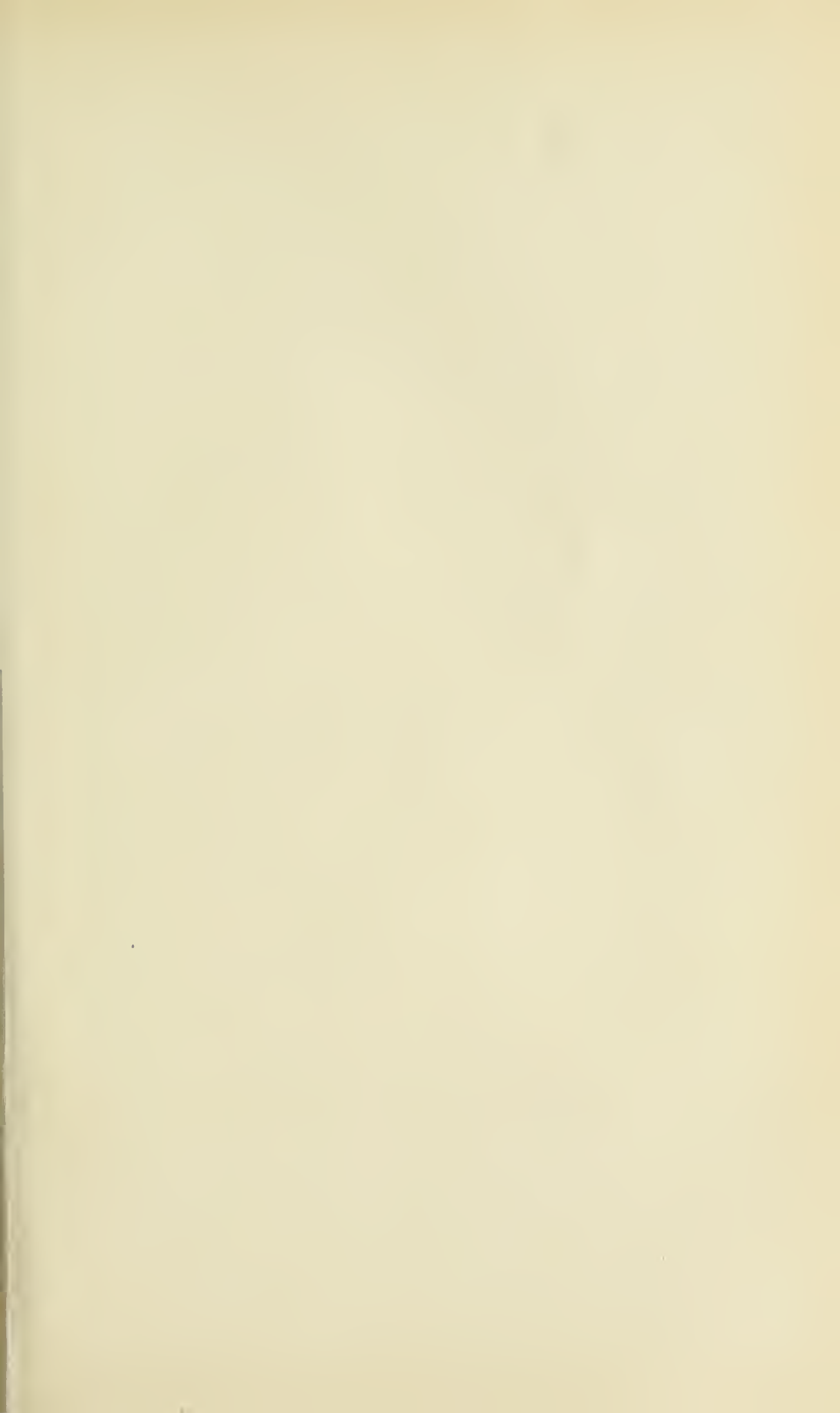


SKULLS OF ZAPUS.

1. *Zapus insignis*.
2. *Z. setchuanus*.

3. *Z. hudsonius*.
4. *Z. orarius*.

5. *Z. trinotatus*.
6. *Z. princeps*.



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