U. S. DEPARTMENT OF AGRICULTURE
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NORTH AMERICAN FAUNA

No. 51

[JULY, 1928]

A TAXONOMIC REVIEW OF THE AMERICAN LONG-TAILED SHREWS

(Genera SOREX and MICROSOREX)

BY

HARTLEY H. T. JACKSON
BIOLOGIST, DIVISION OF BIOLOGICAL INVESTIGATIONS
BUREAU OF BIOLOGICAL SURVEY

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(Continued on page 3 of cover)

B382M

WHITE-LIPPED WATER-SHREW (SOREX PALUSTRIS ALBIBARBIS)

[Natural size]

From mounted specimen in the Lee Museum of Biology, Bowdoin College, Brunswick, Me. Female, collected April 11, 1909, at Brunswick, Me.

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A TAXONOMIC REVIEW OF THE AMERICAN LONG-TAILED SHREWS

(Genera SOREX and MICROSOREX)

By Hartley H. T. Jackson

INTRODUCTION

No other group of American mammals having a wide distribution, and in many localities an abundance of individuals, is so little known to the nonprofessional mammalogist as the long-tailed shrews belonging to the genera Sorex and Microsorex. Neither are the individuals of any other group of common mammals so seldom seen in life by the professional field mammalogist, nor are the habits of such individuals less known to him. And probably no other group of mammals offers so many difficulties and problems in the way of taxonomic study. These arise from numerous features, no one of which may be peculiar to shrews, but the combination occurs in no other large group of mammals. The small size of shrews makes slight errors of measurements, external or cranial, large proportionally, and makes necessary the constant use of the microscope for the study of cranial and dental characters. The absence of color pattern, and a definite color variation between species that in many cases seems scarcely more than individual, makes identification by color alone possible only in a comparatively few instances. The early anastomosis of the separate cranial bones into one compact whole, which occurs while the animal is yet juvenile, makes comparison of the various individual bones of the skull impossible; all outlines of the individual cranial bones are lost in adult shrews. The simple dentition of shrews offers little opportunity for differentiation of form or cusps. Variability of skulls and teeth due to age of the individual is excessive, so much so that the skull of an adult animal may appear entirely unlike the skull of a young animal of the same subspecies; great care must therefore be exercised in making comparisons to be certain that the individuals are of corresponding age and development. Finally, there is a wide range of individual cranial variation, particularly in the size of the skull; shrews seem more prone to produce "runty" skulls or abnormal dentition than most other mammals.

In popular parlance the American long-tailed shrews might superficially be divided into four groups, namely, the long-tailed shrews proper, the saddleback shrews (the *arcticus* group), the water shrews (*palustris* group), and the marsh shrews (*bendirii* group). So little are shrews known to the layman that when actually seen they are generally confused with mice, though in reality as closely related to

wolves or foxes as to mice. Occasionally, however, they are distinguished by modifying terms, as in sections of Alaska, where O. J. Murie reports that they are known as "sharp-nosed mice"; or in the Gallatin country of Montana, where C. W. Richmond says they are called "dormice," or in the Jackson Hole region of Wyoming, where, according to Alexander Wetmore, the water shrews are known locally as "fish-mice." In many localities shrews are known as "moles" or "young moles," and the water shrew as "water mole." One of the most peculiar local names is reported by A. K. Fisher, who says that in Dismal Swamp, Va., *Sorex longirostris fisheri* is called "smell fast." Shrews are known to some of the Indian tribes, who have special names for them; thus, the Chippewas of northern Wisconsin and Minnesota know the little animals as "oke-pa-ku-kue" or "oke-pa-kue-kue"; the Klamath Indians call *S. vagrans* "shu-zhi"; Vernon Bailey (manuscript notes) reports that the Taos Indians of New Mexico recognize the shrew under the name "pah-ka-che-una"; and the Kwakiool name for the mole or shrew in British Columbia is "kiap-kepu-s" (Dawson, 1888, p. 93). The common shrew of eastern Canada (*S. cinereus*) was known to the Labrador Eskimos as the ukounavik (Packard, 1866, p. 266). According to Nelson the long-tailed shrew was known to the Alaskan Eskimos as the "u-gu-gi-nuk," and when it was found strayed out on the sea ice by them, it was the subject of a curious superstition.

> They claim that there is a kind of water shrew living on the ice at sea which is exactly like the common land shrew in appearance, but which is endowed with demoniac quickness and power to work harm. If one of them is disturbed by a person, it darts at the intruder and burrowing under the skin, works about inside at random and finally enters the heart and kills him. As a consequence of this belief the hunters are in mortal terror if they chance to meet a shrew on the ice at sea, and in one case that I knew of a hunter stood immovable on the ice for several hours until a shrew he happened to meet disappeared from sight, whereupon he hurried home, and his friends all agreed that he had had a very narrow escape. (Nelson, 1887, p. 271.)

DISTRIBUTION AND HABITAT

The genus Sorex is distributed throughout a large portion of the continents of Europe, Asia, and North America. It is absent from the extreme southern and torrid sections and more abundant both in species and individuals in the north-temperate and boreal parts. In North America the range of the genus extends over the entire northern part of the continent from the Arctic Ocean south to northern Florida and Alabama in the eastern United States; Indiana, Illinois, and Nebraska in the middle United States; and in the higher elevations of the mountains of the West to Guatemala. The range of the water and marsh shrews (subgenera Neosorex and Atophyrax) extends from southern Quebec, Ontario, Manitoba, southern Northwest Territories, northern British Columbia, and southeastern Alaska, south to Pennsylvania, Wisconsin, and Minnesota in the eastern United States, to Arizona and New Mexico in the Rocky Mountains, to the Mount Whitney region, California, in the Sierra Nevada, and along the Pacific coast to northern California. The range of the genus Microsorex extends from northern Quebec, northern Ontario, and central and western Alaska south to the northern United States.

The characteristic habitats of long-tailed shrews are moist situations with an abundance of vegetation, such as mossy and grassy banks along streams, meadows, sphagnum bogs, and damp woods, particularly of coniferous trees. There is, however, considerable variation in the dominant habitats among the various species, while certain of the common forms seem less restricted in habitat and may be found at times in associations that could hardly be considered characteristic of the particular species. For example, the species *cinereus* is of wide distribution and ordinarily may be expected in the normal shrew habitat of damp woods, mossy banks of streams, coniferous swamps, and sphagnum bogs; yet there are numerous records of specimens of this species taken in houses and other buildings, particularly in the far north, and of other individuals in dry woods and meadows in the eastern United States. The species *fumeus* is most frequently reported from hemlock woods, but may occasionally occur in meadows near timber.

As a general rule, *Sorex vagrans* prefers damp meadows and *S. obscurus* the mossy banks of streams; at any rate, in many regions where the two species occur, as, for example, *S. v. amoenus* and *S. o. obscurus* in the Sierra Nevada, a majority of each species is trapped in the respective habitats indicated above. In regard to the trapping of a specimen of *S. o. obscurus* in the Manzano Mountains, N. Mex., J. H. Gaut remarks in his field report:

> A gopher trapped in a tunnel made by the animal was discovered to have a small opening in its side with parts of the intestines gone and immediately upon discovering this fact I removed the specimen and replaced it with a small trap baited with some of the remaining portions of the intestines. An hour later the trap was visited and found to be holding fast one of these little shrews. The hole in which the trap was placed was thoroughly covered with dirt, in such manner that no animal could possibly have entered at that particular place.

In the coast region of Washington it is known that *S. o. setosus* frequently inhabits the runways of moles (Scapanus). The species *obscurus* is also occasionally found in buildings, but such cases must be considered exceptional.

Habitat records of the rare *Sorex dispar* would indicate that the species usually lives among rocks. It is said that the type specimen was trapped among some large, angular rocks at the head of a wooded talus of loose rock just below low cliffs, which shaded the spot and kept it cool, and that a second specimen was taken in a crevice between some rocks on the bare, open summit of Mount Marcy, N. Y. (Batchelder, 1896, p. 133.) Mearns also records the species as being trapped in hollows under mossy stones, usually in wet balsam or spruce woods, or in weedy swamps, in the Catskill Mountains, N. Y. (Mearns, 1898, p. 356); and at Mount Greylock, Mass., Copeland caught one specimen under a rock at the edge of a moist grassy clearing surrounded by woods, and another near a small brook in swampy woods of spruce, hemlock, and scattered birches thickly carpeted with sphagnum (Copeland, 1912b, p. 162). The first known specimens of *S. gaspensis* were all caught near small streams. One was trapped among dead tree stumps that were lying partly submerged and almost surrounded by water and shaded by overhanging spruce trees. A second was procured in a trap set in such a position at the foot of a low cliff facing a stream that the animal must have passed through

shallow water to reach the trap; a dark, damp forest spread on all sides; deep moss covered the ground and obscured the stream in places, and many trees bore hanging moss. The third specimen was caught along a small stream that came through a narrow canyon on a cool, north slope covered with a forest of spruce and balsam; the trap was set among driftwood and wet leaves between bowlders. (Anthony and Goodwin, 1924, p. 1; Goodwin, 1924, p. 252.)

One of the western species, *Sorex trowbridgii*, may be found in the regulation damp, mossy habitat of long-tailed shrews, but it also displays a marked preference for the drier woods, and in parts of western Washington and Oregon it is frequently most abundant in dry fir timber.

The two closely related species *Sorex merriami* and *S. leucogenys* have an unusual habitat for shrews, in that they have been found only in an arid sagebrush association. The type and only known specimen of *S. tenellus* was also collected among loose rocks on a dry hillside a long distance from water.

The water shrews (subgenus Neosorex) are seldom found at any great distance from water, which may be a lake or pond, a brook, or merely a pothole in a swamp, bog, or forest. They seem to prefer a more or less wooded habitat and are rarely found in marshes devoid of bushes or trees. They tend to be more boreal than members of the subgenus Atophyrax and in the western United States are usually found at the higher altitudes in the Canadian Zone. Nevertheless, in March, 1920, G. G. Cantwell collected three specimens at an altitude of about 300 feet at Rockport, Skagit County, Wash. The streams in which these specimens were caught, however, came down from mountains 4,000 to 6,000 feet high not more than 2 miles distant.

The marsh shrews (subgenus Atophyrax) seem to be less truly aquatic than the members of the subgenus Neosorex, and although found in damp woods and other habitats such as are frequented by Neosorex, they also occur in tule or sedge marshes. At Lake Cushman, Wash., in the midsummer of 1894, C. P. Streator caught three specimens in traps baited with rolled oats and set on an old beaver dam.

Shrews of the genus Microsorex do not seem to differ particularly in their habitat preference from certain members of the genus Sorex, as, for example, *cinereus*. Such reports as are available indicate that the pigmy shrews are most frequently found in damp woods, sometimes of deciduous trees. But they are also found in tamarack swamps and muskegs, and occasionally in marshes and even in dry woods. The type specimen of *Microsorex h. washingtoni* was found dead in a trail in dry pine woods. E. A. Preble reports one of this genus taken January 4, 1904, in the potato cellar of a dwelling house at Fort Simpson, Northwest Territories, Canada. Of the first two specimens of *M. h. winnemana* collected, one (type specimen) was captured in the decayed interior of a fallen log in mixed woods of maple and other deciduous trees and the other was found in the decayed heart of a dead chestnut tree on a dry hillside some distance from water. The third specimen of *winnemana* was captured by G. W. J. Blume, who sent it to Wirt Robinson, who in turn pre-

sented it to the United States National Museum. In a letter to Colonel Robinson Mr. Blume states:

> As I recall the capture of the shrew, I noticed movements in the leaves on one of the hillsides on my place at Alta Vista, Va., and thinking it to be a mole plowing the surface as they sometimes do in gravelly or very rooty ground, I started to scratch among the leaves to catch it. The shrew started to run and I caught it in my hands. I think there was a rock pile not far distant which was probably its home. It was in dry, wooded land, probably not over 100 yards from running water but not close to a swamp. There was no dense underbrush, but plenty of natural concealment afforded by the leaves, rocks, old logs, etc., in the vicinity.

HABITS

Long-tailed shrews are such elusive midgets and such meager definitely planned research has been done on their life history that comparatively little is known about their habits. That the various species have certain general habits more or less in common is self-assertive, but that the different species also have specialized habits varying to meet their different habitats and environments is also evident. For example, one could hardly assume that the habits of the semi-desert species, *Sorex merriami*, would be similar in detail to those of *S. dispar*, which inhabits the comparatively cool, humid coniferous forest region of the eastern United States. Yet almost nothing is known about the specialized habits of either of these species. Shrews are the active, vicious, voracious little imps of the mammal world. They are largely nocturnal, but are not infrequently active during the daytime, particularly under the snow in winter or during cloudy weather at any season of the year. They are apparently active during the entire winter and do not hibernate, although they have small hibernating glands, and it has been erroneously written that they do hibernate. (Ärnbäck-Christie-Linde, 1907, p. 466.) They live for the most part in little burrows and runways underneath logs, rocks, leaves, and grass, where they hunt insects and worms. These runways may be made by the shrews themselves or by various species of mice or other shrews. At Tuckerton, N. J., in the summer of 1892, E. A. Preble captured five specimens of *S. cinereus* under one of several small haystacks scattered over the meadows. Some of these were kept alive in a deep can for several hours. They constantly moved their long snouts in every direction, apparently depending more on the sense of touch and smell than on sight. Residents stated that during especially high tides at this place these shrews would be drowned out of their retreats and would fairly swarm on the driftwood. (Preble manuscript.)

Long-tailed shrews are exceedingly quick and active and move with a queer, jerky, trotlike run, starting and stopping abruptly. They may be considered almost strictly terrestrial, although they occasionally climb small branches of very low bushes, fallen trees, or herbs. Morris M. Green writes (manuscript) that while watching a deer runway on the north branch of Moose River in the Adirondacks, N. Y., during the summer of 1894, he saw a little shrew no bigger than a thimble, which climbed up a fern stock within 5 feet of him. Another shrew went through his pail of fishworms and ate every one of them. Though in no sense aquatic (except the subgenera Neosorex

and Atophyrax), they are good swimmers when occasion demands it of them. Long-tailed shrews evidently have a wide local range, as is witnessed by Nelson's observations in Alaska.

> After snow falls they travel from place to place by forcing a passage under the snow, and frequently keep so near the surface that a slight ridge is left to mark their passage. On the ice of the Yukon I have traced a ridge of this kind over a mile, and was repeatedly surprised to see what a direct course the shrews could make for long distances under the surface. These minute tunnels were noted again and again crossing the Yukon from bank to bank. (Nelson, 1887, p. 271.)

These little animals are exceedingly savage and voracious and will fight and devour one another upon least provocation. Merriam's account of how he confined three of them under a tumbler is familiar to many students:

> Almost immediately they commenced fighting, and in a few minutes one was slaughtered and eaten by the other two. Before night one of these killed and ate its only surviving companion, and its abdomen was much distended by the meal. Hence in less than eight hours one of these tiny wild beasts had attacked, overcome, and ravenously consumed two of its own species, each as large as itself. (Merriam, 1884a, p. 76; 1884c, p. 174.)

Over considerable periods of time, these little gluttons, when in captivity, have been known to eat their own weight in meat on an average of once every three hours. Early in the summer of 1900, W. H. Osgood caught two shrews in the same trap on Vancouver Island, British Columbia. One of them, not killed by the trap, proceeded to devour the other and had nearly accomplished it when Osgood visited the trap. H. H. Sheldon reports (manuscript) an instance in August, 1919, at Ogema, Wis., in which the entire tail of a shrew (*Sorex c. cinereus*) was all that remained in a trap, and about a foot away he found one dead with tail intact but with its head bruised and part of the skin torn from the nose and jaws. This one had evidently fought the one in the trap, the latter losing its tail but winning the fight. George G. Cantwell, in his field report from the Mount Rainier region, Wash., for the summer of 1919, states that on one occasion while he was setting traps beside a small stream a trap on the opposite side containing a freshly caught mouse was visited by a shrew (*S. vagrans*), which at once started feeding on the mouse. On account of its poor eyesight, the shrew failed to detect the observer only a few feet away, but as a twig snapped the little animal at once dodged into a hole in the bank and did not appear again. In a letter dated July 17, 1889, at Plover Mills, Ontario, R. Elliott writes that on May 21, 1888, he captured one (*S. c. cinereus*) under a small log among dry leaves. He placed it in a large bottle with plenty of air and gave it two earthworms, each of which it took by the "tail" and rapidly nipped through and through to the head and left it dead. The shrew afterwards ate part of one of the worms. Mr. Elliott then gave the shrew a May beetle, which it instantly attacked viciously. The sharp feet of the insect seemed to irritate the shrew to an inordinate degree, and at the end of two or three minutes the beetle was torn and entirely eaten. Ten minutes afterwards it was given another May beetle, which, too, was almost entirely eaten, the head and elytra alone remaining. About half an hour later the shrew died.

Very little is known in regard to the nests and home life of long-tailed shrews. They build nests of grass and leaves under logs, in

stumps, and similar situations, but few of these have been found, much less critically studied. On October 14, 1924, Stuart Criddle found eight young of *Sorex cinereus haydeni* several days old dead in a nest made of brome-grass leaves, with a few ground-cherry leaves on the outside, situated under a brome-grass sheaf near Treesbank, Manitoba. In the nest there was also the anterior part of the skull of an adult. Judging from the dates of collection of pregnant specimens, the height of the breeding season is June, July, and August, although a few have been taken as late as the last of September that had been nursing, and others contained embryos as early as March 29 in Inyo County, Calif., and the middle of May on Prince of Wales Island, Alaska.

From the data available as based upon the number of fetuses in specimens trapped, as recorded by collectors, it would appear that the number of young varies in different species. From these records *Sorex cinereus* appears to have the largest litters, with an average of 7.2 for 8 specimens, the minimum being 4 and the maximum 10. The average for 5 specimens of *S. palustris navigator* is 6 fetuses, minimum 5, maximum 7. In 8 litters *S. vagrans* has a minimum of 3 and a maximum of 9, with an average of 5.8. Sixteen records for *S. obscurus* show an average of 5.4 per litter, with a minimum of 4 and a maximum of 8; of these 16 litters one-half were of 5 each. A single specimen of *S. arcticus* had 6 embryos, as did also one of *S. ornatus*. Three embryos were found in a specimen of *S. t. trowbridgii*, and 4 in one of *S. t. mariposae*. The smallest number of fetuses recorded is 2 from the specimen of *S. leucogenys* from Mount Magruder, Esmeraldo County, Nev. This lone record may give a clue to one of the possible causes for the apparent scarcity of shrews of the *merriami* group.

Long-tailed shrews are preyed upon by numerous species of animals, although comparatively few of their enemies will eat them except in cases of extreme hunger. It is well known that domestic cats kill numbers of shrews but seldom eat them, and in olden times it was believed that shrews were poisonous to cats. Fragments of shrew skulls and bones are frequently found in owls' pellets; the only record of *Sorex longirostris* in Alabama is a complete animal, now in alcohol, taken from the stomach of a barred owl. This same species of shrew has been taken from the esophagus of a hooded merganser. (Audubon and Bachman, 1854, p. 250.) Hawks also are known to prey upon shrews occasionally, and one has been recorded from the stomach of a bear. (Osgood, 1907, p. 63.) Certain fishes, particularly trout, may at times catch them, and A. H. Twitchell in a letter dated September 18, 1917, at Flat, Alaska, reports finding during August of that year the remains of six shrews, probably *S. tundrensis*, in the stomachs of three graylings.

Aside from the numbers killed by natural enemies, long-tailed shrews seem to have an unusually high mortality rate, as compared with many mammals, as many of them are accidently trapped in ditches, springs, and wells. It is not at all unusual to find several dead shrews in an uncovered well or spring, and such accidental deaths have been responsible for several specimen records. Although members of the genus Sorex are pugnacious and physically strong in proportion to their size, they seem sensitive to any external

shock or stimulus, and individuals are not infrequently found dead on the surface of the ground. Undoubtedly some of these are killed by other animals and abandoned as unfit for food, but many show no signs of injury and appear to have perished merely from nervous shock, extremes of temperature, or the like. O. J. Murie in a field report states that a Mr. Quinn, of McGrath, Alaska, while traveling in the vicinity of Rainey Pass one winter during a continued severe cold spell, found numerous shrews frozen along the trail. The writer recalls a case late in August, 1919, at Ogema, Wis., when one of the field men in his party, who chanced to come upon a specimen of *Sorex arcticus laricorum*, which was running across a road, dropped a felt hat over the animal. He then carefully raised the brim of the hat, expecting to capture the shrew alive, but to his surprise the animal was dead, though apparently not touched by the hat. An interesting account of sensitiveness in a shrew has been described by Gillman (1876) as follows:

> In the heavily timbered forest in the neighborhood of Cheboygan, Mich., on a cold day in October, 1875, I caught a characteristic full-grown specimen of Thompson's shrew (*Sorex Thompsoni* Baird).[1] The pretty little creature had been busy about an old decayed stump, where it seemed to have its home. It uttered no audible cry, though at first it made several hostile demonstrations, endeavoring to escape, and, seizing my fingers in its mouth, tried to bite them, but the delicacy of its teeth rendered the attempt futile. Having no suitable place in which to deposit it, I carefully wrapped it in paper, allowing its head to protrude, and held it in my hand. Some sportsmen were out shooting on the bay about a mile off, and the reports of their guns came to us from time to time, generally so much muffled by the distance as to be barely distinguishable, yet the shrew invariably responded to each detonation with a quick, spasmodic movement, evidently of alarm. Holding the animal as I did, the movement was immediately perceptible. Though aware that the acuteness of the auditory organs of these animals and their allied genera is most wonderful, I was hardly prepared for so unequivocal a proof of its extreme sensitiveness, which, under the circumstances, I was enabled to test repeatedly in this individual Sorex.
>
> It was my intention to preserve the animal alive, and take it with me on my return home for further experiment and study of its habits; but, to my regret, on unfolding the paper on my way to the house at which I was staying I found the shrew had died. I have little doubt that its death was caused by fright, as I handled it most carefully so as not to hurt it.

Long-tailed shrews seldom use a call note and, as a rule, are not noisy animals. The writer has heard *Sorex c. cinereus* utter a series of sharp squeaks and also a weak purrlike grunt. Charles W. Richmond in his field report states that he observed a shrew (probably *S. o. obscurus*) in Gallatin County, Mont., and says that it frequently stopped to sniff the air suspiciously and occasionally uttered a "little snort." When fighting, either against members of their own species or other enemies, they frequently indulge in much squeaking and make a considerable noise for such mites. In the Mount Hood region, Oreg., in the spring of 1919, George G. Cantwell caught a *S. t. trowbridgii* in his hand from under a flake of bark. The shrew fought vigorously "with much squealing" and finally squirmed out of the grasp of its captor and disappeared like a ghost, for no conspicuous hole or apparent cover was in the vicinity to afford concealment.

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[1] This name is a synonym of *Microsorex hoyi thompsoni* (Baird), but Gillman's animal was probably *Sorex cinereus cinereus* Kerr.

The habits of the water shrews (subgenus Neosorex), so far as known, do not differ essentially from those of other shrews, except in adaptations to a more aquatic habitat. Water shrews rank high among the best swimmers of the nonmarine mammals, although opportunities for observing them in the act of swimming are rarely presented. They can swim, dive, float, run along the bottom of a pool or creek, or actually run on the surface of the water with the greatest ease. In a bog near Rhinelander, Wis., in August, 1906, the author saw one run a distance of about 5 feet across a small pool, the surface of which was glossy smooth. The body and head of the animal were entirely out of water, the surface tension of the water supporting the shrew, and at each step the animal took there appeared to be held by the fibrillae on the foot a little globule of air, which was also discernible in the shadow at the bottom of the pool, exactly as one might notice in the case of the water strider (*Gerris remigis*). (Miall, 1903, p. 12, 349.) It is probable, however, that this water-walking feat can be accomplished by water shrews only when the water is very still and quiet, and in running or rough water it would seem that the animals would be required to swim.

Walter P. Taylor in his field report for Cat Creek, Clallam County, Wash., states that on the evening of September 5, 1921, he saw a *Sorex palustris navigator*, which he at first mistook for a frog, in a shallow "running" creek. He noticed that it was walking rather jerkily through the water, at first in water not so deep but that it could touch the rocks beneath, but soon in water that must have been beyond its depth. It did not sink, but remained half exposed, "walking" rapidly along on top of the water. The animal had a dry, fluffy appearance.

Edward A. Preble saw one running on the water, July 27, 1910, in a small creek some 25 miles east of Telegraph Creek, British Columbia. He noted that the shrew followed the edge of the stream close to the bank and seemed scarcely to sink at all below the water line but gave the impression rather of running on the water film, progressing at a good rate and making only very slight ripples.

At the Three Sisters, Oreg., in July, 1914, Vernon Bailey caught a *S. p. navigator* in his hands, tied a string to its leg, and put it in the water. At first it fluffed out its fur and "sat on top of the water like a duck." Lowering itself into the water, it swam rapidly, though using but one foot, to a log, upon which it climbed. Then it would dive and dart about under water like a silver fish, going to the bottom and under logs and sticks, apparently seeing or knowing its way and just where to hide. According to Bailey, it swam with relatively greater speed and skill than the otter, which always seemed to him the most wonderful mammal in the water.

George G. Cantwell observed one in the Mount Rainier region, Wash., in the summer of 1919, which ran rapidly through the shallow water of a swift mountain stream, and swam or dived through the deeper pools with great speed, using all four feet in swimming with the same motions it used in running over the ground. While under water the thick coat of fur of the animal was surrounded by a silvery layer of air, and when the animal came to the surface again it appeared to be dry.

A. Brazier Howell (1924, p. 27) states in regard to an individual of *S. p. navigator* that "it dived and swam under a bank so quickly that I had opportunity to be sure of nothing except that while swimming it kicked both hind feet in unison after the manner of a frog." This method of swimming is at variance with the observations of others.

An interesting note on this same species made by the late Theodore Roosevelt is extracted from a letter (manuscript) of his dated November 26, 1888:

> I was near Kootanei Lake, in British Columbia, and while taking lunch near a small rapid brook I saw a Water Shrew swimming down it. While swimming its body looked like a flattened disc studded with silvery bubbles. It ran along the bottom and over the rocks very fast, and swam and dived well. I saw it catch a very minute fish and eat it on a wet, water-washed stone. At last by an under grab I caught it. Its tail was conspicuously longer than its head and body, and it was, without doubt, a Neosorex. I skinned it with my pocket knife and put a little hoop in the reversed skin, but as I was traveling very light, had to put it in my pocket. That afternoon I shot a bear and camped by it, being very hungry. I put the little Shrew skin out on a log and turned away a moment, and to my horror, in the interval the Indian who was with me threw the log into the fire, and of course the skin vanished. I was really very sorry.

FOOD AND ECONOMIC STATUS

Shrews are chiefly insectivorous in their food selections, but they will eat other flesh and occasionally vegetable matter. Stomach examinations of true Sorex, including representatives of the species *cinereus*, *fumeus*, *longirostris*, *vagrans*, *obscurus*, and *trowbridgii*, have shown the following among the contents: Hymenoptera, Coleoptera, Diptera (both larval and adult), caterpillars, crickets, spiders, hair and flesh of shrews and mice, and moss, seeds, and other vegetable material. That shrews are not entirely averse to certain vegetable food is attested by the manner in which they will eat rolled oats placed on baited traps. Their food probably does not vary much with the seasons, for shrews, being active in winter and feeding as they do mostly in burrows in the ground and in runways under the leaves, obtain dormant and pupating insects during the colder months of the year. Shrews are known to eat earthworms, although stomach examinations have not shown earthworms in the contents. The food of the water shrew (subgenus Neosorex) does not appear from stomach examinations to differ much from that of other shrews. The water shrew is known to eat small fish, however, and is also reported to feed upon fish eggs. It seems probable that a detailed study of its food would show the insects consumed to be more of aquatic species than those taken by other shrews. Also the stomach examinations of marsh shrews (subgenus Atophyrax) show no marked differences from those of other shrews, although 35 per cent of the contents of one stomach was snails. Nothing is known of the food of the members of the genus Microsorex.

Since shrews are such voracious eaters and feed principally upon insects with an occasional dessert of young mice, they are of considerable economic value in holding down certain pests of agriculture and forestry. Unfortunately, they are usually mistaken for mice by the layman and killed on sight. In parts of the extreme north, par-

ticularly in Alaska, long-tailed shrews are sometimes reported as a nuisance on account of their climbing into caches of fresh meat or fresh or dried fish, some of which they eat and the remainder ruin with their filth. In these same regions they may also become a nuisance in houses during winter. Water shrews, also, are occasionally reported to do damage in fish ponds and trout streams by destroying fish and fish eggs, but these shrews are not plentiful enough to do any serious damage except locally, and then but rarely. On the whole, shrews are among the most beneficial mammals.

YOUNG

Only scant information is available on the young of the genera Sorex and Microsorex. The litter of eight of *Sorex cinereus haydeni* collected by Stuart Criddle, at Aweme, Manitoba, and already referred to (*antea*, p. 7), are the youngest long-tailed shrews that the writer has seen. Although of indeterminable age, they are undoubtedly at least 10 or more days old and more than half the size of adults. They are covered with very short hair, and the tails are proportionately somewhat shorter than in adults. In all probability shrews are born blind, hairless, and, relatively speaking, but slightly developed. Following birth, however, it would seem that development and growth is comparatively rapid, although they remain in the nest until well along toward maturity. It is this habit of remaining in the nest until so nearly mature that makes young shrews so scarce in collections.

In the Criddle specimens the partly developed molariform teeth and first incisors appear above the alveola, while the unicuspids are still covered by the dermis, and difficult to detect in gross examination.

The only other young examined is a litter of five *Sorex longirostris fisheri* collected in May, 1905, by W. L. Ralph and J. W. Daniel, jr., in Dismal Swamp, Va. The young in this litter appear to be a few days older than those in the litter of *S. cinereus haydeni*, and offer no juvenile peculiarities not shown in the other litter.

WEIGHT

Among the species of long-tailed shrews are the smallest of American mammals, and even the larger forms are no bigger than some of the smaller species of mice. The smallest American shrew is *Microsorex hoyi winnemana*, which may also be the smallest mammal known. There are no weights available for this subspecies, however, nor for any others of the pigmy shrews (Microsorex), except two male specimens of *M. h. hoyi* collected by Bernard Bailey at Elk River, Minn. One of these, taken on March 25, 1926, weighed 2.1 grams; the other, collected two days later, weighed 2.9 grams. Neither of these was fat nor was the stomach of the latter so full as that of the first, although the latter weighed more.

Two females of *Sorex cinereus haydeni* weighed by Vernon Bailey at Walhalla, N. Dak., each weighed 3.3 grams, while a third collected

at that time weighed 3.6 grams. Bailey also weighed specimens of *S. c. cinereus* at Michigamme, Mich., late in the summer of 1923, the weights ranging from 3.5 to 5.5 grams. In the Stikine River region of British Columbia, in 1919, Joseph Dixon weighed several specimens of *S. c. cinereus*, 15 adults of which averaged 4.5 grams, with a minimum of 2.8 grams and a maximum of 6.1. Part of these specimens were approaching *S. c. streatori*, which is a larger subspecies than typical *cinereus*. Two males of *S. c. cinereus* collected and weighed by O. J. Murie at Fairbanks, Alaska, January 19, 1922, balanced at 2.7 and 2.8 grams, while a female October 14, 1921, from the same locality weighed 2.84 grams. Another female of this same subspecies collected by Murie February 18, 1922, on the South Fork of the Kuskokwim River, Alaska, weighed 2.85 grams.

Two males of *Sorex v. vagrans* collected at Puyallup, Wash., July 4, 1914, were weighed at 7 grams each by T. H. Scheffer. Eighteen specimens of *S. o. obscurus* from the Stikine region of British Columbia, as weighed by Joseph Dixon in the summer of 1919, averaged 6.9 grams, with a minimum of 4.8 grams and a maximum of 8.7 grams.

Seventeen western water shrews (*Sorex palustris navigator*) collected by parties from the Museum of Vertebrate Zoology, University of California, in various parts of the Sierra Nevada, but chiefly from the Yosemite region, California, averaged 12.3 grams, the minimum being 9.1 grams and the maximum 19.5 grams. A single individual of the marsh shrew (*S. b. bendirii*), a female collected October 14, 1914, at Puyallup, Wash., was found by T. H. Scheffer to weigh 12 grams.

The above data must not be taken for more than their actual value, for the weighing of a few specimens in the field is unsatisfactory for comparative use. Certain individual specimens may be fat, others lean or emaciated; some may be heavy with young, others worn and of light weight from the care of young; young and old may offer different weights; some individuals may be gorged with food, others empty; even the molting process might affect the weight of the animal. For purposes of comparative weights of different species it is therefore essential to weigh individuals that are in every respect in corresponding physical condition, and large series of them. The foregoing weights are therefore merely suggestive of the comparative weights of a few species.

EXPLANATIONS

EXTERNAL MEASUREMENTS

External measurements of shrews, unless otherwise stated in the text, are in millimeters and are those made by the collector from the animal in the flesh. The following have been used:

Total length.—Tip of nose to end of terminal tail vertebra.

Tail vertebrae.—Base of tail at superior surface to end of terminal tail vertebra.

Hind foot.—Posterior border of heel to apex of longest claw.

CRANIAL MEASUREMENTS

Cranial measurements, unless otherwise stated, were made by the author with a vernier caliper. The following (fig. 1) have been employed:

Condylobasal length.—Antero-posterior diameter of skull from anterior median point between bases of first upper incisors to most posterior point of occipital condyle.

Palatal length.—Greatest antero-posterior diameter of palate in median line. (This measurement was taken by use of fine-pointed dividers on vernier caliper.)

Cranial breadth.—Greatest lateral diameter of skull.

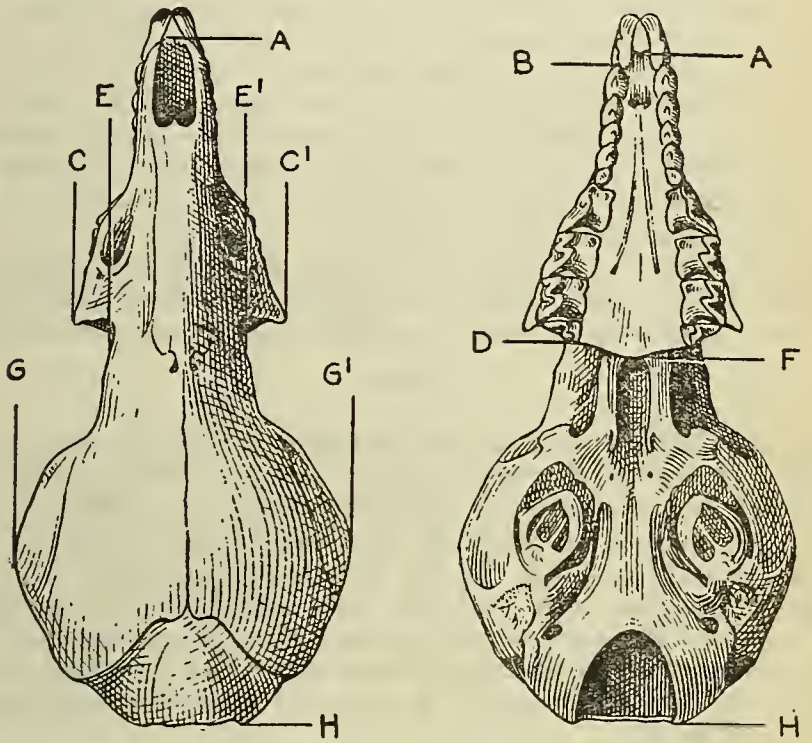

Fig. 1.—Skull of *Sorex bendirii palmeri*, showing cranial measurements employed. Enlarged three diameters

Cranial breadth, G–G'.
Condylobasal length, A–H.
Interorbital breadth, E–E'.
Palatal length, A–F.
Maxillary breadth, C–C'.
Maxillary tooth row, B–D.

Interorbital breadth.—Least lateral diameter of skull measured just posterior to maxillary processes.

Maxillary breadth.—Greatest lateral diameter of skull through maxillary processes.

Maxillary tooth row.—Antero-posterior diameter of upper tooth row between anterior border of second incisor and posterior border of last molar measured at alveolar border.

MATURITY OF SKULLS

On account of the great differences in the skulls of shrews of different ages it is essential in making comparisons to have specimens of approximately the same maturity. There are, of course, no sharp

age-division points in the life of the animal, but in making comparisons skulls have been classed as those of animals that were immature, young adult, adult, and old adult. Skulls of immature and old adult animals show more individual variation than those of the young adult and adult and are therefore less satisfactory for taxonomic purposes. In general terms these four classes of skull maturity may be defined as follows:

Immature.—Brain case usually moderately high, and unflattened, with sutures not distinctly closed; no sagittal or lambdoidal ridge; teeth usually not fully developed, unworn; first upper incisors protruding much beyond premaxillae anteriorly.

Young adult.—Brain case usually high and unflattened, with sutures closed; sagittal ridge absent or weakly developed, lambdoidal ridge absent; teeth fully developed, unworn; first upper incisors protruding much beyond premaxillae anteriorly.

Adult.—Brain case usually slightly flattened, with sutures closed; sagittal ridge moderately developed, lambdoidal ridge absent or weakly developed; teeth fully developed, usually unworn or slightly worn, sometimes moderately worn; first upper incisors protruding slightly beyond premaxillae anteriorly.

Old adult.—Brain case flattened, with sutures closed; sagittal and lambdoidal ridges both usually well developed; teeth usually much worn; first upper incisors scarcely protruding beyond premaxillae.

TEETH

Unless otherwise specified, comparisons of relative sizes of unicuspidate teeth are as they are viewed from an extero-lateral aspect, while comparisons of relative sizes and shapes of molariform teeth are as the upper molariform teeth are viewed from an inferior aspect (that is, looking dorsad). In the detailed examination of teeth a binocular microscope was used, the most satisfactory magnification being obtained with No. 1 oculars and a 40-millimeter objective.

The nomenclature of the tooth cusps and other principal elements of the molariform teeth can be determined from the accompanying diagram. (Fig. 2).

COLORS

The names of colors used throughout the text are those of Ridgway (1912). In some cases, where it has been impossible to match the colors of specimens exactly with those of Ridgway, other modifying or comparative terms are used.

In making comparative studies of the color of mammals, especially those with glossy or iridescent fur, it is essential always to view each specimen from approximately the same angle and to have the light rays from an approximately constant angle. In the author's color studies of moles, the animal was viewed from the anterior end. (Jackson, 1915, p. 20.) In making color observations upon shrews the animal has been viewed from the posterior end. Diffused daylight from a window was allowed to strike the shrew at an agle of 30° to 45° anterior to a plane perpendicular to the longitudinal axis of the animal. The shrew was then viewed at varying angles, usually slightly laterally, from the light rays but always posteriorly

to the animal and in the same plane as the reflected light rays; that is, in the plane at an angle of 30° to 45° posterior to a plane perpendicular to the longitudinal axis of the animal.

GROUPS

As a matter of convenience for other workers in the study and identification of specimens, the writer has divided the American long-tailed shrews into assemblages of one or more species, which he calls

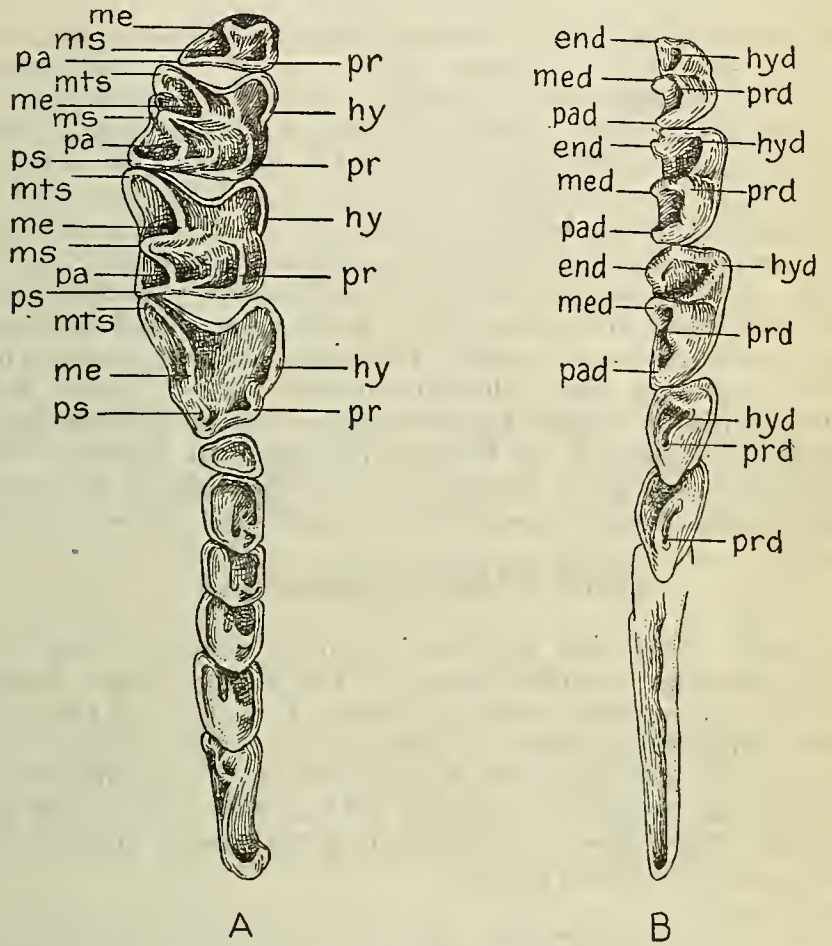

FIG. 2.—Teeth of *Sorex bendirii bendirii*, showing principal cusps. Enlarged about 10 diameters. A, left upper teeth; B, left lower teeth

me = metacone.	ps = parastyle.	med = metaconid.
ms = mesostyle.	hy = hypocone.	pad = paraconid.
mts = metastyle.	pr = protocone.	hyd = hypoconid.
pa = paracone.	end = entoconid.	prd = protoconid.

groups. The author is fully cognizant of the fact that the term "group" as thus used does not, and should not, have any status in the nomenclature of zoological classification and is employed solely for convenience. Nevertheless he has endeavored to bring within each group closely related forms, and, therefore, each group represents more or less a taxonomic unit. Furthermore, an effort has been made to arrange the groups and species in phylogenetic sequence from the more simple morphologically to the more complex, and to arrange subspecies in accordance with intergrading forms. Strict

adherence to such a method, however, has not been possible, since linear arrangement can not express what may actually be radial, parallel, or possibly, in the case of subspecies, even partly concentric. Although "groups," as previously stated, have been made as a matter of convenience, genera, subgenera, species, and subspecies have been recognized on the strength of structural characters and zoological relationships regardless of convenience in classification.

MATERIAL EXAMINED

The present revision recognizes 89 forms of 39 species of American long-tailed shrews and is based upon a study of 10,431 specimens, mostly skins accompanied by skulls. Of this number, the genus Sorex comprises 10,293 (subgenus Sorex, 9,369; subgenus Neosorex, 721; subgenus Atophyrax, 203); and Microsorex, 138. Type specimens or essentially topotypes of all described forms except *Sorex hydrodromus* Dobson have been examined. In some groups and species the material has been fairly adequate for a thorough investigation. In others the number of specimens available has been entirely too small for satisfactory conclusions. And always more juvenile specimens were needed. The study has been based primarily upon specimens in the collection of the United States National Museum, including therein the Merriam collection and the large and important collection of the Bureau of Biological Survey. Without the cooperation of other institutions and individuals, however, this revision in its present completeness could not have been accomplished.[2]

THE FAMILY SORICIDAE

The family Soricidae, exclusive of fossil forms, is composed of some 24 currently recognized genera. The family ranges throughout North America, extreme northern South America, and the the tropical and temperate regions of Europe, Asia, and Africa. It is a compact, rather homogeneous group, the members of which are small to medium-size mouselike animals, with minute eyes, sharp-pointed snouts, and small ears, the ear conch always being present, though inconspicuous in certain genera.

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[2] The author expresses his gratitude and appreciation to each of the following for the loan of specimens or for various other courtesies: Joseph Grinnell, of the Museum of Vertebrate Zoology, University of California; H. E. Anthony and G. G. Goodwin, of the American Museum of Natural History; Wilfred H. Osgood, of the Field Museum of Natural History; Samuel Henshaw and Glover M. Allen, of the Museum of Comparative Zoology of Harvard College; R. M. Anderson, of the National Museum of Canada; Witmer Stone, of the Academy of Natural Sciences of Philadelphia; Manton Copeland, of Bowdoin College; A. G. Ruthven and Lee R. Dice, of the Museum of Zoology, University of Michigan; George Wagner, of the University of Wisconsin; W. T. Shaw, formerly of the State College of Washington; M. H. Spaulding, of the Montana State College; C. D. Bunker, of the Kansas University Museum of Natural History; S. A. Barrett, of the Public Museum of the City of Milwaukee; O. A. Peterson, of the Carnegie Museum; J. D. Figgins, of the Colorado Museum of Natural History; L. L. Snyder, of the Royal Ontario Museum of Zoology; Clinton G. Abbott and Lawrence M. Huey, of the Natural History Museum, San Diego, Calif.; Francis Kermode, of the Provincial Museum, British Columbia; Philip Cox, of the Miramichi Natural History Society and the Provincial Museum, New Brunswick; Frank Smith, of the Illinois State Laboratory of Natural History; W. L. Burnett, of Colorado State College; Donald R. Dickey, Pasadena, Calif.; Stuart Criddle, Treesbank, Manitoba; C. F. Batchelder, Cambridge, Mass.; Stanley G. Jewett, Portland, Oreg.; A. Brazier Howell, Washington, D. C.; D. E. Brown, Seattle, Wash.; A. S. Pope, Chicago; J. Dewey Soper, Ottawa, Canada; D. E. Kent, Rutland, Vt.; George I. Kirk, Rutland, Vt.; E. R. Warren, Colorado Springs, Colo.; Alex Walker, Tillamook, Oreg.; Harley B. Sherman, Gainesville, Fla.; Bernard Bailey, Elk River, Minn.; and G. G. Cantwell, Palms, Calif.; and to Oldfield Thomas, of the British Museum (Natural History), who has supplied many notes on specimens in that museum; and to Gerrit S. Miller, jr., who has allowed absolute freedom in the division of mammals of the United States National Museum.

The clavicle is long and slender; humerus relatively long and slender (length more than twice width); pelvis relatively broad (width more than one-third length); no os falciforme on the fore foot; terminal phalanges of fore foot simple, not bifurcate.

The skull is somewhat conoidal, relatively long and narrow, the individual bones anastomosed into one compact whole with but little indication of the sutures; the zygomatic arch is absent, but represented by a rudimentary zygomatic process of the maxilla; audital bullae absent, the tympanic bone annular and not connected with the skull by osseous tissue; exterior pterygoid region angular and not inflated, no exterior pterygoid plate; mandible with double articulation.

First upper incisor large, elongated, projecting anteriorly, two-lobed, the anterior lobe the larger; first lower incisor greatly elongated, extending anteriorly in line of mandible, the upper edge with two or more slightly developed lobes; remaining incisors and canines, both upper and lower, and first and second upper premolars if present, simple unicuspidate; crowns of upper molars low, W-shaped in inferior outline; crowns of lower molars low, M-shaped in superior outline.

SUBFAMILIES

The family Soricidae is usually divided into three subfamilies, namely, Soricinae, Crocidurinae, and Scutisoricinae. The last two are not represented in the American fauna. Soricinae is represented in America by five genera, namely, Sorex, Microsorex, Blarina, Cryptotis, and Notiosorex. The present revision includes only the two genera Sorex and Microsorex, which, however, represent a greater part of the American species.

PELAGES AND MOLTS

The hair of long-tailed shrews is fine, soft, and silky, but not of such velvet-like texture as is found in moles, though it approaches such a degree in the subgenera Neosorex and Atophyrax and sometimes in immature individuals of any species. The pelage of shrews seldom shows the high gloss common to that of moles, nor, except in a few localized races, does it display the metallic iridescence characteristic of some species of moles in certain pelages.

It is usual for mammals to have two types of hairs; one type is short, fine, and numerous, and forms the underfur; the other is longer, coarser, stiffer, and comparatively sparse, and forms a protective covering, the overhair. In the long-tailed shrews there is no sharp distinction between underfur and overhair, either in texture or length, although in some individuals a few scattered hairs seem slightly heavier than the majority. Shrews are primitive mammals in many respects, and this lack of hair specialization may be another indication of primitive characters.

TIME OF MOLTING

So far as known, every species of long-tailed shrew has two molts annually, one in spring and one in fall. Although there is some variation in the time of molting among the different species, particu-

larly in the spring, nevertheless individuals of nearly any species may be found in process of molt during May and early in June, and without exception of any species the autumnal molt may be looked for late in September or during October, apparently with slight regard to altitude or latitude. The spring molt of *Sorex veraepacis* seems to be earlier than in other forms, and *S. cinereus* may also molt as early as early April, while *S. bendirii* is not apt to begin molting before June. The time of molting is considered in more detail in the discussion under each species in the text following.

MANNER OF MOLTING

In general, during the spring molt the first appearance of the new fur is on the crown and nape, from where it gradually replaces the old on the head. The molt line then passes caudad over the shoulders and back, and ventrad over the sides, in the earlier stages moving more rapidly dorsally than ventrally, but in the later stages apparently more rapidly on the ventral parts, since often the entire underparts are in fresh pelage before the fur on the posterior part of the back has molted. In fact, during spring the rump is nearly always the last part of a shrew to retain the old hair. Often, in the early stages of molting the old fur over the entire body is underlaid with the new, short hairs. Occasionally the mid-dorsal region will molt before the nape and the region over the shoulders do, but such cases are exceptions and seem to occur more frequently in the water and marsh shrews (subgenera Neosorex and Atophyrax) than in true Sorex.

The characteristic autumnal molt almost reverses the sequence of that of spring. Usually the first new fur in the fall appears on the rump and posterior half of back; the molt then works cephalad and ventrad, gradually covering the entire animal, the head usually being the last part to change pelage. Sometimes, however, molt may start earlier on the head, leaving the shoulders and anterior portion of the back the last to molt.

VARIATIONS

GEOGRAPHIC VARIATION

Geographic variation in long-tailed shrews manifests itself chiefly in variations of paleness or darkness, in size both external and cranial, in tail length, and in general shape of the skull, particularly in degree of deflation of brain case, in breadth of rostrum and brain case, and in size of teeth and, correlated with it, length of molar tooth row. Geographic variations when constant in character and of commensurate degree may be recognized nomenclatorially as subspecific characters, particularly when such characters occur over a definite geographic area.

As a rule there is comparatively little geographic variation in long-tailed shrews, and individual subspecies usually have an extensive geographic range. This is especially noticeable in such forms as *Sorex c. cinereus*, which ranges nearly across the North American Continent from east to west and has a north and south range from extreme northern Canada to the northern United States; and in *S. o. obscurus*, which is found with scarcely any variation from north-

central Alaska to northern New Mexico. As in all groups of mammals, there are certain forms with restricted ranges apparently dependent upon peculiar environmental factors or upon more or less complete geographic isolation, but such forms, although superficially similar, are usually specifically distinct from their nearest allies.

There are several reasons for this lack of pronounced geographic variations in long-tailed shrews. The members of the family Soricidae are all comparatively simple colored grays and browns without distinct patterns. As the skull structure and the dentition are also very simple, there is little opportunity for variation in chromatic, cranial, or dental characters. In other words, the mere simplicity of the mammal tends to limit the possibilities for variations. Probably a more important factor in limiting these variations, however, is the phylogenetic age of the group. Shrews are geologically among the oldest of true placental mammals, and as such their characters are deep-seated and fixed. As an example the western water shrew (*Sorex palustris navigator*), which inhabits the boreal elevations of many of the mountains of the western United States, might be cited. These shrews from the different ranges are very constant in characters and show comparatively little variation, yet their habitats on the different mountains are often separated by broad expanses of desert or arid plain, which to this species has been an absolute barrier for possibly millions of years.

INDIVIDUAL VARIATION

The general shape and proportions of skulls of any form of long-tailed shrew, if of corresponding maturity and from the same locality, are seemingly very constant, yet when placed upon percentage basis the variation may amount to as much as 5 per cent from an average. Variation in actual size of skull, based upon any of several measurements, such as condylobasal length, greatest length, or breadth of cranium, may be even greater and in rare instances in large series has amounted to 7.5 per cent from the average. There is also a correspondingly great variation in the external measurements of total length, tail length, and hind foot, as computed from measurements taken by collectors in the field.

There is a tendency for certain skulls of shrews to be "runty," or to have an abnormally shortened rostrum, or abnormal dentition. This does not occur in any great number of specimens, but nevertheless appears to be more frequent than in most other families of Mammalia. Thus a skull of *Sorex c. cinereus* (No. 150083. U. S. Nat. Mus.) from Mount Washington, N. H., has an abnormally shortened rostrum and interorbital region. A specimen of *S. v. vagrans* (No. 233087, U. S. Nat. Mus.) from Bear Prairie, Mount Rainier, Wash., has the third upper incisor (second "unicispid") on the right side bicuspidate. In a specimen of *S. p. pacificus* (No. 9648, Field Mus. Nat. Hist.) from Eureka, Calif., the left upper first premolar (fifth unicuspid) has two distinct cusps, one directly caudad to the other. A specimen of *S. o. obscurus* (No. 988, Nat. Mus. Canada) from the mouth of Salmon River, British Columbia, has a supernumerary unicuspidate tooth interposed between the third and fourth unicuspids;

the accessory tooth is smaller than either of the normally third or fourth unicuspids, and considerably smaller than the fourth. Two skulls of *S. o. longicauda* (Nos. 74702 and 100570, U. S. Nat. Mus.) from Wrangell, Alaska, have each only four unicuspids on each side in the upper tooth row; the first premolar (fifth unicuspid) is evidently the one lacking.

One of the most peculiar dental abnormalities occurs in a skull of *Microsorex h. hoyi* (No. 373, collection of Stuart Criddle, Treesbank, Manitoba) from Aweme, Manitoba. In each of the upper tooth rows one of the unicuspids is lacking, apparently the first one (second incisor), though it may possibly be the second (third incisor). The tooth row is compact, the space that would normally have been occupied by the missing tooth being taken up by a slight increase in the postero-anterior diameter of each of the other unicuspids. The increase in the size of the unicuspids is particularly noticeable in the case of the third. In normal individuals of Microsorex this tooth is so thin in postero-anterior diameter as to be a mere plate, but in the aberrant specimen this diameter is nearly half the lateral dimension. The two tooth rows are symmetrical with each other and present a striking anomaly.

Except for some fading or "rusting," due to wear, the color of shrews of a given species from the same locality and in the same pelage is fairly constant. The fresh pelage is usually a trifle darker and more grayish than the old, and this sometimes gives the appearance of actual color variation. Shrews seldom exhibit abnormal color phases, such as melanism and albinism. The author has never seen a melanistic long-tailed shrew. A specimen of *Sorex o. obscurus* (No. 932, Prov. Mus. British Columbia) collected February 13, 1917, at Okanagan, British Columbia, seems to be a partial albino. This specimen is white on the chin and upper throat, the white extending ventrad and caudad on the left almost to the left fore leg. The color of the eyes of this specimen was not indicated by the collector. Another specimen of *S. o. obscurus* (No. 22060, Mus. Vert. Zool., Univ. Calif.), a male collected July 21, 1915, at an altitude of 10,800 feet at the head of Lyell Canyon, Yosemite National Park, Calif., has a general tone of color over the entire animal of pale ochraceous buff, the underparts being paler and more whitish; the base of hairs is pale smoke gray. A skin without skull (No. 241190, U. S. Nat. Mus.) of what is apparently *S. tundrensis*, received at the National Museum on February 18, 1926, from H. O. Brown, of Shungnak, Alaska, is entirely white, although the color of the eyes is unknown.

SEXUAL VARIATION

So far as known, there is no sexual variation of color, size, or proportions in any of the American long-tailed shrews. The adult males of all species have a relatively long and narrow gland on each flank, which develops conspicuously during the breeding season. The relative size of this gland varies with the different species, and in the genus Microsorex it is particularly large in proportion to the size of the animal, being about 9 millimeters long or nearly equal to the length of the hind foot; it is small in *Sorex cinereus*, being only about 2 or 3 millimeters long; in *S. obscurus* and *S. arcticus* it is

about half the length of the hind foot, or about 6.5 millimeters in the former and 7 millimeters in the latter (Preble, 1908, p. 243–249). The use of this gland as a taxonomic character, however, is not satisfactory, since not only is its use as such limited to less than half the specimens available, but also the gland is exceedingly difficult to measure accurately because of its position in the hair and the varying degrees of stretching it receives in different skins as made by different collectors.

AGE VARIATION

Externally, shrews display little variation with age. As a rule, younger animals appear slenderer than adults and have their tails a trifle more hairy and sometimes slenderer.

Cranially, long-tailed shrews display great variation from the juvenile to the senile stage. The brain case flattens and appears to broaden with advancing age; the sutures of the cranium close; the sagittal and lambdoidal ridges develop; the first incisors gradually grow anteriorly, then inferiorly, producing an entirely different aspect in old age from that of young; and the unicuspids seem to become somewhat swollen and broadened with age. These variations are described in more detail under the heading "Maturity of Skulls," page 13.

SEASONAL VARIATION

The only pronounced seasonal variation in the long-tailed shrews is in color and length of pelage. In nearly all species the winter pelage is longer and the color at that season is decidedly more grayish than in summer. The color difference between summer and winter fur is very marked in some species, as *Sorex cinereus*, *S. fumeus*, *S. vagrans*, and *S. ornatus*, in all of which the winter fur not only is more grayish but tends to be actually paler than is summer. In *S. arcticus* the winter pelage is darker than in summer, producing a more noticeable saddleback effect. The marsh and water shrews (*S. bendirii* and *S. palustris*) and *S. trowbridgii*, species already gray in summer pelage, have paler color in the winter coat.

HISTORY

The earliest reference in literature to a long-tailed shrew inhabiting America is that of Forster, who recorded a specimen sent in by Mr. Graham from the settlement on Severn River, Hudson Bay, under the name *Sorex araneus* Linn. (Forster, 1772, p. 370, 380). Forster's specimen was of the species known to-day as *S. arcticus* Kerr, a shrew superficially like the European *S. araneus*, but which did not receive a scientific name until 20 years after its discovery, although Forster actually noticed differences between the two forms. Forster also had two other specimens of shrews from the same region, which he did not identify (op. cit., p. 381) and which belonged to the species now known as *S. cinereus* Kerr. A few years later Pennant (1784, p. 139) redescribed the three Forster specimens, virtually copying Forster's descriptions, and placed them under "Foetid?" shrew, a common name for *S. araneus* Linn. Forster and Pennant, however, used no Latin binomials. It remained for Kerr (1792, p. 206), basing his descriptions upon Pennant, to give valid names to

both of Forster's species; the first one he calls "Labradore Shrew—*Sorex arcticus*"; the second species he named "Gray Labradore Shrew—*Sorex arcticus cinereus*" (vide Jackson, 1925a, p. 55).

In November, 1826, Isidor Geoffroy St. Hilaire read an account of this same shrew, which had been named *Sorex arcticus cinereus* by Kerr, before the Société d'Histoire Naturelle at Paris, and, about two months later, published a description of the animal under the name *Sorex personatus* (Geoffroy, 1827a, p. 319), a name used for many years for the common long-tailed shrew of the eastern United States and Canada, always erroneously dating, however, from a redescription by Geoffroy published late in the same year (Geoffroy, 1827b, p. 122).

In 1828, Richardson was responsible for another name for *Sorex arcticus cinereus* Kerr, when he described *Sorex forsteri* (Richardson, 1828, p. 516). In this same paper, moreover, Richardson described the first American water-shrew known, under the name *Sorex palustris* (Richardson, 1828, p. 517). Thus, at this date, April, 1828, only three species of shrews had been described from the American continent. This is not so suprising, when one recalls the difficulties of collecting small mammals, particularly shrews, in those days when there were no small-mammal traps and when the capture of any small mammal was more or less chance or the result of the hard labor of digging for nests, setting snares, or making deadfalls.

Probably the first contribution to the knowledge of the American shrews, which in any way could be dignified by the title of a revision or review of the group, was that of Bachman in 1837. Bachman listed and described 13 species of shrews, 7 of which were long-tailed ones. Of the 7, 4 were described as new, only 1 of which, his *Sorex longirostris* (Bachman, 1837, p. 370), stands to-day. His name *Sorex richardsonii* (op. cit., p. 383), now a synonym of *S. arcticus* Kerr, was for many years used for the common saddle-backed shrew of America. Bachman also named *Sorex cooperi* (op. cit., p. 388) and *Sorex fimbripes* (op. cit., p. 391), both now synonyms of *S. cinereus* Kerr. He also listed *Sorex palustris* Richardson (op. cit., p. 396), which he had not seen, and *Sorex forsteri* Richardson (op. cit., p. 386) and *Sorex personatus* I. Geoffroy (op. cit., p. 398), the last also not seen, both synonyms of *S. cinereus* Kerr.

One year after Bachman's paper appeared, Gray (1838) classified the family into two major divisions, namely, land shrews and water shrews. Under his land shrews were three genera, Corsira, Myosorex, and Sorex. Only Corsira was represented by American species, where he placed *Sorex forsteri*, *S. longirostris*, *S. cooperi*, and *S. richardsonii* Bachman. Gray also first used the name Blarina, as a subgenus of Corsira, where he placed all the American short-tailed species of shrews then known, and also *S. personatus* [*S. c. cinereus*] (op. cit., p. 124). Under his water shrews were two genera, Amphisorex and Crossopus; of American species, *S. palustris* Richardson was included under Amphisorex (op. cit., p. 125); and *S. fimbripes* Bachman, under Crossopus (op. cit., p. 126). Gray was confused in the actual relationships of many of the species, and his paper added little new, except his attempted arrangement of the species into genera and subgenera.

In 1842, the genus Otisorex was named, with *Otisorex platyrhinus* the type species (De Kay, 1842, p. 22), a name, however, which is a synonym of *Sorex cinereus* Kerr. De Kay also included Bachman's species *Sorex longirostris* in the genus Otisorex (op. cit., p. 23.) This same year Duvernoy described *Amphisorex lesueurii* from Indiana (Duvernoy, 1842a, p. 33), a synonym of *S. c. cinereus* Kerr, and in another contribution dwelt in considerable detail upon the structure, development, and function of shrews' teeth (Duvernoy, 1842b). This latter paper was supplemented the following year (Duvernoy, 1843), and an essentially modified and revised edition of the whole work with the addition of illustrations was published a few years later (Duvernoy, 1846).

Sundevall, in a synopsis with brief descriptions of the shrews, divides the genus Sorex into three subgenera, the second of which, Sorex proper, he classifies into divisions 1 and 2 (Sundevall, 1843). In the first division he includes the American short-tailed shrews; under the second ("*Corsira* Gray, *Amphisorex* Duvern.") he lists ("omnes mihi ignotae") five species, namely, *S. richardsoni* Bachman, *S. forsteri* Rich., *S. lesueurii* Duvernoy, *S. personatus* Is. Geoffry, and *S. longirostris* Bachm. (Sundevall, 1843, p. 182–183). The third subgenus recognized by Sundevall is Crossopus, where he allocates *S. palustris* Rich., but remarks "Non vidi." (Op. cit., p. 187.) Under the heading "Sorices incerti," Sundevall lists among several other species *S. fimbripes* Bachman. (Op. cit., p. 188.) Although Sundevall had apparently never seen a specimen of an American shrew, his grouping of the species was probably the best that had been presented up to that time.

In 1848 Pomel classified the insectivores into families, tribes, genera, and sections, each with a name and description. He used Hydrogale as a section name under the genus Sorex, but raised it to generic rank in the remark "si ce caractère se confirmait, ce type pourrait être érigé en un genre distinct: *H. fimbripes*, l'espèce est le *sorex fimbripes* Bachm." (Pomel, 1848, p. 248.) He also described the genus Galemys (not of Kaup, 1829) and placed therein the American species *Sorex palustris* under the section Crossopus (op. cit., p. 249.) Pomel placed *S. longirostris* Bachman in the genus Musaraneus Brisson and in the section Crocidura, thus: [*Musar.* (*Croc.*)] *Bachmani* (*longirostris junior* Bachm.) (Op. cit., p. 249.) Pomel's sections were in reality subgenera.

A few years later Baird's epoch-marking work on the mammals of North America appeared in which he recognized 13 species of long-tailed shrews. (Baird, 1857, p. 7–56.) Baird described the genus Neosorex with *Neosorex navigator* the type species. (Op. cit., p. 11.) He also described as new 7 other species, namely: *Sorex trowbridgii*, *S. vagrans*, *S. suckleyi*, *S. pachyurus*, *S. haydeni*, *S. hoyi*, and *S. thompsoni*. In spite of the inadequacy of the material with which Baird worked, of the 8 new specific names that he proposed all except *suckleyi* and *pachyurus* are applicable to forms recognized today. Baird, however, recognized *S. forsteri*, *S. platyrhinus*, *S. cooperi*, and *S. personatus*, all of which are synonymous. He listed *S. palustris* Rich. and *S. fimbripes* Bachman, species of which he had not examined specimens. (Op. cit., p. 55.)

In 1867 and 1868 Mivart published a somewhat detailed account of the osteology of the Insectivora (Mivart, 1867, p. 68) and divided the order into seven families, the family Sorices being represented by a single genus Sorex (op. cit., p. 141). Mivart made many comparisons between Sorex and other genera, but inasmuch as he designated no species in these comparisons the value of his work is nullified.

Almost simultaneously with the appearance of the last part of Mivart's osteological work appeared the first part of the account of the shrews of the world by Fitzinger (1868). He recognized 10 species of American long-tailed shrews, 6 of which, however, are synonymous among his other 4 species as known to-day. He described as new *Sorex wagneri* (Fitzinger, 1868, p. 512), a synonym of *S. longirostris* Bachman. Fitzinger evidently did not consult the important contribution of Baird (1857), since he listed none of the species described as new in Baird's work.

The results of the important investigations of E. Brandt on the dentition of shrews was published in three sections, which appeared, respectively, in 1869, 1871, and 1874. This study was based upon specimens of nine species of shrews belonging to 5 genera, the dentition of which are described in detail. Although Brandt included no American species, his work is valuable in its general application to certain American species and for comparative purposes. Previous to the German issue of this publication (Brandt, 1869–1874) there had been an edition in Russian (Brandt, 1865).

In his "Synopsis of Insectivorous Mammals," Gill (1875) classified the order into families, subfamilies, and genera, giving detailed descriptions of families and subfamilies and a review of the more important works to that date. Gill recognized two genera of American long-tailed shrews, namely, Sorex Linnaeus and Hydrogale Pomel, using the latter name to replace that of Neosorex Baird (Gill, 1875, p. 111). Two years later appeared the important studies on American insectivorous mammals by Coues (1877), in which he recognized two genera of American long-tailed shrews, Neosorex and Sorex, and as a subgenus of Sorex named Microsorex, with the type species *Sorex hoyi* Baird. Coues did not discuss or list the various species and subspecies, but described two new species of long-tailed shrews (op. cit., p. 650), one, *Sorex pacificus* from Baird MS., a valid species; the other, *Sorex sphagnicola*, now a synonym of *S. arcticus*. Later in this same year, Alston (1877) described the first-known long-tailed shrew from Central America under the name *Sorex verae-pacis*, although the animal had been known to Gray (1843, p. 79) many years previously.

In 1884, Merriam described as a new genus and species *Atophyrax bendirii* (Merriam, 1884b, p. 217), a large marsh shrew from Klamath County, Oreg. Shortly afterwards there appeared an important anatomical paper by Parker (1885), in which was described and beautifully illustrated the development of the skull of *Sorex vulgaris* (=*S. araneus*), not an American species, but one directly comparable, as far as ontogeny is concerned, particularly with *S. arcticus* Kerr.

The problematical *Sorex hydrodromus* from Unalaska Island, Alaska, was described by Dobson in 1889 in a paper in which he also remarks upon the uselessness of retaining Neosorex as a distinct

genus. (Dobson, 1889, p. 374.) At the time this paper appeared Dobson was working upon the part on the Soricidae of his monograph of the Insectivora, the first number of that part appearing in May of the following year (Dobson, 1890). Unfortunately Dobson's ill health and death prevented him from completing the momentous task, so that all that was published on the Soricidae was the fascicle of six plates, and these bear evidence in misnamed figures of not being proof-read by their careful and able author. In this work, the interesting American species, *Sorex merriami*, is named and figured. (Dobson, 1890, pl. 23, fig. 6.)

During the next three years in three papers Merriam (1890, 1891, and 1892b) described six new forms of Sorex. It was not until 1895, however, when the revisions by Miller and Merriam were published, that a clear presentation of the relationships of the American species as understood at that time was had. Miller's contribution was a review of the members of the genus Sorex (including subgenera Sorex, Microsorex, and Neosorex) occurring east of the Great Plains of the United States. He had examined in the British Museum the original specimens of *Sorex palustris*, *S. forsteri*, and *S. parvus* described by Richardson, which enabled him to describe more accurately these specimens and clarify questions of their relationships. He recognized seven species from the eastern United States, one of which, *S. fumeus*, he described as new (Miller, 1895, p. 50). Merriam's synopsis (1895) comprises the most complete account published of the long-tailed shrews of the entire region of North America and Central America. Merriam recognized 41 species and subspecies, which he included in the single genus Sorex, divided into four subgenera; 33 species and subspecies were placed in the subgenus Sorex, 1 in the subgenus Microsorex, 4 in the subgenus Neosorex, and 3 in the subgenus Atophyrax. In this revision, Merriam described 21 new species and subspecies, all of which are recognized in the present revision. And of the 41 forms recognized by Merriam, all except *S. sphagnicola* (=*S. arcticus*) and *S. vagrans dobsoni* (=*S. v. monticola*) are recognized in the present work, although his *S. personatus* here appears under the name *S. cinereus*, and his *S. richardsoni* as *S. arcticus*. Merriam's contribution was a big stepping-stone in the climb toward a knowledge of this difficult group.

In 1896 Batchelder described an interesting and distinctive species of shrew from New York under the name *Sorex macrurus*, which being preoccupied he later renamed *Sorex dispar* (Batchelder, 1911). During the 30 years following the revisions by Miller and Merriam (1895), there appeared numerous other descriptions of new species or subspecies of American long-tailed shrews by Merriam (1897, 1899, 1900, 1902), Bangs (1899), Elliot (1899, 1903b), Osgood (1901a, 1901b, 1909), Preble (1902, 1910), Nelson and Goldman (1909), Bailey (1913), Jackson (1917, 1918, 1919, 1921b, 1922, 1925a, 1925b, 1925c, 1926), and Anthony and Goodwin (1924); there were also published several papers treating upon the distribution or habits of American forms. During this period, however, only four contributions stand out above the others as needing special mention here. The first of these is an anatomical paper by Ärnbäck-Christie-Linde (1907), which treats in some detail of the muscles of *S. pygmaeus* and *S. vulgaris*, European forms, the latter not far removed from *S.*

arcticus. In this account, also, the side glands are mentioned as occurring only in males, and the investigator considers that the members of the family Soricidae hibernate because they are provided with "Winterschlafdrusen oder braunem Fettgewebe," a case where present knowledge of habits apparently does not substantiate a supposed structural adaptation.

Hollister's paper (1911) was a brief review of the Sorex of the Eastern United States, in which was described the new species *Sorex fontinalis*. Hollister recognized five species from the region. He considered *Amphisorex lesueurii* Duvernoy to be a synonym of *S. longirostris* Bachman, and *S. fimbripes* Bachman to be unidentifiable; he identified *S. acadicus* Gilpin with *S. personatus* Geoffroy.

Grinnell (1913a) discussed the characters, relationships, and distribution of six species and subspecies of Sorex from west-central California. Three new forms were described, all of which are recognized in the present monograph.

Glover M. Allen (1915) described as new *Neosorex palustris acadicus* (=*S. p. gloveralleni* Jackson), carefully compared it with related forms, and listed all the other known subspecies with an outline of their respective geographic ranges.

LIST OF GENERIC NAMES USED FOR AMERICAN LONG-TAILED SHREWS

Amphisorex Duvernoy, Mém. de la Soc. Mus. d'Hist. Nat. Strasbourg, tome 2, sig. 5, p. 23, 1835. Type species *Sorex hermanni* Duvernoy, the animal of which is *Sorex arcuus tetragonurus* Hermann and the skull, *Neomys fodiens fodiens* Schreber (vide Miller, 1912a, pp. 29, 42, 70). Used generically for *Amphisorex lesueurii* Duvernoy qui *Sorex cinereus cinereus* Kerr.

Atophyrax Merriam, Trans. Linn. Soc. New York 2: 217, August, 1884. Type species *Atophyrax bendirii* Merriam. A subgenus of Sorex Linnaeus.

Corsira Gray, Proc. Zool. Soc. London, part 5, 1837, p. 123, May, 1838. Type species *Sorex vulgaris* Linnaeus. A synonym of Sorex Linnaeus to which Gray referred *Sorex forsteri* Richardson qui *Sorex cinercus cinereus* Kerr.

Crocidura Wagler, Isis von Oken 25: 275, 1832. Earliest available name for the Old World genus of which *Sorex leucodon* Hermann is the type species. Used generically in synonymy for several species of American Sorex by Fitzinger (1868), who refers to Reichenbach.

Croscopus ? Fitzinger, Sitzungber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, Band 57, Abt. 1, p. 632, 1868. Misprint for Crossopus Wagler. Used in synonymy under *Crossopus fimbripes* qui *Sorex cinereus cinereus* Kerr.

Crossopus Wagler, Isis von Oken 25: 275, 1832. Type species *Sorex fodicns* Beckstein=*Sorex fodiens* Schreber. A synonym of Neomys Kaup. First used for an American species as *Crossopus palustris* Reichenbach (1847, p. 161), qui *Sorex palustris palustris* Richardson.

Galemys Pomel, Archives Sci. Physiques et Nat., Genève 9: 249, November, 1848. Included Brachysorex Duvernoy, Crossopus Wagler, and Pachyura de Sélys-Longchamps. Not Galemys Kaup (1829), which is a genus of Talpidae. Included *Sorex palustris* Richardson.

Hydrogale Pomel, Archives Sci. Physiques et Nat., Genève 9: 248, November, 1848. Type species *Sorex fimbripes* Bachman. Not Hydrogale Kaup, 1829, qui Neomys Kaup. Used to replace Neosorex Baird by Gill (1875, p. 111).

Microsorex Coues, Bul. U. S. Geol. and Geogr. Surv. Territories 3: no. 3, p. 646, May 15, 1877. Earliest available name for the genus of which *Sorex hoyi* Baird is the type species. Described as a subgenus by Coues from Baird manuscript. Raised to rank of genus by Elliot (1901a, p. 377).

Musaraneus Brisson, Regnum Animale, p. 126, 1762. A synonym of Sorex Linnaeus. Pomel placed *Sorex longirostris* Bachman in this genus and in his "section" *Crocidura* under the specific name *bachmani*, thus: "[*Musar.* (*Croc.*)] *Bachmani* (*longirostris junior* Bachm.)."

Neosorex Baird, Report Pacific Railroad Survey, vol. 8, part 1, Mammals, p. 11, 1857. Type species *Neosorex navigator* Baird. A subgenus of Sorex Linnaeus.

Otisorex DeKay, Zoology of New York, part 1, Mammalia, p. 22, and plate 5, fig. 1, 1842. Type species *Otisorex platyrhinus* DeKay, qui *Sorex cinereus* Kerr. A synonym of Sorex Linnaeus. DeKay also included *Sorex longirostris* Bachman in the genus.

Sorax Hollister, Proc. U. S. National Museum 40: 378, April 17, 1911. Misprint for Sorex.

Sorex Linnaeus, Systema Naturae, edition 10, vol. 1, p. 53, 1758. Available name for the genus of which *Sorex araneus* Linnaeus is the type species.

KEY TO THE GENERA AND SUBGENERA OF AMERICAN LONG-TAILED SHREWS

a^1. Unicuspids 5, in superficial lateral view appearing to be only 3, the third and fifth being scarcely, if at all, visible; third unicuspid disklike, antero-posteriorly flattened; primary (anterior) lobe of first upper incisor relatively long and narrow, the length more than twice the width and more than twice the length of secondary lobe ..... Genus Microsorex (p. 200)

a^2. Unicuspids 5, in superficial lateral view appearing to be 5, the fifth sometimes minute and indistinct; third unicuspid not disklike, not antero-posteriorly flattened; primary (anterior) lobe of first upper incisor relatively broad, the length less than twice the width and usually less than twice the length of secondary lobe ..... Genus Sorex (p. 30)

b^1. Size smaller; hind foot less than 18; and if hind foot is over 16, color distinctly brown ..... Subgenus Sorex (p. 31)

b^2. Size larger; hind foot 18 or more; color grayish, never distinctly brown.

c^1. Rostrum shorter and little down-curved; anterior end of premaxilla scarcely narrower dorso-ventrally than middle portion; dorso-ventral diameter of rostrum measured at third unicuspid equal about half the diameter between anterior border of infraorbital foramen and posterior border of first incisor; posterior end of interior cutting edge of anterior portion of internal basal shelf of first and second upper molars usually without cusplike lobe; hind foot distinctly fimbriate. Subgenus Neosorex (p. 175)

c^2. Rostrum relatively longer and distinctly down-curved; anterior end of premaxilla much narrower dorso-ventrally than middle portion; dorso-ventral diameter of rostrum measured at third unicuspid less than half the diameter between anterior border of infraorbital foramen and posterior border of first incisor; posterior end of interior cutting edge of anterior portion of internal basal shelf of first and second upper molars usually with distinct cusplike lobe; hind foot slightly fimbriate. Subgenus Atophyrax (p. 192)

LIST OF AMERICAN GENERA, SPECIES, AND SUBSPECIES OF LONG-TAILED SHREWS, WITH TYPE LOCALITIES

SOREX CINEREUS GROUP

Sorex cinereus cinereus Kerr	Fort Severn, Ontario (p. 40).
cinereus miscix Bangs	Black Bay, Labrador (p. 50).
cinereus haydeni Baird	Fort Buford, N. Dak. (p. 51).
cinereus streatori Merriam	Yakutat, Alaska (p. 53).
cinereus hollisteri Jackson	St. Michael, Alaska (p. 55).
fontinalis Hollister	Near Beltsville, Md. (p. 56).
lyelli Merriam	Mount Lyell, Calif. (p. 57).
preblei Jackson	Jordan Valley, Oreg. (p. 58).

SOREX FUMEUS GROUP

Sorex fumeus fumeus Miller ..... Peterboro, N. Y. (p. 63).
fumeus umbrosus Jackson ..... James River, Nova Scotia (p. 65).

SOREX ARCTICUS GROUP

Sorex arcticus arcticus Kerr ..... Fort Severn, Ontario (p. 68).
arcticus laricorum Jackson ..... Elk River, Minn. (p. 71).
tundrensis Merriam ..... St. Michael, Alaska (p. 72).
hydrodromus Dobson ..... Unalaska Island, Alaska (p. 74).

SOREX PRIBILOFENSIS GROUP

Sorex pribilofensis Merriam ..... St. Paul Island, Pribilof Group, Alaska (p. 76).

SOREX MERRIAMI GROUP

Sorex merriami Dobson ..... Fort Custer, Mont. (p. 78).
leucogenys Osgood ..... 3 miles east of Beaver, Utah (p. 81).

SOREX SCLATERI GROUP

Sorex sclateri Merriam ..... Tumbala, Chiapas, Mexico (p. 82).

SOREX LONGIROSTRIS GROUP

Sorex longirostris longirostris Bachman ..... Cat Island, mouth of Santee River, S. C. (p. 85).
longirostris fisheri Merriam ..... Lake Drummond, Dismal Swamp, Va. (p. 87).

SOREX DISPAR GROUP

Sorex dispar Batchelder ..... Beedes, N. Y. (p. 89).
gaspensis Anthony and Goodwin ..... Mount Albert, Quebec (p. 91).

SOREX TROWBRIDGII GROUP

Sorex trowbridgii trowbridgii Baird ..... Astoria, Oreg. (p. 94).
trowbridgii humboldtensis Jackson ..... Mad River, Calif. (p. 96).
trowbridgii montereyensis Merriam ..... Monterey, Calif. (p. 97).
trowbridgii mariposae Grinnell ..... Yosemite Valley, Calif. (p. 98).

SOREX VAGRANS-OBSCURUS GROUP

Sorex vagrans vagrans Baird ..... Shoalwater Bay, Wash. (p. 104).
vagrans vancouverensis Merriam ..... Goldstream, British Columbia (p. 106).
vagrans nevadensis Merriam ..... Reese River, Nev. (p. 107).
vagrans halicoetes Grinnell ..... Palo Alto, Calif. (p. 108).
vagrans amoenus Merriam ..... Near Mammoth, Calif. (p. 109).
vagrans monticola Merriam ..... San Francisco Mountain, Ariz. (p. 110).
vagrans orizabae Merriam ..... Mount Orizaba, Puebla, Mexico (p. 113).
durangae Jackson ..... El Salto, Durango, Mexico (p. 114).
obscurus obscurus Merriam ..... Lemhi Mountains, Idaho (p. 117).
obscurus neomexicanus Bailey ..... Cloudcroft, N. Mex. (p. 123).
obscurus parvidens Jackson ..... Bluff Lake, San Bernardino Mountains, Calif. (p. 124).

Sorex obscurus shumaginensis Merriam	Popof Island, Alaska (p. 125).
obscurus alascensis Merriam	Yakutat, Alaska (p. 126).
obscurus malitiosus Jackson	Warren Island, Alaska (p. 128).
obscurus elassodon Osgood	Moresby Island, Queen Charlotte Islands, British Columbia (p. 130).
obscurus longicauda Merriam	Wrangell, Alaska (p. 131).
obscurus prevostensis Osgood	Prevost Island, Queen Charlotte Islands, British Columbia (p. 133).
obscurus isolatus Jackson	Nanaimo, Vancouver Island, British Columbia (p. 134).
obscurus setosus Elliot	Happy Lake, Olympic Mountains, Wash. (p. 135)
obscurus permiliensis Jackson	Mount Jefferson, Oreg. (p. 137).
obscurus bairdi Merriam	Astoria, Oreg. (p. 139).
yaquinae Jackson	Yaquina Bay, Oreg. (p. 140).
pacificus pacificus Coues	Fort Umpqua, Oreg. (p. 142).
pacificus sonomae Jackson	Gualala, Calif. (p. 143).

SOREX STIZODON GROUP

Sorex stizodon Merriam	San Cristobal, Chiapas, Mexico (p. 147).

SOREX VERAEPACIS GROUP

Sorex veraepacis veraepacis Alston	Coban, Guatemala (p. 149).
veraepacis chiapensis Jackson	San Cristobal, Chiapas, Mexico (p. 150).
veraepacis mutabilis Merriam	Reyes, Oaxaca, Mexico (p. 151).
macrodon Merriam	Orizaba, Vera Cruz, Mexico (p. 152).

SOREX SAUSSUREI GROUP

Sorex saussurei saussurei Merriam	North slope of Sierra Nevada de Colima, Jalisco, Mexico (p. 155).
saussurei veraecrucis Jackson	Xico, Vera Cruz, Mexico (p. 156).
saussurei oaxacae Jackson	Mountains near Ozolotepec, Oaxaca, Mexico (p. 157).
saussurei cristobalensis Jackson	San Cristobal, Chiapas, Mexico (p. 157).
saussurei godmani Merriam	Volcan Santa Maria, Guatemala (p. 158).
saussurei salvini Merriam	Calel, Guatemala (p. 159).
emarginatus Jackson	Sierra Madre near Bolanos, Jalisco, Mexico (p. 159).
ventralis Merriam	Cerro San Felipe, Oaxaca, Mexico (p. 160).
oreopolus Merriam	North slope Sierra Nevada de Colima, Jalisco, Mexico (p. 162).

SOREX ORNATUS GROUP

Sorex ornatus ornatus Merriam	Mount Pinos, Calif. (p. 166).
ornatus californicus Merriam	Walnut Creek, Calif. (p. 168).
ornatus lagunae Nelson and Goldman	La Laguna, Sierra Laguna, Lower California, Mexico (p. 169).
trigonirostris Jackson	Ashland, Oreg. (p. 170).
sinuosus Grinnell	Grizzly Island, near Suisun, Calif. (p. 171).
juncensis Nelson and Goldman	Socorro, Lower California, Mexico (p. 172).
tenellus Merriam	Lone Pine Creek, Alabama Hills, near Lone Pine, Calif. (p. 172).
myops Merriam	Pipers Creek, White Mountains, Calif. (p. 173).
nanus Merriam	Estes Park, Colo. (p. 174).

SOREX PALUSTRIS GROUP

Sorex palustris palustris Richardson	Between Hudson Bay and Rocky Mountains, Canada (p. 178).
palustris hydrobadistes Jackson	Withee, Wis. (p. 180).
palustris albibarbis (Cope)	Profile Lake, Franconia Mountains, N. H. (p. 181).
palustris gloveralleni Jackson	Digby, Nova Scotia (p. 183).
palustris navigator (Baird)	Near head of Yakima River, Cascade Mountains, Wash. (p. 184).
alaskanus Merriam	Point Gustavus, Glacier Bay, Alaska (p. 189).

SOREX BENDIRII GROUP

Sorex bendirii bendirii (Merriam)	Eighteen miles southeast of Fort Klamath, Oreg. (p. 194).
bendirii palmeri Merriam	Astoria, Oreg. (p. 197).
bendirii albiventer Merriam	Lake Cushman, Olympic Mountains, Wash. (p. 198).

MICROSOREX HOYI GROUP

Microsorex hoyi hoyi (Baird)	Racine, Wis. (p. 202).
hoyi thompsoni (Baird)	Burlington, Vt. (p. 204).
hoyi winnemana Preble	Bank of Potomac River, 4 miles below Great Falls, Fairfax County, Va. (p. 206).
hoyi intervectus Jackson	Lakewood, Wis. (p. 206).
hoyi alnorum (Preble)	Robinson Portage, Manitoba (p. 208).
hoyi eximius (Osgood)	Tyonek, Alaska (p. 208).
hoyi washingtoni Jackson	Loon Lake, Wash. (p. 209).

Genus SOREX Linnaeus

Sorex Linnaeus, Systema Naturae, ed. 10, vol. 1, p. 53, 1758.
Musaraneus Brisson, Regnum Animale, p. 126, 1762.
Oxyrhin Kaup, Skizzirte Entwickelungs-Geschich. und natürl. System europäischen Thierwelt, p. 120, 1829.
Amphisorex Duvernoy, Mém. de la Soc. Mus. d'Hist. Nat. Strasbourg 2, sig. 5, p. 23, 1835.
Corsira Gray, Proc. Zool. Soc. London, part 5, 1837, p. 123, May, 1838.
Otisorex, DeKay, Zoology of New York, part 1, Mammalia, p. 22 and pl. 5, fig. 1, 1842.
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Neosorex Baird, Rept. Pacific Railroad Survey 8, part 1, Mammals, p. 11, 1857.
Atophyrax Merriam, Trans. Linnaean Soc. New York 2: 217, August, 1884.
Homalurus Schulze, Schriften des Naturwissenschaft. Vereins des Harzes, Wernigerode, 5: 28, 1890.

Type species.—*Sorex araneus* Linnaeus.

Geographic range of American species.—From the Arctic Ocean, south through Alaska, Yukon, Northwest Territories, Quebec, and Labrador, to central South Carolina, northern Florida, Alabama, and southern Illinois in the eastern United States, to central Nebraska in the Great Plains region, to southern Utah and southern Nevada in the Great Basin region, to southern Lower California on the Pacific coast, and in the mountains of Utah, Colorado, New Mexico, and Arizona, and south through the mountains of Mexico to western Guatemala.

Generic characters.—Size small, form murine; pelage soft and velvetlike; tail more or less completely covered with hairs, moderately long, in most species about three-fourths length of head and body, but varying from one-half length of head and body (*Sorex tundrensis*) to about equal length of

head and body (*S. trowbridgii*); ears small, moderately haired, nearly concealed by the fur, the auditory meatus covered by a lobe from the antitragus and a fold of the inner side of the conch; eyes minute; snout acute, extending well beyond incisors anteriorly; hind feet of relatively medium size, varying from scarcely to heavily fimbriate, the soles naked, with normally 6 tubercles; mammae, 6: abdominal, 1: 1; inguinal, 2: 2.

Skull somewhat conoidal, rather elongate, not much deflated, relatively weak, yet compact, the separate bones anastomosing very early and the sutures disappearing before maturity; moderately broad brain case; considerably constricted interorbitally. Zygomatic arch absent, represented by a rudimentary zygomatic process of the maxilla. Rostrum moderately long, more or less triangular in superior outline, broad posteriorly, narrow and greatly attenuated anteriorly. Anterior nares opening at an anterior-superior angle. Infraorbital foramina large and prominent. Foramen magnum oval, comparatively large. Mesopterygoid space moderately elongate, relatively narrow, the sides nearly parallel but slightly converging posteriorly. Palate long and narrow, abruptly converging anterior to first molariform tooth. Posterior border of palate truncate, straight, slightly thickened into a noticeable ridge. Palatine foramina small, scarcely distinguishable. Horizontal ramus of mandible moderately heavy and nearly straight, being but slightly curved ventrad medially; angle of mandible long and slender; coronoid long, moderately heavy, tapering gradually toward tip.

Dentition simple. First upper incisor large, elongate, two-lobed, the anterior (primary) lobe relatively broad, the length less than twice the width and usually less than twice the length of secondary lobe. The five teeth following the first upper incisor, namely, second and third upper incisors, canine, and first and second premolars, are simple peglike teeth, essentially unicuspidate in all species and actually so in most species, and are designated as "unicuspids." Second and third upper incisors with or without distinct ridge from apex to inner border of cingulum, sometimes in certain species with a very slight cusp near terminus of ridge; ridge from cusp of second or third incisor not distinctly and sharply curved caudad toward terminus and not with a pronounced secondary cusp near terminus of ridge on cingulum. Canine essentially like second incisor in shape, possibly variable in size, but never noticeably antero-posteriorly flattened. First and second premolars essentially like other unicuspids, variable in relative size, tending to be less cuspidate and less pigmented. Third premolar (first "molariform tooth") more or less triangular in ventral surface outline, broad posteriorly, narrower anteriorly, posterior border emarginate; metacone well developed, the mesostyle and parastyle practically obsolete. First and second molars relatively large, squarish in ventral surface outline, emarginate posteriorly; parastyle, paracone, mesostyle, metacone, metastyle, and protoconule well developed; hypocone moderately developed. Third upper molar small, somewhat triangular, broad anteriorly, acute exteriorly, abruptly narrowing posteriorly; paracone, metacone, and protoconule moderately developed, parastyle and mesastyle only slightly developed.

Lower incisor elongate and narrow, in line with horizontal ramus of mandible, the cutting edge with three lobes. Canine unicuspidate, somewhat flattened laterally. Premolar simple, slightly larger than canine and relatively broader, with secondary cusp and longitudinal groove. First and second lower molars moderate in size, truncate posteriorly, gradually rounded on exterior of anterior half to become acute anteriorly; protoconulid, hypoconid, paraconid, metaconid, and entoconid well developed. Third lower molar similar in outline to second, somewhat smaller, with the hypoconid and entoconid somewhat reduced. Bases of lower incisor and premolar not closely approximated, separated by space nearly equal antero-posterior diameter of canine.

Dentition: i., $\frac{3}{1}$; c., $\frac{1}{1}$ pm., $\frac{3}{1}$; m., $\frac{3}{3}$; total, 32.

Subgenus SOREX Linnaeus

Type species.—*Sorex araneus* Linnaeus.

Geographic range of American species.—That of the genus Sorex.

Diagnostic characters.—Size relatively small; hind foot less than 18; feet never densely fimbriate, sometimes slightly fimbriate; rostrum moderately short, not distinctly curved ventrad.

Remarks.—The subgenus Sorex as here constituted is divided for convenience into 14 groups containing 35 species. Several of these

species display very fundamental differences when compared with certain others, and future more detailed investigations upon genera and subgenera of Soricidae may possibly necessitate subgeneric or even generic divisions among species here classified in the subgenus Sorex. Any conclusions that will in any way approach finality in regard to the major divisions in the classification of the Soricidae can be reached only after a detailed study, not alone of skins and skulls, but also of alcoholics and skeletons, both of young and adult individuals, representing every distinctive species in the family. Such material, even of American species, is not now available in any institution.

KEY TO THE SUBSPECIES OF THE SUBGENUS SOREX

a^1. Third unicuspid not smaller than fourth.
  b^1. Known geographic range north of United States-Mexico boundary.
    c^1. Infraorbital foramen with posterior border lying caudad to plane of interspace between m^1 and m^2.
      d^1. Size larger; total length more than 115; hind foot more than 13; condylobasal length more than 16.8 ..... *dispar* (p. 89).
      d^2. Size smaller; total length less than 115; hind foot less than 13; condylobasal length less than 16.8 ..... *gaspensis* (p. 91).
    c^2. Infraorbital foramen with posterior border lying even with or anterior to plane of interspace between m^1 and m^2.
      d^1. Maxillary breadth less than 4.6.
        e^1. Condylobasal length 15 or more.
          f^1. Palatal length 6.2 or more; maxillary tooth row usually more than 5.7.
            g^1. Color more grayish; cranial breadth 8 or more; geographic range northeastern coast region of North America ..... *miscix* (p. 50).
            g^2. Color more brownish; cranial breadth less than 8; geographic range northwestern coast region of North America ..... *streatori* (p. 53).
          f^2. Palatal length less than 6.2; maxillary tooth row usually less than 5.7.
            g^1. Size smaller; maxillary tooth row 5.2 or less ..... *haydeni* (p. 51).
            g^2. Size larger; maxillary tooth row more than 5.2.
              h^1. Known geographic range confined to California ..... *lyelli* (p. 57).
              h^2. Known geographic range not including California.
                i^1. Color paler; tail shorter; rostrum narrower ..... *hollisteri* (p. 55).
                i^2. Color darker; tail longer; rostrum broader ..... *cinereus* (p. 40).
        e^2. Condylobasal length usually less than 15.
          f^1. Condylobasal length less than 14.7; interorbital breadth 3.1 or more; known geographic range confined to eastern Oregon ..... *preblei* (p. 58).
          f^2. Condylobasal length more than 14.7; interorbital breadth less than 3.1; known geographic range confined to Maryland ..... *fontinalis* (p. 56).
      d^2. Maxillary breadth more than 4.6.
        e^1. Known geographic range confined to Unalaska Island, Alaska ..... *hydrodromus* (p. 74).
        e^2. Known geographic range not including Unalaska Island, Alaska.
          f^1. Condylobasal length more than 17.5; cranial breadth 8.5 or more; maxillary tooth row 6.1 or more.
            g^1. Coloration distinctly tricolor (color of back sharply darker than sides); tail less than 45.
              h^1. Color paler; tail usually less than 38; condylobasal length usually less than 18.5 ..... *tundrensis* (p. 72).
              h^2. Color darker; tail usually more than 38; condylobasal length more than 18.5.

i^1. Brain case relatively flatter; interorbital breadth usually more than 3.7 ..... *laricorum* (p. 71).
i^2. Brain case relatively higher; interorbital breadth usually less than 3.7 ..... *arcticus* (p. 68).
g^2. Coloration distinctly bicolor (back same color as sides); tail 45 or more.
h^1. Slightly smaller; more reddish; known geographic range entirely within United States ..... *fumeus* (p. 63).
h^2. Slightly larger; more grayish; known geographic range Maine and eastern Canada ..... *umbrosus* (p. 65).
f^2. Condylobasal length less than 17.5; cranial breadth less than 8.5; maxillary tooth row less than 6.1.
g^1. Hind foot 13 or more; palatal length less than 6; maxillary breadth less than 5; known geographic range confined to Pribilof Islands, Alaska ..... *pribilofensis* (p. 76).
g^2. Hind foot less than 13; palatal length more than 6; maxillary breadth 5 or more.
h^1. Total length less than 100; condylobasal length less than 16.4; cranial breadth less than 8.1 ..... *merriami* (p. 78).
h^2. Total length more than 100; condylobasal length more than 16.4; cranial breadth more than 8.1 ..... *leucogenys* (p. 81).
b^2 Known geographic range south of United States-Mexico boundary.
c^1. Condylobasal length less than 17.9; maxillary tooth row less than 6.5.
d^1. Tail less than 50.
e^1. Condylobasal length less than 17.4; maxillary tooth row less than 6.3.
f^1. Cranial breadth less than 8.3 ..... *emarginatus* (p. 159).
f^2. Cranial breadth more than 8.3 ..... *ventralis* (p. 160).
e^2. Condylobasal length more than 17.4; maxillary tooth row more than 6.3.
f^1. Cranial breadth less than 8.5; maxillary breadth less than 5.2 ..... *oreopolus* (p. 162).
f^2. Cranial breadth more than 8.5; maxillary breadth more than 5.2 ..... *stizodon* (p. 147).
d^2. Tail more than 50 ..... *godmani* (p. 158).
c^2. Condylobasal length more than 17.9; maxillary tooth row 6.5 or more.
d^1. Tail less than 50.
e^1. Cranial breadth 9 or more ..... *oaxacae* (p. 157).
e^2. Cranial breadth less than 9.
f^1. Total length usually more than 109; tail more than 45.
g^1. Hind foot 14 or more; cranial breadth 8.6 or more ..... *saussurei* (p. 155).
g^2. Hind foot less than 14; cranial breadth less than 8.6 ..... *cristobalensis* (p. 157).
f^2. Total length less than 109; tail less than 45 ..... *salvini* (p. 159).
d^2. Tail more than 50.
e^1. Hind foot about 15; condylobasal length less than 19; cranial breadth less than 9 ..... *veraecrucis* (p. 156).
e^2. Hind foot about 16; condylobasal length more than 19; cranial breadth more than 9 ..... *sclateri* (p. 82).
a^2. Third unicuspid smaller than fourth.
b^1. Known geographic range east of Mississippi River.
c^1. Total length less than 95; condylobasal length less than 15 ..... *longirostris* (p. 85).
c^2. Total length 95 or more; condylobasal length 15 or more ..... *fisheri* (p. 87).
b^2. Known geographic range west of Mississippi River.
c^1. Known geographic range north of United States-Mexico boundary.

d^1. Tail sharply bicolor; underparts of body scarcely, if any, paler than upper parts; ridge extending from apex of unicuspid toward interior edge of cingulum but slightly pigmented and rarely pigmented to cingulum, separated from cingulum by longitudinal groove, and never ending in distinct cusplet.

e^1. Color gray rather than brown; tail more than 0.8 of head-and-body length; maxillary breadth usually less than 5.4.

f^1. Size smaller; condylobasal length less than 17.7; maxillary breadth less than 5.1 ..... *trowbridgii* (p. 94).

f^2. Size larger; condylobasal length more than 17.7; maxillary breadth more than 5.1 ..... *humboldtensis* (p. 96).

e^2. Color brown rather than gray; tail less than 0.8 of head-and-body length; maxillary breadth 5.4 or more.

f^1. Color darker; condylobasal length usually less than 18.4; cranial breadth usually less than 9.2; range western California ..... *montereyensis* (p. 97).

f^2. Color paler; condylobasal length usually more than 18.4; cranial breadth usually more than 9.2; range eastern California and extreme western Nevada ..... *mariposae* (p. 98).

d^2. Tail not sharply bicolor; underparts of body distinctly paler than upper parts; ridge extending from apex of unicuspid toward interior edge of cingulum well pigmented usually to cingulum, not separated from cingulum by longitudinal groove, and usually ending in a distinct cusplet more or less pigmented.

e^1. Foramen magnum placed relatively ventrad, encroaching less into supraoccipital and more into basioccipital; ~~mesoconid~~ metacone of first upper molariform tooth (pm^3) comparatively low.

f^1. Geographic range north of United States-Canada boundary.

g^1. Known geographic range confined to Vancouver Island.

h^1. Tail length less than 45; condylobasal length less than 17; maxillary breadth 4.7 or less ..... *vancouverensis* (p. 106).

h^2. Tail length more than 45; condylobasal length more than 17; maxillary breadth more than 4.7 ..... *isolatus* (p. 134).

g^2. Known geographic range not including Vancouver Island.

h^1. Tail length usually less than 52.

i^1. Total length usually less than 110; tail usually less than 44; protoconulid of m_1 comparatively low.

j^1. Color darker; hind foot usually 12 or less; geographic range coast region of southwestern British Columbia ..... *vagrans* (p. 104).

j^2. Color paler; hind foot usually 12 to 13; geographic range interior region of southern British Columbia and Alberta ..... *monticola* (p. 110).

i^2. Total length usually more than 110; tail usually more than 44; protoconulid of m_1 comparatively high.

j^1. Color paler; brain case usually rising abruptly in frontal region ..... *shumaginensis* (p. 125).

j^2. Color darker; brain case usually not rising abruptly in frontal region.

k^1. Hind foot less than 14; cranial breadth less than 8.6 ..... *obscurus* (p. 117).

k^2. Hind foot 14 or more; cranial breadth 8.6 or more ..... *alascensis* (p. 126).

h^2. Tail length usually more than 52.
i^1. Known geographic range confined to Prevost Island, British Columbia ..... *prevostensis* (p. 133).
i^2. Known geographic range not including Prevost Island, British Columbia.
j^1. Hind foot over 14.
k^1. Known geographic range confined to Warren and Coronation Islands, Alaska ..... *malitiosus* (p. 128).
k^2. Known geographic range not including Warren and Coronation Islands, Alaska ..... *longicauda* (p. 131).
j^2. Hind foot 14 or less.
k^1. Tail usually more than 55; skull higher and more arched; dental pigmentation heavier ..... *setosus* (p. 135).
k^2. Tail usually less than 55; skull lower and less arched; dental pigmentation lighter ..... *elassodon* (p. 130).
f^2. Geographic range south of United States-Canada boundary.
g^1. Length of tail less than 50.
h^1. Hind foot 14 or more; maxillary tooth row more than 6.5 ..... *neomexicanus* (p. 123).
h^2. Hind foot less than 14; maxillary tooth row less than 6.5.
i^1. Total length usually more than 110; tail usually more than 44; interorbital breadth 3.7 or more ..... *obscurus* (p. 117).
i^2. Total length usually less than 110; tail usually less than 44; interorbital breadth usually less than 3.7.
j^1. Tail usually more than 40.
k^1. Metaconid of m_1 comparatively high; superior border of foramen magnum less acute ..... *parvidens* (p. 124).
k^2. Metaconid of m_1 comparatively low; superior border of foramen magnum more acute.
l^1. Color darker; hind foot usually 12 or less; maxillary tooth row usually less than 5.7 ..... *vagrans* (p. 104).
l^2. Color paler; hind foot usually more than 12; maxillary tooth row usually more than 5.7 ..... *monticola* (p. 110).
j^2. Tail usually less than 40.
k^1. Total length less than 100; cranial breadth usually less than 8.2; maxillary breadth less than 4.7 ..... *nevadensis* (p. 107).
k^2. Total length usually 100 or more; cranial breadth usually more than 8.2; maxillary breadth more than 4.7.
l^1. Color paler; interorbital breadth less than 3.4 ..... *amoenus* (p. 109).
l^2. Color darker; interorbital breadth more than 3.4 ..... *halicoetes* (p. 108).
g^2. Length of tail more than 50.
h^1. Hind foot more than 15.5; cranial breadth more than 9.5; maxillary tooth row more than 7.2.
i^1. Condylobasal length less than 21; cranial breadth less than 10; maxillary tooth row less than 7.8 ..... *yaquinae* (p. 140).
i^2. Condylobasal length 21 or more; cranial breadth more than 10; maxillary tooth row more than 7.8.

j^1. Color paler; size larger; known geographic range Pacific coast region north of Point Arena, Calif. ..... *pacificus* (p. 142).

j^2. Color darker; size smaller; known geographic range Pacific coast region from Point Arena, Calif., south ..... *sonomae* (p. 143).

h^2. Hind foot less than 15.5; cranial breadth less than 9.5; maxillary tooth row less than 7.2.

i^1. Color less reddish; cranial breadth less than 8.8 ..... *setosus* (p. 135).

i^2. Color more reddish; cranial breadth more than 8.8.

j^1. Total length more than 122; maxillary tooth row usually more than 6.6 ..... *bairdi* (p. 139).

j^2. Total length less than 122; maxillary tooth row usually less than 6.6 ..... *permilicnsis* (p. 137).

e^2. Foramen magnum placed relatively dorsad, encroaching more into supraoccipital and less into basio-occipital; mesoconid of first upper molariform tooth (pm^3) comparatively high.

f^1. Condylobasal length more than 16.3; maxillary breadth usually more than 4.7.

g^1. Color darker, blackish; palate shorter, less than 6.7 ..... *sinuosus* (p. 171).

g^2. Color paler, never blackish; palate longer, 6.7 or more ..... *ornatus* (p. 166).

f^2. Condylobasal length less than 16.3; maxillary breadth usually less than 4.7.

g^1. Tail less than 40; condylobasal length less than 15.4; cranial breadth less than 7.2.

h^1. Hind foot less than 11; condylobasal length less than 14.8; known geographic range Colorado ..... *nanus* (p. 174).

h^2. Hind foot more than 11; condylobasal length more than 14.8; known geographic range California.

i^1. Interorbital breadth less than 3.2 ..... *tenellus* (p. 172).

i^2. Interorbital breadth more than 3.2 ..... *myops* (p. 173).

g^2. Tail more than 40; condylobasal length more than 15.4; cranial breadth more than 7.2.

h^1. Condylobasal length more than 15.8; palatal length more than 6; known geographic range confined to California ..... *californicus* (p. 168).

h^2. Condylobasal length less than 15.8; palatal length less than 6; known geographic range confined to Oregon ..... *trigonirostris* (p. 170).

c^3 Known geographic range south of United States-Mexico boundary.

d^1. Known geographic range confined to Lower California.

e^1. Condylobasal length less than 16; maxillary breadth less than 4.6 ..... *juncensis* (p. 172).

e^2. Condylobasal length more than 16; maxillary breadth more than 4.6.

f^1. Color paler ventrally ..... *ornatus* (p. 166).

f^2. Color darker ventrally ..... *lagunae* (p. 169).

d^2. Known geographic range not including Lower California.

e^1. Condylobasal length less than 17.9; maxillary tooth row less than 6.5.

f^1. Tail less than 48.

g^1. Palatal length less than 6.8; interorbital breadth usually less than 3.6; maxillary breadth usually less than 5.

h^1. Tail usually more than 40; cranial breadth 8.2 or more ..... *monticola* (p. 110).

h^2. Tail usually less than 40; cranial breadth usually less than 8.2 ..... *orizabae* (p. 113).

g^2. Palatal length more than 6.8; interorbital breadth more than 3.6; maxillary breadth 5 or more.
h^1. Condylobasal length more than 17.5; maxillary tooth row more than 6.3 ..... *oreopolus* (p. 162).
h^2. Condylobasal length less than 17.5; maxillary tooth row less than 6.3 ..... *ventralis* (p. 160).
f^2. Tail more than 48.
g^1. Total length less than 115; hind foot less than 14 ..... *durangae* (p. 114).
g^2. Total length more than 115; hind foot more than 14 ..... *godmani* (p. 158).
e^2. Condylobasal length more than 17.9; maxillary tooth row 6.5 or more.
f^1. Condylobasal length more than 19; cranial breadth more than 9.6.
g^1. Cranial breadth more than 10; molariform teeth weaker ..... *veraepacis* (p. 149).
g^2. Cranial breadth less than 10; molariform teeth heavier ..... *macrodon* (p. 152).
f^2. Condylobasal length less than 19; cranial breadth less than 9.6.
g^1. Cranial breadth 9 or more.
h^1. Tail more than 52 ..... *mutabilis* (p. 151).
h^2. Tail less than 52.
i^1. Condylobasal length more than 9.2; maxillary tooth row more than 6.8 ..... *chiapensis* (p. 150).
i^2. Condylobasal length less than 9.2; maxillary tooth row less than 6.8 ..... *oaxacae* (p. 157).
g^2. Cranial breadth less than 9.
h^1. Tail more than 50 ..... *veraecrucis* (p. 156).
h^2. Tail less than 50.
i^1. Total length usually more than 109; tail more than 45.
j^1. Hind foot 14 or more; cranial breadth 8.6 or more ..... *saussurei* (p. 155).
j^2. Hind foot less than 14; cranial breadth less than 8.6 ..... *cristobalensis* (p. 157).
i^2. Total length less than 109; tail less than 45 ..... *salvini* (p. 159).

SOREX CINEREUS GROUP

The *cinereus* group includes four species: *Sorex cinereus*, *S. lyelli*, *S. preblei*, and *S. fontinalis*.

Geographic range.—Labrador, northern Quebec, and all of Canada and Alaska, except certain islands; south through the eastern United States to southeastern Maryland, and in the mountains to North Carolina and Tennessee, to central Ohio, southern Indiana, northern Illinois, Iowa, northern Nebraska, in the Rocky Mountains to northern New Mexico, eastern Oregon, and the coast region of Washington; also the Sierra Nevada of central California.

Diagnostic characters.—Size small, tail medium in length, hind foot small. Skull relatively weak, with narrow rostrum, weak dentition; the fourth unicuspidate tooth generally smaller than the third, rarely about equal; unicuspids with pigmented ridge extending from apex of tooth to interior edge of cingulum, in unworn teeth sometimes ending in very minute pigmented cusplet on cingulum. Members of the *cinereus* group may be distinguished from any of the *longirostris* or *vagrans-obscurus* groups by the relatively narrower rostrum of *cinereus*, narrower (extero-interiorly) molariform teeth, and by the relative size of the fourth unicuspid to the third, usually smaller than or rarely equal to the third in *cinereus* group; larger than the third in *longirostris* and *vagrans-obscurus* groups. Smaller than any form of the *arcticus*, *fumeus*, or *dispar* groups, with smaller hind foot, and distinctly smaller skull, weaker dentition,

the molariform teeth being narrower (extero-interior diameter); rostrum decidedly narrower both actually and relatively than in members of *arcticus* and *fumeus* groups. Tail relatively longer than in *pribilofensis* group, and coloration not tricolor; skull relatively much narrower, particularly interorbitally and rostrally; dentition weaker, the internal ridge on unicuspids less heavily pigmented. Somewhat smaller than either species of the *merriami* group, darker ventrally and on feet; skull relatively longer, higher, and narrower, not swollen interorbitally (as in *merriami* group), unicuspidate teeth less crowded and not relatively deeper (supero-inferiorly) than broad (antero-posteriorly) in lateral aspect.

Remarks.—The *cinereus* group, although comprising only eight recognizable forms belonging to four species, has a wide geographic range entirely across the northern half of the North American Continent. In many places in the Canadian and Boreal Zones shrews of this group are among the more common mammals.

Although members of the *cinereus* group are superficially similar both externally and cranially to *S. minutus* of Europe, the two appear to be actually not closely related. The dentition of *S. minutus*, particularly as shown in the characters in the first upper incisor, is very different from that of *S. cinereus* and its related forms.

SOREX CINEREUS Kerr

[Synonymy under subspecies]

Geographic range.—That of the *cinereus* group, except that part of California inhabited by *Sorex lyelli*, that part of eastern Oregon inhabited by *S. preblei*, and that part of Maryland inhabited by *S. fontinalis*. (Fig. 3.)

Diagnostic characters.—Somewhat larger in all respects than *S. lyelli*, *S. fontinalis*, or *S. preblei*, with correspondingly larger skull, relatively higher brain case (except in certain specimens of *S. c. haydeni*), and usually with longer, narrower rostrum; unicuspidate tooth row relatively and actually longer than in *S. lyelli*, *S. fontinalis*, or *S. preblei*, the unicuspids being less crowded and with greater antero-posterior diameter.

Subspecies and geographic variation.—The species *cinereus* is divided into five subspecies: *cinereus*, *miscix*, *haydeni*, *streatori*, and *hollisteri*.

The species as a whole is rather variable, as is also each of the subspecies. Each subspecies, however, in its extreme form is well defined and has average differences over considerable geographic areas. Beginning from the southern border of the range of the species, there is a general tendency for an increase in size toward the northeast and northwest, which culminates in the subspecies *miscix* and *streatori*, each recognizable also by color differences. Still farther northward along the Arctic coast the animal becomes somewhat smaller again, and on the Bering coast of Alaska this tendency reaches a climax in the pale, small, rather short-tailed form *hollisteri*. The form from the Great Plains region is small, in keeping with other specimens from the southern part of the range of the species, but has additional characters of pale color, short tail, and short, broad rostrum, and is recognized under the name *haydeni*.

Time of molting.—The transition from winter to summer pelage may occur any time between the first of April and the last of June, depending somewhat upon latitude and altitude. A male of *S. c. cinereus* in early process of molt was collected at Hinckley, Minn., March 31, 1890. A female from Fort Totten, N. Y., is at about the same stage, April 4, 1908. Two other females from Jobs Knob, W. Va. (April 10 and 13, 1897), have the summer fur well advanced under the old over the entire backs, the one collected on the earlier date having the underparts in fresh pelage. A male from St. Marys Lake, Mont., has the summer hair appearing under the worn winter fur over the entire animal (June 7, 1895). A male of *S. c. haydeni* from Fairmount, N. Dak., is in the height of the molting process (May 22, 1915); while another collected on June 7, 1915,

at the near-by locality of Blackmer is in complete summer pelage. A male from Ekalaka, Mont., collected on May 29, 1916, is about half molted. Three other males have about completed the molt in the Bear Lodge Mountains, Wyo., June 22, 1912, others of the same date and locality being in summer fur. A male *S. c. streatori* from Skagway, Alaska, June 1, 1899, and one from Orca, Alaska, June 25, 1899, are in process of change from winter to summer pelage.

The winter pelage is usually acquired during October in the southern part of the range of the species, and in the more northern parts during early September or even late August. Two females of *S. c. cinereus*, one collected September 4, 1893, at Montauk Point, Suffolk County, N. Y., and the other taken November 20, 1893, at Wilmington, Mass., are both in early stages of the autumnal molt. A series from Prince Edward Island collected between October

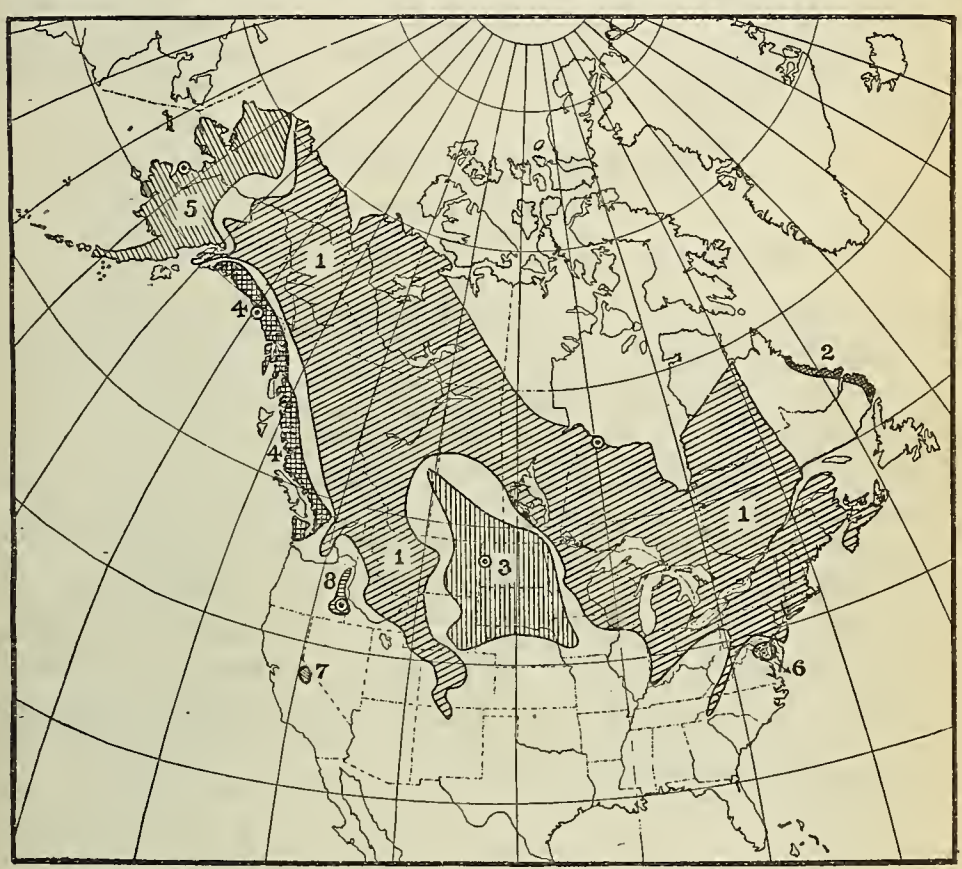

FIG. 3.—Geographic range of the species and subspecies of *Sorex cinereus* group

1. *S. cinereus cinereus.*
2. *S. c. miscix.*
3. *S. c. haydeni.*
4. *S. c. streatori.*
5. *S. c. hollisteri.*
6. *S. fontinalis.*
7. *S. lyelli.*
8. *S. preblei.*

27 and November 10, 1897, is for the most part in full winter pelage; two males from this series taken November 3 and 10 are in early stages of transition. Another series from St. Elmo, Colo., is in winter pelage early in October, 1907, and numerous specimens from the mountains of Wyoming are in process of molt during middle September. A female from the Highwood Mountains, Mont., has the molt well begun, August 22, 1910. Numerous specimens from west-central Alberta were molting the last few days of August and the first week of September. Specimens from British Columbia (Bennett, Cariboo Lake, Glenora, and Sicamous) were undergoing change of pelage from the middle to the last of September; and the same is true of a large series from Great Bear Lake, Northwest Territories, many of which are in full winter pelage. Specimens from the Cook Inlet region of Alaska were changing from summer to winter pelage between August 24 and September 20, 1900, while a few from the

mountains near Eagle, Alaska, show beginning of the molt during the last half of August. The majority of specimens of *S. c. miscix* are in winter pelage in October. A female from Black Bay, Labrador, is in summer pelage October 3; another female is in early process of molt September 24; while a male is at about the same stage October 20. Representatives of *S. c. haydeni* from Fort Custer, Mont., are with one exception in full winter pelage the middle of November, 1895; a female, taken November 13, is still in process of molting. Two females collected October 26, 1893, at Portland, N. Dak., are in full winter pelage. One taken October 9, 1901, 10 miles south of Cody, Nebr., shows the beginning of the pelage change. Two males of *S. c. streatori* from Wrangell, Alaska, had begun to molt September 12, 1895. The majority of specimens in the topotype series of *S. c. hollisteri*, collected during the middle of September, 1899, are changing from summer to winter fur; several had already acquired the full winter coat, even as early as September 10. Other specimens of *hollisteri* from Nushagak, Alaska, were molting during the middle of September, 1902; and specimens from Kakhtul River, Alaska, show molt as early as August 29, the same year.

SOREX CINEREUS CINEREUS Kerr

Cinereous Shrew

(Pls. 2, a; 4, u; 5, s; 7, a; 11, a; 12, a)

Sorex arcticus cinereus Kerr, Animal Kingdom, p. 206, 1792.

Sorex personatus I. Geoffroy-Saint Hilaire, Dictionnaire Classique d'Hist. Nat. 11: 319, January, 1827.

Sorex forsteri Richardson, Zool. Journ. 3: no. 12, January–April, 1828, p. 516, April, 1828. Type locality, "Hudson's Bay countries."

Sorex cooperi Bachman, Journ. Acad. Nat. Sci. Philadelphia 7: part 2, p. 388, 1837. Type locality, "North Western Territory."

Sorex fimbripes Bachman, Journ. Acad. Nat. Sci. Philadelphia 7: part 2, p. 391, 1837. Type locality, Drury Run, Pa.

Corsira forsteri J. E. Gray, Proc. Zool. Soc. London, part 5, 1837, p. 124, May, 1838.

Otisorex platyrhinus De Kay, Zool. New York, part 1, Mammalia, p. 22, 1842. Type locality, Tappan, Rockland County, N. Y.

S[orex] platyrrhinchus Linsley, Amer. Journ. Sci. and Arts 43: no. 2, p. 346, October 6, 1842. Type locality, Stratford, Conn. (Misspelling or emendation of *platyrhinus* De Kay, with redescription.)

Amphisorex lesueurii Duvernoy, Mag. de Zool., d'Anat. Comp. et de Palaeont., series 2, 4th year, Monog. du Genre Musaraigne, p. 33, November, 1842. Type locality, Wabash River Valley, Ind.

S[orex] lesueurii Sundevall, Kongl. [Svenska] Vetenskapsacad. Handl., 1842, p. 182, 1843.

[*Sorex*] *lesneurii* (sic) Reichenbach, Praktische Naturgesch. Menschen und Säugth., p. 165, 1847.

H[ydrogale] fimbripes Pomel, Arch. Sci. Phys. et Nat. 9: 248, 1848.

S[orex] platyrrhinus (sic) Wagner, Suppl. Schreber Säugth. 5: 547, 1855.

Sorex platyrhinus Baird, Report Pacific R. R. Survey 8: part 1, Mammals, p. 25, 1857.

Amphisorex lesuerii (sic) Baird, Report Pacific R. R. Survey 8: part 1, Mammals, p. 27, 1857. (In questionable synonymy under *Sorex cooperi* Bachman.)

Sorex lesueri (sic) Baird, Report Pacific R. R. Survey 8: part 1, Mammals, p. 27, 1857. (In synonymy under *S. cooperi* Bachman.)

Sorex fosteri (sic) Packard, Proc. Boston Soc. Nat. Hist. 10: 266, 1866.

Sorex acadicus Gilpin, Proc. and Trans. Nova Scotian Inst. Nat. Sci. 1: part 2 (erroneously marked vol. 2, part 2), p. 2, 1867. Type locality, Nova Scotia.

Amphisorex forsteri Fitzinger, Sitzungsber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 509, 1868. (In synonymy.)

Crocidura cooperi Fitzinger, Sitzungsber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 513, 1868. (In synonymy.)

Otisorex platyrrhinus Fitzinger, Sitzungsber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 584, 1868. (In synonymy.)

Sorex platyrhynchus Fitzinger, Sitzungsber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 584, 1868. (In synonymy.)
Crocidura platyrhyncha Fitzinger, Sitzungber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 585, 1868. (In synonymy.)
Crossopus fimbripes Fitzinger, Sitzungber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 631, 1868.
Crocidura fimbripes Fitzinger, Sitzungber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 631, 1868. (In synonymy.)
Crocopus ? fimbripes Fitzinger, Sitzungsber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 632, 1868. (In synonymy.)
Sorex platyrinus Gilpin, Proc. and Trans. Nova Scotian Inst. Nat. Sci. 2: part 2, p. 59, 1869.
Sorex acadica ? Gilpin, Proc. and Trans. Nova Scotian Inst. Nat. Sci. 2: part 2, p. 59, 1869.
Sorex fimbriata Holder, Hist. of the Amer. Fauna, part 3, p. 30, 1877.
Sorex idahoensis Merriam, North Amer. Fauna No. 5, p. 32, July 30, 1891. Type locality, Timber Creek, altitude 8,200 feet, Salmon River Mountains [now Lemhi Mountains], Idaho.
Amphisorex lesueri (sic) Herrick, Mammals of Minnesota, Geol. and Nat. Hist. Surv. Minnesota, Bul. 7, p. 48, 1892. (In synonymy under *Sorex cooperi* Bachman.)
Amphisorex leseurii (sic) Butler, Proc. Indiana Acad. Sci., 1891, p. 163, 1892.
Sorex platyrhinchus (sic) Miller, North Amer. Fauna No. 10, p. 39, December 31, 1895.
Amphisorex leseueri (sic) Miller, North Amer. Fauna No. 10, p. 53, December 31, 1895. (In synonymy under *Sorex personatus* Geoffroy.)
Amphisorex lesueuri Merriam, North Amer. Fauna No. 10, p. 60, December 31, 1895. (In synonymy under *Sorex personatus* Geoffroy.)
[*Sorex personatus*] *lesueuri* Merriam, North Amer. Fauna No. 10, p. 61, December 31, 1895.
[*Sorex*] *platyrhnehus* (sic) Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 366, 1901.
Sorex personatus lesueurii Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 235, December 27, 1901.
Sorax (sic) *personatus lesueurii* Hollister, Proc. U. S. Nat. Mus. 40: 378, April 17, 1911.
Sorex longirostris lesueurii Hollister, Proc. U. S. Nat. Mus. 40: 380, April 17, 1911.
Sorex foresteri (sic) Fleming, Nat. Hist. Toronto Region (Publ. by Canadian Inst.), p. 209, November, 1913.
Sorex cinereus cinereus Jackson, Journ. Mamm. 6: 56, February, 1925.
Sorex frankstownensis Peterson, Ann. Carnegie Mus. 16: 292. March, 1926. Type locality, Frankstown Cave, near Hollidaysburg, Blair County, Pa.

Type specimen.—None now known to exist.

Type locality.—Fort Severn, Ontario, Canada.

Geographic range.—Northern Quebec and all of northern Canada, west to central Alaska, northern Kenai Peninsula, western British Columbia (except coastal region); south to New Jersey, the mountains of North Carolina and Tennessee, central Ohio, southern Indiana, northern Illinois, northeastern Iowa, eastern Minnesota, northern and eastern Manitoba, northern Saskatchewan, through the mountains of Idaho, western Montana and western Wyoming to northern New Mexico, and northeastern and central Washington (fig. 3).

Diagnostic characters.—Size medium; larger than *Sorex fontinalis*, *S. lyelli*, *S. preblei*, *S. c. haydeni* or *S. c. hollisteri*, smaller than *S. e. streatori* or *S. c. miscix*. Darker and more brownish (less grayish) than *miscix*, particularly in winter pelage; skull shorter than that of *miscix* with relatively shorter and broader rostrum, and lower brain case. Larger and with relatively longer tail than *S. c. haydeni;* color darker both in summer and winter, particularly on the sides, tending less to development of tricolor pattern; skull averaging slightly larger than that of *haydeni*, with relatively and actually

longer palate, and relatively narrower rostrum. Larger and with slightly longer tail than *hollisteri;* color darker, particularly in summer, underparts in both winter and summer pelages less whitish; skull about the size of that of *hollisteri* or slightly larger, with broader rostrum. Paler than *streatori*, especially on the underparts; tail shorter and hind feet smaller; skull smaller than that of *streatori*, with weaker rostrum.

Color.—Winter pelage: Upper parts grayish fuscous, frequently tending toward chaetura drab or hair brown, extending well down on the sides; underparts smoke gray or between smoke gray and pale smoke gray; tail essentially bicolor, chaetura drab or fuscous above, buffy below nearly to tip. *Summer pelage:* Much more brownish than winter pelage. Upper parts rather variable, fuscous-black, mummy brown, or sometimes Prout's brown, usually extending well onto the sides and gradually blending with colors of underparts; sometimes with a distinct lateral ribbon of drab or buffy brown; underparts usually smoke gray, sometimes light grayish olive, or even tinged with deep olive-buff tending toward avellaneous; tail as in winter.

Skull.—Medium in size for the *cinereus* group (condylobasal length about 15.8 mm.). Smaller than that of *S. c. miscix*, with relatively shorter and broader rostrum, and shallower brain case. Averaging larger than that of *S. c. haydeni*, with relatively and actually longer palate, relatively narrower rostrum, and usually with less densely pigmented dentition. About the size of that of *S. c. hollisteri* or slightly larger, with broader, less attenuate rostrum. Smaller than that of *S. c. streatori*, with rostrum smaller, dentition weaker, and the molariform teeth usually less deeply emarginate posteriorly.

Measurements.—Adult male and adult female from Drury Run, Clinton County, Pa.: Total length, 98; 95; tail vertebrae, 40; 39; hind foot, 11; 12. Average of four adult females from Washington County, R. I.: Total length, 100.5 (99–102); tail vertebrae, 41.5 (40–43); hind foot, 12.4 (11.8–12.7). Average of three adult females from Mamie Lake, Vilas County, Wis.: Total length, 101.7 (99–103); tail vertebrae, 38.7 (38–40); hind foot, 12 (12–12). Average of three adult males from Pahaska (mouth of Grinnell Creek), Park County, Wyo.: Total length, 96.3 (95–97); tail vertebrae, 41.7 (39–44); hind foot, 12 (12–12). Skull: Skull of adult male (teeth moderately worn) and adult female (teeth slightly worn) from Drury Run, Clinton County, Pa.: Condylobasal length, 15.6; 16.0; palatal length, 5.9; 6.0; cranial breadth, 7.6; 7.6; interorbital breadth, 3.1; 2.9; maxillary breadth, 4.1 4.0 maxillary tooth row, 5.5; 5.5. Average of four skulls of adult females (teeth slightly worn) from Washington County, R. I.: Condylobasal length, 15.7 (15.4–16.2); palatal length, 6.0 (6.0–6.0); cranial breadth 7.6 (7.6–7.7); interorbital breadth, 3.0 (2.9–3.1); maxillary breadth, 4.1 (4.0–4.3); maxillary tooth row, 5.5 (5.4–5.6). Average of four skulls of adult males (teeth moderately worn) from Roan Mountain, N. C.: Condylobasal length, 15.5 (15.1–15.9); palatal length, 5.9 (5.8–6.0); cranial breadth, 7.5 (7.3–7.6); interorbital breadth, 3.1 (2.9–3.2); maxillary breadth, 4.1 (4.0–4.2); maxillary tooth row, 5.4 (5.3–5.5). Average of five skulls of adult females (teeth slightly worn) from Mamie Lake, Vilas County, Wis.; Condylobasal length, 15.8 (15.5–16.0); palatal length, 6.0 (5.8–6.1); cranial breadth, 7.6 (7.5–7.8); interorbital breadth, 3.0 (3.0–3.1); maxillary breadth, 4.0 (3.9–4.1); maxillary tooth row, 5.5 (5.3–5.7). Average of three skulls of adult males (teeth slightly worn) from Pahaska (mouth of Grinnell Creek), Park County, Wyo.: Condylobasal length, 15.5 (15.4–15.5); palatal length, 6.0; (6.0–6.0); cranial breadth, 7.6 (7.4–7.7); interorbital breadth, 3.0 (3.0–3.1); maxillary breadth, 4.0 (4.0–4.1); maxillary tooth row, 5.4 (5.3–5.5). Average of five skulls of adult females (teeth slightly worn) from Fort Resolution, Northwest Territories: Condylobasal length, 16.0 (15.9–16.1); palatal length, 6.0 (6.0–6.0); cranial breadth, 7.8 (7.6–8.0); interorbital breadth, 3.0 (2.9–3.1); maxillary breadth, 4.0 (3.9–4.1); maxillary tooth row, 5.5 (5.4–5.6).

Remarks.—The common long-tailed shrew of the northeastern United States and Canada was first given recognition with a valid scientific name by Kerr (1792, p. 206), who described the species under the name *Sorex arcticus cinereus*, basing his description upon the account given by Pennant (1784, p. 139), which in turn was based upon that of Forster (1772, p. 381), neither Pennant nor Forster giving the animal a Latin designation (Jackson, 1925a, p. 55).

Several years later, November 17, 1826, Isidor Geoffroy Saint Hilaire read an account of the animal before the Société d'Histoire Naturelle at Paris, and the following year, 1827, he published two descriptions of the species under the name *Sorex personatus*, which has been generally used for the species since Miller's and Merriam's revisions of 1895. The earlier of these descriptions appeared in Dictionnaire Classique d'Histoire Naturelle (Geoffroy, 1827a, p. 319). This volume bears date of January, 1827, on the title page, and was actually distributed before February 10, 1827. The other account, and the one which has heretofore been quoted as the original description of *personatus*, appeared in Mémoires du Muséum d'Histoire Naturelle (Geoffroy, 1827b, p. 122). The latter volume bears as a date upon the title page only the year, 1827; Sherborn, however (Sherborn, 1914, p. 368), is authority for fixation of its date of publication as December, 1827. Further evidence that the article in the Dictionnaire appeared earlier than the one in the Mémoires is furnished in a footnote in which Geoffroy states:

> Ce Mémoire a été composé en octobre 1826, et lu le 17 novembre suivant à la Société d'Histoire naturelle: quelques recueils scientifiques et même quelques gazettes en ont rendu compte à cette époque, d'après ma lecture; et j'en ai moi-même, désirant prendre date sur les faits nouveaux qu'il renferme, inséré un extrait dans le tome onzième du Dictionnaire classique. (Geoffroy, 1827b, p. 122.)

The following year Richardson (1828, p. 516) described the same species from the vicinity of Hudson Bay, giving it the name *Sorex forsteri*, the type of which is in the British Museum and has been examined by Miller, who states that the specimen is a typical *S. personatus* [=*cinereus*]. (Miller, 1895, p. 41.)

Bachman's description and type locality of *Sorex cooperi* (Bachman, 1837, p. 388) are too indefinite for positive subspecific identification, but it seems most logical that the name should be treated as a synonym of *S. c. cinereus*. His species *S. fimbripes* (Bachman, 1837, p. 391) according to Hollister is not positively identifiable even as to species (Hollister, 1911, p. 40), but it seems to the present reviser that Bachman's description and figure of *fimbripes* clearly refer to *S. c. cinereus*, and it is placed in synonymy under this form. De Kay's *Otisorex platyrhinus* (De Kay, 1842, p. 22) certainly belongs in synonymy here.

The name *Amphisorex lesueurii* Duvernoy (1842a, p. 33) has been placed in synonymy under both *S. personatus* I. Geoffroy and *S. longirostris* Bachman. Merriam, in his remarks under *S. personatus*, states:

> Another form that will probably require separation comes from the extreme southern limit of range of the species, where it overlaps from the Transition into the Upper Austral or Carolinian Zone. If worthy of recognition, it will probably take the name *lesueuri*, proposed by Duvernoy in 1842 for a specimen from Wabash Valley, Indiana. Specimens of this form are extremely rare, and have been examined from only two localities—Sandy Spring, Md., and New Harmony, Ind. (Merriam, 1895, p. 61.)

And in a footnote he states:

> Unfortunately, the skull of the specimen from New Harmony can not be found.

Hahn placed *Amphisorex lesueurii* Duvernoy in synonymy under *Sorex longirostris* Bachman on the basis that all available specimens

from southern Indiana had proved to be *longirostris*. (Hahn, 1909, p. 607.)

Hollister, a few years later, writes:

> The name *Sorex personatus lesueurii* (Duveruoy), based on a specimen from the Wabash Valley, Ind., has been used for a southern form of *personatus*. As no specimen of a shrew of the *personatus* type is known from southern Indiana, and the few specimens collected in that region have all very surprisingly proved referable to *Sorex longirostris* Bachman, it is obvious that the name *Amphisorex lesueurii* Duvernoy is not applicable to a *personatus* shrew. (Hollister, 1911, p. 378.)

Hollister further states:

> The skin without skull, from New Harmony, Ind., recorded somewhat doubtfully by Doctor Merriam as *Sorex personatus lesueurii*, seems certainly to be *S. longirostris*. At that time the occurrence of this species in Indiana was unthought of, and the determination of a skin alone, with so few specimens of *longirostris* for comparison, was virtually impossible. . . . If larger series from Illinois and Indiana should show the northern specimens to be separable, the name *Sorex longirostris lesueurii* (Duvernoy), type-locality Wabash River, Ind., is available. (Hollister, 1911, pp. 379–380.)

An examination of the New Harmony specimen has disclosed the skull concealed in the skin from which the writer has had it removed and finds it to be that of *S. c. cinereus*. It is smaller than typical *cinereus*, but in this respect it is only in keeping with the general tendency for certain skulls from the southern part of the range of the species to be smaller than average northern specimens. In external measurements the specimen is also a trifle smaller than normal individuals, but in color it does not differ from true *cinereus*.

The type specimen of *Amphisorex lesueurii* Duvernoy is not known to be in existence. The original description of it (Duvernoy, 1842a, p. 8, pp. 33–34, pl. 50) is rather unsatisfactory and difficult to assign to either *S. longirostris* or *S. cinereus;* certainly it does not refer to any other shrew. There is nothing in the description that would seem to apply specifically to *S. longirostris* as distinguished from *S. cinereus*. There are, however, certain parts of the description that would lead one to believe that the Duvernoy specimen was of the species *cinereus* rather than *longirostris*. Under the subgenus *Amphisorex* the upper unicuspidate teeth are characterized as five in number diminishing gradually from the first to the last,[3] a character that fits *S. cinereus* but technically would not apply to *S. longirostris*. Moreover *S. longirostris*, so far as known, does not assume in any pelage what could reasonably be called a "couleur * * * d'un gris cendré assez foncé" (Duvernoy, 1842a, p. 33), while some specimens of *S. cinereus* might be so described. Duvernoy (1842a, p. 50) figures the animal natural size, indicating a color distinctly more grayish than in either of the species *longirostris* or *cinereus*. On the same plate are found sketches of the side of the lower jaw and sole of the hind foot. The sketch of the foot shows no diagnostic characters. That of the mandible indicates the length (antero-posterior diameter) of the first incisor to be considerably greater than it would be in *S. longirostris*, and the ascending ramus arises more obliquely from the horizontal ramus, in both these respects being like *S. cinereus*. In view of these facts it is necessary to consider *Amphisorex lesueurii* Duvernoy, a synonym of *S. c. cinereus* Kerr.

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[3] "Les incisives inférieures à trenchant dentelé; les supérieures fourchues, ayant leur talon prolongé. Les petites dents qui les suivent, au nombre de cinq, diminuent graduellement de la première à la dernière, qui est rudimentaire." (Duvernoy, 1842a, p. 8.)

Gilpin was next to add a distinctly new name to the synonymy of this form when he called a shrew from Nova Scotia *Sorex acadicus*. (Gilpin, 1867, p. 2.) The measurements given by Gilpin agree favorably with *S. cinereus* from that region and can apply to no other shrew.

The type specimen of *Sorex idahoensis* Merriam (Merriam, 1891, p. 32) and other specimens of "*idahoensis*" from the type region agree almost exactly with specimens of *S. c. cinereus* from the eastern United States and Canada.

As late as the year 1890 Dobson misidentified *S. c. cinereus* for *S. arcticus*, under the name *richardsonii*, when he figured the teeth of one from Nova Scotia. (Dobson, 1890, pl. 23, fig. 9.)

Peterson (1926) named *Sorex frankstounensis*, basing his description upon Pleistocene material consisting of a right mandible with all the teeth and a fragment of a left mandible with M_1 and M_2, from Frankstown Cave, near Hollidaysburg, Blair County, Pa. The type specimen is No. 11159a, Carnegie Museum, catalogue of vertebrate fossils. The describer designates several distinctive characters for his new species as compared with *S. personatus* (=*S. cinereus*). Through the kindness of Mr. Peterson, the author has been privileged to examine the type mandible and finds that all of these distinctive characters are covered by the variation in *S. c. cinereus*. As compared with certain specimens of *S. c. cinereus* from Maine, New York, Michigan, and Wisconsin, the type mandible of *S. frankstounensis* agrees perfectly. *S. frankstounensis* Peterson must therefore become a synonym of *S. c. cinereus* Kerr.

There are indeed few, if any, subspecies of American mammals that have the extensive geographic range of *S. c. cinereus*, and the uniformity of its characters over this range is surprising. Not that there is no individual and local geographic variation. Often specimens from the same bog or forest are distinctly different, and frequently series of specimens from adjoining localities show average differences. But these can always be matched perfectly by other series of specimens from some distant localities, so that it is impossible to assign these slight variations to any geographic area.

Intergradation between *S. c. cinereus* and *S. c. miscix* is clearly indicated in specimens from Nova Scotia and eastern Quebec, many of which have skulls almost identical with those of *miscix*, but all are more nearly like true *cinereus* in color. The seven rather unsatisfactory alcoholic specimens from Fort Chimo, Quebec, are provisionally referred to *S. c. cinereus*, although on geographic grounds one might suspect specimens from this locality would be nearer *miscix*.

Specimens from Indiana, southern Wisconsin, and Iowa show an approach toward *S. c. haydeni* in size, but in other respects are like typical *S. c. cinereus*. Specimens from Boulder, Pearl, and Loveland, Colo., show a slight tendency toward *haydeni;* most of the skulls from these localities, however, match those of true *cinereus*. The single specimen from Loveland, an old male, has a peculiar, runty skull, smaller even than that of typical *haydeni*, with a small, short brain case, but with a rostrum comparable in size and proportions with that of *S. c. cinereus*. Externally the animal is more like *haydeni* than *S. c. cinereus*, and the writer would be inclined to refer

it to the former subspecies were it not for the fact that it would be the only representative of *haydeni* examined from this region, and furthermore that the series of several specimens from the near-by vicinity of Boulder are easily referable to the subspecies *cinereus*. A single specimen from 8,800 feet in the Sierra Madre Mountains, Wyo., shows a slight approach toward *haydeni*, and certain specimens from the valleys of western Montana could about as well be called *haydeni* as *S. c. cinereus*.

Intergradation with *S. c. streatori* is definitely shown in specimens from western British Columbia; and specimens from southern British Columbia, even as far east as Glacier, show tendencies toward *streatori* in color, size, and cranial characters.

The majority of specimens from interior Alaska are chromatically essentially typical of the subspecies *cinereus*, but show an inclination toward *S. c. hollisteri* in certain skulls that are somewhat narrower than in true *cinereus* and have correspondingly narrower rostra. Mount McKinley and the region at the head of the Toklat River produce skulls typical of *S. c. cinereus*, but the skins show an approach toward *hollisteri* in their apparently somewhat paler color of the underparts, and in their shorter tails than in typical *cinereus*. Specimens from Kenai Peninsula and the region of Cook Inlet, Alaska, are referred to *S. c. cinereus;* in reality they may be intermediates between *S. c. streatori* and *hollisteri;* their skulls are essentially like those of typical *cinereus*, but the rostra average narrower, indicating the influence of *hollisteri*. In fact, many of the specimens from Kenai Peninsula can be referred to either *S. c. cinereus* or *hollisteri* with about equal propriety.

Specimens examined.—Total number, 2,063, as follows:

Alaska: Barabori (Kenai Peninsula), 9[4]; Barroa, 1[4]; Caribou Camp (Kenai Peninsula), 14[4]; Chandlar River (Endicott Mountains), 1[4]; Charlie Creek (near), Yukon River, 1; Circle, 4; Circle (20 miles above, Yukon River), 3; Circle (40 miles above, Yukon River), 4; Eagle (mountains near), 40; Eagle City, 2; Fairbanks, 4; Fort Yukon, 3; Hope (Cook Inlet), 16; Hope (mountains near Cook Inlet), 4; Hulahula River, 1[4]; Kenai Mountains, 9[4]; Kenai Peninsula, 11[4]; Kuskokwim River (north fork, base Mount Sischoo), 2; Kuskokwim River (south fork, 10 miles above mouth of Post River), 1; Little Moose Creek (tributary of Clearwater, fork of Toklat River), 4; Moose Camp (Kenai Peninsula), 24[4]; Mount McKinley (Bear Creek), 2; Mount McKinley (Glacier Creek), 1; Mount McKinley (north side), 2; Mount Sischoo, 1; Nenana, 1; Point Barrow, 4[5]; Seldovia, 96[4]; Sheep Creek, Kenai Peninsula, 4[4]; Sheep Creek (Kenai Peninsula), 34[4]; Tanana, 12; Toklat River (head of), 2; Tyonek (Cook Inlet), 20; White Pass (Glacier), 1; Yukon River, 1; Yukon River (mouth of Porcupine River), 1.

Alberta: Athabaska Delta (east branch, 1 mile north of outlet of Jack Fish Lake), 1[6]; Athabaska Delta (15 miles northwest of Fort Chipewyan, Egg Lake, 2[7]; Athabaska Lake, 1; Athabaska Lake (outlet), 5; Athabaska Landing, 1; Athabaska River (30 miles above Athabaska Landing), 6; Athabaska River (Calling River), 1; Athabaska River (Cascade Rapid, 20 miles above Fort McMurray), 2; Athabaska River (Mountain Rapid), 2; Athabaska River (Pelican Rapid), 1; Athabaska River (50 miles above Pelican Rapid), 1; Athabaska River (30 miles above Pelican River), 1; Banff, 3; Blindman River, 4[4]; Calgary, 1; Canmore, 1; Cavell Creek (mouth of, Jasper Park, altitude 4,000 feet),

[4] Amer. Mus. Nat. Hist.
[5] Acad. Nat. Sci. Philadelphia, 3.
[6] Acad. Nat. Sci. Philadelphia.
[7] Mus. Comp. Zool., 1.

1[8]; Crows Nest Pass, 4[9]; Dunvegan (about 75 miles north, Fort St. John Trail, Peace River), 1[10]; Edmonton, 1[11]; forks of Blindmans and Red Deer Rivers, 7[6]; Fort Chipewyan, 7; Fort McMurray, 1[6]; Henry House, 2[12]; Henry House (15 miles south), 1; Henry House (25 miles west), 5; Island Lake (15 miles west of Lake St. Ann), 1; Lake Athabaska (Cypress Point), 2; Lake Athabaska (Goose Island), 1[6]; Lake Athabaska (10 miles west, northeast of Sand Point), 1[13]; Mount Forget-me-not, 1[8]; Muskeg Creek (15 miles from mouth), 2; Muskeg Creek (20 miles from mouth), 13; Ptarmigan Lake, 1[4]; Red Deer River, 13[14]; St. Albert, 1; Shovel Pass (Jasper Park, altitude 7,500 feet), 1[8]; Slave River (Smith Landing), 4; Slave River (10 miles below Peace River), 3; Smoky River Trail (midway between Muskeg Creek and Baptiste River), 2; Smoky Valley (50 miles north of Jasper House), 4; South Edmonton, 2; Stony River, 3; Stony River (25 miles north Jasper), 1; Waterton Lakes Park, 12.[8]

British Columbia: Atlin, 1[15]; Bad River (on lake, 2,350 feet), 1; Bear Lake (site Fort Connolly), 1; Bennett, 6; Big Salmon River (near Canyon), 1; Cariboo Lake (near Kamloops), 1; Fernie, 3[8]; Field, 4[16]; Fort Grahame, 1; Glacier, 8[17]; Hazleton, 8; Hazleton (altitude 959 feet), 3[10]; Hope (Lake House), 2[6]; Kispiox Valley (23 miles north of Hazelton), 3[10]; Klappan River Valley, 1; Level Mountain, 1[4]; Liard River (mouth of Kachika River), 1[4]; McDame Creek (Quartz Creek, altitude 3,600 feet), 1; McDame Post (Dease River), 8; Monashee, 2[6]; Moose Lake, 5; Moose Pass, 1; Moose River (south fork), 1; Moose River (north fork), 4; Parsnip River (head), 1; Penticton, 3[18]; Pine River (head east branch South Pine River), 2; Raspberry Creek, 6[4]; Salmon River, 2[8]; Sicamous, 1; Stikine River (at Great Glacier), 7[10]; Tacla Lake (north end), 1; Tacla Lake (Babine Trail, 12 miles west), 1; Tatletuey Lake (12 miles west Thudade Lake), 1; Telegraph Creek, 23[19]; Yellowhead Lake, 3.

Colorado: Blackhawk, 1; Boulder County, 7; Buchanan Pass, Boulder County, 3; Dixie Lake, Boulder County, 1[20]; Hermit, 1; Homestead Ranch, Larimer County, 1[20]; Loveland, 1; Mount Bross, Grant County, 1[20]; Pearl (North Park, altitude 9,000 feet), 1; Rabbit Ear Mountains (Arapahoe Pass), 1; Ruby Lake, 1; St. Elmo (altitude 10,100 feet), 7.

Connecticut: Hamden, 1; Stonington, 1.

Idaho: American Falls, 1; Bitterroot Mountains, 2[4]; Cedar Mountain (W. S. C. Camp, altitude 4,000–4,500 feet), 2[21]; Ketchum, 1[6]; Lemhi Mountains (type locality of *idahoensis*), 4; Packers Meadow, 1; Sawtooth City, 1; Sawtooth Lake, 1; Sawtooth National Forest, 1.

Illinois: West Northfield, 2.

Indiana: New Harmony, 1; Porter County, 4.

Iowa: Buchanan County, 2.

Maine: Brooklin, 3; Campobello Island, 2[6]; Caribou, Aroostook County, 1[13]; Haven, 1; Mount Katahdin (altitude 4,250 feet), 1; North Haven, 2; Orono, 1; Sebec Lake, 2; Small Point, 1; South Twin Lake, Penobscot County, 11[4]; Third Mopang Lake, Washington County, 6[22]; Upton, 1[6]; South West Harbor, Mount Desert Island, 2.

Manitoba: Echimamish River, 4; Fort Garry, 1; Hill River (near Swampy Lake), 1; Knee Lake (near outlet), 1; Lake Winnipeg, 4; Norway House, 3; Norway House (Island Lake), 1[8]; Oak Lake, 2[3]; Oxford House, 7; Pine Lake, 1; Red River Settlement, 3; Robinson Portage, 3; Swampy Lake (near outlet), 1; York Factory, 2.

Maryland: Bittinger, Garrett County, 2.

Massachusetts: Barnstable Neck, 2[6]; Bedford, 3[6]; Danvers, 1; Harvard, 4[23]; Lunenburg, 2; Marshfield (near Snake Hill), South River, 2; Middleboro, 14; Mount Greylock, 2[6]; Nantucket, 7[6]; Randolph, 2[6]; Wareham, 6[6]; Williamstown, 1; Wilmington, Middlesex County, 3; Woburn, 1; Woods Hole, 2.

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[4] Amer. Mus. Nat. Hist.
[6] Acad. Nat. Sci. Philadelphia.
[8] Nat. Mus. Canada.
[9] Nat. Mus. Canada, 3; Acad. Nat. Sci. Philadelphia, 1.
[10] Mus. Vert. Zool., Univ. Calif.
[11] J. D. Soper coll., Edmonton, Alberta.
[12] Nat. Mus. Canada, 1.
[13] Univ. Mich.
[14] Amer. Mus. Nat. Hist., 12.
[15] Provincial Mus. British Columbia.
[16] Acad. Nat. Sci. Philadelphia, 2.
[17] Amer. Mus. Nat. Hist., 2.
[18] Nat. Mus. Canada, 2.
[19] Amer. Mus. Nat. Hist., 13; Mus. Vert. Zool., 9.
[20] Colo. Mus. Nat. Hist.
[21] State Coll. Wash.
[22] Acad. Nat. Sci. Philadelphia.
[23] Mus. Comp. Zool., 2.

Michigan: Alger County, 2[13]; Ann Arbor, 5[24]; Chippewa County, 3[13]; Fish Hawk Lake, Gogebic County, 5[13]; Honey Creek, Washtenaw County, 1[13]; Michigamme, 3; Palmer, 1; Pleasant Lake, Livingston County, 1[13]; Porcupine Mountains, Ontonagon County (T. 51 N., R. 43 W., S. 14), 1[13]; Rush Lake, Huron County, 1[13]; Whitefish Point, Chippewa County, 1.[13]

Minnesota: Burntside Lake, 1; Elk River, 60; Fort Ripley, 1; Fort Snelling, 31[25]; Hinckley, 3; Long Prairie, 1; Minneapolis, 12; Ottertail County, 2[26]; Princeton, 1; Steele County, 1[22]; Tower, 1.

Montana: Big Belt Mountains (Camas Creek, 4 miles south of Fort Logan), 1; Big Timber (14 miles south), 1; Boulder Creek (8 miles south of Big Timber), 1; Bozeman, 1[27]; Carter (National Bison Range), 1; Chief Mountain, 1; Crazy Mountains (near head Big Timber Creek), 2; Deer Lodge County, 1; Dry Creek, 1; Fish Creek, Glacier Park, 1; Florence, 5[28]; Highwood Mountains, 2; Hilger (7 miles northeast), 2; Indian Creek, Glacier Park, 1; Lake McDonald, 1; Little Belt Mountains (Sheep Creek, 16 miles north of White Sulphur Springs), 2; Little Belt Mountains (Dry Wolf Creek, 20 miles southwest of Stanford), 2; Lolo, 1; St. Marys Lake, 4[29]; Stevensville, 1; Sun River, 1; Waterton Lake, 1; West Fork of West Gallatin River (Gallatin National Forest, altitude 6,500 feet), 7; Yellowstone (4 miles southwest), 1[30]; Zortman, 1; Zortman (Ruby Creek), 1.

New Brunswick: Bathurst (15 miles from, Miramichi Road), 40[8]; Gulquac Lake, Victoria County, 4[4]; Hampton, 1; Long Lake, Victoria County, 4[4]; Maugerville, Sunbury County, 2[31]; Point Le Preaux, 1[6]; Restigouche River, 1[6]; St. Johns, 1; Tobique Point, Victoria County, 3[4]; Tobique River (forks of), Victoria County, 13[4]; Tracy Station, Sunbury County, 1[8]; Trousers Lake, Victoria County, 40[1]; Yougall, 17.[8]

New Hampshire: Fabyans, 1; Fitzwilliam, 1; Mount Washington (summit), 4; Ossipee, Carroll County, 1.

New Jersey: Beach Haven, Ocean County, 1[22]; Bear Swamp (south side), Burlington County, 3[22]; Bridgeport (near), Gloucester County, 1[22]; Cape May, 16[22]; Chairville Pond, Burlington County, 3[22]; Essex County Park, 3[4]; Haddonfield, 1[22]; Mauricetown, Cumberland County, 7[22]; Mays Landing, 23[32]; Millburn, 5[4]; Port Norris, Cumberland County, 8[22]; South Mountain Reservation, Essex County, 19[4]; South Orange Reservation, 4[4]; Tabor, 2[4]; Tuckerton, 5.

New Mexico: Pecos Baldy, 1; Pecos Baldy (altitude 11,000 feet), 1; Twining (altitude 10,500–10,700 feet), 6.

New York: Adirondacks, 1; Amityville, Long Island, 1; Berlin (altitude 1,100 feet), 2[4]; Big Moose Lake, 2; Catskill Mountains, 2; Fort Totten, 4; Gull Lake, Adirondack Mountains, 1; Highland Falls, 1; Locust Grove, 7; Minerva, 1[4]; Montauk, 2[4]; Montauk Point, Suffolk County, 11; Mountain View, 3; Northwood, 10[4]; Ossining, 1; Peterboro, 2; Piseco, 1; Point Rock, 1; Tupper Lake, 3[6]; Waterville, 1; West Hampton, 1.

North Carolina: Roan Mountain, 4; Roan Mountain (altitude 4,700 feet), 2; Roan Mountain (altitude 6,000 feet), 14; Roan Mountain (altitude 6,300 feet), 1.

Northwest Territories: Anderson River region, 5; Anderson River region (Fort Anderson), 3; Anderson River region (Lower Anderson River), 2; Fort Liard, 1; Fort Norman, 2[29]; Fort Providence, 10; Fort Rae, 23; Fort Resolution, 15; Fort Resolution (Mission Island), 2; Fort Simpson, 11; Fort Smith, 2[29]; Fort Wrigley, 2; Franklin Bay, 2; Grandin River, 1; Great Bear Lake (Fort Franklin), 24; Great Slave Lake, 5; Great Slave Lake (Big Island), 1; Harrowby Bay, 1[4]; Horton River (Coal Creek), 2[4]; Kozaryuak River, Coronation Gulf, 1[8]; Lake St. Croix, 3; Mackenzie River (Nahanni River Mountains), 3; Old Fort Good Hope (near), 1; Peels River, 4; Richard Island (east of,

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[4] Amer. Mus. Nat. Hist.
[6] Acad. Nat. Sci. Philadelphia.
[8] Nat. Mus. Canada.
[13] Univ. Mich.
[22] Acad. Nat. Sci. Philadelphia.
[24] Univ. Mich., 1.
[25] Amer. Mus. Nat. Hist., 4.
[26] G. G. Cantwell coll., Palms, Calif.
[27] Mont. State Coll.
[28] Mont. State Coll., 1.
[29] Amer. Mus. Nat. Hist., 1.
[30] D. R. Dickey coll., Pasadena, Calif.
[31] Miramichi Nat. Hist. Soc., Chatham, New Brunswick.
[32] Acad. Nat. Sci. Philadelphia, 12.

Mackenzie Delta), 1[4]; Slave River (100 miles below Fort Smith), 3; Toker Point (south of), 3.[4]

Nova Scotia: Barren, Victoria County, 1[8]; Barrington Passage, 23[8]; Brier Island (Digby Neck, extremity), 1; Camp Point, Cape Breton Island, 1[8]; Cheticamp Lake, Cape Breton Island, 4[8]; Digby, 12[33]; Halifax, 9[7]; Ingonish Centre, 1[8]; James River, 5; Kedgemakooge Lake, 1; Kings County, 6[8]; Little River (Digby Neck, 1/2 mile from shore), 3; Newport, 2.[4]

Ontario: Algonquin Park, 6; Dows Swamp (near Ottawa), 1[8]; Emsdale, 5; Lac Seul, 1[8]; Humboldt Bay, Lake Nipigon, 3[34]; Long Swamp (near Billing Bridge), 1[8]; Lorne Park, 2[8]; Macdiarmid (Lake Nipigon), 5[34]; Macgregor Bay (District of Manitoba), 3[34]; Michipicoton Island, 6; North Bay, 2[6]; Ottawa, 1; Rat Portage, 1; Sand Lake, 2.

Ohio: Cleveland, 1; Ellsworth, 1; Milford Center, 1.

Pennsylvania: Drury Run, Clinton County (type locality of *fimbripes*), 3; Frankstown Cave, near Hollidaysburg, Blair County (type locality of *frankstounensis*), 1[34a]; Kennett Square, 2[22]; Lake Ganoga, Sullivan County, 2[22]; Lake Leigh (North Mountain), 2[22]; Summit Mills, Somerset County, 1.[22]

Prince Edward Island: Alberton, 1[4]; Georgetown, 8[29]; Kensington, 2[49]; Lennox Island, 2; Mount Stewart, 7.[17]

Quebec: Alymer, 2[8]; Berry Mountain Camp, Matane County, 1[8]; Big Island, Blue Sea Lake, 1[8]; Burbridge, 2[8]; Clearwater Lake, 1[8]; Federal Mine, Gaspé County, 2[8]; Fort Chimo, 7; Gaspé Peninsula (Cascapedia River), 1[4]; Gaspé Peninsula (Cascapedia River, Lazy Bogan Mountain), 1[4]; Gaspé Peninsula (Cascapedia River, Loon Lake), 1[4]; Gaspé Peninsula (Cascapedia River, Tracadie), 2[4]; Godbout, 58; Lac Aux Sables, 8[22]; Lake Edward, 16[6]; Mount Albert, 5[4]; Rupert, 2; St. Rose, 4; Seal Lake, 1[8]; Ste. Anne des Monts (Gaspé), 3[4]; Ste. Anne River, Gaspé County, 4.[8]

Rhode Island: Washington County, 15.

Saskatchewan: Lake Athabaska (Fair Point), 1; Lake Athabaska (Poplar Point), 4[7]; Lake Athabaska (8 miles northeast of Moose Island), 2[7]; Lake Athabaska (mouth Beaver River), 1.[10]

Tennessee: Roan Mountain, Carter County (altitude 6,000 feet), 2[22]; Roan Mountain, Carter County (altitude 6,200 feet), 1.[22]

Vermont: Burlington, 2; Mount Mansfield, 4; Newfane, 1[4]; Pico Peak, 5[4].

Virginia: Mount Rogers, Grayson County (altitude 5,719 feet), 1.

Washington: Bauerman Ridge (west end, at Tungsten Mine, altitude 6,800 feet, Okanogan County), 1; Conrad Meadows (3 miles above, south fork Tieton River, altitude 4,200 feet), 1[21]; Curlew (5 miles west, Ferry County, altitude 2,800 feet), 2; Lake Chelan (head of), 1; Lake Keechelus, 1[13]; Loon Lake, Stevens County (altitude 2,400 feet), 2; Metaline, Pend Oreille County, 1; Mount Rainier (Paradise Creek, altitude 5,200 feet), 1; Tunk Mountain, Okanogan County (altitude 3,500 feet), 1; Yakima Indian Reservation (Signal Peak, altitude 4,000 feet, Yakima County), 1.

West Virginia: Cranberry Glades, Pocahontas County, 5; Jobs Knob, 8[35]; Pocahontas County (near head of Cranberry River), 8.

Wisconsin: Beaver Dam, 3[36]; Cataline, Marinette County, 4[37]; Clarks Lake, Door County, 2; Connors Lake (18 miles west-northwest of Phillips, Sawyer County), 8; Conover (near), 1[38]; Crescent Lake, Oneida County, 8; Danbury, 1; Delavan, 7[39]; Dousman, 1; Eagle River, 2; Elco, 2[40]; Elkhart Lake (Sheboygan Swamp), 6; Ellison Bay, 1; Ellsworth, Pierce County, 1; Fish Creek, 1; Florence, 3; Herbster, 4; Kelley Brook, Oconto County, 2[37]; Kelly Lake, Oconto County, 11; Lac Vieux Desert, 4[38]; Lake St. Germain, Vilas County, 6; Lakewood, 10; Long Lake, Washburn County, 13; Madeline Island (Apostle

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[4] Amer. Mus. Nat. Hist.
[6] Acad. Nat. Sci. Philadelphia.
[7] Mus. Comp. Zool., 1.
[8] Nat. Mus. Canada.
[10] Mus. Vert. Zool., Univ. Calif.
[13] Univ. Mich.
[17] Amer. Mus. Nat. Hist., 2.
[21] State Coll. Wash.
[22] Acad. Nat. Sci. Philadelphia.
[29] Amer. Mus. Nat. Hist., 1.
[33] Mus. Comp. Zool., 8.
[34] Royal Ontario Mus. Zool.
[34a] Carnegie Mus.
[35] Mus. Comp. Zool., 6.
[36] D. R. Dickey coll., 1; Univ. Wis. Zool. Mus., 1; Field Mus. Nat. Hist., 1.
[37] Public Mus. Milwaukee.
[38] Field Mus. Nat. Hist.
[39] Public Mus. Milwaukee, 2.
[40] Univ. Wis. Zool. Mus.
[49] Mus. Comp. Zool.

Islands), 3; Mamie Lake, 15; Mather, 1; McAllister, 2; Mercer, 3; Meridean, 2; Milton, 1[38]; Milwaukee, 1; Milwaukee County, 1[37]; Nashotah, 1; Newport, Door County, 1[37]; Ogema, 6; Outer Island (Apostle Islands), 12; Prairie du Sac, Sauk County, 4[37]; Prescott, Pierce County, 3[37]; Presque Isle (Apostle Islands), 1; Racine, 3; Rhinelander, 8[41]; Rib Hill, Marathon County, 7; Sand Island (Apostle Islands), 1; Sayner, 22[38]; Solon Springs, 11[42]; Spread Eagle, 1[38]; Stevens Point, 1; Sumner, 2[38]; Washington Island, Door County, 3; Wild Rose, 3; Withee, 2.

Wyoming: Big Horn Mountains (west slope, head of Trappers Creek, altitude 8,500 feet), 19; Big Horn Mountains (west slope, head of Trappers Creek, altitude 9,500 feet), 1; Big Horn Mountains (head north fork Powder River), 1; Big Piney, 1; Black Rock Creek, Lincoln County, 1; Cokeville, 1; Evanston, 1; Moran (1 mile north), 5; Moran (Lake Emma Matilda), 6; Pacific Creek, 2; Pahaska (Grinnell Creek), 8; Pahaska (Grinnell Creek, altitude 7,000 feet), 15; Pahaska (mouth of Grinnell Creek, altitude 6,600 feet), 3; Pahaska Tepee (mouth of Grinnell Creek, altitude 6,300 feet), 6; Salt River Mountains (10 miles southeast of Afton, 7,500 feet), 2; Sierra Madre Mountains (south base, Bridger Peak, altitude 8,800 feet), 1; Teton Mountains (Moose Creek, altitude 6,800 feet), 8; Teton Pass (above Fish Creek, altitude 7,200 feet), 12; Valley (altitude 7,500 feet), 2; Yellowstone Park (Mountain Creek), 1.

Yukon: Caribou Crossing (Yukon River), 2; Chandindu River (Yukon River), 1; Dawson (near Stewart River), 1; Forks Macmillan River, 1; Fort Selkirk (50 miles below, Yukon River), 1; Lake Lebarge (Yukon River), 1; Yukon River (Carbiou Crossing), 1.

SOREX CINEREUS MISCIX Bangs

Labrador Cinereous Shrew

(Pl. 2, b)

Sorex personatus miscix Bangs, Proc. New England Zool. Club 1: 15, February 28, 1899.

[*Sorex*] [*merriami*] *miscix* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 376, 1901.

Sorex cinereus miscix Jackson, Journ. Mamm. 6: 56, February, 1925.

Type specimen.—No. 8651, Museum of Comparative Zoology, Harvard College, Bangs collection; ♂ adult (teeth very slightly worn), skin and skull; collected October 10, 1898, by Ernest Doane.

Type locality.—Black Bay, Labrador.

Geographic range.—Labrador south of latitude 58° north. (Fig. 3.)

Diagnostic characters.—Somewhat larger than *Sorex c. cinereus*, with paler, more grayish color, particularly in winter pelage. Skull longer than average skulls of *S. c. cinereus*, with relatively longer and narrower rostrum and higher brain case.

Color.—Winter pelage: Upper parts drab more or less tending toward smoke gray, sometimes almost grayish hair brown; becoming paler on the sides. Underparts between pale olive-gray and pale smoke gray, sometimes tinged with pale pinkish buff. Tail drab above; avellaneous to light pinkish cinnamon below, nearly to tip. *Summer pelage:* Darker and more brownish than winter pelage. Upper parts sepia or slightly paler, usually becoming somewhat darker on the rump, and paler on the sides. Underparts pale smoke gray sometimes tinged with pinkish buff or avellaneous. Tail about as in winter.

Skull.—Similar to that of *S. c. streatori.* Longer than average skulls of *S. c. cinereus*, with relatively longer, narrower, and more attenuate rostrum, higher brain case, and longer tooth row.

Measurements.—Type specimen (adult male): Total length, 104; tail vertebrae, 44; hind foot, 14. Average of eight adult females from type locality: Total length, 100.9 (95–110); tail vertebrae, 43 (39–46); hind foot, 13.1 (12–14).

[37] Public Mus. Milwaukee.
[38] Field Mus. Nat. Hist.
[41] Univ. Wis. Zool. Mus., 2.
[42] Field Mus. Nat. Hist., 10.

Skull: Type specimen (adult male; teeth very slightly worn): Condylobasal length, 16.9; palatal length, 6.6; cranial breadth, 8.1; interorbital breadth, 3.2; maxillary breadth, 4.0; maxillary tooth row, 6.0. Average of four skulls of adult females (teeth very slightly worn) from type locality: Condylobasal length, 16.6 (16.5–16.8); palatal length, 6.6 (6.4–6.7); cranial breadth, 8.1 (8.0–8.3); interorbital breadth, 3.2 (3.1–3.2); maxillary breadth, 4.1 (4.1–4.2); maxillary tooth row, 5.8 (5.7–5.9).

Remarks.—The Labrador form of *S. cinereus* is at best a poorly defined subspecies, distinguished from typical *cinereus* chiefly by slight average color differences in winter pelage. The skull of *S. c. miscix* also averages larger and with narrower rostrum than that of the subspecies *cinereus*, but there are many skulls of the latter, particularly from the northern part of its range, which are practically inseparable from skulls of *miscix*. Certain specimens of *cinereus* from eastern Quebec, Prince Edward Island, Nova Scotia, and New Brunswick show a tendency in color toward *miscix* but on the whole are nearer *S. c. cinereus*, to which they have been referred.

Specimens examined.—Total number, 75, as follows:

Labrador: Black Bay (type locality), 48[43]; Hopedale, 3[43]; L'Anse au Loup, 5[43]; Maddovik, 3[43]; Okak, 4[43]; Paradise, 9; Paradise River (20 miles above mouth), 2; Sandwich Bay, 1.[43]

SOREX CINEREUS HAYDENI Baird

Plains Cinereous Shrew

(Pl. 2, c)

Sorex haydeni Baird, Report Pacific R. R. Survey 8: part 1, Mammals, p. 29, 1857.

Sorex personatus haydeni Allen, Bul. Amer. Mus. Nat. Hist. 8: 257, November 25, 1896.

Sorex cinereus haydeni Jackson, Journ. Mamm. 6: 56, February, 1925.

Type specimen.—No. 1685, U. S. Nat. Mus., adult, sex unknown, alcoholic with broken skull unremoved; collected in 1855 by F. V. Hayden.

Type locality.—Fort Union, Nebr. (later Fort Buford, now Mondak, Mont., near Buford, Williams County, N. Dak.).

Geographic range.—Extreme east-central Alberta (Islay), southern Saskatchewan, southwestern Manitoba, south through extreme western Minnesota to northwestern Iowa, northern Nebraska, and through eastern Montana to southeastern Wyoming. (Fig. 3.)

Diagnostic characters.—Smaller than *Sorex c. cinereus*, with shorter tail; color paler, both in summer and winter, tending more to develop a tricolor pattern, darkest on the back, paler on the sides in a longitudinal ribbon, palest on the underparts; skull slightly smaller than that of *S. c. cinereus*, with relatively and actually shorter palate and relatively broader rostrum. About the size of *S. c. hollisteri*, or slightly smaller, with shorter tail, and tending more to develop tricolor pattern (dorsally usually darker, paler on the sides); rostrum decidedly shorter and broader than in *hollisteri*.

Color.—Winter pelage: Upper parts averaging paler than corresponding pelage of *S. c. cinereus*, usually hair brown or drab, sometimes nearly fuscous posteriorly; color of upper parts usually not extending onto the sides, which are generally rather sharply defined from the back and more nearly the color of the underparts; underparts between pale olive-gray and pale smoke gray, sometimes smoke gray; tail cinnamon brown or Saccardo's umber above, avellaneous or pinkish buff below, nearly to tip. *Summer pelage:* Paler than corresponding pelage of *S. c. cinereus*. Upper parts hair brown, drab, or olive-brown, paler on the sides, which frequently are rather sharply contrasted from

[43] Mus. Comp. Zool.

both the back and underparts in a distinct longitudinal ribbon of wood brown or avellaneous; under parts smoke gray or pale smoke gray, usually faintly tinged with pinkish buff; tail as in winter.

Skull.—Smaller than that of *S. c. cinereus* (condylobasal length about 15.3), with relatively and actually shorter palate, relatively broader rostrum, and more densely pigmented dentition. About the size of that of *S. c. hollisteri*, but with decidedly shorter, broader, less attenuate rostrum.

Measurements.—Average of five adult females from Lostwood, N. Dak.: Total length, 88.2 (85–92); tail vertebrae, 32.8 (30–36); hind foot, 11.4 (11–12). *Skull:* Skulls of two adult females (teeth slightly worn) from Lostwood, N. Dak.: Condylobasal length, 15.3; 15.0; palatal length, 5.5; 5.5; cranial breadth, 7.5; 7.5; interorbital breadth, 3.0; 3.0; maxillary breadth, 4.3; 4.4; maxillary tooth row, 5.2; 5.0. Skull of adult female (teeth slightly worn) from Williston, N. Dak.: Condylobasal length, 15.0; palatal length, 5.6; cranial breadth, 7.3; interorbital breadth, 3.0; maxillary breadth, 4.2; maxillary tooth row, 5.2.

Remarks.—The pale, short-tailed form of *S. cinereus* inhabiting the northern part of the central plains region is confined largely to the Transition Zone. It is a rather variable form particularly in cranial characters, which show everywhere in a broad border along its range an approach toward *S. c. cinereus*. Specimens referable to *S. c. haydeni* have been examined from as far north as Osler, Saskatchewan; these are typical of *haydeni* in color and measurements, but show an inclination toward the subspecies *cinereus* in having relatively longer and narrower rostra than specimens from the type region. The same is true of specimens from Laramie Peak and Fort Steele, Wyo., Portland, N. Dak., and most localities in eastern Montana. Others from southwestern Manitoba are essentially like typical *haydeni* in external characters but may show cranially a strong tendency toward *S. c. cinereus*. A large series from Aweme, Manitoba, is particularly puzzling and interesting. Nearly all the skins in this series are like typical *haydeni* in color and measurements, there being only a few that are like typical *cinereus* in color and only a few that have measurements of that subspecies. The skulls are extremely variable, ranging from a half dozen of those of the extreme style of *haydeni* (small and flat, with short and relatively broad rostrum) to several of the extreme style of *S. c. cinereus* (larger and decidedly higher, with long and narrow rostrum), with a few displaying intermediate skull characters. The contrast between the extremes in this series, if only the extremes from this locality were considered, is so great as to suggest different species. Certain specimens from the Turtle Mountains, N. Dak., are intermediate and could with about equal propriety be referred to either *haydeni* or true *cinereus* were they not surrounded geographically by *haydeni*. Alcoholic specimens, from which the skulls have been removed for study, from Fort Sisseton, S. Dak., and a skin with skull from Browns Valley, Minn., can also about as well be referred to one form as the other.

Specimens examined.—Total number 206, as follows:

Alberta: Islay, 2.[44]
Iowa: Sac City (2 miles west), 1; Wall Lake, 1.
Manitoba: Aweme, 64[45]; Carberry, 6; Killarney, 1.
Minnesota: Browns Valley, 1; Kittson County, 1; Madison, 1[46]; Moorhead, 6.

[44] J. D. Soper coll., Edmonton, Alberta.
[45] Royal Ontario Mus. Zool., 6; Stuart Criddle coll., Treesbank, Manitoba, 54.
[46] Acad. Nat. Sci. Philadelphia.

Montana: Crow Agency, 1; Ekalaka (5 miles southeast), 3; Fort Custer, 7; Medicine Bow, 1.
Nebraska: Bassett, Rock County, 4[47]; Kennedy, 1; Niobrara River (10 miles south of Cody), 1; Perch, Rock County, 10[47]; Two-mile Lake, Cherry County, 1.
North Dakota: Blackmer, 2; Bottineau, 1; Cannon Ball, 1; Fairmount (Sioux River), 1; Fargo, 2; Fish Lake (Birchwood), 2; Fort Buford (type locality), 1; Grand Forks, 1; Kenmare, 2; Lostwood (6 miles north), 9; Oakes, 2; Portland, 7; St. John (Fish Lake, 8 miles north of west), 1; Selfridge, 1; Steele, 1; Turtle Mountains (Birchwood), 2; Walhalla, 2; Williston (south of river), 1.
Saskatchewan: Indian Head, 12[48]; Osler, 3.[49]
South Dakota: Beadle County, 1; Custer, 3[50]; Custer (16 miles west), 2; Deadwood, 2; Dumont (Black Hills National Forest, altitude 6,100 feet), 5; Elk Mountain (20 miles north), 1; Fort Pierre, 2; Fort Sisseton, 8; Vermilion, 1.
Wyoming: Bear Lodge Mountains (Warren Peak, altitude 6,000 feet), 4; Fort Steele, 1; Laramie Peak (north slope, altitude 8,000 feet), 1; Laramie Peak (north slope, altitude 8,800 feet), 1; Rattlesnake Creek (Black Hills, altitude 6,000 feet), 1; Sherman, 1; Springhill, 1; Sundance, 3; Wolf (Eaton's Ranch), 1.

SOREX CINEREUS STREATORI Merriam

Streator Cinereous Shrew

(Pl. 2, d)

Sorex personatus streatori Merriam, North Amer. Fauna No. 10, p. 62, December 31, 1892.
Sorex cinereus streatori Jackson, Journ. Mamm. 6: 56, February, 1925.

Type specimen.—No. 73537, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth moderately worn), skin and skull; collected July 9, 1895, by C. P. Streator.

Type locality.—Yakutat, Alaska.

Geographic range.—Pacific coast region of North America from the southeastern part of Kenai Peninsula, Alaska, south to central Washington west of the Cascades. (Fig. 3.)

Diagnostic characters.—Darkest of the species; largest of the west American subspecies, with longest tail and largest hind foot. In color most nearly like *Sorex c. cinercus* but darker, particularly on ventral parts; larger, with longer tail and larger hind foot; skull longer than that of the subspecies *cinercus*, with longer and usually heavier rostrum, heavier dentition, the molariform teeth usually more deeply emarginate posteriorly. Decidedly larger in all respects than *S. c. hollisteri;* much darker, the underparts buffy rather than whitish; skull much larger and heavier, with distinctly larger rostrum. About the size of *S. c. miscix*, but very much darker in all pelages; skull much like that of *miscix* but teeth greater in extero-interior diameter.

Color.—Winter pelage: Upper parts scarcely different from corresponding pelage of *S. c. cinereus*, underparts decidedly more buffy. Upper parts grayish fuscous or chaetura drab, sometimes tending toward hair brown, extending well down on sides where it becomes slightly more drabbish, blending gradually with color of underparts drabbish avellaneous; tail fuscous above, avellaneous below nearly to tip. *Summer pelage:* Much darker and more brownish than in winter. Darker than *S. c. cinercus* in corresponding pelage. Upper parts fuscous-black or fuscous, extending well onto the sides and gradually blending with colors of underparts; underparts heavily tinged with buffy brown or wood brown, sometimes with pinkish buff, rarely indicating more or less light grayish olive; tail about as in winter.

[47] Amer. Mus. Nat. Hist.
[48] Acad. Nat. Sci. Philadelphia, 3; Nat. Mus. Canada, 9.
[49] Mus. Comp. Zool.
[50] Amer. Mus. Nat. Hist., 1.

Skull.—Large for the *cinereus* group (condylobasal length 16 millimeters or over), with rather large rostrum. Longer than that of *S. c. cinereus*, with longer and usually heavier rostrum, longer tooth row, heavier dentition, the molariform teeth usually more deeply and acutely emarginate posteriorly. Larger and heavier than that of *S. c. hollisteri*, with decidedly larger rostrum, and heavier dentition. Much like that of *S. c. miscix* but teeth greater in extero-interior diameter.

Measurements.—Type specimen (adult male): Total length, 107; tail vertebrae, 50; hind foot, 12.5. Average of four other adult males from type locality: Total length, 105.5 (102–111); tail vertebrae, 45 (42–48); hind foot, 12.8 (12–13). Average of three adult males from Sitka, Alaska: Total length, 104 (102–107); tail vertebrae, 45.8 (45–47); hind foot, 13.3 (13–13.5). *Skull:* Type specimen (adult male; teeth moderately worn): Condylobasal length, 16.7; palatal length, 6.3; cranial breadth, 7.6; interorbital breadth, 3.2; maxillary breadth, 4.2; maxillary tooth row, 6.0. Average of four skulls of adult males (teeth moderately worn) from type locality: Condylobasal length, 16.3 (16.0–16.6); palatal length, 6.3 (6.2–6.4); cranial breadth, 7.7 (7.5–7.8); interorbital breadth, 3.2 (3.2–3.2); maxillary breadth, 4.1 (4.0–4.2); maxillary tooth row, 5.9 (5.8–6.0). Average of three skulls of adult males (teeth slightly worn) from Sitka, Alaska: Condylobasal length, 16.6 (16.4–16.8); palatal length, 6.3 (6.2–6.4); cranial breadth, 7.7 (7.5–7.9); interorbital breadth, 3.2 (3.1–3.2); maxillary breadth, 4.2 (4.1–4.3); maxillary tooth row, 6.0 (6.0–6.0).

Remarks.—Streator's cinereous shrew is confined to certain islands and a narrow strip of territory along the Pacific coast from the south side of Prince William Sound, Alaska, to the south side of the Strait of Juan de Fuca, Wash. In consideration of the extensive north and south range of the form it retains its characters throughout this area with remarkable uniformity. A short distance inland it intergrades with *S. c. cinereus*, as it does throughout extreme southern British Columbia, where specimens of *S. c. cinereus* from as far east as Glacier show tendencies toward *S. c. streatori* in color, size, and cranial characteristics.

Specimens examined.—Total number, 365, as follows:

Alaska: Anan Creek (mainland), 1[51]; Bradfield Canal, 11[52]; Chenega Island (Prince William Sound, 6[52]; Chichagof Island (Tenakee Inlet), 21; Chickamin River (Behm Canal), 1[52]; Cordova (Prince William Sound), 16[52]; Cordova Bay (head of, Prince William Sound), 7[52]; Ellamar (Prince William Sound), 6[52]; Elrington Island (Prince William Sound), 19[52]; Etolin Island, 2[52]; Fools Inlet (Wrangell Island), 2[52]; Fort Wrangell, 5[53]; Freshwater Bay (Chichagof Island), 1[52]; Glacier Bay, 1[52]; Glacier Bay (Bartlett Cove), 9[52]; Glacier Bay (Coppermine Cove), 2[52]; Grafton Island (Prince William Sound), 2[52]; Haines, 5; Hasselborg Lake (Admiralty Island), 1[52]; Hawkins Island (east side of Canoe Passage, Prince William Sound), 3; Hawkins Island (west side of Canoe Passage, Prince William Sound), 3[52]; Helm Bay, 1[52]; Hinchinbrook Island (Northeast Bay, Prince William Sound), 16[52]; Hoodoo Island (Prince William Sound), 17[52]; Hoonah (Chichagof Island), 7[52]; Horn Cliff (Beach), 1; Idaho Inlet (Chichagof Island), 1[52]; Inian Islands, 1[51]; Juneau, 11; Kelp Bay (Baranof Island), 1[51]; Kupreanof Island, 6; La Touche (La Touche Island, Prince William Sound), 19[52]; Loring, 5; Mitkof Island, 1[52]; Mitkof Island (Petersburg), 5; Orca, 1; Peril Strait (Baranof Island), 6[52]; Port Conclusion (Baranof Island), 3[51]; Port Frederic (Chichagof Island), 3[52]; Port Nell Juan (head of, Prince William Sound), 12[52]; Port Snettisham, 2[52]; Quadra Cannery, 2[54]; Quadra Lake, 4[54]; Red Bluff Bay (Baranof Island), 5[52]; Redoubt Lake (Baranof Island), 1[51]; Revillagigedo, 1[52]; Rodman Bay (Baranof Island), 5[52]; Sitka, 19[55]; Skagway, 6; Taku River, 3[52]; Thomas Bay, 6[52]; Valdez Narrows (Prince William Sound), 8; Wrangell, 33[56]; Yakutat (type locality), 6.

[51] D. R. Dickey coll., Pasadena, Calif.
[52] Mus. Vert. Zool.
[53] Amer. Mus. Nat. Hist.
[54] D. R. Dickey coll., 3.
[55] Amer. Mus. Nat. Hist., 2.
[56] C. G. Cantwell, coll., Palms, Calif., 3; D. R. Dickey coll., 19.

British Columbia: Howe Sound (Gibsons Landing), 1; Metlakatla, 2[57]; Mount Baker Range (49th parallel, altitude 6,000 feet), 4[58]; Observatory Inlet (Hastings Arm), 1[59]; Port Simpson, 3; River Inlet (head of Inlet), 4; Sumas, 1.[58]

Washington: Cedarville, 1; Glacier (altitude 900 feet), 1; Neah Bay, 1; Quiniault River (head North Fork, altitude 4,000 feet, Jefferson County), 1; Skohomish River (Mason County), 1[60]; Whatcom Pass (36 miles east of Glacier, altitude 5,200 feet, Whatcom County), 2.[61]

SOREX CINEREUS HOLLISTERI Jackson

Hollister Cinereous Shrew

(Pl. 2, e)

Sorex personatus arcticus Merriam, Proc. Washington Acad. Sci. 2: 17, March 14, 1900. (Not *Sorex arcticus* Kerr, 1792.)

Sorex cinereus hollisteri Jackson, Journ. Mamm. 6: 55, February, 1925.

Type specimen.—No. 99305, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected September 14, 1899, by W. H. Osgood.

Type locality.—St. Michael, Alaska.

Geographic range.—Western Alaska from Franklin Point south to the head of Cook Inlet (Anchorage). (Fig. 3.)

Diagnostic characters.—Similar externally to *Sorex c. cinereus* but averaging very slightly smaller with shorter tail; color paler, particularly in summer; underparts in both winter and summer pelage more nearly whitish; skull about the size of that of *S. c. cinereus* or slightly smaller, with actually and relatively narrower rostrum and usually with higher brain case. Much paler than *S. c. streatori* both dorsally and ventrally; smaller, with shorter tail, shorter hind foot, and smaller skull.

Color.—Winter pelage: Similar to *S. c. cinereus* but averaging slightly paler and apparently more flecked with whitish-tipped hairs above, and more distinctly whitish ventrally. *Summer pelage:* Much paler and more brownish than in winter. Decidedly paler than *S. c. cinereus* in corresponding pelage. Upper parts drab, sometimes almost olive-brown, usually shading into wood brown or avellaneous on the sides; underparts smoke gray or pale smoke gray, frequently tinged with pinkish buff; tail buffy brown or olive-brown, sometimes almost clove brown above, avellaneous or light drab below nearly to tip.

Skull.—Averaging somewhat smaller than that of *S. c. cinereus*, with actually and relatively narrower, more attenuate rostrum and usually with higher brain case. Smaller than that of *S. c. streatori*, with decidedly smaller and narrower rostrum, and weaker dentition.

Measurements.—Type specimen (adult female): Total length, 108; tail vertebrae, 39; hind foot, 12. Average of five adult females from type locality: Total length, 98 (92–104); tail vertebrae, 35.6 (32–38); hind foot, 11.9 (11–12.5). Average of six adult males from Kings Cove, Alaska Peninsula, Alaska: Total length, 93.2 (90–97); tail vertebrae, 38.2 (36–41); hind foot, 11.7 (11–12). *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 15.5; palatal length, 6.0; cranial breadth, 7.6; interorbital breadth, 2.9; maxillary breadth, 3.8; maxillary tooth row, 5.4. Average of five skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 15.7 (15.4–15.9); palatal length, 6.0 (5.9–6.1); cranial breadth, 7.6 (7.4–7.8); interorbital breadth, 3.0 (2.9–3.1); maxillary breadth, 4.0 (3.9–4.1); maxillary tooth row, 5.5 (5.4–5.6). Average of six skulls of adult males (teeth slightly worn) from Kings Cove, Alaska Peninsula, Alaska: Condylobasal length, 15.3 (15.2–15.5); palatal length, 5.9 (5.8–6.0); cranial breadth, 7.5 (7.2–7.8); interorbital breadth, 3.0 (2.9–3.1); maxillary breadth, 3.8 (3.7–3.9); maxillary tooth row, 5.4 (5.3–5.5).

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[57] Nat. Mus. Canada, 1.
[58] Mus. Comp. Zool.
[59] Nat. Mus. Canada.
[60] Univ. Mich.
[61] State Coll. Wash., 1.

Remarks.—In its extreme form, represented by specimens from the Alaska Peninsula, *S. c. hollisteri* is a well-defined subspecies. It is confined to the coast region of Alaska from Alaska Peninsula northward, specimens from localities but little interior from the coast (vicinity of Lake Clark) showing an approach toward *S. c. cinereus*, with which it intergrades in central Alaska. A single skin without skull from St. Lawrence Island, Alaska, is provisionally referred to *hollisteri*.

Specimens examined.—Total number, 283, as follows:

Alaska: Akchookuk Lake, 2; Anchorage (Chester Creek), 1; Becharof Lake (Alaska Peninsula), 2; Bethel, 24[62]; Bettles, 11; Bristol Bay, 2; Chalitna River (head of), 9; Chignik, 11; Cold Bay (Alaska Peninsula), 1; Doonnockchogaweet Mountain, 1; Fairbanks, 1; Flat, 1; Frosty Peak (east base, Alaska Peninsula), 17; Good News Bay, 2; Hooper Bay, 1; Kakhtul River, 8; Katmai, 2; Kanatak (Portage Bay, Alaska Peninsula), 1; Kings Cove (Alaska Peninsula), 54; Kokechik River, 1; Kokwok, 5; Kokwok River (45 miles up), 1; Kokwok River (80 miles up), 16; Koyukuk River (Hacket Creek), 1; Kruzgamepa Hot Springs (north-northeast of Nome, long. 165 west, lat. 65 north), 1[63]; Lake Aleknagik, 5; Lake Clark, 7; Lake Clark (head Nogheling River), 1; Lake Clark (lower end of lake), 1; Lake Iliamna (Iliamna Village), 1; Lake Weelooluk, 1; Moller Bay (Alaska Peninsula), 4[64]; Nome, 1; Norton Bay, 1; Nulato, 22; Nunivak Island, 1; Nushagak, 15; Nushagak River, 1; Nushagak River (Lewis Point), 4; Point Protection, 2; Richardson (Tanana River), 7; St. Lawrence Island, 1[65]; St. Michael (type locality), 27; St. Michael Island, 2; Sawtooth Mountains, 1; Stuyahok Landing, 1; Wainwright, 1[66].

SOREX FONTINALIS Hollister

Maryland Shrew

(Pls. 2, f; 4, v; 5, t; 7, b)

Sorex fontinalis Hollister, Proc. U. S. Nat. Mus. 40: 378, April 17, 1911.

Type specimen.—No. 85439, U. S. Nat. Mus., ♀ adult (teeth moderately worn), skin and skull; collected November 6, 1898, by Gerrit S. Miller, jr.

Type locality.—Cold Spring Swamp, near Beltsville, Prince Georges County, Md.

Geographic range.—Known only from south-central and southeastern Maryland. (Fig. 3.)

Diagnostic characters.—Size small; smaller than *Sorex c. cinereus*, with shorter tail. Skull smaller than that of *S. c. cinereus*, with relatively narrow brain case, shorter rostrum, and shorter unicuspid row.

Color.—Winter pelage: Upper parts fuscous or olive-brown, becoming lighter on the sides, about drab; underparts smoke gray washed with pinkish buff; tail bicolor, fuscous above, buffy beneath nearly to tip. *Summer pelage:* Upper parts paler and much more brownish (less gray) than in winter, about snuff brown; flanks slightly paler than back; underparts and tail about as in winter pelage.

Time of molting.—Specimens collected November 6 to March 8 are in winter pelage. A male from Hyattsville, Md., was in complete summer fur May 3, 1900, while another male collected the same day is in winter pelage but shows indications of the beginning of molt on the rump.

Skull.—Smaller than that of *S. c. cinereus*, with much smaller, narrower brain case, shorter and relatively wider rostrum. Teeth about the size and

[62] Acad. Nat. Sci. Philadelphia, 2; D. R. Dickey coll., Pasadena, Calif., 1.
[63] Mus. Comp. Zool.
[64] Amer. Mus. Nat. Hist.
[65] Acad. Nat. Sci. Philadelphia.
[66] Colo. Must. Nat. Hist.

proportions of those of *S. c. cinereus*, unicuspid tooth row shorter with teeth more crowded. In general proportions somewhat like that of *S. lyelli* or *S. preblei;* smaller than that of *S. lyelli*, more flattened, narrower interorbitally and with smaller molariform teeth; larger than the skull of *S. preblei*, with longer maxillary tooth row.

Measurements.—Type specimen (adult female): Total length, 90; tail vertebrae, 31; hind foot, 10. Two adult males from Hyattsville, Md.: Total length, 86, 98; tail vertebrae, 33, 37; hind foot, 11, 11. *Skull:* Type specimen (adult female; teeth moderately worn): Condylobasal length, 14.9; palatal length, 5.5; cranial breadth, 7.0; interorbital breadth, 2.9; maxillary breadth, 4.0; maxillary tooth row, 5.4. Skulls of two adult males (teeth slightly worn) from Hyattsville, Md.: Condylobasal length, 14.9, 14.9; palatal length, 5.7, 5.7; cranial breadth, 7.2, 7.1; interorbital breadth, 3.0, 3.0; maxillary breadth, 4.2, 4.1; maxillary tooth row, 5.3, 5.5.

Remarks.—Intergradation between *S. fontinalis* and *S. cinereus* is not indicated in any of the specimens examined. It is true that there is a gradual decrease in the size of *S. cinereus* and a tendency for its rostrum to shorten from the northern part of its range southward, but the difference between small southern specimens of *S. c. cinereus* and specimens of *S. fontinalis* is sharp and distinct. It is possible that when specimens are available from the region between the type locality and the mountains of Maryland and Pennsylvania, or from northeastern Maryland and Delaware, intergradation between the two forms may be shown; until then *fontinalis* must be given full specific rank.

Specimens examined.—Total number, 18, as follows:

Maryland: Beltsville (Cold Spring Swamp, near) (type locality), 2; Cabin John, 1; Cambridge, 1[67]; Hollywood, 1; Hyattsville, 6[68]; Landover, 1; Laurel, 4; Sandy Spring, 1; Tuxedo, 1.

SOREX LYELLI MERRIAM

MOUNT LYELL SHREW

(PLS. 2, G; 5, U; 7, C)

Sorex tenellus lyelli Merriam, Proc. Biol. Soc. Washington 15: 75, March 22, 1902.

Type specimen.—No. 109530, U. S. Nat. Mus., Biological Survey collection; ♂ young adult (teeth unworn), skin and skull; collected August 29, 1901, by Walter K. Fisher.

Type locality.—Mount Lyell, Tuolumne County, Calif.

Geographic range.—Crest of the central Sierra Nevadas in California. (Fig. 3.)

Diagnostic characters.—Size small, smaller than most subspecies of *Sorex cinereus*, about the size of *S. c. hollisteri* or *S. c. haydeni*, larger and paler than *S. fontinalis* or *S. preblei.* Skull flatter than in *S. cinereus* and relatively broader interorbitally. Skull in general proportions somewhat like that of *S. fontinalis* or *S. preblei;* somewhat larger than that of *S. fontinalis*, apparently less flattened and broader interorbitally; distinctly larger than that of *S. preblei*, with longer maxillary tooth row.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts hair brown to drab, sometimes almost olive-brown, paler on the sides; underparts pale olive-gray or pale smoke grap faintly tinged with pale olive-buff or tilleul buff; tail buffy brown, olive-brown, or between buffy brown and hair brown above, light drabbish below, darkening toward tip.

Skull.—Differs from that of any of the subspecies of *S. cinereus* in being flatter through the brain case and wider interorbitally. About the size of that of *S. c. hollisteri*, noticeably flatter, palatal length less, rostrum shorter and broader, and interorbital breadth greater. About the size of that of *S. c.*

[67] Donald R. Dickey coll., Pasadena, Calif. [68] Univ. Wis. Zool. Mus., 1.

haydeni or slightly larger, more flattened, broader interorbitally, rostrum relatively narrower, and maxillary tooth row longer. In general proportions most nearly like that of *S. fontinalis*, somewhat larger and apparently less flattened, broader interorbitally, and with heavier molariform teeth. Considerably larger than the skull of *S. preblei*, with relatively narrower rostrum, and longer tooth row.

Measurements.—Type specimen (young adult male); total length, 103; tail vertebrae, 41; hind foot, 12. Adult female from Vogelsang Lake, altitude 10,350 feet, Yosemite Park, Calif.: Total length, 102; tail vertebrae, 39; hind foot, 11. *Skull.*—Type specimen (young adult male; teeth unworn): Condylobasal length, 15.4; palatal length, 5.6; cranial breadth, 7.3; interorbital breadth, 3.1; maxillary breadth, 4.1; maxillary tooth row, 5.5. Skull of adult female (teeth moderately worn) from Vogelsang Lake, altitude 10,350 feet, Yosemite Park, Calif.: Condylobasal length, 15.2; palatal length, 5.8; cranial breadth, 7.5; interorbital breadth, 3.3; maxillary breadth, 4.2; maxillary tooth row, 5.5.

Remarks.—In the original description this form was placed as a subspecies of *S. tenellus* (Merriam, 1902, p. 75). It really has no close connection with *S. tenellus*, although it shows some superficial similarities, particularly in its having a rather flat skull. This flatness, however, is not nearly so pronounced as in the species *tenellus*, and in the type specimen, which was a young adult, seems to be somewhat accentuated, the brain case of its comparatively weak skull appearing to have become a trifle contracted and flattened medially during the cleaning process. This species, which represents *S. cinereus* in the Sierra Nevada, is rare in collections, only five specimens being available from a region where hundreds of shrews have been trapped.

Specimens examined.—Total number, 5, as follows:

California: Lyell Canyon (head of, Yosemite Park, altitude 9,800 feet), 1[69]; Mammoth, Mono County, 1[70]; Mount Lyell (type locality), 1; Vogelsang Lake (altitude 10,350 feet), Yosemite Park, 1[69]; Williams Butte (1 mile south, altitude 6,900 feet, Mono County, 1.[69]

SOREX PREBLEI Jackson

Preble Shrew

(Pls. 2, H; 5, V)

Sorex preblei Jackson, Journ. Washington Acad. Sci. 12: 263, June 4, 1922.

Type specimen.—No. 208032, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth moderately worn), skin and skull; collected July 3, 1915, by Edward A. Preble. Original number, 5972.

Type locality.—Jordan Valley, altitude 4,200 feet, Malheur County, Oreg.

Geographic range.—Known only from eastern Oregon. (Fig. 3.)

Diagnostic characters.—Smallest of the western forms of the *cinereus* group; color paler and more grayish than in *Sorex c. cinereus*, possibly a shade darker and more grayish than in *S. lyelli;* hind foot small. Skull considerably flattened, small (smallest of the *cinereus* group), with relatively short rostrum.

Color.—Worn winter pelage: Upper parts between hair brown and mouse gray, the sides and flanks scarcely paler; underparts pale smoke gray, slightly tinged with tilleul buff; tail above olive brown basally, darkening to clove brown toward tip, avellaneous below, darkening apically. *Summer pelage* (type specimen): Upper parts darker and more brownish than in winter, between hair brown and olive brown, paling on the sides; underparts pale smoke gray, very faintly tinged with cartridge buff; tail as in winter pelage.

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[69] Mus. Vert. Zool. [70] D. R. Dickey coll., Pasadena, Calif.

Skull.—Small, rather flat, with relatively broad rostrum and short tooth row. More nearly like that of *S. lyelli* or *S. fontinalis* than like that of *S. cinereus*, but smaller than either, with shorter maxillary tooth row.

Measurements.—Type specimen (adult male): Total length, 95; tail vertebrae, 36; hind foot, 11. Adult male from Sled Springs, 25 miles north of Enterprise, Oreg.: Total length, 85; tail vertebrae, 35; hind foot, 11. *Skull.*—Type specimen (adult male; teeth moderately worn): Condylobasal length, 14.6; palatal length, 5.4; cranial breadth, 7.1; interorbital breadth, 3.1; maxillary breadth, 4.2; maxillary tooth row, 5.1. Skull of adult male (teeth slightly worn) from Sled Springs, 25 miles north of Enterprise, Oreg.: Condylobasal length, 14.2; palatal length, 5.6; cranial breadth, 7.2; interorbital breadth, 3.1; maxillary breadth, 4.1; maxillary tooth row, 5.2.

Remarks.—With the possible exception of *S. nanus*, *S. preblei* is the smallest of the western American members of the genus. It is easily distinguished from *S. nanus* by its higher and broader brain case and different dentition. It is most nearly like *S. lyelli* and *S. fontinalis*, from which it can be differentiated by characters above mentioned. In fact, additional specimens may prove its intergradation with *S. lyelli*, but on the basis of material at hand it is necessary to consider the two specifically distinct.

The specimen from Diamond, Oreg., is a young female that lacks the entire rostrum and teeth and is provisionally referred to *S. preblei.*

Specimens examined.—Total number, 3, as follows:

Oregon: Diamond (altitude 4,300 feet), 1; Enterprise (25 miles north at Sled Springs, altitude 4,600 feet), 1; Jordan Valley (altitude 4,200 feet), Malheur County (type locality), 1.

TABLE 1.—*Cranial measurements of adult specimens of* Sorex cinereus *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. c. cinereus:										
North Carolina—Roan Mountain (6,000 feet).	54479	♂	15.5	5.9	7.6	3.2	4.1	5.4	Moderate	
Do	54480	♂	15.4	5.9	7.3	2.9	4.2	5.4	do	
Do	54482	♂	15.1	5.8	7.5	3.1	4.2	5.3	do	
Do	54487	♂	15.9	5.6	7.6	3.2	4.0	5.5	do	
Northwest Territories—Fort Resolution.	110828	♀	16.0	6.0	8.0	3.1	4.1	5.5	Slight	
Do	110833	♀	16.0	6.0	7.8	2.9	4.0	5.4	do	
Do	110834	♀	16.1	6.0	8.0	3.1	4.0	5.5	do	
Do	110835	♀	15.9	6.0	7.6	3.0	3.9	5.6	do	
Do	116061	♀	15.9	6.0	7.6	3.0	4.0	5.6	do	
Pennsylvania—Drury Run, Clinton County.	57870	♂	15.6	5.9	7.6	3.1	4.1	5.5	Moderate	
Do	57872	♀	16.0	6.0	7.6	2.9	4.0	5.5	Slight	
Rhode Island—Washington County.	120876	♀	15.4	6.0	7.6	2.9	4.0	5.4	do	
Do	120881	♀	15.7	6.0	7.6	3.0	4.0	5.6	do	
Do	120884	♀	15.7	6.0	7.7	3.1	4.2	5.5	do	
Do	120885	♀	16.2	6.0	7.6	3.0	4.3	5.6	do	
Wisconsin—Mamie Lake, Vilas County.	226969	♀	15.5	5.8	7.5	3.0	4.0	5.3	do	
Do	226970	♀	16.0	6.0	7.6	3.1	3.9	5.5	do	
Do	227238	♀	15.8	6.0	7.6	3.0	4.1	5.5	do	
Do	227243	♀	15.7	5.9	7.7	3.1	4.0	5.5	do	
Do	227249	♀	15.9	6.1	7.8	3.0	4.1	5.7	do	
Wyoming—Pahaska, mouth Grinnell Creek, Park County.	169852	♂	15.5	6.0	7.7	3.0	4.0	5.4	do	
Do	169859	♂	15.4	6.0	7.4	3.0	4.0	5.5	do	
Do	169860	♂	15.5	6.0	7.6	3.1	4.1	5.3	do	

TABLE 1.—*Cranial measurements of adult specimens of* Sorex cinereus *group*—Continued

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. c. haydeni:										
North Dakota—										
Lostwood	208220	♀	15.3	5.5	7.5	3.0	4.3	5.2	Slight	
Do	208223	♀	15.0	5.5	7.5	3.0	4.4	5.0	do	
Williston	202240	♀	15.0	5.6	7.3	3.0	4.2	5.2	do	Essentially typo locality.
S. c. streatori:										
Alaska—										
Yakutat	73537	♂	16.7	6.3	7.6	3.2	4.2	6.0	Moderate	Type specimen.
Do	73535	♂	16.1	6.2	7.5	3.2	4.0	5.8	do	Type locality.
Do	73540	♂	16.6	6.4	7.8	3.2	4.1	5.9	do	Do.
Do	73546	♂	16.6	6.2	7.8	3.2	4.1	6.0	do	Do.
Do	73548	♂	16.0	6.3	7.6	3.2	4.2	5.9	do	Do.
Sitka	73794	♂	16.4	6.2	7.5	3.1	4.1	6.0	Slight	
Do	73799	♂	16.8	6.4	7.7	3.2	4.2	6.0	do	
Do	73800	♂	16.5	6.3	7.9	3.2	4.3	6.0	do	
S. c. hollisteri:										
Alaska—										
St. Micbael	99305	♀	15.5	6.0	7.6	2.9	3.8	5.4	do	Ty pespecimen.
Do	99293	♀	15.7	6.1	7.7	2.9	3.9	5.5	do	Type locality.
Do	99294	♀	15.9	5.9	7.7	3.1	4.1	5.4	do	Do.
Do	99295	♀	15.4	6.0	7.4	2.9	3.9	5.5	do	Do.
Do	99298	♀	15.9	6.0	7.8	3.1	4.0	5.6	do	Do.
Do	99303	♀	15.7	6.0	7.5	3.0	4.0	5.6	do	Do.
Kings Cove, Alaska Peninsula.	177308	♂	15.3	6.0	7.2	2.9	3.9	5.4	do	
Do	177312	♂	15.3	5.9	7.6	3.0	3.7	5.5	do	
Do	177315	♂	15.2	5.9	7.5	2.9	3.8	5.3	do	
Do	177316	♂	15.2	5.8	7.8	3.1	3.8	5.4	do	
Do	177317	♂	15.5	5.9	7.4	3.0	3.8	5.4	do	
Do	177320	♂	15.5	5.9	7.4	2.9	3.9	5.3	do	
S. c. miscix:										
Labrador—										
Black Bay	[1] 8651	♂	16.9	6.6	8.1	3.2	4.0	6.0	Veryslight.	Type specimen.
Do	[1] 7936	♀	16.6	6.4	8.0	3.2	4.2	5.8	do	Type locality.
Do	[1] 7937	♀	16.6	6.7	8.1	3.1	4.1	5.8	do	Do.
Do	[1] 7939	♀	16.8	6.7	8.0	3.2	4.1	5.9	do	Do.
Do	[1] 7941	♀	16.5	6.5	8.3	3.1	4.1	5.7	do	Do.
Sorex lyelli:										
California—										
Mount Lyell	109530	♂	15.4	5.6	7.3	3.1	4.1	5.5	Unworn	Type specimen; young adult.
Vogelsang Lake, 10,350 feet, Yosemite Park.	[2] 23001	♀	15.2	5.8	7.5	3.3	4.2	5.5	Moderate	
Sorex fontinalis:										
Maryland—										
Beltsville	85439	♀	14.9	5.5	7.0	2.9	4.0	5.4	do	Type specimen.
Hyattsville	76593	♂	14.9	5.7	7.2	3.0	4.2	5.3	Slight	
Do	76709	♂	14.9	5.7	7.1	3.0	4.1	5.5	do	
Sorex preblei:										
Oregon—										
Jordan Valley, 4,200 feet, Malheur County.	208032	♂	14.6	5.4	7.1	3.1	4.2	5.1	Moderate	Type specimen.
Sled Springs, 4,600 feet, 25 miles north of Enterprise, Wallowa County.	231711	♂	14.2	5.6	7.2	3.1	4.1	5.2	Slight	

[1] Mus. Comp. Zool. [2] Mus. Vert. Zool.

SOREX FUMEUS GROUP

The *fumeus* group includes a single species—*Sorex fumeus*. All necessary group comparisons are made under the species.

Geographic range.—Nova Scotia, New Brunswick, southeastern Quebec, south-central Ontario, south through New York, north-

western New Jersey, Pennsylvania, and western Maryland, to south-central Ohio and the mountains of northern Georgia; also southeastern Wisconsin (Racine). (Fig. 4.)

Diagnostic characters.—Size medium; tail medium in length, bicolor, scantily haired; color dull, in effect essentially concolor, except tail. Skull medium in size, relatively broad with short, broad interorbital region and mesopterygoid space; brain case moderately flattened; infraorbital foramen large and situated well posteriorly; lachrymal foramen situated over space between first and second molars; dentition moderate; molariform teeth rather deeply emarginate posteriorly; unicuspid teeth broader (extero-interior diameter) than long

FIG. 4.—Geographic range of the subspecies of *Sorex fumeus*
1. *S. f. fumeus.* 2. *S. f. umbrosus.*

(antero-posterior diameter), the third larger than the fourth; internal ridge extending from apex of unicuspid to about one-half distance toward internal edge of cingulum, moderately pigmented near apex. The fumeus group can be distinguished externally from any forms of the *arcticus* or *pribilofensis* groups by its distinctly unicolor (except tail) appearance. In general aspect the skull of *fumeus* resembles in proportions somewhat that of *pribilofensis* but is much larger in all respects, with the preorbital region less swollen and the infraorbital foramen situated relatively farther back, the second upper premolar not lacking the distinct cusplike process on interior edge of basal shelf, and the unicuspid teeth without the internal heavily pigmented ridge from apex to edge of cingulum completely developed. Compared with the skull of any of the

arcticus group that of *fumeus* is flatter throughout, with considerably less deep, relatively narrower, and less angular brain case, less attenuate rostrum, narrower interorbitally, infraorbital foramen larger and relatively slightly farther back on rostrum, antero-posterior diameter of unicuspids relatively less, molariform teeth more deeply emarginate posteriorly, and cusps of i^1 narrower than in *arcticus*, the secondary cusp relatively smaller. Externally sometimes superficially like members of the *cinereus* group, but larger, particularly feet, and tail longer; skull decidedly larger and heavier than any of the *cinereus* group, with distinctly heavier rostrum and dentition, and with unicuspids lacking the pigmented ridge extending from apex of tooth to interior edge of cingulum (ridge is incomplete and only partly pigmented, near apex of tooth, in *S. fumeus*). Color in winter pelage like *S. dispar* in summer pelage, but tail shorter and less hairy, and skull much heavier and broader in all proportions; mesopterygoid space broader; upper incisors larger, unicuspids heavier and of different relative sizes (in *dispar* the third and fourth are about subequal). Decidedly larger in all proportions than any of the *longirostris* group and differing in dentition. Similar in color to certain specimens of the *trowbridgii* group and not dissimilar in certan cranial features; differs from any of *trowbridgii* group in that unicuspids are relatively much wider (extero-interior diameter), wider than long (antero-posterior diameter), and third unicuspid is larger than fourth. Larger than any of the *merriami* group and never whitish on the ventral parts; skull radically different, much larger than that of *S. merriami*, more truncate posteriorly, relatively narrower interorbitally, much less swollen orbitally, rostrum relatively longer, more attenuate, and relatively narrower, particularly through infraorbital region; infraorbital foramina larger and situated farther back; dentition different.

SOREX FUMEUS Miller

[Synonymy under subspecies]

Geographic range.—That of the *fumeus* group. (Fig. 4.)

Diagnostic characters.—Those of the *fumeus* group.

Subspecies and geographic variation.—The species *fumeus* includes two subspecies: The typical form, *fumeus*, and *umbrosus*. The color of the species is fairly constant throughout its range, a tendeney toward a reduction of reddish of the upper parts reaching its climax in the subspecies *umbrosus* in Nova Scotia. Geographical variation in the skulls is completely swamped by the extensive individual and local variation.

Time of molting.—In the southern part of the range of *Sorex fumeus* the spring molt may begin as early as the middle of April, though most specimens at that time are still in full winter pelage. The transition in the south apparently occurs generally during May, for the majority of June specimens are in summer pelage. A male from Roan Mountain, N. C., shows first indications of the molt April 19, 1893, while another from the same locality is in worn winter pelage May 3. A male from Mount Rogers, Va., has the molt about half completed June 22, 1903, while a second one collected at the same place and time is in complete winter pelage. Middle May specimens from Maryland and most middle and late June specimens from New York and Vermont are in complete summer fur, although a breeding female from Lake George, N. Y., has not fully completed the molt July 10. Two specimens, a male and a female, from Halifax, Nova Scotia, are in process of molt July 18, 1894. A male from River du Loup, Quebec, has acquired practically all the summer fur July 16, 1900.

The winter pelage of *S. fumeus* is usually obtained in full by the last week in October or first week in November. Occasionally specimens are in complete winter pelage early in October (Roan Mountain, N. C., October 11, 1892; Topsham, Me., October 3, 1915; Digby, Nova Scotia, October 10, 1893), but the transition seems to occur more frequently about that time or the middle of the month. A female from Black Mountain, W. Va., is in summer pelage October 29, 1900, but three others collected between October 28 and November 1, the same year, are in full winter pelage. A female from Digby, Nova Scotia, in worn summer pelage had not begun to molt October 25, 1893; another female from the same place has the winter fur coming in under the summer fur over the entire upper parts and abdomen October 22.

SOREX FUMEUS FUMEUS Miller

Smoky Shrew

(Pls. 2, 1; 4, w; 5, w; 7, d; 11, b; 12, b)

Sorex fumeus Miller, North Amer. Fauna No. 10, p. 50, December 31, 1895.
Sorex fumeus fumeus Jackson, Proc. Biol. Soc. Washington 30: 149, July 27, 1917.

Type specimen.—No. 7.7.7.2582, British Museum (No. 2582, collection of Gerrit S. Miller, jr.); ♀ adult, skin and skull; collected September 24, 1893, by Gerrit S. Miller, jr.

Type locality.—Peterboro, Madison County, N. Y.

Geographic range.—New Hampshire, Vermont, Connecticut, Rhode Island, and northern New York, south through northwestern New Jersey, Pennsylvania, and western Maryland, to south-central Ohio and northwestern Georgia; also recorded from Ontario (North Bay) and southeastern Wisconsin (Racine). (Fig. 4.)

Diagnostic characters.—Characters given under the species *Sorex fumeus* will separate *S. f. fumeus* from all shrews except *S. f. umbrosus*. It averages slightly smaller than *umbrosus*, and is distinctly more reddish brown (less grayish) in summer pelage.

Color.—Winter pelage: Distinctly grayish. Upper parts in general effect either mouse gray or deep mouse gray, occasionally almost dark mouse gray. Underparts a trifle paler than the upper parts, usually mouse gray, frequently silvery in certain lights. Tail indistinctly bicolor, fuscous above, chamois or honey yellow beneath nearly to tip; feet chamois, the outer edge dusky. *Summer pelage:* Decidedly more brownish than winter pelage. Upper parts about olive-brown or slightly darker; underparts somewhat paler than upper parts, usually drab or wood brown, showing more or less intermixture of deep neutral gray of base of hairs; tail and feet as in winter.

Skull.—Medium in size, relatively short and broad, with short rostrum and relatively short and broad interorbital region; brain case moderately flattened; infraorbital foramen large and placed well back; dentition moderate, molariform teeth rather deeply emarginate posteriorly; third unicuspid larger than fourth. Skull decidedly larger and relatively broader than that of *S. c. cinereus*, with much heavier rostrum and dentition; about equal in length to that of *S. dispar* but decidedly broader and heavier throughout, with wider rostrum and heavier dentition; somewhat smaller than that of *S. cinereus*, flatter throughout, with less depth of rostrum and brain case, relatively wider and shorter interorbitally, and with smaller unicuspidate teeth. Not essentially different from that of *S. f. umbrosus*.

Measurements.—Two adult males from type locality: Total length, 124, 120; tail vertebrae, 45, 45; hind foot, 13, 13.4. Adult female from Renova, Pa.: Total length, 111; tail vertebrae, 45; hind foot, 13. Average of 3 adult females from Cranberry Glades, Pocahontas County, W. Va.: Total length, 117.7 (115–120); tail vertebrae, 47.7 (47–48); hind foot, 14.3 (14–15). *Skull:* Average of 3 skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 18.1 (18.0–18.3); palatal length, 6.8 (6.8–6.9); cranial breadth, 8.9 (8.7–9.0); interorbital breadth, 3.8 (3.7–3.9); maxillary breadth, 5.3 (5.2–5.4); maxillary tooth row, 6.2 (6.2–6.3). Skulls of two adult males (teeth slightly worn) from Travellers Repose, W. Va.: Condylobasal length, 18–6, 18.3; palatal length, 7.2, 7.1; cranial breadth, 8.8, 8.9; interorbital breadth, 4.0, 3.8; maxillary breadth, 5.3, 5.4; maxillary tooth row, 6.6, 6.6. Average of 4 skulls of adult females (teeth slightly worn) from Roan Mountain, N. C.: Condylobasal length, 18.8 (18.0–18.6); palatal length, 7.0 (6.8–7.2); cranial breadth, 8.9 (8.7–9.0); interorbital breadth, 3.9 (3.8–4.0); maxillary breadth, 5.2 (5.2–5.3); maxillary tooth row, 6.4 (6.2–6.5).

Remarks.—Two specimens of *S. f. fumeus* were in the United States National Museum as long ago as 1855. Both of these have the brain cases broken away and absent, but both have the rostra and teeth in

fairly good condition. One of them from Carlisle, Pa., was misidentified by Baird (1857, p. 22) with *S. forsteri* Richardson, a synonym of *S. c. cinereus;* the other, from Racine, Wis., he identified as *S. richardsoni* (Baird, 1857, p. 24). The Wisconsin specimen, here referred to the subspecies *fumeus*, is the only one known from that region; it is in worn summer pelage, very faded, and, with its broken skull, is unsuitable for critical subspecific comparison. Still later, Dobson (1890, pl. 23, fig. 5) misidentified a specimen from Lake George, N. Y., as *S. platyrhinus* (DeKay), a synonym of *S. c. cinereus.*

The majority of specimens of *S. f. fumeus* now in collections have come from the Appalachian Mountains, where the form seems to be not uncommon in certain localities. In color, the subspecies is constant throughout most of its range, but there is a pronounced variation in the skulls, particularly in the degree of flatness of the brain case. In some cases this appears to be local; in others all degrees of flatness of the cranium are present at a given locality; nowhere can a definite geographic range be assigned to these variations. The skulls from Travellers Repose, W. Va., and Renovo, Pa., have as shallow and flat brain cases as any, but specimens from intervening localities in Maryland, from north in New York, and south in North Carolina have skulls with high brain cases. Moreover, some of the skulls from as near Travellers Repose as Black Mountain, and Cranberry Glades, Pocahontas County, W. Va., have high brain cases; and in the large series from Roan Mountain, N. C., are found skulls both with comparatively high brain cases and low ones, and also intermediates with varying degrees of depth.

In the extreme northeastern part of its range, *S. f. fumeus* approaches *S. f. umbrosus* in color. A majority of the specimens from Vermont, New Hampshire, and western Massachusetts shows this tendency, and even one from Tupper Lake in the Adirondacks, N. Y., and another from the Catskills in the same State, are almost as gray as typical *umbrosus.* Specimens from Peterboro, N. Y., the type locality of the subspecies *fumeus*, however, are as reddish-brown as those from the southern part of the range of the subspecies. The writer has been unable to examine a specimen, now in the British Museum, recorded from North Bay, Ontario (Miller, 1897, p. 35); the locality has been provisionally included on the map (p. 61) in the range of *S. f. fumeus.*

Specimens examined.—Total number, 161, as follows:

Connecticut: Monroe, 1.
Georgia: Brasstown Bald (altitude 4,700 feet), 1.
Maryland: Bittinger, 3; Finzel, 6.
Massachusetts: Mount Greylock, 6.[71]
New Hampshire: Antrim, 1[72]; Dublin, 1[72]; Intervale, 1[73]; Mossy Brook (Mount Monadnock), 1; Ossipee, 4; Waterville, 1; Webster, 1.[72]
New Jersey: Culvers Gap, Sussex County, 1[74]; Delaware Water Gap, 1[74]; Greenwood Lake (south end, Passaic County), 1.[74]
New York: Berlin (altitude 1,100 feet), 18; East Greenwich, 1; Hunter Mountain (Catskill Mountains), 3; Lake George, 6; Peterboro (type locality), 6; Piseco, 1; Tupper Lake, 1.[72]
North Carolina: Roan Mountain, 5; Roan Mountain (altitude 6,000 feet), 12; Roan Mountain (altitude 6,300 feet), 2; Roan Mountain (Magnetic City), 1.

[71] Manton Copeland coll., Brunswick, Me.
[72] Mus. Comp. Zool.
[73] Univ. Mich. Mus.
[74] Acad. Nat. Sci., Philadelphia.

Ohio: Alma, 1[73]; Carrollton, 2[73]; Hopetown, 1[73]; Overton, 1.[73]
Pennsylvania: Bushkill Creek (7 miles east of Cresco, Monroe County), 1[74]; Carlisle, 1; Chester County, 1; Eagles Mere, 3[74]; Fleming, 1; Ganoga Glen, Sullivan County, 3[74]; Ganoga Lake (North Mountain), 2[74]; Krings Station, 1[74]; Lake Leigh (North Mountain), 2[74]; Mount Pocono, Monroe County, 2[74]; Renovo, 4; Round Island, 3[74]; Summit Mills, 2[74]; Sayre, 2.
Rhode Island: Chepachet, 1.
Tennessee: High Cliff, 1; Roan Mountain (top), Carter County, 2.[74]
Vermont: Mount Mansfield, 3; Rutland, 1[75]; Woodstock, 2.[71].
Virginia: Mount Rogers (altitude 5,719 feet), Grayson County, 2; Paris, 1; Washington (Devils Stairs, altitude 2,000 feet), 1.
West Virginia: Black Mountain, 4[76]; Cranberry Glades (head Cranberry River), Pocahontas County, 10; Franklin, 1; Rowlesburg, 1; Travellers Repose, 5; White Sulphur, 2[77]; White Sulphur Springs, 1[71]; Winding Gulf, 3.
Wisconsin: Racine, 1.

SOREX FUMEUS UMBROSUS Jackson

Nova Scotian Smoky Shrew

S[orex] fumens (sic) Cox, Canadian Record Sci. 7:118, 1896. (Nomen nudum, misprint for *S. fumeus*.)
Sorex fumeus umbrosus Jackson, Proc. Biol. Soc. Washington 30: 149, July 27, 1917.

Type specimen.—No. 150065, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected July 29, 1907, by W. H. Osgood. Original number 3140.

Type locality.—James River, Antigonish County, Nova Scotia.

Geographic range.—Nova Scotia, New Brunswick, southeastern Quebec, and Maine. (Fig. 4.)

Diagnostic characters.—Similar to *Sorex f. fumeus* but averaging slightly larger, and in summer pelage distinctly less reddish brown (more grayish brown) on upper parts.

Color.—Winter pelage: Similar to that of *S. f. fumeus*. *Summer pelage:* Brown of the upper parts noticeably less reddish than in the subspecies *fumeus*. Upper parts fuscous-black mixed with grayish; underparts drab mixed with deep neutral gray of base of hairs; tail bicolor, fuscous-black above, honey yellow, cinnamon-buff, or chamois below nearly to tip; feet chamois, the outer side dusky.

Skull.—Similar to that of *S. f. fumeus*, possibly averaging slightly larger.

Measurements.—Type specimen (adult male): Total length, 127; tail vertebrae, 52; hind foot, 14. Two adult males from type locality: Total length, 127, 126; tail vertebrae, 49, 45; hind foot, 14, 14.5. *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 19.0[78]; palatal length, 7.2; cranial breadth, 9.3; interorbital breadth, 3.9; maxillary breadth, 5.3; maxillary tooth row, 6.8. Skulls of two adult females (teeth very slightly worn) from type locality: Condylobasal length, 17.8, 18.5; palatal length, 7.2, 7.2; cranial breadth, 8.5, 9.1; interorbital breadth, 3.9, 3.9; maxillary breadth, 5.0, 5.1; maxillary tooth row, 6.5, 6.6.

Remarks.—Although not a strikingly differentiated form, specimens of *S. f. umbrosus* from Nova Scotia are in series readily separable from specimens of *S. f. fumeus* from central New York and the southern Appalachian Mountains. Intergradation between the

[71] Manton Copeland coll., Brunswick, Me.
[73] Univ. Mich. Mus.
[74] Acad. Nat. Sci. Philadelphia.
[75] Amer. Mus. Nat. Hist.
[76] Field Mus. Nat. Hist.
[77] Field Mus. Nat. Hist., 1.
[78] In the original description of this subspecies the condylobasal length was misprinted as 24.0 (Jackson, 1917, p. 150).

two forms, however, is clearly indicated over the greater part of the New England States and western New Brunswick. Specimens from Maine are referable to *umbrosus;* while specimens from New Hampshire, Vermont, and western Massachusetts (Mount Greylock) can be referred to *S. f. fumeus*, although displaying an approach toward *umbrosus.* The small series from Hampton, southeastern New Brunswick, is typical of *umbrosus* in every respect, yet a specimen from Restigouche River, northwestern New Brunswick, shows a strong tendency toward the subspecies *fumeus.*

Specimens examined.—Total number, 62, as follows:

Maine: Brunswick, 4[79]; King and Bartlett Lake, 1[80]; Mud Pond, Penobscot County, 2[81]; North Belgrade, 1[79]; Topsham, 3.[82]
New Brunswick: Bathurst (15 miles from, Miramichi Road), 1[83]; Hampton, 3; Maugerville, 2[84]; Restigouche River, 1.[85]
Nova Scotia: Barrington Passage, 17[83]; Digby, 13[86]; Halifax, 3[87]; James River (type locality), 6; Little River, Digby Neck, 2; Newport, 1.[81]
Quebec: Gaspé Peninsula (Cascapedia River, Tracadie), 1[81]; Riviere du Loup, 1.[85]

TABLE 2.—*Cranial measurements of adult specimens of* Sorex fumeus *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. f. fumeus:										
New York: Peterboro.	111122	♀	18.3	6.8	9.0	3.9	5.4	6.2	Slight	Type locality.
Do	111123	♀	18.1	6.8	8.7	3.7	5.2	6.3	do	Do.
Do	140945	♀	18.0	6.9	8.9	3.9	5.2	6.2	do	Do.
West Virginia: Travellers Repose.	87025	♂	18.6	7.2	8.8	4.0	5.3	6.6	do	
Do	87026	♂	18.3	7.1	8.9	3.8	5.4	6.6	do	
North Carolina: Roan Mountain.	47823	♀	18.0	6.8	8.7	3.7	5.2	6.2	do	
Do	47825	♀	18.5	7.2	9.0	3.9	5.2	6.5	do	
Do	47826	♀	18.1	6.9	9.0	4.0	5.3	6.3	do	
Do	55818	♀	18.6	7.0	8.9	3.8	5.2	6.5	do	
S. f. umbrosus:										
Nova Scotia: James River.	150065	♂	[1]19.0	7.2	9.3	3.9	5.3	6.8	Slight	Type specimen.
Do	150061	♀	17.8	7.2	8.5	3.9	5.0	6.5	Very slight	Type locality.
Do	150064	♀	18.5	7.2	9.1	3.9	5.1	6.6	do	Do.

[1] In the original description of this subspecies this measurement was misprinted as 24.0 (Jackson, 1917, p. 150).

SOREX ARCTICUS GROUP

The *arcticus* group includes three species: *Sorex arcticus*, *S. tundrensis*, and *S. hydrodromus.*

Geographic range.—Western Alaska from Bering Strait to Bristol Bay, east to mouth of Anderson River, Northwest Territories, southeast across Alberta, Saskatchewan, Manitoba, and western Ontario to northeastern South Dakota, and central Minnesota and Wisconsin; also Nova Scotia and New Brunswick. (Fig. 5.)

Diagnostic characters.—Medium size, with moderately short tail, and tricolor pattern; the back distinctly darker than the sides, which in turn are dis-

[79] Lee Mus. Biol., Bowdoin College.
[80] Acad. Nat. Sci. Philadelphia.
[81] Amer. Mus. Nat. Hist.
[82] Manton Copeland coll., Brunswick, Me. 2; Lee Mus. Biol., 1.
[83] Nat. Mus. Canada.
[84] Miramichi Nat. Hist. Soc. Chatham, New Brunswick.
[85] Field Mus. Nat. Hist.
[86] Univ. Mich., 1; Mus. Comp. Zool., 10.
[87] Mus. Comp. Zool.

tinctly darker than the ventral parts. Skull moderate in all dimensions; dentition moderately heavy; unicuspids rather heavy and swollen, the fourth smaller than the third; internal ridge extending from apex of unicuspid toward cingulum incomplete, weakly pigmented, and not ending in secondary cusplet. Larger than any of the *cinereus* group, with larger hind foot, distinctly larger skull, heavier dentition, the molariform teeth being relatively, as well as actually, broader (extero-interior diameter). Compared with any of the *fumeus* group, *S. arcticus* is distinctly tricolored, the skull is higher, rostrum more attenuate, wider interorbitally, antero-posterior diameter of unicuspids relatively greater, molariform teeth less emarginate posteriorly, and cusps of i^1 broader, the secondary cusp relatively larger. Larger and darker than *S. pribilofensis* with higher, more angular brain case, longer, more attenuate rostrum, and with internal ridge on unicuspid scarcely pigmented. Larger than *S. merriami*, darker, particularly the underparts; rostrum longer and higher and interorbital region less inflated than in *S. merriami*, the interorbital region being relatively very much narrower.

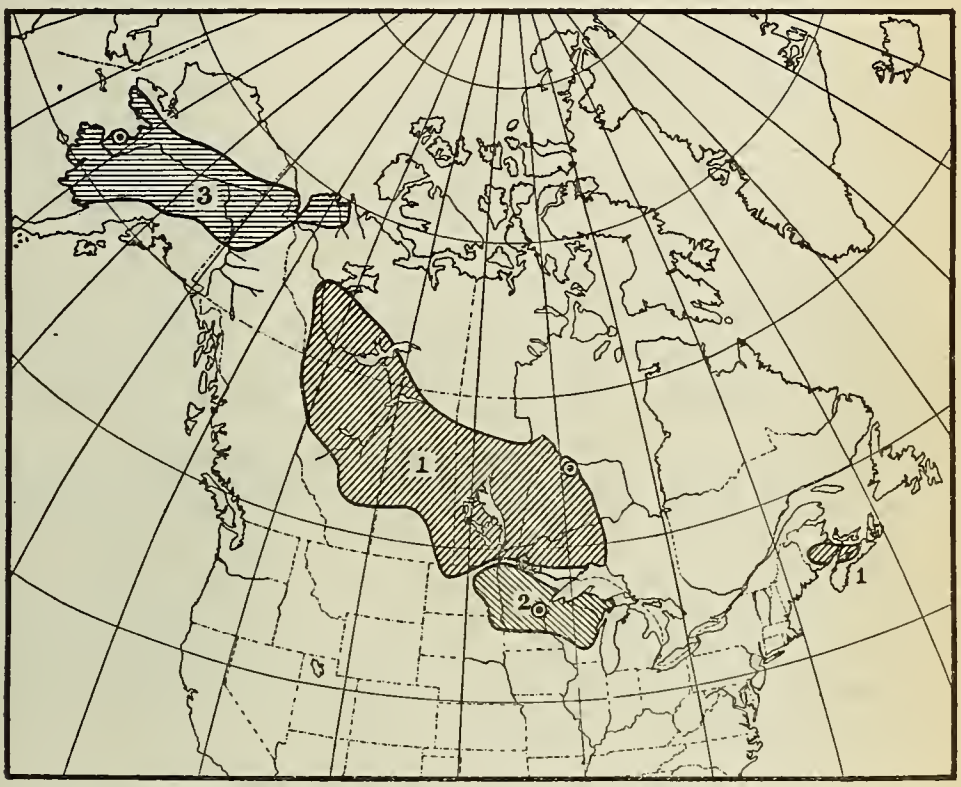

FIG. 5.—Geographic range of subspecies of *Sorex arcticus* and of the species *S. tundrensis*

1. *S. arcticus arcticus.* 2. *S. a. laricorum.* 3. *S. tundrensis.*

Remarks.—The *arcticus* group resembles superficially the *fumeus* group, from which, however, it is differentiated by marked cranial characters, not only of proportions and shape of skull, but dentally, particularly in the shape of the first upper incisor. It frequently occurs with *S. cinereus*, but can readily be distinguished externally from that species by the size of the feet and the pronounced tricolor pattern.

SOREX ARCTICUS KERR

[Synonymy under subspecies]

Geographic range.—West-central Northwest Territories (Fort Norman), southeasterly across Alberta, Saskatchewan, Manitoba, and

western Ontario to northeastern South Dakota, and central Minnesota and Wisconsin; also Nova Scotia and New Brunswick. (Fig. 5.)

Diagnostic characters.—Size medium (hind foot about 14 millimeters); color rich brownish, tricolor, dark, the dorsal parts in winter almost black; skull medium in size, with brain case moderate in depth (*Sorex a. laricorum*) to high (*S. a. arcticus*), rostrum long and high, dentition moderately heavy. In all pelages *S. arcticus* is distinctly darker than *S. tundrensis*, and in winter pelage has the color of the sides more contrasted from that of the underparts; *S. arcticus* is somewhat larger than *S. tundrensis*, with longer tail; skull larger than that of *S. tundrensis*, with higher, longer, and broader rostrum, longer mesopterygoid space, post-glenoid processes usually more developed, palate longer, teeth larger and broader.

Subspecies and geographic variation.—The species *arcticus* is divided into two subspecies, *arcticus* and *laricorum*. The species as a whole retains its characteristics with considerable precision over its range, the only geographic variation being toward the south, where it tends to become paler, and this, associated with a lowering of the brain case, shortening of the antero-posterior diameter of the supraoccipital, and broadening of the interorbital region, is recognized subspecifically in *laricorum*.

Time of molting.—The transition from winter to summer fur seems to occur for the most part in June. In a series of nine specimens from Norway House, Manitoba, collected June 18 to 23, 1900, are five females in complete summer pelage and three females and one male in winter pelage. None of these is in actual process of molting, although the condition of the skin and pelage of the male would seem to indicate that it would soon begin the new growth of hair. The specimen from Fort Norman, Northwest Territories, is in winter pelage June 14, 1904, while a female from Fort Smith is in full summer fur June 21, 1901. A male from Slave River, 10 miles below the mouth of Peace River, Alberta, collected June 10, 1901, shows clearly the summer pelage coming in under the worn winter fur over the entire animal. A breeding female in delayed spring molt from Island Lake, Alberta, has summer pelage on the face, crown, and chin, the rest of the animal still retaining the winter fur August 12, 1895.

Evidence indicates that the fall molt in *S. arcticus* takes place most often during the latter part of September and first of October. In the series of 25 skins from South Edmonton, Alberta, collected between September 8 and 23, 1894, are 5 that show the beginning stages of the fall molt; 3 of these, a male and 2 females, were taken September 23; another, a male, September 8; and the fifth, a female, on the 15th. The skins of 4 or 5 others of this series, collected September 10 to 15, seem to indicate, by the condition of the skin of the backs, preparation for molting. The series of 32 skins from St. Albert, Alberta, was collected between October 30 and November 3, 1895; all are in full winter pelage except a female taken November 3, which has just begun molting on the posterior third of the back. A male from Athabaska Landing, Alberta, has the molt well begun September 14, 1903.

SOREX ARCTICUS ARCTICUS Kerr

American Saddle-backed Shrew

(Pls. 2, j; 4, x; 7, e; 11, c; 12, c)

Sorex arcticus Kerr, Animal Kingdom, p. 206, 1792 (not *Sorex personatus arcticus* Merriam, 1900).

Sorex richardsonii Bachman, Journ. Acad. Nat. Sci. Philadelphia 7: part 2, p. 383, 1837.[88]

S[orex] richardsoni Sundevall, Kongl. [Svenska] Vetenskapsacad. Handl., 1842, p. 182, 1843.

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[88] *Type specimen.*—No. 55.12.24.92, British Museum (A. 139 of Zool. Soc. London Museum; 527 of Zool. Soc. London Ms. list; and 160 of Zool. Soc. London List, 1838), in original stuffed condition but taken off stand, skull incomplete. The writer is indebted to Oldfield Thomas for this information. This is the specimen described by Richardson as *Sorex parvus* and is therefore the type of *Sorex richardsonii* Bachman, since this name was distinctly given to Richardson's animal. Mr. Thomas has kindly furnished the following measurements of the specimen: Hind foot, without claws, 13.2 millimeters; hind foot, with claws, 14.5; length of upper tooth series, 8.7.

Sorex sphagnicola Coues, Bul. U. S. Geol. and Geog. Surv. 3: 650, May 15, 1877. Type locality: Fort Liard, Northwest Territories.

Sorex belli Merriam, Proc. Biol. Soc. Washington 7: 25, April 13, 1892. (Based on Dobson Ms., 1885. Type locality: Shamattawa River, tributary of Hayes River, Hudson Bay, Manitoba.) Nomen nudum.

Sorex sphagnicolus Merriam, Proc. Biol. Soc. Washington 7: 25, April, 1892.

Sorex arcticus arcticus Jackson, Proc. Biol. Soc. Washington 38: 127, November 13, 1925.

Type specimen.—None known to exist.

Type locality.—Settlement on Severn River, Hudson Bay, now known as Fort Severn, mouth of Severn River, Ontario, Canada.

Geographic range.—West-central Northwest Territories (Fort Norman), southeasterly across Alberta, Saskatchewan, Manitoba, to northwestern North Dakota and the north shore of Lake Superior, Ontario; also Nova Scotia and New Brunswick. (Fig. 5.)

Diagnostic characters.—Rather larger than *Sorex tundrensis*, darker and much richer colored, skull larger with heavier rostrum. Somewhat darker on back and sides in winter pelage than *S. a. laricorum* with skull higher, and deeper through brain case, supraoccipital greater in antero-posterior diameter, and interorbital region somewhat more constricted.

Color.—Tricolor in all pelages, distinctly so in winter, less in summer. *Winter pelage:* Upper parts a ribbon of rich dark fuscous-black or blackish brown extending from the nose to the base of the tail, becoming slightly paler on the face and nose; sides sharply contrasted with back, snuff brown to wood brown, which extends onto sides of face; underparts paler and more grayish than sides, the line of color demarcation usually not so sharply defined as that between the back and sides, smoke gray more or less tinged with light drab, avellaneous, or pinkish buff, in late winter becoming densely tinged with drab, wood brown, or avellaneous; tail indistinctly bicolor, fuscous or fuscous-black above, avellaneous to buffy brown below, darkening toward tip, the terminal fourth nearly as dark below as above; feet above dark buffy brown, darker on wrists and ankles. *Summer pelage:* Paler above, darker and more brownish below than in winter pelage, therefore less pronounced tricolor pattern. Upper parts fuscous, sometimes almost mummy brown; sides olive-brown or slightly paler, sometimes tending toward cinnamon-brown; underparts usually drab, sometimes avellaneous. Feet and tail as in winter.

Skull.—Medium in size; brain case high and arched, not flattened; rostrum large, moderately elongate, high, attenuate. Compared with the skull of *S. a. laricorum* that of *S. a. arcticus* is noticeably higher, more arched and less flattened, with antero-posterior diameter of supraoccipital greater; interorbital region usually more constricted, and palate averaging shorter.

Measurements.—Average of 4 adult males from South Edmonton, Alberta: Total length, 112 (108–115); tail vertebrae, 40 (38–42); hind foot, 14 (14–14). Average of 4 adult females from South Edmonton, Alberta: Total length, 113 (111–115); tail vertebrae, 40 (39–42); hind foot, 13.5 (13–14). *Skull:* Average of 4 skulls of adult males (teeth slightly worn) from South Edmonton, Alberta: Condylobasal length, 18.6 (18.5–18.7); palatal length, 7.2 (7.2–7.2); cranial breadth, 9.3 (9.2–9.4); interorbital breadth, 3.5 (3.4–3.6); maxillary breadth, 5.1 (5.0–5.2); maxillary tooth row, 6.6 (6.5–6.6). Average of 4 skulls of adult females (teeth slightly worn) from South Edmonton, Alberta: Condylobasal length, 19.0 (18.7–19.1); palatal length, 7.4 (7.3–7.5); cranial breadth, 9.3 (9.2–9.4); interorbital breadth, 3.7 (3.7–3.7); maxillary breadth, 5.1 (5.0–5.2); maxillary tooth row, 6.7 (6.5–6.8). Skulls of 2 adult females (teeth slightly worn) from Wingard, Saskatchewan: Condylobasal length, 18.9, 18.6; palatal length, 7.4, 7.2; cranial breadth, 9.2, 9.3; interorbital breadth, 3.5, 3.5; maxillary breadth, 5.1, 5.0; maxillary tooth row, 6.6, 6.4.

Remarks.—A specimen of the American saddle-backed shrew, one of the most beautiful American insectivores, was mentioned as early as 1772, when Forster referred one from the settlement on Severn River, Hudson Bay, to *Sorex araneus* Linn., remarking that the specimen was much blacker on the back than the European animal (Forster, 1772, p. 380), a color difference between *S. arcticus* and

S. araneus which, in the aggregate, actually exists. So similar are the two species, however, that it is not surprising that Forster called his specimen *S. araneus*. A few years later Pennant gave a description of the same specimen, basing his account on that of Forster and referring the specimen with question to the Foetid shrew [i. e., *S. araneus* Linn.]. (Pennant, 1784, p. 139.) Eight years later, and 20 years after the animal was first described, it was redescribed by Kerr, who based his description mainly on that of Pennant and gave the species the tenable name of *S. arcticus*. (Kerr, 1792, p. 206.)

In 1829, Richardson fairly accurately described a specimen of *S. arcticus*, but considered it probably to be *Sorex parvus* Say (Richardson, 1829, p. 8), an entirely different animal, now placed in the separate genus Cryptotis. This description became the basis of Bachman's description of *Sorex richardsonii* (Bachman, 1837, p. 383), a name that has been generally used for the species during recent years. Dobson misidentified *S. arcticus* with *S. vulgaris* Linnaeus (Dobson, 1890, pl. 23, figs. 4), itself a synonym of *S. araneus* Linn.

The type specimen of *S. sphagnicola* Coues, in the United States National Museum, is an imperfect skin consisting of the head, nape, hinder third of the body, the hind feet, and tail, and is not accompanied by the skull. It is in summer pelage and apparently was molting, and matches almost perfectly certain specimens of *S. a. arcticus* in similar condition of pelage. The name *sphagnicola*, therefore, should be retained in synonymy under *S. a. arcticus*, with which, under the name *richardsonii*, it has already been identified. (Preble, 1908, p. 246.)

The most northerly point from which a specimen of *S. a. arcticus* has been examined is Fort Norman, Northwest Territories; this specimen and others from the region of Great Slave Lake agree in all essentials with specimens from the vicinity of Edmonton, Alberta, and Norway House, Manitoba. One skull from Fort Simpson, Northwest Territories, has a shallower brain case than that of average *S. a. arcticus*, in this respect appearing something like that of *S. a. laricorum*. In southern Manitoba (Red River Settlement) and western North Dakota an approach toward *laricorum* is evident in a tendency for the brain case to be shallower, although the single specimen from Kenmare, N. Dak., is almost a perfect match cranially with typical *S. a. arcticus*. The imperfect specimens examined from New Brunswick and Nova Scotia are provisionally referred to *S. a. arcticus* rather than to *laricorum*.

Specimens examined.—Total number, 124, as follows:

Alberta: Athabaska Delta (east branch, 1 mile west of Jack Fish Lake), 1[89]; Athabaska Delta (east branch, 9 miles north of Jack Fish Lake), 2[90]; Athabaska Landing (5 miles above), 2; Athabaska River (Pelican Rapid), 1; Blindmans and Red Deer Rivers, 3[89]; Dunvegan (about 75 miles north, Fort St. John Trail, Peace River), 1[91]; Fort Chipewyan (6 miles northwest) 1; Island Lake (15 miles west Lake St. Ann), 3; St. Albert, 32; Slave River (10 miles below Peace River), 1; Slave River (25 miles below Peace River), 1; South Edmonton, 24.

Manitoba: Aweme, 1[92]; Lake Manitoba (south end), 1; Lake Winnipeg, 1; Norway House, 9; Red River Settlement, 3; Robinson Portage, 1; Shamattawa River (tributary of Hayes River), 1[93]; Swampy Lake (near outlet), 1.

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[89] Mus. Comp. Zool.
[90] Mus. Comp. Zool., 1.
[91] Mus. Vert. Zool.
[92] Royal Ontario Mus. Zool.
[93] Nat. Mus. Canada.

New Brunswick: Maugerville, 2.[94]
North Dakota: Lostwood (6 miles north), 1; Kenmare, 1.
Northwest Territories: Fort Norman, 4[95]; Fort Rae, 1; Fort Rae (25 miles south, Trout Rock), 4; Fort Resolution, 4; Fort Simpson, 5; Fort Smith, 1; Great Slave Lake (Big Island), 1; Great Slave Lake (Buffalo River), 1.
Nova Scotia: Truro (1¾ miles east-southeast), 1.[96]
Ontario: Macdiarmid (Lake Nipigon), 2.[92]
Saskatchewan: Indian Head, 1[93]; Portage La Loche, 1; Wingard, 4.

SOREX ARCTICUS LARICORUM Jackson

Southern Saddle-backed Shrew

(Pls. 2, k; 5, y)

Sorex pachyurus Baird (nec [*S.*] *pachyurus* Kuster, 1835, qui *Pachyura etrusca* Savi), Report Pacific R. R. Survey 8: part 1, Mammals, p. 20, 1857. Type locality: Pembina, N. Dak. (not Minnesota, as stated by Baird).

Sorex arcticus laricorum Jackson, Proc. Biol. Soc. Washington 38: 127, November 13, 1925.

Type specimen.—No. 186837, U. S. Nat. Mus., Merriam collection (No. $\frac{2019}{2552}$); ♂ adult (teeth slightly worn), skin and skull; collected February 19, 1886, by Vernon Bailey. Original number, 75.

Type locality.—Elk River, Sherburne County, Minn.

Geographic range.—Eastern North Dakota, northeastern South Dakota, northern and central Minnesota, and northern Wisconsin and Michigan. (Fig. 5.)

Diagnostic characters.—Similar to *Sorex a. arcticus*, possibly averaging paler on upper parts and sides in winter pelage; skull decidedly flatter and shallower than that of the subspecies *arcticus*, less constricted interorbitally, palate somewhat longer.

Color.—Winter pelage: Essentially like that of *S. a. arcticus* but averaging somewhat paler. *Summer pelage:* Indistinguishable from that of the subspecies *arcticus*.

Skull.—Size about that of *S. a. arcticus* but general appearance distinctly flatter; brain case decidedly shallower and more flattened, the antero-posterior diameter of supraoccipital less; palate somewhat longer (antero-posterior diameter), and interorbital breadth greater.

Measurements.—Type specimen, adult male, measured from dry skin by writer: Total length, 117; tail vertebrae, 42; hind foot, 14. Two adult males from Rhinelander, Wis. Total length, 115, 117; tail vertebrae, 40, 39; hind foot, 14, 14. *Skull.*—Skull of type specimen (adult male, teeth slightly worn): Condylobasal length, 19.0; palatal length, 7.6; cranial breadth, 9.3; interorbital breadth, 3.8; maxillary breadth, 5.3; maxillary tooth row, 6.8. Average of 6 skulls of adult males (teeth slightly worn) from type locality: Condylobasal length, 18.9 (18.6–19.1); palatal length, 7.7 (7.5–7.8); cranial breadth, 9.3 (9.1–9.5); interorbital breadth, 3.8 (3.7–3.9); maxillary breadth, 5.2 (5.1–5.3); maxillary tooth row, 6.7 (6.6–6.9). Skull of type specimen of *S. pachyurus* Baird, adult (teeth slightly worn), sex unknown, from Pembina, N. Dak.: Condylobasal length, 18.9; palatal length, 7.7; cranial breadth, 9.3; interorbital breadth, 3.8; maxillary breadth, 5.3; maxillary tooth row, 6.7.

Remarks.—Baird's description of *Sorex pachyurus* was based upon two specimens from Pembina, N. Dak.; a third specimen from Fort Ripley, Minn., was referred with some hesitation to the species (Baird, 1857, p. 22). Specimen No. 1674, now a skeleton (No. 38820),

[92] Royal Ontario Mus. Zool.
[93] Nat. Mus. Canada.
[94] Miramichi Nat. Hist. Soc. Chatham, New Brunswick.
[95] Amer. Mus. Nat. Hist., 3.
[96] Provincial Mus., Halifax, Nova Scotia.

at that time an alcoholic, is considered the type specimen (Lyon and Osgood, 1909, p. 247) since it is figured (Baird, 1857, pl. 27). The two specimens were in winter pelage; Baird was led astray in comparing them with a summer specimen of *S. fumeus*, which he believed to be *S. arcticus*, from Racine, Wis., and did not associate them with true *arcticus*. Unfortunately the name *S. pachyurus* Baird is not available, since it is antedated more than 20 years by *S. pachyurus* Kuster (1835, p. 77), a synonym of *Pachyura etrusca* Savi, a shrew of southern Europe. The form of *arcticus* found in eastern North Dakota, and in Minnesota, Wisconsin, and Michigan, is named *laricorum* in reference to one of its prevailing habitats, tamarack and spruce swamps.

Intergradation between *S. a. arcticus* and *S. a. laricorum* is indicated in specimens from Manitoba and western North Dakota. Specimens from Wisconsin and Michigan referred to *laricorum* are not exactly typical in every respect; they compare favorably in length of palate and interorbital breadth but have higher brain cases, in some cases as high as in *S. a. arcticus*.

Specimens examined.—Total number, 95, as follows:

Manitoba: Aweme, 2[97]; Carberry, 1.
Michigan: Chippewa County, 1[98]; Gogebic Lake, Ontonagon County, 6[98]; Mud Lake, Gogebic County, 5.[98]
Minnesota: Bridgman, 1; Elk River (type locality), 47; Fort Ripley, 1; Fort Snelling, 1; Minneapolis, 3; Winnibigoshish, 1.
North Dakota: Fort Totten, 1; Pembina (type locality of *S. pachyurus* Baird), 4; Stump Lake, 1; Valley City, 1.[99]
South Dakota: Fort Sisseton, 1; Fort Wadsworth, 1.
Wisconsin: Conover, 1[1]; Lake St. Germain, Vilas County, 4; Mamie Lake, Vilas County, 3; Mercer, 1; Pelican Lake, Oneida County, 1[1]; Rhinelander, 3[2]; Sayner, 1[1]; Solon Springs, 2[1]; Withee, 1.

SOREX TUNDRENSIS Merriam

Tundra Saddle-backed Shrew

(Pls. 2, L; 4, Y; 5, Z; 7, F; 12, D)

Sorex tundrensis Merriam, Proc. Washington Acad. Sci. 2: 16, March 14, 1900.

Type specimen.—No. 99286, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected September 13, 1899, by W. H. Osgood.

Type locality.—St. Michael, Alaska.

Geographic range.—Western and central Alaska from Bering Strait and Bristol Bay eastward, northern Yukon, and northwestern Northwest Territories. (Fig. 5.)

Diagnostic characters.—Size medium; color pattern tricolor (in winter, general effect almost bicolor, the sides only indistinctly different from underparts), the brown back sharply contrasting with the pale grayish underparts; skull medium in size and depth, with moderately developed rostrum and dentition. Slightly smaller than *Sorex arcticus*, with shorter tail; decidedly paler in all pelages than *S. arcticus*, the underparts in summer grayish instead of brownish, and in winter the grayish not brown and the back never tending toward black. Skull a trifle smaller than that of *S. arcticus*, with a decidedly smaller and lower rostrum, shorter mesopterygoid space, postglenoid processes usually smaller, shorter palate, and smaller teeth.

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[97] Stuart Criddle coll., Treesbank, Manitoba.
[98] Univ. Michigan Mus.
[99] Morris J. Kernall coll., Valley City, N. Dak.
[1] Field Mus. Nat. Hist.
[2] Univ. Wisconsin Zool. Mus.

Color.—Winter pelage: Essentially bicolor in general effect, the back brown, sides grayish faintly tinged with brownish and barely different from the pale grayish underparts. Entire upper parts from nose, crown, nape, to base of tail a broad ribbon of brown, between Prout's brown and cinnamon-brown, sometimes tending toward snuff brown; underparts and sides pale smoke gray more or less tinged with light buff, sometimes with warm buff, the sides and flanks usually somewhat more heavily tinged than the underparts but not sharply differentiated; tail bicolor, above between snuff brown and Saccardo's umber, sometimes tending toward sayal brown, darkening at tip; below usually pale ochraceous-buff, sometimes light ochraceous-buff, nearly to tip, which is brownish; feet usually drab, slightly darker on the outer side and paler on the inner. *Summer pelage:* More variable than winter pelage. Distinctly tricolor in general effect; the back dark brown, the sides pale brown, the underparts grayish. Upper parts from nose and face to rump and base of tail usually sepia or Prout's brown, sometimes mummy brown particularly in fresh unfaded pelage; cheeks, face below ears, and sides to thighs, drab to wood brown; underparts smoke gray usually tinged with cream-buff, in general effect sometimes almost olive-buff; tail and feet as in winter.

Time of molting.—The transition from winter to summer pelage occurs usually during April or early May. Out of 13 specimens collected during April and the last week of March, 1903, by Charles Sheldon at the head of the Toklat River, Alaska, 7 show indications of molt, the other 6 being in full winter pelage. A skin from 80 miles up Kokwok River, Alaska, has obtained the summer fur on the posterior third of the back, May 6, 1912. Other specimens from Nushagak and Mount Sischoo, Alaska, collected, respectively, May 24, 1911, and June 6, 1912, are in fresh summer pelage.

The winter pelage is generally obtained during September. In a series of 17 skins collected at the type locality between September 1 and 23, 1899, the following conditions of pelage are found: Two collected September 1, and 1 each on the second and third, show no signs of molting; 3 others, collected respectively on the 1st, 2d, and 12th, show the skin of the rumps to be in a condition preparatory for molting; 6 others taken September 1, 2, 6, 11, 15, and 20, have the new fur under the old over most of the back; 2 others collected on the 15th have winter pelage over the posterior halves of their backs, and the other 2 captured September 13 and 23, have the entire upper parts, thighs, and most of the sides, in winter pelage. Two specimens from the mountains near Eagle, Alaska, are beginning to molt August 9 and September 1, 1903, but 31 others collected at the same place during August are all in summer fur. October specimens from the head of the Toklat River, Alaska, are in winter pelage.

Skull.—Medium in size and depth; rostrum medium in size, dentition moderate; third unicuspid larger than fourth. Skull slightly smaller than that of *S. arcticus;* rostrum smaller and lower, particularly basally; lower orbitally; shorter mesopterygoid space; postglenoid processes averaging smaller; shorter palate; and smaller, narrower, more densely pigmented teeth.

Measurements.—Type specimen (adult male): Total length, 108; tail vertebrae, 32; hind foot, 13. Average of 3 adult females from type locality: Total length, 105.7 (101–108); tail vertebrae, 31.7 (30–33); hind foot, 13 (13–13). Average of 6 adult males from head of Seward Creek, mountains near Eagle, Alaska: Total length, 105.8 (101–112); tail vertebrae, 35 (32–38); hind foot, 13.7 (12.5–14). *Skull:* Type specimen (adult male, teeth slightly worn): Condylobasal length, 18.3; palatal length, 7.1; cranial breadth, 9.1; interorbital breadth, 3.7; maxillary breadth, 4.9; maxillary tooth row, 6.3. Average of 3 adult females (teeth slightly worn) from type locality: Condylobasal length, 18.2 (18.0–18.4); palatal length, 7.1 (7.0–7.2); cranial breadth, 9.1 (9.0–9.2); interorbital breadth, 3.6 (3.5–3.7); maxillary breadth, 4.9 (4.8–5.0); maxillary tooth row, 6.3 (6.2–6.4). Average of 6 skulls of adult males (teeth slightly worn) from head of Seward Creek, mountains near Eagle, Alaska: Condylobasal length, 18.1 (17.8–18.5); palatal length, 7.0 (6.7–7.2); cranial breadth, 9.1 (9.0–9.3); interorbital breadth, 3.8 (3.7–3.9); maxillary breadth, 5.0 (4.8–5.1); maxillary tooth row, 6.3 (6.1–6.4).

Remarks.—There is no marked geographic variation in *S. tundrensis.* Certain specimens from the interior of Alaska have larger skulls than any now available from the type region near the Bering coast, but the smallest skulls from the type region can be matched almost perfectly with skulls from the same interior localities pro-

ducing large skulls, and the averages are unusually constant. Likewise, certain skins from the upper Yukon (vicinity of Circle and Charlie Creek), Alaska, have decidedly darker backs than any in the type series, but it is undoubtedly due to the fresh condition of their summer pelage. The series taken in August at the head of Seward Creek, in the mountains near Eagle, Alaska, also an interior locality on the upper Yukon drainage, is indistinguishable from topotypes in corresponding pelage. A skin in fresh summer pelage (May 24) from Nushagak, Alaska, essentially on the Bering coast, has the darkest upper parts of any specimen examined.

In none of the specimens of *S. tundrensis* has anything been observed that can be construed to be an approach toward *S. arcticus*. Although *S. tundrensis* occurs at Fort Anderson, Northwest Territories, and *S. a. arcticus* at Fort Norman, only a comparatively short distance away, the two forms retain their characters and do not differ appreciably from specimens from their respective type regions.

Specimens examined.—Total number, 183, as follows:

Alaska: Bethel, 2; Bettles, 5; Charlie Creek, Yukon River, 3; Circle, 1; Circle (20 miles above, on Yukon River), 2; Doonnockchogaweet Mountains, 1; Eagle (mountains near), 35; Fort Yukon, 4; Good News Bay, 4; Hooper Bay, 4; Kanuluk, 2; Kokwok River (80 miles up), 5; Kruzgamepa Hot Springs, 1[3]; Kuskokwim River, 1; Kuskokwim River (Crooked Creek, 200 miles above Bethel), 1[4]; Lake Aleknagik, 1; Lake Weelooluk, 1; Mount McKinley (Bear Creek), 1; Mount Sischoo, 1; Nome River, 1; Nulato, 20; Nushagak, 1; Nushagak River (Lewis Point), 1; Richardson, 4; St. Michael (type locality), 32; Savage River, 1; Sawtooth Mountains, 2; Stuyahok Landing, 1; Tanana, 1; Toklat River (head of), 21.

Northwest Territories: Anderson River (lower region, between Fort Anderson and Liverpool Bay), 17; Peel River, 4; Toker Point (south of), 1.[5]

Yukon: Fortymile, 1.

SOREX HYDRODROMUS Dobson

Unalaska Saddle-backed Shrew

Sorex hydrodromus Dobson, Annals and Mag. Nat. Hist. (6th series) 4: 373, November, 1889.

[*Neosorex*] *hydrodomus* (sic) Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 379, March, 1901.

Neosorex hydrodromus Miller, Proc. Boston Soc. Nat. Hist. 31: 119, August, 1903.

Type locality.—Unalaska Island, Aleutian Islands, Alaska.

Type specimen.—Not seen by the writer. No. 85, collection of the Zoological Museum of the Academy of Sciences of the Union of Socialistic Soviet Republics.

Geographic range.—Known only from type locality.

General characters.—From original description: "Scarcely larger than *S. minutus*, and therefore much smaller than *S. palustris*, which it also differs from in dentition, but resembles in the fringed condition of the digits of the manus and pes. The tail is nearly as long as the body and is clothed rather thinly with moderately long hairs, which do not form a fringe; in the form of the muzzle and ears there is nothing peculiar or different from that of *S. minutus;* the feet, however, differ remarkably in the possession of fringes to the digits both of the manus and pes, as well as or even better developed than in *Crossopus fodiens;* a thick comb-like fringe of stiff hairs also extends along the outer and inner margins of both manus and pes, being especially dense and well developed along the outer margins." (Dobson, 1889, p. 373.)

[3] Mus. Comp. Zool. [4] D. R. Dickey coll., Pasadena, Calif. [5] Amer. Mus. Nat. Hist.

Color.—From original description: "Fur reddish brown above, yellowish brown beneath; chin, throat, and chest with greyish-tipped hairs; the base of the hairs both above and beneath dark bluish grey." (Dobson, 1889, p. 373.)

Skull.—From original description: "The teeth closely resemble those of *S. vulgaris;* as in that species the third incisor is the largest and longest of the unicuspidate teeth; the first maxillary tooth is very nearly equal to the second incisor and quite intermediate in size between the third incisor and the second maxillary tooth; the third maxillary tooth is even more internal than in *S. vulgaris,* in this respect resembling the American representatives of that species, and its long axis is at right angles to the direction of the jaw, its inner and posterior convex margin fitting into the concavity on the inner and anterior side of the fourth maxillary tooth. The mandibular teeth closely resemble those of *S. vulgaris.*" (Dobson, 1889, p. 373.) (Fig. 6.)

Measurements.—From original description: "Length: Head and body, 53 millim.; tail, 46; eye from end of muzzle, 9½; ear, length, 6½; elbow to end of middle digit, without claw, 13; manus, 6; pes, 13; distance between tips of first upper incisor and last premolar, 3½." (Dobson, 1889, p. 373.)

Remarks.—Dobson remarks in regard to his *S. hydrodromus:*

This species is evidently aquatic, like *Crossopus fodiens,* the fringe of the manus and pes being even better developed than in that species; but in all generic characters it agrees with those of the genus *Sorex.* While agreeing with *Sorex palustris* from the adjoining continent of America in external characters, it differs from it in the proportions of its teeth, resembling in this respect the section of which *S. vulgaris* is typical, while *S. palustris* agrees with those represented by *S. vagrans.* (Dobson, 1889, p. 374.)

FIG. 6.—Rostrum of *Sorex hydrodromus.* Enlarged seven diameters. After Dobson, 1889, p. 373

Unfortunately the writer has been unable to examine a specimen of this shrew. Merriam, who also never saw the species, placed it with acknowledged uncertainty in the subgenus Neosorex (Merriam, 1895, p. 94–95), probably being led to do so by Dobson's account of the "thick comb-like fringe of stiff hairs along the outer and inner margins of both manus and pes." Elliot (1901a, p. 379) and Miller and Rehn (1903, p. 119) recognized Neosorex as a genus and included therein the species *hydrodromus,* apparently following Merriam's lead. Except for the description of the fringed feet, there is nothing in the original account to associate closely *S. hydrodromus* with Neosorex, and Dobson clearly intimated the distinct difference between the two forms when he stated:

No better proof could be afforded of the uselessness of retaining Neosorex as a distinct genus for the American species characterized by the possession of swimming-fringes in the digits, while the tail is simple, as in Sorex. These species are in fact aquatic forms of the genus Sorex. (Dobson, 1889, p. 374.)

The original description, as quoted almost entire in the present account of the species, and the illustration of the upper teeth fit *S. tundrensis* almost precisely and make it necessary to place *S. hydrodromus* in the *arcticus* group. The known geographic ranges of *S. tundrensis* and the subgenus Neosorex also support this contention. Until specimens from the type locality are available, the exact status of the form will remain in doubt. The description so closely fits *S. tundrensis* that the possibility of *S. hydrodromus* Dobson preoccupying *S. tundrensis* Merriam is strongly suggested, and at best *S.*

tundrensis may prove only subspecifically distinct from *S. hydrodromus.*

TABLE 3.—*Cranial measurements of adult specimens of* Sorex arcticus *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. a. arcticus:										
Alberta—South Edmonton.	69150	♂	18.5	7.2	9.4	3.5	5.0	6.5	Slight	
Do	69161	♂	18.5	7.2	9.3	3.4	5.1	6.6	do	
Do	69163	♂♂	18.7	7.2	9.3	3.6	5.2	6.6	do	
Do	69171	♂♂	18.6	7.2	9.2	3.5	5.1	6.5	do	
Do	69151	♀	19.1	7.5	9.3	3.7	5.2	6.8	do	
Do	69158	♀	19.0	7.3	9.4	3.7	5.0	6.5	do	
Do	69159	♀	18.7	7.4	9.4	3.7	5.0	6.6	do	
Do	69173	♀	19.1	7.3	9.2	3.7	5.1	6.7	do	
Saskatchewan—Wingard.	73180	♀	18.9	7.4	9.2	3.5	5.1	6.6	do	
Do	73181	♀	18.6	7.2	9.3	3.5	5.0	6.4	do	
S. a. laricorum:										
Minnesota—Elk River.	186837	♂	19.0	7.6	9.3	3.8	5.3	6.8	do	Type specimen.
Do	186843	♂	19.0	7.7	9.4	3.9	5.3	6.8	do	Type locality.
Do	186845	♂♂	18.7	7.5	9.5	3.7	5.1	6.6	do	Do.
Do	186849	♂♂	18.6	7.6	9.1	3.8	5.3	6.6	do	Do.
Do	186852	♂♂	19.1	7.8	9.2	3.8	5.2	6.9	do	Do.
Do	186855	♂♂	19.1	7.8	9.4	3.9	5.3	6.8	do	Do.
Do	186856	♂	18.8	7.6	9.3	3.7	5.2	6.7	do	Do.
North Dakota—Pembina.	38820	------	18.9	7.7	9.3	3.8	5.3	6.7	do	Type specimen of *S. pachyurus* Baird.
S. tundrensis:										
Alaska—St. Michael.	99286	♂	18.3	7.1	9.1	3.7	4.9	6.3	do	Type specimen.
Do	99276	♀	18.0	7.0	9.2	3.5	4.8	6.2	do	Type locality.
Do	99277	♀	18.4	7.2	9.1	3.6	4.8	6.4	do	Do.
Do	99279	♀	18.1	7.1	9.0	3.7	5.0	6.2	do	Do.
Alaska—Mountains near Eagle.	131000	♂	18.0	7.1	9.1	3.9	5.1	6.2	do	
Do	131006	♂	18.3	7.0	9.1	3.7	5.1	6.3	do	
Do	131011	♂♂	18.5	7.2	9.3	3.8	5.1	6.4	do	
Do	131018	♂♂	18.0	7.1	9.2	3.7	4.8	6.1	do	
Do	131032	♂♂	17.9	6.9	9.0	3.8	5.0	6.3	do	
Do	131034	♂	17.8	6.7	9.0	3.8	5.0	6.2	do	

SOREX PRIBILOFENSIS GROUP

The *pribilofensis* group includes a single species: *Sorex pribilofensis.* All necessary group comparisons are made under the species.

SOREX PRIBILOFENSIS MERRIAM

PRIBILOF SHREW

(PLS. 2, M; 4, Z; 5, A′; 7, H; 11, D; 12, E)

Sorex pribilofensis Merriam, North Amer. Fauna No. 10, p. 87, December 31, 1895.

Type specimen.—No. 30911, U. S. Nat. Mus., Biological Survey collection; ♀ adult, alcoholic with skull not removed; collected July 29, 1891, by C. Hart Merriam.

Type locality.—St. Paul Island, Pribilof Group (in Bering Sea), Alaska.

Geographic range.—Known only from type locality.

Diagnostic characters.—Size small; tail rather short, hairy; color pattern somewhat like *S. tundrensis,* in summer pelage tricolor, in winter distinctly bicolor. Skull short and broad, interorbital region broad, mesopterygoid space

short, rostrum heavy; dentition moderately heavy, the third unicuspid larger than the fourth. Compared with any of the *cinereus* group, *S. pribilofensis* has a relatively shorter tail, a more tricolor pattern in summer pelage, and in winter pelage has the dark color of the upper parts much more reduced to a longitudinal ribbon; the skull of *S. pribilofensis* is relatively much broader and shorter than that of *S. cinereus*, distinctly broader interorbitally, with a decidedly heavier rostrum, broader palate, and heavier dentition; molars relatively broader (extero-interiorly) than in *S. cinereus*, the unicuspids larger, with internal ridge from apex to edge of cingulum as in the species *cinereus* (but more heavily pigmented than in *S. c. cinereus*). Similar in external proportions and general color pattern to members of the *arcticus group* but smaller, and paler in winter pelage; skull shorter and broader interorbitally than that of any members of the *arcticus* group, with flatter, more rotund (less angular) brain case, shorter, less attenuate rostrum, and with internal pigmented ridge on unicuspid extending from apex to cingulum (in *arcticus* group this ridge is short and on the internal part of the cingulum only and is scarcely pigmented).

Color.—Winter pelage: Distinctly bicolor, the color of the underparts encroaching upon the back and meeting in a sharp line. Top of nose, crown, ears, nape, back, and rump to base of tail a sharply defined longitudinal ribbon of drabbish hair brown; entire underparts, lips, cheeks, sides of head below eyes and ears, flanks, and sides of body well up toward back pale olive gray, usually very faintly tinged with pale olive buff. Tail bicolor; drab above, pale pinkish buff beneath nearly to tip. *Summer pelage:* Tricolor, the back sharply defined from sides, which are less clearly defined from the ventral parts. Top of head and back to base of tail a distinct longitudinal strip of brownish (between hair brown and olive brown); sides of head and body paler, drab to between wood brown and avellaneous; underparts smoke gray, sometimes slightly tinged or stained with olive buff; tail as in winter, less hairy.

Time of molting.—The evidence at hand seems to show that the transition from winter to summer pelage usually occurs in June or early in July. Out of 24 specimens collected in June, July, and early in August, all except 7 are in complete summer pelage. A female collected June 26, 1895, still retains the entire worn winter pelage. A male, June 22, 1890, has acquired about half of the summer fur, and 2 others, collected July 5, 1914, are in about the same status. A female, August 14, 1895, has the last remnants of the winter fur, while 2 males, collected one day earlier, are approximately one-half molted.

The fall change occurs about the middle of October. Eleven of twenty-five specimens collected between October 22 and 26, 1914, are in complete winter pelage; 11 are in process of molting; 3 are still in summer pelage.

Skull.—Short and broad, particularly interorbitally; rostrum moderately short, heavy; mesopterygoid space short; brain case moderately flattened, not angular; dentition moderately heavy; molariform teeth about as broad (extero-internal diameter) as long (antero-posterior diameter); cusplike processes of basal shelves of molariform teeth reduced; interior edge of basal shelf of second upper premolar without distinct cusplike process; unicuspid teeth relatively large and broad (extero-interior diameter), decreasing gradually in size posteriorly, the third larger than the fourth, the fifth relatively large, but much smaller than the fourth; unicuspid teeth each with internal heavily pigmented ridge from apex to edge of cingulum.

Measurements.—Average of 8 adult males from type locality: Total length, 96.2 (92–103); tail vertebrae, 34.7 (32–37); hind foot, 13.8 (13–14.5). *Skull:* Average of 10 skulls of adult males (teeth slightly worn) from type locality: Condylobasal length, 15.8 (15.4–16.0); palatal length, 5.7 (5.6–5.8); cranial breadth, 7.8 (7.7–8.0); interorbital breadth, 3.7 (3.6–3.8); maxillary breadth, 4.8 (4.7–4.9); maxillary tooth row, 5.5 (5.4–5.6).

Remarks.—The interesting little Pribilof shrew as far as known is confined to St. Paul Island, in Bering Sea, where it is not uncommon. It is strikingly different from any other American Sorex, showing some affinity toward the *cinereus* group in the possession of pigmented ridges on the internal sides of the unicuspid teeth, but, on the whole, it is probably more closely related to the *arcticus* group.

Specimens examined.—One hundred and twenty-one[6] from the type locality.

[6] Mus. Comp. Zool., 1.

TABLE 4.—*Cranial measurements of adult specimens of* Sorex pribilofensis *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. pribilofensis:										
Alaska—St. Paul Island.	206181	♂	16.0	5.7	7.9	3.7	4.8	5.5	Slight	Type locality.
Do	206182	♂	15.8	5.7	7.9	3.7	4.8	5.4	do	Do.
Do	206183	♂	15.9	5.7	7.9	3.6	4.8	5.4	do	Do.
Do	63232	♂	15.8	5.7	7.8	3.7	4.8	5.5	do	Do.
Do	63233	♂	15.9	5.7	7.9	3.7	4.8	5.4	do	Do.
Do	63234	♂	16.0	5.7	8.0	3.8	4.9	5.6	do	Do.
Do	63235	♂	15.5	5.6	7.9	3.6	4.7	5.4	do	Do.
Do	217965	♂	15.9	5.7	7.7	3.6	4.7	5.5	do	Do.
Do	217969	♂	16.0	5.8	7.7	3.7	4.8	5.6	do	Do.
Do	217975	♂	15.4	5.7	7.7	3.8	4.9	5.4	do	Do.

SOREX MERRIAMI GROUP

The *merriami* group includes two species: *Sorex merriami* and *S. leucogenys.*

Geographic range.—Known only from arid regions of southeastern Montana, southwestern North Dakota, southeastern Washington, north-central Oregon, Nevada, and southwestern Utah. (Fig. 7.)

Diagnostic characters.—In size somewhat larger than *S. cinereus,* pale (grayish drab above), with distinctly whitish underparts and feet. Skull relatively short and broad, flattened through the brain case, relatively high and swollen interorbitally, with a short, broad rostrum, which compared with that of other members of the genus found within its geographic range, is abruptly truncate anteriorly (nares region). The third upper unicuspidate tooth of most of the west American shrews is smaller than the fourth. Exceptions to this are found in *S. cinereus* and *S. arcticus,* both species that may possibly occur within certain parts of the geographic range of shrews of the *merriami* group, and, like them, have the third upper unicuspid larger than or, infrequently in *S. cinereus* equal to the fourth. Members of the *merriami* group, however, have the unicuspids relatively narrow and elongate (in lateral aspect), and tending to be more crowded together than in *S. cinereus* or *S. arcticus.*

Remarks.—Although the number of specimens available that represent the *merriami* group is small and insufficient for satisfactory evidence as to distribution and variation, nevertheless it shows that the species *merriami* and *leucogenys* are very closely related forms differing markedly from any other shrews. The members of this group appear to inhabit arid or semidesert regions, much in contrast with the habitat preference of most species of long-tailed shrews.

SOREX MERRIAMI DOBSON

MERRIAM SHREW

(PLS. 2, N; 4, A′; 6, A; 7, I; 11, E; 12, F)

Sorex merriami Dobson, Monograph of the Insectivora, systematic and anatomical, part 3, fasc. 1, pl. 23, fig. 6, May, 1890.

Type specimen.—No. 186441, U. S. Nat. Mus., Merriam collection (old No. $\frac{1001}{4861}$); ♀ adult (teeth slightly worn), alcoholic with skull removed; collected December 26, 1884, by Charles E. Bendire.

Type locality.—Fort Custer, Bighorn County, Mont.

Geographic range.—Known only from five localities in southwestern North Dakota, southeastern Montana, northern Nevada, north-central Oregon, and southeastern Washington. (Fig. 7.)

Diagnostic characters.—Size small, larger than *Sorex cinereus*, smaller than *S. arcticus;* color pale, underparts and feet distinctly whitish; tail medium in length, decidedly bicolor, whitish below to tip. Skull relatively short and broad, flattened through the brain case, high and swollen orbitally, with short, broad rostrum. Dentition heavy; unicuspid row relatively short, the fourth

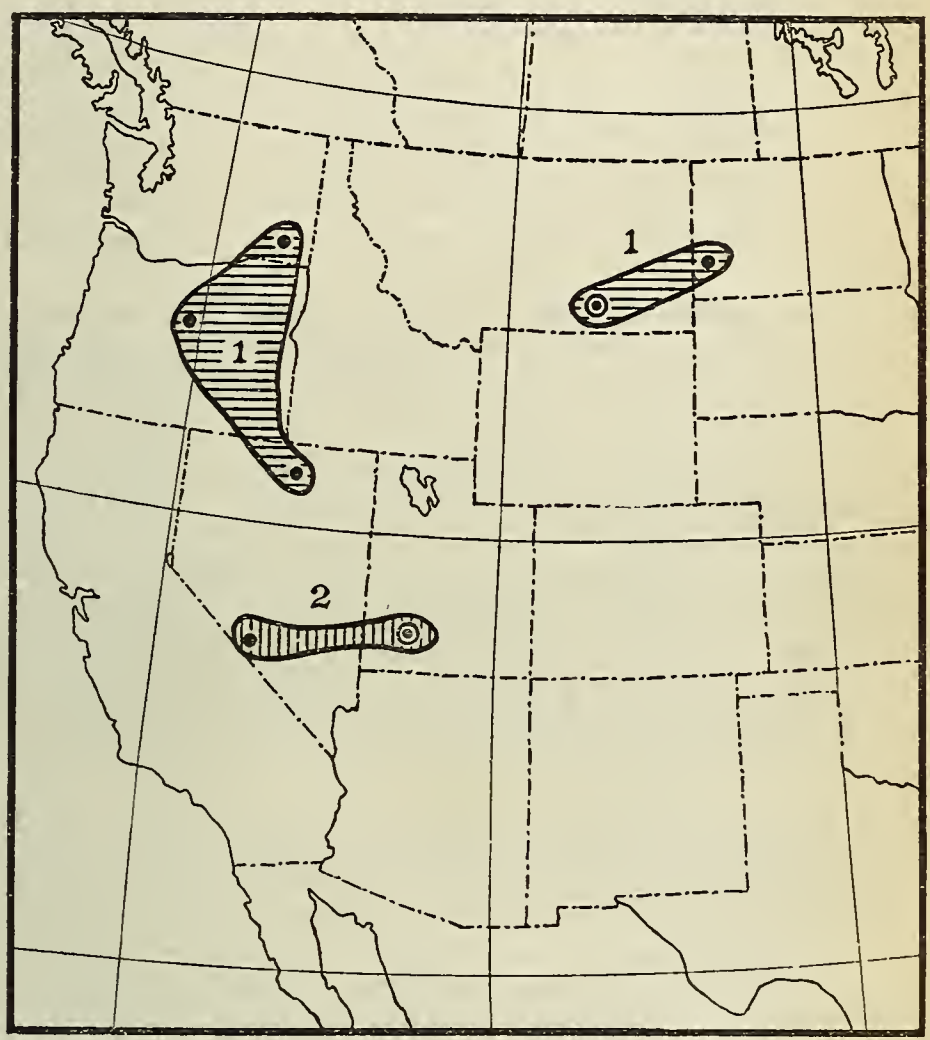

FIG. 7.—Geographic range of species of *Sorex merriami* group

1. *S. merriami.* 2. *S. leucogenys.*

unicuspid smaller than third. Skull somewhat smaller than that of *S. leucogenys*, with flatter brain case and anterior halves of unicuspid tooth rows more approximated and more nearly parallel.

Color.—Winter pelage:[7] Upper parts drab, becoming paler on the flanks; underparts, chin, lips, and feet, distinctly whitish, the feet tinged with light buff; tail bicolor, wood brown above, whitish beneath to tip. *Summer pelage:*[8] Upper parts grayish drab becoming light drab on the flanks; underparts nearly white, very faintly tinged with pale olive-buff; tail and feet as in winter.

[7] Based on alcoholic specimen from Elko County, Nev.
[8] Based on imperfect skin from Medora, N. Dak.

Skull.—Short and broad, flattened through brain case, high and swollen orbitally; rostrum short and broad, particularly broad through region of infraorbital foramina, which open relatively well forward; mesopterygoid space short, the sides relatively heavy. Teeth large, the molars as broad (exterointernally) as long (antero-posteriorly), deeply emarginate posteriorly; teeth densely pigmented; unicuspid tooth row short, the fourth unicuspid smaller than the third; unicuspids placed relatively vertical to antero-posterior axis of alveolar borders; antero-posterior diameter of each unicuspid considerably less than supero-inferior diameter; unicuspids without heavily pigmented internal ridge from apex to edge of cingulum; first upper incisors small.

Measurements.—Type specimen (adult female) (measured from alcoholic specimen after removal of skull): Total length, 90; tail vertebrae, 35; hind foot. 11.5. *Skull.*—Type specimen (adult female; teeth slightly worn): Condylobasal length, 15.8; palatal length, 6.3; cranial breadth, 8.0; interorbital breadth. 4.0; maxillary breadth, 5.0; maxillary tooth row, 5.6. Skull of adult (teeth slightly worn), sex unknown, from Golconda (100 miles northeast of), Nevada: Condylobasal length, 16.2; palatal length, 6.4; cranial breadth 7.9; interorbital breadth, 3.8; maxillary breadth, 5.1; maxillary tooth row, 5.8.

Remarks.—Regarding the type specimen of *S. merriami*, Merriam has written:

> The type and only known specimen of this remarkable shrew was presented to me by Maj. Charles E. Bendire, who collected it at the post garden, on the Little Big Horn River, about a mile and a half above Fort Custer, Mont., December 26, 1884. I sent it, with all my other shrews to Dr. George E. Dobson, who was then engaged on a monographic revision of the Soricidae. Unfortunately, owing to Dr. Dobson's continued ill health, all that has ever been published of this monograph is a fasciculus of plates, showing the jaws and teeth of certain species, with a page of explanation facing each plate (Monog. Insectivora, Part III, fasc 1, May, 1890). The present species is named and its peculiar dentition shown in Pl. XXIII, fig. 6, of this work. But the remarkable shape of the palate and peculiarities of the skull as a whole are not shown. The skull was removed from the alcoholic specimen by Dr. Dobson, and I have sometimes wondered whether by any possible accident it could have been transposed with that of some Asiatic species, it is so very unlike all known American shrews. When the specimen was returned the alcoholic bore my original label and number (1001), but the skull was numbered differently (1886; its proper number is 4861). Dr. Dobson afterwards wrote me that his number was an error, and that the skull belonged to my alcoholic No. 1001. [Merriam, 1895, p. 88–89.]

Since the time Merriam published the foregoing remarks, four additional specimens of this rare shrew have come to light. Unfortunately, none of these is a perfect specimen. On June 23, 1896, Vernon Bailey found a dead shrew in a creek valley, 7 miles southeast of Antelope, Oreg. From this specimen, a mere fragment of skin and body that has been in alcohol, the partly crushed skull has been removed. It agrees well with that of the type of *S. merriami*, except that it seems a trifle higher through the brain case.

The remains of a small shrew were found among the rocks on a high butte near Medora, N. Dak., on June 13, 1913, by S. G. Jewett. Some animal had killed the shrew and eaten its head, so that only the skin of the hind half of the body, the hind feet, and tail are available for study. The color of the animal and the habitat where it was found indicate that the specimen is with little doubt *S. merriami.*

The third specimen was obtained by Edmund Heller, November 26, 1914, at Desert Ranch, Elko County, Nev., where it had been caught by a house cat. The skull of this specimen is slightly larger and with somewhat higher brain case than that of the type of *S. merriami*, but it is decidedly more nearly like this form than *S. leucogenys.*

The last specimen to make its appearance, a skin accompanied by a broken skull, was collected by George G. Cantwell, November 18, 1919, at the entrance to an old badger digging on top of a "high bunch grass hill," at Starbuck (altitude 645 feet), Columbia County, Wash. It shows no appreciable differences from the type specimen of *S. merriami.*

Specimens examined.—Total number, 5, as follows:

Montana: Fort Custer (type locality), 1.
Nevada: Desert Ranch, 100 miles northeast of Golconda, Elko County, 1.
North Dakota: Medora, 1.
Oregon: Antelope (7 miles southeast), 1.
Washington: Starbuck (altitude 654 feet), 1.

SOREX LEUCOGENYS Osgood

White-cheeked Shrew

(Pls. 2, o; 4, b'; 6, b; 7, j)

Sorex leucogenys Osgood, Proc. Biol. Soc. Washington 22: 52, April 17, 1909.

Type specimen.—No. 157952, U. S. Nat. Mus., Biological Survey collection; ♀ adult, skin and skull; collected August 12, 1908, by W. H. Osgood.

Type locality.—Mouth of the canyon of Beaver River, about 3 miles east of Beaver, Beaver County, Utah.

Geographic range.—Known only from type locality and Esmeralda County, Nev. (Fig. 7.)

Diagnostic characters.—Essentially like *Sorex merriami* in color, but slightly larger; skull larger than that of *S. merriami,* higher through the brain case, and with anterior halves of unicuspid tooth rows less approximated and less nearly parallel.

Color.—Winter pelage: Unknown. *Summer pelage:* Similar to *S. merriami.* Upper parts pale hair brown or grayish drab becoming light drab on the flanks; underparts nearly white, faintly tinged with pale olive-buff; chin, lips, and sides of face below eyes pale olive-buff; feet whitish, tinged with light buff; tail distinctly bicolor, drab above, whitish below, tipped with whitish.

Skull.—Larger than that of *S. merriami,* with relatively and actually broader and higher brain case, which rises more abruptly in frontal region, the unicuspid tooth rows tending to approach each other at the anterior ends with more regularity (in straight line) and with anterior halves less approximated and more diverging posteriorly.

Measurements.—Type specimen (adult female): Total length, 107; tail vertebrae, 38; hind foot, 12.5. Adult female from Mount Magruder, Nev.: Total length, 105; tail vertebrae, 40; hind foot, 12. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 16.5; palatal length, 6.5; cranial breadth, 8.3; interorbital breadth, 3.8; maxillary breadth, 5.1; maxillary tooth row, 5.8. Skull of adult female (teeth slightly worn) from Indian Spring, Mount Magruder, Nev.: Condylobasal length, 16.9; palatal length, 6.7; cranial breadth, 8.4; interorbital breadth, 4.0; maxillary breadth, 5.4; maxillary tooth row, 6.0.

Remarks.—The type specimen of *S. leucogenys* was trapped on a dry Upper Sonoran slope about 200 yards from running water. The Indian Spring specimen is paler than the type specimen, which may be due chiefly to the differences in the make-up of the skins, the former being stuffed considerably fuller than the latter. Its skull has the high brain case and other characters of the type specimen of *S. leucogenys* and is even slightly accentuated in size. The White Mountains specimen differs from the type only in slightly heavier molariform teeth and in a somewhat less reddish coloration, which is undoubtedly

due to seasonal variation. The external measurements as taken by the collector are less than of the type of *S. leucogenys*, but the skull does not show a corresponding differentiation; if anything it is larger. Although the skull of *S. merriami* from northern Nevada is slightly larger than the type skull of that species and has a trifle higher brain case, the approach toward *S. leucogenys* does not clearly indicate intergradation between the two forms.

Specimens examined.—Three as follows:

Nevada: Chiatovich Creek, altitude 8,200 feet, White Mountains, Esmeralda County, 1[9]; Indian Spring, altitude 7,700 feet, Mount Magruder, Esmeralda County, 1.[10]

Utah: Beaver (3 miles east of), Beaver County (type locality), 1.

TABLE 5.—*Cranial measurements of adult specimens of* Sorex merriami *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. merriami:										
Montana—Fort Custer.	186441	♀	15.8	6.3	8.0	4.0	5.0	5.6	Slight	Type specimen.
Nevada—100 miles northeast of Golconda.	210121	------	16.2	6.4	7.9	3.8	5.1	5.8	---do------	
S. leucogenys:										
Utah—Beaver River.	157952	♀	16.5	6.5	8.3	3.8	5.1	5.8	---do------	Type specimen.
Nevada—Mount Magruder.	[1] K572	♀	16.9	6.7	8.4	4.0	5.4	6.0	---do------	

[1] Collection of Donald R. Dickey, Pasadena, Calif.

SOREX SCLATERI GROUP

The *sclateri* group includes a single species—*Sorex sclateri*. All necessary group comparisons are made under the species.

SOREX SCLATERI MERRIAM

SCLATER SHREW

(PLS. 2, P; 4, C'; 6, C; 8, A)

Sorex sclateri Merriam, Proc. Biol. Soc. Washington 11: 288, July 15, 1897.

Type specimen.—No. 75872, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected October 23, 1895, by E. W. Nelson and E. A. Goldman.

Type locality.—Tumbala, altitude 5,000 feet, Chiapas, Mexico.

Geographic range.—Known only from the type locality.

Diagnostic characters.—Size relatively large; tail long, hind foot large; color dark, both dorsally and ventrally; skull large, relatively long and narrow, interorbital region rather elongate, interpterygoid space long, dentition moderately heavy, weakly pigmented, the third unicuspid larger than the fourth. Similar in external appearance to *S. veraepacis*, possibly darker ventrally; skull decidedly narrower than of *S. veraepacis*, the brain case less angular and more flattened, the interorbital region more elongate, and the relative size of the third and fourth unicuspids reversed.

[9] Mus. Vert. Zool. [10] D. R. Dickey coll., Pasadena, Calif.

Color.—Winter pelage: Upper parts dark clove brown or dark bister, or almost blackish clove brown; underparts scarcely paler than upper parts, clove brown or between clove brown and bister; tail clove brown above, slightly paler below. *Summer pelage:* Unknown.

Time of molting.—A male collected October 22, 1895, has acquired the new fur except on the occiput, nape, and rump, which are in process of molting. The three other specimens, collected October 23, 24, and 25, appear to be in fresh pelage.

Skull.—Large, relatively long and narrow; the interorbital and post-palatal regions noticeably relatively elongate; brain case narrow, flattened, gently rotund laterally (not angular) in superior aspect; dentition moderately heavy, weakly pigmented, the third unicuspidate tooth slightly larger than the fourth.

Measurements.—Type specimen (adult female): Total length, 126; tail vertebrae, 52; hind foot, 16. Adult male from type locality: Total length, 125; tail vertebrae, 52; hind foot, 16. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 19.9; palatal length, 8.0; cranial breadth, 9.2; interorbital breadth, 4.4; maxillary breadth, 5.9; maxillary tooth row, 7.4. Skull of adult male (teeth slightly worn) from type locality: Condylobasal length, 19.6; palatal length, 7.7; cranial breadth, 9.2; interorbital breadth, 4.4; maxillary breadth, 5.6+; maxillary tooth row, 7.2.

Remarks.—Although *S. sclateri* is very similar to *S. veraepacis* in superficial external appearance, averaging scarcely a shade darker and more brownish in color, it shows pronounced differences in cranial characters, and the two species are apparently not closely related. Only four specimens of the Sclater shrew are available for study, but in these four the characters diagnostic of the species are very uniform.

Specimens examined.—Four, from the type locality.

SOREX LONGIROSTRIS GROUP

The *longirostris* group includes a single species.—*Sorex longirostris.* All necessary group comparisons are made under the species.

SOREX LONGIROSTRIS Bachman

[Synonymy under subspecies]

Geographic range.—Atlantic Plain and Piedmont region from northern Virginia and southern Maryland south to northern Florida (Alachua County) and central Alabama (Autauga County); eastern and southern Illinois and southwestern Indiana. (Fig. 8.)

Diagnostic characters.—Small; with short rostrum and crowded unicuspid tooth row; first and second unicuspids about equal in size, the third and fourth decidedly smaller than first and second, the third somewhat smaller than the fourth; fifth unicuspid very much smaller than fourth, almost minute; teeth inextensively pigmented. Differs from the *cinereus* group in its relatively shorter, broader rostrum, shorter and more crowded unicuspid row, third upper unicuspid smaller than the fourth, and antero-posterior diameter of unicuspid teeth less than extero-interior (lateral) diameter; extero-interior diameter of molariform teeth relatively much greater than in those of the *cinereus* group and first incisors, both upper and lower, relatively smaller. Much smaller than any of the *fumeus* or *arcticus* groups, and with different skull proportions and dentition. Sometimes similar to certain forms of the *ornatus* and *vagrans-obscurus* groups. Usually more reddish or darker in color than any of the *ornatus* group, skull higher through the brain case and less depressed interorbitally, first incisors weaker, unicuspid tooth row and mesopterygoid space shorter. Differs from members of the *vagrans-obscurus* group in a more flattened brain case, shorter unicuspid tooth row with the individual teeth relatively less in antero-posterior diameter, more extensively pigmented dentition, and relatively and actually shorter mesopterygoid space.

Subspecies and geographic variation.—The species *longirostris* includes the two subspecies *longirostris* and *fisheri*. Insufficient specimens are available to show clearly the variations of the species over its entire range, but the subspecies *longirostris* appears to be very constant in characters over its comparatively wide distribution, grading rather abruptly into the localized larger *fisheri* with its larger and relatively narrower skull.

Time of molting.—A male and a female of the subspecies *longirostris* taken April 16, 1907, at Reevesville, Ill., show fresh summer pelage over the entire ventral parts and head, the upper parts being in worn winter pelage; two males collected on April 16 and 18 of the same year at the same place are in worn winter pelage. The specimen of *fisheri* from Chapanoke, N. C., collected March

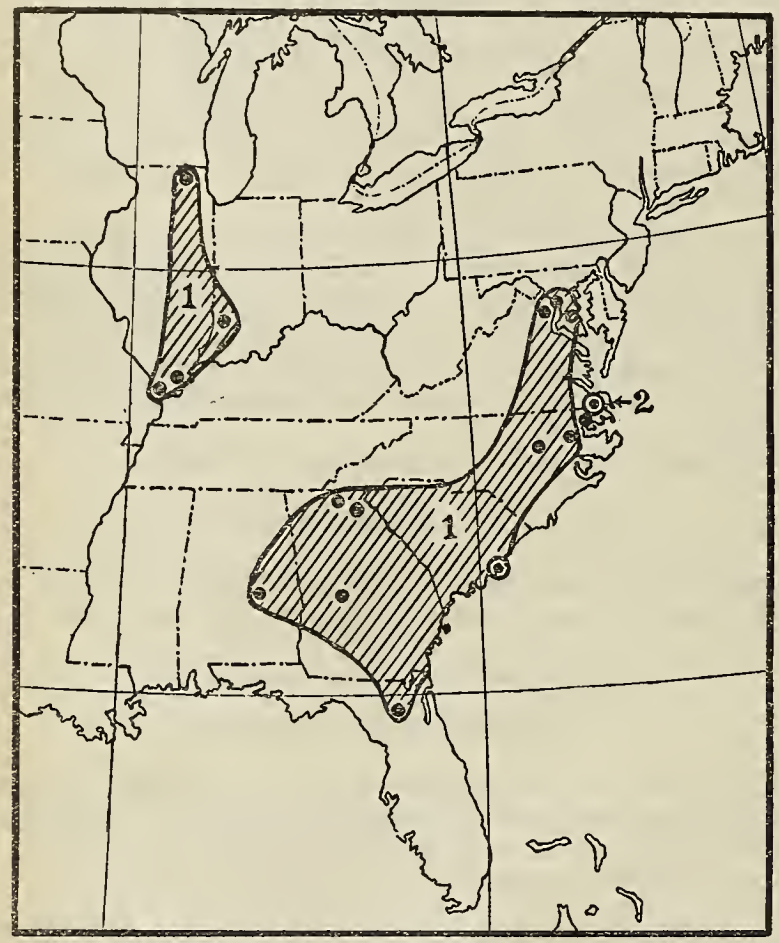

FIG. 8.—Geographic range of subspecies of *Sorex longirostris*

1. *S. l. longirostris.* 2. *S. l. fisheri.*

20, 1897, has the molt beginning on the midback. A male *fisheri* collected May 23, 1905, at the type locality shows the summer pelage coming in under the worn winter fur on the back, while another male taken at the same time and an unsexed individual collected June 5, 1895, at Dismal Swamp, have obtained the full summer pelage.

None of the specimens of *S. l. longirostris* examined is in process of changing from the summer to the winter pelage. Specimens of this form collected November 27 and 28, 1906, at Olive Branch, Ill., have apparently acquired the full winter coat. A specimen of *S. l. fisheri* caught October 21, 1895, has the new fur incoming under the old over most of the back, while the type specimen, a male collected October 11, has the winter fur on the rump, the fur on the remainder of the back and the abdomen being in the process of renewal.

Remarks.—The species *S. longirostris* is composed of only two forms, comprising a compact lot separable from all other groups by

the combined characters above enumerated. The shrews of this species differ from all other Sorex of eastern America in having the third unicuspid considerably smaller than the fourth, a characteristic common to most species of Sorex of western America, and absent from those of the intervening plains region. For this reason, combined with the apparent scarcity of individuals and the uniformity of characters within the species, one might be inclined to believe that it is a relict group of the preglacial fauna occupying the faunally old portion of the southeastern United States.

SOREX LONGIROSTRIS LONGIROSTRIS Bachman

Bachman Shrew

(Pls. 2, q; 5, a; 6, d; 8, b; 11, f; 12, g)

Sorex longirostris Bachman, Journ. Acad. Nat. Sci. Philadelphia 7: part 2, p. 370, 1837.

O[tisorex] longirostris De Kay, Zool. New York, part 1, Mammalia, p. 23, 1842.

[*Musar[aneus]* (*Croc[idura]*)] *bachmani* Pomel, Arch. Sci. Phys. et Nat. 9: 249, 1848.

Sorex wagneri Fitzinger, Sitzungsber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abtheil 1, p. 512, 1868.

Type specimen.—Not known now to exist. Collected by Alexander Hume.

Type locality.—Hume Plantation, swamps of the Santee River [Cat Island, mouth of Santee River], S. C.

Geographic range.—Atlantic Plain and Piedmont region (except vicinity of Dismal Swamp, Va., inhabited by *S. l. fisheri*) from northern Virginia and southern Maryland, south to northern Florida (Alachua County) and central Alabama (Autauga County); eastern and southern Illinois and southwestern Indiana. (Fig. 8.)

Diagnostic characters.—Size small, with relatively short tail (about equal length of body without head); about the size of *S. fontinalis*, more reddish in color, with distinct cranial characters; skull relatively short and broad, with flattened brain case and short rostrum; unicuspids short (antero-posterior diameter) and broad (extero-interior diameter), the third smaller than the fourth. Separated from all other American shrews except *S. l. fisheri* by group characters. Smaller than *fisheri*, with decidedly smaller and relatively broader skull with shorter rostrum.

Color.—Winter pelage: Upper parts Prout's brown, or mummy brown, sometimes almost fuscous, shading gradually on the sides into cinnamon brown; underparts tinged strongly with smoke gray mixed with drab, and showing considerable deep neutral gray of base of hairs. Tail indistinctly bicolor, Prout's brown or mummy brown above, cinnamon brown or ochraceous tawny below. *Summer pelage:* Very slightly paler than in winter pelage, the underparts more drab or avellaneous. Tail as in winter.

Skull.—Small, with short rostrum, and broad, flattened brain case. Differs from that of *S. cinereus* and *S. fontinalis* in group characters. Much smaller than that of *S. l. fisheri* and relatively broader with shorter rostrum.

Measurements.—Adult male from Raleigh, N. C.: Total length, 87; tail vertebrae, 32; hind foot, 11.5. Adult male from Falls Church, Va.: Total length, 79; tail vertebrae, 33; hind foot, 11. Average of three adult males from Olive Branch, Ill.: Total length, 83.7 (79–90); tail vertebrae, 28.3 (27–30); hind foot, 10.3 (10–10.5). *Skull:* Skull of adult (sex unknown; teeth slightly worn) from Butler, Ga.: Condylobasal length, 14.6; palatal length, 5.1; cranial breadth, 7.3; interorbital breadth, 3.2; maxillary breadth, 4.2; maxillary tooth row, 5.0. Skull of adult male (teeth slightly worn) from Raleigh, N. C.: Condylobasal length, 14.1; palatal length, 5.1; cranial breadth, 7.2; interorbital breadth, 3.0; maxillary breadth, 4.2; maxillary tooth row, 5.0. Skull of adult male (teeth slightly worn) from Falls Church, Va.: Condylobasal length,

14.4; palatal length, 5.2; cranial breadth, 7.4; interorbital breadth, 3.2; maxillary breadth, 4.3; maxillary tooth row, 5.1. Imperfect skulls of two adults (sex unknown; teeth moderately worn) from Bicknell, Ind.: Palatal length, 5.1, 5.2; interorbital breadth, 3.2, 3.0; maxillary breadth, 4.6, 4.1; maxillary tooth row, 4.8, 4.8.

Remarks.—Apparently local in distribution, and either rare or difficult to trap, probably both, this little shrew is represented in collections by comparatively few specimens. The knowledge of its presence in a given locality has frequently been purely accidental. The first one brought to the attention of zoologists was found in a newly dug ditch in the Santee Marshes of South Carolina and upon it was based the original description. Bachman also describes another specimen, which was found in the gullet of a hooded merganser (*Lophodytes cucullatus*) (Bachman, 1837, p. 372), and a specimen in the United States Bureau of Biological Survey collection was taken from the stomach of a barred owl (*Strix varia alleni*) shot near Autaugaville, Ala. Another had evidently fallen over the cliffs to the shore of Chesapeake Bay, Md., where it was found dead by Marcus Ward Lyon, jr.

Although the specimens examined come from widely separated localities, represented in most cases by a single individual, there is little variation in the color or cranial characters. Indiana and Illinois specimens seem to average a trifle less reddish in color than specimens from the Atlantic States, and they may possibly have on the average shorter unicuspid rows and smaller molariform teeth, but the differences are slight and inconstant, and, on the basis of the specimens examined, not marked enough for subspecific separation. The skulls from Raleigh, N. C., seem to average very slightly higher through the brain case than those from Georgia, but the difference is nonessential. The skull from Chesapeake Beach, Md., is relatively somewhat narrower than typical specimens, which probably indicates a tendency toward *S. l. fisheri*, though there is no approach in size. The specimen from Falls Church, Va., is almost identical with the Georgia ones, which are assumed to be typical. Unfortunately, efforts to procure specimens of Sorex from the type locality of *S. l. longirostris* have proved futile. There seems little doubt, however, of the status of the form.

The status of *Amphisorex lesueurii* Duvernoy, the description of which has been misidentified as that of *S. longirostris*, is discussed under *S. c. cinereus* (p. 43–44).

Specimens examined.—Total number, 24, as follows:

Alabama: Bear Swamp, 4 miles northeast of Autaugaville, 1.
District of Columbia: Washington, 1.
Florida: Newnans Lake, near Gainesville, Alachua County, 1.[11]
Georgia: Butler, 1; Young Harris, 1.
Illinois: Olive Branch, 3[12]; Pistakee Lake, Henry County, 1[13]; Reevesville, 4.[12]
Indiana: Bicknell, 3.
Maryland: Chesapeake Beach, Calvert County, 3; Hall, Prince Georges County, 1.
North Carolina: Raleigh, 3.
Virginia: Falls Church, 1.

[11] Harley B. Sherman coll., Gainesville, Fla.
[12] Field Mus. Nat. Hist.
[13] Ill. State Lab. Nat. Hist.

SOREX LONGIROSTRIS FISHERI Merriam

Fisher Shrew

(Pls. 2, r; 5, b)

Sorex fisheri Merriam, North Amer. Fauna No. 10, p. 86, December 31, 1895.

Type specimen.—No. 75166, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth very slightly worn), skin and skull; collected October 11, 1895, by A. K. Fisher.

Type locality.—Lake Drummond, Dismal Swamp, Va.

Geographic range.—Known only from Dismal Swamp, Va., and adjacent part (Chapanoke) of North Carolina. (Fig. 8.)

Diagnostic characters.—Similar to *Sorex l. longirostris* but much larger with color usually duller above and more tinged with drab or wood brown on the underparts; skull distinctly larger in all dimensions than that of the subspecies *longirostris*, relatively somewhat narrower.

Color.—*Winter pelage:* Upper parts and sides fuscous; underparts moderately tinged with drab or wood brown, showing mixture of deep neutral gray of base of hairs. Tail bicolor, fuscous above, drab below nearly to tip. *Summer pelage:* Somewhat brighter than winter pelage. Upper parts Prout's brown, mummy brown, or near fuscous, becoming slightly paler on the sides; underparts drab or wood brown, rarely showing any trace of the deep neutral gray of base of hairs. Tail as in winter.

Skull.—Much larger than that of *S. l. longirostris*, relatively narrower with longer rostrum. About the size of that of large individuals of *S. c. cinereus*, but easily distinguished by its flatness of brain case, wide rostrum, and other group characters.

Measurements.—Type specimen (adult male): Total length, 108; tail vertebrae, 39; hind foot, 12. Two adult females from type locality: Total length, 102, 98; tail vertebrae, 40, 34; hind foot, 13, 11.5. *Skull:* Skulls of two adult males (teeth slightly worn), type specimen and topotype: Condylobasal length, 15.9, 15.9; palatal length, 5.6, 5.4; cranial breadth, 7.8, 7.7; interorbital breadth, 3.5, 3.5; maxillary breadth, 4.4, 4.5; maxillary tooth row, 5.4, 5.4. Skulls of two adult females (teeth slightly worn) from type locality: Condylobasal length, 16.4, 15.4; palatal length, 5.6, 5.5; cranial breadth, 8.2, 7.5; interorbital breadth, 3.6, 3.3; maxillary breadth, 4.8, 4.5; maxillary tooth row, 5.8, 5.3. Skull of adult male (teeth slightly worn) from Chapanoke, N. C.: Condylobasal length, 15.8; palatal length, 5.5; cranial breadth, 7.3; interorbital breadth, 3.4; maxillary breadth, 4.4; maxillary tooth row, 5.6.

Remarks.—The distribution of *S. l. fisheri* is evidently restricted to a small area in the Dismal Swamp region of southeastern Virginia and northeastern North Carolina. There is considerable variation in size among the skulls from the type locality, but the smallest skulls of *fisheri* are distinctly larger than the largest of *S. l. longirostris*. The single specimen of *fisheri* available from North Carolina barely suggests an approach toward *S. l. longirostris*.

Specimens examined.—Total number, 16, as follows:

North Carolina: Chapanoke, Perquimans County, 1.[14]
Virginia: Lake Drummond, Dismal Swamp (type locality), 15.

[14] Acad. Nat. Sci., Philadelphia.

TABLE 6.—*Cranial measurements of adult specimens of* Sorex longirostris *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. l. longirostris:										
Georgia—										
Butler	38425	------	14.6	5.1	7.3	3.2	4.2	5.0	Slight	
Young Harris	159415	------	13.9	5.0	7.2	3.1	4.2	5.0	---do	
North Carolina—Raleigh.	81972	♂	14.1	5.1	7.2	3.0	4.2	5.0	---do	
Virginia—Falls Church.	87190	♂	14.4	5.2	7.4	3.2	4.3	5.1	---do	
Maryland—Chesapeake Beach.	151738	♂	14.3	5.1	7.0	3.2	4.2	5.0	---do	
Indiana—Bicknell	168737	------	------	5.1	-----	3.2	4.6	4.8	Moderate	
Do	168834	------	------	5.2	-----	3.0	4.1	4.8	---do	
S. l. fisheri:										
Virginia—Lake Drummond.	75166	♂	15.9	5.6	7.8	3.5	4.4	5.4	Very slight	Type specimen.
Do	75168	♂	15.9	5.4	7.7	3.5	4.5	5.4	Slight	Type locality.
Do	75167	♀	16.4	5.6	8.2	3.6	4.8	5.8	---do	Do.
Do	140810	♀	15.4	5.5	7.5	3.3	4.5	5.3	---do	Do.
North Carolina—Chapanoke.	[1] 10573	♂	15.8	5.5	7.3	3.4	4.4	5.6	---do	

[1] Acad. Nat. Sci., Philadelphia.

SOREX DISPAR GROUP

The *dispar* group contains two species.—*Sorex dispar* and *S. gaspensis.*

Geographic range.—Gaspé Peninsula, Quebec; mountains of eastern New York, western Massachusetts, northeastern Pennsylvania, and southern West Virginia. (Fig. 9.)

Diagnostic characters.—Size, medium; color, dull grayish; back almost concolor with underparts; tail, long, moderately hairy; skull, smooth, nonangular, long and narrow, moderately flattened; rostrum, relatively long and narrow, depressed; infraorbital foramen with posterior border lying behind the plane of interspace between m^1 and m^2; dentition, moderate; unicuspids, relatively narrow (extero-interior diameter), the third about equal the fourth in size.

In color, members of the *dispar* group are not unlike *S. fumeus* in winter pelage but differ from any member of the *fumeus* or *arcticus* groups in relatively longer tail; long, narrow, depressed rostrum; narrow palate; in the position of the infraorbital foramen; weaker dentition, with pm^2 with posterior portion of cingulum less expanded internally, and narrower unicuspidate teeth. Compared with any of the *cinereus* group, either species of the *dispar* group is larger, with larger, more flattened skull and more depressed rostrum, which is even more accentuated in ratio of length to breadth than that of *S. cinereus;* molariform teeth relatively wider (extero-interior diameter) than in *cinereus* group, the interior ridge from the apex to cingulum of the unicuspidate teeth less developed, less pigmented. Somewhat like the western *S. trowbridgii* in color, but with tail not so clearly bicolor; and radically different cranially and ventrally.

Remarks.—The *dispar* group has a limited distribution in the eastern United States and Canada, and individuals belonging thereto are apparently rare, since less than 30 are known to exist in collections. The group is clearly differentiated from any other Sorex in the extreme posterior position of the infraorbital foramen.

SOREX DISPAR Batchelder

Gray Long-tailed Shrew

(Pls. 2, s; 4, d′; 6, e; 8, c; 11, g; 12, h)

Sorex macrurus Batchelder (nec *S. macrourus* Lehmann, 1822, qui *Neomys fodiens*), Proc. Biol. Soc. Washington 10:133, December 8, 1896.
Sorex dispar Batchelder (substitute for *S. macrurus* Batchelder), Proc. Biol. Soc. Washington 24:97, May 15, 1911.

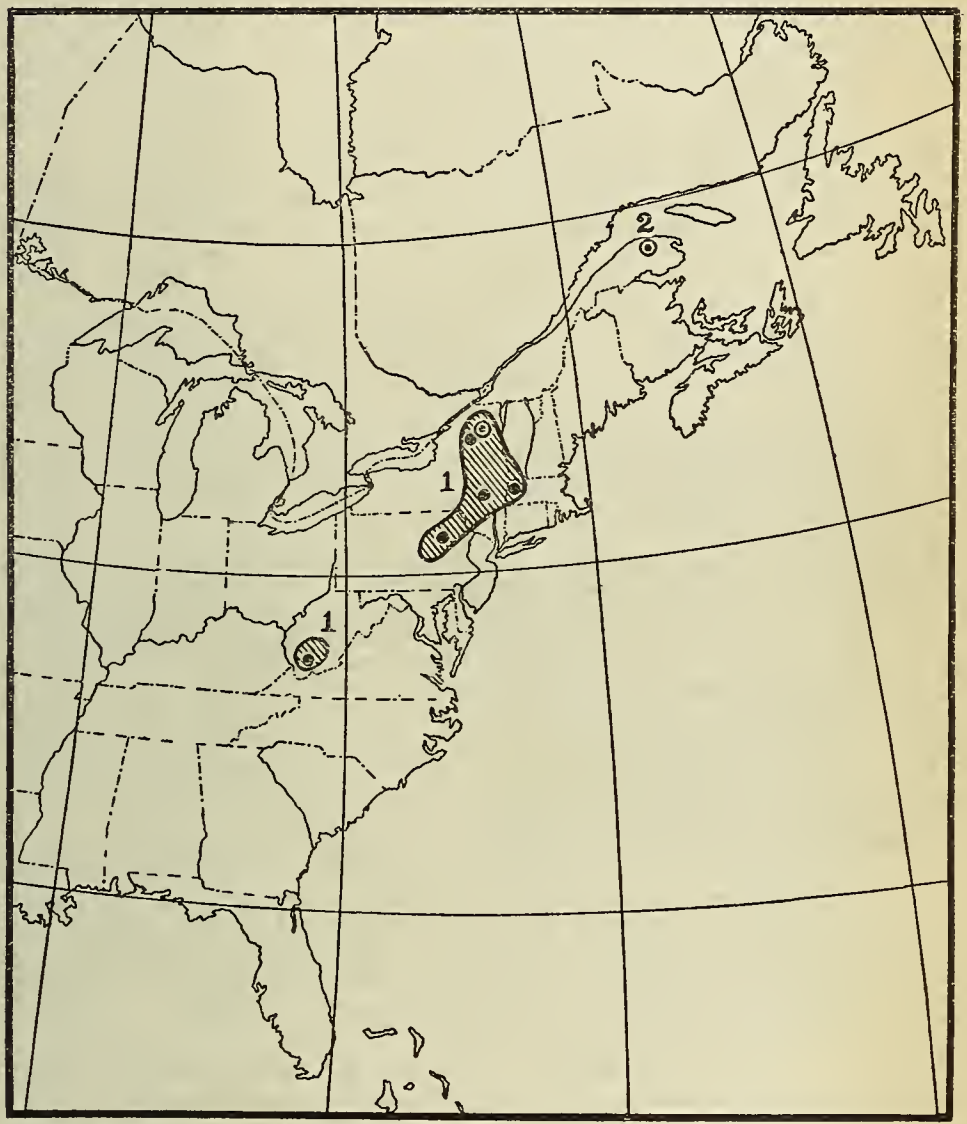

Fig. 9.—Geographic range of species of *Sorex dispar* group

1. *S. dispar.* 2. *S. gaspensis.*

Type specimen.—No. 1384, collection of C. F. Batchelder, Cambridge, Mass.; ♂ adult (teeth unworn), skin and skull, left maxillary process broken away; collected September 9, 1895, by C. F. Batchelder.

Type locality.—Beedes (sometimes called Keene Heights), Essex County, N. Y.

Geographic range.—Mountains of eastern New York, western Massachusetts, northeastern Pennsylvania, and southern West Virginia. (Fig. 9.)

Diagnostic characters.—Similar to *Sorex gaspensis* but distinctly larger, darker, and tending to be more brownish in color; hind foot actually larger than in *S. gaspensis* but in proportion to body length relatively smaller; skull noticeably larger than that of *S. gaspensis*, with corresponding heavier dentition.

Color.—Winter pelage: Unknown. *Summer pelage:* Dull, grayish, scarcely paler ventrally than on back. Upper parts dark mouse gray to deep mouse gray with a perceptible tinge of chaetura black or chaetura drab, in some lights appearing more or less finely flecked with whitish; underparts about same tone of color as upper parts, scarcely, if any, paler; tail fuscous-black above, usually paler beneath, particularly basally, chaetura drab or hair brown, sometimes almost as dark as above (fuscous-black), occasionally, when much worn, honey yellow or cinnamon-buff. Upper surfaces of feet more or less clothed with fuscous hairs, particularly on outer edge.

Time of molting.—Of the specimens of *S. dispar* examined, only one is in process of molting. A male collected September 4, 1896, on Hunter Mountain, in the Catskills, N. Y., shows indications of the incoming of the winter pelage under the worn summer pelage on the rump. Another male from the same place, collected a day previous, is in worn summer pelage with no signs of molting.

Skull.—Medium in size; smooth, not angular, moderately flattened; relatively long and narrow, brain case narrow, rather low; orbital region elongated (antero-posteriorly); rostrum relatively long and narrow, depressed; mesopterygoid space elongate; molariform dentition moderately heavy; first incisors small; unicuspidate teeth relatively narrow (extero-interior diameter), the first and second about subequal, the third and fourth smaller than the first and second, the third about equal the fourth or possibly slightly smaller, the fifth relatively large but considerably smaller than third; unicuspids with cingulum weakly developed.

Measurements.—Type specimen (adult male): Total length, 130; tail vertebrae, 60; hind foot, 15. Two adult males from Hunter Mountain, Catskill Mountains, N. Y.: Total length, 124, 121; tail vertebrae, 55, 56; hind foot, 15, 14. Two adult females from Hunter Mountain, Catskill Mountains, N. Y.: Total length, 122, 125; tail vertebrae, 56, 58; hind foot, 14.5, 15. Adult male from 4 miles southwest of Pemberton, W. Va.: Total length, 131; tail vertebrae, 62; hind foot, 14. *Skull:* Type specimen (adult male, teeth unworn): Condylobasal length, 18.2; palatal length, 7.0; cranial breadth, 8.1; interorbital breadth, 3.5; maxillary tooth row, 6.1. Skulls of two adult males (teeth slightly worn) from Hunter Mountain, Catskill Mountains, N. Y.: Condylobasal length, 18.0, 17.3; palatal length, 6.9, 6.6; breadth of cranium, 8.0, 7.9; interorbital breadth, 3.3, 3.3; maxillary breadth, 4.2, 4.2; maxillary tooth row, 6.2, 6.1. Skulls of two adult females (teeth slightly worn) from Hunter Mountain, Catskill Mountains, N. Y.: Condylobasal length, 17.6, 17.9; palatal length, 6.6, 6.8; cranial breadth, 8.0, 8.1; interorbital breadth, 3.3, 3.4; maxillary breadth, 4.2, 4.3; maxillary tooth row, 6.1, 6.1. Skull of adult male (teeth slightly worn) from 4 miles southwest of Pemberton, W. Va.: Condylobasal length, 18.0; palatal length, 6.9; cranial breadth, 8.0; interorbital breadth, 3.4; maxillary breadth, 4.5; maxillary tooth row, 6.3.

Remarks.—So different from any other species of American shrew is *S. dispar* that, once the animal is known, critical comparisons with other forms in the region inhabited by it are unnecessary. In color it is not unlike *S. fumeus* in winter pelage, but it can usually be distinguished by its longer tail (55 or more). Cranially, it differs from all other American shrews in its relatively long, narrow, flattened skull with long, narrow, depressed rostrum and peculiar dentition. It does not fit into any other group of shrews, showing in minor respects suggestions of the *cinereus*, *fumeus*, and *arcticus* groups, but differing radically from each of them in other characters.

Specimens examined.—Total number, 15, as follows:

Massachusetts: Mount Graylock, 3.[15]
New York: Beedes (sometimes known as Keene Heights), Essex County (type locality), 1;[16] Hunter Mountain, Catskill Mountains, 8; Mount Marcy (summit), 1.[16]
Pennsylvania: Lake Leigh (North Mountain), Sullivan County, 1.[17]
West Virginia: Winding Gulf (4 miles southwest of Pemberton), 1.

SOREX GASPENSIS Anthony and Goodwin

Gaspé Peninsula Shrew

Sorex gaspensis Anthony and Goodwin, Amer. Mus. Novitates, no. 109, p. 1, March 10, 1924.

Type specimen.—No. 64190, Amer. Mus. Nat. Hist., ♂ young adult (teeth unworn), skin and skull, the skull slightly crushed in pterygoid region; collected September 5, 1923, by G. G. Goodwin.

Type locality.—Mount Albert, altitude 2,000 feet, Gaspé Peninsula, Quebec.

Geographic range.—Known only from Gaspé Peninsula, Quebec. (Fig. 9.)

Diagnostic characters.—Similar to *S. dispar* but distinctly smaller, paler, and more grayish (less brownish) in color; hind foot small, actually considerably smaller than in *S. dispar*, but in proportion to body length relatively slightly larger; skull distinctly smaller than that of *S. dispar* with correspondingly weaker dentition.

Color.—Winter pelage: Unknown. *Summer pelage:* Distinctly paler and more grayish than that of *S. dispar*. Upper parts between deep mouse gray and deep neutral gray, or slightly paler; underparts scarcely paler than upper parts; tail essentially as in *S. dispar*, possibly less fuscous; feet a shade paler.

Time of molting.—A female collected September 7, 1923, shows the intrusion of the winter fur under the summer pelage over the posterior half of the back.

Skull.—Essentially similar in proportions to that of *S. dispar* but decidedly smaller in all dimensions, the mesopterygoid space apparently relatively shorter, teeth smaller, and dental pigmentation heavier.

Measurements.—Type specimen (young adult male): Total length, 102; tail vertebrae, 47; hind foot, 10.5.[18] Adult male and young adult female from type locality: Total length, 100, 95; tail vertebrae, 47, 47; hind foot, 12, 12. *Skull:* Type specimen (young adult male, teeth unworn): Condylobasal length, 16.3; palatal length, 6.4; cranial breadth, 7.4; interorbital breadth, 3.0; maxillary tooth row, 5.6. Skulls of adult male (teeth moderately worn) and young adult female (teeth very slightly worn) from type locality: Condylobasal length, 16.1, 15.8; palatal length, 6.5. 6.4; cranial breadth, 7.3, 7.9; interorbital breadth, 3.2, 3.0; maxillary breadth, 4.0, 3.7; maxillary tooth row, 5.5, 5.6.

Remarks.—Although the material at present available shows no specific connection between *S. gaspensis* and *S. dispar*, it is possible that additional specimens from the regions now separating the known geographic ranges of the two forms may show intergradation between them. The members of this group of shrews are local in distribution, and apparently scarce where found.

Specimens examined.—Three,[19] from the type locality.[19a]

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[15] Manton Copeland coll., Brunswick, Me.
[16] C. F. Batchelder coll., Cambridge, Mass.
[17] Acad. Nat. Sci., Philadelphia.
[18] Evidently an error; measures 12 millimeters in the dry skin.
[19] Amer. Mus. Nat. Hist.
[19a] George G. Goodwin, of the American Museum of Natural History, writes under date of Nov. 22, 1927, in a letter to the author: "* * * this summer I took nine specimens of *Sorex gaspensis* in the Gaspé Peninsula, south of Shickshock Range. I found this shrew to be comparatively common in the Cascapedia Valley. The specimens average slightly larger than the three that I took at Mount Albert; hind foot in every case measuring 12.5 mm. One specimen had a total length of 115 mm., and 55 mm. for length of tail. They seem to have the same habits as the water shrew [i. e., *Sorex palustris gloveralleni*]."

TABLE 7.—*Cranial measurements of adult specimens of* Sorex dispar *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. dispar:										
New York—										
Beedes	[1]1384	♂	18.2	7.0	8.1	3.5	-----	6.1	Unworn	Type specimen.
Hunter Mountain.	83159	♀	17.6	6.6	8.0	3.3	4.2	6.1	Slight	
Do	83160	♀	17.9	6.8	8.1	3.4	4.3	6.1	do	
Do	83161	♂	18.0	6.9	8.0	3.3	4.2	6.2	do	
Do	83162	♂	17.3	6.6	7.9	3.3	4.2	6.1	do	
S. gaspensis:										
Quebec—Mount Albert.	[2]64189	♂	16.1	6.5	7.3	3.2	4.0	5.5	-----	Type locality.
Do	[2]64190	♂	16.3	6.4	7.4	3.0	-----	5.6	-----	Type specimen.
Do	[2]64191	♀	15.8	6.4	7.9	3.0	3.7	5.6	-----	Type locality.

[1] C. F. Batchelder, coll., Cambridge, Mass. [2] Amer. Mus. Nat. Hist.

SOREX TROWBRIDGII GROUP

The *trowbridgii* group includes a single species—*Sorex trowbridgii*. All necessary group comparisons are made under the species.

SOREX TROWBRIDGII BAIRD

[Synonymy under subspecies]

Geographic range.—Extreme southwestern British Columbia, western Washington and Oregon, extreme northern California, western California south to San Raphael Mountains, and eastern California south to Kaweah River; chiefly in Transition Zone. (Fig. 10.)

Diagnostic characters.—Size medium; tail moderately long, sharply bicolor, dark above, nearly white (or pale ochraceous-buff) below; underparts of body scarcely, if any, paler than back. Skull medium in size, moderately depressed, the third unicuspid smaller than fourth, ridge extending from apex of unicuspid toward interior edge of cingulum but slightly pigmented and rarely pigmented to cingulum, separated from cingulum by antero-posterior groove, and never ending in distinct cusplet. Compared with *S. obscurus*, the color of *S. trowbridgii* and subspecies is more sooty, and it differs from any of the *obscurus* group in the relatively narrower teeth, and in that the internal ridge from the apex of the unicuspid is different. Compared with any of the *ornatus* group, *S. trowbridgii* is larger, with distinctly larger skull, higher brain case, broader cranium, broader mesopterygoid space, and longer tooth row.

Subspecies and geographic variation.—The species *trowbridgii* is divided into four subspecies: *trowbridgii*, *humboldtensis*, *montereyensis*, and *mariposae*. Beginning at the northern edge of the range of the species (subspecies *trowbridgii*) and passing toward the south through the region inhabited by *humboldtensis* to that occupied by *montereyensis*, there is a gradually intensifying of the reddish element in the color and a shortening of the tail, particularly south of the type region of *humboldtensis*, and a broadening of the palate and rostrum, which is correlated with an increase in size of the molariform teeth. Toward the east and northeast of *montereyensis* the color of the animal becomes paler, recognized in the subspecies *mariposae*.

Time of molting.—The spring molt usually occurs during June or late in May but may start as early as the last of April. Thus 7 specimens collected at Chehalis, Wash., April 26 to April 30, 1918, are all in more or less worn winter pelage, while 8, collected April 30, show the beginning of the molt on the back. Two males from Neah Bay, Wash., have the molt barely started May 14 and 23, while 1 from Sumas, British Columbia, is considerably more advanced May 26. Three individuals from near Inverness, Calif., have the molt well

started May 27, and June 5 and 8, while 1 from near Cazadero, the same State, is in similar condition June 22. Specimens from Oregon show molt as follows: Swan Lake, June 13; Eugene, 2 females, June 18; Yaquina Bay, June 19; Vida, June 25; and Reston, July 7. Specimens showing late molt are 1 from Prattville, Calif., molt nearly completed, July 24; 1 from East Fork Kaweah River, Calif., complete except for posterior half of back, July 28; and 1 from Canyon Creek, Calif., which still shows barely a trace of the winter fur on the rump, August 11.

The fall molt in *S. trowbridgii* is usually completed by the first or second week of November and frequently by late in October. In rare instances it may begin as early as late in July, as in a male and female from Aptos, Calif., collected, respectively, on July 23 and 20, 1909, in each of which the fresh winter pelage is beginning to appear on the rump. Other evidence of early fall molt is found in 2 males from the south base of Santa Lucia Peak, Calif., August 26, 1902, and another from San Rafael Mountains, Calif., August 30, 1903. The majority of fall specimens in actual process of molt appear to have been collected during October and are represented by specimens from Lakeview, Oreg., October 2; Verdi, Nev., October 15 and 16; and from the following localities in California: Monterey, October 6; Pacheco Peak, October 17 and 18; Orick, October 20 and 21; Michigan Bluff, October 28. Five specimens from Point Reyes, Calif., collected November 3 to 5, are all in complete winter fur except 1 that still shows a trace of the summer fur on the head, and 2 females from Briceland are still in process of molting November 11. Only 3 specimens of the subspecies *trowbridgii* that show molt are available, all of which have the molt well advanced under the old fur; they were collected at the following localities in Washington; Mount Rainier, September 18; Lake Quinault, September 27; and Mount Stewart, October 2.

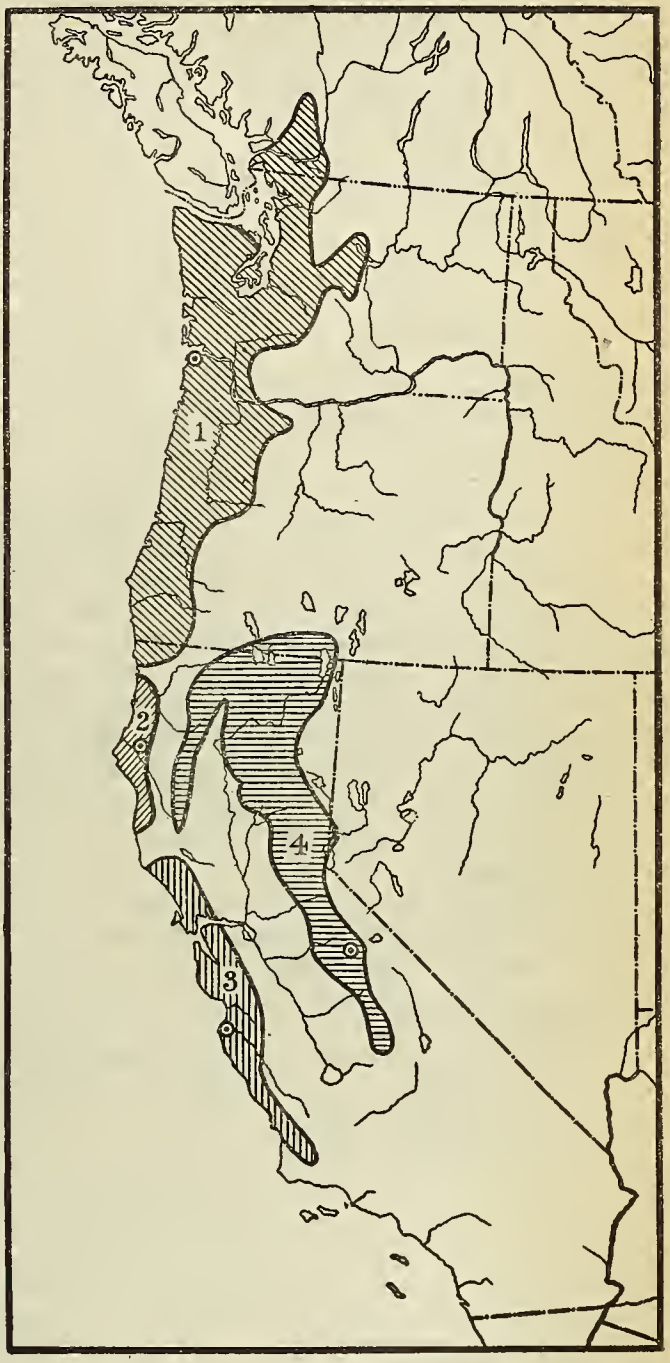

FIG. 10.—Geographic range of subspecies of *Sorex trowbridgii*

1. *S. t. trowbridgii.*
2. *S. t. humboldtensis.*
3. *S. t. montereyensis.*
4. *S. t. mariposae.*

Remarks.—The species *trowbridgii* forms a well-differentiated group separated from others by distinct dental characters in the unicuspidate teeth. Its distribution is limited to a comparatively short range from southwestern British Columbia south over the northern two-thirds of California, where it is confined largely to the Transition Zone. The species appears to be less confined to marshes and damp habitats than some others and is frequently found in dry woods.

SOREX TROWBRIDGII TROWBRIDGII Baird

TROWBRIDGE SHREW

(Pls. 2, t; 5, c; 6, f; 8, d; 11, h; 12, i)

Sorex trowbridgii Baird, Report Pacific R. R. Survey 8: part 1, Mammals, p. 13, 1857.
Sorex trowbridgei True, Proc. U. S. Nat. Mus. 7: 606, 1885.
Sorex trowbridgii trowbridgii Jackson, Journ. Washington Acad. Sci. 12: 264, June 4, 1922.

Type specimen.—Cotypes No. $\frac{8\,1\,3}{3\,0\,8\,8}$, U. S. Nat. Mus.; sex unknown, adult (teeth moderately worn), poorly made skin and skull (cranium broken and right mandible missing); received from W. P. Trowbridge, United States Army; skin catalogued July, 1855, skull January, 1857. This (No. $\frac{8\,1\,3}{3\,0\,8\,8}$) is the only specimen of which Baird gives skull measurements in the original description. It is hereby selected as the lectotype of *Sorex trowbridgii.* No. 967, U. S. Nat. Mus., sex unknown, poorly made skin without skull[20]; collected June 10, 1855, by James Wayne, received from W. P. Trowbridge, United States Army, and entered in the museum catalogue November, 1855.

Type locality.—Astoria, mouth of Columbia River, Clatsop County, Oreg.

Geographic range.—Extreme southwestern British Columbia, western Washington and Oregon, and extreme northwestern California (south to mouth of Klamath River). (Fig. 10.)

Diagnostic characters.—Color rather dark and grayish; darker and more grayish than *S. t. montereyensis* or *S. t. mariposae,* with relatively longer tail. Skull comparatively narrow, with noticeably narrow rostrum and weak dentition. About the color of *S. t. humboldtensis,* ratio of total length to length of tail vertebrae about the same, averaging a bit smaller. Rostrum and dentition weaker than in *humboldtensis.*

Color.—Winter pelage: Upper parts deep mouse gray to almost dark mouse gray, slightly, if at all, tending toward brownish; underparts scarcely paler than upper parts, mouse gray to deep mouse gray, sometimes very slightly tinged with drabish; tail sharply bicolor, fuscous, to fuscous-black or chaetura black above, whitish below, sometimes near cartridge buff or light buff, to tip. *Summer pelage:* A trifle more brownish and possibly paler than in winter. Upper parts between deep mouse gray and chaetura drab to between mouse grap and hair brown; underparts essentially like back, scarcely if any paler; tail about as in winter.

Skull.—Comparatively narrow, particularly in rostral region; frontal region arising rather abruptly to moderately elevated brain case; dentition weak, particularly unicuspids and first upper molariform tooth. Rostrum narrower and dentition weaker than in any other form of *S. trowbridgii.*

Measurements.—Two adult females from type locality: Total length, 115, 130; tail vertebrae, 56, 59; hind foot, 13, 14. Average of 4 adults females from

[20] The skull has been removed from the skin, but is missing. It has not been entered in the museum catalogue, and Baird (1857) makes no mention of it.

Vida, Oreg.: Total length, 117 (113–120); tail vertebrae, 54.3 (52–57); hind foot, 13.5 (13–14). Average of 3 adult males from Sumas, British Columbia: Total length, 114.7 (112–117); tail vertebrae, 55.7 (55–57); hind foot, 13.8 (13.5–14). *Skull:* Lectotype (adult, sex unknown; teeth moderately worn): Condylobasal length, 17.5±; palatal length, 6.8; cranial breadth 8.6±; interorbital breadth, 3.8; maxillary breadth, 5.0; maxillary tooth row, 6.5. Two skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 17.6, 17.6; palatal length, 6.9, 6.9; cranial breadth, 8.6, 8.9; interorbital breadth, 3.8, 3.8; maxillary breadth, 4.9, 5.0; maxillary tooth row, 6.4, 6.6. Average of 4 skulls of adult females (teeth slightly worn) from Vida, Oreg.: Condylobasal length, 17.3 (17.1–17.5); palatal length, 6.8 (6.7–6.9); cranial breadth, 8.6 (8.3–8.9); interorbital breadth, 3.8 (3.6–3.9); maxillary breadth, 4.9 (4.8–5.0); maxillary tooth row, 6.4 (6.3–6.5). Average of 3 skulls of adult males (teeth slightly worn) from Sumas, British Columbia: Condylobasal length, 17.5 (17.4–17.6); palatal length, 6.9 (6.8–7.0); cranial breadth, 8.6 (8.5–8.8); interorbital breadth, 3.9 (3.8–4.0); maxillary breadth, 5.0 (4.9–5.0); maxillary tooth row, 6.5 (6.4–6.6).

Remarks.—Judging from the notes of various collectors of *S. t. trowbridgii*, the form is apparently more plentiful in log-strewn forests than in marshes and habitats favorable to certain other shrews, and although confined within a geographic range covered by what is generally known as the humid northwest coast region of the United States, the little mammal is as apt to be found on the drier forested hills as on the moist lowlands. Wherever found the form is easily identified, as shrews go, by the characters previously given, the long, sharply bicolor tail together with the size of the animal and the dark underparts of its body nearly concolor with its back being particularly good recognition marks.

Direct intergradation with *S. t. humboldtensis* is indicated in specimens of *S. t. trowbridgii* from Requa and Crescent City, Calif. Also one of the four skulls from Prospect, Oreg., shows a noticeable approach toward *humboldtensis* in breadth of rostrum and size of molars, but the three others are like those of typical *trowbridgii*. Specimens from Siskiyou, Oreg., and Stud Horse Canyon, in the Siskiyou Mountains, and Preston Peak, Calif., shows a tendency toward *S. t. mariposae*. A single specimen from Stehekin, at the head of Lake Chelan, Wash., appears a shade paler than average specimens of *S. t. trowbridgii*.

Specimens examined.—Total number, 219, as follows:

British Columbia: Cascade Mountains (altitude 1,000 feet), 1; Douglas, 1[21]; Hope, 4[22]; Second Summit (altitude 6,000 feet, Skagit River), 1[21]; Sumas, 36.[23]

California: Crescent City, 5[24]; Klamath River (Happy Camp), 1; Preston Peak (altitude 5,500 feet), 1; Requa, 1[25]; Siskiyou Mountains (altitude 6,500 feet, Stud Horse Canyon), 2.

Oregon: Astoria (type locality), 6; Blaine, 3[26]; Blue River, 1; Drew, 1; Empire, 1; Eugene, 2; Fish Hatchery (2 miles west of Vida), 2; Gold Beach, 4[25]; Marshfield, 1; Mercer, 1[27]; Netarts, 6[28]; Netarts Bay, 2[27]; Parkdale (2 miles west, altitude 1,500 feet), 3; Philomath (5 miles southwest), 4; Portland, 1; Prospect, 4[28]; Prospect (Rogue River), 1[28]; Reston, 1; Siskiyou, 3; Three Sisters (Alder Springs, altitude 4,300 feet), 1; Three Sisters (north slope, altitude 6,000 feet), 2; Vida, 9; Yaquina Bay, 2.

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[21] Nat. Mus. Canada.
[22] Mus. Comp. Zool.
[23] Acad. Nat. Sci. Philadelphia, 9; Field Mus. Nat. Hist., 2.
[24] D. R. Dickey coll., Pasadena, Calif., 1.
[25] Field Mus. Nat. Hist.
[26] D. R. Dickey coll., 1; Univ. Mich., 2.
[27] S. G. Jewett coll., Portland, Oreg.
[28] D. R. Dickey coll.

Washington: Aberdeen, 2; Ashford (Nisqually Valley), 1; Blaine, 2; Blewett Pass (2 miles south, altitude 3,000 feet, Kittitas County), 1; Blewett Pass (altitude 5,000 feet, Chelan County), 1[28]; Brookfield, 1; Cathlamet, 1; Cedarville, 1; Chehalis, 5; Chehalis (8 miles west), 3; Darrington (altitude 600 feet), 1; Destruction Island, 1; Duckabush, 1; Elwha, 1[29]; Elwha (altitude 425 feet), 2; Everett, 2[29]; Everett (4 miles south), 1; Glacier (altitude 900 feet), 1; Harstine Island, Mason County, 1; Hoodsport, 2; Index, 2; Index (north fork Skykomish River), 1[29]; Kapowsin, 1; Kirkland, 1[25]; Kirkland (3 miles east), 4; Lake Cushman, 1[30]; Lake Quinault, 1; Lake Whatcom, 1; Longmire (Mount Rainier, altitude 3,000 feet), 3[28]; Mount Rainier (Spray Park), 1[29]; Mount Rainier (Ohanapecosh Springs, altitude 2,000 feet), 4; Mount Rainier (Mesler's ranch, 1 mile west Rainier Park, altitude 2,000 feet), 1; Mount Rainier (Tahoma Creek, altitude 2,500 feet), 1; Mount Stewart (6 miles south, north fork Teanaway River, altitude 3,500 feet), 2; Mount Vernon, 12; Neah Bay, 8; North Bend (altitude 600 feet), 1; Olympic Mountains (3 miles southeast of Mount Elinor), 3; Point Defiance Park, Tacoma, 2[23]; Potlatch, 4[28]; Puget Sound, 2; Puyallup, 5[31]; Rockport (altitude 300 feet), 2; Scattle, 2[32]; Stehekin (head of Lake Chelan, altitude 1,079 feet), 1; Steilacoom, 3; Tacoma (5 miles east), 1[28]; Tacoma (6 miles south), 1; Tenino, 2; Tokeland (Shoalwater Bay), 1.

SOREX TROWBRIDGII HUMBOLDTENSIS Jackson

Humboldt Bay Shrew

Sorex trowbridgii humboldtensis Jackson, Journ. Washington Acad. Sci. 12: 264, June 4, 1922.

Type specimen.—No. 97271, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected June 11, 1899, by Walter K. Fisher. Original number, 914.

Type locality.—Carsons Camp, Mad River, Humboldt Bay, Humboldt County, Calif.

Geographic range.—Coastal region of northern California from mouth of Klamath River south to Point Arena. (Fig. 10.)

Diagnostic characters.—In general intermediate between *Sorex t. trowbridgii* and *S. t. montereyensis.* About the color of *S. t. trowbridgii,* tending to be larger, with tail proportionately to body length about as in the subspecies *trowbridgii.* Skull larger, and broader in all dimensions than that of *S. t. trowbridgii,* with heavier dentition. Averaging a shade darker and less brownish than *montereyensis,* with relatively and actually longer tail; skull with narrower rostrum and somewhat weaker dentition than in *montereyensis.*

Color.—Winter pelage: Essentially like that of *S. t. trowbridgii;* possibly averaging a shade darker. *Summer pelage:* Indistinguishable from that of *S. t. trowbridgii.*

Skull.—Intermediate in most respects between that of *S. t. trowbridgii* and that of *S. t. montereyensis.* Larger and broader than that of *S. t. trowbridgii,* with noticeably heavier rostrum and dentition. Rostrum narrower and dentition weaker than in *S. t. mariposae* or *montereyensis.*

Measurements.—Type specimen (adult male): Total length, 132; tail vertebrae, 62; hind foot, 14. Average of three adult males from Arcata, Humboldt County, Calif.: Total length, 131 (129–133); tail vertebrae, 60.3 (60–61); hind foot, 14.7 (14–15). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 17.8; palatal length, 7.2; cranial breadth, 8.9; interorbital breadth, 4.1; maxillary breadth, 5.4; maxillary tooth row, 6.7. Average of three skulls of adult males (teeth moderately worn) from Arcata, Humboldt County, Calif.: Condylobasal length, 18.2 (18.2–18.3); palatal length, 7.2

[25] Field Mus. Nat. Hist.
[28] D. R. Dickey coll.
[29] State Coll. of Wash.
[30] Univ. Mich.
[31] D. R. Dickey coll., 1; G. G. Cantwell coll., Palms, Calif., 1.
[32] Field Mus. Nat. Hist., 1.

(7.1–7.2); cranial breadth, 9.0 (8.9–9.1); interorbital breadth, 4.0 (3.9–4.1); maxillary breadth, 5.3 (5.3–5.3); maxillary tooth row, 6.9 (6.9–6.9).

Remarks.—Although in reality intermediate between *S. t. trowbridgii* and *S. t. montereyensis*, the subspecies *humboldtensis* in its typical form averages larger than either. Externally it is more like *S. t. trowbridgii;* cranially it is apparently rather nearer *montereyensis.* Some of the specimens from near Mendocino City, Calif., here referred to *humboldtensis*, could be referred to *montereyensis* with almost equal propriety in so far as external characters are concerned; cranially, however, they are much nearer *humboldtensis.* Specimens from 7 miles north of Hardy, Mendocino County, Calif., have shorter tails than typical representatives of *humboldtensis*, but in color and cranial characters they are similar to this subspecies.

Specimens examined.—Total number, 80, as follows:

California: Alton Junction, 2; Arcata, 5[33]; Briceland, 2; Carlotta, 8[34]; Cuddeback, 1[35]; Dyerville, 2[34]; Dyerville (5 miles south), 3; Eureka, 11[36]; Fair Oaks, 3[37]; Hoopa Valley, 7; Mad River, Humboldt Bay (type locality), 10; Mendocino, 11[38]; Orick, 5[39]; Sherwood, 1[39]; Trinidad, 9.[39]

SOREX TROWBRIDGII MONTEREYENSIS Merriam

Monterey Shrew

(Pl. 2, u)

Sorex montereyensis Merriam, North Amer. Fauna No. 10, p. 79, December 31, 1895.

Sorex montereyensis montereyensis Grinnell, Univ. California Publ. Zool. 10: 188, March 20, 1913.

Sorex t[rowbridgii] montereyensis Jackson, Journ. Washington Acad. Sci. 12: 264, June 4, 1922.

Type specimen.—No. $\frac{32000}{44810}$, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull (basioccipital region slightly broken); collected October 1, 1891, by Vernon Bailey.

Type locality.—Monterey, Monterey County, Calif.

Geographic range.—Coast region of California from Point Arena south to San Raphael Mountains. (Fig. 10.)

Diagnostic characters.—Tending to be more brownish than either *Sorex t. trowbridgii* or *S. t. humboldtensis*, with relatively and actually shorter tail; skull broader and heavier than that of either subspecies *trowbridgii* or *humboldtensis*, the postorbito-frontal region less constricted, dentition heavier. Slightly darker and more brownish than *S. t. mariposae*, with apparently average smaller skull with narrower cranium.

Color.—More brownish than *S. t. trowbridgii*, particularly in winter. *Winter pelage:* Upper parts chaetura drab or between chaetura drab and fuscous; underparts but slightly paler than upper parts, hair-brown or slightly paler; tail distinctly bicolor, less sharply so than in *S. t. trowbridgii*, above fuscous to mummy brown, below near pale orchraceous-buff nearly to tip. *Summer pelage:* Scarcely paler or more brownish than in winter. Upper parts fuscous, sometimes tending toward chaetura drab or olive-brown; underparts near hair brown; tail as in winter.

Skull.—Moderately broad and heavy; broader throughout and a trifle more flattened cranially than that of *S. t. trowbridgii* or *S. t. humboldtensis*, with

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[33] Mus. Vert. Zool., 3.
[34] D. R. Dickey coll., Pasadena, Calif.
[35] Mus. Vert. Zool.
[36] Field Mus. Nat. Hist., 4; Mus. Vert. Zool., 6.
[37] Mus. Comp. Zool., 1; Mus. Vert. Zool., 2.
[38] Field Mus. Nat. Hist., 2; Mus. Vert. Zool., 6.
[39] D. R. Dickey coll., 1.

rostrum averaging distinctly broader and dentition heavier. Similar to that of *S. t. mariposae*, possibly averaging smaller with narrower cranium.

Measurements.—Type specimen (adult male): Total length, 120; tail vertabrae, 54; hind foot, 15. Average of five adult females from Monterey and Pacific Grove, Calif.: Total length, 123 (114–131); tail vertebrae, 51.8 (48–56); hind foot, 14.3 (13.5–15). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 18.0; palatal length, 7.3; cranial breadth, 9.1; interorbital breadth, 4.2; maxillary breadth, 5.6; maxillary tooth row, 7.0. Average of five skulls of adult females (teeth slightly worn) from Monterey and Pacific Grove, Calif.: Condylobasal length, 18.2 (18.0–18.4); palatal length, 7.3 (7.2–7.4); cranial breadth, 9.0 (8.7–9.2); interorbital breadth, 4.2 (4.0–4.3); maxillary breadth, 5.6 (5.4–5.7); maxillary tooth row, 6.9 (6.8–7.0).

Remarks.—Although for many years treated as specifically distinct from *S. trowbridgii*, the form *S. t. montereyensis* is clearly subspecifically connected with it through *humboldtensis*. Specimens of *montereyensis* from Nicasio, Point Reyes, and other points in Marin County, Calif., show in some respects an approach toward *humboldtensis* in that they seem to average somewhat darker than typical *montereyensis*, and a few of the skulls show narrower rostra; their dentition, however, is heavy, as in true *montereyensis*, in nearly every individual. Summer specimens from Mount Saint Helena, Calif., are inclined toward *S. t. mariposae* in color.

Specimens examined.—Total number, 284, as follows:

California: Aptos (5 miles south), 5; Bear Basin (head of Carmel River), 3; Bear Valley (head of Carmel River), 1; Bells Station, Santa Clara County, 1; Berkeley, 3[40]; Berkeley (Strawberry Creek), 1[41]; Berkeley (first canyon north of Strawberry Creek), 1[41]; Boulder Creek, 3; Cazadero (7 miles west, altitude 900 feet), 3[42]; Cone Peak, Monterey County, 1; Divide (altitude 800 feet, between Mill Valley and Muir Woods), Marin County, 1[42]; Freestone (altitude 300 feet), 1[42]; Freemont Peak, Gabilan Range, 2; The Geysers, Sonoma County, 1; Gilroy (near), 3[43]; Gualala, 5[42]; Gualala (Sonoma County side of Gualala River), 3[42]; Hardy (7 miles north, Mendocino County), 4[41]; Hayward, 1[42]; Inverness, 37[44]; Lagunitas, 4; La Honda, 2[45]; La Honda, San Mateo County, 13[46]; Marin County, 2; Mendocino, 4[42]; Menlo Park, 1[42]; Milpitas Ranch (south base Santa Lucia Peak), 2; Monterey (type locality), 16[47]; Morro, 2; Mount Hamilton, 1[45]; Mount St. Helena, 2; Mount Tamalpais, 1; Mount Tamalpais (altitude 2,000 feet), 1; Mount Veeder, 16; Nicasio, 68[48]; Oakland, 6[49]; Olema, 1; Pacheco Peak (summit), 3; Pacific Grove, 2; Palo Alto, 1[43]; Petaluma, 3[45]; Pine Valley (10 miles northwest Tassajara Springs), 1; Point Pinos (Pacific Grove P. O.), Monterey County, 1; Point Reyes, 24[50]; Portolo, San Mateo County, 17[51]; San Luis Obispo, 1; San Rafael Mountains (Peach Tree River), Santa Barbara County, 1; Stevens Creek, Santa Clara County, 2[42]; Tassajara Creek (6 miles below Tassajara Springs), 3; Telegraph Canyon (near Berkeley), 1[42]; Watsonville (10 miles north, altitude 2,000 feet), Santa Cruz County, 1[52]; Woodside (Santa Cruz Mountains, San Mateo County), 1.

SOREX TROWBRIDGII MARIPOSAE Grinnell

Yosemite Shrew

Sorex montereyensis mariposae Grinnell, Univ. Calif. Publ. Zool. 10: 189, March 20, 1913.

Sorex trowbridgii mariposae Grinnell, Univ. Calif. Publ. Zool. 21: 314, January 27, 1923.

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[40] Acad. Nat. Sci., Philadelphia.
[41] D. R. Dickey coll., Pasadena, Calif.
[42] Mus. Vert. Zool.
[43] Mus. Comp. Zool.
[44] D. R. Dickey coll., 6; Mus. Vert. Zool., 31.
[45] Field Mus. Nat. Hist.
[46] Amer. Mus. Nat. Hist.
[47] D. R. Dickey coll., 6; Mus. Vert. Zool., 6.
[48] Mus. Vert. Zool., 1; Mus. Comp. Zool., 4; Field Mus. Nat. Hist., 10; Amer. Mus. Nat. Hist., 13.
[49] Public Mus. Milwaukee.
[50] Field Mus. Nat. Hist., 5; Mus. Comp. Zool., 3; Mus. Vert. Zool., 3.
[51] D. R. Dickey coll., 2; Field Mus. Nat. Hist., 11; Mus. Comp. Zool., 4.
[52] Univ. of Mich.

Type specimen.—No. 12979, Mus. Vert. Zool., Univ. California; ♀ adult (teeth moderately worn), skin and skull; collected May 27, 1911, by J. and H. W. Grinnell.

Type locality.—Yosemite Valley, 4,000 feet altitude, Mariposa County, Calif.

Geographic range.—Extreme south-central Oregon, northern California south through the inner coast range, to about 39° 30′ N., and southeast of Sacramento Valley to Kaweah River; also extreme west-central Nevada near California line. (Fig. 10.)

Diagnostic characters.—Similar to *Sorex t. montereyensis* but slightly paler and more drabish (less brownish) in color, with apparently average larger skull with broader brain case.

Color.—Winter pelage: Upper parts between hair brown and mouse gray; underparts smoke gray tinged with light drab or drab gray, tail bicolor, hair brown to drab above, below pale ochraceous-buff to nearly pale pinkish cinnamon. *Summer pelage:* Upper parts hair brown; underparts light drab or slightly paler, sometimes near drab gray; tail bicolor, hair bown to drab above, near tilleul buff below.

Skull.—Similar to that of *S. t. montereyensis*, possibly averaging larger with broader cranium.

Measurements.—Type specimen (adult female): Total length, 121; tail vertebrae, 51; hind foot, 14. Average of three adult females from altitudes 4,700 feet to 6,400 feet, Yosemite Park, Mariposa County, Calif.: Total length, 117.7 (116–120); tail vertebrae, 50.3 (50–51); hind foot, 14.5 (14–15), *Skull:* Type specimen (adult female; teeth moderately worn): Condylobasal length, 18.6; palatal length, 7.7; cranial breadth, 9.3; interorbital breadth, 4.2; maxillary breadth, 5.7; maxillary tooth row, 7.1. Average of three skulls of adult females (teeth slightly worn) from altitudes of 4,700 feet to 6,400 feet, Yosemite Park, Mariposa County, Calif.: Condylobasal length, 18.6 (18.4–18.8); palatal length 7.4 (7.3–7.5); cranial breadth 9.3 (9.2–9.4); interorbital breadth, 4.2 (4.1–4.3); maxillary breadth, 5.6 (5.5–5.7); maxillary tooth row, 7.0 (6.9–7.1).

Remarks.—The Yosemite form of *trowbridgii* closely resembles *S. t. montereyensis*, being but slightly paler and more drabish in color, and with slight cranial differences. It apparently intergrades with both *S. t. humboldtensis* and *montereyensis*. The four specimens from Liarly Ranch, 4 miles south of Mount Sanhedrin, Mendocino County, Calif., are provisionally referred to *S. t. mariposae*. Two of these specimens, collected in August, 1905, are more brownish than typical *mariposae* and in color show an approach toward *montereyensis*, to which they could about as well be referred; the other two, collected in August, 1913, are darker and more grayish than typical *mariposae* and in this respect approach *humboldtensis*, but the skulls show no tendency toward that form. A single specimen from South Yolla Bolly Mountain, Calif., is like *mariposae* in color, but cranially shows a distinct similarity to *humboldtensis*. Except that the skulls may run a trifle smaller and the dentition appears weaker, specimens from Swan Lake Valley and Lakeview, Oreg., do not differ from those of average typical *mariposae*.

Specimens examined.—Total number, 77, as follows:

California: American River (Middle Fork), 1; Beswick, 1; Canyon Creek (altitude 4,600 feet), 3; Carberry's Ranch, 1; Castle Lake (altitude 5,434 feet), 1[53]; Chinquapin (near, altitude 6,200 to 6,400 feet), 3[53]; Cisco (altitude 6,000 feet), 4[53]; Downieville, 1; Dutch Flat (altitude 3,400 feet), 1[53]; Eldorado County, 2; Emerald Bay, 1; Emerald Bay (Lake Tahoe), 1; Fyffe, 2[54]; Fyffe (altitude 3,600 feet), 1[53]; Gentrys Big Oak Flat Road (altitude 5,800 feet, Yosemite Park), 1[53]; Giant Forest, Sequoia National Park, 1; Glen Alpine Springs, 1[53]; Hayden

[53] Mus. Vert. Zool. [54] Mus. Comp. Zool.

Hill, 1; Indian Canyon (east fork, Mariposa County), 1[53]; Jackson Lake, Siskiyou County, 1[53]; Kaweah River (east fork), 1; Liarly's Ranch (8 miles east of Hearst, Mendocino County), 3[55]; Merced Grove Big Trees, Mariposa County (altitude 5,400 feet), 2[53]; Merced Lake (2 miles east), Yosemite Park, 1[53]; Michigan Bluff, 1; Mount Lassen (south base, Mill Creek, altitude 5,000 feet), 2; Mount Shasta (Mud Creek, timber-line), 1; Mount Shasta (Upper Mud Creek), 4; Mount Tallac, Eldorado County, 3[56]; Myers, Eldorado County, 1[57]; Parker Creek, Warner Mountains, 2[53]; Placerville, 1[53]; Prattville (12 miles northeast), 1; Sequoia National Park (Halsted Meadows), 5; Slipperyford, 1[58]; South Yolla Bolly Mountain, 2[55]; Squaw Creek Valley (Warmcastle Soda Springs), 1; Sweetwater Creek (altitude 3,800 feet, 2 miles east Feliciana Mountain), 2[53]; "The Spring" Yosemite Falls Trail, Yosemite Valley (altitude 4,700 feet), 2[53]; Tower House, Shasta County, 2[53]; Tower House (altitude 1,268 feet), Shasta County, 1[53]; Yosemite, 1; Yosemite Valley (altitude 4,000 feet, type locality), 3.[53]

Nevada: Verdi, 2.

Oregon: Lakeview, 1; Swan Lake Valley, 2.

TABLE 8.—*Cranial measurements of adult specimens of* Sorex trowbridgii *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. t. trowbridgii:										
Oregon—										
Astoria	3088	------	17.5±	6.8	8.6±	3.8	5.0	6.5	Moderate	Lectotype.
Do	24315	♀	17.6	6.9	8.6	3.8	4.9	6.4	Slight	Type locality.
Do	89021	♀	17.6	6.9	8.9	3.8	5.0	6.6	---do	Do.
Vida	204440	♀	17.5	6.9	8.9	3.6	4.8	6.4	---do	
Do	204473	♀	17.3	6.9	8.4	3.8	5.0	6.5	---do	
Do	204475	♀	17.1	6.7	8.8	3.9	5.0	6.3	---do	
Do	204476	♀	17.1	6.8	8.3	3.8	4.9	6.5	---do	
British Columbia—										
Sumas	62999	♂	17.5	6.9	8.6	3.8	4.9	6.5	---do	
Do	99748	♂	17.5	7.0	8.5	4.0	5.0	6.6	---do	
Do	102688	♂	17.4	6.8	8.8	3.9	5.0	6.4	---do	
S. t. humboldtensis:										
California—										
Carsons Camp, Mad River, Humboldt Bay.	97271	♂	17.8	7.2	8.9	4.1	5.4	6.7	---do	Type specimen.
Arcata	97251	♂	18.3	7.2	9.1	3.9	5.3	6.9	Moderate	
Do	[1] 11813	♂	18.2	7.2	8.9	4.1	5.3	6.9	---do	
Do	[1] 11814	♂	18.2	7.1	9.0	4.0	5.3	6.9	---do	
S. t. montereyensis:										
California—										
Monterey	44810	♂	18.0	7.3	9.1	4.2	5.6	7.0	Slight	Do.
Do	44809	♀	18.3	7.3	8.7	4.2	5.5	6.8	---do	Type locality.
Do	[1] 3467	♀	18.1	7.4	9.0	4.1	5.6	7.0	---do	Do.
Do	[2] C125	♀	18.4	7.3	9.1	4.0	5.4	7.0	---do	Do.
Pacific Grove	107920	♀	18.0	7.2	9.2	4.3	5.7	6.9	---do	Do.
Do	159943	♀	18.1	7.3	9.0	4.2	5.5	6.8	---do	
S. t. mariposae:										
California—										
Yosemite Valley, 4,000 feet.	[1] 12979	♀	18.6	7.7	9.3	4.2	5.7	7.1	Moderate	Type specimen.
Yosemite Valley, 4,700 feet.	[1] 21541	♀	18.8	7.5	9.4	4.2	5.6	7.1	Slight	Essentially type locality.
Merced Grove Big Trees, 5,400 feet.	[1] 22013	♀	18.4	7.4	9.3	4.3	5.7	7.0	---do	
Near Chinquapin, 6,400 feet.	[1] 22015	♀	18.5	7.3	9.2	4.1	5.5	6.9	---do	

[1] Mus. Vert. Zool. [2] Donald R. Dickey, coll., Pasadena, Calif.

[53] Mus. Vert. Zool. [55] Mus. Vert. Zool., 1. [56] Amer. Mus. Nat. Hist. 1; Mus. Comp. Zool., 2. [57] D. R. Dickey coll., Pasadena, Calif. [58] Acad. Nat. Sci. Philadelphia.

SOREX VAGRANS-OBSCURUS GROUP

The *vagrans-obscurus* group includes five species—*Sorex vagrans*, *S. durangae*, *S. obscurus*, *S. yaquinae*, and *S. pacificus*.

Geographic range.—Western North America from western (Seward Peninsula) and central Alaska, south through British Columbia and Alberta, east to central Montana and Colorado, south to southern California, southern New Mexico, and in the mountains through Arizona to the States of Michoacan, Puebla, and Vera Cruz, Mexico.

Diagnostic characters.—Size variable in the different species, small (*S. vagrans*) to large (*S. pacificus*), skull but moderately flattened, rostrum comparatively short and broad, third unicuspid distinctly smaller than fourth, the ridge extending internally from apex of unicuspid to border of cingulum well developed, usually heavily pigmented, and tending apically to form a distinct cusplet. Compared with the *trowbridgii* group, the teeth are relatively broader, and the internal ridge from the apex of the unicuspid different. Compared with any of the *ornatus* group, the skull is less flattened; the foramen magnum is placed relatively ventrad, encroaching less into supraoccipital and more into basioccipital; metacone of pm^3 comparatively low.

Remarks.—The members of the *vagrans-obscurus* group constitute several forms the exact relationships of which in some cases are complicated and difficult to solve. The relationship between *S. v. monticola* and *S. o. obscurus*, both of which occur in the Rocky Mountains, is particularly perplexing. Actual intergradation between these two apparently does not exist, although certain specimens are difficult to identify. As one passes eastward from the coast region of Washington there is noticeable an increase in size, in length of tail, and in size of skull and teeth of *S. vagrans*, which becomes recognizable in the subspecies *monticola*. Exactly the reverse occurs in the representative (*S. o. setosus*) of the species *obscurus* from the coast region eastward to its intergrading form, the subspecies *obscurus*. Intergradation of *S. o. obscurus* with *setosus*, and of *S. v. vagrans* with *monticola* is clearly demonstrated. The result is, that in the coast region of Washington and British Columbia, where representatives of the species *vagrans* and *obscurus* occur, they are contrastedly different, whereas throughout the Rocky Mountains, wherever the two species occur, they can be separated only by most careful study.

SOREX VAGRANS Baird

[Synonymy under subspecies]

Geographic range.—Extreme southern British Columbia, western Montana, south to central California, central Nevada, and in the Rocky Mountains through Arizona, the States of Michoacan, Puebla, and Vera Cruz, Mexico. (Fig. 11.)

Diagnostic characters.—Size small, tail comparatively short, hind foot small. The species *vagrans* needs critical comparison only with the species *obscurus* from which it differs not only in size but in cranial and dental characters as follows: Skull smaller, narrower, particularly interorbitally and through rostrum, palate shorter; superior border of foramen magnum tending to be more acute; teeth smaller, the protoconid of m_1 lower than in *Sorex obscurus*, relatively and actually narrower unicuspids, and smaller i^1. Compared with *S. durangae* the skull of *S. vagrans* is decidedly weaker and narrower, with the lachrymal region not swollen (as in *S. durangae*), and the rostrum and dentition distinctly weaker.

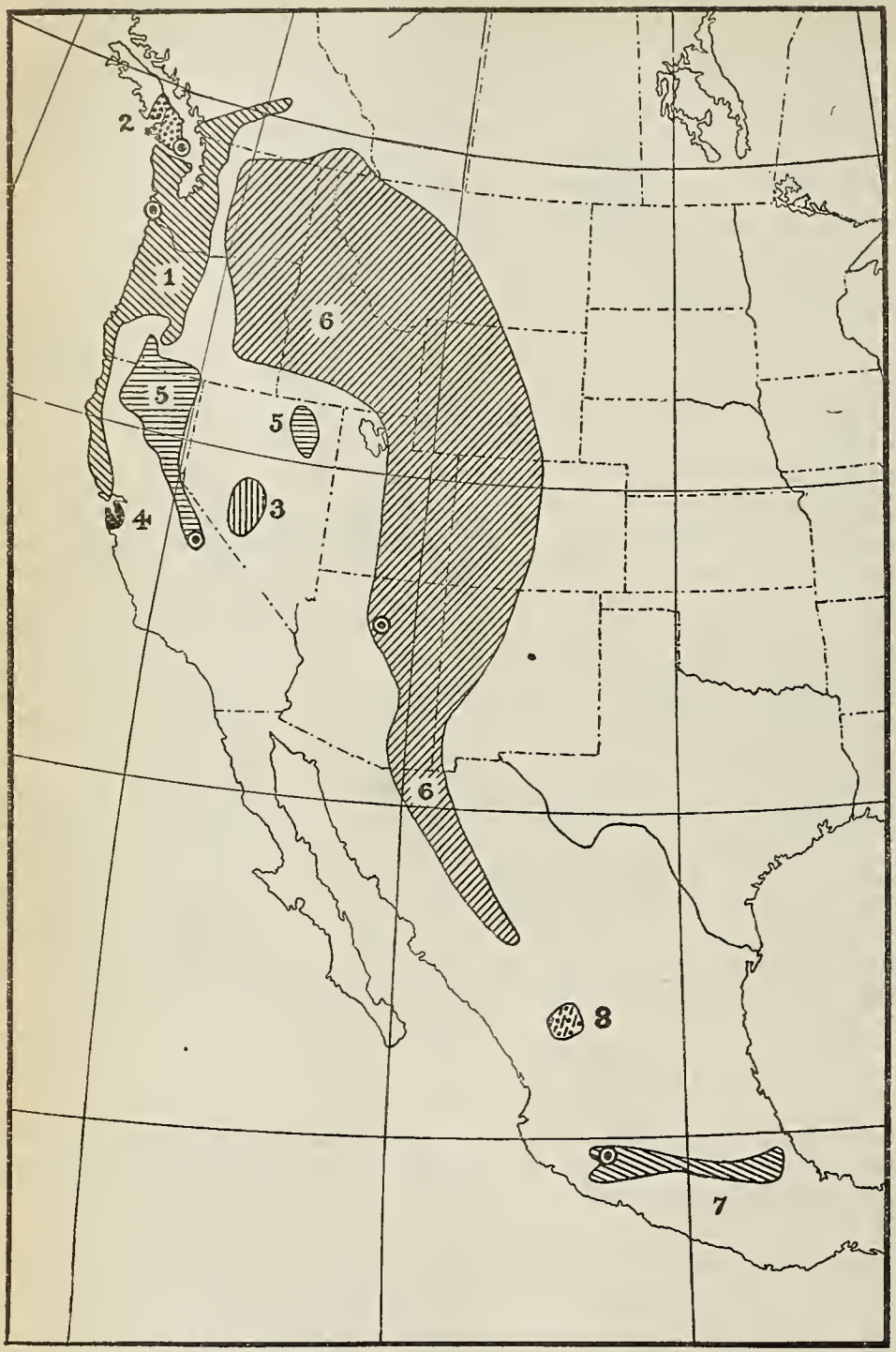

FIG. 11.—Geographic range of subspecies of *Sorex vagrans* and of the species *S. durangae*

1. *S. v. vagrans.*
2. *S. v. vancouverensis.*
3. *S. v. nevadensis.*
4. *S. v. halicoetes.*
5. *S. v. amoenus.*
6. *S. v. monticola.*
7. *S. v. orizabae.*
8. *S. durangae.*

Subspecies and geographic variation.—The species *vagrans* is divided into seven subspecies: *vagrans, vancouverensis, nevadensis, halicoetes, amoenus, monticola,* and *orizabae.* Starting with the typical form in the coast region of Washington, there is a slight darkening of color toward the northward, which on Vancouver Island, British Columbia, is recognizable in the subspecies *vancouverensis.* Southward there is also a tendency for the color to darken as well as a noticeable increase in size, which culminates in the darkest subspecies, *halicoetes.* Toward the southeast from the region of typical *vagrans* there is a slight tendency toward a darker form, the tail shortens a trifle, and the skull becomes somewhat smaller in *amoenus* and in *nevadensis,* which is also small and rather dark with a flatter skull. Eastward from the region of the subspecies *vagrans* there is a slight increase in size, a slight paling, and an increase in tail length recognizable in the form *monticola,* which to the extreme south in Mexico passes into the smaller, slightly darker form *orizabae,* with its comparatively narrow skull.

Time of molting.—The earliest indication of spring molt is in a female *S. v. vagrans* from Duckabush, Wash., January 31, 1919, which shows a darkened condition of the skin over the entire back and flanks, and to a less extent on the ventral parts. Another specimen from the same locality January 26 is in worn winter pelage. A female from Tokeland, Shoalwater Bay, Wash., retains winter pelage May 7, 1918, while another shows indications of beginning molt May 4. A male from Chehalis, Wash., has summer pelage coming in under the winter fur over the entire back, April 29, 1918. One from Kirkland, in the same State, has the mid-back in summer fur, rump in winter pelage, and shoulders and head in process of molt, May 13, 1911. Twenty-nine specimens of *S. v. vagrans* collected at Neah Bay, Wash., the last half of May, 1897, are for the most part in complete summer pelage. A male of *S. v. halicoetes* from Belmont, Calif., has the molt well started over the entire animal March 21, 1908, and another from Elmhurst, Calif., has the molt in about the same condition as the Belmont specimen on April 1, 1908. A female *halicoetes* from Palo Alto, Calif., has the molt barely begun on a small spot in the mid-back May 6. A male *S. v. amoenus* from Donner, Calif., has fresh summer fur on the head, shoulders, anterior back, flanks, and anterior two-thirds of the ventral parts, July 11, 1900, while a female from the same locality has the summer fur just coming in under the winter pelage over the entire back as late as July 17. Of a series of 14 specimens of *S. v. monticola* collected at Wallowa Lake, Oreg., between April 10 and 19, 1919, 7 retain the worn winter pelage, 6 are in summer fur, and 1 is in process of molting, the summer fur appearing under the winter over the entire back on April 10. A specimen from Stevensville, Mont., shows molt March 15, 1910. Specimens of *S. v. orizabae* from the type locality are in winter pelage April 22 to 25, 1893. One from Cofre de Perote, Vera Cruz, shows new fur coming in under the old on May 30.

The winter pelage is usually acquired during October. The earliest indications of fall molt are in a female of *S. v. vagrans* from Trout Lake, Wash., which has winter pelage appearing on the midback, occiput, and ventral parts, the remainder of the animal being in worn summer fur, August 28, 1918. A male collected August 29, 1897, at Soleduc River, altitude 4,000 feet in the Olympic Mountains, Wash., has the entire posterior half of the back, the right flank, nape, and ventral parts in winter pelage, the anterior part of the left side still retaining the summer fur. Other specimens of *S. v. vagrans* in process of fall molt have been collected at Lake Quinault, Wash., September 27, 1921; Steilacoom, Wash., October 5, 1891; Toledo, Wash., November 5, 1918; Tacoma, Wash., December 23, 1918; Yamsay Mountains, Oreg., September 6 and October 14, 1914; Upper Klamath Marsh, Oreg., September 11, 1914; Portland, Oreg., 3 females, October 13, 1914; Empire, Oreg., October 14, 21, and 22, 1909; Drain, Oreg., 3, November 22 and 23, 1894; Crescent City, Calif., three, October 13 and 14, 1905; and Point Reyes, Calif., October 27 and 29, 1904. Of 16 specimens of *S. v. amoenus* from Dana, Calif., collected between September 25 and October 1, 1904, 2 females and 4 males retain full summer fur, September 25 to 29; a female has complete winter fur September 30; and 5 males and 4 females collected between September 25 and October 1 are in various stages of molt, for the most part not far advanced. Specimens of *S. v. monticola* show molting at the following dates: Cornucopia, Oreg., September 3, 1915; Wallowa Lake, Oreg., September 14, 1897; Burns, Oreg., October 5, 6, and 8, 1916; and Anthony, Oreg., October 16, 18, and 28,, 1907. A female of *S. v. orizabae* from the north

slope of Volcan Toluca, D. F., Mexico, has acquired fresh winter pelage on the posterior half of the back, while another collected September 10 at the same locality retains the summer fur.

SOREX VAGRANS VAGRANS Baird

Vagrant Shrew

(Pls. 2, v; 5, d; 6, g; 8, e; 12, j)

Sorex vagrans Baird, Report Pacific R. R. Survey 8: pt. 1, Mammals, p. 15, 1857.
Sorex suckleyi Baird, Report Pacific R. R. Survey 8: pt. 1, Mammals, p. 18, 1857.
Type locality, Steilacoom, Pierce County, Wash.
Sorex vagrans vagrans Miller, U. S. Nat. Mus. Bul. 79, p. 14, December 31, 1912.

Type specimen.—No. 1675, U. S. Nat. Mus.; ♂ adult, alcoholic, entirely devoid of hair, skull not removed; received from J. G. Cooper, and entered in museum catalogue October 23, 1856.

Type locality.—Shoalwater Bay (known also as Willapa Bay), Pacific County, Wash.

Geographic range.—Extreme southwestern mainland of British Columbia, western Washington, western Oregon, and northwestern California south to San Francisco Bay. (Fig. 11.)

Diagnostic characters.—Size small, tail medium in length (about two-thirds as long as head and body), feet small. Similar to *Sorex v. amoenus*, but averaging paler and rather more brownish in color, with slightly longer tail. More blackish above in winter pelage and paler and less brownish beneath in all pelages than *S. v. vancouverensis*. Upper parts in winter pelage similar to those of *S. v. halicoetes*, the underparts decidedly paler and less brownish; skull weaker than that of *halicoetes*. A shade darker and more reddish than *S. v. monticola*, with smaller rostrum and weaker dentition.

Color.—Winter pelage: Upper parts usually near chaetura black, frequently tending toward fuscous-black, sometimes more or less indistinctly and finely flecked with whitish hair tips, occasionally showing greenish reflections in certain lights; ears more reddish than general tone of upper parts; sides and flanks usually paler than upper parts; chaetura drab to hair brown; underparts pale smoke gray or occasionally almost smoke gray, usually tinged with pale pinkish buff; tail scarcely bicolor, mummy brown above, somewhat paler below, particularly basally. *Summer pelage:* Paler and more reddish than in winter. Upper parts usually near mummy brown, sometimes tending toward sepia, rarely almost fuscous; sides and flanks sometimes almost concolor with back, usually slightly paler, about between Saccardo's umber and olive-brown; underparts smoke gray mixed and washed with between wood brown and avellaneous; tail about as in winter.

Skull.—Small, with rather high brain case, moderately short mesopterygoid space, short and narrow rostrum, and weak dentition. Rostrum weaker and more attenuate than that of *S. v. halicoetes*, dentition weaker, and length of maxillary tooth row less. Skull slightly smaller than that of *S. v. monticola*, with somewhat weaker rostrum and smaller molariform teeth. Skull less flattened than that of *S. v. nevadensis*, with rostrum relatively broader and less attenuate.

Measurements.—Average of four adult males from Aberdeen, Wash.: Total length, 103.8 (102–105); tail vertebrae, 42.5 (42–44); hind foot, 12 (12–12). *Skull:* Average of four skulls of adult males (teeth slightly worn) from Aberdeen, Wash.: Condylobasal length, 16.6 (16.4–16.8); palatal length, 6.5 (6.4–6.6); cranial breadth, 8.2 (7.9–8.3); interorbital breadth, 3.3 (3.2–3.4); maxillary breadth, 4.6 (4.5–4.8); maxillary tooth row, 5.6 (5.5–5.7).

Remarks.—This is the common small shrew of the lower altitudes of the coast region of Washington, Oregon, and northern California, where it is confined principally to the Transition Zone. The subspecies *vagrans* clearly shows intergradation with *S. v. monticola*, *S. v. amoenus*, and *S. v. halicoetes*. Specimens from Lapine and

Paulina Lake, Oreg., particularly, show an approach toward *amoenus*, one specimen (No. 204920, U. S. Nat. Mus., Biol. Surv. coll.) from the latter locality being practically indistinguishable from typical *amoenus*, but on the whole the series seems to be nearer *S. v. vagrans*. Certain specimens from certain places (Crescent City, Eureka, Arcata, Point Reyes) of the coast region of California are a trifle larger than typical specimens of *S. v. vagrans* and have somewhat larger skulls with heavier rostra. Skulls of this character, however, are not dominant among these specimens and probably indicate an approach toward *halicoetes*.

A specimen (No. 234302, U. S. Nat. Mus., Biol. Surv. coll.) collected by George G. Cantwell at Richardson, Lopez Island, San Juan County, Wash., February 21, 1920, is especially interesting and suggestive. On the label to this specimen Cantwell has written "Habitat, Salt Marsh"; on the labels of 5 other specimens, collected the previous day at the same locality, there is no mention of the habitat and they may or may not have been trapped in a salt marsh, but probably not. The skulls of all 6 specimens are essentially identical and agree with those of typical *Sorex v. vagrans*. The color of the "salt marsh" specimen, however, is decidedly darker than the other 5, particularly ventrally, and is indistinguishable in this respect, from specimens of typical *S. v. halicoetes*. One is surely warranted in suspecting that salt water may affect the color of the hair under certain conditions. Here lies an interesting problem for investigation.

Specimens examined.—Total number, 632, as follows:

British Columbia: Agassiz, 1[59]; Burrard Inlet, 1[59]; Cape Flattery, 1; Hope, 1[60]; Hope (Lake House), 8[60]; Hope (Roab's Ranch), 2[60]; Langley, 1; Lulu Island, 6[59]; Mount Baker Range, 1[59]; Nahun Plateau, 2[61]; Okanagan, 9[62]; Port Moody, 16; Saturna Island, 10[60]; Sumas, 39[63]; Westminster Junction, .4.[64]

California: Arcata, 2[63]; Carlotta, 1[66]; Carlotta (at mouth Eel River), 2[66]; Crescent City, 20; Cuddeback, 1[65]; Eureka, 3[67]; Eureka (5 miles north), 2[66]; Eureka (5 miles northeast), 1[66]; Ferndale, 5[65]; Humboldt Bay, 10; Inverness, 12[65]; Inverness (8 miles west), 1[65]; Loleta, 1[66]; Novato Point, Marin County, 1[65]; Petaluma, 3; Point Arena, 1[65]; Smith River, Del Norte County, 2; Point Reyes, 8.[68]

Oregon: Albany, 4[66]; Beaverton, 1; Blaine, 4[69]; Cascade Mountains, 1; Corvallis, 2; Deschutes River (east fork), 2; Deschutes River (Farwell Bend), 1; Drain, 5; Empire, 5; Eugene, 2; Florence, 1; Gardiner, 2[70]; Gold Beach, 4; Hillsboro (5 miles southeast), 1; Lapine, 8; Looking Glass, Douglas County, 1; McKenzie Bridge (10 miles south, O'Leary Mountain, altitude 5,000 feet), 1; McKenzie Bridge (10 miles east, Lost Creek), 2; Mapleton, 1; Marshfield, 10[71]; Mercer, 1[72]; Mount Hood (north slope, altitude 2,800 feet), 2; Mount Hood (west slope, near timberline), 1; Mount Jefferson (west base, Permilia Lake), 2; Oregon City, 3[73]; Parkdale (2 miles west, altitude 1,500 feet), 1; Paulina Lake, 7; Philomath (5 miles southwest), 5; Portland, 22[74]; Portland (Westmoreland addition), 14[75]; Portland (Switzler Lake), 5; Port Orford, 1; Salem, 10[76]; Scottsburg, 3; Seaside, 1; Shelburn,

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[59] Acad. Nat. Sci. Philadelphia.
[60] Mus. Comp. Zool.
[61] Provincial Mus. British Columbia.
[62] Mus. Comp. Zool., 4; Provincial Mus. British Columbia, 5.
[63] Mus. Comp. Zool., 20; Acad. Nat. Sci. Philadelphia, 3.
[64] Amer. Mus. Nat. Hist.
[65] Mus. Vert. Zool.
[66] D. R. Dickey coll., Pasadena, Calif.
[67] Mus. Vert. Zool., 2; D. R. Dickey coll., 1.
[68] Mus. Comp. Zool., 1.
[69] Univ. Mich.
[70] Field Mus. Nat. Hist.
[71] Field Mus. Nat. Hist., 8; Mus. Comp. Zool., 2.
[72] S. G. Jewett coll., Portland, Oreg.
[73] D. R. Dickey coll., 1.
[74] Mus. Vert. Zool., 2.
[75] Mus. Vert. Zool., 3; S. G. Jewett coll., Portland, Oreg., 11.
[76] Amer. Mus. Nat. Hist., 2.

1; Sheridan, 2; Silverlake (10 miles southwest, west Silver Creek, altitude 4,650 feet), 3; Three Sisters (north slope, altitude 5,000 to 6,000 feet), 3; Tillamook (Fairview), 2[77]; Upper Klamath Marsh, 2; Vida, 1; Warmsprings (20 miles west, Mill Creek), 2; Yamsay Mountains (West Fork, Silver Creek, altitude 7,000 feet), 4; Yamsay Mountains (Yamsay River, altitude 4,800 feet), 1.

Washington: Aberdeen, 20; Avon, 3; Bear Prairie, Mount Rainier, 1; Beaver Creek (altitude 1,700 feet), Whatcom County, 5[78]; Blaine, 1; Blyn, 1; Carson, 1; Cat Creek (altitude 4,500 feet, Olympic Mountains, 1[79]; Cathlamet, 1; Chehalis, 2; Chehalis (8 miles west), 2; Clinton (3 miles north), 1; Duckabush, 6; Dungeness, 1; East Sound, Orcas Island, 3; Easton, 3; Elwha, 1[79]; Enumclaw, 1; Forks, 1; Fort Steilacoom, 1; Friday Harbor, San Juan Island, 1; Glacier (altitude 900 feet), 1; Goldendale, 1; Goldendale (15 miles north, near Potato Hill, Simcoe Mountains), 1[79]; Greenbank, 2; Greenville (Grays Harbor County), 1; Hamilton, 1; Hoodsport, 1; Ilwaco, 1; Kent, 1; Kirkland, 20; La Conner, 5; Lake Cushman, 17[80]; Lake Quinault, 2; Lake Washington (near Renton), 2; Lake Whatcom, 1; Lapush, 5; Lopez Island, 4[81]; Mount Vernon, 2; Neah Bay, 31[76]; Nisqually, 22[82]; Nisqually Flats, 2; Northbend, 2; Oakville, 1; Olympia (4 miles south), 1; Olympic Mountains (altitude 5,200 feet), Soleduck River, 1; Oso (altitude 550 feet), 2; Port Townsend, 3; Puget Island (1 mile south), 2; Puget Sound, 12; Puyallup, 20[83]; Quinault Lake, 7; Redmont (Sammamish River), 2; Reflection Lake (altitude 4,850 feet), Mount Rainier, 1[79]; Richardson, 6; Roy, 3; San de Fuca, 3; Sauk, 1; Seattle (near), 1[65]; Sequim, 4; Shelton, 3[84]; Shoalwater Bay (type locality), 2; Signal Peak (altitude 4,000 feet), 1; Skokomish River (north fork), Olympic Mountains, 1; Steilacoom (type locality of *suckleyi*), 2; Stevenson, 1; Suez (10 miles south Neah Bay), 2; Tacoma (6 miles south), 2; Tacoma Tide Flats, 2[66]; Tenino, 4; Tokeland (Shoalwater Bay), 4; Toledo, 1; Toledo (45 miles southeast), Cascade Mountains, Skamania County, 2; Trout Lake (15 miles south Mount Adams, altitude 1,940 feet), 5; Vashon Island, 2; Westport, 5; Whidbey Island (north end), 4; White Salmon (15 miles northwest, Berry Creek), 1.

SOREX VAGRANS VANCOUVERENSIS Merriam

Vancouver Shrew

Sorex vancouverensis Merriam, North Amer. Fauna No. 10, p. 70, December 31, 1895.

Type specimen.—No. 71913, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth moderately worn), skin and skull; collected May 10, 1895, by Clark P. Streator.

Type locality.—Goldstream, Vancouver Island, British Columbia.

Geographic range.—Southern half of Vancouver Island, British Columbia. (Fig. 11.)

Diagnostic characters.—Darker than *S. v. vagrans*, particularly the ventral parts, which are distinctly more brownish; upper parts in winter pelage more reddish-brown (tending less toward grayish) than in *S. v. vagrans*. Tail longer than in *S. v. amoenus* and underparts darker and of different color (brownish). Upper parts in winter pelage more reddish brown and somewhat paler than *S. v. halicoetes* and differing somewhat cranially.

Color.—Winter pelage: Upper parts between chaetura drab and hair brown, tending somewhat toward grayish; sides slightly more brownish than back; underparts between drab and wood brown; tail usually scarcely bicolor, sometimes more distinctly so, near mummy brown above, buffy below at base and sometimes nearly to tip. *Summer pelage:* Upper parts fuscous or slightly

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[65] Mus. Vert. Zool.
[66] D. R. Dickey coll., Pasadena, Calif.
[76] Amer. Mus. Nat. Hist., 2.
[77] Alexander Walker coll., Tillamook, Oreg.
[78] State Coll. Wash., 2.
[79] State Coll. Wash.
[80] Amer. Mus. Nat. Hist., 1; Univ. Michigan, 5.
[81] D. E. Brown coll., Seattle, Wash.
[82] Acad. Nat. Sci. Philadelphia, 21.
[83] D. R. Dickey coll., 5; G. G. Cantwell coll., Palms, Calif., 9.
[84] Acad. Nat. Sci. Philadelphia, 1.

darker; sides scarcely paler than back; general tone of underparts drab to hair brown; tail as in winter.

Skull.—Essentially like that of *S. v. vagrans.*

Measurements.—Type specimen (adult male): Total length, 110; tail vertebrae, 43; hind foot, 12. Average of six adult males from Alberni Valley, Vancouver Island, British Columbia: Total length, 106.5 (97–115); tail vertebrae, 41.7 (40–43); hind foot, 12 (11–13). *Skull:* Type specimen (adult male; teeth moderately worn): Condylobasal length, 16.6; palatal length, 6.5; cranial breadth, 8.2; interorbital breadth, 3.2; maxillary breadth, 4.5; maxillary tooth row, 5.7. Average of six skulls of adult males (teeth moderately worn) from Alberni Valley, Vancouver Island, British Columbia: Condylobasal length, 16.4 (16.1–16.8); palatal length, 6.5 (6.4–6.6); cranial breadth, 8.2 (8.1–8.4); interorbital breath, 3.3 (3.2–3.4); maxillary breadth, 4.6 (4.5–4.7); maxillary tooth row, 5.6 (5.5–5.7).

Remarks.—This representative of the species *vagrans* is limited in its distribution to Vancouver Island, British Columbia. It is closely related to *S. v. vagrans*, from which it differs only in its general darker color with its ventral parts more brownish, and in winter pelage with its upper parts more rusty brown.

Specimens examined.—Total number, 97, as follows:

British Columbia: Alberni (18 miles south, Golden Eagle Mine), 4[85]; Alberni Valley, 70[85]; Bear Lake, Vancouver Island, 1[86]; Errington, 2[85]; French Creek, Vancouver Island, 1[85]; Goldstream (type locality), 1; Nanaimo, 1; Parksville, 1[85]; Sahtlam, 1[87]; Shawnigan Lake, 1[88]; Victoria, 14.[89].

SOREX VAGRANS NEVADENSIS Merriam

Nevada Shrew

(Pl. 2, w)

Sorex nevadensis Merriam, North Amer. Fauna No. 10, p. 71, December 31, 1895.

Type specimen.—No. $\frac{24891}{32302}$, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn); collected November 24, 1890, by Vernon Bailey.

Type locality.—Reese River at about 6,000 feet, at line between Lander and Nye Counties, Nev.

Geographic range.—Central Nevada. (Fig. 11.)

Diagnostic characters.—In winter pelage similar to *Sorex v. vagrans* and *S. v. amoenus* in color; skull more flattened, the rostrum weaker and more attenuate. Darker than *S. v. monticola* in winter pelage, smaller, and with more flattened skull having weaker dentition and more attenuate rostrum.

Color.—Winter pelage: Similar to corresponding pelage of *S. v. amoenus*, but slightly paler above, with more distinctly bicolor tail (paler below). Upper parts chaetura drab or between chaetura drab and hair brown; sides paler, drab or between drab and light drab; underparts smoke gray very lightly washed and intermixed with pale pinkish cinnamon; tail bicolor, mummy brown above, drab below nearly to tip. *Summer pelage:* Unknown.

Skull.—Brain case more flattened, and rostrum relatively narrower and more attenuate than in any other subspecies; dentition weak (about as in *S. v. vagrans*).

Measurements.—Type specimen (adult male) and topotype (adult male): Total length, 96, 98; tail vertebrae, 39, 39; hind foot, 12, 13. *Skull:* Type specimen (adult male; teeth slightly worn) and topotype (adult male; teeth slightly worn): Condylobasal length, 16.6, 16.1; palatal length, 6.6, 6.6; cranial breadth,

[85] Mus. Vert. Zool.
[86] Nat. Mus. Canada.
[87] Provincial Mus. British Columbia.
[88] Amer. Mus. Nat. Hist.
[89] Acad. Nat. Sci. Philadelphia, 3; Nat. Mus. Canada, 9; Provincial Mus. British Columbia, 2.

7.9, 8.2; interorbital breadth, 3.2, 3.2; maxillary breadth, 4.6, 4.5; maxillary tooth row, 5.6, 5.7.

Remarks.—On account of insufficient material, the exact status of *S. v. nevadensis* is unsatisfactorily determined. It probably intergrades with both *S. v. amoenus* and *S. v. monticola.* The specimen (an alcoholic) from Cloverdale, Nev., has the weak dentition of typical *nevadensis* and a rather narrow rostrum; the skull is not so much flattened, however, and in this respect the individual tends to approach *amoenus* or *monticola.*

Specimens examined.—Total number, 4, as follows:

Nevada: Cloverdale, 1; Reese River (type locality), 3.

SOREX VAGRANS HALICOETES Grinnell

Salt-marsh Shrew

(Pl. 2, x)

Sorex halicoetes Grinnell, Univ. Calif. Publ. Zool. 10: 183, March 20, 1913.

Type specimen.—No. 3638, Mus. Vert. Zool., Univ. California; ♂ young adult (teeth much worn), skin and skull (skull with left side of brain case broken away); collected May 6, 1908, by Joseph Dixon.

Type locality.—Salt marsh near Palo Alto, Santa Clara County, Calif.

Geographic range.—Coast region of California, south and east of San Francisco Bay; between latitudes 37° and 38° north. (Fig. 11.)

Diagnostic characters.—Color dark (blackish above), the underparts decidedly dark and brownish, the skull with rather broad rostrum and relatively long maxillary tooth row. Upper parts in winter pelage about the color of corresponding pelage of *S. v. vagrans*, but with underparts decidedly darker and more brownish. Underparts about as in *S. v. vancouverensis*, but upper parts less reddish-brown, and somewhat darker. Rostrum heavier and maxillary tooth row longer than in either *S. v. vagrans* or *vancouverensis.* Underparts darker and more brownish than in *S. v. amoenus*, tail rather longer, and rostrum somewhat heavier. Darker both dorsally and ventrally than *S. v. monticola*, with shorter tail, but similar in cranial characteristics.

Color.—Winter pelage: Upper parts chaetura black or between chaetura black and fuscous-black, sometimes almost chaetura drab; ears more reddish than back; sides and flanks scarcely paler than back, a shade more brownish; general tone of underparts a drabish or buffy dark gray, deep mouse gray heavily tinged and intermixed with between drab or hair brown, or buffy brown; tail mummy brown, scarcely bicolor, sometimes paler below particularly basally. *Summer pelage:* Unknown.

Skull.—Rostrum heavier and less attenuate than in *S. v. vagrans* or *S. v. amoenus*, dentition heavier, and length of maxillary tooth row greater. Scarcely distinguishable from the skull of *S. v. monticola.*

Measurements.—Type specimen (adult male): Total length, 108; tail vertebrae, 40; hind foot, 12. Adult male and adult female from type locality: Total length, 106, 105; tail vertebrae, 40, 39; hind foot, 13, 12. *Skull:* Type specimen (adult male; teeth much worn): Condylobasal length, 16.8; palatal length, 6.5; interorbital breadth, 3.6; maxillary breadth, 5.0; maxillary tooth row, 5.9. Skulls of adult male (teeth much worn) and adult female (teeth slightly worn) from type locality; Condylobasal length, 17.0, 16.5;; palatal length, 6.6; 6.4; cranial breadth, 8.5, 8.3; interorbital breadth, 3.5, 3.5; maxillary breadth, 4.8, 4.9; maxillary tooth row, 6.0, 6.0.

Remarks.—This dark form differs from *S. v. vagrans* not alone in color, but also cranially. Intergradation with the subspecies *vagrans* is indicated in specimens from the coast region of California north of San Francisco Bay. Specimens from San Mateo County, Calif., are not in strict conformity with typical *S. v. halicoetes.* In

fact one of the two specimens from San Mateo is almost exactly the color of certain specimens of *S. v. vagrans*. It is in worn and faded pelage, however, and is hardly comparable. The skull of it is indistinguishable from that of *halicoetes*.

Specimens examined.—Total number, 30, as follows:

California: Belmont, 1[90]; Berkeley, 1; Elmhurst, 4[90]; Melrose Marsh, Alameda County, 1[90]; Palo Alto (type locality), 10[91]; Redwood City, 3[90]; San Francisco, 5[92]; San Gregorio, 2[90]; San Mateo, 2; West Berkeley, 1.

SOREX VAGRANS AMOENUS Merriam

Sierra Shrew

Sorex amoenus Merriam, North Amer. Fauna No. 10, p. 69, December 31, 1895.
Sorex shastensis Merriam, North Amer. Fauna No. 16, p. 87, October 28, 1899. Type locality, Wagon Camp, Mount Shasta (altitude 5,700 feet in the lower part of Canadian Zone), Calif.
Sorex vagrans amoenus Merriam, North Amer. Fauna No. 16, p. 87, October 28, 1899.

Type specimen.—$\frac{29784}{41863}$, U. S. Nat. Mus., Biological Survey collection; ♂ old adult (teeth much worn), skin and skull; collected July 22, 1891, by E. W. Nelson.

Type locality.—Near Mammoth, altitude about 8,000 feet[93], head of Owens River, east slope Sierra Nevada, Mono County, Calif.

Geographic range.—South-central Oregon, northwestern California, south in the Sierra Nevada to Mammoth, Calif.; northeastern Nevada. (Fig. 11.)

Diagnostic characters.—Similar to *Sorex v. vagrans* but averaging a trifle darker and less reddish in summer pelage, and with somewhat shorter tail. Paler than *S. v. halicoetes*, particularly the ventral parts, and differing cranially. Skull higher and with less attenuate rostrum than that of *S. v. nevadensis*. Darker, especially in winter, and with shorter tail than *S. v. monticola*, the skull usually with narrower rostrum and weaker dentition.

Color.—Winter pelage: Usually more or less tricolor. Upper parts fuscous-black, sometimes tending toward chaetura drab, certain specimens displaying in some lights greenish reflections; sides and flanks distinctly paler and more drabbish, between drab and hair brown, sometimes inclining toward olive-brown; underparts smoke gray washed with pinkish buff; tail indistinctly bicolor, mummy brown above, paler below, particularly basally. *Summer pelage:* Less tricolor than in winter. Upper parts fuscous or between fuscous and hair brown, scarcely paling on the sides; underparts and tail about as in winter.

Skull.—Essentially like that of *S. v. vagrans*.

Measurements.—Type specimen (old adult male): Total length, 103; tail vertebrae, 38; hind foot, 12. Adult female from Mammoth, Calif.: Total length, 99; tail vertebrae, 38; hind foot, 12.7. *Skull:* Type specimen (old adult male; teeth much worn): Condylobasal length, 16.8; palatal length, 6.6; cranial breadth, 8.5; interorbital breadth, 3.3; maxillary breadth, 4.8; maxillary tooth row, 5.9. Skull of adult female (teeth very slightly worn) from Mammoth, Calif.: Condylobasal length, 16.5; palatal length, 6.4; cranial breadth, 8.2; interorbital breadth, 3.2; maxillary breadth, 4.8; maxillary tooth row, 5.7.

Remarks.—*S. v. amoenus* averages a shade darker than *S. v. vagrans* and has a shorter tail. Intergradation between the two forms is evident in certain specimens from southwestern Oregon and northern California. Thus specimens from Crater and Diamond Lakes, Oreg., can about as well be referred to *S. v. vagrans* as to

[90] Mus. Vert. Zool.
[91] Mus. Vert. Zool., 7.
[92] Amer. Mus. Nat. Hist., 1.
[93] Not Mammoth Pass, 10,000 feet, as stated by Merriam (1895, p. 69). See Howell, A. B., 1923, p. 266.

amoenus, and those from Hornbrook, Calif., although referable to *amoenus*, show a tendency toward the subspecies *vagrans*. The single specimen from Reno, Nev., shows no appreciable approach toward *S. v. nevadensis*.

Merriam's *S. shastensis* is here placed in synonymy under *S. v. amoenus*. The type specimen of *S. shastensis* (No. 95450, United States National Museum, Bureau of Biological Survey collection), upon careful comparison, proves to be only a small representative of *amoenus*. In the series of 23 specimens of *amoenus* from Mount Shasta the type specimen of *S. shastensis* is the minimum in size of skull and dentition, and in some respects is rather aberrant; but it is perfectly connected by gradual intergrades with the rest of the series and can be matched almost perfectly by occasional skulls of *amoenus* throughout the range of the subspecies.

Specimens examined.—Total number, 292, as follows:

California: Alvord (Owen Valley), Inyo County, 1; Bear Creek (head, altitude, 6,400 feet), Trinity County, 1[94]; Beswick, 1; Bieber (altitude, 4,500 feet), 1; Brownell, Klamath Lake (altitude, 4,300 feet), 1; Buck Ranch, Plumas County, 20[95]; Burney (12 miles east, altitude, 4,700 feet, Redding-Bieber Road), 1; Canyon Creek (altitude, 6,000–7,500 feet), Trinity County, 2; Carberrys Ranch, 4; Cassel, 2; Castle Lake (altitude, 5,400 feet), Siskiyou County, 2[94]; Cliff House, 2[96]; Dana, 17; Davis Creek, Goose Lake, 1; Donner (altitude, 7,500–7,900 feet), 3; Dry Creek (altitude, 4,800 feet), Warner Mountains, 1[94]; Fall Lake, Fall River Valley, 3; Fort Crook, 11; Goose Nest Mountain, Siskiyou County, 2; Hornbrook, 3; Independence Lake, Nevada County, 7[94]; Lake Audrain, 1[95]; Lassen Creek, Modoc County, 1[95]; Lassen Peak, 13; Lincoln Creek, Sierra County, 1; Long Valley (Convict Creek, altitude, 6,800 to 6,900 feet), 4[95]; Mammoth, Mono County, 3[95]; Mammoth (head of Owens River, near) (type locality), 2; Mayten, 9[97]; Mono Lake, 5[98]; Mount Conness, 1; Mount Dana, 1; Parker Creek (head north fork, altitude, 7,300 feet), Warner Mountains, 2[94]; Phillips, Eldorado County, 2[95]; Plumas County (altitude, 6000 feet), 1; Prattville (12 miles northeast), 2; Rush Creek (head), Siskiyou County, 3[94]; Salmon River (south fork), Siskiyou County, 3[94]; Shasta region, 1[94]; Sierra Valley, 1; Sisson, 24[99]; Spring Garden Ranch (vicinity), Grizzly Mountains, 3; Squaw Creek (head of), Mount Shasta, 2; Squaw Creek (altitude, 7,800 to 8,100 feet), Mount Shasta, 3; Sugar Hill (Goose Lake Meadows, altitude, 4,800 feet), Modoc County, 1[94]; Tallac, 3; Upper Ash Creek, Mount Shasta, 1; Upper Mud Creek, Mount Shasta, 8; Wagon Camp, Mount Shasta (type locality of *shastensis*), 5; Warmcastle Soda Springs, Squaw Creek Valley, 2; Warner Creek (Drakes Hot Springs), 1; Williams Butte (altitude, 6,900 feet), 2.[94]

Nevada: Mountain City, 1; Reno, 1[94]; Ruby Lake, 3; Ruby Mountains, 9.

Oregon: Anna Creek, Mount Mazama (altitude 6,000 feet), 1; Crater Lake, 24[1]; Diamond Lake, 6; Fort Klamath, 36[2]; Klamath Falls, 8[3]; Old Fort Klamath, 1[95]; Plush, Lake County, 1; Warner Creek, Warner Mountains, 1; Warner Mountains, 3.

SOREX VAGRANS MONTICOLA Merriam

Rocky Mountain Shrew

(Pl. 2, y)

Sorex monticolus Merriam, North Amer. Fauna No. 3, p. 43, September 11, 1890.

Sorex dobsoni Merriam, North Amer. Fauna No. 5, p. 33, July 30, 1891. Type locality, Alturas or Sawtooth Lake, altitude about 7,200 feet, east base of Sawtooth Mountains, Blaine County, Idaho.

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[94] Mus. Vert. Zool.
[95] D. R. Dickey coll., Pasadena, Calif.
[96] Mus. Comp. Zool.
[97] Mus. Vert. Zool., 7.
[98] Mus. Vert. Zool., 4.
[99] Mus. Vert. Zool., 4; D. R. Dickey coll., 13.
[1] D. R. Dickey coll., 6; Mus. Vert. Zool., 1.
[2] Amer. Mus. Nat. Hist., 1.
[3] G. G. Cantwell coll., Palms, Calif., 2.

Sorex vagrans dobsoni Merriam, North Amer. Fauna No. 10, p. 68, December 31, 1895.

Sorex vagrans monticola Merriam, North Amer. Fauna No. 10, p. 69, December 31, 1895.

Type specimen.—No. $\frac{17599}{24535}$, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected August 28, 1889, by C. Hart Merriam and Vernon Bailey.

Type locality.—San Francisco Mountain, altitude 11,500 feet, Coconino County, Ariz.

Geographic range.—Extreme southern British Columbia, eastern Washington, eastern Oregon, Idaho, western Montana, western Wyoming, south through eastern Utah, western Colorado, eastern Arizona, and western New Mexico to southern Chihuahua, Mexico. (Fig. 11.)

Diagnostic characters.—Differs from *Sorex v. vagrans*, *S. v. amoenus*, *S. v. nevadensis*, and *S. v. orizabae* in its slightly larger size and longer tail, distinctly paler and more grayish coloration (particularly in winter); skull with heavier rostrum and larger teeth than in *S. v. vagrans*, *amoenus*, or *nevadensis*. Skull relatively broader, brain case expanding more abruptly anteriorly, shorter maxillary tooth row, and heavier unicuspids than in *orizabae*. Similar to *S. o. obscurus*, but with average shorter tail and smaller foot, weaker and shorter rostrum, and smaller teeth.

Color.—Winter pelage: Upper parts hair brown or between hair brown and chaetura drab; sides and flanks usually a trifle paler than back, drabbish; underparts pale olive-gray washed with pale pinkish buff; tail bicolor, hair brown or olive-brown above, avellaneous or pinkish buff below. *Summer pelage:* Upper parts usually between olive-brown and fuscous, sometimes almost hair brown, frequently somewhat darker posteriorly than anteriorly; sides usually about same color as upper parts, sometimes slightly paler (drabbish); underparts smoke gray washed with avellaneous, vinaceous-buff, or occasionally tilleul buff; tail about as in winter or less clearly bicolor.

Skull.—Rostrum and teeth relatively heavy for the species *vagrans*, heavier than in any other subspecies of *S. vagrans* except *S. v. halicoetes*. Skull practically indistinguishable from that of *halicoetes*. Similar to that of *S. o. obscurus*, but palate averaging narrower; rostrum smaller, narrower, and more attenuate; dentition weaker, especially unicuspidate teeth.

Measurements.—Type specimen (adult male): Total length, 107; tail vertebrae, 45; hind foot, 12.5. Average of 3 adult males from Mount Thomas, White Mountains, Ariz.: Total length, 107.3 (104–110); tail vertebrae, 41.3 (40–43); hind foot, 12.8 (12.5–13). Adult male from Alturas (Sawtooth) Lake, Blaine County, Idaho (type locality of *S. dobsoni* Merriam): Total length, 106; tail vertebrae, 42; hind foot, 13. *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 16.7; palatal length, 6.7; cranial breadth, 8.2; interorbital breadth, 3.5; maxillary breadth, 4.8; maxillary tooth row, 5.8. Average of 3 skulls of adult males (teeth very slightly worn) from Mount Thomas, White Mountains, Ariz.: Condylobasal length, 16.3 (16.2–16.4); palatal length, 6.6 (6.5–6.7); cranial breadth, 8.2 (8.2–8.2); interorbital breadth, 3.5 (3.5–3.6); maxillary breadth, 4.7 (4.6–4.8); maxillary tooth row, 5.8 (5.7–6.0). Skull of adult male (teeth slightly worn) from Alturas (Sawtooth) Lake, Blaine County, Idaho (type locality of *S. dobsoni*): Condylobasal length, 16.4; palatal length, 6.5; cranial breadth, 8.3; interorbital breadth, 3.3; maxillary breadth, 4.7; maxillary tooth row, 5.7. Skulls of 2 adult females (teeth slightly worn) from Sawtooth City, Idaho (essentially type locality of *S. dobsoni* Merriam): Condylobasal length, 16.2, 16.9; palatal length, 6.6, 6.7; cranial breadth, 8.2, 8.3; interorbital breadth, 3.5, 3.7; maxillary breadth, 4.8, 5.0; maxillary tooth row, 5.9, 5.8.

Remarks.—Merriam's *Sorex dobsoni*, which he later treated as a subspecies of *vagrans*, is here placed in synonymy under *S. v. monticola*. Although there is considerable local variation in the species *vagrans* throughout the Rocky Mountains from Arizona to Idaho, this variation can nowhere be assigned to a definite geographic area, and specimens of *dobsoni* from Idaho can be matched almost per-

fectly with specimens of *monticola* from Arizona, both as to color and cranial characters. In fact, even the topotype series of the two forms when carefully compared are surprisingly similar. The subspecies *monticola* intergrades with *S. v. vagrans* along the eastern slope of the Cascade Mountains, in Washington, winter specimens from Ellensburg and Yakima, in that State, being nearer *monticola* in color, but showing a decided approach toward *S. v. vagrans* cranially, as do also the two specimens from Entiat, Wash. Specimens referred to *monticola* from Sierra Madre near Guadelupe-y-Calvo, Chihuahua, Mexico, indicate a slight approach in cranial characters toward *S. v. orizabae.*

It is sometimes difficult to determine whether certain specimens are *S. o. obscurus* or *S. v. monticola.* Although the two forms are often superficially similar, it seems reasonably certain that they are not specifically related. Much of the geographic range of *monticola* is in common with that of *S. o. obscurus*, yet the two forms are rarely collected at actually the same locality, *S. o. obscurus* apparently having a higher zonal distribution and being largely confined to the Boreal Zone, while *monticola* occurs in the lower parts of the Boreal Zone and in upper Transition Zone. Moreover, it appears that *monticola* more frequently occurs in meadows and marshes, while *S. o. obscurus* inhabits creek banks and moist woods, though too much dependence should not be placed on this habitat preference.

Specimens examined.—Total number, 414, as follows:

Arizona: Burro Creek (near head, altitude 9,000 feet), White Mountains, 1; Fly Park, Chiricahua Mountains, 4; Graham Mountains (altitude, 9,200 feet), 2; Huachuca Mountains, 1; Little Colorado River, White Mountains, 4; Mount Thomas (altitude, 9,500 to 11,000 feet), White Mountains, 12; Prieto Plateau (altitude, 9,000 feet, south end Blue Range), Greenlee County, 1; San Francisco Mountain (altitude, 8,000 to 11,000 feet) (type locality), 3; Springerville, 1; Stone Cabin Canyon (altitude, 8,500 feet), Santa Rita Mountains, 1; Summerhaven (altitude, 7,500 feet), Santa Catalina Mountains, 3; Spruce Creek, Tunitcha Mountains, 7; White River, Horseshoe Cienega (altitude, 8,300 feet), White Mountains, 5.

British Columbia: Cascade (altitude 4,000 feet), 7[4]; Trail, 2.[4]

Chihuahua: Sierra Madre (near (Guadalupe-y-Calvo), 5.

Idaho: Albion, 1; Alturas (Sawtooth) Lake (type locality of *dobsoni*), 2; Bald Mountain Ranger Station (10 miles south Idaho City, altitude, 7,400 feet), Boise National Forest, 1; Cayuse Creek (10 miles north of Featherville), 1; Cedar Mountain (altitude, 4,000 feet), 3[5]; Coeur d'Alene, 2; Irwin (10 miles southeast), 5; McKinnis (7 miles east), Shoshone County, 2[6]; Mullan, 2; Nampa, 6[7]; New Meadows, 1; Nezperce, 2; Osborne, 1; Pocatello, 1; Sawtooth City, 5; Seven Devils Mountains, 1; Swan Lake, 1; Tamarack, 1.

Montana: Bass Creek (altitude 4,600 feet, northwest of Stevensville), 3; Big Snowy Mountains (altitude, 5,500 feet), 1; Big Snowy Mountains, Meagher County, 2; Corvallis, 5; Fish Creek, Glacier Park, 2; Flathead Lake, 6; Florence, 16[8]; Nyack, 1; Prospect Creek (near Thompson), 4; Pryor Mountains, 5; Stevensville, 4; Stevensville (8 miles northeast), 2; Summit, Flathead County, 2; Thompson Pass, 2; Timber Creek (head), Big Snowy Mountains, 1; Tobacco Plains, 1.

New Mexico: Chusca Mountains, 1; Copper Canyon, Magdalena Mountains, 3; Kingston, 1; Willow Creek (altitude, 8,000 feet), Mogollon Mountains, 3.

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[4] Nat. Mus. Canada.
[5] State Coll. Wash.
[6] D. R. Dickey coll., Pasadena, Calif.
[7] Mus. Vert. Zool., 1.
[8] Mont. State Coll., 9.

Oregon: Anthony, 55[9]; Austin, 1; Beech Creek, 6; Bourne, 7; Burns, 4; Cornucopia, 13[10]; Diamond, 2; Elgin, 2; Enterprise (25 miles north at Sled Springs, altitude, 4,600 feet), 4; Homestead (altitude, 1,800 feet), 1; Hot Lake, 2; Huntington (altitude, 2,100 feet), 1; Ironside (altitude, 4,000 feet), 8[11]; Jordan River (8 miles west of Jordan Valley), 1; Kamela, 2; Kieger Gorge, Steen Mountains, 3; Maury Mountains, 3; McEwen, 1; Meacham, 3; Meacham (10 miles west), 2; Pullman, 1; Rock Creek, Baker County, 1; Strawberry Butte, 1; Strawberry Mountains, 12; Wallowa Lake (altitude, 4,000 feet), 23; Wallowa Mountains south of Wallowa Lake (altitude, 8,100 feet), 1.

Utah: Bear River (mouth of), 2; Midvale, 1; Ogden, 4; Provo (near shores of Utah Lake), 1; Salt Lake City, 1.

Washington: Barron (altitude 5,000 feet), 2; Bauerman Ridge (east end, near head Haig Creek, altitude 6,500 feet), Okanogan County, 1; Blewett Pass (2 miles south, altitude 3,000 feet), Kittitas County, 3; Blue Mountains, 7[5]; Bly (altitude 1,000 feet), 1; Cedar Mountains, 4[5]; Conconully, 1; Curlew (5 miles west, altitude 2,800 feet), 2; Dayton (21 miles southeast, Blue Mountains), 1; Ellensburg (altitude 1,500 feet), 2; Entiat, Entiat River (20 miles from mouth), 2; Hidden Lakes (altitude 4,100 feet), Okanogan County, 1; Hompeg Falls, Blue Mountains, 2[12]; Loomis (altitude 1,300 feet), 1; Marcus, 1; Marshall, 7; Metaline (9 miles north, altitude 2,600 feet), 2; Moses Lake (altitude 1,000 feet), 1; Odessa (6 miles east, Sylvan Lake), 4; Oroville (altitude 1,000 feet, Osoyoos Lake), 1; Prescott, 4[12]; Pullman, 1; Rogersburg, 1; Sheep Mountain (Park Mountain, altitude 6,500 feet), 3; Snake River (road to Gap Hill, altitude 2,500 feet), 1[5]; Starbuck (altitude 645 feet), 3; Sullivan Lake (altitude 3,000 feet), 1; Twisp (altitude 1,600 feet), 1; Wallula, 1[12]; Wawawai (altitude 600 feet), 4[5]; Wawawai (5 miles northeast), 1; Yakima (10 miles west at Wiley City, altitude 2,000 feet), 4; Z Canyon, Pend Oreille County, 2.

Wyoming: Apollinaris Spring, Yellowstone National Park. 1[6]; Bighorn Mountains (altitude 8,400–9,000 feet), 3; Cokeville (altitude 6,400 feet), 1; Mammoth Hot Springs, 1; Moran (Lake Emma Matilda), 2; Salt River (10 miles north of Afton, altitude 6,200 feet), 2[5]

SOREX VAGRANS ORIZABAE Merriam

Orizaba Shrew

(Pl. 2, z)

Sorex orizabae Merriam, North Amer. Fauna No. 10, p. 71, December 31, 1895.

Type specimen.—No. 53633, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth moderately worn), skin and skull (skull broken in two through the orbital region); collected April 24, 1893, by E. W. Nelson.

Type locality.—Mount Orizaba, altitude 9,500 feet on west slope, State of Puebla, Mexico.

Geographic range.—Mountains of west-central Vera Cruz, west to central Michoacan, Mexico. (Fig. 11.)

General characters.—About the size of *Sorex v. vagrans*, but a shade darker in summer pelage, skull relatively longer and narrower, molariform teeth heavier, and maxillary tooth row longer. Apparently smaller and a tone darker than *S. v. monticola*, with shorter tail; skull relatively narrower than in *monticola*, brain case expanding less abruptly anteriorly, maxillary tooth row a trifle longer, and unicuspidate teeth narrower.

Color.—Winter pelage: Upper parts fuscous to nearly fuscous-black, slightly paling on the flanks; underparts smoke gray mixed and washed with light drab or between light drab and avellaneous; tail indistinctly bicolor, between

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[5] State Coll. Wash.
[6] D. R. Dickey coll., Pasadena, Calif.
[9] Amer. Mus. Nat. Hist., 42; Mus. Vert. Zool., 8.
[10] Univ. Mich., 2.
[11] Amer. Mus. Nat. Hist.
[12] Mus. Vert. Zool.

mummy brown and sepia above, buffy brown below, darkening toward tip. *Summer pelage:* Upper parts mummy brown, sometimes tending toward olive-brown paling on the sides and flanks; underparts about as in winter, possibly a little more buffy; tail as in winter.

Skull.—Medium in size; relatively the most elongate and narrowest of the species *vagrans*, maxillary tooth row long, molars relatively large (about as in *S. v. monticola*), posterior emargination of second upper premolar relatively narrow and deep, unicuspidate teeth narrow (narrower than in *monticola*).

Measurements.—Type specimen (adult female): Total length, 103; tail vertebrae, 38; hind foot, 13. Average of 3 adult males from type locality: Total length, 103.7 (98–109); tail vertebrae, 36.3 (31–40); hind foot, 12.8 (12.5–13.0). Adult female from Cofre de Perote, Vera Cruz, Mexico: Total length, 98; tail vertebrae, 33.5; hind foot, 13. Two adult females from north slope of Volcan Toluca, Mexico, Mexico: Total length, 98, 108; tail vertebrae, 35, 40; hind foot, 13, 14. *Skull:* Skulls of 2 adult males (teeth much worn) from type locality: Condylobasal length, 16.9; 16.5; palatal length, 6.6, 6.5; cranial breadth, 8.2, 8.0; interorbital breadth, 3.3, 3.4; maxillary breadth, 4.6, 4.6; maxillary tooth row, 6.0, 6.0. Skull of adult female (teeth moderately worn) from Cofre de Perote, Vera Cruz, Mexico: Condylobasal length, 16.5; palatal length, 6.5; cranial breadth, 7.8; interorbital breadth, 3.5; maxillary breadth, 4.6; maxillary tooth row, 6.0. Skulls of 2 adult females (teeth slightly worn) from north slope of Volcan Toluca, Mexico, Mexico: Condylobasal length, 17.2, 17.0; palatal length, 6.6, 6.5; cranial breadth, 8.0, 7.8; interorbital breadth, 3.5, 3.5; maxillary breadth, 4.8, 4.6; maxillary tooth row, 6.0, 6.1.

Remarks.—The skulls of specimens from the north slope of Volcan Toluca, State of Mexico, Mexico, are a little larger than the typical skulls of *S. v. orizabae* that have been examined. A specimen from Cofre de Perote, State of Vera Cruz, and others from Nahuatzin, Michoacan, although differing for the most part in age from the series from the type locality, agree well in all diagnostic characters. Some of the skulls from Mount Tancitaro, Michoacan, seem to be slightly flatter through the brain case than typical specimens.

Specimens examined.—Total number, 22, as follows:

Mexico: Salazar, 2; Volcano Toluca (north slope), 3.
Michoacan: Mount Tancitaro, 4; Nahuatzin, 3; Patamban, 1.
Puebla: Mount Orizaba (type locality), 6.
Tlaxcala: Mount Malinche, 2.
Vera Cruz: Cofre de Perote, 1.

SOREX DURANGAE Jackson

Durango Shrew

(Pls. 2, A'; 5, E; 6, H; 8, F)

Sorex durangae Jackson, Proc. Biol. Soc. Washington 38: 127, November 13, 1925.

Type specimen.—No. 94540, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth much worn), skin and skull; collected July 19, 1898, by E. W. Nelson and E. A. Goldman. Original number 12774.

Type locality.—El Salto, Durango, Mexico.

Geographic range.—Known only from type locality. (Fig. 11.)

Diagnostic characters.—Larger and darker than *Sorex v. monticola;* skull decidedly broader and heavier than that of *S. v. orizabae* or *monticola*, with more swollen lachrymal region, and heavier rostrum and dentition. Darker and more grayish than *S. o. obscurus*, and differs cranially from any form of *S. obscurus* in its peculiarly high and broad lachrymal region and the relatively narrow (lateral diameter) and deep posterior emargination of the molars.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts fuscous-black scantily flecked and grizzled with whitish hair-tips, scarcely paling on the

sides; general tone of underparts hair brown tending somewhat toward grayish; tail indistinctly bicolor, olive-brown above, buffy brown below darkening a trifle toward tip.

Skull.—Medium in size (about that of *S. o. obscurus*), rather broad interorbitally, moderately flattened through brain case, with relatively high rostrum, broad and high lachrymal region, somewhat heavy dentition with the posterior emargination of molars relatively deep (antero-posteriorly) and narrow (laterally).

Measurements.—Type specimen (adult male): Total length, 112; tail vertebrae, 50; hind foot, 13 (measured from dry skin by the writer). *Skull:* Type specimen (adult male; teeth much worn): Condylobasal length, 17.1; palatal length, 6.7; cranial breadth, 8.4; interorbital breadth, 3.7; maxillary breadth, 5.0; maxillary tooth row, 6.3.

Remarks.—The type specimen and a topotype of *S. durangae*, the only two specimens seen, are both fully adult and have their teeth too worn for satisfactory study. With only this scant material it is impossible to determine the relationship of this form to either *S. vagrans* or *S. obscurus*. Although in many respects similar to *S. obscurus* it seems hardly probable that it is directly connected with that species. Nor is there evidence of connection with *S. vagrans*, although specimens of *S. v. monticola* have been examined from as far south as Sierra Madre near Guadalupe-y-Calvo, Chihuahua. It seems possible, however, that specimens from the region between that locality and the type region of *S. durangae* may show intergradation between *monticola* and *S. durangae*.

Specimens examined.—Two, from the type locality.

SOREX OBSCURUS Merriam

[Synonymy under subspecies]

Geographic range.—Western and north-central Alaska southeasterly through British Columbia and Alberta, Washington, and western Oregon, in the mountains to southern California (latitude 34° north), and through Idaho, western Montana, western Wyoming, and western Colorado, southern Utah, and southern New Mexico. (Fig. 12.)

Diagnostic characters.—Size larger than *Sorex vagrans*, decidedly smaller than *S. yaquinae* or *S. pacificus*. Skull larger, broader, particularly interorbitally and through rostrum, and palate longer than in *S. vagrans;* superior border of foramen magnum tending to be less acute; teeth larger, the protoconid of m_1 higher than in *S. vagrans*, relatively and actually broader unicuspids, and larger *i*.[1] Lachrymal region of skull much more depressed, and relatively and actually narrower than in *S. durangae*, the molars more broadly (lateral diameter) and less deeply emarginate posteriorly.

Subspecies and geographic variation.—The species *obscurus* is divided into 13 subspecies: *obscurus, neomexicanus, parvidens, shumaginensis, alascensis, malitiosus, elassodon, longicauda, prevostensis, isolatus, setosus, permiliensis,* and *bairdi*. Passing directly northward from the type region of *S. obscurus* (Idaho), there is very little variation, even as far north as western Alaska; toward the south from the type region the characters also remain constant except in southern New Mexico, where a noticeable increase in size is recognizable in *neomexicanus*. Southwestward through the Sierra Nevada of California, the representatives of the species are almost identical with those from the type region, but in the San Bernardino Mountains decrease in size associated with a flattened cranium and small teeth is recognized in *parvidens*. Westward from the type region there is a gradual increase in size of the animal and the length of tail through *setosus* into *longicauda* and related Alaska forms *shumaginensis, alascensis, malitiosus, elassodon,* and *prevostensis* on the north, and *permiliensis* and *bairdi* toward the south. On Vancouver Island, British Columbia, the species becomes smaller and a shade darker again in the form *isolatus*.

Time of molting.—The earliest spring molt indicated in material examined is in specimens of *S. o. elassodon* from Admiralty Island, Alaska, where several are in process of molt the last week of April, and 1 has complete summer pelage, May 3. What appears to be a delayed molt occurs in three males from this

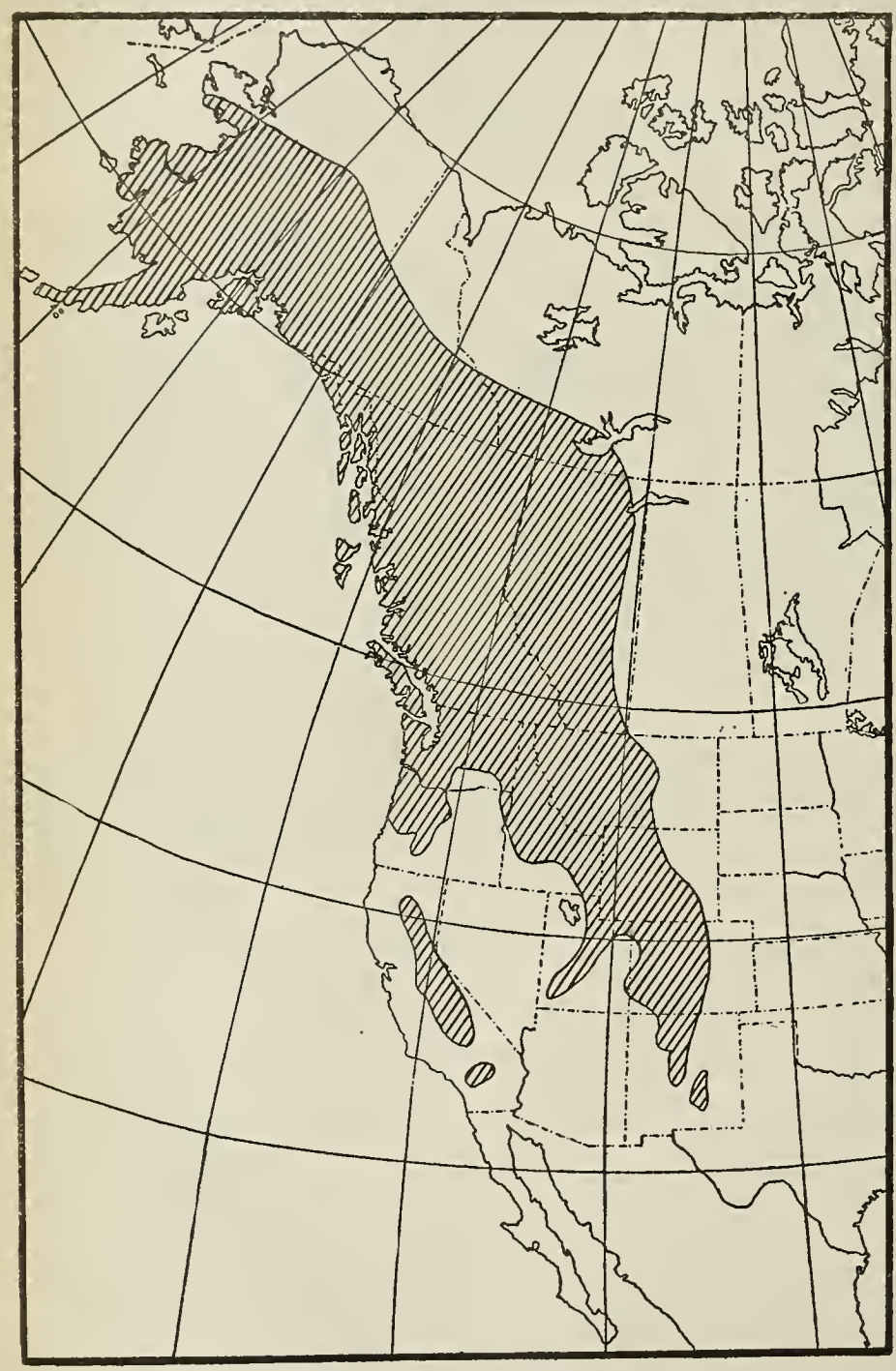

FIG 12.—Geographic range of the species *Sorex obscurus*

same locality, which still show traces of winter fur August 2 and 4. Of 15 specimens collected between May 14 and 26, 1903, on Prince of Wales Island, Alaska, 9 are in complete summer fur, while 6 retain a major portion of the winter fur, 2 of the latter having been collected as late as May 25 and 26.

Of 11 specimens of *S. o. obscurus* collected between May 31 and June 17, 1919, at Telegraph Creek, British Columbia, all have acquired complete summer pelage except a male collected June 17, which retains patches of winter fur on the rump, flanks, and shoulders. A female of *S. o. neomexicanus* is in full fresh summer pelage May 31, 1900, at Cloudcroft, N. Mex., while another with same date and locality has fresh summer fur except for a patch of winter pelage on the rump. The majority of specimens of this species have full summer pelage by the first week of June, although molt may sometimes be delayed until late in June or early in July.

The winter fur is usually acquired during September, and by the middle of October the majority of specimens of *S. obscurus*, whether in the northern or southern part of the range of the species, are in winter pelage. All of 7 specimens of *S. o. obscurus* collected September 7 to 9, 1903, at Athabaska River, Alberta, appear on first glance to be in full summer pelage, but examination shows 6 of them to have the winter fur coming in under the summer. Two individuals of *S. o. obscurus* from Glen Aulin, Yosemite National Park, Calif., have the new winter pelage well advanced over the back, October 2 and 3, 1915. Of 41 specimens of *S. o. shumaginensis* collected at Tyonek, Cook Inlet, Alaska, between September 13 and 20, 1900, 20 still retain full summer fur, 13 show early stages of molt, while 8 have the winter fur well advanced or nearly complete. Of these 8 none was taken prior to September 17.

SOREX OBSCURUS OBSCURUS Merriam

Dusky Shrew

(Pls. 2, B′; 5, F; 6, I; 8, G; 11, I; 12, K; 13, G)

Sorex vagrans similis Merriam, North Amer. Fauna No. 5, p. 34, July 31, 1891. (Not *S. similis* Hensel, Zeitschr. der Deutsch. Geolog. Gesellsch. 7: 459, 1855, qui *Neomys similis*.)

Sorex obscurus Merriam, North Amer. Fauna No. 10, p. 72, December 31, 1895. New name for *S. vagrans similis* Merriam.

Sorex obscurus obscurus Miller, U. S. Nat. Mus. Bul. 79, p. 15, December 31, 1912.

Type specimen.—No. $\frac{23525}{30943}$, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected August 26, 1890, by Vernon Bailey and B. H. Dutcher. Original number 1670 (Bailey catalogue).

Type locality.—Near Timber Creek, altitude 8,200 feet, Salmon River Mountains (now Lemhi Mountains), 10 miles west of Junction, Lemhi County, Idaho.

Geographic range.—Central Alaska, southeasterly through northern and eastern British Columbia, southwestern Northwest Territories, Alberta, extreme southwestern Saskatchewan, eastern Washington, Idaho, western Montana, western Colorado, south to southern Utah and north-central New Mexico. (Fig. 13.)

Diagnostic characters.—Size rather small for the species *obscurus*, with relatively short tail, and medium hind foot. Skull small, with medium-sized rostrum, and moderate dentition. Somewhat similar to *S. o. setosus* but paler, with relatively and actually shorter tail, and average smaller hind foot; skull averaging slightly smaller than that of *sctosus*, very slightly less constricted interorbitally, with average smaller molariform teeth. Externally similar to *S. o. parvidens*, the skull broader both mastoidally and interorbitally, molariform teeth usually less deeply emarginate posteriorly, the unicuspids broader, and the first incisors larger. Darker than *S. o. shumaginensis*, tending less toward a tricolor pattern, the skull less depressed orbitally, and on the average with rather longer palate, broader and less attenuate rostrum. Similar in color to *S. o. alascensis*, but slightly smaller, with decidedly smaller hind foot; skull smaller than that of *alascensis* with narrower rostrum and brain case, and weaker dentition. Different in color and much smaller than either *S. o. longicauda* or *S. o. bairdi*, with shorter tail and much smaller hind foot; skull cor-

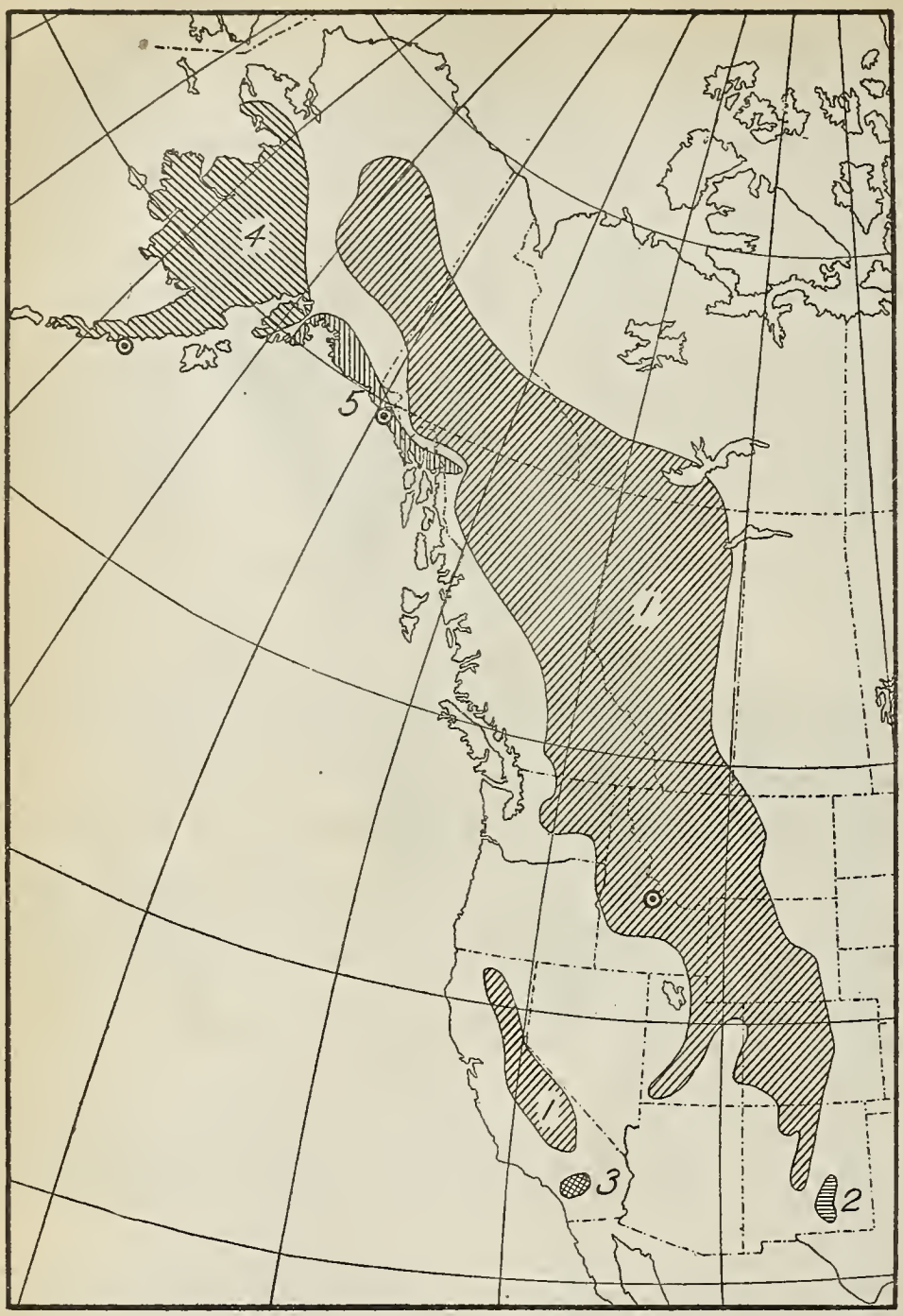

FIG. 13.—Geographic range of *Sorex obscurus obscurus, S. o. neomexicanus, S. o. parvidens, S. o. shumaginensis,* and *S. o. alascensis*

1. *S. o. obscurus.*
2. *S. o. neomexicanus.*
3. *S. o. parvidens.*
4. *S. o. shumaginensis.*
5. *S. o. alascensis.*

respondingly smaller in all proportions. About the size of *S. o. isolatus*, but paler, particularly on ventral parts; skull less constricted interorbitally than that of *isolatus*, with heavier dentition, especially the unicuspidate teeth and incisors. Smaller than *S. o. neomexicanus*, with smaller, narrower skull. Similar to *S. v. monticola*, but with average longer tail and larger foot, longer and heavier rostrum, and larger teeth.

Color.—Winter pelage: Upper parts most nearly hair brown, or between hair brown and chaetura drab, more or less mixed with deep neutral gray of base of hairs, becoming rather paler on the sides and grading into color of underparts; underparts pale smoke gray, sometimes more or less silvery, frequently tinged with pale pinkish buff; tail bicolor, usually olive-brown or between olive-brown and hair brown above, avellaneous to nearly pinkish buff below nearly to tip. *Summer pelage:* Distinctly more brownish (less grayish) than in winter pelage. Upper parts usually between olive-brown and buffy brown, more nearly olive-brown, tending very slightly toward Saccardo's umber, rarely toward hair brown or drab; color of upper parts extending well down on sides and gradually blending with color of the underparts; underparts smoke gray to pale smoke gray, in most cases more or less tinged with avellaneous to pale pinkish buff or pale olive-buff; tail about as in winter.

Skull.—Relatively small for the species *obscurus* (about the size of that of *S. o. parvidens*, *S. o. shumaginensis*, and *S. o. isolatus*); brain case moderately broad and flattened, rostrum medium, dentition moderate. Less constricted interorbitally than that of either *parvidens* or *isolatus* with heavier dentition, particularly the unicuspids and incisors; cranium broader and less flattened than in *parvidens*. Somewhat smaller than that of *S. o. setosus*, very slightly less constricted interorbitally, with smaller molariform teeth. Distinctly smaller and weaker than that of *S. o. neomexicanus*, *S. o. alascensis*, or *S. o. longicauda*.

Measurements.—Type specimen (adult female): Total length, 111; tail vertebrae, 46; hind foot, 13. Average of 4 adult males from Mammoth Hot Springs, Yellowstone National Park, Wyo.: Total length, 110.3 (108–113); tail vertebrae, 45.8 (44–47); hind foot, 12.9 (12.7–13). Average of 5 adult males from mountains near Eagle, Alaska: Total length, 115 (109–119); tail vertebrae, 45.6 (40–49); hind foot, 13.3 (13–13.5). Two from Mount Whitney, Calif.: Total length, 103, 119; tail vertebrae, 43, 49; hind foot, 13, 13. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 17.1; palatal length, 7.0; cranial breadth, 8.3; interorbital breadth, 3.7; maxillary breadth, 4.8; maxillary tooth row, 6.2. Skulls of 2 adult females (teeth slightly worn) from type locality: Condylobasal length, 17.3, 16.9; palatal length, 7.0, 6.8; cranial breadth, 8.4, 8.2; interorbital breadth, 3.7, 3.8; maxillary breadth, 4.9, 5.0; maxillary tooth row, 6.4, 6.2. Average of 4 skulls of adult males (teeth slightly worn) from Mammoth Hot Springs, Yellowstone National Park, Wyo.: Condylobasal length, 16.8 (16.4–17.2); palatal length, 6.9 (6.8–7.0); cranial breadth, 8.4 (8.2–8.5); interorbital breadth, 3.7 (3.7–3.7); maxillary breadth, 5.0 (4.9–5.1); maxillary tooth row, 6.2 (6.0–6.3). Average of 5 skulls of adult males (teeth slightly worn) from mountains near Eagle, Alaska: Condylobasal length, 17.2 (16.6–17.6); palatal length, 6.8 (6.7–6.9); cranial breadth, 8.4 (8.4–8.5); interorbital breadth, 3.7 (3.7–3.7); maxillary breadth, 5.0 (4.9–5.2); maxillary tooth row, 6.1 (6.0–6.3). Skulls of 2 adult females (teeth slightly worn) from Mount Whitney, Calif.: Condylobasal length, 16.7, 16.9; palatal length, 6.7, 6.7; cranial breadth 8.4, 8.3; interorbital breadth, 3.8, 3.7; maxillary breadth, 5.0, 4.9; maxillary tooth row, 6.1, 6.0.

Remarks.—The dusky shrew was first recognized by Merriam (1891, p. 34) under the name *Sorex vagrans similis*. The name *Sorex similis*, however, had been previously used by Hensel (1855, p. 459) for a shrew from bone deposits at Cagliari, Sardinia. Later Merriam (1895, p. 72) renamed his Idaho form *Sorex obscurus*.

Like most other shrews, *S. o. obscurus* shows considerable individual variation, but the constancy of its general characters as a whole is truly surprising. It has an extensive latitudinal range throughout the Rocky Mountains from north-central Alaska south to central New Mexico and to the southern end of the Sierra Nevada in California, and specimens from extreme parts of the range match almost perfectly in essential characters. Specimens from many localities in western British Columbia indicate intergradation between *S. o. obscurus* and *S. o. setosus*. Thus specimens from Hope, British Columbia, which the writer has referred to *S. o. obscurus* can, with almost equal propriety, be called *S. o. setosus*. Some of the specimens

from Hazelton and vicinity have larger skulls and longer rostra than in typical *obscurus;* and, in fact, certain specimens from as far inland in British Columbia as Nelson show a tendency toward *setosus* in size of skulls. Skulls from Tanana, Alaska, are essentially like those of typical *obscurus.* The single skin from Tanana, however, shows in its winter pelage a tendency toward the color of *S. o. shumaginensis.* Specimens from Wells, Chilkat Valley, Alaska, although referable to the subspecies *obscurus*, show an approach toward *S. o. alascensis.* Certain specimens from the Cheonee Mountains, British Columbia, however, are noticeably inclined toward *alascensis* in cranial characters. Some of the specimens from southern Colorado and northern New Mexico show a slight approach toward *S. o. neomexicanus*, but it is not pronounced.

Specimens examined.—Total number, 1,082, as follows:

Alaska: Alatna, 1; Bettles, 5; Eagle (mountains near), 18; Richardson (Tanana River), 8; Savage River, 8; Tanana, 1; Toklat River (head of), 11; Wells, Chilkat Valley, 5[13]; Yukon River (20 miles above Circle), 1.

Alberta: Athabaska River (30 miles above Athabaska Landing), 7; Athabaska River (Swift Current), 2; Cavell Creek (mouth, altitude, 4,000 feet, Jasper Park), 1[14]; Crows Nest Pass, 9[15]; Henry House, 2; Henry House (15 miles south of), 5; Moose Mountain, 1[14]; Muskeg Creek (20 miles from mouth), 7; Red Deer River, 1[16]; Rodent Valley (25 miles west of Henry House), 1; Shovel Pass (altitude 7,500 feet), 4[14]; Smoky Valley (50 miles north of Jasper House), 1; Stony River (35 miles north of Jasper House), 1; Sulphur Prairie (Grand Cache River), 3; Waterton Lakes Park, 51.[14]

British Columbia: Babine Mountains (6 miles north of Babine Trail, altitude 5,200 feet), 1; Barkerville, 7; Bear Lake (site of Fort Connolly), 2; Bennett City, 6; Big Salmon River (south branch, near Canyon), 1; Caribou Lake (near Kamloops), 2; Chapa-atan River (mountains near, a head branch of Stikine River), 4; Cheonee Mountains, 3[16]; Cranbrook, 3[17]; Cranbrook (altitude 2,950–3,000 feet), 14[18]; Doch-da-on Creek, Stikine River, 1[19]; Doch Don Creek, Stikine River, 1[19]; Douglas, 3[14]; Fernie, 1[14]; Field, 3[20]; Flood Glacier, Stikine River, 1[19]; Fort Grahame, 3; Glacier, 13[21]; Glenora (above timber line), 1; Glenora, Stikine River, 3[19]; Golden, 1; Hazelton, 24[22]; Hope, 12[23]; Hudsons Hope, 2; Junction (4 miles north of Telegraph Creek), 7; Kispiox Valley (23 miles north Hazelton), 6[19]; Klappan River Valley (20 miles above mouth of Klappan River), 1; Klappan River Valley (Tset-ee-yeh River), 1; Level Mountain, 4[16]; Little Tahltan River, 1[16]; McDame Creek (Dease River, Quartz Creek, altitude 3,500 to 3,600 feet), 3; McDame Post, Dease River, 6; Mica Mountain (altitude 5,000 feet), 1[14]; Midway, 1[14]; Monishee, 1[23]; Moose River (north fork), 1; Moose Lake, 2; Moose Pass, 1; Myers Creek, 1[14]; Nelson, 9[24]; Nelson (6 miles south, Silver King Mine), 6; Nine-mile Mountain (altitude 4,500 feet, northeast of Hazelton), 11[19]; Okanagan, 9[25]; Okanagan Lake (west side, altitude 2,500 to 3,000 feet), 2; Okanagan Lake (9 miles west, altitude 5,000 feet), 1; Raspberry Creek, 10[16]; Salmon River (mouth of), 2[14]; Sawmill Lake (near Telegraph Creek), 5[19]; Second Summit (Skagit River, altitude 5,000 feet), 3[14]; Sicamous, 1; Similkameen River (3 miles east of, 5 miles north of U. S. boundary), 1; Skagit, 1[14]; Telegraph Creek, 3[16]; Telegraph Creek (summit, altitude 3,600 feet), 1; Wall Lake, 1; Wilson Creek (Atlin), 1[17]; Yellowhead Lake, 2[26]

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[13] D. R. Dickey coll., Pasadena, Calif.
[14] Nat. Mus. Canada.
[15] Acad. Nat. Sci. Philadelphia, 2; Nat. Mus. Canada, 7.
[16] Amer. Mus. Nat. Hist.
[17] Provincial Mus. British Columbia.
[18] C. B. Garrett coll., Cranbrook, British Columbia, 4.
[19] Mus. Vert. Zool.
[20] Acad. Nat. Sci. Philadelphia, 1.
[21] Acad. Nat. Sci. Philadelphia, 1; Amer. Mus. Nat. Hist., 7.
[22] Nat. Mus. Canada, 2; Mus. Vert. Zool., 21.
[23] Mus. Comp. Zool.
[24] Acad. Nat. Sci. Philadelphia.
[25] Provincial Mus. British Columbia, 5; Mus. Comp. Zool., 3.
[26] Nat. Mus. Canada, 1.

California: Big Pine Creek (10 miles west Big Pine, Sierra Nevada, altitude 8,000 feet, Inyo County), 1[19]; Bishop Creek (Sierra Nevada, altitude 6,600 to 7,000 feet), 5; Bullfrog Lake (altitude 10,600 feet), Fresno County, 4[19]; Cottonwood Lakes, 1[19]; Donner (altitude 7,900 feet), 1; Echo, Eldorado County (altitude 7,000 feet), 4[23]; Fletcher Creek (near Vogelsang Lake, Yosemite Park), 1[19]; Gem Lake, Mono County, 1[19]; Gilmore Lake, Mount Tallac, 1[16]; Glen Aulin (Tuolumne River, Yosemite Park, altitude 7,700 feet), 4[19]; Greenville (8 miles northwest), 1; Horse Corral Meadows, Fresno County, 3; Horse Corral Meadows (Fresno County, altitude 7,600 feet), 1[19]; Independence Lake, 4[19]; Indian Canyon (east fork, altitude 7,300 feet), Mariposa County, 4[19]; Jordan Hot Springs, Sierra Nevada, Tulare County, 1[19]; Kaweah River (east fork), 7; Kearsarge Pass (Sierra Nevada, altitude 6,000 feet), 1[19]; Kern Lakes, 1; Kern River (north fork, altitude 9,600 feet, Sierra Nevada), 1; Kern River (south fork), 4; Kings River Canyon, Fresno County (altitude 5,000 feet), 4[19]; Lake Tenaya, 5; Little Brush Meadow, Tulare County, 4[19]; Little Cottonwood Creek, Sierra Nevada, Inyo County, 2[19]; Little Onion Valley, Sierra Nevada, 1[19]; Lone Pine Creek (altitude 4,500 feet), Inyo County, 2[19]; Lyell Canyon (head of, altitude 9,800 to 10,800 feet), Yosemite National Park, 5[19]; Mammoth, Mono County, 23[27]; McCloud River, 1; Merced Lake (1 mile east), Yosemite National Park (altitude 7,400 to 7,500 feet), 7[19]; Mineral King, Sierra Nevada, 2; Moltkes Meadows (altitude 9,000 feet), Sierra Nevada, 1; Mono Meadow (near, Yosemite National Park), 7[19]; Mount Dana, 5; Mount Hoffman (near), 1[19]; Mount Lyell, 11; Mount Tallac, 1[23]; Mount Whitney (altitude 10,500 feet), 2[23]; Mount Whitney (head of Big Cottonwood Creek), 5; Mount Whitney (Whitney Creek), 4[28]; Mount Whitney (Whitney Meadows), 1[28]; Mount Whitney (Whitney Meadows, altitude 9,700 feet), 1; Onion Valley (altitude 8,500 feet, Sierra Nevada), 7[19]; Phillips, Eldorado County, 1[27]; Pine City, Mono County, 3[29]; Porcupine Flat (altitude 8,100 feet), Yosemite National Park, 14[19]; Pyramid Peak, Eldorado County, 1[16]; Round Valley, 1; San Joaquin River (altitude 8,000 feet, Sierra Nevada), 4; Sequoia National Park (Halstead Meadows), 4; Silver Lake, 2[16]; Summit, 1; Tuolumne Meadows (Yosemite National Park, altitude 8,600 feet), 15[19]; Tuolumne Meadows (Muir Meadow, altitude 9,300 feet), 1; Tuolumne Meadows (Mount Unicorn), 1; Tuolumne Meadows (north base Mount Lyell), 8; Tuolumne Meadows (Soda Springs), 4; Twin Lakes, Tulare County (head of north fork of Kaweah River), 1[19]; Vogelsang Lake (altitude 10,350 feet), Yosemite National Park, 3[19]; Warren Fork, Mono County (altitude 9,200 feet), 5[19]; Whitney Creek, Tulare County, 1[19]; Williams Butte, Mono County, 2[19].

Colorado: Almont, 2; Baxter Pass (altitude 8,500 feet), 2; Black Hawk, 1; Boulder, 3; Boulder (5 miles west, 5,600 feet), 3; Boulder County, 6; Buchanan Pass, Boulder County, 1; Colorado Springs (Hunters Creek, a tributary of Bear Creek, altitude 7,250 to 7,400 feet), 1[16]; Crested Butte, 1[19]; Eldora, 1; Fort Garland, 2; Gores Range, 1; Hermit, 1; Lake Moraine, El Paso County, 1[23]; Longs Peak (at timberline), 1; Monshower Meadows (27 miles west Saguache, 3 miles east Cochotope Pass), 2; Mount McClellan (altitude, 11,000 feet), 2; Navajo River, 6[30]; Nederland, 8[31]; Poudre (by river), 1[32]; Rabbit Ear Mountains (Arapahoe Pass), 2; St. Elmo (altitude, 10,100 feet), 2; Silver Lake, Boulder County, 5[30]; Silverton, 4; Uncompaghre Plateau (altitude, 8,500 feet), 3; Upper Navajo River, 1[30]; Ward (altitude, 9,500 feet), 1.

Idaho: Bald Mountain Ranger Station (10 miles south Idaho City, altitude, 7,400 feet), 2; Cabinet Mountains (east Priest Lake), 2; Lemhi Mountains (type locality), 7; Pahsimeroi Mountains, 1; Preuss Mountains, 1; Priest Lake, 4; Trude (4 miles south, altitude, 6,500 feet), 1.[27]

Montana: Bass Creek (northwest of Stevensville, altitude 4,000 feet), 1; Bear Paw Mountains (20 miles southeast of Fort Assiniboine), 2; Beartooth Mountains (at timberline), 2; Big Belt Mountains (Camas

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[16] Amer. Mus. Nat. Hist.
[19] Mus. Vert. Zool.
[23] Mus. Comp. Zool.
[27] D. R. Dickey coll.
[28] Field Mus. Nat. Hist.
[29] D. R. Dickey coll., 2.
[30] Colorado Mus. Nat. Hist.
[31] Acad. Nat. Sci. Philadelphia, 2.
[32] Kans. Univ. Mus.

Creek, 4 miles south of Fort Logan), 7; Big Snowy Mountains (15 miles south of Heath, north fork Flat Willow Creek), 1; Buffalo (13 miles west Buffalo Canyon), 2; Corvallis, 2; Emigrant Gulch (3 miles southeast Chico), 2; Fish Creek, Glacier Park, 2; Florence, 1; Gunsight Lake, Glacier Park, 2; Highwood Mountains, 13; Lewistown (7 miles northeast, Judith Mountains), 1; Little Belt Mountains (Dry Wolf Creek, 20 miles southwest of Stanford), 1; Little Belt Mountains (Neihart), 1; Little Belt Mountain (Otter Creek, 10 miles southwest of Geyser), 1; Little Belt Mountain (Sheep Creek, 16 miles north White Sulphur Springs), 1; Moccasin Mountains (5 miles northwest of Hilger), 3; McDermit Lake, 1; Ruby Mountains, 4; St. Mary Lakes, 10[33]; Stevensville (8 miles northeast), 3; Sula, 1; Upper Stillwater Lake, 1; Ward Peak (Madison National Forest), 1; West Gallatin River (west fork), 4; Yellowstone, 1[27]; Zortman, 1.

New Mexico: Jemez Mountains (head Santa Clara Creek, altitude 9,000 feet), 2; Jemez Mountains (Valle Sante Rosa, altitude 8,500 feet), 1; Manzano Mountains (east slope, near south end), 2; Pecos Baldy (altitude 11,000 to 11,700 feet), 4; Red River (3 miles north of, altitude 10,700 feet), 2; Taos (altitude 7,400 feet), 1; Twining (5 miles south of, altitude 9,800 to 12,500 feet), 5.

Northwest Territories: Fort Resolution, Mission Island, 1; Fort Simpson, 4[20]; Nahanni River Mountains, Mackenzie River, 1.

Oregon: Anthony, 2[34]; Wallowa Lake, 1; Wallowa Mountains (south of Wallowa Lake, altitude 8,500 feet), 1.

Saskatchewan: Cypress Hills (north edge of, 30 miles south of Maple Creek), 13[14].

Utah: Beaver Mountains (Puffer Lake), 2; Currant Creek, Uinta Forest, 1; Fish Lake Plateau, 2; La Sal Mountains (altitude 11,000 feet), 1; Manti, 3; Parowan Mountains (Brian Head), 2; Pine Valley Mountains (altitude 8,300 feet), 10; Wasatch Mountains (summit, altitude 7,000 feet), 1.

Washington: Bauerman Ridge (west end, at Tungsten Mine, Okanogan County, altitude 6,800 feet), 1; Conconully, 2; Easton, 10; Entiat (20 miles up Entiat River), 1; Lake Chelan (head), 4; Pasayten River (near mouth east fork, altitude 3,900 feet), 1; Round Top Mountain, 2[35]; Stehekin, 4; Wenatchee, 1; Yakima Indian Reservation, Signal Peak (altitude 4,000 feet), 4.

Wyoming: Afton (10 miles north, Salt River), 1; Afton (10 miles southeast, Salt River Mountains), 5; Astringent Creek, Yellowstone National Park, 1; Bear Creek (3 miles southwest of Eagle Peak, altitude 7,500 feet), 6; Beartooth Lake, 15; Big Horn Mountains (west slope, head of Trappers Creek, altitude 8,500 feet), 6; Black Mountain (northeast base, Pat O'Hara Creek), 12; Black Rock Creek (2 miles west of Pass), 2; Bridgers Pass, 2; Bronx, Fremont County, 2[23]; Casper Mountains (7 miles south of Casper, altitude 6,000 feet), 6; Evanston, 1; Ferris Mountains (altitude 7,800 to 8,500 feet), 13; Flat Mountain, Yellowstone National Park, 1; Green Mountains (8 miles east of Rongis, altitude 8,000 feet), 4; Jackeys Creek (3 miles south of Dubois), 1; Laramie Peak (north slope, altitude 8,000 to 8,800 feet), 7; La Barge Creek (altitude 9,000 feet), 1; Mammoth Hot Springs, 11; Moran, 7; Needle Mountain (altitude 10,000 feet), 2; Pacific Creek, 3; Pahaska (mouth of Grinnell Creek), 15; Pahaska (Grinnell Creek, altitude 7,000 to 7,500 feet), 18; Pahaska Tepee (north Grinnell Creek, altitude 6,300 feet), 8; Rattlesnake Mountains (altitude 7,000 to 7,500 feet), 18; Shirley Mountains (altitude 7,600 feet), 7; Sierra Madre Mountains (altitude 8,800 feet, south base Bridger Peak), 3; Springhill (12 miles north of Laramie Peak, altitude 6,300 feet), 10; Stanley (3 miles west, altitude 8,000 to 8,500 feet), 3; Surveyors Park (12 miles northeast of Pinedale, altitude 8,000 feet),

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[14] Nat. Mus. Canada.
[23] Mus. Comp. Zool.
[26] Nat. Mus. Canada, 1.
[27] D. R. Dickey coll.
[33] Amer. Mus. Nat. Hist., 1.
[34] Amer. Mus. Nat. Hist., 1; Mus. Vert. Zool., 1.
[35] State Coll. Wash.

2; Teton Mountains (Moose Creek, altitude 6,800 feet), 9; Teton Mountains (south of Moose Creek, altitude 10,000 feet), 3; Teton Pass (above Fish Creek, altitude 7,200 feet), 15; Tower Falls, Yellowstone National Park, 1; Valley (Absaroka Mountains, altitude 7,000 to 7,500 feet), 14; Willow Park, Yellowstone National Park, 2; Woods Post Office, 1.

Yukon: Teslin Lake (near, Teslin Post), 1.[14]

SOREX OBSCURUS NEOMEXICANUS Bailey

New Mexican Dusky Shrew

(Pl. 2, c')

Sorex obscurus neomexicanus Bailey, Proc. Biol. Soc. Washington 26: 133, May 21, 1913.

Type specimen.—No. 100440, U. S. Nat. Mus., Biological Survey collection; ♂ old adult (teeth moderately worn), skin and skull; collected May 29, 1900, by Vernon Bailey.

Type locality.—Cloudcroft, altitude 9,000 feet in the Sacramento Mountains, Otero County, N. Mex.

Geographic range.—Mountains of south-central New Mexico. (Fig. 13.)

Diagnostic characters.—Similar to *Sorex o. obscurus* in size and color, possibly a trifle darker; skull larger and heavier than that of *S. o. obscurus*, much broader interorbitally and through brain case, with decidedly heavier dentition.

Color.—*Winter pelage:* Unknown. *Summer pelage:* Essentially like corresponding pelage of *S. o. obscurus*, possibly averaging a trifle darker. Upper parts fuscous to olive-brown, the color of the upper parts extending, slightly paler, well down over the sides; underparts smoke gray heavily tinged with avellaneous to light buff; tail indistinctly bicolor, olive-brown above, avellaneous to wood brown or almost buffy brown below, nearly to tip.

Skull.—Moderate in length, relatively rather broad, with heavy dentition. Maxillary tooth row long, about equal in length to that of *S. o. longicauda*. Skull larger and heavier than that of *S. o. obscurus*, much broader, with decidedly heavier dentition.

Measurements.—Type specimen (old adult male): Total length, 118; tail vertebrae, 45; hind foot, 15. Two adult females from type locality: Total length, 106, 103; tail vertebrae, 42, 41; hind foot, 14, 14. *Skull:* Type specimen (old adult male; teeth moderately worn); Condylobasal length,, 18.0; palatal length, 7.2; cranial breadth, 8.9; interorbital breadth, 4.0; maxillary breadth, 5.4; maxillary tooth row, 6.9. Average of three skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 17.6 (17.4–17.7); palatal length, 7.1 (7.0–7.2); cranial breadth, 8.8 (8.6–8.9); interorbital breadth, 3.9 (3.9–3.9); maxillary breadth, 5.3 (5.2–5.4); maxillary tooth row, 6.8 (6.7–6.9).

Remarks.—Specimens of *S. o. neomexicanus* are known only from certain mountain ranges in south-central New Mexico. The subspecies has a larger skull than that of *S. o. obscurus* with broader rostrum and heavier dentition. The size of the molariform teeth approaches that of *S. o. longicauda*, but the general shape of the skull is different and the New Mexican animal has a decidedly shorter tail. Intergradation with *S. o. obscurus* is indicated in certain specimens of the subspecies *obscurus* from northern New Mexico.

Specimens examined.—Total number, 10, as follows:

New Mexico: Capitan Mountains (southwest slope), 2; Cloudcroft (type locality), 7; Cloudcroft (10 miles northeast of), 1.

[14] Nat. Mus. Canada.

SOREX OBSCURUS PARVIDENS Jackson

San Bernardino Dusky Shrew

(Pls. 2, d′; 5, g)

Sorex obscurus parvidens Jackson, Journ. Mamm. 2: 161, August 19, 1921.

Type specimen.—No. 56561, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected October 3, 1893, by J. E. McLellan. Original number 242.

Type locality.—Spring known as Thurmans Camp, Bluff Lake, altitude about 7,500 feet, San Bernardino Mountains, Calif.[36]

Geographic range.—Known only from the San Bernardino and San Gabriel Mountains, San Bernardino County, Calif. (Fig. 13.)

Diagnostic characters.—Similar in size and color to *Sorex o. obscurus;* skull about the size of that of *S. o. obscurus*, narrower interorbitally, with distinctly flatter cranium, which is less expanded mastoidally (consequently the skull averages narrower in greatest lateral diameter); molariform teeth more deeply emarginate posteriorly than in *S. o. obscurus*, the unicuspids narrower, and the first incisors smaller. Paler than *S. o. isolatus* and less brownish ventrally; skull with flatter and narrower brain case than in that of *isolatus*.

Color.—*Winter pelage* unknown. Probably not essentially different from winter pelage of *S. o. obscurus*. *Summer pelage:* Similar to that of *S. o. obscurus;* upper parts between olive-brown and buffy brown, tending slightly toward Saccardo's umber, and gradually blending with color of underparts; underparts smoke gray more or less tinged with avellaneous or light ochraceous-buff; tail indistinctly bicolor, olive-brown above, buffy brown below darkening toward tip.

Skull.—Narrower interorbitally than that of *S. o. obscurus*, with narrower and distinctly flatter brain case, and on the average weaker dentition, particularly the unicuspidate teeth, the molariform teeth usually with more deeply emarginate posterior borders. Skull similar to that of *S. o. isolatus* but with narrower and decidedly flatter brain case.

Measurements.—Type specimen (adult male): Total length, 105; tail vertebrae, 45; hind foot, 12 (12.8 measured from dry skin by writer). Adult female from type locality: Total length, 106; tail vertebrae, 41; hind foot, 12 (12.6 measured from dry skin by writer). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 17.1; palatal length, 6.7; cranial breadth, 8.1; interorbital breadth, 3.5; maxillary breadth, 5.0; maxillary tooth row, 6.2. Skull of adult female (teeth slightly worn) from type locality: Condylobasal length, 16.4; palatal length, 6 4; cranial breadth, 8.0; interorbital breadth, 3.5; maxillary breadth, 4.9; maxillary tooth row, 5.8.

Remarks.—The rather flat and narrow skull of *S. o. parvidens*, combined with its weak dentition, distinguishes it from other forms of *S. obscurus*. The subspecies is probably confined to the San Bernardino and San Gabriel Mountains, Calif.

Specimens examined.—Total number, 7, as follows:

California: Bluff Lake, San Bernardino Mountains (altitude 7,500 feet) (type locality), 6[37]; Camp Baldy (San Antonio Canyon, altitude 4,200 feet), San Bernardino County, 1.[38]

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[36] In the original description of this form the writer designated Thurmans Camp, Bluff Lake, as on the "western side of San Bernardino Peak," obtaining these data from the catalogue and a letter of the collector of the type specimen, J. E. McLellan. (Jackson, 1921b, p. 161.) The writer is indebted to several of his California friends, namely, Joseph Grinnell, Laurence M. Huey, Donald R. Dickey, and Edmund C. Jaeger, for calling attention to the fact that Bluff Lake is not on the western side of San Bernardino Peak, but is separated from the peak by Santa Ana Canyon. McLellan's original notes give the locality as "a spring (called Thurmans Camp) on the west side of San Bernardino Peak at an altitude of about 9,000 feet." The only camp in the San Bernardino Mountains known as Thurmans Camp has long been abandoned and was located on what is now known as Bluff Lake, at an altitude of about 7,500 feet.

[37] D. R. Dickey coll., Pasadena, Calif., 2.

[38] D. R. Dickey coll.

SOREX OBSCURUS SHUMAGINENSIS Merriam

Shumagin Dusky Shrew

(Pls. 3, a; 6, j)

Sorex alascensis shumaginensis Merriam, Proc. Washington Acad. Sci. 2: 18, March 14, 1900.

S[orex] shumaginensis Osgood, North Amer. Fauna No. 21, p. 71, September 26, 1901.

[*Sorex*] [*glacialis*] *shumaginensis* Elliot, Field Columb. Mus. Publ. 45 (zoöl. series 2): 373, 1901.

Sorex obscurus shumaginensis Allen, Bul. Amer. Mus. Nat. Hist. 16: 228, 1902.

Type specimen.—No. 97993, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected July 17, 1899, by DeA. Saunders (measured by C. Hart Merriam and numbered 2210 in A. K. Fisher's catalogue).

Type locality.—Popof Island, Shumagin Islands, Alaska.

Geographic range.—Western Alaska, from Seward Peninsula southeast to the northern part of Kenai Peninsula. (Fig. 13.)

Diagnostic characters.—About the size of *Sorex* o. *obscurus*, but paler and tending more toward a tricolor pattern, the sides buffy and paler than the upper parts, but darker and more buffy than the underparts; skull about the size of that of *S.* o. *obscurus*, with on the average somewhat shorter palate, rather narrower and more attenuate rostrum; more depressed orbitally, the brain case usually higher and rising more abruptly in the frontal region, dentition weaker. Smaller and paler than *S. o. alascensis;* skull smaller than that of *alascensis*, with shorter palate, narrower rostrum, and weaker dentition.

Color.—Winter pelage: Essentially like the winter pelage of *S.* o. *obscurus*. *Summer pelage:* Paler than corresponding pelage of *S.* o. *obscurus*, and tending toward a tricolor pattern, the sides buffy, paler than the upper parts, darker and more buffy than the underparts. Upper parts between olive-brown and buffy brown, slightly tending toward Saccardo's umber; sides, from the cheeks to the thighs, between wood brown and avellaneous, more nearly avellaneous; underparts pale smoke gray, sometimes tinged with pale olive-buff; tail as in *S.* o. *obscurus*.

Skull.—About the size of that of *S.* o. *obscurus*, with shorter palate, somewhat narrower and more attentuate rostrum; more depressed and constricted interorbitally, the brain case usually higher and rising more abruptly in the frontal region; dental pigmentation dark and intense; molariform teeth averaging smaller than in *S.* o. *obscurus*. Skull smaller than that of *S.* o. *alascensis*, with shorter and narrower palate, narrower and more attenuate rostrum; relatively narrower interorbitally, with weaker dentition.

Measurements.—Type specimen (adult male): Total length, 112; tail vertebrae, 42; hind foot, 14. Average of 6 adult males from King Cove, Alaska: Total length, 112.7 (107–118); tail vertebrae, 48.3 (45–52); hind foot, 13.8 (13–14). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 17.3; palatal length, 6.5; cranial breadth, 8.7; interorbital breadth, 3.6; maxillary breadth, 4.9; maxillary tooth row, 6.0. Average of 5 skulls of adult males (teeth very slightly worn) from type locality: Condylobasal length, 17.4 (17.1–17.8); palatal length, 6.6 (6.4–6.8); cranial breadth, 8.4 (8.3–8.5); interorbital breadth, 3.6 (3.5–3.7); maxillary breadth, 4.9 (4.8–5.0); maxillary tooth row, 6.1 (6.0–6.2). Average of 6 skulls of adult males (teeth slightly worn) from King Cove, Alaska: Condylobasal length, 16.8 (16.7–17.0); palatal length, 6.5 (6.4–6.6); cranial breadth, 8.6 (8.5–8.7); interorbital breadth, 3.5 (3.4–3.7); maxillary breadth, 4.8 (4.6–4.9); maxillary tooth row, 5.9 (5.8–6.0).

Remarks.—In summer pelage, *S. o. shumaginensis* in its typical form is readily separable from *S. o. obscurus* by its color; there are also good cranial differences. Specimens from Tyonek and Hope on Cook Inlet, Alaska, show an approach toward *S. o. obscurus* or *S. o.*

alascensis in that some of them have skulls that have rather longer rostra than in typical *shumaginensis*, and are less depressed orbitally and have their brain cases more flattened. They approach the subspecies *obscurus* more nearly than they do *alascensis*, and probably represent intergrades between *S. o. obscurus* and *shumaginensis*.

Five alcoholic specimens with imperfect skulls from Nulato, Alaska, and a similar specimen from St. Michael are provisionally referred to *S. o. shumaginensis*.

Specimens examined.—Total number, 381, as follows:

Alaska: Alaska Peninsula, 6[39]; Aniak, 1; Barabori, Kenai Peninsula, 1[39]; Becharof Lake, 8; Bethel, 7; Caribou Camp, Kenai Peninsula, 7[39]; Chignik, 6; Cold Bay, 14; Dillingham, 1; Ekwok, 1; Frosty Peak (east base), Alaska Peninsula, 15; Good News Bay, 1; Homer, 1[39]; Hope, 15; Hope (mountains near), 13; Kakhtul River, 5; Kakwok, 3; Kakwok River (80 miles up), 1; Kanatak, Portage Bay, 4; Katmai, 1[40]; Kenai Mountains, 37[39]; Kenai Peninsula, 24[39]; King Cove, 22; Kuskokwim River (200 miles above Bethel, Crooked Creek), 1[41]; Lake Aleknagik, 6; Moose Camp, Kenai Peninsula, 3[39]; Morzhovoi Bay, 7; Moller Bay, 1; Nome River, 2[39]; Nulato, 5; Nushagak, 15; Nushagak (25 miles above, Nushagak River), 1; Nushagak River, 1; Popof Island (type locality), 3; Russian Mission, 1[42]; Sand Point, Popof Island, 45[39]; St. Michaels, 1; Sawtooth Mountains, 2; Seldovia, 24[39]; Sheep Creek, 14[39]; Skwentna River (Mountain Climber Road House), 1; Tyonek, 48; Ugagik River, Alaska Peninsula, 3; Unga, 2; Unga Island, 1.

SOREX OBSCURUS ALASCENSIS Merriam

Alaskan Dusky Shrew

(Pl. 3, b)

Sorex obscurus alascensis Merriam, North Amer. Fauna No. 10, p. 76, December 31, 1895.

Sorex glacialis Merriam, Proc. Washington Acad. Sci. 2: 16, March 14, 1900. Type locality: Point Gustavus, east side of entrance to Glacier Bay, Alaska.

S[*orex*] *alascensis* Merriam, Proc. Washington Acad. Sci. 2: 18, March 14, 1900.

[*Sorex*] [*glacialis*] *alascensis* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 372, 1901.

Sorex alascensis alascensis Miller, U. S. Nat. Mus. Bul. 79, p. 16, December 31, 1912.

Type specimen.—No. 73539, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected July 10, 1895, by C. P. Streator.

Type locality.—Yakutat, Alaska.

Geographic range.—Coast region of Alaska from southern part of Kenai Peninsula south to Juneau; also Sheslay River, British Columbia. (Fig. 13.)

Diagnostic characters.—Similar in color to *Sorex o. obscurus* or very slightly darker, a trifle larger, with distinctly larger hind foot; skull larger than that of *S. o. obscurus*, with broader rostrum and brain case, and heavier dentition. Smaller, with shorter tail, and averaging paler than *S. o. longicauda;* skull smaller than that of *longicauda*, with noticeably shorter palate and rostrum, shorter maxillary tooth row, and weaker dentition. Larger and darker than *S. o. shumaginensis;* skull larger than that of *shumaginensis*, with longer palate, broader rostrum, and heavier dentition. Similar to *S. o. elassodon*, but

[39] Amer. Mus. Nat. Hist.
[40] Nat. Geog. Soc., Washington, D. C.
[41] D. R. Dickey coll., Pasadena, Calif.
[42] Mus. Vert. Zool.

hind foot larger; skull similar to that of *elassodon*, with broader rostrum and heavier unicuspidate teeth.

Color.—Winter pelage: Not appreciably different from that of *S. o. obscurus* or *S. o. shumaginensis*. *Summer pelage:* Similar to that of *S. o. obscurus*, averaging a trifle darker. Upper parts usually between olive-brown and sepia, frequently almost mummy brown, or mummy brown tending toward Dresden brown; color of upper parts extending well down on the sides and gradually mixing with color of ventral parts; underparts smoke gray more or less tinged with light buff or pinkish buff; tail bicolor, near olive-brown above, usually avellaneous to cinnamon-buff, sometimes buffy brown, below nearly to tip.

Skull.—Larger than that of *S. o. obscurus*, with relatively shorter palate (actually about the same), broader brain case and rostrum, longer tooth row, and heavier dentition. Larger than that of *S. o. shumaginensis*, with longer and broader palate, broader and less attenuate rostrum; relatively broader interorbitally, with distinctly heavier dentition. Compared with that of *S. o. longicauda*, smaller, with distinctly shorter palate and rostrum, shorter tooth row, and weaker dentition. Somewhat similar to that of *S. o. elassodon*, with broader brain case and rostrum, heavier dentition (particularly unicuspidate teeth), the dental pigmentation more extensive and intensive. Brain case higher, and dentition heavier with more extensive and intensive pigmentation than in *S. o. malitiosus*.

Measurements.—Type specimen (adult female): Total length, 115; tail vertebrae, 45; hind foot, 14.5. Average of three adult females from type locality: Total length, 118.3 (114–121); tail vertebrae, 50 (50–50); hind foot, 14.7 (14–15). *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 17.6; palatal length, 6.8; cranial breadth, 8.6; interorbital breadth, 3.7; maxillary breadth, 5.1; maxillary tooth row, 6.2. Average of three skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 17.7 (17.7–17.8); palatal length, 6.8 (6.7–6.9); cranial breadth, 8.7 (8.7–8.8); interorbital breadth, 3.7 (3.6–3.8); maxillary breadth, 5.2 (5.0–5.3); maxillary tooth row, 6.3 (6.2–6.4). Skull of type specimen of *S. glacialis* (adult male; teeth moderately worn) from Point Gustavus, Glacier Bay, Alaska: Condylobasal length, 17.6; palatal length, 6.8; cranial breadth, 8.6; interorbital breadth, 3.8; maxillary breadth, 5.0; maxillary tooth row, 6.4.

Remarks.—The comparatively large series of shrews now available from the coast region of Alaska shows that *Sorex glacialis* Merriam is identical with *S. o. alascensis* Merriam. The type specimen of *S. glacialis* is in very fresh summer pelage (June 12), and consequently the color of the upper parts is darker and more grayish than it would have been later in the season. A topotype taken a day earlier than the type specimen is darker above than typical *alascensis*, but matches specimens of *S. o. longicauda* from Wrangell, Alaska; the underparts of it are identical in color with specimens of *alascensis* in similar pelage. The skulls of both of the Point Gustavus specimens are indistinguishable from those of *alascensis*. Both specimens are easily referable to *alascensis*, at best showing only a slight tendency toward *longicauda* in the color of the underparts. Specimens from Juneau, Alaska, are intermediate between *alascensis* and *longicauda* in both external and cranial character. They are nearer to *alascensis*, however, to which they are here referred. A single specimen of a young animal from Taku River, Alaska, is likewise referable to *alascensis*, though showing a slight inclination toward *longicauda*.

Some of the specimens from islands in Prince William Sound have weaker dentition than typical *S. o. alascensis*, indicative of an approach toward *S. o. shumaginensis*.

Specimens examined.—Total number, 201, as follows:

Alaska: Bartlett Bay (in Glacier Bay), 26[43]; Cordova Bay (head of Prince William Sound), 1[44], Cordova Bay (head of, head of Cordova Inlet, Prince William Sound), 1[44]; Disc Island (Prince William Sound), 10[44]; Drier Bay (Knight Island, Prince William Sound), 20[44]; Eleanor Island (Prince William Sound), 6[44]; Elrington Island (north end, Prince William Sound), 3[44]; Glacier Bay (type locality of *glacialis*), 5[45]; Green Island (Prince William Sound), 3[44]; Hanning Bay (Montague Island, Prince William Sound), 5[44]; Hawkins Island (Prince William Sound), 5[44]; Herring Bay (Knight Island, Prince William Sound), 3[44]; Hinchinbrook Island (Prince William Sound), 6[44]; Hoodoo Island (Prince William Sound), 5[44]; Juneau, 36; La Touche (La Touche Island, Prince William Sound), 5[44]; Mendenhall River, 1; Montague Island (Prince William Sound), 16[44]; Montague Island (Zaikof Bay, Prince William Sound), 6[46]; Orca, 1; Portage, 2[44]; Port Nell Juan (mouth, Prince William Sound), 2[44]; Taku River, 2[44]; Valdez Narrows (Prince William Sound), 12[44]; Wortmans (Prince William Sound), 1[44]; Yakutat (type locality), 9[47]; Yakutat Bay, 1; Yakutat Bay (north shore), 2.

British Columbia: Sheslay River, 5[48]; Sheslay River (headwaters), 1.[48]

SOREX OBSCURUS MALITIOSUS Jackson

Warren Island Dusky Shrew

Sorex obscurus malitiosus Jackson, Proc. Biol. Soc. Washington 32: 23. April 11, 1919.

Type specimen.—No. 8401, Mus. Vert. Zool., Univ. California; ♀ adult (teeth slightly worn), skin and skull; collected May 21, 1909, by H. S. Swarth.

Type locality.—East side of Warren Island, Alaska.

Geographic range.—Known only from Warren and Coronation Islands, Alaska. (Fig. 14.)

Diagnostic characters.—Similar in size and superficial appearance to *Sorex o. longicauda*. Skull slightly more flattened than that of *longicauda* of corresponding age, the lachrymal foramen smaller and superior portion of rostrum broader. Larger than *S. o. classodon* with relatively larger feet; skull broader than that of *classodon* with longer rostrum. Larger than *S. o. alascensis* with longer tail; skull larger than that of *alascensis*, more flattened and averaging broader interorbitally.

Color.—Winter pelage: Tending to be more brownish than corresponding pelage of *S. o. longicauda*. Upper parts between chaetura drab and fuscous-black; underparts smoke gray heavily washed and intermixed with drab to wood brown; tail bicolor, between olive brown and sepia above, between buffy brown and tawny olive below nearly to tip. *Summer pelage:* Essentially like *longicauda* in similar pelage. Upper parts near mummy brown, becoming a very trifle darker on posterior parts (rump) and paling gradually into drabbish on the flanks; underparts and tail essentially as in winter.

Skull.—Broad, flat, and rather massive for the species *obscurus*. Slightly more flattened than that of *S. o. longicauda*, less depressed interorbitally, the brain case flatter and rising somewhat less abruptly in the frontal region, superior portion of rostrum broader and more flattened, lachrymal foramen smaller, unicuspidate teeth narrower, dental pigmentation less extensive. Larger, broader interorbitally, with broader, longer rostrum, and more deeply pigmented and heavier dentition than in *S. o. classodon*. Larger than that of *S. o. alascensis*, more flattened, averaging broader interorbitally, with relatively longer palate and heavier dentition.

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[43] D. R. Dickey coll., Pasadena, Calif., 4; Mus. Vert. Zool., 22.
[44] Mus. Vert. Zool.
[45] Mus. Vert. Zool., 3.
[46] Mus. Vert. Zool., 4.
[47] D. R. Dickey coll., 1.
[48] Amer. Mus. Nat. Hist.

Measurements.— Type specimen (adult female): Total length, 120; tail vertebrae, 56; hind foot, 15. Average of five adult males from type locality: Total length, 129.8 (126–135); tail vertebrae, 56.4 (53–61); hind foot, 15.4 (15–16). *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 18.4; palatal length, 7.3; cranial breadth, 8.8; interorbital breadth, 3.8; maxillary breadth, 5.3; maxillary tooth row, 6.6. Average of five skulls of adult males (teeth slightly worn) from type locality: Condylobasal length, 18.4 (17.8–18.8); palatal length, 7.3 (7.2–7.4); cranial breadth, 8.9 (8.7–9.1); interorbital breadth, 4.0 (3.9–4.0); maxillary breadth, 5.2 (5.1–5.4); maxillary tooth row, 6.6 (6.4–6.7).

Remarks.—As far as known *S. o. malitiosus* is confined to Warren and Coronation Islands, Alaska. The specimens from Coronation Island are not strictly typical of *malitiosus*, being somewhat smaller, and the skulls have rather narrower brain cases. In fact, they could with almost equal propriety be called *S. o. elassodon*. In appearance and general characters *malitiosus* is more like *S. o. longicauda* than *elassodon*, although its geographic range is completely separated from that of *longicauda* by that of *elassodon*. Its skull is flattened, as in *elassodon*, but is much larger, heavier, and more massive.

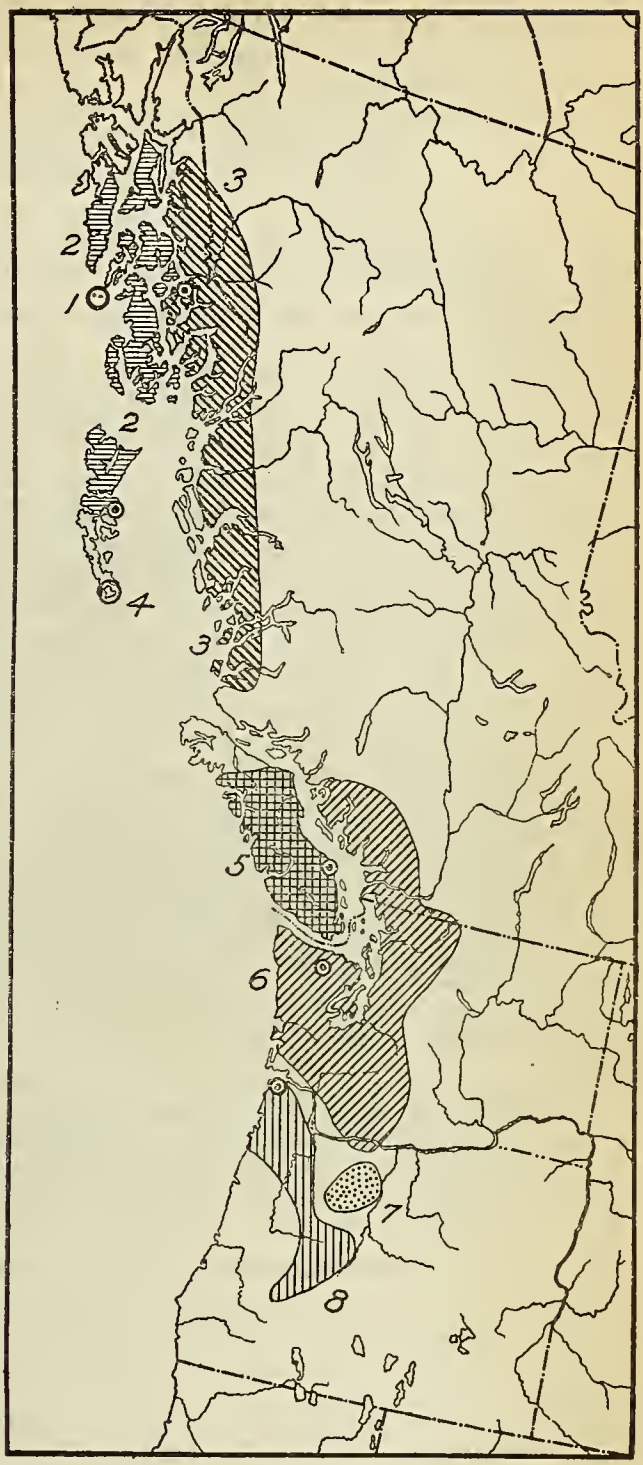

FIG. 14.—Geographic range of *Sorex obscurus malitiosus*, *S. o. elassodon*, *S. o. longicauda*, *S. o. prevostensis*, *S. o. isolatus*, *S. o. setosus*, *S. o. permiliensis*, and *S. o. bairdi*

1. *S. o. malitiosus.*
2. *S. o. elassodon.*
3. *S. o. longicauda.*
4. *S. o. prevostensis.*
5. *S. o isolatus.*
6. *S. o. setosus.*
7. *S. o. permiliensis.*
8. *S. o. bairdi.*

Specimens examined.—Total number, 21, as follows:

Alaska: Egg Harbor, Coronation Island, 11;[49] Warren Island (east side type locality), 10.[49]

SOREX OBSCURUS ELASSODON Osgood

QUEEN CHARLOTTE DUSKY SHREW

(PL. 3, c)

Sorex longicauda classodon Osgood, North Amer. Fauna No. 21, p. 35, September 26, 1901.

Sorex obscurus classodon Elliot, Field Columb. Mus. Publ. 105 (zool. series 6): 450, 1905.

Type specimen.—No. 100597, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected June 13, 1900, by W. H. Osgood.

Type locality.—Cumshewa Inlet near old Indian village of Clew, Moresby Island, Queen Charlotte Islands, British Columbia.

Geographic range.—Certain islands of southeastern Alaska and British Columbia from Admiralty Island, Alaska, south to Moresby Island, Queen Charlotte Group, British Columbia (except Coronation and Warren Islands, Alaska, inhabited by *Sorex o. malitiosus*), including Admiralty, Baranof, Prince of Wales, Duke, Mitkof, and Forrester Islands, Alaska, and Graham, Langara, and Moresby Islands, British Columbia. (Fig. 14.)

General characters.—About the color of *S. o. longicauda*, but smaller, with relatively and actually shorter tail and smaller feet; skull smaller than that of *longicauda*, with shorter palate and narrower rostrum. Smaller and paler than *S. o. prevostensis*, with shorter palate and narrower rostrum. Much larger with distinctly longer tail and somewhat larger hind foot than *S. o. obscurus;* slightly darker; skull longer than that of *S. o. obscurus*, with rostrum actually about same dimensions, relatively smaller. Externally similar to *S. o. alascensis*, but hind foot shorter; skull about same size as that of *alascensis*, narrower through brain case and rostrum. Smaller than *S. o. malitiosus*, with smaller feet; skull narrower than that of *malitiosus* with shorter rostrum. Tail averaging shorter than in *S. o. setosus* and skull different.

Color.—*Winter pelage:* Unknown. *Summer pelage:* Similar to corresponding pelage of *S. o. longicauda*. Upper parts mummy brown to fuscous, the color of the back extending well down over the sides, changing gradually to color of underparts; underparts usually drab, or between wood brown and avellaneous, sometimes almost buffy brown, usually showing more or less of deep neutral gray of underparts; tail indistinctly bicolor, near fuscous above, drab or buffy brown below.

Skull.—Smaller than that of *S. o. longicauda* or *S. o. prevostensis*, with shorter palate and narrower rostrum. Skull longer than that of *S. o. obscurus*, with rostrum relatively smaller (actually about same dimensions). Similar to that of *S. o. alascensis*, with narrower brain case and rostrum, weaker dentition (particularly unicuspidate teeth), and less extensive and intensive dental pigmentation. Smaller, narrower interorbitally, with shorter, narrower rostrum and less intensely pigmented and weaker dentition than in *S. o. malitiosus*. Compared with that of *S. o. setosus*, the brain case is flatter, rostrum lower, and dentition less intensely and extensively pigmented.

Measurements.—Type specimen (adult male): Total length, 123; tail vertebrae, 52; hind foot, 14. Average of four adult males from type locality: Total length, 126 (119–131); tail vertebrae, 53.5 (52–55); hind foot, 13.8 (13–14). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 17.9; palatal length, 6.9; cranial breadth, 8.6; interorbital breadth, 3.5; maxillary breadth, 4.7; maxillary tooth row, 6.1. Average of four skulls of adult males (teeth slightly worn) from type locality: Condylobasal length, 17.9 (17.6–18.1); palatal length, 6.8 (6.7–6.9); cranial breadth, 8.6 (8.4–8.7); interorbital

[49] Mus. Vert. Zool.

breadth, 3.7 (3.5–3.9); maxillary breadth, 4.9 (4.7–5.0); maxillary tooth row, 6.3 (6.1–6.4).

Remarks.—Although confined to certain islands off the coast of British Columbia and Alaska, intergradation of characters between *S. o. elassodon*, *S. o. longicauda*, and *S. o. alascensis* seems clearly established. Specimens from the extreme northern end (Hawk Inlet) of Admiralty Island, Alaska, show a decided approach toward *alascensis*, several of the skulls being almost indistinguishable from typical skulls of *alascensis*. Certain skulls from Mitkof Island, Alaska, show, in their dentition, a slight approach toward *longicauda*, but on the whole they are easily referable to *elassodon*. A skin without skull (No. 238296, U. S. Nat. Mus.) from Port Conclusion, Baranof Island, Alaska, is provisionally referred to *elassodon*.

Specimens from Forrester Island, Alaska, are not strictly like typical *S. o. elassodon*, but the differences are too slight and inconstant for diagnosis as a different form. Externally these specimens are like *elassodon*, but some of their skulls seem a trifle larger than those of *elassodon* and have higher brain cases. There is indeed considerable variation, both geographic and individual, among the individuals of this species from nearly all the different islands. To recognize each of these slight geographic variations by name would cause only incomprehensible confusion.

Specimens examined.—Total number, 191, as follows:

Alaska: Admiralty Island (near Killisnoo), 2; Calder Bay, Prince of Wales Island, 2[50]; Coffman Cove, Prince of Wales Island, 1[51]; Duke Island, 2[50]; Forrester Island, 13[52]; Hawk Inlet, 13[50]; Heceta Island, 1[50]; Klawak Lake, Prince of Wales Island, 4[53]; Kuiu Island (Three-mile Arm), 1[50]; Kupreanof Island, 30[54]; Mitkof Island, 5[55]; Mitkof Island (Petersburg), 10; Mole Harbor, Admiralty Island, 7[50]; Point Baker, 1[51]; Port Conclusion, Baranof Island, 1[56]; Port Protection, Prince of Wales Island, 3[50]; Prince of Wales Island (Kasaan Bay), 18; Rocky Bay (northwest coast of Dall Island), 1[50]; St. John Harbor (Zarembo Island), 1[50]; San Alberta Bay (Prince of Wales Island, north shore), 2[50]; Scow Bay, Kupreanof Island, 1; Scow Bay, Mitkof Island, 2[51]; Shakan, Prince of Wales Island, 1[50]; Windfall Harbor, Admiralty Island, 10[50]; Woewodski Island, 4[57].

British Columbia: Graham Island, Queen Charlotte Islands, 2[58]; Langara Island, Queen Charlotte Islands, 2[51]; Massett (Graham Island, Queen Charlotte Islands), 10[59]; Moresby Island (Cumshewa Inlet, Queen Charlotte Islands) (type locality), 25; Skidegate (Graham Islands, Queen Charlotte Islands), 3[60]; Queen Charlotte Islands, 13.[57]

SOREX OBSCURUS LONGICAUDA Merriam

Long-tailed Dusky Shrew

(Pl. 3, d)

Sorex obscurus longicauda Merriam, North Amer. Fauna No. 10, p. 74, December 31, 1895.

S[orex] longicauda Merriam, Proc. Washington Acad. Sci. 2:16, March 14. 1900.

[*Sorex*] [*obscurus*] *longicaudus* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 372, 1901.

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[50] Mus. Vert. Zool.
[51] D. R. Dickey coll., Pasadena, Calif.
[52] D. R. Dickey Coll., 1; Mus. Vert. Zool., 10.
[53] Mus. Vert. Zool., 3.
[54] Mus. Vert. Zool., 14.
[55] Mus. Vert. Zool., 4.
[56] No skull, provisionally referred to *S. o. elassodon*.
[57] Amer. Mus. Nat. Hist.
[58] Nat. Mus. Canada.
[59] D. R. Dickey coll., 1; Nat. Mus. Canada, 3.
[60] Nat. Mus. Canada, 2.

Type specimen.—No. 74711, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected September 9, 1895, by C. P. Streator.

Type locality.—Wrangell, Alaska.

Geographic range.—Coastal region of southeastern Alaska and British Columbia from Port Snettisham, Alaska, south to River Inlet, British Columbia, including certain adjacent islands in Alaska, as Etolin, Gravina, Revillagigedo, Sergief, and Wrangell. (Fig. 14.)

Diagnostic characters.—Size large for the species *obscurus* (total length about 125); about the size of *Sorex o. bairdi* but with tail averaging longer, and color decidedly less reddish; skull somewhat similar in size and proportions to that of *bairdi*, with average shorter palate, narrower rostrum, higher and narrower brain case, and smaller and narrower unicuspids. Much larger, darker, with decidedly longer tail and hind foot than *S. o. obscurus;* skull decidedly larger in all dimensions than that of *S. o. obscurus*, with relatively longer rostrum, higher brain case, and heavier dentition. Averaging somewhat darker than *S. o. alascensis*, larger, with longer tail and hind foot; skull larger than that of *alascensis* with relatively longer and narrower rostrum, and longer maxillary teeth row, and heavier dentition. Larger than *S. o. classodon*, with relatively and actually longer tail and larger feet; skull larger than that of *elassodon*, with longer, broader rostrum. Differs cranially from *S. o. malitiosus*, which it resembles externally. Averaging paler than *S. o. prevostensis* with relatively longer tail and larger hind foot; skull similar to that of *prevostensis*, the rostrum averaging slightly narrower. In color about like *S. o. setosus*, but larger, with larger hind foot; skull larger than that of *setosus*, with longer, heavier rostrum, longer tooth row, and heavier dentition.

Color.—Winter pelage: Usually a trifle darker than corresponding pelage of *S. o. obscurus* or *S. o. alascensis*. General effect of upper parts chaetura drab to fuscous, showing more or less dark neutral gray of base of hairs; color of upper parts extending, scarcely paling, well down on the sides, gradually changing into color of underparts; underparts usually pale olive-gray, or smoke gray to pale smoke gray, sometimes very faintly tinged with avellaneous; tail bicolor or indistinctly bicolor, near olive-brown, or tending toward sepia, above usually avellaneous, sometimes buffy brown below nearly to tip. *Summer pelage:* Upper parts fuscous to mummy brown, becoming scarcely, if any, paler on the sides; underparts relatively dark (but distinctly paler than upper parts), usually avellaneous to drab, more or less mixed with deep neutral gray of base of hairs, sometimes almost buffy brown; tail essentially as in winter.

Skull.—About the size and proportions of that of *S. o. bairdi*, with average shorter palate, narrower rostrum, higher and narrower brain case, smaller molariform teeth, which are generally more deeply emarginate posteriorly, and smaller and distinctly narrower unicuspids. Decidedly larger in all dimensions than that of *S. o. obscurus*, with relatively and actually longer rostrum, higher brain case, and much heavier dentition. Larger than the skull of *S. o. alascensis*, with relatively longer and narrower rostrum, longer maxillary tooth row, and heavier dentition. Larger than that of *S. o. elassodon*, with longer, broader rostrum and heavier and more deeply pigmented dentition. Slightly less flattened than that of *S. o. malitiosus*, a trifle more depressed interorbitally, the brain case higher and arising somewhat less abruptly in the frontal region, superior portion of rostrum narrower, lachrymal foramen larger, unicuspidate teeth broader, and dental pigmentation more extensive. Similar to that of *S. o. prevostensis*, the rostrum averaging somewhat narrower. Larger than that of *S. o. setosus*, with longer, heavier rostrum, longer tooth row, and heavier dentition, and tending to have the anterior end of first upper molariform tooth (second premolar) less truncate anteriorly (the tooth appearing more triangular in outline) than in *setosus*.

Measurements.—Type specimen (adult male): Total length, 128; tail vertebrae, 59; hind foot, 15.5. Average of eight adult females from type locality: Total length, 128 (122–133); tail vertebrae, 58.8 (56–62); hind foot, 15.3 (14.5–16). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 18.7; palatal length, 7.5; cranial breadth, 8.8; interorbital breadth, 3.8; maxillary breadth, 5.1; maxillary tooth row, 6.8. Average of eight skulls of adult females (teeth very slightly worn) from type locality: Condylobasal length, 18.6 (17.7–19.1); palatal length, 7.3 (7.1–7.5); cranial breadth,

8.8 (8.4–9.0); interorbital breadth, 3.9 (3.7–4.0); maxillary breadth, 5.2 (5.1–5.3); maxillary tooth row, 6.7 (6.5–6.9).

Remarks.—The large series of specimens of *S. o. longicauda* from the type locality displays a surprising degree of individual variation, especially in cranial characters. The subspecies as a whole, however, is well defined. Intergradation with the subspecies *elassodon*, *alascensis*, and *setosus* is clearly established. In fact, specimens from the entire coast region of British Columbia as far south as River Inlet are intermediate between *longicauda* and *setosus*, but in the aggregate are referable to *longicauda*.

Specimens examined.—Total number, 281, as follows:

Alaska: Anan Creek (mainland), 3[61]; Boca de Quadra, 4[62]; Bradfield Canal, 2[63]; Burroughs Bay (mainland), 1[64]; Chickamin River (Behm Canal), 5[63]; Crittenden Creek (mainland near Wrangell), 1; Etolin Island, 3[65]; Fort Wrangell, 14[66]; Gravina Island (opposite Ketchikan), 1[63]; Helm Bay, 9[63]; Ketchikan (mouth of Fish Creek), 2; Loring, 11; Portage Cove, Revillagigedo Island, 5[63]; Port Snettisham, 1[63]; Quadra Cannery, 7[67]; Quadra Lake, 3[64]; Sergief Island (mouth of Stikine River), 2[63]; Sumdum Village (mainland), 1[64]; Thomas Bay, 16[63]; Wrangell (type locality), 88[68]; Wrangell Island, 10.[63]

British Columbia: Great Glacier, Stikine River, 9[63]; Inverness (mouth Skeena River), 15; Khutze Inlet, 2[69]; Metlakatla, 6[70]; Port Simpson, 25; River Inlet (head), 35.

SOREX OBSCURUS PREVOSTENSIS Osgood

Prevost Island Dusky Shrew

Sorex longicauda prevostensis Osgood, North Amer. Fauna No. 21, p. 35, September 26, 1901.

Sorex obscurus prevostensis Elliot, Field Columb. Mus. Publ. 105 (zool. series 6): 450, 1905.

Type specimen.—No. 100618, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected July 3, 1900, by W. H. Osgood.

Type locality.—North end of Prevost Island (Kunghit Island on some maps), on coast of Houston Stewart Channel, Queen Charlotte Islands, British Columbia.

Geographic range.—Known only from type locality. (Fig. 14.)

Diagnostic characters.—Similar to *Sorex o. longicauda* but averaging darker, with relatively slightly shorter tail; skull similar to that of *longicauda*, the rostrum averaging slightly broader. Larger and darker than *S. o. elassodon*, with larger hind foot; skull with longer palate and broader rostrum than in that of *elassodon*.

Color.—Winter pelage: Color of full winter fur unknown. Worn winter pelage of upper parts apparently darker and slightly more brownish than in *S. o. longicauda*, about fuscous-black; worn winter fur of underparts apparently about same color as in summer pelage. *Summer pelage:* Slightly darker than that of *longicauda* or *S. o. elassodon*. Upper parts fuscous to fuscous-black, or mummy brown, the color of back encroaching well down over sides and changing gradually to color of underparts; underparts usually near drab, or between wood brown and buffy brown; tail rather indistinctly bicolor, fuscous or between clove brown and olive-brown above, usually near buffy brown or wood brown below.

Skull.—Similar to that of *S. o. longicauda*, the rostrum averaging slightly broader. Compared with that of *S. o. elassodon*, palate longer, rostrum broader, dentition heavier.

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[61] D. R. Dickey coll., Pasadena, Calif., 2.
[62] D. R. Dickey coll., 2; Mus. Vert. Zool., 2.
[63] Mus. Vert. Zool.
[64] D. R. Dickey coll.
[65] Mus. Vert. Zool., 2.
[66] Amer. Mus. Nat. Hist.
[67] G. G. Cantwell coll., Palms, Calif., 1; D. R. Dickey coll., 5.
[68] D. R. Dickey coll., 24; G. G. Cantwell coll., 2; Mus. Vert. Zool., 8.
[69] Provincial Mus. British Columbia.
[70] Nat. Mus. Canada.

Measurements.—Type specimen (adult male): Total length, 133; tail vertebrae, 58; hind foot, 15. Average of three adult females from type locality: Total length, 136.3 (132–142); tail vertebrate, 56 (53–59); hind foot, 14.7 (14–15). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 18.8; palatal length, 7.2; cranial breadth, 9.1; interorbital breadth, 4.0; maxillary breadth, 5.5; maxillary tooth row, 6.5. Average of four skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 18.5 (18.3–18.7); palatal length, 7.2 (7.1–7.3); cranial breadth, 8.9 (8.7–9.0); interorbital breadth, 3.9 (3.7–4.1); maxillary breadth, 5.4 (5.2–5.7); maxillary tooth row, 6.7 (6.5–6.8).

Remarks.—The Prevost Island shrew is not a widely differentiated subspecies and is more nearly like *S. o. longicauda* than *S. o. elassodon*, the nearest subspecies geographically. It is rather darker colored than *longicauda* and tends to be more brownish.

Specimens examined.—Total number, 14, from the type locality.

SOREX OBSCURUS ISOLATUS Jackson

Vancouver Dusky Shrew

(Pl. 3, e)

Sorex obscurus isolatus Jackson, Journ. Washington Acad. Sci. 12: 263, June 14, 1922.

Type specimen.—No. 177719, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth moderately worn), skin and skull; collected May 21, 1911, by Alexander Wetmore. Original number 517.

Type locality.—Mouth of Millstone Creek, Nanaimo, Vancouver Island, British Columbia.

Geographic range.—Vancouver Island, British Columbia. (Fig. 14.)

Diagnostic characters.—About the size of *S. o. obscurus* or *S. o. parvidens*, but darker than either, particularly the ventral parts, which are also decidedly more brownish. Unicuspidate teeth smaller than in *S. o. obscurus*, and the posterior borders of molariform teeth tending to be more deeply emarginate. Somewhat similar in color to *S. o. setosus*, but averaging smaller in all proportions, with relatively shorter tail; skull smaller than that of *setosus*, with relatively weaker dentition.

Color.—Winter pelage: Upper parts most nearly chaetura drab mixed with grayish, gradually blending with color of underparts; underparts smoke gray tinged with drab or between drab and avellaneous; tail somewhat bicolor, olive-brown above, buffy brown to almost tawny olive or clay color below. *Summer pelage:* Upper parts fuscous to olive-brown, paling slightly on the sides, and gradually encroaching on color of underparts; underparts smoke gray, heavily tinged with buffy brown or even darker; tail as in winter.

Skull.—Similar to that of *S. o. obscurus*, narrower interorbitally, with on the average rather weaker dentition, particularly the unicuspidate teeth, the molariform teeth being usually a trifle more emarginate posteriorly. Skull similar to that of *S. o. parvidens*, but broader and higher through the brain case.

Measurements.—Type specimen (adult male): Total length, 113; tail vertebrae, 49; hind foot, 14. Adult female from type locality: Total length, 118; tail vertebrae, 48; hind foot, 14. *Skull:* Type specimen (adult male; teeth moderately worn): Condylobasal length, 17.4; palatal length, 6.6; cranial breadth, 8.5; interorbital breadth, 3.5; maxillary breadth, 4.9; maxillary tooth row, 6.3. Skull of adult female (teeth moderately worn) from type locality: Condylobasal length, 17.3; palatal length, 6.7; cranial breadth, 8.6; interorbital breadth, 3.5; maxillary breadth, 4.9; maxillary tooth row, 6.1.

Remarks.—In some respects *S. o. isolatus* is more nearly like *S. o. obscurus* than *S. o. setosus*, though geographically its range is adjacent to *setosus*. In color it is more nearly like *setosus*, and also in the general aspect of its skull; in size and body proportions, however,

and in dental characters it is more nearly like *S. o. obscurus*. In color it is not at all dissimilar to *S. v. vancouverensis*, but it has on the average a longer tail, larger hind feet, and the skull is broader rostrally and has heavier dentition.

Specimens examined.—Total number, 48, as follows:

British Columbia: Alberni Valley, Vancouver Island, 7[71]; Barclay Sound, 1[72]; Comox, 2[73]; Cowichan Lake, 1[74]; Departure Bay, 1[74]; Errington, Vancouver Island, 4[71]; French Creek, Vancouver Island, 2[71]; Golden Eagle Mine (18 miles south of Alberni, Vancouver Island), 5[71]; Goldstream, 5; Little Qualican River (Vancouver Island), 7[71]; Nanaimo (type locality), 3; Newcastle Island, 1[74]; Nootka, 3[74]; Parkville, Vancouver Island, 6[71].

SOREX OBSCURUS SETOSUS Elliot

Olympic Dusky Shrew

(Pl. 3, f)

Sorex sctosus Elliot, Field Columb. Mus. Publ. 32 (zool. series 1): 274, March, 1899.

Sorex obscurus setosus Jackson, Proc. Biol. Soc. Washington 31: 127, November 29, 1918.

Type specimen.—No. $\frac{6\,2\,1\,3}{2\,3\,8}$, Field Mus. Nat. Hist.; ♂ adult (teeth slightly worn), skin and skull; collected August 18, 1898, by D. G. Elliot.

Type locality.—Happy Lake, Olympic Mountains, Clallum County, Wash.

Geographic range.—Extreme southwestern British Columbia, western Washington, and extreme northwest-central Oregon (Parkdale), chiefly west of the Cascade Mountains. (Fig. 14.)

Diagnostic characters.—Color dark; tail relatively long. Similar in color to *S. o. longicauda*, smaller, with smaller feet; skull smaller than that of *longicauda*, with shorter, weaker rostrum, shorter maxillary tooth row and weaker dentition. Similar to *S. o. elassodon* with average slightly longer tail and cranial differences. Darker than *S. o. obscurus*, with relatively and actually longer tail, and average larger hind foot; skull averaging slightly larger than that of *S. o. obscurus*, very slightly more constricted interorbitally, with, on the average, rather larger molariform teeth. About the size of *S. o. permiliensis*, with tail averaging a trifle longer, and color darker and decidedly more grayish (less reddish); skull essentially the size of that of *permiliensis*, possibly averaging slightly shorter, with narrower brain case, the unicuspidate teeth (particularly anterior two) somewhat weaker, and the posterior margins of molariform teeth usually less deeply emarginate. Larger than *S. o. isolatus* with longer tail; dentition, especially unicuspids and first incisors, heavier than in *isolatus*.

Color.—*Winter pelage:* Somewhat darker than corresponding pelage of *S. o. obscurus*, about as in *S. o. longicauda*. General effect of upper parts fuscous to fuscous-black, sometimes almost mummy brown, showing more or less dark neutral gray of base of hairs; color of upper parts extending well down on the sides, becoming scarcely paler, and gradually mixing with color of underparts, which are decidedly paler; underparts usually pale olive-gray, or smoke gray to pale smoke gray, sometimes faintly tinged with light buff or avellaneous; tail indistinctly bicolor, near olive-brown or tending toward sepia above, buffy brown or avellaneous, sometimes drabbish, below nearly to tip. *Summer pelage:* Darker than that of *S. o. obscurus;* essentially like that of *longicauda*. Upper parts mummy brown to fuscous, becoming scarcely paler on the sides; underparts usually relatively dark (decidedly paler than upper parts), about drab to

[71] Mus. Vert. Zool.
[72] Amer. Mus. Nat. Hist.
[73] Nat. Mus. Canada, 1.
[74] Nat. Mus. Canada.

avellaneous; more or less mixed with deep neutral gray of base of hairs, sometimes almost buffy brown; tail essentially as in winter.

Skull.—Intermediate in many respects between that of *S. o. obscurus* and *S. o. longicauda*. Averaging slightly larger than that of *S. o. obscurus* with higher brain case, somewhat more constricted interorbitally, with average larger molariform teeth. Smaller than the skull of *longicauda*, with shorter, weaker rostrum, shorter maxillary tooth row, weaker dentition, and tending to have anterior end of first upper molariform tooth (second premolar) more truncate anteriorly (appearing less triangular in outline of superior surface) than in *longicauda*. Apparently averaging shorter than the skull of *S. o. permiliensis*, with narrower cranium, the unicuspids (particularly anterior two) somewhat weaker, and the posterior borders of molariform teeth tending to be less deeply emarginate. Compared with that of *S. o. classodon* the skull of *setosus* is higher and more arched, particularly through brain case and rostrum, and the dental pigmentation is heavier and more extensive.

Measurements.—Type specimen (adult male): Total length, 120; tail vertebrae, 54; hind foot, 13. Average of 3 adult males from Quinault Lake, Wash.: Total length, 125.3 (124–126); tail vertebrae, 59.7 (59–60); hind foot, 13.7 (13–14). Average of 4 adult females from Mount Vernon, Wash.: Total length, 123.3 (118–128); tail vertebrae, 56.8 (55–59); hind foot, 14 (14–14). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 17.3; palatal length, 6.7; cranial breadth, 8.3; interorbital breadth, 3.6; maxillary breadth, 4.9; maxillary tooth row, 6.0. Average of 3 skulls of adult males (teeth slightly worn) from Quinault Lake, Wash.: Condylobasal length, 17.6 (17.3–17.8); palatal length, 7.1 (7.0–7.2); cranial breadth, 8.6 (8.5–8.7); interorbital breadth, 3.6 (3.5–3.6); maxillary breadth, 5.0 (4.9–5.0); maxillary tooth row, 6.3 (6.2–6.4). Average of 4 skulls of adult females (teeth slightly worn) from Mount Vernon, Wash.: Condylobasal length, 17.6 (17.4–17.8); palatal length, 7.0 (6.9–7.1); cranial breadth, 8.6 (8.5–8.7); interorbital breadth, 3.6 (3.5–3.7); maxillary breadth, 5.1 (4.9–5.3); maxillary tooth row, 6.3 (6.2–6.4).

Remarks.—Persons who are familiar with Soricidae, as understood to-day, know that the presence or absence of a flank gland is of no specific or subspecific diagnostic value, although its size, shape, and other characteristics may be. Nevertheless Elliot's description of this form and his specific name, *setosus*, were based primarily upon the presence of flank glands in two specimens that he himself collected in the Olympic Mountains, Wash. The name becomes tenable for the subspecies of *obscurus* found in the coastal region of southwestern British Columbia and in Washington west of the Cascade Mountains. A number of the specimens from British Columbia have smaller skulls and weaker dentition than typical *setosus*, indicating an approach toward *S. o. obscurus*. Indeed, in several of these the teeth are as small as in the smaller toothed representatives of the subspecies *obscurus*, but in other essential characters they are nearer *setosus*. Specimens from Carson and Mount Rainier, Wash., though referable to *setosus*, are intermediate between it and *S. o. obscurus*.

Specimens examined.—Total number, 475, as follows:

British Columbia: Agassiz, 10[75]; Brackendale, Howe Sound, 4[75]; Burrard Inlet, 7[75]; Chilliwack, 1; Chilliwack Lake, 3[75]; Chilliwack Valley, 47[75]; Gibsons Landing, Howe Sound, 16; Huntingdon, 2[75]; Langley, 2; Lund, Malaspina Inlet, 17; Mount Baker Range, 2[76]; Mount Baker Range (altitude 6,000 feet), 1[77]; Mount Lehman, 1[78]; Port Moody, 19; Rossland, 2[75]; Sumas, 21[79]; Tami Hy Creek, 1[75]; Thurston, 13[75]; Vancouver District (altitude 7,300 feet), 1.[75]

Oregon: Parkdale (2 miles west, altitude 1,500 feet), 2.

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[75] Nat. Mus. Canada.
[76] Mus. Comp. Zool.
[77] Acad. Nat. Sci. Philadelphia.
[78] Amer. Mus. Nat. Hist.
[79] Acad. Nat. Sci. Philadelphia, 3; Mus. Comp. Zool., 1; Nat. Mus. Canada, 2.

Washington: Aberdeen, 5; Avon, 1; Barron (Bonite Mine, altitude 5,000 feet, Whatcom County), 1; Bear Prairie, Mount Rainier, 3; Buck Creek Pass (7 miles east Glacier Peak, altitude 5,500 feet), 1; Canyon Creek (3 miles south Soleduck River, altitude 3,550 to 4,550 feet), Clallam County, 10[80]; Carson (15 miles north at Government Springs, altitude 1,300 feet), 5; Cascade River (head of), 2; Cascade Tunnel, Chelan County (altitude 3,373 feet), 3[80]; Cat Creek (headwaters, altitude 4,500 feet), Clallam County, 9[81]; Cathlamet, 5; Cedarville, 3; Chehalis (8 miles west), 1; Chilliwack River (altitude 2,000 feet), Whatcom County, 2; Cloudy Pass (headwaters Agnes Creek), 1[82]; Conrad Meadows, 1; Crescent Lake (5 miles west), Olympic Mountains, 1; Dosewallips River (headwaters, Olympic Mountains, altitude, 4,500 feet), 3; Duckabush, 1; Elwha Basin (altitude 2,750 feet), Jefferson County, 5; Elwha River (Boulder Creek, altitude 560 feet), Clallam County, 4; Enumclaw, 1; Everett, 2; Glacier, 3; Glacier Basin (altitude 5,900 feet), Mount Rainier, 4; Grenville, Grays Harbor County, 2; Hamilton, 1; Happy Lake (type locality), 2[83]; Happy Lake (altitude 4,900 feet), Clallam County, 2; Hoh River (Glacier Creek, 8 miles southeast Olympic Ranger Station), Jefferson County, 1; Ilwaco, 3; James Lake (altitude 4,370 feet), Mount Rainier, 2[80]; Kapowsin, 1; Keechelus Lake, 9[84]; Kirkland, 1; Lake Cushman, 9[85]; Lake Quinault (altitude 180 feet), 3; Lapush, 8[86]; Longmire, Mount Rainier, 8[80]; Lyman Lake (altitude 5,500 feet), Chelan County, 1; McCain (Scenic, Tye River, altitude 2,100 feet), King County, 1; Messlers Ranch (1 mile west Rainier Park, altitude 2,000 feet), Mount Rainier, 5; Mora, 1; Mount Adams (Gotchen Creek, altitude 5,500 feet), 4[87]; Mount Angeles (altitude 5,000 to 6,000 feet), 4; Mount Baker, 6[82]; Mountain Meadows (altitude 4,000 feet), Mount Rainier, 1; Mount Rainier (west slope 5,400 feet), 1; Mount Rainier (west slope 6,800 feet), 1; Mount St. Helens (altitude 5,500 to 6,000 feet), 2; Mount St. Helens (8 miles south, altitude 600 feet), 2; Mount Vernon, 28; Neah Bay, 17; Oakville, 3; Ohanapecosh Lake (altitude 2,000 feet), Mount Rainier, 5; Olympia (4 miles south), 1; Owyhigh Lakes (altitude 5,100 feet), Mount Rainier, 2; Paradise Park (altitude 5,400 to 6,300 feet), Mount Rainier, 8[88]; Paradise Creek (altitude 5,200 feet), Mount Rainier, 4; Pasayten River (west fork, altitude 4,700 feet), Okanogan County, 2; Potlatch, 6[89]; Puget Island (1 mile south Cathlamet), 1; Puget Sound, 2; Quinault Lake, 18; Quinault River (headwaters, north fork, altitude 4,000 feet), Jefferson County, 1; Reflection Lake (altitude 4,900 feet), Mount Rainier, 3; Rockport (altitude 300 feet), 2; Roy, 1; St. Andrews Park (altitude 5,500 feet), Mount Rainier, 2; Seattle, 1; Scenic, 1[82]; Shelton, 2; Soleduck Divide (altitude 5,000 feet), 2[82]; Soleduck River (near head, altitude 4,500 feet), Olympic Mountains, 2; Spirit Lake (altitude 5,000 feet), Mount St. Helens, 2; Spray Park (altitude 5,500 feet), Mount Rainier, 4[80]; Stehekin (altitude 1,079 feet), 4[82]; Steilacoom, 2; Suez (10 miles south Neah Bay), 2; Suiattle River (Chiwawa Mountain fork, altitude 4,500 feet), Snohomish County, 4; Sunset Park (altitude 5,000 feet), 2[80]; Tacoma, 1; Tacoma (5 miles east), 1[89]; Tahoma Creek (altitude 2,500 to 2,900 feet), Mount Rainier, 3; Tenino, 2; Tokeland, Shoalwated Bay 2; Whatcom Pass (altitude 5,200 feet), Whatcom County, 2.

SOREX OBSCURUS PERMILIENSIS Jackson

Cascade Dusky Shrew

Sorex obscurus permiliensis Jackson, Proc. Biol. Soc. Washington 31: 128, November 29, 1918.

Type specimen.—No. 91048, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected October 2, 1897, by J. A. Loring.

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[80] State Coll. Wash., 1.
[81] State Coll. Wash., 2.
[82] State Coll. Wash.
[83] Field Mus. Nat. Hist.
[84] D. R. Dickey coll., Pasadena, Calif., 1; Acad. Nat. Sci. Philadelphia, 7; Univ. Mich., 1.
[85] Univ. Mich., 5.
[86] G. G. Cantwell coll., Palms, Calif., 1.
[87] State Coll. Wash., 3.
[88] D. R. Dickey coll., 2.
[89] D. R. Dickey coll.

Type locality.—Permilia Lake, west base of Mount Jefferson, Cascade Range, Marion County, Oreg.

Geographic range.—Known only from the Cascade Mountains (and foothills) of northern Oregon (Mount Hood south to Mount Jefferson). (Fig. 14.)

Diagnostic characters.—About the size of *Sorex o. setosus* with, on the average, slightly shorter tail; decidedly more reddish and paler in summer pelage than *setosus;* skull essentially the size of that of *setosus* (possibly averaging slightly longer), with broader brain case, the unicuspidate teeth (particularly anterior two) somewhat heavier, and the posterior margins of molariform teeth usually more emarginate. Slightly smaller and paler than *S. o. bairdi*, with actually and relatively smaller feet; skull smaller than that of *bairdi* with shorter palate, and decidedly weaker dentition.

Color.—Winter pelage: Upper parts slightly darker than hair brown, occasionally approaching chaetura drab, extending, very slightly paler, well down on sides; color of underparts in winter pelage unknown. *Summer pelage:* Decidedly more reddish than winter pelage. Upper parts between snuff brown and sepia, or slightly more yellowish than olive-brown, between Saccardo's umber and olive-brown, paling very slightly on the sides and grading into color of the underparts; underparts slightly paler than back, usually between buffy brown and tawny-olive, sometimes tending toward avellaneous; tail scarcely bicolor, above about same color as upper parts of body, becoming very slightly paler below.

Skull.—Large for the species *obscurus;* somewhat smaller than that of *S. o. bairdi*, averaging very slightly larger than that of *S. o. setosus*, and much larger and heavier than that of *S. o. obscurus*. Brain case broad, slightly flattened; rostrum relatively rather long and wide; interorbital region somewhat elongate, not much depressed; dentition moderately heavy, with intense and moderately extensive pigmentation. Skull most nearly like that of *setosus*, but averaging slightly longer, with broader brain case, the unicuspidate teeth (especially anterior two) somewhat heavier, and the posterior margins of the molariform teeth usually more emarginate. Rostrum and palate shorter than in that of *bairdi*, with decidedly weaker dentition. The zygomatic ridge of squamosal shows slight tendency to develop into shelf-like extension, but less so than in the skull *bairdi*.

Measurements.—Type specimen (adult male): Total length, 117; tail vertebrae, 51; hind foot, 14. Average of five adult females from type locality: Total length, 116.8 (112–120); tail vertebrae, 53.4 (50–58); hind foot, 14 (14–14). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 17.9; palatal length, 7.2; cranial breadth, 8.8; interorbital breadth, 3.7; maxillary breadth, 5.2; maxillary tooth row, 6.4. Average of five skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 17.9 (17.6–18.4); palatal length, 7.2 (7.0–7.5); cranial breadth, 9.0 (8.8–9.3); interorbital breadth, 3.8 (3.6–4.0); maxillary breadth, 5.2 (5.1–5.3); maxillary tooth row, 6.4 (6.2–6.6).

Remarks.—The series of 17 specimens of *S. o. permiliensis* from the type locality was collected October 1 to 4, 1897. Three of these are in worn summer pelage; the others, including the type, are in various stages of molting from summer to winter pelage; none is in full winter fur, the underparts of all still retaining the summer coat. September specimens in summer pelage from Mount Hood, Oreg., appear a trifle darker than those from the type locality; this is partly due to the less expanded condition of the skins and partly to less worn pelage, but it may also indicate an approach toward *S. o. setosus*. A specimen of *setosus* from Conrad Meadows, Yakima County, Wash., also indicates in color and cranial characters intergradation between *setosus and permiliensis*. A single specimen from Detroit, Oreg., shows cranially an approach toward *S. o. bairdi*.

Specimens examined.—Total number, 21, as follows:

Oregon: Cascade Mountains (east base, Camas Prairie, southeast Mount Hood), 1; Detroit, 1; Mount Hood (near timberline), 2; Mount Jefferson (west base, Permilia Lake) (type locality), 17.

SOREX OBSCURUS BAIRDI Merriam

Baird Dusky Shrew

(Pl. 3, g)

Sorex bairdi Merriam, North Amer. Fauna No. 10, p. 77, December 31, 1895.
Sorex obscurus bairdi Jackson, Proc. Biol. Soc. Washington 31: 127, November 29, 1918.

Type specimen.—No. $\frac{17414}{24318}$, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected August 2, 1889, by T. S. Palmer.

Type locality.—Astoria, Oreg.

Geographic range.—Extreme northwestern Oregon (Astoria, Netarts, Portland) southeasterly and southeast of the Willamette River and west of the Cascade Mountains to Prospect, Jackson County. (Fig. 14.)

Diagnostic characters.—Size large for the species *obscurus;* about the size of *Sorex o. longicauda,* but with shorter tail and more reddish color; skull somewhat similar in size and proportions to that of *longicauda,* with average longer palate, broader rostrum, flatter and broader brain case, and larger and broader unicuspids. Slightly larger and darker than *S. o. permiliensis,* with actually and relatively larger feet; skull larger than that of *permiliensis,* with longer palate and decidedly heavier dentition. Somewhat similar in color to *Sorex yaquinae* (not so reddish), but decidedly smaller; skull smaller and higher than that of *S. yaquinae,* with weaker dentition, particularly noticeable in the unicuspids and first upper incisors.

Color.—*Winter pelage:* Unknown. *Summer pelage:* Darker than corresponding pelage of *S. o. permiliensis;* somewhat like that of *S. o. longicauda,* but a trifle paler and more reddish. Upper parts usually most nearly between olive-brown and sepia, rarely almost fuscous, the color of upper parts extending well down over the sides, mixing gradually with color of the underparts; underparts drab tending strongly toward wood brown or buffy brown; tail scarcely bicolor, olive-brown above, buffy brown (darkening toward tip) below.

Skull.—Large and broad for the species *obscurus,* with large rostrum, and heavy dentition. About the size and general proportions of that of *S. o. longicauda* but with average longer palate, broader rostrum, broader and lower brain case, larger molariform teeth, which are usually less deeply emarginate posteriorly, and larger and distinctly broader unicuspids. Larger than that of *S. o. permiliensis,* with longer palate and rostrum, and decidedly heavier dentition, and with the zygomatic ridge of squamosal tending more to develop into a shelflike extension.

Measurements.—Type specimen (adult female): Total length, 130; tail vertebrae, 57; hind foot, 15. Average of three adult females from type locality: Total length, 125.7 (124–127); tail vertebrae, 53.7 (52–55); hind foot, 14.7 (14–15). *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 19.1; palatal length, 7.8; cranial breadth, 9.3; interorbital breadth, 4.1; maxillary breadth, 5.5; maxillary tooth row, 6.9. Average of three skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 18.5 (18.2–18.6); palatal length, 7.5 (7.4–7.6); cranial breadth, 9.0 (8.9–9.0); interorbital breadth, 3.8 (3.7–3.9); maxillary breadth, 5.3 (5.2–5.4); maxillary tooth row, 6.7 (6.6–6.7).

Remarks.—The Baird shrew is confined to lower elevations in Oregon west of the Cascade Mountains where it occurs at least as far south as Prospect, in Jackson County. The exact limits of its range and its relation to *Sorex yaquinae* are not satisfactorily determined. Specimens from Portland show an approach toward *S. o. permiliensis.* In color they are like *S. o. bairdi,* but in size of hind foot they are about as near *permiliensis.* The skulls also show the influence of *permiliensis,* one being practically identical with those of *bairdi* from

the type locality, others showing a tendency toward those of *permiliensis*.

Specimens examined.—Total number, 71, as follows:

Washington: Alpha, 1.[90]

Oregon: Astoria (type locality), 12; Blaine, 8[91]; Blue River, 1; McKenzie Bridge, 1; Netarts, 10[92]; Netarts Bay, 2[93]; Portland, 6; Prospect, 8[92]; Seaside, 3; Three Sisters (north slope, altitude 6,000 feet), 4; Tillamook, 6[94]; Tillamook (8 miles south, Pleasant Valley), 2[92]; Vida, 7.

SOREX YAQUINAE Jackson

Yaquina Shrew

(Pls. 3, H; 5, H; 6, K; 8, H; 12, L)

Sorex yaquinae Jackson, Proc. Biol. Soc. Washington 31: 127, November 29, 1918.

Type specimen.—No. 73051, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected July 18, 1895, by B. J. Bretherton.

Type locality.—Yaquina Bay, Lincoln County, Oreg.

Geographic range.—West-central Oregon north of the Umpqua River, from the coast east to Willamette Valley. (Fig. 15.)

Diagnostic characters.—In color and superficial appearance similar to *Sorex pacificus*, but smaller and with shorter tail and feet. Skull decidedly smaller in all dimensions than that of *S. pacificus*, with weaker rostrum, noticeably shorter tooth row and smaller teeth, particularly the second maxillary premolar; dental pigmentation darker than in *S. pacificus*. Somewhat more reddish in color than *S. o. bairdi*, and decidedly larger; skull larger and somewhat flatter than that of *bairdi*, with heavier dentition, particularly prominent in the unicuspids and first upper incisors.

Color.—Winter pelage: General tone of upper parts mummy brown or fuscous, tending slightly toward fuscous-black, paling almost imperceptibly on the head and face; color of back continuing well down on the sides and gradually changing into color of underparts. Underparts slightly paler than upper parts, near olive-brown or slightly darker; tail indistinctly bicolor, hair brown or drab above, light drab or avellaneous below; feet and tarsi avellaneous. *Summer pelage:* Distinctly more reddish than in winter. Upper parts between Prout's brown and cinnamon-brown, sometimes inclining toward sepia. Underparts slightly paler; near snuff brown, usually between snuff brown and Saccardo's umber; tail and feet about as in winter.

Skull.—Similar in general outline to that of *S. pacificus* but much smaller in all dimensions. Compared with that of other American members of the subgenus Sorex large, with broad and moderately flattened brain case; zygomatic ridge of squamosal developed, forming a trace of a shelf (more than in *S. o. bairdi* and decidedly less than in *S. pacificus*); interorbital region elongate, depressed; dentition heavy, heavier than that of *bairdi*, much weaker than that of *S. pacificus;* teeth rather intensively but not extensively pigmented; first and second unicuspids relatively broad, appearing more or less swollen (less so than in *S. pacificus*).

Measurements.—Type specimen (adult female): Total length, 137; tail vertebrae, 59; hind foot, 16. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 20.7; palatal length, 8.3; cranial breadth, 9.7; interorbital breadth, 4.3; maxillary breadth, 5.9; maxillary tooth row, 7.6. Skull of adult male (teeth slightly worn) from Gardiner, Oreg.: Condylobasal length, 20.0; palatal length, 8.0; cranial breadth, 9.9; interorbital breadth, 4.2; maxillary breadth, 6.1; maxillary tooth row, 7.4.

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[90] Univ. Mich.

[91] Univ. Mich., 6: D. R. Dickey coll., Pasadena, Calif., 2.

[92] D. R. Dickey coll.

[93] S. G. Jewett coll., Portland, Oreg.

[94] S. G. Jewett coll., 3; Alex. Walker coll., Tillamook, Oreg., 3.

Remarks.—The specimens of this shrew available are entirely inadequate for a satisfactory determination of its relationships with *S. o. bairdi* and *S. pacificus*. The species occupies a limited geographic range in western Oregon, and at Gardiner apparently occurs with *S. p. pacificus*, but in spite of general similarities these two shrews seem to be entirely distinct. It may be possible that the Umpqua River separates the two forms at Gardiner and that additional specimens may show intergradation between them nearer the headwaters of that stream. In a series of eight shrews from Vida, Oreg., there is a single specimen of *S. yaquinae* that is distinctly separable from the other seven, which are referable to *S. o. bairdi*. The differences, however, between certain specimens of *S. yaquinae* and *bairdi* are not great, and it is possible that additional specimens may show specific affinity between these two forms.

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

Oregon: Elkhead, 1; Eugene (3 miles west, Spencer Butte), 2[95]; Gardiner, 2; Mapleton, 3; Philomath (5 miles southwest), 2; Vida, 1; Yaquina Bay (type locality), 1.

SOREX PACIFICUS COUES

[Synonymy under subspecies]

Geographic range.—Pacific coast region from Umpqua River, Oreg., south to Point Reyes, Marin County, Calif. (Fig. 15.)

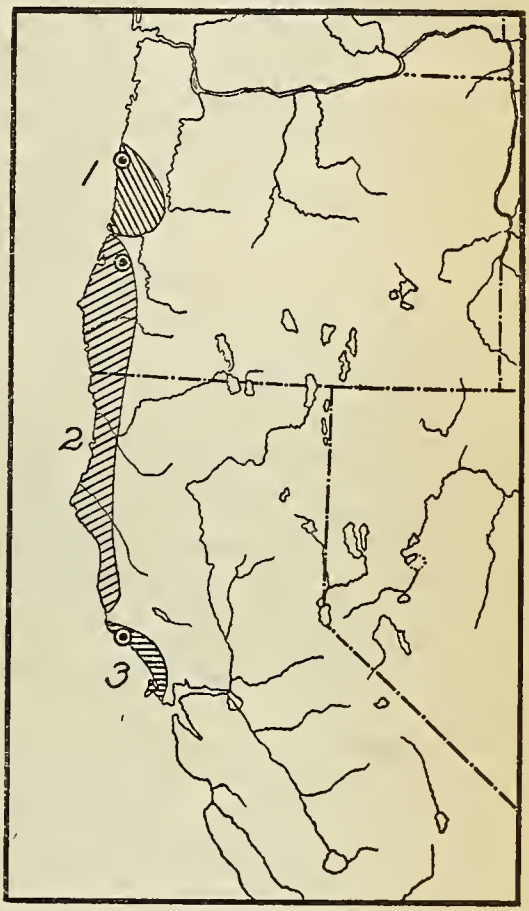

FIG. 15.—Geographic range of *Sorex yaquinae* and of subspecies of *S. pacificus*

1. *S. yaquinae.*
2. *S. p. pacificus.*
3. *S. p. sonomae.*

Diagnostic characters.—Size large (largest of the subgenus Sorex); cinnamon-like both above and below, the underparts scarcely differentiated from the back, the tail essentially unicolor; skull large and broad, with heavy rostrum; zygomatic ridge of squamosal well developed, forming a distinct shelf-like process extending posteriorly nearly to mastoidal region; dentition heavy, the unicuspids broad and swollen. Needs critical comparison only with *Sorex yaquinae*, which it resembles in color; larger than *S. yaquinae*, with larger feet; skull decidedly larger in all dimensions than that of *S. yaquinae*, with heavier rostrum, zygomatic ridge of squamosal more developed, noticeably longer tooth row and larger teeth, particularly the second upper premolar; dental pigmentation less intense.

Subspecies and geographic variation.—The species *pacificus* includes two subspecies—the typical form, *pacificus*, in the northern part of its range, and

[95] S. G. Jewett coll., Portland, Oreg.

sonomae in the southern part. The only noticeable geographic variation is a slight decrease in size and reduction of the reddish cinnamon color, in summer, toward the south, which culminates in the subspecies *sonomae*.

Time of molting.—Only a few specimens of *S. pacificus* in transition from winter to summer pelage are available, but it would appear that the spring molting usually occurs during May. Most of the June specimens are in complete summer pelage. Three males, however, from Crescent City, Calif., are in process of molt, though nearly completed, July 1, 3, and 5, 1899, and a female from the same locality still retains a trace of the winter pelage on the rump as late as July 30, 1894. A male from near Hardy, Calif., has a remnant of the winter fur June 22, 1919.

Winter pelage is usually acquired during October, and by the first to the middle of November the majority of specimens are in full winter coat. Seven males collected at Fair Oaks, Humboldt County, Calif., show indications of the beginning of the autumnal molt August 25 to 29, 1910, and three other males collected at Requa, Calif., show first traces of the molt on August 27, 28, and 31, 1901. A male from Gardiner, Oreg., has retained the summer pelage and is in early process of molt as late as November 26, 1901, and a female collected at the same place is in similar condition of pelage November 28, 1901.

SOREX PACIFICUS PACIFICUS Coues

Pacific Shrew

(Pls. 3, 1; 5, 1; 6, 1; 8, 1)

Sorex pacificus Coues, Bul. U. S. Geol. and Geog. Surv. Terr. 3: no. 3, p. 650, May 15, 1877.

Sorex pacificus pacificus Jackson, Journ. Mamm. 2: 162, August 19, 1921.

Type specimen.—No. 3266, U. S. Nat. Mus., adult (teeth slightly worn), sex unknown, poorly made skin, with fragmentary skull inside; skin torn about the mouth so as to expose what teeth are present, which consist of the upper incisors and unicuspids of both sides, the first upper molariform tooth (upper second premolar) of right side, the first four mandibular teeth of right side and first three of left; catalogued March 8, 1858, in U. S. National Museum; received from E. P. Vollum.

Type locality.—Fort Umpqua, mouth of Umpqua River, Douglas County, Oreg.

Geographic range.—Pacific coast region from the mouth of the Umpqua River, Oreg., south to Mendocino, Calif. (Fig. 15.)

Diagnostic characters.—Characters given under the species *pacificus* will separate the subspecies *pacificus* from all shrews except *S. p. sonomae*. Summer pelage usually slightly paler than in *sonomae;* size averaging larger, particularly noticeable cranially.

Color.—*Winter pelage:* Upper parts mummy brown or fuscous, tending toward fuscous-black; color of back extending well down over sides; underparts slightly paler than upper parts, nearly between olive-brown and buffy brown, sometimes tending toward Saccardo's umber; tail essentially unicolor, usually olive-brown, sometimes buffy brown, or even Saccardo's umber or tawny-olive. *Summer pelage:* Distinctly more reddish or cinnamon than in winter. Upper parts between Prout's brown and cinnamon-brown, sometimes between snuff brown and Saccardo's umber; underparts scarcely paler than back, usually between snuff brown and Saccardo's umber, sometimes inclining toward sepia; tail essentially as in winter.

Skull.—Large, broad, and massive (largest of the subgenus Sorex), with heavy rostrum and large teeth. Similar to that of *S. p. sonomae*, but averaging larger in all dimensions.

Measurements.—Adult female from Gardiner, Oreg. (essentially type locality): Total length, 150; tail vertebrae, 64; hind foot, 17.5. Average of five adult males from Eureka, Calif.: Total length, 144.8 (137–153); tall vertebrae,

64.2 (62–67); hind foot, 17.2 (17–17.5). *Skull:* Adult female (teeth very slightly worn) from Gardiner, Oreg. (essentially type locality): Condylobasal length, 21.6; palatal length, 9.0; cranial breadth, 10.4; interorbital breadth, 4.7; maxillary breadth, 6.4; maxillary tooth row, 8.1. Average of five skulls of adult males (teeth slightly to moderately worn) from Eureka, Calif.: Condylobasal length, 22.1 (21.4–23.0); palatal length, 9.3 (9.0–9.5); cranial breadth, 10.6 (10.4–11.2); interorbital breadth, 4.5 (4.4–4.7); maxillary breadth, 6.6 (6.5–6.9); maxillary tooth row, 8.5 (8.3–8.8).

Remarks.—There is some variation in size among the skulls of *S. p. pacificus* and in any large series of Californian specimens individuals can occasionally be found that are scarcely larger than certain skulls of *S. p. sonomae.* Specimens from the vicinity of Mendocino City, Calif., are intermediate in characters between *S. p. pacificus* and *sonomae*, but in the aggregate they are nearer *S. p. pacificus.*

Specimens examined.—Total number, 186, as follows:

California: Arcata, 9[96]; Carlotta, 3[97]; Carsons Camp, Mad River, Humboldt Bay, 5; Cape Mendocino, 2; Crescent City, 18[98]; Cuddleback, 4[99]; Dyerville (5 miles south of), 1; Elk River, 1[1]; Eureka, 33[2]; Fair Oaks, 19[3]; Ferndale, 1[99]; Gasquet, 4; Hardy, 3[97]; Hardy (7 miles north), 1[97]; Loleta, 7[97]; Mendocino, 19[4]; Orick, 15[5]; Requa, 16[6]; Smith River, 2; Trinidad, 9[99]; Trinidad Head, 1.

Oregon: Fort Umpqua, Douglas County (type locality), 1; Gardiner, 2[7]; Goldbeach, 6[7]; Marshfield, 3[8]; Myrtle Point, 1.

SOREX PACIFICUS SONOMAE Jackson

Sonoma Shrew

Sorex pacificus sonomae Jackson, Journ. Mamm. 2: 162, August 19, 1921.

Type specimen.—No. 19658, Mus. Vert. Zool., University of California; ♀ adult (teeth moderately worn), skin and skeleton; collected July 2, 1913, by Alfred C. Shelton.

Type locality.—Sonoma County side of Gualala River, Gualala, Calif.

Geographic range.—Coast region of California from Point Arena south to Point Reyes. (Fig. 15.)

Diagnostic characters.—Similar to *Sorex p. pacificus* but averaging smaller, and a trifle darker and less reddish in summer pelage.

Color.—*Winter pelage:* Essentially like that of *S. p. pacificus. Summer pelage:* Averaging somewhat darker and less reddish than that of *S. p. pacificus;* scarcely more reddish or cinnamon than winter pelage. Upper parts mummy brown or fuscous, the color of the upper parts extending well down over the sides; underparts between olive-brown and buffy brown, tending toward sepia; tail essentially unicolor, about same color as underparts.

Skull.—Similar to that of *S. p. pacificus* but averaging smaller. Separable from that of *S. yaquinae* by specific characters.

Measurements.—Type specimen (adult female): Total length, 133; tail vertebrae, 59; hind foot, 16. Average of three adult males from type locality: Total length, 141.7 (141–143); tail vertebrae, 59 (54–63); hind foot, 17 (17–17). *Skull:* Type specimen (adult female; teeth moderately worn): Condylobasal length, 21.1; palatal length, 8.9; cranial breadth, 10.3; interorbital breadth, 4.5; maxillary breadth, 6.3; maxillary tooth row, 8.1. Average of three skulls of adult males (teeth moderately worn) from type locality: Condylobasal

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[96] Mus. Vert. Zool., 6.
[97] D. R. Dickey coll., Pasadena, Calif.
[98] Field Mus. Nat. Hist., 1.
[99] Mus. Vert. Zool.
[1] Mus. Comp. Zool.
[2] D. R. Dickey coll., 2; Mus. Comp. Zool., 1; Field Mus. Nat. Hist., 11; Mus. Vert. Zool., 17.
[3] Mus. Comp. Zool., 3; Mus. Vert. Zool., 16.
[4] Field Mus. Nat. Hist., 3; Mus. Vert. Zool., 10.
[5] D. R. Dickey coll., 2.
[6] Field Mus. Nat. Hist., 15; Mus. Comp. Zool., 1.
[7] Field Mus. Nat. Hist.
[8] Field Mus. Nat. Hist., 2.

length, 21.4 (21.0–21.7); palatal length, 9.1 (8.9–9.2); cranial breadth, 10.5 (10.3–10.8); interorbital breadth, 4.5 (4.4–4.6); maxillary breadth, 6.4 (6.3–6.5); maxillary tooth row, 8.2 (8.0–8.4).

Remarks.—The southern form of *S. pacificus* is separable from true *pacificus* only in average differences of size and color. The larger skulls of *S. p. sonomae* can be fairly well matched by a very few small skulls of the subspecies *pacificus* from Eureka and other points in northern California. The differences on the whole, however, are well marked.

Specimens examined.—Total number, 35, as follows:

California: Bohemian Grove, Monte Rio, Sonoma County, 1[8]; Cazadero (7 miles west), Sonoma County, 2[9]; Gualala, 14[9]; Gualala, Gualala River (Sonoma County side) (type locality), 11[9]; Inverness, 5[10]; Point Arena, 2.[9]

TABLE 9.—*Cranial measurements of adult specimens of* Sorex vagrans-obscurus *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. v. vagrans:										
Washington—Aberdeen.	24321	♂	16.4	6.5	7.9	3.2	4.6	5.5	Slight	
Do	24331	♂	16.6	6.6	8.3	3.4	4.8	5.7	do	
Do	24336	♂	16.8	6.4	8.2	3.3	4.6	5.6	do	
Do	24339	♂	16.5	6.4	8.2	3.3	4.5	5.6	do	
S. v. vancouverensis:										
British Columbia—Goldstream	71913	♂	16.6	6.5	8.2	3.2	4.5	5.7	Moderate	Type specimen.
Alberni Valley	[1] 12508	♂	16.1	6.4	8.1	3.2	4.6	5.6	do	
Do	[1] 12514	♂	16.6	6.6	8.2	3.3	4.6	5.7	do	
Do	[1] 12516	♂	16.5	6.5	8.4	3.2	4.5	5.6	do	
Do	[1] 12525	♂	16.1	6.5	8.2	3.4	4.5	5.5	do	
Do	[1] 12526	♂	16.5	6.5	8.2	3.2	4.7	5.6	do	
Do	[1] 12541	♂	16.8	6.5	8.2	3.3	4.5	5.7	do	
S. v. halicoetes:										
California—Palo Alto	[1] 3638	♂	16.8	6.5	-----	3.6	5.0	5.9	Much	Type specimen.
Do	[1] 3635	♀	16.5	6.4	8.3	3.5	4.9	6.0	Slight	Type locality.
Do	[1] 3639	♂	17.0	6.6	8.5	3.5	4.8	6.0	Much	Do.
S. v. amoenus:										
California—Mammoth (near).	41863	♂	16.8	6.6	8.5	3.3	4.8	5.9	do	Type specimen.
Do	[2] D97	♀	16.5	6.4	8.2	3.2	4.8	5.7	Very slight	Type locality.
S. v. nevadensis:										
Nevada—Reese River	32302	♂	16.6	6.6	7.9	3.2	4.6	5.6	Slight	Type specimen.
Do	32303	♂	16.1	6.6	8.2	3.2	4.5	5.7	do	Type locality.
S. v. monticola:										
Arizona—San Francisco Mountain.	24535	♂	16.7	6.7	8.2	3.5	4.8	5.8	do	Type specimen.
White Mountains	208664	♂	16.3	6.7	8.2	3.6	4.8	5.8	Very slight	
Do	208665	♂	16.4	6.6	8.2	3.5	4.7	6.0	do	
Do	209335	♂	16.2	6.5	8.2	3.5	4.6	5.7	do	
Idaho—Alturas Lake	75000	♂	16.4	6.5	8.3	3.3	4.7	5.7	Slight	Type locality of *S. dobsoni.*
Sawtooth City	74999	♀	16.2	6.6	8.2	3.5	4.8	5.9	do	Do.
Do	75005	♀	16.9	6.7	8.3	3.7	5.0	5.8	do	Do.
S. v. orizabae:										
Puebla—Mount Orizaba.	53631	♂	16.9	6.6	8.2	3.3	4.6	6.0	Much	Type locality.
Do	53634	♂	16.5	6.5	8.0	3.4	4.6	6.0	do	Do.
Vera Cruz—Cofre de Perote.	54440	♀	16.5	6.5	7.8	3.5	4.6	6.0	Moderate	
Mexico—North slope of Volcan Toluca.	55898	♀	17.2	6.6	8.0	3.5	4.8	6.0	Slight	
Do	55900	♀	17.0	6.5	7.8	3.5	4.6	6.1	do	
S. durangae:										
Durango—El Salto	94540	♂	17.1	6.7	8.4	3.7	5.0	6.3	Much	Type specimen.

[1] Mus. Vert. Zool.
[2] D. R. Dickey coll., Pasadena, Calif.
[9] Mus. Vert. Zool.
[10] D. R. Dickey coll., 4; Mus. Vert. Zool., 1.

TABLE 9.—*Cranial measurements of adult specimens of* Sorex vagrans-obscurus *group*—Continued

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. o. obscurus:										
Idaho—Salmon River Mountains.	30943	♀	17.1	7.0	8.3	3.7	4.8	6.2	Slight	Type specimen.
Do	30940	♀	17.3	7.0	8.4	3.7	4.9	6.4	do	Type locality.
Do	30942	♀	16.9	6.8	8.2	3.8	5.0	6.2	do	Do.
Alaska — Mountains near Eagle.	131014	♂	16.6	6.7	8.4	3.7	4.9	6.0	do	
Do	131065	♂	17.4	6.9	8.5	3.7	5.2	6.0	do	
Do	131069	♂	17.1	6.8	8.5	3.7	5.0	6.1	do	
Do	131070	♂	17.6	6.8	8.4	3.7	5.1	6.3	do	
Do	131082	♂	17.3	6.9	8.4	3.7	4.9	6.2	do	
California — Mount Whitney.	41224	♀	16.7	6.7	8.4	3.8	5.0	6.1	do	
Do	42550	♀	16.9	6.7	8.3	3.7	4.9	6.0	do	
Wyoming—Mammoth Hot Springs, Yellowstone National Park.	120590	♂	16.8	6.8	8.5	3.7	5.0	6.3	do	
Do	120591	♂	16.8	6.8	8.2	3.7	4.9	6.1	do	
Do	120594	♂	16.4	6.8	8.5	3.7	4.9	6.0	do	
Do	120597	♂	17.2	7.0	8.4	3.7	5.1	6.2	do	
S. o. neomexicanus:										
New Mexico—Cloudcroft.	100440	♂	18.0	7.2	8.9	4.0	5.4	6.9	Moderate	Type specimen.
Do	100442	♀	17.4	7.2	8.6	3.9	5.4	6.9	Slight	Type locality.
Do	118789	♀	17.7	7.1	8.8	3.9	5.3	6.7	do	Do.
Do	118791	♀	17.6	7.0	8.9	3.9	5.2	6.7	do	Do.
S. o. parvidens:										
California—Bluff Lake, San Bernardino Mountains.	56561	♂	17.1	6.7	8.1	3.5	5.0	6.2	do	Type specimen.
Do	56558	♀	16.4	6.4	8.0	3.5	4.9	5.8	do	Type locality.
Do	56559	♂	17.2	6.5	8.0	3.3	4.9		do	Do.
S. o. shumaginensis:										
Alaska—										
Pop of Island, Shumagin Islands.	97993	♂	17.3	6.5	8.7	3.6	4.9	6.0	do	Type specimen.
Do	[3] 17648	♂	17.8	6.8	8.3	3.6	4.9	6.2	Very slight	Type locality.
Do	[3] 17655	♂	17.8	6.6	8.4	3.7	5.0	6.0	do	Do.
Do	[3] 17670	♂	17.1	6.4	8.3	3.6	4.8	6.0	do	Do.
Do	[3] 17681	♂	17.2	6.5	8.4	3.5	5.0	6.1	do	Do.
Do	[3] 17682	♂	17.3	6.8	8.5	3.6	5.0	6.1	do	Do.
Kings Cove, Alaska Peninsula.	177020	♂	16.8	6.5	8.6	3.4	4.6	5.9	Slight	
Do	177021	♂	16.8	6.5	8.5	3.7	4.9	6.0	do	
Do	177025	♂	16.7	6.5	8.7	3.4	4.8	5.9	do	
Do	177041	♂	17.0	6.4	8.6	3.6	4.8	6.0	do	
Do	177305	♂	16.8	6.4	8.6	3.5	4.9	5.8	do	
Do	177307	♂	16.9	6.6	8.5	3.4	4.6	5.8	do	
S. o. alascensis:										
Alaska—										
Yakutat Bay	73539	♀	17.6	6.8	8.6	3.7	5.1	6.2	do	Type specimen.
Do	73536	♀	17.7	6.9	8.8	3.8	5.3	6.4	do	Type locality.
Do	73538	♀	17.7	6.7	8.7	3.7	5.3	6.4	do	Do.
Do	73541	♀	17.8	6.8	8.7	3.6	5.0	6.2	do	Do.
Point Gustavus, Glacier Bay.	97709	♂	17.6	6.8	8.6	3.8	5.0	6.4	Moderate	Type specimen of *S. glacialis*.
S. o. malitiosus:										
Alaska—East side of Warren Island.	[1] 8401	♀	18.4	7.3	8.8	3.8	5.3	6.6	Slight	Type specimen.
Do	[1] 8398	♂	18.3	7.4	8.7	4.0	5.3	6.7	do	Type locality.
Do	[1] 8399	♂	18.6	7.3	9.1	3.9	5.4	6.7	do	Do.
Do	[1] 8402	♂	18.4	7.3	8.9	4.0	5.2	6.7	do	Do.
Do	[1] 8405	♂	17.8	7.2	8.8	4.0	5.2	6.4	do	Do.
Do	[1] 8406	♂	18.3	7.3	8.8	4.0	5.1	6.6	do	Do.
S. o. elassodon:										
British Columbia—Cumshewa Inlet, Moresby Island, Queen Charlotte Islands.	100597	♂	17.9	6.9	8.6	3.5	4.7	6.1	do	Type specimen.
Do	100593	♂	17.6	6.7	8.4	3.5	4.7	6.1	do	Type locality.
Do	100595	♂	17.9	6.9	8.6	3.7	4.9	6.3	do	Do.
Do	100598	♂	18.0	6.8	8.7	3.9	5.0	6.4	do	Do.
Do	100601	♂	18.1	6.8	8.7	3.7	4.8	6.3	do	Do.

[1] Mus. Vert. Zool.

[3] Amer. Mus. Nat. Hist.

TABLE 9.—*Cranial measurements of adult specimens of* Sorex vagrans-obscurus *group*—Continued

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. o. longicauda:										
Alaska—Wrangell	74711	♂	18.7	7.5	8.8	3.8	5.1	6.8	Slight	Type specimen.
Do	74694	♀	18.5	7.3	9.0	3.8	5.3	6.6	Very slight	Type locality.
Do	74697	♀	18.3	7.2	8.7	3.9	5.2	6.5	do	Do.
Do	74708	♀	18.5	7.4	9.0	4.0	5.3	6.8	do	Do.
Do	74709	♀	18.8	7.4	9.0	3.9	5.2	6.8	do	Do.
Do	74713	♀	19.1	7.5	9.0	4.0	5.2	6.9	do	Do.
Do	74718	♀	17.7	7.1	8.6	3.8	5.1	6.5	do	Do.
Do	100566	♀	19.0	7.5	9.0	3.8	5.2	6.8	do	Do.
Do	100568	♀	18.8	7.3	8.4	3.7	5.3	6.7	do	Do.
S. o. prevostensis:										
British Columbia—Houston Stewart Channel, Prevost Island, Queen Charlotte Islands	100618	♂	18.8	7.2	9.1	4.0	5.5	6.5	Slight	Type specimen.
Do	100612	♀	18.4	7.2	8.7	4.0	5.4	6.6	do	Type locality.
Do	100616	♀	18.6	7.2	9.0	4.1	5.7	6.8	do	Do.
Do	100619	♀	18.7	7.3	8.9	3.7	5.2	6.7	do	Do.
Do	107254	♀	18.3	7.1	8.9	3.8	5.4	6.5	do	Do.
S. o. isolatus:										
British Columbia—Nanaimo	177719	♂	17.4	6.6	8.5	3.5	4.9	6.3	Moderate	Type specimen.
Do	177721	♀	17.3	6.7	8.6	3.5	4.9	6.1	do	Type locality.
S. o. setosus:										
Washington—Happy Lake, Olympic Mountains	[4] 238	♂	17.3	6.7	8.3	3.6	4.9	6.0	Slight	Type specimen.
Quinault Lake	89647	♂	17.7	7.1	8.7	3.6	4.9	6.4	do	
Do	89655	♂	17.8	7.2	8.6	3.5	5.0	6.3	do	
Do	89660	♂	17.3	7.0	8.5	3.6	5.0	6.2	do	
Mount Vernon	88817	♀	17.8	7.1	8.6	3.7	5.3	6.4	do	
Do	88824	♀	17.8	7.1	8.7	3.5	4.9	6.3	do	
Do	88832	♀	17.5	6.9	8.5	3.6	5.0	6.3	do	
Do	88833	♀	17.4	6.9	8.6	3.6	5.2	6.2	do	
S. o. permiliensis:										
Oregon—Permilia Lake, west base Mount Jefferson	91048	♂	17.9	7.2	8.8	3.7	5.2	6.4	do	Do.
Do	91047	♀	17.6	7.1	8.9	3.8	5.2	6.4	do	Type locality.
Do	91053	♀	17.8	7.2	8.8	3.7	5.1	6.4	do	Do.
Do	91055	♀	17.6	7.0	9.3	4.0	5.3	6.2	do	Do.
Do	91059	♀	18.4	7.5	9.0	3.8	5.2	6.6	do	Do.
Do	91061	♀	18.3	7.4	8.8	3.6	5.3	6.4	do	Do.
S. o. bairdi:										
Oregon—Astoria	24318	♀	19.1	7.8	9.3	4.1	5.5	6.9	do	Type specimen.
Do	24317	♀	18.6	7.4	9.0	3.7	5.2	6.6	do	Type locality.
Do	89022	♀	18.4	7.6	8.9	3.8	5.4	6.7	do	Do.
Do	89129	♀	18.2	7.5	9.0	3.9	5.3	6.7	do	Do.
S. yaquinae:										
Oregon—Yaquina Bay	73051	♀	20.7	8.3	9.7	4.3	5.9	7.6	do	Type specimen.
Gardiner	69445	♂	20.0	8.0	9.9	4.2	6.1	7.4	do	
S. p. pacificus:										
Oregon—Gardiner	[4] 9633	♀	21.6	9.0	10.4	4.7	6.4	8.1	Very slight	Essentially type locality.
California—Eureka	63521	♂	22.5	9.5	10.6	4.4	6.5	8.5	Moderate	
Do	[4] 9647	♂	21.6	9.3	10.4	4.4	6.5	8.3	Slight	
Do	[4] 9648	♂	23.0	9.5	11.2	4.7	6.9	8.8	do	
Do	[1] 11748	♂	21.4	9.0	10.4	4.5	6.5	8.3	do	
Do	[1] 11758	♂	22.2	9.4	10.5	4.6	6.8	8.5	do	
S. p. sonomae:										
California—Gualala	[1] 19658	♀	21.1	8.9	10.3	4.5	6.3	8.1	Moderate	Type specimen.
Do	[1] 19651	♂	21.4	9.2	10.8	4.5	6.4	8.4	do	Type locality.
Do	[1] 19652	♂	21.0	8.9	10.3	4.4	6.3	8.0	do	Do.
Do	[1] 19668	♂	21.7	9.2	10.4	4.6	6.5	8.2	do	Do.

[1] Mus. Vert. Zool. [4] Field Mus. Nat. Hist.

SOREX STIZODON GROUP

The *stizodon* group includes a single species: *Sorex stizodon*. All the necessary group comparisons are made under the species.

SOREX STIZODON Merriam

Pale-toothed Shrew

(Pls. 3, j; 5, j; 6, m; 8, j; 12, m)

Sorex stizodon Merriam, North Amer. Fauna No. 10, p. 98, December 31, 1895.

Type specimen.—No. 75885, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn); skin and skull; collected September 25, 1895, by E. W. Nelson and E. A. Goldman.

Type locality.—San Cristobal, altitude 9,000 feet, Chiapas, Mexico.

Geographic range.—Known only from the type locality.

Diagnostic characters.—Size rather small, color of ventral parts scarcely paler than back, tail relatively short. Skull broad and flattened, with noticeably short and wide rostrum; dentition moderately heavy, weakly pigmented, the third unicuspid about equal the fourth in size. Most nearly like *S. s. saussurei*, somewhat smaller, and darker ventrally; skull relatively shorter and broader than that of the species *saussurei*, particularly the rostral region; dentition weaker.

Color.—*Winter pelage:* Unknown. *Summer pelage:* Upper parts bister, or a shade darker; underparts a trifle paler than upper parts, bister tending toward snuff brown; tail dark mummy brown above, slightly paler beneath.

Skull.—Distinctly flat and broad in superior aspect, the rostrum relatively short and wide, and brain case broad and flat; mesopterygoid space short and broad; occipital foramen small, narrow in intero-exterior diameter; dentition moderately heavy, very weakly pigmented; third uncuspid about equal in size to fourth. Differs from other Mexican Sorex in the scanty pigmentation of the teeth; and in having the intero-exterior diameter of first upper molariform tooth distinctly greater than the antero-posterior diameter.

Measurements.—Type specimen (adult female): Total length, 107; tail vertebrae, 41; hind foot, 13.5. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 17.5; palatal length, 7.0; cranial breadth, 8.9; interorbital breadth, 4.2; maxillary breadth, 5.6; maxillary tooth row, 6.4.

Remarks.—Only the type specimen of *S. stizodon* is available for study. This shows so many distinctive characters and differs so widely from other shrews in two or three of these characters that it seems well to place the species in a group by itself. Its nearest affinity is probably *S. saussurei*, from which, however, it is distinctive in cranial characters.

Specimen examined.—One, the type specimen.

SOREX VERAEPACIS GROUP

The *veraepacis* group includes two species—*Sorex veraepacis* and *S. macrodon*.

Geographic range.—Central Vera Cruz and central Guerrero south and east to southern Oaxaca, Mexico; central and southern Chiapas, Mexico, and western Guatemala. (Fig. 16.)

Diagnostic characters.—Size large; tail long, dark both superiorly and inferiorly; color of body parts dark both dorsally and ventrally, the underparts scarcely, if any, paler than upper parts. Skull rather massive with relatively broad, high, and laterally angular cranium; broad interorbitally; wide mesopterygoid space; dentition rather heavy, the third unicuspidate tooth

smaller than the fourth; unicuspids with well-defined internal ridge (usually more or less pigmented in unworn teeth) extending from apex to cingulum, the cingulum relatively broad and distinct. Skull relatively higher, broader, and more angular than in any of the *saussurei* group, and the unicuspidate teeth different.

Remarks.—Shrews of the *veraepacis* group hardly need critical comparison with those of any other except the *saussurei* group. The large size, long tail, and dark colors of the members of this group together with the large skull with high and broad cranium are distinctive among other Mexican and Central American Sorex. Certain individual specimens of *S. v. mutabilis* may be superficially similar to some specimens of *S. saussurei*, particularly of the subspecies *veraecrucis*, but the combined external and cranial characters readily separate the two forms.

FIG. 16.—Geographic range of subspecies of *Sorex veraepacis* and of the species *S. macrodon*

1. *S. v. veraepacis.* 2. *S. v. mutabilis.* 3. *S. v. chiapensis.* 4. *S. macrodon.*

SOREX VERAEPACIS ALSTON

[Synonymy under subspecies]

Geographic range.—Central Guerrero east through central Oaxaca; central and southern Chiapas, and western Guatemala. (Fig. 16.)

Diagnostic characters.—Similar to *Sorex macrodon;* rostrum narrower; anterior nares smaller with noticeably thinner and weaker premaxillary borders, and molariform dentition weaker.

Subspecies and geographic variation.—The species *veraepacis* is composed of three subspecies, namely, *veraepacis, mutabilis,* and *chiapensis.* In the more westerly and northwesterly part of its range (subspecies *mutabilis*) the species is smaller and more brownish and a shade paler in color, with skull that is comparatively narrow in all dimensions and has smaller teeth. There is a gradual accentuation in size, in broadness of the skull, and size of teeth toward the east and south, which reaches a maximum in the subspecies *veraepacis* in Guatemala. There is also a tendency for the species to become progressively less brownish from the northwest toward the southeast.

Time of molting.—A male collected near Ozolotepec, Oaxaca, Mexico, March 26, 1895, has the spring molt well started; a male and a female, collected respectively March 26 and 27, from the same locality are still in winter pelage. Beginning of molt is shown in a male from Omilteme, Guerrero, May 18, 1903.

Just the bare beginning of the autumnal molt is indicated in three specimens collected October 20 to 22, 1894, at Reyes, Oaxaca; the other specimens from that locality collected at the same time still retain their summer fur without signs of molting. Specimens from San Cristobal, Chiapas, Mexico, collected between September 29 and October 6, all show that the autumnal molt has begun, although but slightly advanced in any of them.

SOREX VERAEPACIS VERAEPACIS Alston

Verapaz Shrew

(Pls. 3, K; 5, K; 6, N; 9, A; 11, J; 12, N)

Corsira icmlyas Gray, Proc. Zool. Soc. London, part 11, 1843, p. 79, 1843. (Nomen nudum.)

Sorex verae-pacis Alston, Proc. Zool. Soc. London, 1877, p. 445, October, 1877.

C[orsira] teculyas (sic) Alston, Proc. Zool. Soc. London, 1877, p. 445, October, 1877. (In synonymy.)

Sorex veraepacis veraepaeis Jackson, Proc. Biol. Soc. Washington 38: 130, November 13, 1925.

Type specimen.—Two cotypes: No. 43.6.13.8, British Museum (Natural History), skin and skull; No. 43.9.15.2, British Museum (Natural History), skin without skull. Upon the suggestion of Oldfield Thomas, No. 43.6.13.8, British Museum (Natural History), is hereby designated a lectotype, and No. 43.9.15.2, British Museum (Natural History), a lectoparatype.

Type locality.—Coban, Guatemala.

Geographic range.—Central and western Guatemala at about latitude 16° north. (Fig. 16.)

Diagnostic characters.—Size largest of the species *veraepacis;* skull relatively and actually broader than that of *Sorex v. mutabilis* or *chiapensis*, particularly interorbitally and through the brain case.

Color.—*Winter pelage:* Upper parts clove brown or darker, between clove brown and chaetura black; underparts between chaetura drab and hair brown, tending toward fuscous; tail above essentially same color as back, scarcely, if any, paler below. *Summer pelage*: Unknown.

Skull.—Largest of the species (condylobasal length over 19); noticeably broad interorbitally and through brain case (cranial breadth 10 or more); mesopterygoid space wide; dentition rather heavy. In size about equal that of *S. macrodon*, but anterior nares smaller with distinctly thinner and weaker premaxillary borders.

Measurements.—Average of four adult females from Todos Santos, Guatemala: Total length, 124.3 (119–128); tail vertebrae, 51 (48–57); hind foot, 15.5 (15–16). *Skull:* Average of four skulls of adult females (teeth slightly worn) from Todos Santos, Guatemala: Condylobasal length, 19.7 (19.4–19.9); palatal length, 8.0 (7.9–8.1); cranial breadth, 10.2 (10.1–10.3); interorbital breadth, 4.6 (4.4–4.8); maxillary breadth, 5.9 (5.7–6.1); maxillary tooth row, 7.5 (7.3–7.6).

Remarks.—The writer has seen no specimens of *S. v. veraepacis* from the type locality. Alston, who based his description on two specimens, says, "second to fourth [incisors] simple, gradually diminishing in size, canine [fourth unicuspid] slightly smaller than fourth incisor [third unicuspid]" (Alston, 1877, p. 455). This is also shown in his figure (op. cit., p. 446). Merriam, however, states on authority of Oldfield Thomas, who examined the type specimen, that the fourth unicuspid is distinctly higher than the third, and that

Alston's description is wrong (Merriam, 1895, p. 83). As already pointed out by Merriam (op. cit., p. 83), the relations of these teeth are correctly shown by Dobson (1890, pl. 23, fig. 8). The species, however, was misidentified by Dobson with *Sorex pacificus*.

Specimen examined.—Total number, 12, as follows:

Guatemala: Todos Santos, 12.

SOREX VERAEPACIS CHIAPENSIS Jackson

Chiapas Shrew

Sorex veraepacis chiapensis Jackson, Proc. Biol. Soc. Washington 38: 129, November 13, 1925.

Type specimen.—No. 75877, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected October 1, 1895, by E. W. Nelson and E. A. Goldman. Original number 8528.

Type locality.—San Cristobal, altitude 9,500 feet, Chiapas, Mexico.

Geographic range.—Central Chiapas, Mexico, to west-southwestern Guatemala. (Fig. 16.)

Diagnostic characters.—Intermediate in many respects between *Sorex v. veraepacis* and *S. v. mutabilis;* color in winter pelage, essentially like *S. v. veraepacis*, more grayish (less brownish) than *mutabilis;* smaller than *S. v. veraepacis*, about the size of *mutabilis* or a trifle larger, with shorter tail. Skull somewhat similar to that of *mutabilis*, broader through cranium and interorbitally, with wider mesopterygoid space.

Color.—Winter pelage: Upper parts clove brown or between clove brown and chaetura black; underparts slightly paler than clove brown or between chaetura drab and hair brown tending toward fuscous; tail near clove brown above, scarcely paler below. *Summer pelage:* Fuscous above, sometimes tending toward clove brown; underparts hair brown or between hair brown and fuscous; tail fuscous to clove brown above, scarcely paler below.

Skull.—Decidedly smaller than that of *S. v. veraepacis*, with noticeably narrower cranium. About the size of that of *S. v. mutabilis*, broader through cranium and interorbitally, *mesopterygoid space wider*, dentition usually somewhat heavier.

Measurements.—Type specimen (adult female): Total length, 120; tail vertebrae, 48; hind foot, 14.5. Average of three adult males from type locality: Total length, 119.3 (117–123); tail vertebrae, 48.3 (45–51); hind foot, 14.7 (14–15). *Skull:* Type specimen (adult female; teeth slightly worn); Condylobasal length, 18.3; palatal length, 7.3; cranial breadth, 9.5; interorbital breadth, 4.2; maxillary breadth, 5.3; maxillary tooth row, 7.0. Average of three skulls of adult males (teeth slightly worn) from type locality: Condylobasal length, 18.4 (18.3–18.6); palatal length, 7.3 (7.2–7.4); cranial breadth, 9.4 (9.3–9.5); interorbital breadth, 4.3 (4.2–4.4); maxillary breadth, 5.4 (5.3–5.5); maxillary tooth row, 7.1 (6.9–7.2).

Remarks.—Although in reality an intermediate between *S. v. veraepacis* and *S. v. mutabilis*, *S. v. chiapensis* is more like the former in external appearance but nearer the latter cranially. Skulls of *chiapensis* can be separated from those of true *veraepacis* by their smaller size, and from those of *mutabilis* by their wide mesopterygoid space. The geographic range of this form, when considered in relation to the range of the subspecies *veraepacis*, is rather aberrant and does not conform strictly with what one might expect from the topography of the region. The affinities of the few specimens available, however, seem very clear.

Specimens examined.—Total number, 19, as follows:

Chiapas: Pinabete, 1; San Cristobal (type locality), 8.
Guatemala: Calel, 4; Volcano Santa Maria, Quezaltenango, 6.

SOREX VERAEPACIS MUTABILIS Merriam

Dark-bellied Shrew

(Pl. 3, l)

Sorex saussurei caudatus Merriam, North Amer. Fauna No. 10, p. 84, December 31, 1895. Not *S. caudatus* Hodgson (nomen nudum, qui *S. caudatus* Horsfield), Annals and Mag. Nat. Hist. (series 2) 3: 203, 1849. Not *S. caudatus* Horsfield, Catal. Mamm. Mus. East Indian Co., p. 135, 1851, from Sikim and Darjeling, India.

Sorex saussurei mutabilis Merriam, Science (n. s.) 8: 782, December 2, 1898. New name for *S. saussurei caudatus* Merriam.

Sorex saussurii mutabilis Elliot, Field Columb. Mus. Publ. 105 (zool. series 6): 456, 1905.

Sorex veraepacis mutabilis Jackson, Proc. Biol. Soc. Washington 38: 130, November 13, 1925.

Type specimen.—No. 69600, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected October 21, 1894, by E. W. Nelson and E. A. Goldman.

Type locality.—Reyes (near Cuicatlan), altitude 10,200 feet, Oaxaca, Mexico.

Geographic range.—Central Guerrero east to north-central and east-central, and south to south-central Oaxaca. (Fig. 16.)

Diagnostic characters.—About the size of *S. v. chiapensis* or a trifle smaller, with relatively longer tail; color more brownish than in either *S. v. veraepacis* or *chiapensis;* skull averaging smaller and relatively narrower than that of *chiapensis,* decidedly smaller and narrower than that of *s. v. veraepacis,* with weaker dentition.

Color.—Winter pelage: Upper parts clove brown or a shade paler; underparts slightly darker than between wood brown and drab; tail clove brown above, very slightly, if any, paler beneath. *Summer pelage:* Upper parts between clove brown and sepia, sometimes almost bister or mummy brown; underparts usually darker than wood brown, almost between Saccardo's umber and bister, frequently scarcely paler than upper parts; tail as in winter.

Skull.—About the size of that of *S. v. chiapensis,* averaging a trifle smaller and relatively narrower; *mesopterygoid space narrower* than in *chiapensis;* and dentition averaging weaker.

Measurements.—Type specimen (adult female): Total length, 126; tail vertebrae, 57; hind foot, 14.5. Average of three adult females from type locality: Total length, 123.7 (121–128); tail vertebrae, 57 (56–58); hind foot, 14.8 (14.5–15). *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 18.7; palatal length, 7.3; cranial breadth, 9.4; interorbital breadth, 4.3; maxillary breadth, 5.3; maxillary tooth row, 6.9. Average of three skulls of adult females (teeth slightly to moderately worn) from type locality: Condylobasal length, 18.3 (18.0–18.5); palatal length, 7.3 (7.2–7.4); cranial breadth, 9.1 (9.0–9.1); interorbital breadth, 4.1 (4.0–4.2); maxillary breadth, 5.3 (5.1–5.5); maxillary tooth row, 6.8 (6.6–6.9).

Remarks.—In his original description of this shrew, Merriam remarked upon the variability of skulls from single localities, more particularly from Reyes and Mount Zempoaltepec, stating that two types exist: "(1) A large skull with high brain case, large m^3 (with squarish body), long unicuspidate row, the anterior teeth of which are not markedly swollen; and (2) a slightly smaller skull with flatter brain case, smaller m^3 (with narrower body and rounded angles), shorter unicuspidate row, the first and second teeth of which are conspicuously swollen (broadened)" (Merriam, 1895, p. 84). Merriam was inclined to look upon these differences as sexual. The critical studies of the present investigator indicate clearly to him that these two so-called types represent two distinct species; the one with

the small flat skull, *saussurei;* the one with the large skull and high brain case, *veracpacis.* Moreover, in each of the series, the two forms can be separated by color differences, *S. s. saussurei* having distinctly paler ventral parts than *S. v. mutabilis.*

Specimens examined.—Total number 35, as follows:

Guerrero: Omilteme, 1.
Oaxaca: Cerro San Felipe, 4; Mount Zempoaltepec, 13; Ozolotepec, 3; Reyes (near Cuicatlan) (type locality), 7; Tontontepec, 7.

SOREX MACRODON Merriam

Large-toothed Shrew

(Pls. 3, m; 5, l; 9, b)

Sorex macrodon Merriam, North Amer. Fauna No. 10, p. 82, December 31, 1895.

Type specimen.—No. 58272, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected January 26, 1894, by E. W. Nelson and E. A. Goldman.

Type locality.—Orizaba, altitude 4,200 feet, Vera Cruz, Mexico.

Geographic range.—West-central Vera Cruz. (Fig. 16.)

Diagnostic characters.—Similar to *Sorex v. mutabilis* in color, possibly darker; size large, about as *S. v. veraepacis.* Differs cranially from any forms of the species *veraepacis* in the broad anterior nares with thick and heavy premaxillary borders.

Time of molting.—Only two specimens showing the molt are available. One of these, a male, was collected at Xico, Vera Cruz, July 6, 1893, and is apparently in complete summer pelage except for the retention of a very small patch of winter fur on the rump. The other, also a male, collected January 26, 1894, at Orizaba, Vera Cruz, is in complete winter pelage except on the cheeks, face, and occiput, which are in process of molt.

Color.—Winter pelage: Upper parts clove brown or a shade darker, or tending toward sepia, but darker; underparts scarcely paler than upper parts, between clove brown and sepia or a shade paler; tail dark clove brown above, clove brown or between clove brown and olive-brown below. *Summer pelage:* Barely different from winter pelage, possibly a shade paler. Upper parts clove brown tending toward bister; underparts most nearly between clove brown and sepia; tail as in winter.

Skull.—Large and massive; about the size of that of *S. v. veraepacis;* rostrum broader anteriorly; anterior nares broad, the premaxillary borders thick and heavy; dentition heavy; third unicuspid distinctly smaller than the fourth.

Measurements.—Type specimen (adult male): Total length, 128; tail vertebrae, 52; hind foot, 15.5. Adult male from Xico, Vera Cruz, Mexico: Total length, 130; tail vertebrae, 50; hind foot, 15. *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 19.6; palatal length, 8.0; cranial breadth, 9.7; interorbital breadth, 4.6; maxillary breadth, 6.0; maxillary tooth row, 7.4. Skull of adult male (teeth moderately worn) from Xico, Vera Cruz, Mexico: Condylobasal length, 19.2; palatal length, 8.0; cranial breadth, 9.9; interorbital breadth, 4.7; maxillary breadth, 6.1; maxillary tooth row, 7.3.

Remarks.—The geographic range of *S. macrodon,* as far as is known, occupies a small area in central Vera Cruz. The species shows close affinities with *S. veraepacis* and it would seem not at all improbable that when specimens are available from other localities the two forms may prove to be conspecific.

E. W. Nelson, in his manuscript report, states that his first specimen of this species was taken in the fir belt at 9,500 feet on the west slope of Mount Orizaba. Soon after he began his work at Xico, a specimen was taken under a rock in a damp place in a dense patch of low woods on the side of a canyon near town. Afterwards, in work-

ing higher up the slope, he found them to be rather common in the dense oak forest from 5,500 to 6,500 feet, which he considered to be their proper home. According to Nelson (manuscript), they are never found among grass and weeds, but seek the bare situations under logs and large stones in the damp forest, where their presence is indicated by curious broad runways made in the soft, loose earth. These runways were often from 3 to 4 inches broad and extended the entire length of the log or other shelter, and usually began at the entrance of the animal's burrow, which led into the ground under the base of the shelter.

Specimens examined.—Total number, 7, as follows:

Vera Cruz: Orizaba (type locality), 4; Xico, 3.

TABLE 10.—*Cranial measurements of adult specimens of* Sorex veraepacis *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. v. veraepacis:										
Guatemala—Todos Santos.	77029	♀	19.4	8.0	10.1	4.4	5.7	7.3	Slight	
Do	77030	♀	19.8	8.1	10.3	4.5	5.8	7.5	do	
Do	77032	♀	19.9	8.1	10.2	4.7	6.1	7.6	do	
Do	77033	♀	19.7	7.9	10.3	4.8	6.0	7.4	do	
Do	77034	♀	19.5	7.9	10.2	4.6	5.9	7.5	do	
S. v. mutabilis:										
Oaxaca—Reyes	69600	♀	18.7	7.3	9.4	4.3	5.3	6.9	do	Type specimen.
Do	69598	♀	18.0	7.2	9.1	4.2	5.2	6.9	do	Type locality.
Do	69601	♀	18.5	7.3	9.0	4.1	5.5	6.6	Moderate	Do.
Do	69602	♀	18.5	7.4	9.1	4.0	5.1	6.9	do	Do.
S. v. chiapensis:										
Chiapas—San Cristobal.	75877	♀	18.3	7.3	9.5	4.2	5.3	7.0	Slight	Type specimen.
Do	75878	♂	18.3	7.2	9.5	4.2	5.5	6.9	do	Type locality.
Do	75882	♂	18.6	7.4	9.3	4.3	5.3	7.1	do	Do.
Do	75884	♂	18.4	7.3	9.4	4.4	5.5	7.2	do	Do.
S. macrodon:										
Vera Cruz—										
Orizaba	58272	♂	19.6	8.0	9.7	4.6	6.0	7.4	do	Type specimen.
Xico	55101	♂	19.2	8.0	9.9	4.7	6.1	7.3	Moderate	

SOREX SAUSSUREI GROUP

The *saussurei* group includes four species: *Sorex saussurei*, *S. emarginatus*, *S. ventralis*, and *S. oreopolus*.

Geographic range.—Mexico, from southern Coahuila and southern Zacatecas south through Chiapas; extreme western Guatemala. (Fig. 17.)

Diagnostic characters.—Size medium to small; skull relatively flat, brain case rounded laterally (not angular); mesopterygoid space relatively narrow (except in *S. emarginatus*); teeth medium to small, the third unicuspid about equal the fourth in size, sometimes slightly smaller, sometimes slightly larger (distinctly larger in the three available specimens of *S. emarginatus*); unicuspids with poorly defined internal ridge (not pigmented) extending from near apex to cingulum, the cingulum relatively narrow, sloping, and indistinct. Compared with any of the *veraepacis* group the skull of any of the *saussurei* group is flatter, has a brain case more rounded (less angular) laterally, shorter unicuspidate tooth row, with different internal ridge and cingulum on unicuspids. Except in *S. emarginatus*, the mesopterygoid space in any of the *saussurei* group is relatively longer and narrower than in the *veraepacis* group.

Remarks.—The members of the *saussurei* group, particularly the species *saussurei*, show many similarities to members of the *trowbridgii* group, especially in the general shape of skull and in the dentition. Geographically the two groups are now widely separated, but it seems not improbable either that one is the direct offshoot of the other, or that both are derived from a common ancestral form.

SOREX SAUSSUREI MERRIAM

[Synonymy under subspecies]

Geographic range.—Mexico, from southern Coahuila and southern Zacatecas south through Chiapas; extreme western Guatemala. (Fig. 17.)

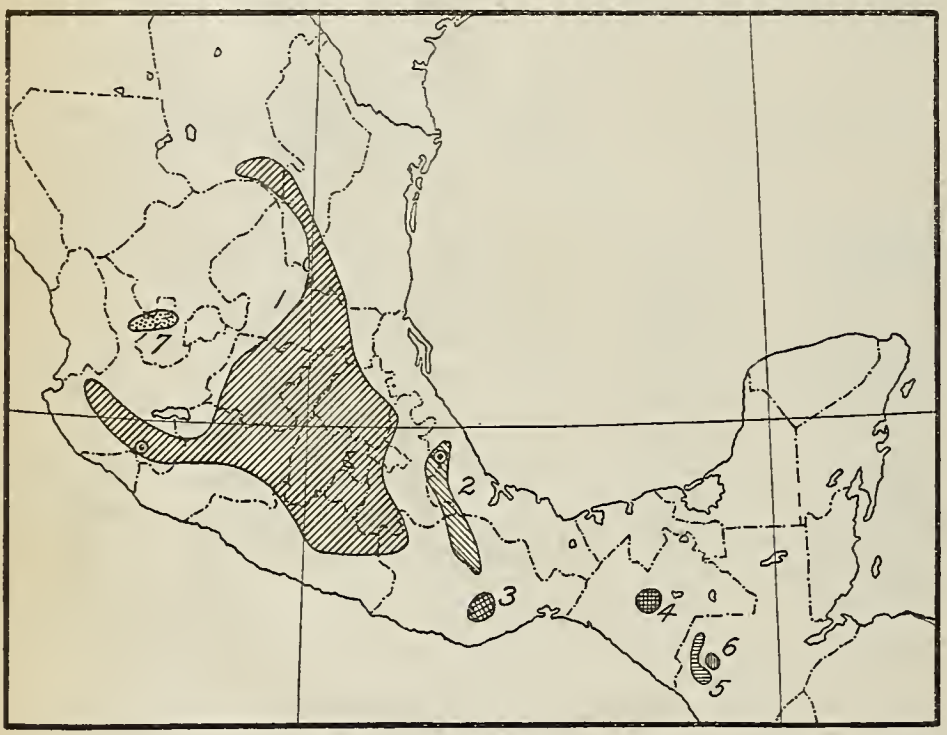

FIG. 17.—Geographic range of subspecies of *Sorex saussurei* and the species *S. emarginatus*

1. *S. s. saussurei.* 2. *S. s. veraecrucis.* 3. *S. s. oaxacae.* 4. *S. s. cristobalensis.* 5. *S. s. godmani.* 6. *S. s. salvini.* 7. *S. emarginatus.*

Diagnostic characters.—Except its subspecies *salvini*, the species *saussurei* is larger than *S. emarginatus*, *S. ventralis*, or *S. oreopolus*. The skull of *S. saussurei* is more depressed rostrally, the brain case more flattened, palate longer, and dentition heavier than in either *S. ventralis* or *S. oreopolus*. Compared with the skull of *S. emarginatus* that of the species *saussurei* differs in its larger size, relatively narrower and longer mesopterygoid space, broader and less emarginate first upper molariform tooth, and relatively larger fourth upper unicuspid.

Subspecies and geographic variation.—The species *saussurei* includes six subspecies: *saussurei*, *veraecrucis*, *oaxacae*, *cristobalensis*, *godmani*, and *salvini*. The subspecies *saussurei*, which occupies the most northwesterly part of the range of the species, is the palest in color and has a comparatively short tail. Passing easterly there is a slight tendency toward darkening in the color, and a noticeable increase in tail length, which culminates in the subspecies *veraecrucis*. The tendency toward darkening reaches extreme in the forms *oaxacae* and *cristobalensis*. The subspecies *godmani* is also dark colored and

with long tail, but quite in contrast the form *salvini*, although dark, has a short tail.

Time of molting.—Very few of the specimens at hand show indications of molting. A female from Omilteme, Guerrero, has fresh pelage May 17, 1903.

A female collected at Encarnacion, Hidalgo, Mexico, on October 4, 1896, has a trace of the winter pelage under the old fur over the posterior half of the back. Two females collected at Nahuatzin, Michoacan, have the molt well begun October 9 and 10, 1892, while a third appears to be in worn summer pelage October 12, and two others have the fresh pelage October 9 and 10.

SOREX SAUSSUREI SAUSSUREI Merriam

Saussure Shrew

(Pls. 3, n, o; 5, m; 6, o; 9, c; 11, k; 13, a)

Sorex saussurei Merriam, Proc. Biol. Soc. Washington 7: 173, September 29, 1892.
Sorex saussurii Elliot, Field Columb. Mus. Publ. 105 (zool. series 6): 456, 1905.
Sorex saussurei saussurei Miller, U. S. Nat. Mus. Bul. 79, p. 19, December 31, 1912.

Type specimen.—Number $\frac{33667}{45702}$, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth moderately worn), skin and skull; collected April 23, 1892, by E. W. Nelson.

Type locality.—North slope of Sierra Nevada de Colima, altitude about 8,000 feet, Jalisco, Mexico.

Geographic range.—Extreme southern Coahuila south through western Tamaulipas, Guanajuato, Hidalgo, and western Puebla to northwestern Oaxaca and central Guerrero, west through northern Michoacan to west-central Jalisco. (Fig. 17.)

Diagnostic characters.—Similar in color to *Sorex s. veraecrucis* and *S. emarginatus*, tail shorter than in *veraecrucis;* paler, particularly ventrally, than *S. s. oaxacae.* Skull averaging relatively broader and shorter in interorbital region than in that of *veraecrucis*, but relatively and actually narrower in all proportions than in *oaxacae.* Differs cranially and dentally from *S. emarginatus.*

Color.—Winter pelage: Upper parts fuscous to clove brown; underparts smoke gray to nearly pale smoke gray, more or less tinged with drabbish, rarely tinged with almost wood brown; tail sepia to mummy brown or sometimes near clove brown above, paler beneath, usually near wood brown. *Summer pelage:* Somewhat paler and more brownish than winter pelage. Upper parts fuscous or slightly paler, more frequently near bister or between sepia and bister; underparts about as in winter, possibly in certain specimens more stained with brownish; tail as in winter.

Skull.—Medium in size, moderately flattened, rather heavy rostrum. Relatively broader and shorter in interorbital region than that of *S. s. veraecrucis;* relatively and actually narrower in all proportions than that of *S. s. oaxacae.* Essentially like that of *S. s. salvini*, on the average a trifle larger.

Measurements.—Type specimen (adult female): Total length, 115; tail vertebrae, 48; hind foot, 14. Adult female from type locality: Total length, 122; tail vertebrae, 46; hind foot, 15. Two adult females from Nahuatzin, Michoacan, Mexico: Total length, 109, 115; tail vertebrae, 48, 47; hind foot, 14, 14. *Skull:* Type specimen (adult female, teeth moderately worn): Condylobasal length, 18.4; palatal length, 7.6; cranial breadth, 8.9; interorbital breadth, 4.3; maxillary breadth, 5.6; maxillary tooth row, 6.8. Skull of adult female (teeth moderately worn) from type locality: Condylobasal length, 18.0; palatal length, 7.5±; cranial breadth, 8.8; interorbital breadth, 4.2; maxillary breadth, 5.6; maxillary tooth row, 6.8. Skulls of two adult females (teeth slightly worn) from Nahuatzin, Michoacan, Mexico; Condylobasal length, 18.1, 18.2; palatal length, 7.3, 7.4; cranial breadth, 8.6, 8.7; interorbital breadth, 4.1, 4.2; maxillary breadth, 5.4, 5.3; maxillary tooth row, 6.5, 6.6.

Remarks.—The subspecies *saussurei* has one of the most extensive geographic ranges in Mexico of any form of Sorex. There is some local cranial variation in the available specimens, and to a less degree

occasionally an apparent slight color variation. On the whole, however, the subspecies is fairly constant in characters, and to recognize these slight local variations by name would only cause hopeless confusion.

Specimens examined.—Total number, 46, as follows:

Coahuila: Sierra Guadelupe, 2.
Guanajuato: Santa Rosa, 1.
Guerrero: Chilpancingo (mountains near), 2; Omilteme, 1.
Hidalgo: Encarnacion, 2.
Jalisco: San Sebastian, 2; Sierra Nevada de Colima (type locality), 2.
Mexico: Mount Popocatepetl, 2; Salazar, 2; Volcano Toluca (north slope), 1.
Michoacan: Mount Patamban (altitude 10,000 feet), 2; Mount Tancitaro, 6; Nahuatzin, 5; Patzcuaro, 1.[11]
Morelos: Tetela del Volcan, 1.
Nuevo Leon: Miquihuana, 4.
Oaxaca: Tamazulapan, 3; Tlapancingo, 2.
Puebla: Huachinango, 1.
Queretaro: Pinal de Amoles, 4.

SOREX SAUSSUREI VERAECRUCIS Jackson

Vera Cruz Shrew

(Pl. 3, p)

Sorex saussurei veraecrucis Jackson, Proc. Biol. Soc. Washington 38: 128, November 13, 1925.

Type specimen.—Number 55106, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected July 14, 1893, by E. W. Nelson. Original number 5235.

Type locality.—Xico, altitude 6,000 feet, State of Vera Cruz, Mexico.

Geographic range.—North-central part of the State of Vera Cruz south to Mount Zempoaltepec, eastern Oaxaca, Mexico. (Fig. 17.)

Diagnostic characters.—In color essentially like *Sorex s. saussurei*, tail averaging longer, and skull relatively more elongate and narrower in interorbital region. Paler, particularly ventrally, than *S. s. oaxacae*, or any subspecies of *S. saussurei* ranging to the south or east of it.

Color.—*Winter pelage:* Essentially like winter pelage of *S. s. saussurei*. *Summer pelage:* Averaging a shade darker than summer pelage of *S. s. saussurei*. Upper parts fuscous or slightly darker to clove brown; underparts mouse gray heavily tinged with drab or sometimes darker; clove brown to mummy brown above, slightly paler beneath.

Skull.—Relatively more elongate and narrow in interorbital region than that of *S. s. saussurei* or *S. s. oaxacae*. Dentition on the average somewhat heavier than in *S. s. saussurei*.

Measurements.—Type specimen (adult female): Total length, 118; tail vertebrae, 52; hind foot, 15. Adult female from type locality: Total length, 128; tail vertebrae, 60; hind foot, 15. Adult female from Mount Zempoaltepec, Oaxaca, Mexico: Total length, 126; tail vertebrae, 57; hind foot, 15. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 18.3; palatal length, 7.4; cranial breadth, 8.7; interorbital breadth, 4.1; maxillary breadth, 5.3; maxillary tooth row, 6.6. Skull of adult female (teeth unworn) from type locality: Condylobasal length, 18.1; palatal length, 7.4; cranial breadth, 8. 7; interorbital breadth, 4.0; maxillary breadth, 5.4; maxillary tooth row, 6.7. Skull of adult female (teeth slightly worn) from Mount Zempoaltepec, Oaxaca, Mexico: Condylobasal length, 18.2; palatal length, 7.5; cranial breadth, 8.7; interorbital breadth, 4.0; maxillary breadth, 5.3; maxillary tooth row, 6.9.

Remarks.—The Vera Cruz shrew is a long-tailed form of *S. saussurei* the geographic range of which is confined principally to the

[11] Field Mus. Nat. Hist.

higher parts of the Atlantic drainage from central Vera Cruz and Puebla south to northeastern Oaxaca, Mexico. This form occurs with *S. v. mutabilis* at Reyes and Mount Zempoaltepec in the State of Oaxaca, and possibly at other localities. It may be separated from *mutabilis* by its narrower and more depressed skull with less laterally angular brain case. Intergradation with *S. s. saussurei* is indicated in specimens from the western part of the range of *S. s. veraecrucis*.

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

Oaxaca: Mount Zempoaltepec, 2; Reyes (near Cuicatlan), 3.
Puebla: Mount Orizaba, 1.
Vera Cruz: Las Vegas, 1; Xico (altitude 6,000 to 6,500 feet) (type locality), 5.

SOREX SAUSSUREI OAXACAE Jackson

Oaxaca Shrew

(Pl. 3, q)

Sorex saussurei oaxacae Jackson, Proc. Biol. Soc. Washington 38: 128, November 13, 1925.

Type specimen.—Number 71467, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth moderately worn), skin and skull (first left upper incisor missing); collected March 27, 1895, by E. W. Nelson and E. A. Goldman. Original number 7748.

Type locality.—Mountains near Ozolotepec, altitude 10,000 feet, Oaxaca, Mexico.

Geographic range.—Known only from type locality. (Fig. 17.)

Diagnostic characters.—Size and color essentially as in *Sorex s. cristobalensis*, but with skull distinctly shorter, broader, and more depressed. Color decidedly darker than in *S. s. saussurei* or *S. s. veraecrucis*, the skull relatively broader than in either.

Color.—*Winter pelage:* Upper parts near bister, possibly a shade darker; underparts between bister and snuff brown; tail dark, darker than mummy brown or bister above, scarcely paler below. *Summer pelage:* Unknown.

Skull.—Relatively short and broad, noticeably broad through cranium and interorbital region, brain case rather flattened.

Measurements.—Type specimen (adult female): Total length, 114; tail vertebrae, 48; hind foot, 15. *Skull:* Type specimen (adult female; teeth moderately worn): Condylobasal length, 18.2; palatal length, 7.3; cranial breadth, 9.0; interorbital breadth, 4.2; maxillary breadth, 5.6; maxillary tooth row, 6.7.

Remarks.—The type and only specimen available of *S. s. oaxacae* differs from all other subspecies of *S. saussurei* in its relatively wide and flattened skull. In color it is almost indistinguishable from *S. s. cristobalensis*, but it is darker than *S. s. veraecrucis*.

Specimen examined.—One, the type.

SOREX SAUSSUREI CRISTOBALENSIS Jackson

San Cristobal Shrew

(Pl. 3, s)

Sorex saussurei cristobalensis Jackson, Proc. Biol. Soc. Washington 38: 129, November 13, 1925.

Type specimen.—Number 75883, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected

September 19, 1895, by E. W. Nelson and E. A. Goldman. Original number 8429.

Type locality.—San Cristobal, altitude 8,400 feet, Chiapas, Mexico.

Geographic range.—Known only from type locality. (Fig. 17.)

Diagnostic characters.—Cranially essentially like *Sorex s. veraecrucis*, with dentition apparently heavier; color distinctly darker than in *veraecrucis*, and tail shorter. Color about as in *S. s. oaxacae*, but skull distinctly longer and narrower. Color a shade darker than *S. s. godmani*, tail shorter, and skull larger, relatively narrower, with heavier dentition.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts a shade darker than bister, possibly tending toward clove brown; underparts a trifle paler than upper parts; tail somewhat darker than clove brown above, very slightly paler below.

Skull.—Relatively narrow and elongate, particularly elongate in interorbital region (somewhat resembling that of *S. s. veraecrucis*); dentition heavy.

Measurements.—Type specimen (adult female): Total length, 116; tail vertebrae, 46.5; hind foot, 13.5. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 18.5; palatal length, 7.6; cranial breadth, 8.5; interorbital breadth, 4.0; maxillary breadth, 5.4; maxillary tooth row, 6.7.

Remarks.—This form, represented in collections only by the type specimen, is a dark-colored shrew with tail of medium length, and a skull somewhat like that of *S. s. veraecrucis* but with heavier dentition. In color, however, *S. s. cristobalensis* is darker than *veraecrucis*, being more like *S. s. oaxacae*, from which it differs cranially.

Specimen examined.—One, the type.

SOREX SAUSSUREI GODMANI Merriam

Godman Shrew

(Pl. 3, r)

Sorex godmani Merriam, Proc. Biol. Soc. Washington 11: 229, July 15, 1897.
[*Sorex*] *godmanni* Trouessart, Catal. Mamm. tam viventium quam fossilium Supplement, fasc. 1, 1904, p. 135, 1904.

Type specimen.—Number 77044, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected January 28, 1896, by E. W. Nelson and E. A. Goldman.

Type locality.—Volcano Santa Maria, altitude 9,000 feet, Quezaltenango, Guatemala.

Geographic range.—Known only from Todos Santos and Volcano Santa Maria, Guatemala. (Fig. 17.)

Diagnostic characters.—Color dark, almost as dark as *Sorex s. oaxacae* and *S. s. cristobalensis;* tail long. Skull in general proportions much like that of *S. s. saussurei*, somewhat smaller with relatively weaker dentition. Differs cranially from *oaxacae* and *cristobalensis.*

Color.—Winter pelage: Upper parts bister, tending slightly toward clove brown; underparts somewhat paler, darker than wood brown, paler than snuff brown; tail bister or darker above, slightly, if any, paler beneath. *Summer pelage:* Unknown.

Skull.—Dentition weak; medium in size, but apparently rather small in proportion to size of animal; somewhat smaller than that of *S. s. saussurei*, with weaker rostrum. Shorter and with relatively broader cranium and decidedly weaker dentition than in *S. s. cristobalensis.* Smaller, relatively narrower, and with less depressed brain case than in *S. s. oaxacae*, the dentition weaker.

Measurements.—Type specimen (adult female): Total length, 120; tail vertebrae, 57; hind foot, 15. Adult female from Todos Santos, Guatemala: Total

length, 124; tail vertebrae, 55; hind foot, 14.5. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 17.6; palatal length, 7.1; cranial breadth, 8.2; interorbital breadth, 3.7; maxillary breadth, 4.9; maxillary tooth row, 6.3. Skull of adult female (teeth slightly worn) from Todos Santos, Guatemala: Condylobasal length, 17.4; palatal length, 7.1; cranial breadth, 8.6; interorbital breadth, 4.0; maxillary breadth, 5.1; maxillary tooth row, 6.2.

Remarks.—The Godman shrew is a long-tailed and comparatively dark-colored form of *S. saussurei*, being almost as dark as *S. s. oaxacae* or *S. s. cristobalensis*, with a comparatively small skull and weak dentition. It is known only from a limited area in western Guatemala.

Specimens examined.—Total number, 3, as follows:

Guatemala: Todos Santos, 1; Volcano Santa Maria (altitude 9,000 feet) (type locality), 2.

SOREX SAUSSUREI SALVINI Merriam

Salvin Shrew

Sorex salvini Merriam, Proc. Biol. Soc. Washington 11: 229, July 15, 1897.

Type specimen.—Number 77035, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected January 12, 1896, by E. W. Nelson and E. A. Goldman.

Type locality.—Calel, altitude 10,200 feet, Totonicapan, Guatemala.

Geographic range.—Known only from type locality. (Fig. 17.)

Diagnostic characters.—Similar in color to *Sorex s. godmani*, smaller with decidedly shorter tail; skull heavier, particular rostral region, with larger teeth. Color decidedly darker, particularly ventrally, and tail shorter than in *S. s. saussurei*, the skull scarcely distinguishable (a trifle smaller).

Color.—Winter pelage: Scarcely distinguishable from corresponding pelage of *S. s. godmani*, upper parts possibly a shade darker, particularly posteriorly, and underside of tail paler. *Summer pelage:* Unknown.

Skull.—In general proportions essentially like that of *S. s. saussurei*, but a trifle smaller.

Measurements.—Type specimen (adult female): Total length, 104; tail vertebrae, 41; hind foot, 13.5. Adult female from type locality: Total length, 108; tail vertebrae, 43; hind foot, 14. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 18.0; palatal length, 7.4; cranial breadth, 8.4; interorbital breadth, 4.2; maxillary breadth, 5.4; maxillary tooth row, 6.8. Skull of adult female (teeth moderately worn) from type locality: Condylobasal length, 18.0; palatal length, 7.3; cranial breadth, 8.8; interorbital breadth, 4.3; maxillary breadth, 5.6; maxillary tooth row, 6.9.

Remarks.—Although geographically nearer *S. s. godmani*, this subspecies in most characters more nearly resembles *S. s. saussurei*. It is darker than the subspecies *saussurei*, in this respect resembling more nearly *godmani*, but in size and proportions, both externally and cranially, it is more like *S. s. saussurei*.

Specimens examined.—Two, from the type locality.

SOREX EMARGINATUS Jackson

Zacatecas Shrew

(Pls. 3, t; 9, d)

Sorex emarginatus Jackson, Proc. Biol. Soc. Washington 38: 129, November 13 1925.

Type specimen.—Number 90847, U. S. Nat. Mus., Biological Survey collection; ♀ young adult (teeth unworn), skin and skull; collected

September 17, 1897, by E. W. Nelson and E. A. Goldman. Original number 11765.

Type locality.—Sierra Madre near Bolanos, altitude 7,600 feet, Jalisco, Mexico.

Geographic range.—Known only from Sierra Madre near Bolanos, Jalisco, and Plateado, Zacatecas, Mexico. (Fig. 17.)

Diagnostic characters.—Similar externally to *Sorex s. saussurei,* hind foot shorter; differs from *S. ventralis* and *S. oreopolus* and from all forms of the species *saussurei* in its narrow and peculiarly deeply emarginate first upper molariform tooth, and in having the fourth upper unicuspidate tooth distinctly smaller than the third.

Color.—Winter pelage: Unknown. *Summer pelage:* Indistinguishable from summer pelage of *S. s. saussurei.*

Skull.—Small; moderately depressed brain case, short rostrum; mesopterygoid space short and wide; weak dentition; fourth upper unicuspid distinctly smaller than third; first upper molariform tooth narrow, deeply emarginate posteriorly.

Measurements.—Type specimen (young adult female): Total length, 100; tail vertebrae, 42; hind foot, 12.5. Adult male from Plateado, Zacatecas, Mexico: Total length, 106; tail vertebrae, 41; hind foot, 13. *Skull:* Type specimen (young adult female; teeth unworn): Condylobasal length, 16.9; palatal length, 7.0; cranial breadth, 8.0; interorbital breadth, 4.0; maxillary breadth, 5.0; maxillary tooth row, 6.2. Skull of adult male (teeth much worn) from Plateado, Zacatecas, Mexico: Condylobasal length, 16.4; palatal length, 6.8; cranial breadth, 8.0; interorbital breadth, 3.9; maxillary breadth, 5.1; maxillary tooth row, 5.9.

Remarks.—The three specimens of this shrew examined are entirely inadequate to determine its relationship to *S. saussurei* and *S. ventralis.* The species is as small as *S. ventralis,* but the skull in general shape and proportions is more like that of *S. saussurei.* It seems quite within the range of probability that additional specimens may prove *S. emarginatus* to be a subspecies of *S. saussurei.*

Specimens examined.—Total number, 3, as follows:

Jalisco: Bolanos (altitude 7,600 feet) (type locality), 1.
Zacatecas: Plateado (altitude 7,600 to 8,500 feet), 2.

SOREX VENTRALIS Merriam

Cerro San Felipe Shrew

(Pls. 3, u; 9, e)

Sorex obscurus ventralis Merriam, North Amer. Fauna No. 10, p. 75, December 31, 1895.
Sorex ventralis Elliot, Field Columb. Mus. Publ. 71 (zool. series 3): 148, 1903.

Type specimen.—Number 68342, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth much worn), skin and skull; collected August 26, 1894, by E. W. Nelson and E. A. Goldman.

Type locality.—Cerro San Felipe, altitude 10,000 feet, Oaxaca, Mexico.

Geographic range.—Mountains of northern Puebla and central Oaxaca. (Fig. 18.)

Diagnostic characters.—Size small, tail rather short. Smaller and tail shorter than in any form of the *saussurei* group except *Sorex s. salvini.* Skull higher and less flattened than that of *S. saussurei* or *S. emarginatus;* shorter and broader than that of *S. oreopolus.*

Color.—Winter pelage: Upper parts between clove brown and sepia, nearer clove brown; underparts grayish densely tinged with between avellaneous and drab; tail mummy brown or darker above, distinctly paler below. *Summer pelage:* Upper parts usually near sepia, sometimes tending toward mummy

brown; underparts wood brown to avellaneous mixed with grayish of the base of hairs; tail sepia or sepia tending toward mummy brown above, decidedly paler beneath, sometimes almost cinnamon-buff.

Time of molting.—Of 3 specimens from the mountains near Ozolotepec, Oaxaca, Mexico, 2 are in worn winter pelage March 25 and 26, 1895, while the third, a male, shows indications of beginning molt on the flanks, rump, and back, March 27. Of the 9 specimens from 15 miles west of Oaxaca, Oaxaca, Mexico, 5 are in worn winter pelage September 12 to 14, and 17, 1894; 2 have the molt well begun September 15 and 17; and 2 have acquired the winter pelage on the back September 17 and 18.

Skull.—Small, high both rostrally and cranially, rostrum short, dentition weak, the third upper unicuspid smaller than fourth. Skull distinctly higher than that of any subspecies of *S. saussurei*, with shorter and weaker rostrum and smaller molariform teeth. Skull higher and dentition different from *S. emarginatus*. Actually and relatively shorter and broader than that of *S. oreopolus*, with shorter tooth row.

FIG. 18.—Geographic range of *Sorex sclateri, S. stizodon, S. ventralis,* and *S. oreo polus*
1. *S. sclateri.* 2. *S. stizodon.* 3. *S. ventralis.* 4. *S. oreopolus.*

Measurements.—Type specimen (adult male): Total length, 104; tail vertebrae, 37; hind foot, 13. Two adult males from type locality: Total length, 112, 108; tail vertebrae, 43, 40; hind foot, 13, 12.5. Average of three adult females from 15 miles west of Oaxaca, Oaxaca, Mexico: Total length, 107.7 (103–112); tail vertebrae, 43.3 (41–46); hind foot, 13.7 (13.5–14). *Skull:* Type specimen (adult male; teeth much worn): Condylobasal length, 16.7; palatal length, 6.9; cranial breadth, 8.6; interorbital breadth, 4.0; maxillary breadth, 5.2; maxillary tooth row, 6.0. Two skulls of adult males (teeth much worn) from type locality: Condylobasal length, 17.0, 16.4; palatal length, 7.0, 6.9; cranial breadth, 8.7, 8.6; interorbital breadth, 3.9, 3.8; maxillary breadth, 5.1, 5.0; maxillary tooth row, 6.0, 6.1. Average of three skulls of adult females (teeth slightly worn) from 15 miles west of Oaxaca, Oaxaca, Mexico: Condylobasal length, 17.2 (17.1–17.3); palatal length, 7.0 (7.0–7.1); cranial breadth, 8.5 (8.5–8.6); interorbital breadth, 3.9 (3.8–4.0); maxillary breadth, 5.2 (5.0–5.4); maxillary tooth row, 6.1 (6.1–6.2).

Remarks.—In the original description of this form it was treated as a subspecies of *S. obscurus* (Merriam, 1895, p. 75). As a matter of fact, the species is not closely related to *S. obscurus* and differs

cranially in its shorter and broader mesopterygoid space and in lacking the distinct pigmented ridge extending from the apex to the interior border of the cingulum of each unicuspid. There is apparently close relationship between *S. oreopolus* and *S. ventralis*.

Specimens examined.—Total number, 23, as follows:

Oaxaca: Cajonos (near), 2; Cerro San Felipe (type locality), 7; Oaxaca (15 miles west), 9; Ozolotepec (mountains near), 3.
Puebla: Huachinango, 2.

SOREX OREOPOLUS Merriam

Jalisco Shrew

(Pls. 3, v; 9, f)

Sorex oreopolus Merriam, Proc. Biol. Soc. Washington 7: 173, September 29, 1892.

Type specimen.—Number $\frac{3366}{45698}$ U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth moderately worn), skin and skull; collected April 22, 1892, by E. W. Nelson.

Type locality.—North slope of Sierra Nevada de Colima, altitude about 10,000 feet, Jalisco, Mexico.

Geographic range.—Known only from mountains of Jalisco, Mexico. (Fig. 18.)

Diagnostic characters.—Size small, tail short; skull relatively high, long and narrow; dentition weak. Skull distinctly higher with shorter palate and rostrum than in any form of *Sorex saussurei;* longer, higher, and narrower interorbitally than that of *S. emarginatus;* longer and narrower than that of *S. ventralis.*

Color.—*Winter pelage:* Upper parts most nearly clove brown or a trifle paler; underparts avellaneous mixed with grayish at base of hairs; tail between sepia and clove brown above, paler below, near buffy brown. *Summer pelage:* Unknown.

Time of molting.—The two adult males from the type locality still retain the full winter pelage on April 22, 1892. The specimen from Volcan de Nieve, Jalisco, is in extremely worn summer pelage September 12, 1905, and the condition of the skin indicates that molt is beginning.

Skull.—Relatively high, long, and narrow; teeth small; third upper unicuspid smaller than fourth. Similar in general appearance to that of *S. ventralis,* but actually and relatively longer and narrower, with longer tooth row. Higher both rostrally and cranially than that of any subspecies of *S. saussurei,* with shorter and weaker rostrum, and smaller teeth. Brain case and rostrum higher than in *S. emarginatus,* and teeth different.

Measurements.—Type specimen (adult male): Total length, 106; tail vertebrae, 36; hind foot, 13. *Skull:* Type specimen (adult male, teeth moderately worn): Condylobasal length, 17.8; palatal length, 6.9; cranial breadth, 8.3; interorbital breadth, 3.7; maxillary breadth, 5.0; maxillary tooth row, 6.4.

Remarks.—The affinities of *S. oreopolus* are clearly with *S. ventralis* rather than *S. saussurei,* with which it occurs at the type locality. The inadequacy of the material examined makes impossible definite assignment of its relationship with *S. ventralis,* but when more specimens are available it would not be surprising to find *S. oreopolus* only subspecifically distinct from *S. ventralis.*

Specimens examined.—Total number, 3, as follows:

Jalisco: Sierra Nevada de Colima (type locality), 2; Volcano de Nieve, 1.[12]

[12] Amer. Mus. Nat. Hist.

TABLE 11.—*Cranial measurements of adult specimens of* Sorex saussurei *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth-row	Wear of teeth	Remarks
S. s. saussurei:										
Jalisco—Sierra Nevada de Colima.	45702	♀	18.4	7.6	8.9	4.3	5.6	6.8	Moderate.	Type specimen
Do	45701	♀	18.0	7.5±	8.8	4.2	5.6	6.8	...do.....	Type locality.
Michoacan—Nahuatzin.	50766	♀	18.1	7.3	8.6	4.1	5.4	6.5	Slight.....	
Do	50768	♀	18.2	7.4	8.7	4.2	5.3	6.6	...do.....	
S. s. veraecrucis:										
Vera Cruz—Xico	55106	♀	18.3	7.4	8.7	4.1	5.3	6.6	...do.....	Type specimen.
Do	55105	♀	18.1	7.4	8.7	4.0	5.4	6.7	Unworn...	Type locality.
Oaxaca—Mount Zempoaltcpec.	68566	♀	18.2	7.5	8.7	4.0	5.3	6.9	Slight.....	
S. s. oaxacae:										
Oaxaca — Mountains near Ozolotepec.	71467	♀	18.2	7.3	9.0	4.2	5.6	6.7	Moderate.	Type specimen.
S. s. cristobalensis:										
Chiapas—San Cristobal.	75883	♀	18.5	7.6	8.5	4.0	5.4	6.7	Slight.....	Do.
S. s. godmani:										
Guatemala—										
Volcano Santa Maria.	77044	♀	17.6	7.1	8.2	3.7	4.9	6.3	...do.....	Do.
Todos Santos	77023	♀	17.4	7.1	8.6	4.0	5.1	6.2	...do.....	
S. s. salvini:										
Guatemala—Calel	77035	♀	18.0	7.4	8.4	4.2	5.4	6.8	...do	Do.
Do	77071	♀	18.0	7.3	8.8	4.3	5.6	6.9	Moderate.	Type locality.
S. emarginatus:										
Jalisco—Sierra Madre, near Bolanos.	90847	♀	16.9	7.0	8.0	4.0	5.0	6.2	Unworn...	Type specimen, young adult.
Zacatecas—Plateado.	90846	♂	16.4	6.8	8.0	3.9	5.1	5.9	Much.....	
S. ventralis:										
Oaxaca—										
Cerro San Felipe.	68342	♂	16.7	6.9	8.6	4.0	5.2	6.0	...do.....	Type specimen.
Do	68343	♂	17.0	7.0	8.7	3.9	5.1	6.0	...do.....	Type locality.
Do	68347	♂	16.4	6.9	8.6	3.8	5.0	6.1	...do.....	Do.
15 miles west of Oaxaca.	68352	♀	17.1	7.0	8.5	3.8	5.1	6.2	Slight.....	
Do	68355	♀	17.3	7.1	8.5	3.9	5.4	6.1	...do.....	
Do	68358	♀	17.2	7.0	8.6	4.0	5.0	6.1	...do.....	
S. oreopolus:										
Jalisco—Sierra Nevada.	45698	♂	17.8	6.9	8.3	3.7	5.0	6.4	Moderate.	Type specimen.

SOREX ORNATUS GROUP

The *ornatus* group includes seven species: *Sorex ornatus*, *S. sinuosus*, *S. juncensis*, *S. trigonirostris*, *S. myops*, *S. tenellus*, and *S. nanus*.

Geographic range.—Interior southwestern Oregon, California south of latitude 39° north, Lower California, and central Colorado. (Fig. 19.)

Diagnostic characters.—Size rather small, tail comparatively short; skull rather flattened through brain case, depressed interorbitally; foramen magnum placed dorsad, encroaching more into supraoccipital and less into basioccipital. Compared with any of the *trowbridgii* group, smaller, with shorter, more concolor tail; skull smaller than in *S. trowbridgii*, flatter, with narrower cranium and mesopterygoid space, and shorter tooth row. Compared with *vagrans-obscurus* group the skull is flatter, more depressed interorbitally, the foramen magnum located relatively more dorsad and encroaching more into supraoccipital and less into basioccipital; unicuspid teeth viewed laterally are relatively narrower and weaker; metacone of first upper molariform tooth (pm^3) relatively higher. (Fig. 20.)

FIG. 19.—Geographic range of species and subspecies of the *Sorex ornatus* group

1. *S. ornatus ornatus.*
2. *S. o. californicus.*
3. *S. o. lagunae.*
4. *S. trigonirostris.*
5. *S. sinuosus.*
6. *S. juncensis.*
7. *S. tenellus.*
8. *S. myops.*
9. *S. nanus.*

Remarks.—The *ornatus* group has a comparatively limited distribution in western America, the center of abundance for the group appearing to be in southern California. The group is superficially like the *vagrans-obscurus* group in general external appearance, but is usually more grayish in color and with relatively shorter tail; the two groups are distinctively separate in cranial characters. The *ornatus* group is probably more nearly allied to the geographically widely separated *longirostris* group than to any other.

SOREX ORNATUS MERRIAM

[Synonymy under subspecies]

Geographic range.—California south of latitude 39° north, and Lower California. (Fig. 19.)

Diagnostic characters.—Larger than *Sorex tenellus*, *S. nanus* or *S. myops*, with skull distinctly larger in all proportions, the teeth decidedly heavier than in *S. tenellus* or *S. nanus*. Separable from *S. sinuosus* by color alone, it being contrastedly paler (grayish brown) as compared with the blackish of *S. sinuosus*. Skull decidedly flatter and relatively broader than that of *S. juncensis*. Compared with that of *S. trigonirostris* the skull of the species *ornatus*

FIG. 20.—Foramina magna of *Sorex obscurus* and *S. ornatus*. A, *S. obscurus*, dorsal view; B, *S. ornatus*, dorsal view; C, *S. obscurus*, ventral view; D, *S. ornatus*, ventral view. Enlarged two diameters

has a relatively longer rostrum, the sides of which tend to be more convex (rounded), and the mastoidal region more prominent and angular, and weaker dentition.

Subspecies and geographic variation.—The species *ornatus* is divided into three subspecies: *ornatus*, *californicus*, and *lagunae*. The species, like most American shrews, displays considerable individual variation, particularly in the northern half of its range. There is a general tendency toward an increase in size and a darkening of the underparts from the northern part of the range southward. The subspecies *ornatus* is larger than *californicus* and averages a shade darker, particularly ventrally; while *lagunae* is about the size of the subspecies *ornatus*, but still darker.

Time of molting.—Specimens of the species *ornatus* are usually in full summer fur by May, though frequently the molt does not occur until late in June or even the middle of July, and again it may take place in March, or possibly late in February. The type specimen of *S. o. californicus* was in nearly complete molt February 15, and another male from Berkeley, Calif., was molting February 29, 1892. The latter specimen, however, bears some indication that it may have been gaining its winter coat, rather than the summer. A male collected July 18, at Dudley, Mariposa County, Calif., and one taken July 19, at Cuddy Canyon, Frazier Mountain, Ventura County, Calif., are assuming what appears to be summer fur.

The transition from summer to winter pelage occurs most frequently during September or early in October. Specimens are usually in full winter pelage by November, and often by late October. A male of the subspecies *californicus* from Stanford University, Calif., still retains summer fur October 28, 1900, while two from Pacheco Pass are in winter pelage October 11 and 13, 1907, and a female from the same locality has the molt nearly complete October 14. At Gilroy, Calif., a female had the molt progressed about one-half on October 29,

1907. A male of the subspecies *ornatus*, from San Jacinto Mountains, Calif., has the molt begun as early as August 7, 1907, and another from Big Pine Mountain has the fresh winter pelage coming in under the worn summer fur over its entire back, September 11, 1903. A female from San Diego Bay, Calif., was in summer pelage as late as November 5, 1899.

SOREX ORNATUS ORNATUS Merriam

Southern California Long-tailed Shrew

(Pls. 3, w; 5, n; 6, p; 9, g; 11, l; 13, b)

Sorex ornatus Merriam, North Amer. Fauna No. 10, p. 79, December 31, 1895.
Sorex oreinus Elliot, Field Columb. Mus. Publ. 74 (zool. series 3) : 172, April, 1903. Type locality, Aguaje de las Fresas, altitude 6,000 feet, San Pedro Martir Mountains, Lower California, Mexico.
Sorex orinus Elliot, Field Columb. Mus. Publ. 79 (zool. series 3) : 228, June, 1903.

Type specimen.—No. $\frac{31333}{43198}$, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth very slightly worn), skin and skull (skull with posterior and basal portions of cranium broken away); collected October 19, 1891, by E. W. Nelson.

Type locality.—Head of San Emidgio Canyon, Mount Pinos, Kern County, Calif.

Geographic range.—Coast region of California south of Monterey Bay, west slope of the Sierras south of latitude 38° north, south through southwestern California and northern Lower California to latitude 30° north. (Fig. 19.)

Diagnostic characters.—Larger than *Sorex* o. *californicus* and tending to be slightly darker in color ventrally; skull larger than that of *californicus*, higher, and with broader rostrum. Indistinguishable from *S.* o. *lagunae* in size and cranial characters, but paler, especially on ventral parts of both tail and body.

Color.—*Winter pelage:* General tone of upper parts varying from hair brown more or less mixed with, tinted by, or tending toward olive-brown, to almost fuscous or clove brown, sometimes paling slightly on the flanks, gradually merging with color of the underparts; underparts smoke gray or pale smoke gray, sometimes tinged with pale pinkish buff or cartridge buff; tail indistinctly bicolor, buffy brown to olive-brown above, avellaneous, wood brown, or buffy brown below, nearly to tip, darkening apically, sometimes almost pinkish buff or even pale pinkish buff below basally. *Summer pelage:* Upper parts hair brown, drabbish, or buffy brown; underparts smoke gray usually tinged with vinaceous-buff or between pinkish buff and cinnamon-buff; tail as in winter.

Skull.—Skull larger and relatively higher through the brain case than that of *S.* o. *californicus*, broader through rostrum and interorbitally, and dentition heavier. Scarcely distinguishable from the skull of *S.* o. *lagunae*, but usually a trifle higher through brain case. Somewhat similar to that of *S. sinuosus* but slightly wider interorbitally and with longer palate.

Measurements.—Type specimen (adult male) : Total length, 108; tail vertebrae, 43; hind foot, 13. Adult male from Tehachapi, Calif.: Total length, 107; tail vertebrae, 39; hind foot, 12. Adult female (type specimen of *S. oreinus*) from Aguaje de las Fresas, Lower California, Mexico: Total length, 103; tail vertebrae, 43; hind foot, 12. Average of four adult males from El Portal, altitude 2,000 feet, Mariposa County, Calif.: Total length, 102.3 (101–104); tail vertebrae, 43.5 (43–44); hind foot, 12.5 (12–13). *Skull:* Type specimen (adult male; teeth very slightly worn) : Palatal length, 6.9; interorbital breadth, 3.7; maxillary breadth, 5.0; maxillary tooth row, 6.2. Skull of adult male (teeth slightly worn) from Tehachapi, Calif.: Condylobasal length, 16.7; palatal length, 6.8; cranial breadth, 8.2; interorbital breadth, 3.6; maxillary breadth, 5.1; maxillary tooth row, 6.2. Skull of adult female (teeth slightly worn; type specimen of *S. oreinus*) from Aguaje de las Fresas, Lower California, Mexico; Condylobasal length, 16.5; palatal length, 6.8; cranial breadth, 8.2; interorbital breadth, 3.5; maxillary breadth, 4.7; maxillary tooth row, 6.0. Average of four skulls of adult males (teeth slightly worn) from El Portal, altitude 2,000 feet, Mariposa County, Calif.: Condylobasal length, 16.9 (16.5–17.1); palatal length,

6.8 (6.7–7.0) ; cranial breadth, 8.1 (8.0–8.2) ; interorbital breadth, 3.6 (3.4–3.8) ; maxillary breadth, 4.9 (4.8–5.0) ; maxillary tooth row, 6.0 (5.8–6.2).

Remarks.—The subspecies *ornatus* occupies a considerable area in southern California, and at several localities in the northern part of its range shows clearly intergradation with *S. o. californicus.* Specimens from Minkler, Calif., are essentially like typical *S. o. ornatus*, but a single specimen from Orosi, near by, could almost be referred to *californicus.* Certain of the specimens from Monterey, Calif., and immediate vicinity could with about equal propriety be referred to *californicus* as to *S. o. ornatus.* The three from Summit Lake, Calif., except for possibly a trifle shorter tails and scarcely paler underparts, are indistinguishable from typical *ornatus.* The series of specimens from El Portal, Yosemite National Park, is particularly interesting from the viewpoint of variation, the specimens showing almost perfect gradation from minimum to maximum size, one skull [13] being larger than normal. Two or three of the skulls from the San Jacinto Mountains, Calif., are larger and with broader rostra than those of typical specimens of *S. o. ornatus*, but the differences are too inconstant for subspecific recognition. The single specimen with broken skull from Little Lake, Inyo County, Calif., shows no characters whereby it can be separated from *S. o. ornatus.* Specimens from Summit Lake, Calif., collected June 27, 1907, are darker than normal specimens of *S. o. ornatus* but the writer is inclined to believe that this is due largely to their fresh unworn pelage. A female [14] collected January 20, 1924, 2 miles east of Playa del Rey, Los Angeles County, Calif., is provisionally referred to *S. o. ornatus.* The specimen, however, both externally and cranially, is scarcely distinguishable from typical *S. o. californicus*, but inasmuch as there is only the one from this locality, which lies near the known geographic range of true *ornatus*, it seems probable that this individual may be an abnormally small representative of that subspecies.

The type specimen of *S. oreinus* Elliot does not differ from true *ornatus.* Of three specimens from San Quintin, Lower California, Mexico, one, collected August 2, 1902, is typical *S. o. ornatus* in every respect; another, collected August 1, 1902, appears to be intermediate between the subspecies *ornatus* and *lagunae;* the third, collected July 31, 1902, is fully as dark ventrally, both on body and tail, as the type specimen of *lagunae.*

Specimens examined.—Total number, 109, as follows:

California: Bakersfield, 2 [15]; Big Bear Valley, San Bernardino County, 1 [16]; Big Pine Mountain, 1; Big Pines (Swartout Valley, altitude 6,900 feet), Los Angeles County, 1 [16]; Bluff Lake (altitude 7,500 feet), San Bernardino Mountains, 5 [17]; Buena Vista Lake (north side), 1; Cuddy Canyon, Frazier Mountain, Ventura County, 1 [15]; Dudley (altitude 3,000 feet), Mariposa County, 1 [15]; Dulzura, 6 [18]; El Monte (near San Gabriel River Bottom), 2 [15]; El Portal (altitude 1,800 to 2,500 feet), 18 [15]; Fort Tejon, Kern County, 2 [19]; Little Lake (altitude 3,100 feet), 1 [15]; Los Angeles, 3 [20]; Piute Mountains, 1 [21]; Lytle Creek, 2; Minkler,

[13] No. 21523, Mus. Vert. Zool.
[14] No. 9880, collection of Donald R. Dickey, Pasadena, Calif.
[15] Mus. Vert. Zool.
[16] D. R. Dickey coll., Pasadena, Calif.
[17] D. R. Dickey coll., 1; Mus. Vert. Zool., 2.
[18] D. R. Dickey coll., 2; Mus. Vert. Zool., 4.
[19] Mus. Vert. Zool., 4; Field Mus. Nat. Hist., 1.
[20] Field Mus. Nat. Hist.
[21] Mus. Comp. Zool.

2[15]; Monterey, 5[22]; Morro, 2[15]; Mount McGill, 1; Mount Pinos, 2[23]; Orosi, 1; Paraiso Springs, 1; Piru Creek (Bailey's Ranch), 3[20]; Piute, 2; Playa del Rey, Los Angeles County, 1[16]; Point Pinos, Pacific Grove, 1; San Bernardino, 1[24]; San Bernardino Mountains (altitude 7,400 to 7,500 feet), 2[15]; San Diego Bay, 1[15]; San Emigdio Canyon (type locality), 1; San Emigdio Creek (altitude 1,500 feet), 2[15]; San Jacinto Mountains (altitude 8,000 to 9,000 feet), 3; Santa Barbara, 1[16]; Santa Ysabel, 2; Seaside, 1; Strawberry Valley (altitude 6,000 feet), San Jacinto Mountains, 1[15]; Summit Lake (12 miles northwest of Lemoore), 3[25]; Tahquitz Valley (altitude 8,000 feet), San Jacinto Mountains, 3[15]; Tehachapi, 2; Trabuco Canyon (altitude 1,700 feet), Santa Ana Mountains, 1[15]; Ventura River, 1; Walker Basin, Kern County, 1[16];.

Lower California: Aguaje de las Fresas (type locality of *oreinus*), 1[20]; El Rosario, 9[20]; La Grulla, San Pedro Martir Mountains, 1[20]; San Quintin, 3.[20]

SOREX ORNATUS CALIFORNICUS Merriam

California Long-tailed Shrew

(Pls. 3, x; 9, h)

Sorex californicus Merriam, North Amer. Fauna No. 10, p. 80, December 31, 1892.
Sorex californicus californicus Miller, U. S. Nat. Mus. Bul. 79, p. 18, December 31, 1912.
Sorex ornatus californicus Jackson, Journ. Washington Acad. Sci. 12: 264, June 4, 1922.

Type specimen.—No. $\frac{32578}{44426}$ U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected February 15 1892, by C. P. Streator.

Type locality.—Walnut Creek, Contra Costa County, Calif.

Geographic range.—Western and west-central California from latitude 39° north, south to somewhat beyond latitude 37° north (Mendota). (Fig. 19.)

Diagnostic characters.—Smaller in all dimensions than *Sorex o. ornatus*, with the skull usually flatter, rostrum narrower, and dentition weaker. About the size and color of *S. trigonirostris* but separable by specific characters. Skull larger than that of *S. myops*, and larger and with broader rostrum than that of *S. tenellus*.

Color.—*Winter pelage:* Upper parts varying in general hue from slightly darker than hair brown to chaetura drab or fuscous, sometimes almost olive-brown; underparts smoke gray, pale smoke gray, or grayish white, sometimes faintly tinged with pale pinkish buff, or rarely with vinaceous-buff; tail indistinctly bicolor, olive-brown, above, near avellaneous below, darkening toward apex. *Summer pelage:* Scarcely distinguishable from winter pelage, possibly a trifle paler and more brownish; upper parts most nearly hair brown, sometimes slightly darker, or tending toward drab or olive-brown, slightly paling on the sides and blending gradually with color of the underparts; underparts smoke gray or pale smoke gray tinged more or less with buffy; tail as in winter.

Skull.—Smaller than that of *S. o. ornatus*, more flattened through the brain case, narrower through rostrum and interorbitally, with weaker dentition. Smaller than the skull of *S. sinuosus*, somewhat flatter, with narrower rostrum. About the size of that of *S. trigonirostris*, or slightly larger, the mastoid region appearing less prominent and more rotund in dorsal aspect, the rostrum less angular.

Measurements.—Type specimen (adult male): Total length, 89; tail vertebrae, 32; hind foot, 12. Adult male from Berkeley, Calif.: Total length, 96;

[15] Mus. Vert. Zool.
[16] D. R. Dickey coll., Pasadena, Calif.
[20] Field Mus. Nat. Hist.
[22] D. R. Dickey coll., 4.
[23] Mus. Vert. Zool., 1.
[24] Acad. Nat. Sci. Philadelphia.
[25] Mus. Comp. Zool., 1.
[20] San Diego Nat. Hist. Mus., San Diego, Calif.

tail vertebrae, 38; hind foot, 12. *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 16.0; palatal length, 6.3; cranial breadth, 7.8; interorbital breadth, 3.3; maxilliary breadth, 4.5; maxillary tooth row, 5.6. Skull of adult male (teeth slightly worn) from Berkeley, Calif.: Condylobasal length, 15.9; palatal length, 6.3; cranial breadth, 8.0; interorbital breadth, 3.3; maxillary breadth, 4.6; maxillary tooth row, 5.7.

Remarks.—Larger series of *S. o. californicus* from various localities are needed before a satisfactory determination of exact relationships within the subspecies, as at present recognized, can be reached. There are several specimens available from one or two localities, but the number properly measured and with perfect skulls is decidedly meager. Intergradation of *californicus* with *S. o. ornatus* is clearly indicated in specimens from Mendota and Pacheco Pass, Calif., which are referable to *californicus* but show tendencies toward *S. o. ornatus.* Likewise, one of the skulls from Hayward is broader and higher than in typical *californicus* and almost matches skulls of typical *S. o. ornatus;* another skull from Hayward is a trifle larger than that of true *californicus*, but in general proportions show no differences; while a third skull, although badly broken, appears to have been more nearly like typical skulls of *californicus.* The specimen [27] collected June 25, 1912, at Rumsey, Yolo County, Calif., is paler than ordinary *californicus.* This may be a seasonal variation, however, as the animal appears to be in worn winter pelage.

The skulls of specimens from Petaluma, Calif., seem to average a trifle larger and with broader rostra than in typical *S. o. californicus*, and the color of two of the skins is a shade darker than in normal individuals. This may possibly indicate a tendency toward *S. sinuosus*, but the contrast between the darkest specimens of *californicus* and the palest of *S. sinuosus* is so great that, on the basis of present material, one would hardly be warranted in calling them conspecific.

Specimens examined.—Total number, 49, as follows:

California: Auburn, 1; Berkeley, 11 [28]; Chalk Creek, Monterey County, 1 [29]; Concord (5 miles north), 1 [30]; Cordelia, 1 [30]; First Canyon (north of Strawberry Creek), 1 [29]; Gilroy, 1; Glen Ellen, 1; Hayward, 3 [29]; Los Banos (22 miles south), 1 [29]; La Honda, San Mateo County, 1 [31]; Mendota, 2; Pacheco Pass (summit), 3; Palo Alto, 1 [32]; Petaluma, 8 [33]; Redwood City, 4 [34]; Rumsey (altitude 500 feet), 1 [29]; Sunnyvale, 1 [29]; Stanford University, 1; Stonewall Creek (6.3 miles northeast of Soledad, altitude 1,300 feet), Monterey County, 1 [29]; Walnut Creek (type locality), 4.[35]

SOREX ORNATUS LAGUNAE Nelson and Goldman

Laguna Mountain Shrew

Sorex lagunae Nelson and Goldman, Proc. Biol. Soc. Washington 22: 27, March 10, 1909.

Type specimen.—No. 147119, U. S. Nat. Mus., Biological Survey collection; adult ♀ (teeth slightly worn), skin and skull (skull

[27] No. 18481, Mus. Vert. Zool.
[28] Acad. Nat. Sci. Philadelphia, 1; Mus. Vert. Zool., 6.
[29] Mus. Vert. Zool.
[30] D. R. Dickey coll., Pasadena, Calif.
[31] Amer. Mus. Nat. Hist.
[32] Mus. Comp. Zool.
[33] Mus. Vert. Zool., 5.
[34] Mus. Vert. Zool., 2; Univ. Wis. Zool. Mus., 2.
[35] Mus. Vert. Zool., 1.

broken across rostrum); collected January 29, 1906, by E. W. Nelson and E. A. Goldman.

Type locality.—La Laguna, altitude 5,500 feet, Sierra Laguna, Lower California, Mexico.

Geographic range.—Known only from type locality. (Fig. 19.)

Diagnostic characters.—Similar to *S. o. ornatus* in size and cranial characters, but decidedly darker on ventral parts of tail and body.

Color.—*Winter pelage:* Upper parts slightly darker and very slightly more brownish than hair brown; underparts a shade paler than upper parts, between drab and light drab; tail fuscous above, scarcely paler, if any, below. *Summer pelage:* Unknown.

Skull.—Indistinguishable from certain skulls of *S. o. ornatus.*

Measurements.—Type specimen (adult female): Total length, 98; tail vertebrae, 41; hind foot, 12.5. *Skull:* Type specimen (adult female, teeth slightly worn); Condylobasal length, 16.4±; cranial breadth, 7.8; interorbital breadth, 3.5; maxillary breadth, 4.8.

Remarks.—Except for darker color on the ventral parts of its tail and body, *S. o. lagunae* is closely similar to *S. o. ornatus.* The single specimen available for study furnishes rather unsatisfactory comparative material, but it seems probable additional material will substantiate recognition of the form.

Specimen examined.—One, the type.

SOREX TRIGONIROSTRIS Jackson

Oregon Dwarf Shrew

(Pl. 3, z)

Sorex trigonirostris Jackson, Journ. Washington Acad. Sci. 12: 264, June ~~12,~~ 4 1922.

Type specimen.—No. 203608, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected May 5, 1914, by Luther J. Goldman.

Type locality.—Ashland, Jackson County, Oreg. (altitude 1,975 feet).

Geographic range.—Known only from near Ashland, Oreg. (Fig. 19.)

Diagnostic characters.—Similar in size and color to *Sorex o. californicus;* mastoid region of skull more angular and prominent than in *californicus* or any other of the *ornatus* group; rostrum shorter and more angular, the sides less outwardly curved; palate shorter than in *californicus.*

Color.—*Winter pelage:* Unknown. *Summer pelage:* Upper parts grayish, hair brown, becoming drab on the sides; underparts between pale smoke gray and pale olive-gray very faintly tinged with pale olive-buff; tail olive-brown above, avellaneous below nearly to tip.

Skull.—About the size of that of *S. o. californicus,* or slightly smaller; flat, with short, angular rostrum; mastoid region more angular and prominent in dorsal aspect than in any other of the *ornatus* group. Larger than that of *S. myops, S. tenellus,* or *S. nanus,* with actually and relatively broader cranium.

Measurements.—Type specimen (adult female): Total length, 95; tail vertebrae, 34; hind foot, 12. *Skull:* Type specimen (adult female, teeth slightly worn): Condylobasal length, 15.6; palatal length, 5.8; cranial breadth, 7.9; interobital breadth, 3.4; maxillary breadth, 4.5; maxillary tooth row, 5.5.

Remarks.—Consisting of only two specimens, one of which has an imperfect skull, the material representing this form in collections is too meager for satisfactory study. The species, however, seems

closely related to *S. ornatus* and additional material may prove intergradation with that species, probably through *S. o. californicus.*

Specimens examined.—Total number, 2, as follows:

Oregon: Ashland (altitude 1,975 feet) (type locality), 1; Ashland (west slope Grizzly Peak, altitude 3,500 feet), 1.

SOREX SINUOSUS GRINNELL

SUISUN SHREW

(PL. 3, Y)

Sorex sinuosus Grinnell, Univ. Calif. Publ. Zool. 10: 187, March 20, 1913.

Type specimen.—No. 16470, Mus. Vert. Zool., University of California; ♀ adult (teeth slightly worn), skin and skull; collected January 5, 1912, by Miss A. M. Alexander.

Type locality.—Grizzly Island, near Suisun, Solano County, Calif.

Geographic range.—Known only from type locality. (Fig. 19.)

Diagnostic characters.—Color distinctly darker than in any other of the *ornatus* group, almost black both dorsally and ventrally. About the size of *Sorex o. californicus*, head and body possibly averaging slightly larger. Skull somewhat larger, higher, and with broader rostrum than in *californicus;* more nearly like that of *S. o. ornatus.*

Color.—Winter pelage: Dark, almost black; upper parts fuscous-black, chaetura black, or even nearer black, usually with a metallic sheen, gradually paling to color of underparts; underparts hair brown to chaetura drab; tail fuscous-black or mummy brown above, scarcely paler ventrally. *Summer pelage:* Somewhat paler and more brownish (less blackish) than winter pelage; upper parts fuscous to chaetura drab, or slightly darker, the sides paler, almost like ventral parts; underparts hair brown or between hair brown and drab; tail as in winter.

Time of molting.—A single specimen, a male, collected September 6, 1912, is changing from summer to winter pelage and has the molt over half completed. Two females, collected August 25 and September 7, and a male, taken August 24, are in full summer fur. Six specimens, all sexed by the collector as females, and caught between November 25 and January 20, are in full winter pelage.

Skull.—Larger than that of *S. o. californicus*, somewhat higher, with broader rostrum. Not unlike the skull of *S. o. ornatus* but slightly narrower interorbitally, with shorter palate, and on the average, weaker dentition. Larger and heavier than any of the *ornatus* group except *S. o. ornatus* and *S. o. lagunae.*

Measurements.—Type specimen (adult female): Total length, 99; tail vertebrae, 37; hind foot, 12. Average of four adult females from type locality: Total length, 98.9 (92–105); tail vertebrae, 38.8 (37–41); hind foot, 12 (12–12). *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 16.4; palatal length, 6.6; cranial breadth, 7.8; interorbital breadth, 3.6; maxillary breadth, 4.7; maxillary tooth row, 5.7. Average of four skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 16.8 (16.4–16.9); palatal length, 6.6 (6.5–6.6); cranial breadth, 8.0 (7.7–8.2); interorbital breadth, 3.5 (3.4–3.6); maxillary breadth, 4.9 (4.8–4.9); maxillary tooth row, 5.9 (5.8–6.0).

Remarks.—The almost black color of *S. sinuosus* makes the species easily distinguishable from any other member of the *ornatus* group. The species has a very local distribution, being restricted, as far as known, to the brackish marshes of Grizzly Island, bordering Suisun Bay, Solano County, Calif. Intergradation with *S. o. californicus* is not evident, although it is suggested in certain specimens of *californicus* from Petaluma, Calif.

Specimens examined.—Eleven from type locality.[36]

[36] Mus. Vert. Zool.

SOREX JUNCENSIS Nelson and Goldman

Tule Shrew

(Pl. 3, a')

Sorex californicus juncensis Nelson and Goldman, Proc. Biol. Soc. Washington 22: 27, March 10, 1909.

Sorex californicus jucensis (sic) Elliot, Check-List Mammals N. Amer. Continent, the West Indies, and Neighboring Seas, Supplement Amer. Mus. Nat. Hist., New York, p. 146, 1917.

Type specimen.—No. 139594, U. S. Nat. Mus., Biological Survey collection; ♀ (?) young adult (teeth scarcely worn); collected September 1, 1905, by E. W. Nelson and E. A. Goldman.

Type locality.—Socorro, 15 miles south of San Quintin, Lower California, Mexico.

Geographic range.—Known only from type locality. (Fig. 19.)

Diagnostic characters.—About the color of *Sorex o. ornatus*, slightly smaller; skull relatively high and narrow for *ornatus* group; relatively much narrower than that of *S. ornatus* and subspecies.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts drab or slightly darker, the color or upper parts extending well down on sides; underparts smoke gray washed with between avellaneous and vinaceous-buff; tail indistinctly bicolor, between drab and wood brown above, pale ochraceous-buff beneath nearly to tip.

Skull.—About the size of that of *S. o. californicus;* relatively higher than any other of the *ornatus* group; relatively narrower than any other of the *ornatus* group, except those of *S. myops, S. tenellus,* and *S. nanus,* than which it is larger and contrastedly higher in all parts.

Measurements.—Type specimen (young adult female [?]): Total length, 101; tail vertebrae, 41; hind foot, 12.5. *Skull* of type specimen (young adult female [?], teeth scarcely worn): Condylobasal length, 15.6; palatal length, 6.2; cranial breadth, 7.4; interorbital breadth, 3.5; maxillary breadth, 4.5; maxillary tooth row, 5.6.

Remarks.—The distinctly higher and narrow skull of *S. juncensis* separates the species from other members of the *ornatus* group. Unfortunately the only specimen available besides the type is an imperfect skull of a senile individual from the type locality. This skull consists only of rostrum and mandibles but discloses no significant differences from the skull of the type specimen.

The species is closely related to true *ornatus*, specimens of which have been examined from localities only a few miles distant from the type locality of *S. juncensis.* Additional material may show that the two forms are specifically connected.

Specimens examined.—Two, from type locality.

SOREX TENELLUS Merriam

Owens Valley Dwarf Shrew

(Pls. 6, q; 9, i)

Sorex tenellus Merriam, North Amer. Fauna No. 10, p. 81, December 31, 1895.

Sorex tenellus tenellus Miller, U. S. Nat. Mus. Bul. 79, p. 18, December 31, 1912.

Type specimen.—No. $\frac{25083}{32495}$, U. S. Nat. Mus., Biological Survey collection; sex undetermined, adult (teeth slightly worn), skin and skull (posterior right-half of cranium broken away); collected December 22, 1890, by E. W. Nelson.

Type locality.—Along Lone Pine Creek, at upper edge of Alabama Hills at about 5,000 feet,[37] near Lone Pine, Owens Valley, Inyo County. Calif.

Geographic range.—Known only from type locality. (Fig. 19.)

Diagnostic characters.—Similar to *Sorex myops* in color; skull weaker than that of *S. myops*, with narrower rostral region and weaker dentition. Color paler than in *S. o. californicus*, with skull decidedly smaller in all dimensions and relatively narrower, the rostrum distinctly narrower and teeth smaller. Apparently closely related to *S. nanus*, color paler and hind foot larger; skull similar to that of *S. nanus* but larger and possibly proportionally broader.

Color.—Winter pelage: Upper parts drab; slightly paling on the flanks; underparts pale smoke gray tinged with pale olive-buff; tail olive-brown above, tilleul buff below, darkening toward tip. *Summer pelage:* Unknown.

Skull.—Small, flat, weak, with narrow rostrum and small teeth. Smallest in the *ornatus* group except that of *S. nanus* and possibly that of *S. myops*. Narrower interorbitally and rostrally than that of *S. myops*, with smaller teeth.

Measurements.—Type specimen (adult, sex unknown): Total length, 103; tail vertebrae, 42; hind foot, 12.5. *Skull:* Type specimen (adult, sex unknown; teeth slightly worn): Condylobasal length, 15.1; palatal length, 5.9; interorbital breadth, 3.1; maxillary breadth, 4.2; maxillary tooth row, 5.4.

Remarks.—Since this species is known only from the type specimen, its exact status is difficult to determine. It certainly has general affinities with the *ornatus* group, and in some respects it appears that it may be intermediate between *S. nanus* and *S. myops*. The suggestion, however, is too slight to warrant specific connection among these forms.

Specimen examined.—One, the type specimen.

SOREX MYOPS MERRIAM

WHITE MOUNTAINS DWARF SHREW

(PLS. 3, B'; 6, R)

Sorex tenellus myops Merriam, Proc. Biol. Soc. Washington 15: 76, March 22, 1902.

Type specimen.—No. $\frac{29559}{41634}$, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth moderately worn); collected July 13, 1891, by E. W. Nelson.

Type locality.—Pipers Creek (Cottonwood Creek), near main peak of White Mountains, altitude 9,500 feet, Mono County, Calif.

Geographic range.—Known only from type locality. (Fig. 19.)

Diagnostic characters.—Color paler than other California members of the *ornatus* group, except *Sorex tenellus;* in size and color similar to *S. tenellus;* skull heavier, the rostrum noticeably broader, and the teeth larger than in either *S. tenellus* or *S. nanus*. Skull smaller than that of *S. o. californicus*, with shorter palate and narrower brain case.

Color.—Worn winter pelage: Upper parts and sides near drab, possibly slightly paler and inclining toward avellaneous; underparts pale smoke gray tinged with pale olive-buff; tail, above between buffy brown and tawny-olive, below near tilleul buff, darkening toward tip. *Summer pelage:* Upper parts drab, inclining toward hair brown; color of underparts and tail in summer, unknown.

Molting.—The type specimen of *S. myops*, collected July 13, 1891, shows transition from winter to summer pelage; the top of the head and anterior half or more of the back is in fresh summer fur; the remaining parts have the worn winter hair. A topotype, a male, collected one day earlier than the type specimen, is in worn winter pelage.

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[37] Not "summit of Alabama Hills," as stated by Merriam (1895, p. 81). See also Howell, A. B., Journ. Mamm. 4: 266, November, 1923.

Skull.—Small, flat, and relatively narrow. Smaller than the skull of any of the *ornatus* group except that of *S. tenellus* and *S. nanus*. Skull heavier, distinctly broader interorbitally and through rostrum, and with heavier dentition than in *S. tenellus* or *S. nanus*.

Measurements.—Type specimen (adult female): Total length, 98; tail vertebrae, 41; hind foot, 12. Adult male from type locality: Total length, 98; tail vertebrae, 41; hind foot, 12.5. *Skull:* Type specimen (adult female; teeth moderately worn): Condylobasal length, 15.2; palatal length, 6.0; cranial breadth, 7.0; interorbital breadth, 3.3; maxillary breadth, 4.4; maxillary tooth row, 5.6. Skull of adult male (teeth moderately worn) from type locality: Condylobasal length, 15.2; palatal length, 5.9; cranial breadth, 7.0; interorbital breadth, 3.4; maxillary breadth, 4.4; maxillary tooth row, 5.6.

Remarks.—The two specimens of *S. myops*, the only ones known, are very uniform in characters and differ chiefly from *S. tenellus*, their nearest ally, in the skulls, which are noticeably broader interorbitally and through the rostra, and have heavier dentition. This species is probably confined to the White Mountains, Calif., where it is seemingly rare and may even be exterminated by the destruction of its habitat through sheep grazing.

Specimens examined.—Two from type locality.

SOREX NANUS Merriam

Rocky Mountain Dwarf Shrew

(Pls. 3, c′; 9, j)

Sorex tenellus nanus Merriam, North Amer. Fauna No. 10, p. 81, December 31, 1895.

Type specimen.—No. 73773, U. S. Nat. Mus., Biological Survey collection; ♀ young adult (teeth unworn), skin and skull (occipital and supraoccipital region of skull broken away); collected August 3, 1895, by Edward A. Preble.

Type locality.—Estes Park, Larimer County, Colo.

Geographic range.—Known only from the mountains of central and north-central Colorado. (Fig. 19.)

Diagnostic characters.—Smallest of the *ornatus* group. Most nearly like *Sorex tenellus*, but apparently darker. Skull smaller than that of *S. tenellus* and possibly relatively narrower. Skull distinctly narrower, particularly rostrum, than in *S. myops*, the teeth smaller.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts between hair brown and olive-brown, extending well down over sides where it merges with color of ventral parts; underparts smoke gray rather densely mixed and washed with between avellaneous and vinaceous buff; tail indistinctly bicolor, drab above, pale ochraceous buff below nearly to tip.

Skull.—Smallest of the *ornatus* group. In general proportions like that of *S. tenellus*, but smaller and possibly relatively narrower.

Measurements.—Type specimen (young adult female): Total length, 105; tail vertebrae, 42; hind foot, 10. *Skull:* Type specimen (young adult female; teeth unworn): Palatal length, 5.3; cranial breadth, 6.6; interorbital breadth, 3.0; maxillary breadth, 4.0; maxillary tooth row, 5.1. Skull of adult (sex unknown; teeth slightly worn), from West Cliff, Colo., altitude 8,300 feet; Condylobasal length, 14.5; palatal length, 5.4; cranial breadth, 6.7; interorbital breadth, 3.0; maxillary breadth, 4.0; maxillary tooth row, 5.2.

Remarks.—With the possible exception of *S. preblei*, *S. nanus* is the smallest member of the genus. Specimens have been examined only from the mountains of central Colorado, although Merriam records one from Fort Custer, Mont. (Merriam, 1895, p. 82.) The

author has been unable to locate the Montana specimen or to find any record of it other than that published by Merriam.

Specimens examined.—Total number, 2, as follows:

Colorado: Estes Park (type locality), 1; West Cliff (altitude 8,300 feet), 1.

TABLE 12.—*Cranial measurements of adult specimens of* Sorex ornatus *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. o. ornatus:										
California—										
San Emigdio Canyon.	43198	♂	------	6.9	-----	3.7	5.0	6.2	Very slight	Type specimen.
Tehachapi	135947	♂	16.7	6.8	8.2	3.6	5.1	6.2	Slight	
El Portal	[1] 21522	♂	17.1	7.0	8.1	3.6	5.0	6.1	do	
Do	[1] 21525	♂	16.8	6.7	8.0	3.4	4.8	6.0	do	
Do	[1] 21533	♂	17.1	6.8	8.2	3.8	5.0	6.2	do	
Do	[1] 21534	♂	16.5	6.7	8.1	3.4	4.9	5.8	do	
Lower California—Aguaje de las Fresas.	[2] 10842	♀	16.5	6.8	8.2	3.5	4.7	6.0	do	Type specimen of *S. oreinus.*
S. o. californicus:										
California—										
Walnut Creek	44426	♂	16.0	6.3	7.8	3.3	4.5	5.6	do	Type specimen.
Berkeley	44679	♂	15.9	6.3	8.0	3.3	4.6	5.7	do	
S. o. lagunae:										
Lower California—La Laguna.	147119	♀	16.4±	-----	7.8	3.5	4.8	-----	do	Do.
S. trigonirostris:										
Oregon—Ashland	203608	♀	15.6	5.8	7.9	3.4	4.5	5.5	do	Do.
S. sinuosus:										
California—Grizzly Island.	[1] 16470	♀	16.4+	6.6	7.8	3.6	4.7	5.7	do	Do.
Do	16468	♀	16.9	6.5	8.0	3.5	4.9	5.8	do	Type locality.
Do	[1] 16469	♀	16.8	6.6	7.7	3.4	4.8	6.0	do	Do.
Do	[1] 16471	♀	16.4	6.6	8.2	3.6	4.9	5.9	do	Do.
Do	[1] 20790	♀	16.9	6.6	8.2	3.5	4.9	5.9	do	Do.
S. juncensis:										
Lower California—Socorro.	139594	♀?	15.6	6.2	7.4	3.5	4.5	5.6	Very slight	Type specimen young adult.
S. tenellus:										
California—Owens Valley.	32495	------	15.1	5.9	-----	3.1	4.2	5.4	Slight	Type specimen.
S. myops:										
California—White Mountains.	41634	♀	15.2	6.0	7.0	3.3	4.4	5.6	Moderate	Do.
Do	41633	♂	15.2	5.9	7.0	3.4	4.4	5.6	do	Type locality.
S. nanus:										
Colorado—										
Estes Park	73773	♀	------	5.3	6.6	3.0	4.0	5.1	Unworn	Type specimen young adult.
West Cliff	174655	------	14.5	5.4	6.7	3.0	4.0	5.2	Slight	

[1] Mus. Vert. Zool. [2] Field Mus. Nat. Hist.

Subgenus NEOSOREX Baird

Neosorex Baird, Report Pacific R. R. Survey 8: part 1, Mammals, p. 11, 1857.

Type species.—*Neosorex navigator* Baird.

Geographic range.—Northern British Columbia, southern Alaska (Glacier Bay), central Northwest Territories (lat. 64° N.), south in the mountains to southern California, Arizona, and northern New Mexico; east to northern Manitoba and southeastern Quebec, south to northeastern South Dakota, central Minnesota, northern Wisconsin and Michigan, and northeastern Pennsylvania.

Diagnostic characters.—Size rather large, the largest form (*S. p. palustris*) about equal in size to the smallest form (*S. b. bendirii*) of the subgenus Atophyrax; feet more conspicuously fringed with hair than in Atophyrax or Sorex proper. Skull smaller than in Atophyrax; rostrum, particularly anterior portion, comparatively short, scarcely curved ventrally anteriorly; anterior end of premaxilla scarcely narrower dorsoventrally than middle portion; dorsoventral diameter of rostrum measured at third unicuspid equal about half the diameter between anterior border of infraorbital foramen and posterior border of i^1; anterior-posterior diameter of basal portions of upper unicuspids (particularly fifth or last unicuspid) less than in Atophyrax, effecting a relatively short unicuspid tooth row with cusps less widely separated; posterior end of interior cutting edge of anterior portion of internal basal shelf of m^1 and m^2 usually without cusplike lobe; pigmentation of anterior portion of internal basal shelf of m^1 and m^2 less extended posteriorly than in Atophyrax.

Remarks.—The water shrews of the *S. palustris* type form a rather compact group very different from the marsh shrews of the *S. bendirii* type in its extreme form and readily differentiated by the characters designated. In southern British Columbia, however, the two groups approximate each other in certain cranial characters and the cranial differences between them are more of degree than of absoluteness. The relationship of the two subgenera, Neosorex and Atophyrax, is further discussed under the subgenus Atophyrax (p. 192).

Neosorex at best is a poorly characterized subgenus, which differs from the subgenus Sorex solely in the accentuation of the fimbriation on the feet. It differs from the subgenus Atophyrax in this same character as well as cranially.

KEY TO THE SPECIES AND SUBSPECIES OF THE SUBGENUS NEOSOREX

a^1. Skull with highly developed sagittal and lambdoidal crests; condylobasal length less than 19.3 mm ..... *alaskanus* (p. 189).

a^2. Skull smooth, without developed sagittal and lambdoidal crests; condylobasal length 19.3 mm. or more.

b^1 Underparts in summer pelage pale, almost whitish (usually smoke gray)

c^1. Condylobasal length of skull 20.5 mm. or more; maxillary breadth of skull more than 6.1 mm ..... *palustris* (p. 178).

c^2. Condylobasal length of skull less than 20.5 mm.; maxillary breadth of skull 6.1 mm. or less.

d^1. Range east of the Great Plains (confined to Nova Scotia and southeastern Quebec) ..... *gloveralleni* (p. 183).

d^2. Range west of the Great Plains (Sierra Nevada, and Rocky and Cascade Mountains) ..... *navigator* (p. 184).

b^2. Underparts in summer pelage dark, almost blackish (usually fuscous).

c^1. Tail usually bicolor nearly to tip in any pelage; underparts in winter pelage pale, almost whitish (pale smoke gray) ..... *hydrobadistes* (p. 180).

c^2. Tail usually not bicolor in any pelage; underparts in winter pelage dark, never distinctly whitish (usually hair brown) ..... *albibarbis* (p. 181).

SOREX PALUSTRIS GROUP

The *palustris* group includes two species: *Sorex palustris* and *S. alaskanus*.

Geographic range.—That of the subgenus Neosorex.

Diagnostic characters.—Those of the subgenus Neosorex.

SOREX PALUSTRIS Richardson

[Synonymy under subspecies]

Geographic range.—That of the subgenus Neosorex except Point Gustavus, Glacier Bay, Alaska. (Fig. 21.)

Diagnostic characters.—The species *S. palustris* may be separated from *S. bendirii* by group characters. The smaller forms (*navigator* and *gloveralleni*) are essentially like *S. alaskanus* in size and color. The geographically nearer *navigator* differs from *S. alaskanus* in its longer and less angular skull, with relatively longer rostrum and longer mesopterygoid space, and without the highly developed sagittal and lambdoidal crests, and inframaxillary ridge of *S. alaskanus*.

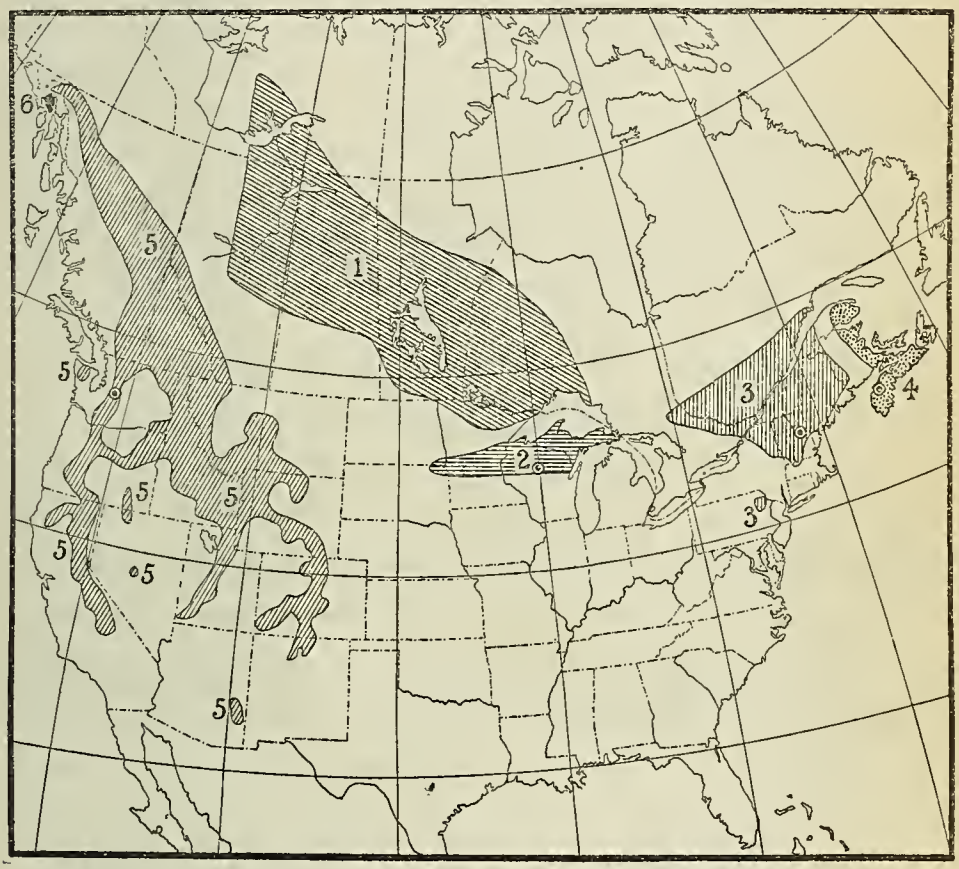

Fig. 21.—Geographic range of species and subspecies of the *Sorex palustris* group

1. *S. p. palustris.*
2. *S. p. hydrobadistes.*
3. *S. p. albibarbis.*
4. *S. p. gloveralleni.*
5. *S. p. navigator.*
6. *S. alaskanus.*

Subspecies and geographic variation.—Under the species *palustris* are included five subspecies: *palustris, hydrobadistes, albibarbis, gloveralleni,* and *navigator.*

Considering the wide geographic range of this species, it shows comparatively little geographic variation. The typical form *palustris* is the largest. The size of individuals decreases rather abruptly toward the west of the range of the subspecies *palustris* into *navigator,* which retains its characters with remarkable constancy over a very extensive range. Southeasterly from the range of *S. p. palustris* there is a gradual decrease in size and in intensity of color of underparts. The extreme accentuation of the dark underparts reaches maximum in specimens of *albibarbis* from eastern New York, Vermont, and New Hampshire, and decreases again northeasterly into the form *acadicus,* which also gives the minimum in size of the eastern forms of *S. palustris.*

Time of molting.—The change from winter to spring pelage seems to occur usually during May or early June, but unfortunately only a few specimens collected at that time of the year are available. An adult male of *S. p. palustris* collected June 8, 1895, at Tower, Minn., has complete summer pelage on the back, but the sides and underparts are in worn winter fur. Specimens of the subspecies *palustris* collected the last week of June in northeastern Manitoba appear to be in summer pelage. Four males of *S. p. navigator* from Sierra Nevada, Calif., are apparently in fresh summer pelage the last week of May, while a female collected at the same time and place is in fresh pelage except on the nose and face. A breeding female taken June 19, 1910, at 5,500 feet altitude in the Warner Mountains, Calif., is in full summer pelage on the back; the head and ventral parts of this animal are in worn winter pelage, but show the new hair growth under the old.

The fall molt is evident in a large number of specimens and seems to occur most frequently during the last half of August and early in September, but not infrequently may begin early in August. In the extreme southern part of the range (New Mexico and southern Sierra Nevada in California) the winter pelage may not appear till considerably later than it does in the north; still on the whole the variation in the time of the fall molt does not appear to be greatly influenced by geographical position. A female of *S. p. palustris* from northeastern Manitoba shows no indication of molting September 15, 1900, yet another female collected in the same region one day earlier seems to be in full winter fur. The latest date at which the writer has noted the incoming winter pelage is in a female collected October 14, 1911, at Big Pine Creek (8,000 feet altitude), Sierra Nevada, Calif.; superficially this animal appears to be in worn summer pelage, but examination shows the new pelage under the old over the entire back, head, sides, and abdomen.

SOREX PALUSTRIS PALUSTRIS Richardson

American Water-shrew

(Pls. 3, d′; 5, o; 6, s; 10, a)

Sorex palustris Richardson, Zool. Journ. 3, no. 12 (January to April, 1828), p. 517, April, 1828.

Amphisorex palustris Gray, Proc. Zool. Soc. London, pt. 5, 1837, p. 125, May, 1838.

Crossopus palustris Reichenbach, Praktische Naturgesch. Menchen und Saugth., p. 161, 1847.

G[alemys] (Cross[opus]) palustris Pomel, Arch. Sci. Phys. et Nat. 9:249, 1848.

Neosorex palustris Verrill, Proc. Boston Soc. Nat. Hist. 9:167, February, 1863.

Sorex (Neosorex) palustris Merriam, North Amer. Fauna No. 10, p. 91, December 31, 1895.

Neosorex palustrius (sic) Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 378 (fig. 72), 1901.

Neosorex palustris palustris G. M. Allen, Proc. Biol. Soc. Washington 28:17, February 12, 1915.

Sorex palustris palustris Jackson, Journ. Mamm. 7:57, February 15, 1926.

Type specimen.—No. 42.10.7.1, British Museum (Natural History), presented by Sir John Richardson. On the label is written "No. 15. Large Shrew Mouse. *Sorex palustris*—Drummond." Stuffed specimen, now dismounted, but not made down into a proper skin; skull imperfect, no brain case.[38]

Type locality.—Marshy places, from Hudson's Bay to the Rocky Mountains.

Geographic range.—Central Northwest Territories (lat. 64° N.), south to east-central Alberta, east and south across Manitoba to northeastern Minnesota and eastern Ontario (Fig. 21.)

Diagnostic characters.—Size largest of the species (total length usually about 160 mm.); color of underparts pale (much paler than in *S. p. albibarbis*, both

[38] For this information the writer is indebted to Oldfield Thomas, who also supplies the following measurements: "Hind foot, c. u. 19 (not quite trustworthy); upper tooth series, 9.8; breadth of palate across molars, 5.6."

in summer and winter pelage; in winter pelage about as in corresponding pelage of *S. p. hydrobadistes*, but much paler in summer), sharply defined from upper parts in all pelages; upper parts in winter about as in *hydrobadistes*, paler and more brownish than corresponding pelage of *albibarbis;* upper parts in summer pelage paler and more brownish than in either *albibarbis* or *hydrobadistes;* tail distinctly bicolor; skull large with relatively heavy rostrum and maxillary region; dentition heavy, particularly second upper premolar, which in this form is largest of the species; posterior border of molariform teeth deeply emarginate; unicuspids relatively large and broad.

Color.—Winter pelage: Upper parts usually fuscous-black to dark fuscous-black or chaetura drab, sometimes tending toward chaetura black or blackish mouse gray, usually with a scarcely perceptible sprinkling of whitish hair bands, and with greenish and purplish iridescence; underparts usually pale smoke gray or between pale smoke gray and smoke gray, sometimes pale olive-gray, more or less glossy or silvery, occasionally stained with Isabella color; color of underparts extending onto upper lip and underparts of limbs; flanks slightly paler than back, more mixed with grayish hairs of underparts; tail bicolor, fuscous-black above, whitish below nearly to tip. *Summer pelage:* Upper parts slightly paler and more brownish than in winter, fuscous-black or chaetura-drab; underparts darker than in winter, smoke gray, pale hair brown or mouse gray; chin and lips about same color as underparts or slightly paler; tail as in winter.

Skull.—Size large, brain case broad, rostrum and maxillary region relatively heavy; dentition heavy, particularly second upper premolar, which in this form reaches maximum size for the species; posterior border of molariform teeth deeply emarginate; unicuspids relatively large and broad; inner sides of cusps of molariform teeth and cusps of unicuspids and first incisors deeply pigmented with mahogany red.

Measurements.—Average of three adult females from Robinson Portage, Manitoba: Total length, 160 (160–160); tail vertebrae, 72 (72–73); hind foot, 20 (19–20). *Skull:* Average of three skulls of adult females (teeth slightly worn) from Robinson Portage, Manitoba: Condylobasal length, 21.0 (20.7–21.5); palatal length, 8.9 (8.8–9.1); cranial breadth, 10.4 (10.2–10.6); interorbital breadth, 4.3 (4.2–4.4); maxillary breadth, 6.2 (6.2–6.2); maxillary tooth row, 7.7 (7.5–7.9).

Remarks.—Although *S. palustris* has been placed in various genera by different workers, it is one of the few of the early described shrews that has not received several synonymous specific names. The subspecies *palustris* has a comparatively wide range throughout central Canada, and intergrades with *S. p. hydrobadistes* in northern Minnesota. A skin of *S. p. palustris* in early summer pelage, without skull, from Tower, Minn., indicates a tendency toward *hydrobadistes*, and an alcoholic specimen from Itasca County in the same State, the color of which can not be definitely ascertained, shows in cranial characters a decided approach toward *hydrobadistes.*

A skull unaccompanied by a skin, from Michipicoten Island, in Lake Superior, Ontario, is provisionally referred to *S. p. palustris.* It is somewhat smaller than skulls of typical *S. p. palustris*, showing in this respect an approach toward *S. p. albibarbis;* but in general shape of the skull and size of the teeth it is like that of *S. p. palustris*, and shows no tendency toward the relatively broad and flat skull of *hydrobadistes.*

Specimens examined.—Total number, 21, as follows:

Alberta: Athabaska Landing (35 miles south), 1; Ranfurly, 1[39]; South Edmonton, 1.

Manitoba: Aweme, 1[40]; Echimamish River, 1; Fort Garry, 1; Hill River (near Swampy Lake), 1; Nelson River, 1; Norway House, 1; Robinson Portage, 5; Winnipeg, 2.

Minnesota: Itasca County (T. 61 N., R. 26 W.), 1; Tower, 1.

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[39] Mus. Comp. Zool. [40] Stuart Criddle coll., Treesbank, Manitoba.

Northwest Territories: Fort Rae, Great Slave Lake, 1; Grandin River, 1. Ontario: Michipicoten Island, 1.

SOREX PALUSTRIS HYDROBADISTES Jackson

Wisconsin Water-shrew

(Pls. 4, a; 11, m)

Sorex palustris hydrobadistes Jackson, Journ. Mamm. 7:57, February 15, 1926.

Type specimen.—No. 229061, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth much worn), skin and skull; collected July 23, 1918, by Hartley H. T. Jackson.

Type locality.—Withee, Clark County, Wis.

Geographic range.—Extreme northeastern South Dakota (Fort Sisseton), central Minnesota, easterly across northern Wisconsin and the upper peninsula of Michigan. (Fig. 21.)

Diagnostic characters.—Size averaging very slightly smaller than *Sorex p. palustris;* color in winter pelage, particularly of underparts, pale, about as in *S. p. palustris;* color in summer pelage, particularly of underparts, dark, about as in *S. p. albibarbis;* skull slightly smaller than that of *S. p. palustris*, flatter, with relatively and actually shorter rostrum; skull larger and heavier than that of *albibarbis;* second upper premolar intermediate in size between that of *S. p. palustris* and *albibarbis;* emargination of posterior borders of molariform teeth about intermediate between that in *S. p. palustris* and *albibarbis.*

Color.—Winter pelage: Similar to winter pelage of *S. p. palustris.* Upper parts usually chaetura drab or fuscous-black, sometimes tending toward chaetura black or blackish mouse gray, usually with a scarcely perceptible sprinkling of whitish hair bands, and sometimes with greenish and purplish iridescence; underparts usually pale smoke gray or between pale smoke gray and smoke gray, sometimes pale olive-gray, more or less glossy or silvery, occasionally stained with Isabella color; color of underparts extending onto upper lip and underparts of limbs; flanks slightly paler than back, more mixed with grayish hairs of underparts; tail bicolor, fuscous-black above, whitish below nearly to tip. *Summer pelage:* Similar to summer pelage of *S. p. albibarbis.* Upper parts slightly more brownish and less glossy than in winter, usually fuscous-black, dark fuscous-black, or chaetura drab; underparts much darker than in winter, scarcely paler than upper parts, fuscous, hair brown, or chaetura drab; chin and lips very slightly paler, more whitish than general color of underparts; tail as in winter.

Skull.—Slightly smaller than that of *S. p. palustris*, flatter, with relatively and actually shorter rostrum, and relatively broader brain case; larger and heavier than that of *S. p. albibarbis*, with relatively wider rostrum; second upper premolar intermediate in size between that of *S. p. palustris* and *albibarbis*, averaging nearer to that of *S. p. palustris;* posterior borders of molariform teeth less deeply emarginate than in *S. p. palustris*, more deeply emarginate than in *albibarbis.*

Measurements.—Type specimen (adult male): Total length, 150; tail vertebrae, 63; hind foot, 20. *Skull:* Skull of type specimen (adult male; teeth much worn): Condylobasal length, 20.5; palatal length, 8.2; cranial breadth, 10.2; interorbital breadth, 4.3; maxillary breadth, 6.1; maxillary tooth row, 7.4. Average of six skulls of adult males (teeth slightly to moderately worn) from Elk River, Minn.: Condylobasal length, 20.6 (20.2–21.0); palatal length, 8.6 (8.0–9.0); cranial breadth, 10.4 (10.0–10.9); interorbital breadth, 4.4 (4.3–4.6); maxillary breadth, 6.4 (6.2–6.5); maxillary tooth row, 7.6 (7.4–7.8).

Remarks.—Although geographically and in most of its cranial characters *S. p. hydrobadistes* is intermediate between *S. p. palustris* and *S. p. albibarbis*, and superficially resembles *S. p. palustris* in color in winter and *albibarbis* in summer, it is strikingly different in color from the subspecies *palustris* in summer and from *albibarbis* in winter. It intergrades with *S. p. palustris* in northern Minne-

sota, and probably also with *albibarbis* in the Great Lakes region of southwestern Ontario, though material examined from that region has been insufficient to establish this point. Specimens from the Upper Peninsula of Michigan are referable to *hydrobadistes*. One collected August 17, 1914, in Chippewa County, Mich., matches typical specimens of *hydrobadistes* both in cranial characters and color except that it is heavily stained with Prout's brown on the throat.

Specimens examined.—Total number, 35, as follows:

Michigan: Chippewa County, 1[41]; Merriweather, Gogebic Lake, 3[41]; Michigamme, 2.
Minnesota: Elk River, 6.
South Dakota: Fort Sisseton, 3; Fort Wadsworth, 1.
Wisconsin: Basswood Lake (10 miles southeast, Iron River), 1; Danbury, 2; Lac Vieux Desert, 3[42]; Lake St. Germain, Vilas County, 1; Marinette County, 1[43]; Mercer, 1; Rhinelander, 4[44]; Sayner, 1[42]; Solon Springs, 4[42]; Withee (type locality), 1.

SOREX PALUSTRIS ALBIBARBIS (Cope)

White-lipped Water-shrew

(Pls. 1; 4, b; 10, b)

Neosorex albibarbis Cope, Proc. Acad. Nat. Sci. Philadelphia, 1862, p. 188, 1862.
Sorex albibarbis Merriam, Proc. Biol. Soc. Washington 7: 25, April, 1892.
Sorex (Neosorex) albibarbis Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1894, part 3, October–December, p. 395, January, 1895.
Sorex palustris albibarbis Rhoads, Mammals of Pennsylvania and New Jersey, p. 191, 1903.
Neosorex palustris albibarbis G. M. Allen, Proc. Biol. Soc. Washington 28: 17, February 12, 1915.

Type specimen.—No. $\frac{1\,1\,2\,3\,9}{3\,8\,7\,4\,3}$, U. S. Nat. Mus., ♀ adult (teeth slightly worn), alcoholic with skull removed; collected in September, 1859, by E. D. Cope.

Type locality.—Profile Lake, Franconia Mountains, Grafton County, N. H.

Geographic range.—Southern Quebec, western New Brunswick, western Ontario, Vermont, eastern New York, south to northeastern Pennsylvania. (Fig. 21.)

Diagnostic characters.—Slightly smaller than *Sorex p. palustris* (total length usually less than 150 mm.); underparts very dark, scarcely defined from upper parts (particularly in summer pelage), much darker than in *S. p. hydrobadistes* in winter pelage; tail usually not bicolor, or indistinctly so; skull smaller than that of *S. p. palustris*, slightly smaller than that of *hydrobadistes;* second upper premolar smaller than in *S. p. palustris* or *hydrobadistes*, slightly larger than in *S. p. gloveralleni* or *S. p. navigator;* posterior borders of molariform teeth less deeply emarginate than in *S. p. palustris* or *hydrobadistes*, and unicuspids relatively narrower.

Color.—Winter pelage: Upper parts dark fuscous-black, chaetura black, or blackish mouse gray to nearly black, frequently with pronounced greenish or purplish iridescence; underparts paler than upper parts, more mixed with whitish, the general tone in typical specimens being mouse gray or hair brown, not infrequently almost fuscous-black or chaetura drab; chin and lips usually paler (more whitish) than general color of underparts; tail usually monochromatic (near fuscous-black), frequently indistinctly bicolor, rarely distinctly bicolor (whitish beneath) nearly to tip. *Summer pelage:* Upper parts

[41] Univ. Mich.
[42] Field Mus. Nat. Hist.
[43] Public Mus. Milwaukee.
[44] E. R. Warren coll., Colorado Springs, Colo., 1; Univ. Wis. Zool. Mus., 3.

averaging slightly paler and more brownish than in winter, fuscous, fuscous-black, or chaetura drab, with less tendency toward iridescence; underparts darker than in winter, with less suffusion of whitish, scarcely paler than upper parts, occasionally as dark as upper parts, fuscous, hair brown, or chaetura drab; chin and lips paler, more whitish, than general color of underparts; tail as in winter.

Skull.—Slightly smaller than that of *S. p. hydrobadistes*, with somewhat weaker dentition; second upper premolar relatively and actually much smaller than in *S. p. palustris*, slightly smaller than in *hydrobadistes*, slightly larger than in *S. p. gloveralleni* or *S. p. navigator;* posterior borders of molariform teeth much less deeply emarginate than in *S. p. palustris*, slightly less than in *hydrobadistes;* unicuspids relatively narrower and dental pigmentation usually less than in *S. p. palustris*.

Measurements.—Type specimen (adult female, measured from alcoholic by the writer): Total length, 144; tail vertebrae, 68; hind foot, 19. Adult male and old adult male from East Wallingford, Vt.: Total length, 145, 151; tail vertebrae, 63, 68; hind foot, 19, 18. *Skull:* Type specimen (adult female, teeth slightly worn): Condylobasal length, 20.0; palatal length, 8.3; cranial breadth, 10.1; interorbital breadth, 4.3; maxillary breadth, 6.1; maxillary tooth row, 7.3. Skulls of adult male (teeth slightly worn) and old adult male (teeth moderately worn) from East Wallingford, Vt.: Condylobasal length, 20.2, 19.9; palatal length, 8.4, 8.0; cranial breadth, 9.9, 10.4; interorbital breadth, 4.1, 4.5; maxillary breadth, 6.0, 6.4; maxillary tooth row, 7.2, 7.4.

Remarks.—The type specimen of *S. p. albibarbis* was caught under a stone on the shore of Profile Lake, N. H. (Cope, 1862, p. 188.) Specimens from Vermont and southern Maine are typical; those from the Adirondack Mountains, N. Y., appear to have more blackish tails than those from the type region, but do not differ in other respects. One from Bushkill Creek, Monroe County, Pa., collected September 28, 1894, in fresh winter pelage except on the throat, is inseparable in color from *albibarbis*, but, unfortunately, the skull seems to have been lost. Two skins collected late in July, 1902, on Mount Katahdin, Me., are like *albibarbis* in color; one of them is much smaller than typical *albibarbis* and is accompanied by a skull that is correspondingly smaller and weaker than typical skulls of that subspecies; it is probably abnormal, however, because the other skin, which is without a skull, has measurements in keeping with true *albibarbis*. The most southerly New England record is Warwick, Mass., from which place Verrill (1863a, p. 165) records a specimen taken in July, 1862.

Intergradation with *S. p. gloveralleni* is indicated in specimens from eastern Quebec (Godbout and St. Rose), which have weaker dentition than typical *S. p. albibarbis*. As far as the reviser is able to judge from the three specimens from Godbout, which are alcoholics, the ventral parts are somewhat paler than in typical *albibarbis*, in this respect approaching *gloveralleni*. The St. Rose specimen, however, is identical in color with *albibarbis*. A specimen from Lake Edward, Quebec, the skull of which is too imperfect for critical study, is in fresh winter pelage, except on the upper chest and throat; the summer pelage of the chest and throat and of the ventral portion of the tail is dark, as in specimens of *albibarbis* from the type region; the fresh winter pelage of the underparts, however, is almost as pale as that of *S. p. palustris*. A skin in summer pelage, without skull, from North Bay, Ontario, matches *albibarbis* in color and is provisionally referred to that form.

Specimens examined.—Total number, 35, as follows:

Maine: Basin Pond, Mount Katahdin, 1; Brunswick, 8[45]; Chimney Pond (altitude 3,000 feet), Mount Katahdin, 1; Norway, 1; Upton, 1.[45]
New Hampshire: Intervale, 1[46]; Profile Lake (type locality), 1.
New York: Tupper Lake, 3.[47]
Ontario: North Bay, 1.[48]
Pennsylvania: Bushkill Creek (7 miles east of Cresco), Monroe County, 1.[49]
Quebec: Godbout, 3; Lac aux Sables, 2[49]; Lake Edward, 1[48]; St. Rose, Temiscouata District, 1.
Vermont: East Wallingford, 4[50]; Mendon, 2[51]; Sherburne, 2[51]; West Bridgewater, 1.[51]

SOREX PALUSTRIS GLOVERALLENI Jackson

Nova Scotian Water-shrew

(Pls. 4, c; 6, t)

Neosorex palustris acadicus G. M. Allen, Proc. Biol. Soc. Washington 28: 15, February 12, 1915. Not *Sorex acadicus* Gilpin, qui *Sorex cinereus* Kerr.
Sorex palustris gloveralleni Jackson, Journ. Mamm. 7: 57, February 15, 1926.

Type specimen.—No. 2046, Mus. Comp. Zool., Harvard Univ., Bangs collection; ♀ adult (teeth slightly worn), skin and skull; collected July 26, 1894, by Outram Bangs.

Type locality.—Digby, Digby County, Nova Scotia.

Geographic range.—Nova Scotia and extreme eastern Quebec (Gaspé Peninsula) south of the St. Lawrence River. (Fig. 21.)

Diagnostic characters.—Size about that of *Sorex p. albibarbis* or slightly smaller; underparts (summer pelage) pale, about as in *S. p. palustris;* upper parts usually slightly paler and more grizzled and finely speckled with whitish hairbands than in *S. p. palustris* or *albibarbis;* in general color much like many specimens of *S. p. navigator;* tail bicolor; skull distinctly smaller than that of *S. p. palustris* or *S. p. hydrobadistes*, slightly smaller, weaker, and less massive than that of *albibarbis;* second upper premolar much smaller than in the subspecies *palustris* or *hydrobadistes*, slightly smaller than in *albibarbis;* posterior borders of molariform teeth about as emarginate as in *albibarbis*, unicuspids slightly smaller.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts chaetura drab or slightly paler, somewhat suffused with whitish hairtips and hairbands; underparts much paler than upper parts, usually pale smoke gray or smoke gray, rarely hair brown; chin and lips more whitish than general tone of underparts; tail bicolor, fuscous-black above, whitish below nearly to tip.

Skull.—Small, much smaller than that of *S. p. palustris* or *S. p. hydrobadistes;* slightly smaller than that of *S. p. albibarbis*, weaker and less massive; about equal in size to that of *S. p. navigator* but higher through brain case and wider interorbitally; dentition relatively weak; second upper premolar much smaller than in *S. p. palustris* or *hydrobadistes*, slightly smaller than in *albibarbis;* posterior borders of molariform teeth less deeply emarginate than in the subspecies *palustris* or *hydrobadistes*, about as in *albibarbis;* unicuspids slightly smaller than in *albibarbis* with similar pigmentation.

Measurements.—Type specimen (adult female) and topotype (old adult female): Total length, 150.5, 158; tail vertebrae, 66.5, 70; hind foot, 20, 19. *Skull:* Skull of type specimen (adult female, teeth slightly worn) and topotype (old adult female, teeth much worn): Condylobasal length, 19.8, 19.5; palatal length, 8.2, 8.0; cranial breadth, 10.0, 10.1; interorbital breadth, 4.3, 4.4; maxillary breadth, 5.5, 5.6; maxillary tooth row, 7.1, 7.1.

Remarks.—Specimens that can be satisfactorily referred to *S. p. gloveralleni* have been examined only from Nova Scotia and the Gaspé Peninsula region of extreme southeastern Quebec, though

[45] Lee Mus. Biol., Bowdoin College.
[46] Univ. Mich.
[47] Univ. Mich., 1; Mus. Comp. Zool., 2.
[48] Mus. Comp. Zool.
[49] Acad. Nat. Sci. Philadelphia.
[50] D. E. Kent coll., Rutland, Vt., 1; G. L. Kirk coll., Rutland, Vt., 3.
[51] G. L. Kirk coll.

certain individuals of *S. p. albibarbis* from eastern Quebec approach *gloveralleni* in dental characters and possibly in color. Superficially *gloveralleni* is often similar to *S. p. navigator*, but the skull is higher through the brain case and wider interorbitally. It is, however, widely separated geographically from *navigator*, two other divergent forms intervening between the two subspecies.

Specimens examined.—Total number, 14, as follows:

Nova Scotia: Aylesford, 1; Digby (type locality), 5[52]; Halifax, 4[53]; James River, 1.
Quebec: Mount Albert, 3.[54]

SOREX PALUSTRIS NAVIGATOR (Baird)

Mountain Water-shrew

(Pls. 4, d, e, f, g, h; 10, c, d; 13, c, d)

Neosorex navigator Baird, Report Pacific R. R. Survey 8: pt. 1, Mammals, p. 11, 1857.
Sorex navigator Verrill, Proc. Boston Soc. Nat. Hist. 9: 167, February, 1863. (In synonymy.)
Sorex (*Neosorex*) *palustris navigator* Merriam, North Amer. Fauna No. 10, p. 92, December 31, 1895.
[*Neosorex*] [*palustris*] *navigator* Elliot, Field Columb. Mus., Publ. 45 (zool. series 2): 379, March, 1901.
Sorex palustris navigator Stephens, California Mammals, p. 254, June, 1906.
Neosorex navigator navigator Miller, U. S. Nat. Mus. Bul. 79, p. 21, December 31, 1912.

Type specimen.—No. $\frac{629}{1780}$, U. S. Nat. Mus.; sex unknown, adult (teeth slightly worn); imperfect skin (from alcoholic) and skull, with posterior part of brain case broken away; collected about August 31, 1853, by J. G. Cooper.

Type locality.—Near head of Yakima River, Cascade Mountains, Wash.

Geographic range.—Extreme northwestern British Columbia and adjacent part of Alaska (Haines), south through eastern British Columbia and southwestern Alberta to the Olympic Mountains, Wash., and through the Cascade Mountains, and in the Sierra Nevada to Mount Whitney (about lat. 36° N.), Calif., south through Washington, Idaho, and eastern Oregon to central Nevada and southern Utah, and in the Rocky Mountains to northern New Mexico and west-central Arizona.

Diagnostic characters.—Average specimens very similar in superficial appearance to *Sorex p. gloveralleni*. Smaller than *S. p. palustris;* about equal in size to *gloveralleni*, but with tail averaging longer; color much as in *S. p. palustris*, but upper parts more grizzled and flecked with whitish-tipped hairs; skull much smaller and flatter than that of *S. p. palustris*, with much weaker dentition; skull about the size of that of *gloveralleni*, but flatter through brain case, usually narrower interorbitally, with rostrum relatively slightly longer and posterior border of molariform teeth more deeply emarginate.

Color.—Winter pelage: Upper parts chaetura drab or slightly darker, dark mouse gray or blackish mouse gray with a brownish tinge, a sprinkling of whitish hair tips and hair bands producing a pronounced grizzled effect and sometimes frosted appearance, usually with a delicate greenish or purplish iridescence; underparts usually pale smoke gray or between pale smoke gray and smoke gray, sometimes whitish pale olive-gray, more or less glossy and silvery,

[52] Mus. Comp. Zool., 4.
[53] Mus. Comp. Zool., 3; E. R. Warren coll., Colorado Springs, Colo., 1.
[54] Amer. Mus. Nat. Hist.

frequently tinged with pale olive-buff; color of underparts extending onto lips and chin; tail bicolor, fuscous-black or chaetura black above, whitish beneath nearly to tip. *Summer pelage:* Upper parts usually more brownish than in winter, chaetura-drab or slightly paler, sometimes almost fuscous-black or chaetura black, somewhat suffused and finely flecked with whitish hair tips and hair bands; underparts variable, depending much upon wear of the pelage, usually pale smoke gray, smoke gray, or light grayish olive, sometimes almost drab to hair brown, or mouse gray; chin and lips more whitish than general tone of underparts; tail as in winter.

Skull.—Much smaller and flatter than that of *S. p. palustris*, with much weaker dentition; about the size of that of *S. p. gloveralleni*, but flatter and usually narrower interorbitally, and posterior border of molariform teeth more emarginate.

Measurements.—Adult male from Mount Rainier, Wash.: Total length, 152; tail vertebrae, 78; hind foot, 19. Average of 4 adult males from Pahaska, Wyo.: Total length, 149 (145–151); tail vertebrae, 74 (72–76); hind foot, 20.3 (20–21). *Skull:* Type (adult, sex unknown, teeth slightly worn): Condylobasal length, 19.8; palatal length, 8.3; cranial breadth, 9.8; interorbital breadth, 4.1; maxillary breadth, 5.4[55]; maxillary tooth row, 7.3. Skull of adult male (teeth slightly worn) from Mount St. Helens, Wash.: Condylobasal length, 19.9; palatal length, 8.1; cranial breadth, 9.9; interorbital breadth, 4.1; maxillary breadth, 5.9; maxillary tooth row, 7.1. Skull of adult male (teeth slightly worn) from Paradise Creek, Mount Rainier, Wash.: Condylobasal length, 19.6; palatal length, 8.3; cranial breadth, 9.8; interorbital breadth, 4.1; maxillary breadth, 5.8; maxillary tooth row, 7.2. Average of 4 skulls of adult males (teeth slightly worn) from Pahaska, Wyo.: Condylobasal length, 19.7 (19.4–20.0); palatal length, 8.1 (7.9–8.3); cranial breadth, 9.6 (9.5–9.6); interorbital breadth, 4.1 (4.1–4.1); maxillary breadth, 5.7 (5.6–5.8); maxillary tooth row, 7.2 (7.1–7.3). Skull of adult female (teeth moderately worn) from Bennett, British Columbia: Condylobasal length, 20.2; palatal length, 8.3; cranial breadth, 10.1; interorbital breadth, 4.2; maxillary breadth, 5.9; maxillary tooth row, 7.4. Average of 6 skulls of adult males (teeth slightly worn) from Mount Whitney, Calif.: Condylobasal length, 19.8 (19.4–20.0); palatal length, 8.2 (8.0–8.4); cranial breadth, 9.8 (9.6–9.9); interorbital breadth, 4.1 (4.0–4.2); maxillary breadth, 5.8 (5.6–6.0); maxillary tooth row, 7.1 (6.9–7.2). Average of 4 skulls of old adult males (teeth much worn) from Mount Whitney, Calif.: Condylobasal length, 19.8 (19.3–20.4); palatal length, 7.8 (7.4–8.0); cranial breadth, 10.2 (10.0–10.4); interorbital breadth, 4.2 (4.1–4.2); maxillary breadth, 5.9 (5.8–6.0); maxillary tooth row, 7.2 (7.0–7.3).

Remarks.—The type specimen of *Neosorex navigator* Baird is an imperfect skin made from an alcoholic. The skull, however, except that a portion of the right posterior part of the brain case is broken away, is in fairly good condition. The specimen was collected by J. G. Cooper, the locality on the front of the label being given as Fort Vancouver, Columbia River, Wash.; on the back of the label is written, apparently in Baird's handwriting: "According to Dr. Cooper, found in lake near summit of Cascade Mts., Aug. 31, '53," a remark evidently taken from Cooper, who states that "this [specimen], according to the label now attached, was found at Fort Vancouver, but I am inclined to consider this a mistake, and that it was really taken while swimming under water in a lake near the summit of the Cascade Mountains, August 31, 1853" (Cooper, 1860b, p. 73). Merriam at the time of his revision of the genus Sorex (Merriam, 1895) had seen none of this form from the Cascade Mountains, and remarks in a footnote:

It is evident that the type specimen, like many other alcoholic mammals collected in the early days, was not labeled until long after its capture, and that little dependence can be placed on either of the alleged localities. Furthermore, since the subgenus Neosorex is unknown from the Cascade region, and prob-

[55] Post maxillary processes broken; actual maxillary breadth was probably about 5.7.

ably does not inhabit western Oregon or Washington, which region is occupied by the allied subgenus Atophyrax, it is highly improbable that the specimen came from either of the alleged localities. It agrees closely with specimens from western Montana, and probably came from some point in northern Idaho or the mountains east of Fort Colville, in extreme northeastern Washington, which region was visited by Dr. Cooper during the same expedition (Merriam, 1895, p. 92).

Since the time Merriam wrote as above, however, several specimens of this shrew have been collected in the Cascade Mountains and even in the Olympic Mountains. In view of the aforementioned statement quoted from Doctor Cooper, supported by his additional statement that "aquatic mammalia * * * abound in the fresh waters; and one seems to be peculiar to the Territory, the water shrew (*Neosorex navigator*) caught while swimming a foot below the surface of one of the lakes at the head of the Yakima River, and at least 2,500 feet above the ocean" (Cooper, 1860a, p. 36), it seems necessary to fix the type locality as near the head of the Yakima River, Cascade Mountains, Wash. This lake may not be one of the so-called "Sneeze" lakes, which include Lakes Keechelus, Kachess, and Clealum, but more probably it is one of the smaller lakes farther up the valley. Stevens remarks:

> The pass at the head of the main Yakima, some 20 miles north of the Nachess Pass, is but 3,466 feet above Vancouver. On the lowest point of the summit is a shallow lake, about 200 yards long, from which the water runs both ways * * * Toward the east the descent in the distance of about three-quarters of a mile is 530 feet, to another lake, about half a mile long. (Stevens, 1855, p. 141.)

It is probable that one of these two small lakes is the actual type locality. The next lake farther down would be the upper of the "Sneeze" lakes, Lake Keechelus.

Although subject to minor individual variations, which in some cases appear to be in a measure geographical, this subspecies retains its characters with comparative uniformity throughout its extensive range. These variations are most noticeable in size and in the depth of emargination of the posterior borders of the molariform teeth, but the differences are too inconstant and their averages too slight for subspecific separation. Thus, in a series from near South Yolla Bolly Mountain, Calif., are specimens that are indistinguishable from typical *S. p. navigator*, while a few others have skulls a little larger than typical specimens and have wider crania. The indentation of the posterior margins of the molariform teeth seems to average less in the series from Toyabe Mountains, Nev., than in typical specimens, but the difference is slight and can be matched by occasional specimens from points throughout the range of *navigator;* in no other respects do the Toyabe Mountain specimens differ from typical *navigator*. A specimen in full summer pelage collected July 10, 1915, at Horseshoe Cienega, 8,300 feet altitude, near the headwaters of White River, White Mountains, Ariz., has a skull inseparable from those of *navigator* from the Cascade or more northern Rocky Mountains; in color, however, it is distinctly different from any other specimens of *navigator* examined, being very dark ventrally, the tail scarcely if at all bicolored, even at the base, but tipped with a small white pencil. In fact, the White Mountains, Ariz., specimen in color resembles more nearly the summer pelage of *S. p. albibarbis* or *S. p. hydrobadistes*,

or even *S. b. bendirii*, than it does typical *navigator*. Unfortunately there are no other specimens available from the White Mountains, Ariz., but one from a few miles south collected at 9,000 feet altitude on Prieto Plateau at the south end of the Blue Range, Ariz., does not differ from *navigator* when in corresponding worn pelage.

The three specimens from Poison Creek, altitude 9,500 feet, in the White Mountains, Calif., seem to average larger and paler than typical *navigator*. The paleness, however, may in a measure be due to the way the specimens are made up, since the fur appears to have been saturated with arsenic. Moreover, many other specimens from the White Mountains, Calif., do not differ to any degree from typical *navigator*.

The series from Highwood Mountains, Mont., while clearly referable to *navigator*, shows an approach toward *S. p. palustris* in the skulls, which are somewhat larger and heavier than in average *navigator*. Specimens from Banff and Henry House, Alberta, are distinctly *navigator*, as are also those from Bennett and Telegraph Creek, British Columbia, and Haines, Alaska, the ones from British Columbia and Alaska showing no approach toward the essential characters of *S. alaskanus*.

Specimens examined.—Total number, 614, as follows:

Alaska: Haines, Lynn Canal, 1.

Alberta: Banff, 2; Brazeau Valley, 1; Henry House, 1; Smoky Valley (50 miles north of Jasper House), 1.

Arizona: Prieto Plateau (south end of Blue Range, altitude 9,000 feet), Greenlee County, 1; White River (Horseshoe Cienega, altitude 8,300 feet), White Mountains, 1.

British Columbia: Bennett, 1; Cariboo (Cottonwood Creek), 1; Chilliwack Valley, 2 [56]; Cranbrook, 3 [57]; Faulder, 2 [58]; Hope (14 miles east, Lake House), 1 [59]; Hot Springs, Atlin, 1 [57]; Nelson (6 miles south of), 3; Seton Creek, Lillooet, 4 [57]; Telegraph Creek, 3 [60]; Telegraph Creek (25 miles east), 1.

California: Aspen Valley, Yosemite National Park (altitude 6,400 feet), 2 [61]; Big Pine Creek (10 miles west Big Pine, altitude 8,000 feet), 2 [62]; Blue Canyon (altitude 4,700 to 5,000 feet), Placer County, 3 [62]; Canyon Creek, Trinity County, 1; Chinquapin (altitude 6,200 feet), Yosemite National Park, Mariposa County, 2 [62]; Cottonwood Lakes (altitude 11,000 feet), Sierra Nevada, 1 [62]; Donner (altitude 7,900 feet), 2; Hat Creek (head), Mount Lassen, 1; Independence Creek (altitude 6,000 feet), Sierra Nevada, 2; Independence Lake, 1 [62]; Kearsarge Pass, Sierra Nevada, 4; Laws (7 miles east, Silver Canyon, altitude 4,600 to 7,000 feet), White Mountains, 9 [62]; Little Onion Valley, Sierra Nevada, 5 [62]; Lone Pine, 5; Lone Pine Creek (altitude 4,500 feet), Inyo County, 2 [62]; Mammoth, 6 [63]; Merced Grove, Big Trees (altitude 5,400 feet), Mariposa County, 6 [62]; Mill Creek (altitude 5,000 feet), Mount Lassen, 2; Mount Lassen (south base), 7; Mount Lassen (southeast side), 1; Mount Lyell (Timberline meadow, north side), 1; Mount Shasta (altitude 7,000 feet), 1 [62]; Mount Shasta (south side, timberline), 1; Mount Unicorn (altitude 8,600 feet, Tuolumne Meadows), 1 [62]; Mount Unicorn (Tuolumne Meadows), Yosemite Park, 1; Mount Whitney, 9; Parker Creek, Warner Mountains, 1 [62]; Porcupine Flat (altitude 8,100 feet), Yosemite Park, 2 [62]; Sequoia National Park (Halsted Meadows), 3; South Yolla Bolly Mountain (one-half mile south, altitude 6,000 feet), Trinity County, 3 [62]; South Yolla Bolly Mountain (2 miles south, altitude 7,500 feet), Tehama

[56] Nat. Mus. Canada.
[57] Provincial Mus. British Columbia.
[58] Stuart Criddle coll., Treesbank, Manitoba.
[59] Mus. Comp. Zool.
[60] Amer. Mus. Nat. Hist., 2.
[61] Mus. Vert. Zool., 1.
[62] Mus. Vert. Zool.
[63] D. R. Dickey coll., Pasadena, Calif., 5; G. G. Cantwell coll., Palms, Calif., 1.

County, 10[62]; Upper Ash Creek, Mount Shasta, 1; Vogelsang Lake (altitude 10,100 to 10,350 feet), Yosemite National Park, 7[62]; Wagon Camp, Mount Shasta, 1; Walker Lake, Mono County, 2[62]; Walker Lake (Warren Fork of Leevining Creek, altitude 9,200 feet), Mono County, 5[62]; White Mountains (McAfee Meadows, altitude 11,600 feet), Mono County, 2[62]; White Mountains (Poison Creek, altitude 9,500 feet), Mono County, 3[64]; White Mountains (Roberts Ranch, Weyman Creek, altitude 8,250 feet), Inyo County, 1[62]; Whitney Creek (altitude 10,650 feet), Sierra Nevada, 5[62]; Whitney Meadows, Mount Whitney, 19[65]; Williams Butte (1 mile south Walker Lake), Mono County, 1[62]; Yosemite National Park (altitude 7,300 feet), Mariposa County, 3.[62]

Colorado: Almont, 2; Blackhawk (Dory Hill Pond), 3[66]; Boulder, 6[67]; Boulder County, 1; Cochetopa Pass, 1; Coventry (Maverick Canyon, altitude 6,400 to 6,800 feet), 4[68]; Crested Butte (Deckers Ranch), 1[69]; Culebia Canyon (altitude 9,100 feet), Costilla County, 1[69]; Elkhorn, 1; Gold Hill, 3; Hermit, 3; Lake Moraine, El Paso County, 11[70]; Marvine, 1; Midde Park, 2; Nederland, 4[71]; Rico, 1; Saguache Park, Cochetopa National Forest, 2; St. Elmo (altitude 10,100 feet), 4.

Idaho: Albion, 2; Birch Creek, 6; Bitterroot Mountains, 1; Cedar Mountains, 2[72]; Crow Creek (head of, altitude 7,500 feet), 1; Fort Hall, 1; Irwin (10 miles southeast), 1; Malad, 13; Salmon River Mountains, 5; Sawtooth City, 1; Sawtooth Lake, 3; Thompson Pass, 1; Warren, 1; Wood River (head of), 1.

Montana: Bear Tooth Mountains, 1; Big Hole Basin, Beaverhead County, 2[73]; Big Timber, 1; Crazy Mountains, 2; Emigrant Gulch (3 miles southeast Chico), 6; Flathead Lake, 5; Florence, 2; Highwood Mountains, 6; Moccasin Mountains (5 miles northwest of Hilger), 1; Paola, 1; Pryor Mountains, 7; Red Lodge, 3; St. Marys Lake, 1; Sheep Creek (16 miles north White Sulphur Springs), Little Belt Mountains, 1; Stanford (20 miles southwest, Dry Wolf Creek), Little Belt Mountains, 8; Thompson Pass, 1; Tyler (10 miles west North Fork at Willow Creek), 1; Upper Stillwater Lake, 1; Ward Peak (altitude 6,000 feet, Washington Creek), Madison National Forest, 2; west fork of West Gallatin River, Gallatin National Forest, 1; Willow Creek (4 miles east of White Sulphur Springs), Castle Mountains, 1.

Nevada: Big Creek (head of, altitude 8,000 feet), Pine Forest Range, 2[62]; Jet Canyon, Toyabe Mountains, 1; Pine Forest Range, 2; South Twin River, Toyabe Mountains, 8.

New Mexico: Costilla Pass (east slope, altitude 9,000 feet), 1; Hopewell (6 miles west, altitude 9,900 feet), 1; Pecos Baldy, 1; Santa Clara Canyon, 1; Taos Mountains (east slope, 8,000 feet), 2; Twining (altitude 10,700 feet), 1; Willis, 1.

Oregon: Anna Creek (altitude 6,000 feet), Mount Mazama, 1; Anthony, 16[74], Beech Creek, 2; Bourne, 16; Cornucopia, 7; Crater Lake, 5; Disaster Peak (altitude 7,000 feet), Malheur County, 1; Drews Creek (near), Lake County, 1; Fort Klamath, 1; Haycreek, 1; Howard, 1; Kieger Gorge (altitude 6,900 feet), Steen Mountains, 1; McKenzie Bridge, 1; Permilia Lake (west base Mount Jefferson), 1; Prospect, Jackson County, 1[64]; Steen Mountains, 1; Strawberry Butte, 3; Strawberry Mountains, 6; Three Sisters, 1; Wallowa Lake (altitude 5,000 to 8,000 feet), 2; Warmspring (20 miles west, Mill Creek), 2.

Utah: Barclay, 2; Clear Creek, 1; Currant Creek (Uinta Forest), 1; Fish Lake Plateau, 2; Parowan Mountains (Brian Head), 4; Park City, 1; Pine Valley, 1; Puffer Lake, 12; Salt Lake City (City Creek Canyon, 1½ miles east from Salt Lake), 1; Wasatch Mountains, 6.

Washington: Bauerman Ridge (Tungsten Mine, altitude 6,800 feet), Okanogan County, 1; Buck Creek Pass (7 miles east of Glacier Peak, altitude 5,500 feet), 1; Calispell Peak (9 miles west Locke, altitude

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[62] Mus. Vert. Zool.
[64] D. R. Dickey coll.
[65] Mus. Vert. Zool., 10; Field Mus. Nat. Hist., 6.
[66] Acad. Nat. Sci. Philadelphia, 1.
[67] Acad. Nat. Sci. Philadelphia, 2; Field Mus. Nat. Hist., 3.
[68] E. R. Warren coll., Colorado Springs, Colo., 1.
[69] E. R. Warren coll.
[70] E. R. Warren coll., 7; Mus. Comp. Zool., 2; Mus. Vert. Zool., 2.
[71] Field Mus. Nat. Hist., 3; Acad. Nat. Sci. Philadelphia, 1.
[72] State Coll. Wash.
[73] Colo. State Coll., 1; Mont. State Coll., 1.
[74] Amer. Mus. Nat. Hist.

3,500 feet), 1; Canyon Creek (3 miles south Soleduck River, altitude 3,550 feet), 22[75]; Carson (15 miles north, Government Springs, altitude 1,300 feet), 1: Cascade Tunnel (altitude 3,350 feet), 1[72]; Cat Creek (headwaters, altitude 4,500 feet), 4[76]; Clover Lake (altitude 5,700 feet, White River Park), Mount Rainier, 1; Elwha, 1; "Fort Vancouver, Columbia River" (lake near summit of Cascade Mountains), (type locality), 1; Gifford (altitude 1,000 feet), 1; Glacier Basin (altitude 5,900 feet), Mount Rainier, 1[72]; Gotchen Creek (near Lava Spring), Mount Adams, 1; Hindoo Creek, Mount Aix, 1[72]; Hoh River (2 miles southeast Olympus Ranger Station, altitude 2,100 feet), 1; Hompeg Falls, Blue Mountains, Columbia County, 1[62]; Lake James (altitude 4,350 feet), Mount Rainier, 1; Longmire (altitude 2,700 feet), Mount Rainier, 1; Longmires Spring (about 3,000 feet), Mount Rainier, 1; Meslers Rranch (1 mile west Mount Rainier National Park, altitude 2,000 feet), 1; Mount Baker, 2[72]; Mount St. Helens (altitude 5,500 feet), 1; Mount Stewart (6 miles south, north fork Teanaway River, altitude 3,500 feet), 2; Owyhigh Lake (altitude 5,100 feet), Mount Rainier, 4[75]; Paradise Creek (altitude 5,200 feet), Mount Rainier, 1; Paradise Park (altitude 5,400 feet), Mount Rainier, 2; Pasayten River (mouth, east fork, altitude 3,900 feet), 1; Pasayten River (west fork, altitude 4,700 feet), 1; Quinault River (head north fork, altitude 4,000 feet), 2; Reflection Lake (4,900 feet), Mount Rainier Park, 1; Rockport, 3; Scenic, 1[72]; Signal Peak, 2; Simcoe Mountains (15 miles north of Goldendale, near Potato Hill), 1[72]; Suiattle River (Chiwawa Mountain Fork, altitude 4,500 feet), 1; Tahoma Creek (altitude 2,500 feet), Mount Rainier, 1; Wallowa Lake (altitude 4,000 feet), 3; Whatcom Pass (altitude 5,200 feet), Whatcom County, 2.

Wyoming: Afton (10 miles north, altitude 6,200 feet, Salt River), 5; Afton (10 miles southeast, Salt River Mountains, altitude 7,500 feet), 2; Bighoru Mountains (altitude 8,400 feet), 1; Black Mountains (northeast base, Pat O'Hara Creek), 5; Casper (7 miles south, Casper Mountains, altitude 6,000 feet), 3; Dubois (3 miles south, Jackeys Creek), 3; Evanston, 2; Ferris Mountains (altitude 7,800 to 8,500 feet), 9; Glen Creek (altitude 7,000 feet), 2[77]; Jackson Hole, 1; Lake Emma Matilda, 4; Lake Fork, Wind River Mountains (altitude 9,600 feet), 1; Laramie, 2; Laramie Mountains (north slope, altitude 8,000 feet), 1; Laramie Mountains (10 miles east of Laramie, altitude 8,500 feet), 3; Mammoth Hot Springs, 5; Medicine Bow Mouutains (Headquarters Park, altitude 10,200 feet), 1; Moose Creek, Teton Mountains (altitude 6,800 feet), 1; Moran, 3; Pacific Creek, 1; Pahaska (mouth Grinnell Creek, altitude 6,300 to 7,000 feet), 8; Rattlesnake Mountains (altitude 7,000 feet), 1; Rongis (8 miles east, altitude 8,000 feet), 3; Shirley Mountains (altitude 7,600 feet), 3; South Pass City, 1; Teton Pass (above Fish Creek, altitude 7,200 feet), 11; Trappers Creek (head, altitude 8,500 feet), Big Horn Mountains, 4; Valley (altitude 7,000 to 7,500 feet), 3; Wolf (Eatons Ranch), 5; Yellowstone Park (northwest corner), 1.

SOREX ALASKANUS Merriam

Glacier Bay Water-shrew

(Pls. 4, i; 5, p; 10, e)

Sorex navigator alaskanus Merriam, Proc. Washington Acad. Sci. 2: 18, March 14, 1900.

[*Neosorex*] [*palustris*] *alaskanus* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 379, March, 1901.

Sorex (*Neosorex*) *palustris alaskanus* Allen, Bul. Amer. Mus. Nat. Hist. 19: 567, 1903.

Neosorex navigator alaskanus Miller, U. S. Nat. Mus. Bul. 79: 21, December 31, 1912.

Sorex alaskanus Jackson, Journ. Mamm. 7: 58, February 15, 1926.

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[62] Mus. Vert. Zool.
[72] State Coll. Wash.
[75] State Coll. Wash., 2.
[76] State Coll. Wash., 1.
[77] Mus. Comp. Zool., 1.

Type specimen.—No. 97713, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected June 12, 1899, by A. K. Fisher.

Type locality.—Point Gustavus, Glacier Bay, Alaska.

Geographic range.—Known only from type locality. (Fig. 21.)

Diagnostic characters.—Essentially like *Sorex p. navigator* in size and color; skull shorter than that of *navigator*, heavier and more angular, with relatively shorter rostrum and shorter mesopterygoid space; sagittal and lambdoidal crests very much developed; a distinct inframaxillary ridge extending above base of unicuspids.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts a trifle paler than chaetura-drab, distinctly flecked and grizzled with whitish hair tips and hair bands; underparts pale smoke gray tinged with pale olive-buff; color of underparts extending onto lips and chin; tail bicolor, fuscous-black above, whitish beneath nearly to tip.

Time of molting.—The type specimen, collected June 12, appears to be in complete summer pelage except on parts of the flank, which show indications of incompleted molt.

Skull.—Shorter, heavier, and more angular than that of *S. p. navigator*, with relatively shorter rostrum and shorter mesopterygoid space; mandible shorter than that of *navigator*, with slightly weaker and relatively lower molariform teeth. Differs from those of all other forms of the subgenus Neosorex in the greatly developed sagittal and lambdoidal crests, which are much more highly developed in comparatively young adults of *S. alaskanus* than in old adults of other forms, and in the well-developed inframaxillary ridge extending the length of the unicuspid row.

Measurements.—Two adult males, type specimen and topotype: Total length, 145, 160; tail vertebrae, 65, 72; hind foot, 18.5, 19. *Skull:* Skulls of two adult males (teeth slightly worn), type specimen and topotype: Condylobasal length, 18.4, 19.2; palatal length, 7.3, 7.9; cranial breadth, 9.5, 9.7; interorbital breadth, 4.1, 4.1; maxillary breadth, 5.3, 5.5; maxillary tooth row, 6.8, 7.2.

Remarks.—Although *S. alaskanus* resembles *S. p. navigator* very closely in superficial external appearance, it differs conspicuously from it and all other forms of the subgenus Neosorex in its highly ridged skull, which apparently is not due to age, and shows little, if any, tendency toward intergradation with *navigator* from the comparatively near-by regions of Alaska and British Columbia. Moreover, *S. alaskanus* is partly, if not completely, isolated on a peninsula cut off by Muir and Davidson Glaciers from the regions known to be inhabited by other forms of the subgenus. It seems best, therefore, to recognize it as a distinct species.

Specimens examined.—Two, from the type locality.

TABLE 13.—*Cranial measurements of adult specimens of* Sorex palustris *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. p. palustris:										
Manitoba—Robinson Portage.	107042	♀	20.9	8.8	10.2	4.2	6.2	7.5	Slight	
Do	107043	♀	20.7	8.8	10.4	4.4	6.2	7.7	do	
Do	107044	♀	21.5	9.1	10.6	4.4	6.2	7.9	do	
S. p. albibarbis:										
New Hampshire—Profile Lake.	38743	♀	20.0	8.3	10.1	4.3	6.1	7.3	do	Type specimen.
Vermont—East Wallingford.	[1] 94	♂	20.2	8.4	9.9	4.1	6.0	7.2	do	
Do	[2] 128	♂	19.9	8.0	10.4	4.5	6.4	7.4	Moderate	
S. p. gloveralleni:										
Nova Scotia—										
Digby	[3] 2046	♀	19.8	8.2	10.0	4.3	5.5	7.1	Slight	Do.
Do	[3] 2049	♀	19.5	8.0	10.1	4.4	5.6	7.1	Much	
Halifax	[4] 3864	♀	19.8	8.0	9.8	4.4	5.7	7.0	Slight.	
Do	[3] 2053	♂	19.9	8.0	10.3	4.5	5.9	7.0	Moderate	
S. p. hydrobadistes:										
Wisconsin—Withee	229061	♂	20.5	8.2	10.2	4.3	6.1	7.4	Much	Do
Minnesota—Elk River.	186887	♂	20.7	8.3	10.4	4.3	6.5	7.6	Slight	
Do	186888	♂	20.3	8.6	10.3	4.4	6.5	7.4	Moderate	
Do	186889	♂	20.6	8.8	10.3	4.6	6.5	7.8	Slight	
Do	186890	♂	21.0	8.8	10.9	4.4	6.3	7.8	do	
Do	186891	♂	20.2	8.0	10.0	4.4	6.2	7.5	do	
Do	186892	♂	21.0	9.0	10.5	4.5	6.3	7.6	do	
S. p. navigator:										
Washington—										
Head Yakima River.	1780	------	19.8	8.3	9.8	4.1	[5] 5.4	7.3	do	Do.
Mount Rainier	89583	♂	19.6	8.3	9.8	4.1	5.8	7.2	do	
Mount St. Helens	90751	♂	19.9	8.1	9.9	4.1	5.9	7.1	do	
Wyoming—Pahaska	169763	♂	19.4	7.9	9.5	4.1	5.6	7.3	do	
Do	169969	♂	19.6	8.2	9.6	4.1	5.7	7.2	do	
Do	169970	♂	20.0	8.3	9.6	4.1	5.8	7.1	do	
Do	169972	♂	19.7	8.1	9.6	4.1	5.7	7.2	do	
Nevada—Toyabe Mountains.	208921	♀	19.5	8.2	9.5	4.1	5.7	7.2	do	
Do	208922	♀	19.5	8.0	9.6	4.2	5.8	7.1	do	
Do	208924	♀	19.8	8.1	9.7	4.1	5.8	7.2	do	
Arizona—Prieto Plateau.	205367	♂	19.9	8.3	9.8	4.2	5.9	7.2	do	
California—Mount Whitney.	42540	♂	19.4	8.0	9.6	4.0	5.6	6.9	do	Adult.
Do	42543	♂	20.0	8.3	9.7	4.2	5.8	7.2	do	Do.
Do	42545	♂	19.9	8.2	9.8	4.2	5.8	7.0	do	Do.
Do	[6] 16286	♂	19.8	8.4	9.8	4.1	6.0	7.2	do	Do.
Do	[6] 16287	♂	20.0	8.1	9.8	4.1	5.9	7.1	do	Do.
Do	[6] 16297	♂	19.4	8.0	9.9	4.1	5.7	7.1	do	Do.
Do	42413	♂	19.3	7.4	10.0	4.2	5.8	7.0	Much	Old adult.
Do	42547	♂	20.4	7.9	10.4	4.1	5.9	7.3	do	Do.
Do	[6] 16288	♂	19.6	8.0	10.0	4.2	5.9	7.1	do	Do.
Do	[6] 16289	♂	19.7	7.9	10.3	4.2	6.0	7.3	do	Do.
British Columbia—Bennett.	128585	♀	20.2	8.3	10.1	4.2	5.9	7.4	Moderate	
S. alaskanus:										
Alaska—Point Gustavus.	97712	♂	19.2	7.9	9.7	4.1	5.5	7.2	Slight	Topotype.
Do	97713	♂	18.4	7.3	9.5	4.1	5.3	6.8	do	Type specimen.

[1] D. E. Kent coll., Rutland, Vt.
[2] G. L. Kirk coll., Rutland, Vt.
[3] Mus. Comp. Zool.
[4] E. R. Warren coll., Colorado Springs, Colo.
[5] Postmaxillary processes broken; actual maxillary breadth was probably about 5.6 or 5.7.
[6] Mus. Vert. Zool.

Subgenus ATOPHYRAX Merriam

Atophyrax Merriam. Trans. Linnaean Soc. New York 2:217, August 28, 1884.

Type species.—*Atophyrax bendirii* Merriam.

Geographic range.—Pacific coast region from extreme southwestern British Columbia (Port Moody) south through western Washington, western Oregon, and northwestern California nearly to Bodega Bay.

Diagnostic characters.—Size large, the smallest form (*Sorex b. bendirii*) about equal to the largest form (*S. p. palustris*) of the subgenus Neosorex; feet large, decidedly less conspicuously fimbriate than in subgenus Neosorex. Skull largest of the genus, that of the smallest form (*S. b. bendirii*) being about equal to or slightly larger than that of the largest form (*S. p. palustris*) of the subgenus Neosorex; rostrum, particularly anterior portion, comparatively long, distinctly curved ventrally anteriorly; anterior end of premaxilla decidedly narrower dorso-ventrally than middle portion, thus producing in lateral view a more acute aspect to the rostrum than in Neosorex; dorso-ventral diameter of rostrum measured at third unicuspid less than half the diameter between anterior border of infraorbital foramen and posterior border of i^1; anteroposterior diameter of basal portions of upper unicuspids (particularly fifth or last unicuspid) greater than in subgenus Neosorex, effecting a relatively long unicuspid tooth row with cusps more widely separated; posterior end of interior cutting edge of anterior portion of internal basal shelf of m^1 and m^2 usually with distinct cusplike lobe; pigmentation of anterior portion of internal basal shelf of m^1 and m^2 more extended posteriorly than in subgenus Neosorex.

Remarks.—In the original description, Merriam (1884b, p. 217) gave Atophyrax full generic rank under the name *Atophyrax bendirii*. Later he treated Atophyrax as a subgenus under Sorex (Merriam, 1895, p. 95). In the extreme form represented in *S. b. palmeri*, the differences between the subgenera Atophyrax and Neosorex are well marked. Certain characters, however, are only relative; and in certain specimens of *S. b. bendirii* from southern British Columbia these characters show a decided approach toward certain specimens of the subgenus Neosorex in all essential features, although there is no actual intergradation. This approach is not only in size and proportions of the skull, but in the weakened development of the cusplike lobe on the posterior end of the interior cutting edge of the anterior portion of the internal basal shelf of the first and second upper molars. Moreover, certain specimens of the subgenus Neosorex show this cusplike lobe developed to a considerable degree.[78] There are, however, enough fundamental differences between the two to warrant the recognition of each as a subgenus.

Representatives of both subgenera in the forms *S. b. bendirii* and *S. p. navigator* occur at Fort Klamath, Oreg., Longmire's Spring, Wash., and Chilliwack, British Columbia, although the two may occupy different habitats at these localities; and the range of *S. p. navigator* overlaps that of *S. b. albiventer* in the Olympic Mountains, Wash. Additional specimens of both groups from western British Columbia may throw more light on the relationships of Neosorex to Atophyrax.

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[78]Among the skulls showing this are the following of *Sorex p. navigator* (all U. S. Nat. Mus., Biological Survey collection):

No. 81513. Fifty miles north of Jasper House, Alberta.
No. 160588. Ferris Mountains, Wyo.
No. 170006. Highwood Mountains, Mont.
No. 209559. Beech Creek, Oreg.

KEY TO THE SPECIES AND SUBSPECIES OF THE SUBGENUS ATOPHYRAX

a^1. Underparts dark, not whitish in any pelage.
  b^1 Condylobasal length of skull less than 22.6 mm.; cranial breadth less than 10.7 ..... *bendirii* (p. 194).
  b^2. Condylobasal length of skull 22.6 mm. or more; cranial breadth 10.7 or more ..... *palmeri* (p. 197).
a^2. Underparts whitish, particularly in winter pelage ..... *albiventer* (p. 198).

SOREX BENDIRII GROUP

The *bendirii* group includes a single species, *Sorex bendirii*.

Geographic range.—That of the subgenus *Atophyrax*. (Fig. 22.)

Diagnostic characters.—Those of the subgenus *Atophyrax*.

SOREX BENDIRII (MERRIAM)

[Synonymy under subspecies]

Geographic range.—That of the subgenus *Atophyrax*. (Fig. 22.)

Diagnostic characters.—Those of the subgenus *Atophyrax*.

Subspecies and geographic variation.—The species *bendirii* includes three subspecies: *bendirii*, *palmeri*, and *albiventer*. The extreme accentuation of the characters of the species is found in specimens of *palmeri* from northwestern Oregon. Radiating from this region as a center there is a gradual reduction in the size of the animal and its skull; in the length, acuteness, and decurvature of the rostrum; and in other essential characters. This reduction is most marked toward the north and reaches its climax in specimens of *S. b. bendirii* from Sumas and Port Moody, British Columbia. The subspecies *albiventer* is a color-phase form intermediate in most other respects between the subspecies *bendirii* and *palmeri*.

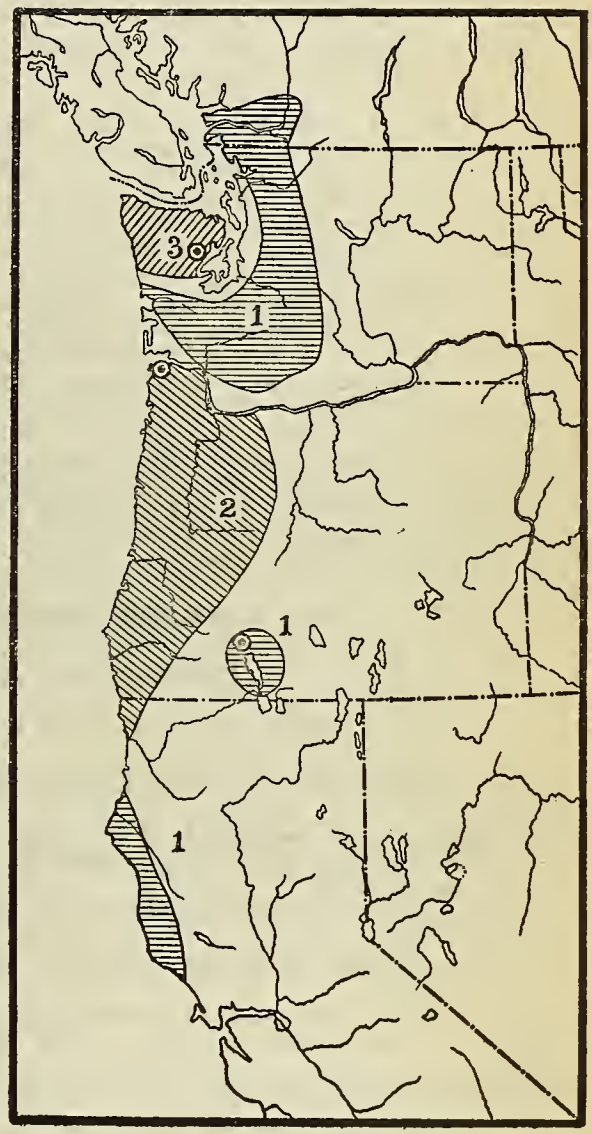

FIG. 22.—Geographic range of subspecies of *Sorex bendirii*

1. *S. b. bendirii*. 2. *S. b. palmeri*. 3. *S. b. albiventer*

Time of molting.—The evidence that there is both a spring and fall molt, and, if there is, which is the spring and which the fall one is not in every case clear. There certainly is a fall molt, however, and specimens of *S. b. albiventer* from Neah Bay, Wash., and one of *S. b. palmeri* from Portland, Oreg., satisfactorily show there is a spring molt.

The transition from the winter pelage to the summer pelage is usually obscure. This is due largely to the wear and fading of the winter pelage, which in this worn and faded condition approaches the summer pelage in

length and color. The molt as a rule is also less regular and defined than in the fall. Specimens of *S. b. bendirii* from the coast region of California show the molt in various stages of completion from June 19 to July 18. A specimen from Gualala, Calif., has the molt completed July 3; another on the same date has it about half completed; while a female collected July 14 is apparently still in worn winter pelage. Most of the skins from Easton, Wash., are in the summer pelage the first week of July, although a male still shows traces of the winter pelage July 3. Some of the specimens from Port Moody, British Columbia, collected July 22 to 28, appear to be in full summer pelage; three males, however, have the molt only about half complete. Specimens of *palmeri* from Crescent City, Calif., are with one exception in summer pelage the first week of July; an adult male collected July 5, 1899, has obtained the summer pelage only on the posterior half of the back, the rest of the animal being in worn winter pelage. A male from Portland, Oreg., collected May 30, 1905, has the summer pelage except on the abdomen. Specimens of *albiventer* from Neah Bay, Wash., are for the most part in winter pelage May 21 to June 7, although four males are in process of molting May 27 to June 7.

The earliest indication of the incoming of the winter pelage is in a male of *S. b. palmeri* collected August 29, 1901, at Requa, Calif.; in this specimen the beginning of the winter pelage is disclosed in the posterior part of the back. Another male from Gasquit, Calif., is in almost the same condition October 29, 1897. A male from Goldbeach, Oreg., is about half molted September 26, 1901, while a female collected September 27 of the same year has only a beginning of the molt on the rump. One from Oregon City, Oreg., is in complete winter pelage except the throat, chest, and sides of the head, October 21, 1893. A specimen of *S. b. bendirii* from near Mount Hood, Oreg., shows first indications of winter pelage under the summer pelage on the back September 6, 1896. A female from Steilacoom, Wash., is in complete winter pelage except on the head, October 13, and one from Puyallup in the same State at essentially the same date has full winter fur. One from Port Moody, British Columbia, is only about half through the molt October 26, 1895.

SOREX BENDIRII BENDIRII (MERRIAM)

BENDIRE MARSH SHREW

(PLS. 4, J; 5, Q; 6, U; 10, F; 11, N; 13, E)

Atophyrax bendirii Merriam, Trans. Linnaean Soc. New York 2: 217, August 28, 1884.

Atophyrax bendirei True. Proc. U. S. Nat. Mus. 7 (1884): 606, 1885.

Sorex bendirii Dobson, Monograph Insectivora, part 3, fasc. 1, pl. 23, fig. 17, and explanation, 1890.

Sorex (*Atophyrax*) *bendirii* Merriam, North Amer. Fauna No. 10, p. 95, December 31, 1895.

[*Atophyrax*] *bendiri* Trouessart, Catalogus Mammalium, supplement, fasc. 1, p. 135, 1904.

Sorex bendirei Stephens, California Mammals, p. 255, June, 1906.

Neosorex bendirii bendirii Miller, U. S. Nat. Mus. Bul. 79, p. 22, December 31, 1912.

Sorex bendirii bendirii Jackson, Journ. Mamm. 7: 58, February 15, 1926.

Type specimen.—No. 186442, U. S. Nat. Mus., Merriam collection; ♂ adult (teeth slightly worn), skin (made from alcoholic specimen) and skull; collected August 1, 1882, by Charles E. Bendire.

Type locality.—About 1 mile from Williamson River, 18 miles southeast of Fort Klamath, Klamath County, Oreg.

Geographic range.—Extreme southwestern British Columbia (Port Moody), south through western Washington east and south of Puget Sound; interior southwestern Oregon; coast region of California from about latitude 41° north south nearly to Bodega Bay. (Fig. 22.)

Diagnostic characters.—Size smallest of the species (total length about 150 mm. to 160 mm.); color of underparts both in summer and winter pelages dark, about as in *Sorex b. palmeri*, scarcely defined from upper parts, darker than in summer specimens of *S. b. albiventer* and strikingly in contrast with whitish underparts of winter specimens of *albiventer;* tail not bicolor in any pelage; skull smallest of the species, slightly smaller than that of *albiventer*, and much smaller than that of *palmeri;* dentition relatively and actually weaker than that of *albiventer*, much weaker than that of *palmeri.*

Color.—*Winter pelage:* Upper parts dark mouse gray to blackish mouse gray or chaetura black to almost black, indistinctly flecked with whitish hair tips, and sometimes with slight purplish and greenish iridescence; underparts scarcely paler than upper parts, usually slightly more brownish, fuscous black or chaetura black, occasionally hair brown; usually narrow touch of whitish on lips; tail fuscous black both above and below. *Summer pelage:* More brownish than in winter; upper parts fuscous to fuscous-black; underparts hair brown or chaetura drab, sometimes drab; throat sometimes stained with Isabella color; occasionally inconspicuously whitish on lips; tail fuscous to fuscous-black both above and below.

Skull.—Smallest of the species (condylobasal length usually about 21 mm.); much smaller than that of *S. b. palmeri*, somewhat smaller than that of *S. b. albiventer;* mesopterygoid space relatively broader than in *palmeri* or *albiventer;* dentition relatively and actually much weaker than that of *palmeri*, somewhat weaker than that of *albiventer.*

Measurements.—Type specimen (adult male)[79]: Total length, 150; tail vertebrae, 68; hind foot, 20. Adult male from Fort Klamath, Oreg.: Total length, 155; tail vertebrae, 71; hind foot, 20. Average of 4 adult females from Gualala, Calif.: Total length, 149.5 (147–153); tail vetebrae, 67 (61–76); hind foot, 19.1 (18.5–20). Average of 5 adult males from Easton, Wash.: Total length, 156.8 (148–163); tail vertebrae 74.4 (71–78); hind foot, 20.2 (20–21). Average of 6 adult females from Sumas, British Columbia: Total length, 151.7 (148–155): tail vertebrae, 67.8 (63–70); hind foot, 19.7 (19–20.5). *Skull:* Type specimen (adult male; teeth very slightly worn); Condylobasal length, 21.4; palatal length, 9.2; cranial breadth, 10.4; interorbital breadth, 4.4; maxillary breadth, 6.3; maxillary tooth row, 8.1. Skull of adult male (teeth very slightly worn) from Fort Klamath, Oreg.: Condylobasal length, 20.9; palatal length, 9.1; cranial breadth, 10.4; interorbital breadth, 4.3; maxillary breadth, 6.4; maxillary tooth row, 8.1. Skulls of 2 adult females (teeth slightly worn) from Gualala, Calif.: Condylobasal length, 21.0, 21.4; palatal length, 9.0, 9.0; cranial breadth, 10.5, 10.5; interorbital breadth, 4.4, 4.4; maxillary breadth, 6.5, 6.4; maxillary tooth row, 8.0, 8.2. Average of 4 skulls of adult males (teeth very slightly worn) from Easton, Wash.: Condylobasal length, 21.3 (21.0–21.7); palatal length, 9.1 (9.0–9.2); cranial breadth, 10.4 (10.3–10.5); interorbital breadth, 4.3 (4.2–4.4); maxillary breadth, 6.3 (6.1–6.4); maxillary tooth row, 8.1 (8.0–8.2). Average of 6 skulls of adult females (teeth very slightly worn) from Sumas, British Columbia: Condylobasal length, 20.9 (20.7–21.0); palatal length, 9.0 (8.9–9.1); cranial breadth, 10.3 (10.0–10.5); interorbital breadth, 4.2 (4.1–4.3); maxillary breadth, 6.2 (6.0–6.3); maxillary tooth row, 7.8 (7.6–8.0).

Remarks.—The uniformity both in color and cranial characters of specimens of *S. b. bendirii* from the widely separated regions of southwestern British Columbia and northern Washington, the Klamath Basin of Oregon, and the coast region of Mendocino County, Calif., is astonishing. Although there are at present no specimens of *S. b. bendirii* available from localities connecting the three distinct regions known to be inhabited by this form, nevertheless it seems probable that with additional specimens its range will be shown to be more or less continuous along the foothills of the Cascade Mountains from southwestern British Columbia to the Klamath

[79] Measurements given by Merriam (1884, p. 222) as measured from the alcoholic.

Basin in Oregon, and thence southwesterly along Klamath Canyon and southerly to the coast region of southern Mendocino County, Calif.

As has already been noted by Merriam (1895, p. 10), two specimens [80] from Gualala, Calif., have the fifth upper unicuspids (first premolars) unusually large and each with a double cusp; these two specimens also have the second upper premolars and the first upper molars more emarginate posteriorly than in average specimens. Three other specimens,[81] however, collected more recently, do not have the first upper premolars bicuspidate and in all essentials agree with typical *S. b. bendirii*. Northward along the coast of California a gradual increase in the size of the animals is noticed until from Requa and Crescent City, Calif., and Goldbeach, Oreg., specimens are intermediate in size between *S. b. bendirii* and *palmeri* though apparently nearer the latter form, to which they are referred. One skull [82] from Crescent City, however, is considerably smaller than the others from that place and is almost as small as *S. b. bendirii*.

Intergradation with *S. b. albiventer* is evident in specimens from the south end of Puget Sound. Specimens from Nisqually River, Puyallup, Oakville, and Steilacoom, Wash., have skulls somewhat larger than those of typical *S. b. bendirii*, and the specimens from Oakville and Steilacoom show an approach toward *albiventer* in color.

Specimens examined.—Total number, 133, as follows:

British Columbia: Chilliwack, 4 [83]; Chilliwack Valley, 1 [84]; Port Moody, 9; Sumas, 39.[85]

California: Eureka, 2 [86]; Gualala, 5 [87]; Carson Camp, Mad River, Humboldt Bay, 3; Mendocino, 2 [88]; Point Arena, 1.[89]

Oregon: Fort Klamath, 1; Prospect, 1 [90]; Williamson River (near, 18 miles southeast of Klamath) (type locality), 1.

Washington: Ashford (near, Nisqually River, altitude 1,800 feet), 1; Cathlamet, 1; Chehalis (8 miles west), 4; Easton, 8; Ilwaco, 2; Keechelus Lake, 1; Kirkland, 1; Longmire Springs, Mount Rainier, 4; Mesler's Ranch (1 mile west Mount Rainier Park, altitude 2,000 feet), 3; Mountain Meadows (altitude 4,000 feet), Mount Rainier, 1; Mount Vernon, 2; Ohanapecosh Springs (altitude 2,000 feet), Mount Rainier, 2; Oakville, 3; Oso (altitude 550 feet), 1; Pacific County, 1 [91]; Puyallup, 19 [92]; Signal Peak (altitude 4,000 feet), 1; Snoqualmie Pass (altitude 3,000 feet), King County, 2 [85]; Steilacoom, 1; Tacoma (6 miles south), 1; Tacoma (5 miles east), 3 [90]; Toledo, 1; Trout Lake (15 miles south Mount Adams, altitude 1,900 feet), Klickitat County, 1.

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[80] Nos. 68163 and 68164, U. S. Nat. Mus., Biological Survey collection. Collected July 14, 1894.
[81] Nos. 19695–19697, Mus. Vert. Zool. Collected July 3, 1913.
[82] No. 97606, U. S. Nat. Mus., Biological Survey collection. Collected July 5, 1899.
[83] Acad. Nat. Sci. Philadelphia.
[84] Nat. Mus. Canada.
[85] Acad. Nat. Sci. Philadelphia, 1; Field Mus. Nat. Hist., 1; Mus. Vert. Zool., 1; Mus. Comp. Zool., 13.
[86] Mus. Comp. Zool., 1; Mus. Vert. Zool., 1.
[87] Mus. Vert. Zool., 3.
[88] Field Mus. Nat. Hist., 1.
[89] Mus. Vert. Zool.
[90] D. R. Dickey coll., Pasadena, Calif.
[91] Amer. Mus. Nat. Hist.
[92] D. R. Dickey coll., 4; G. G. Cantwell
[92] D. R. Dickey coll., 4; G. G. Cantwell coll., Palms, Calif., 8.

SOREX BENDIRII PALMERI Merriam

Palmer Marsh Shrew

(Pls. 4, k; 5, r; 6, v; 10, g)

Sorex (Atophyrax) bendirii palmeri Merriam, North Amer. Fauna No. 10, p. 97, December 31, 1895.

[*Atophyrax*] [*bendirii*] *palmeri* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 381, March, 1901.

Neosorex bendirii palmeri Miller, U. S. Nat. Mus. Bul. 79, p. 22, December 31, 1912.

Type specimen.—No. $\frac{17338}{24263}$, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth moderately worn), skin and skull; collected July 29, 1889, by T. S. Palmer.

Type locality.—Astoria, Clatsop County, Oreg.

Geographic range.—Northwestern Oregon west of the Cascade Mountains, southwestern Oregon west of longitude 123° west, and extreme northwestern California north of the mouth of the Klamath River. (Fig. 22.)

Diagnostic characters.—Size large (total length usually over 170 mm.), largest of the subgenus; color about as in *Sorex b. bendirii*, possibly slightly darker above in winter pelage; underparts dark, scarcely defined from upper parts both in summer and winter; tail not bicolor in any pelage; skull large, larger than that of *S. b. albiventer*, much larger than that of *S. b. bendirii;* dentition relatively and actually much heavier than that of *S. b. bendirii*, somewhat heavier than that of *albiventer.*

Color.—Winter pelage: Upper parts rich fuscous-black or chaetura black, sometimes blackish mouse gray, scantily flecked with whitish hair tips, sometimes with indistinct purplish and greenish iridescence; underparts scarcely paler than upper parts, chaetura drab, fuscous, to fuscous black; sometimes with a trace of whitish on the lips; tail fuscous or fuscous-black, not bicolor. *Summer pelage:* More brownish than in winter; about as in *S. b. bendirii;* upper parts fuscous to fuscous-black; underparts hair brown or chaetura drab; lips sometimes slightly whitish; tail as in winter.

Skull.—Large, largest of the genus (condylobasal length usually 23 mm. or more); much larger than that of *S. b. bendirii* with relatively narrower mesopterygoid space; larger than that of *S. b. albiventer;* dentition heavy, relatively and actually much heavier than that of *S. b. bendirii*, heavier than that of *albiventer;* cusplike development of posterior end of interior edge of anterior portion of internal basal shelf of first and second upper molars more developed than in *S. b. bendirii.*

Measurements.—Type specimen and topotype (adult females): Total length, 165, 170; tail vertebrae 73, 78; hind foot, 20, 21. Average of 3 adult males from Crescent City, Calif.: Total length, 172 (168–174); tail vertebrae, 77 (75–80); hind foot, 21 (21–21). *Skull:* Type specimen (adult female; teeth moderately worn): Condylobasal length, 23.8; palatal length, 10.0; cranial breadth, 11.6; interorbital breadth, 4.8; maxillary breadth, 7.2; maxillary tooth row, 9.0. Skull of adult male (teeth slightly worn) from Oregon City, Oreg.: Condylobasal length, 22.6; palatal length, 9.7; cranial breadth, 11.1; interorbital breadth, 4.8; maxillary breadth, 7.0; maxillary tooth row, 8.9. Average of 3 skulls of adult females (teeth slightly worn) from Eugene, Oreg.: Condylobasal length, 23.3 (23.0–23.5); palatal length, 9.9 (9.6–10.1); cranial breadth, 11.2 (11.0–11.3); interorbital breadth, 4.7 (4.6–4.8); maxillary breadth, 7.0 (6.9–7.1); maxillary tooth row, 9.1 (9.0–9.2). Average of 3 skulls of adult males (teeth slightly worn) from Crescent City, Calif.: Condylobasal length, 22.9 (22.8–23.0); palatal length, 9.7 (9.6–9.8); cranial breadth, 11.0 (10.8–11.2); interorbital breadth, 4.7 (4.7–4.7); maxillary breadth, 6.8 (6.6–6.9); maxillary tooth row, 8.8 (8.6–9.0).

Remarks.—There is some individual variation in the actual size and relative breadth of skulls and even more in the length of rostra and unicuspid tooth rows of this form, but none of these variations can be segregated geographically. Judged from the small number of specimens available from a country comparatively well combed for small mammals, the animal appears to be either rare or local. In its typical form it can be identified easily by its long hind foot and its large, heavy skull.

Specimens examined.—Total number, 32, as follows:

California: Crescent City, 7; Crescent City (4 miles north), 3[93]; Requa, 1.[94]
Oregon: Astoria (type locality), 2; Beaverton, 1; Camas Prairie (east base Cascade Mountains), 1; Eugene, 4[95]; Goldbeach, 2[94]; McKenzie Bridge, 2[96]; Marshfield, 1[94]; Mulino, 3[96]; Oregon City, 1; Portland, 1; Tillamook, 1[93]; Vida, 2[97].

SOREX BENDIRII ALBIVENTER Merriam

White-bellied Marsh Shrew

(Pl. 4, L)

Sorex (Atophyrax) bendirii albiventer Merriam, North Amer. Fauna No. 10, p. 97, December 31, 1895.
[*Atophyrax*] [*bendirii*] *albiventer* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 381, March, 1901.
Neosorex bendirii albiventer Miller, U. S. Nat. Mus. Bul. 79, p. 22, December 31, 1912.

Type specimen.—No. 66198, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth very slightly worn), skin and skull; collected July 7, 1894, by C. P. Streator.

Type locality.—Lake Cushman, Mason County, Olympic Mountains, Wash.

Geographic range.—Northwestern Washington west of Puget Sound and north of latitude 45 degrees north (Olympic region). (Fig. 22.)

Diagnostic characters.—Intermediate in size between *Sorex b. bendirii* and *S. b. palmeri*, but radically different from either in the color of the underparts, which in winter are distinctly whitish and sharply contrasted with blackish of upper parts; underparts in summer slightly paler than in *S. b. bendirii* or *palmeri*, paler and more mixed with whitish than upper parts; tail in winter distinctly bicolor nearly to tip, in summer not bicolor; skull intermediate in size between that of *S. b. bendirii* and that of *palmeri;* dentition heavier than in *S. b. bendirii*, weaker than in *palmeri*.

Color.—*Winter pelage:* Upper parts fuscous-black or between fuscous-black and chaetura black, inconspicuously sprinkled with a few whitish hair tips; occasionally with indistinct purplish or greenish iridescence; underparts whitish, sharply contrasted from upper parts, pale olive-gray tinged with pale olive-buff extending well up on flanks, usually stained on throat with cream-buff; lips whitish; tail distinctly bicolor, fuscous-black above, narrowly whitish below nearly to tip. *Summer pelage:* Upper parts slightly paler and more brownish than in winter, fuscous to fuscous-black; underparts much darker than in winter, drab, perceptibly lightened by admixture of whitish hairs which extend onto the chin and lips; tail fuscous, scarcely paler below than above, not distinctly bicolor.

Skull.—Size medium (condylobasal length usually about 22 mm.); intermediate in size and proportions between the skull of *S. b. bendirii* and that of *S. b. palmeri*.

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[93] D. R. Dickey coll., Pasadena, Calif.
[94] Field Mus. Nat. Hist.
[95] Oreg. State Game Dept., 3.
[96] Oreg. State Game Dept.
[97] Oreg. State Game Dept., 1.

Measurements.—Type specimen (adult male): Total length, 166; tail vertebrae, 78; hind foot, 20.5. Average of 3 adult males (including type) from type locality: Total length, 160.3 (151–166); tail vertebrae, 73.3 (64–78); hind foot, 20.5 (20–21). Average of 4 adult males from Neah Bay, Wash.: Total length, 166.3 (160–169); tail vertebrae, 72.3 (71–73); hind foot, 19.8 (19–20). *Skull:* Type specimen (adult male; teeth very slightly worn): Condylobasal length, 22.1; palatal length, 9.3; cranial breadth, 10.8; interorbital breadth, 4.6; maxillary breadth, 6.6; maxillary tooth row, 8.3. Skulls of 2 adult males (teeth very slightly worn) from type locality: Condylobasal length, 21.9, 22.0; palatal length, 9.3, 9.3; cranial breadth, 10.5, 10.8; interorbital breadth, 4.6, 4.6; maxillary breadth, 6.4, 6.6; maxillary tooth row, 8.3, 8.4. Average of 4 skulls of adult males (teeth slightly worn) from Neah Bay, Wash.: Condylobasal length, 22.1 (22.0–22.2); palatal length, 9.2 (9.0–9.4); cranial breadth, 11.1 (10.8–11.2); interorbital breadth, 4.7 (4.6–4.8); maxillary breadth, 6.6 (6.4–6.7); maxillary tooth row, 8.4 (8.3–8.4).

Remarks.—In full winter pelage with the whitish underparts typical specimens of *S. b. albiventer* are so radically different from *S. b. bendirii* or *S. b. palmeri* that critical comparison with them is unnecessary. In summer pelage, however, the colors of the three forms are more nearly alike, typical *albiventer*, nevertheless, still averaging considerably paler ventrally than *S. b. bendirii* or *palmeri*. In size, *albiventer* on the average is intermediate between *S. b. bendirii* and *palmeri*, though usually nearer the size of *S. b. bendirii*.

A specimen of *S. b. albiventer* collected during the winter of 1890 at Shelton, Wash., shows an approach toward *S. b. bendirii* in color and has a skull slightly smaller than typical *albiventer;* and three skins from the same locality in April, 1918, show a slight tendency toward the subspecies *bendirii* in color. A single specimen from Duckabush, Wash., collected January 24, 1919, is as dark ventrally as most specimens of *S. b. bendirii* and is referred to *albiventer* purely on geographical grounds. It seems probable that if more specimens were available from this locality the majority of them would be of the *albiventer* tone of coloration. More material is needed, however, to form a definite decision. Specimens referred to the subspecies *bendirii* from the south end of Puget Sound also indicate intergradation between *S. b. bendirii* and *albiventer*. The subspecies *albiventer* does not intergrade with *S. b. palmeri*, being separated from it by *S. b. bendirii*, two specimens of which, from Ilwaco and Cathlamet, Wash., are essentially like typical *S. b. bendirii*, although another from Ilwaco shows a very slight approach toward *albiventer* in color.

Specimens examined.—Total number, 38, as follows:

Washington: Canyon Creek (3 miles south Soleduck River, altitude 3,550 feet), 1; Duckabush, 1; Harstine Island, 2; Lake Cushman (type locality), 5[98]; Lapush, 2; Neah Bay, 18; Potlatch, 2[99]; Quinault Lake, 2, Shelton, 4[1]; Soleduck Hot Springs (altitude, 1,750 feet), 1.

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[98] Univ. Mich., 2.
[99] D. R. Dickey coll., Pasadena, Calif.
[1] Acad. Nat. Sci. Philadelphia, 1.

TABLE 14.—*Cranial measurements of adult specimens of* Sorex bendirii *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. b. bendirii:										
Oregon—										
Williamson River	186442	♂	21.4	9.2	10.4	4.4	6.3	8.1	Very slight	Type specimen.
Fort Klamath	79941	♂	20.9	9.1	10.4	4.3	6.4	8.1	---do	
British Columbia—Sumas.	62966	♀	20.9	8.9	10.5	4.3	6.1	7.8	---do	
Do	62968	♀	20.7	9.0	10.0	4.2	6.0	7.6	---do	
Do	62971	♀	21.0	9.1	10.0	4.2	6.3	7.8	---do	
Do	62974	♀	20.8	9.0	10.4	4.1	6.0	7.7	---do	
Do	62975	♀	20.8	8.9	10.3	4.3	6.3	7.6	---do	
Do	62977	♀	21.0	9.0	10.4	4.2	6.3	8.0	---do	
Washington—Easton	41612	♂	21.2	9.2	10.4	4.2	6.1	8.2	---do	
Do	41615	♂	21.3	9.1	10.4	4.4	6.4	8.1	---do	
Do	41616	♂	21.7	9.1	10.5	4.3	6.4	8.0	---do	
Do	41617	♂	21.0	9.0	10.3	4.3	6.2	8.1	---do	
California—Gualala	[1] 19696	♀	21.0	9.0	10.5	4.4	6.5	8.0	Slight	
Do	68164	♀	21.4	9.0	10.5	4.4	6.4	8.2	---do	
S. b. palmeri:										
Oregon—										
Astoria	24263	♀	23.8	10.0	11.6	4.8	7.2	9.0	Moderate	Do.
Oregon City	56898	♂	22.6	9.7	11.1	4.8	7.0	8.9	Slight	
Eugene	[2] 917	♀	23.0	9.6	11.0	4.6	6.9	9.0	---do	
Do	[2] 918	♀	23.5	10.1	11.3	4.8	7.1	9.2	---do	
Do	[2] 919	♀	23.3	10.1	11.2	4.7	6.9	9.1	---do	
California—Crescent City.	97601	♂	22.8	9.6	10.8	4.7	6.6	8.6	---do	
Do	97603	♂	23.0	9.7	11.2	4.7	6.8	8.9	---do	
Do	97604	♂	23.0	9.8	11.0	4.7	6.9	9.0	---do	
S. b. albiventer:										
Washington—										
Lake Cushman	66196	♂	21.9	9.3	10.5	4.6	6.4	8.3	Very slight	
Do	66197	♂	22.0	9.3	10.8	4.6	6.6	8.4	---do	
Do	66198	♂	22.1	9.3	10.8	4.6	6.6	8.3	---do	Do.
Neah Bay	88504	♂	22.2	9.3	11.0	4.8	6.5	8.3	Slight	
Do	88509	♂	22.1	9.4	11.2	4.6	6.4	8.4	---do	
Do	88513	♂	22.2	9.0	10.8	4.7	6.7	8.4	---do	
Do	88515	♂	22.0	9.2	11.2	4.7	6.7	8.3	---do	

[1] Mus. Vert. Zool. [2] Oreg. State Game Dept.

Genus MICROSOREX Coues

Microsorex Coues, Bul. U. S. Geol. and Geog. Sur. Territories 3 : 646, May 15, 1877.

Type species.—*Sorex hoyi* Baird.

Geographic range.—Northern Quebec, northern Ontario, Northwest Territories, central and western Alaska, south in the northern United States to District of Columbia, Ohio, Wisconsin, Minnesota, and northwestern Washington. (Fig. 23.)

Generic characters.—Externally very similar to Sorex, but with tail shorter than in most species of Sorex. Skull in general similar to that of Sorex, usually relatively flatter and narrowed, with short, broad rostrum; infraorbital foramina comparatively small; mandible short and heavy. Dentition simple, first upper incisor large, elongate, two-lobed, the anterior (primary) lobe relatively long and narrow, the length more than twice the width and more than twice the length of secondary lobe; first and second unicuspid teeth (i^2 and i^3) peglike with distinct ridge from cusp to cingulum, distinctly and sharply curved caudad toward terminus, with a pronounced secondary cusp near terminus of ridge on cingulum; third unicuspid disklike, antero-posteriorly flattened; fourth unicuspid (pm^1) normal, peglike; fifth unicuspid (pm^2) minute; molariform teeth not essentially different from those of Sorex. Bases of lower incisor and premolar closely approximated, separated by space equal about one-fourth the antero-posterior diameter of canine. (Fig. 24.)

Dentition: i., $\frac{3}{1}$; c., $\frac{1}{1}$; pm., $\frac{3}{1}$; m., $\frac{3}{3}$; total, 32.

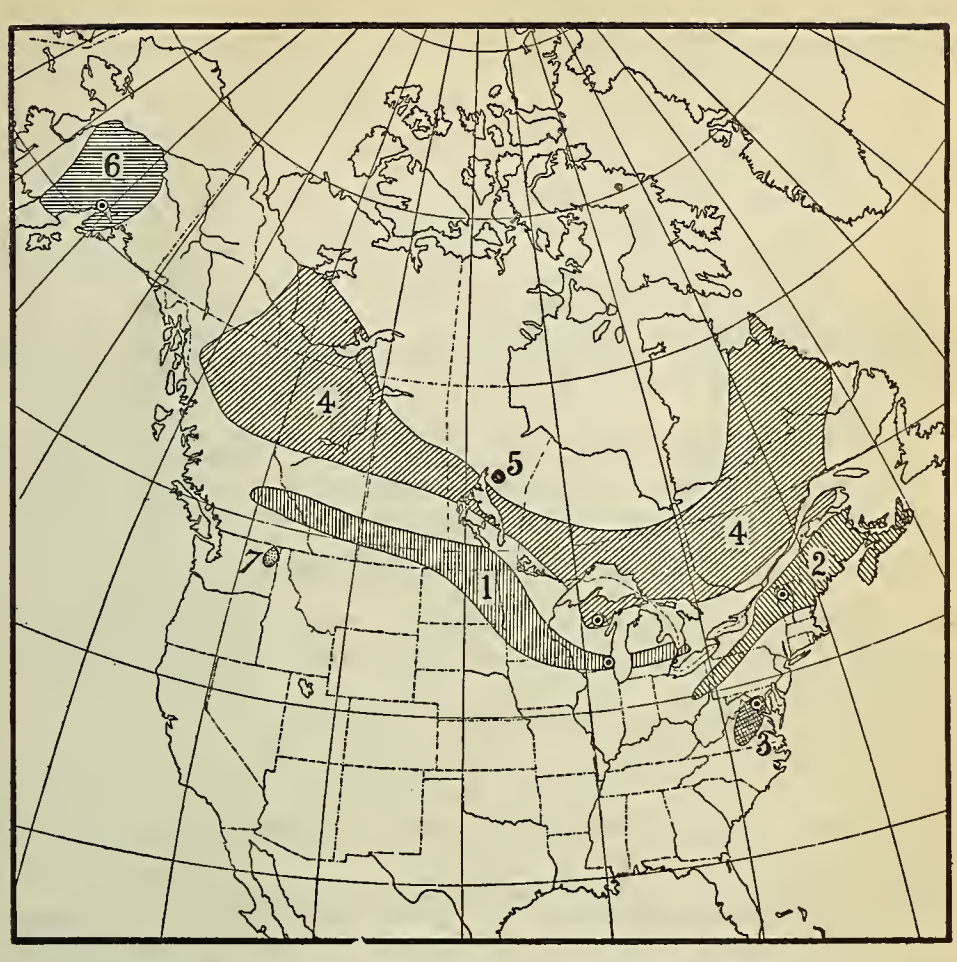

FIG. 23.—Geographic range of subspecies of *Microsorex hoyi*

1. *M. h. hoyi.*
2. *M. h. thompsoni.*
3. *M. h. winnemana.*
4. *M. h. intervectus.*
5. *M. h. alnorum.*
6. *M. h. eximius.*
7. *M. h. washingtoni.*

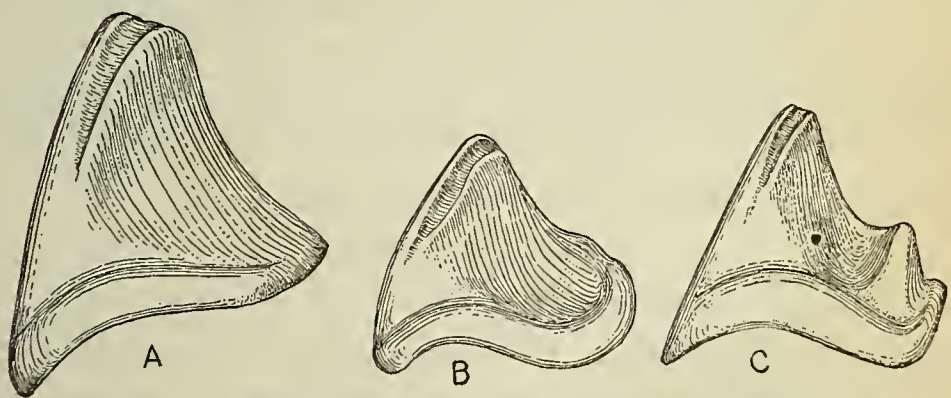

FIG. 24.—Dorsal view of right third upper incisors; A, *Sorex araneus;* B, *S. cinereus cinereus;* C. *Microsorex hoyi hoyi.* Enlarged about 20 diameters

KEY TO THE SUBSPECIES OF MICROSOREX

a^1. Condylobasal length 14.3 or more.
  b^1. Cranial breadth less than 6.7 ..... *hoyi* (p. 202).
  b^2. Cranial breadth more than 6.7.
    c^1. Condylobasal length more than 15.7; cranial breadth 7.3 or more ..... *alnorum* (p. 208).
    c^2. Condylobasal length less than 15.7; cranial breadth less than 7.3.
      d^1. Condylobasal length usually less than 15.3; maxillary tooth row usually less than 5; color more grayish ..... *intervectus* (p. 206).
      d^2. Condylobasal length more than 15.3; maxillary tooth row more than 5; color more brownish ..... *eximius* (p. 208).
a^2. Condylobasal length less than 14.3.
  b^1. Known geographic range confined to Washington ..... *washingtoni* (p. 209).
  b^2. Known geographic range eastern United States or eastern Canada.
    c^1. Condylobasal length more than 13.5; cranial breadth more than 6.2 ..... *thompsoni* (p. 204).
    c^2. Condylobasal length less than 13.5; cranial breadth less than 6.2 ..... *winnemana* (p. 206).

MICROSOREX HOYI GROUP

The *hoyi* group includes a single species—*Microsorex hoyi*. All necessary group comparisons are made under the genus *Microsorex* (p. 200).

MICROSOREX HOYI (BAIRD)

[Synonymy under subspecies]

Geographic range.—That of the genus Microsorex (p. 200). (Fig. 23.)

Diagnostic characters.—Those of the genus Microsorex (p. 200).

Subspecies and geographic variation.—The species *Microsorex hoyi* is divided into seven subspecies, namely: *hoyi*, *thompsoni*, *winnemana*, *intervectus*, *alnorum*, *eximius*, and *washingtoni*. The species reaches its maximum size in the north, where also there appears to be a correlation in the increased height of the brain case. Toward the south there is a gradual diminution in size, which reaches a climax in the forms *winnemana*, *thompsoni*, and *washingtoni*. Westward there is a tendency for the color to become somewhat more reddish-brown, noticeable in the subspecies *eximius* and *washingtoni*.

Time of molting.—The only molting specimens of Microsorex examined are of *M. h. thompsoni*. A female of this form from Brunswick, Me., has the new fur well advanced under the old only over the posterior two-thirds of the back on April 28, 1912. Another female from the same locality had acquired her complete but fresh summer fur May 17, 1922.

A female from Trousers Lake, New Brunswick, has the new fur coming in under the old over the entire upper parts, October 8, 1894. Another specimen of undetermined sex was in about the same condition of molt November 9, 1903.

MICROSOREX HOYI HOYI (BAIRD)

AMERICAN PIGMY SHREW

(PLS. 4, M, T; 6, W; 10, H; 13, I)

Sorex hoyi Baird, Rept. Pacific R. R. Survey, vol. 8, pt. 1, Mammals, p. 32, 1857.

Sorex (*Microsorex*) *hoyi* Merriam, North Amer. Fauna No. 10, p. 89, December 31, 1895.

[*Microsorex*] *hoyi* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 377, March, 1901.

Microsorex hoyi hoyi Jackson, Proc. Biol. Soc. Washington 38: 125, November 13, 1925.

Type specimen.—Lectotype, No. $\frac{6\,3\,2}{1\,7\,8\,3}$, U. S. Nat. Mus.; ♂ adult, poorly made and faded skin, and fragment of skull consisting of base of cranium; collected by P. R. Hoy (no date), entered in museum catalogue April 19, 1855.

Type locality.—Racine, Racine County, Wis.

Geographic range.—Southeastern British Columbia, southern Alberta, southern Manitoba, southeast through eastern North Dakota, northeastern South Dakota, southern Minnesota, and southern Wisconsin, to extreme southern Ontario. (Fig. 23.)

Diagnostic characters.—Size medium, smaller than *Microsorex h. alnorum* or *M. h. eximius*, slightly larger than *M. h. thompsoni*, about the size of *M. h. intervectus*. Color in summer pelage slightly more reddish than in *intervectus* or *thompsoni*. Skull relatively long and narrow, much depressed; longer than that of *thompsoni* with slightly heavier dentition; much more flattened than that of *intervectus*, with narrower brain case.

Color.—Winter pelage: General tone of upper parts between hair brown and olive-brown, sometimes tending toward clove brown; underparts smoke gray or between pale smoke gray and smoke gray, sometimes slightly tinged with pinkish buff or warm buff; tail indistinctly bicolor, mummy brown or Prout's brown above, buffy brown or between buffy brown and drab below, darkening toward tip. *Summer pelage:* Upper parts between sepia and bister; underparts smoke gray, tinged with light buff; tail as in winter.

Skull.—Relatively long, narrow, much depressed; anterior and posterior borders of cranium gently rounded, not angular or truncate; dentition moderate. Longer than the skull of *M. h. thompsoni*, with slightly heavier dentition. Cranium less angular, narrower, and more depressed than in *M. h. intervectus*.

Measurements.—Average of three adults[2] (sex undetermined), alcoholic specimens, from Elk River, Minn., measured by the writer: Total length, 81.3 (80–82); tail vertebrae, 30.7 (30–31); hind foot, 10.5 (10–11). *Skull:* Average of three skulls of adult females (teeth slightly to moderately worn) from Elk River, Minn.: Condylobasal length, 14.7 (14.3–15.0); palatal length, 5.3 (5.2–5.3); cranial breadth, 6.5 (6.4–6.6); interorbital breadth, 3.1 (3.0–3.1); maxillary breadth, 4.3 (4.2–4.3); maxillary tooth row, 4.9 (4.8–4.9).

Remarks.—In the original description of this form Baird (1857, p. 32) listed and described two specimens from Racine, Wis., an alcoholic with skull inside (No. 1688, U. S. Nat. Mus.) and a skin with skull (No. $\frac{6\,3\,2}{1\,7\,8\,3}$, U. S. Nat. Mus.). As has already been pointed out by Preble (1910, p. 102), No. 1688 proves to be a specimen of *Sorex cinereus*. Baird's illustration of the external parts (1857, pl. 28) on close scrutiny would also indicate this. The skull figured by Baird (1857, pl. 28) undoubtedly belongs to his other specimen (No. $\frac{6\,3\,2}{1\,7\,8\,3}$) since he gives a description and measurements of it (op. cit., p. 33) and does not mention the skull of No. 1688. Preble (1910, p. 102) therefore regards the skull No. 1783 as the type of *S. hoyi* Baird. Inasmuch as Baird (1857, p. 32–33), however, describes the skin, which is still in the United States National Museum collection, it must also be considered with the specimen. The present reviser therefore designates skin and skull No. $\frac{6\,3\,2}{1\,7\,8\,3}$, United States National Museum, the lectotype of *Sorex hoyi* Baird.

Unfortunately, since the time of Baird, the skull of the lectotype has become so badly damaged that now all that remains is a fragment of the base of the cranium and a portion of the parietals. This fragment, however, together with Baird's description and illustrations

[2] Nos. 187002, 187003, and 187004, U. S. Nat. Mus. Apparently these same specimens were measured by Merriam (1895, p. 90) with a slight variation from the measurements of the writer.

(1857, p. 32–33, pl. 28) seems to establish the identity of the form Topotypes would be a welcome asset toward strengthening our knowledge, but it is hardly probable that additional specimens can ever be obtained at the type locality, which has undergone marked physiographic and ecological changes under so-called civilization. The skull is of the flat type quite in contrast with the skulls of *M. h. intervectus* from northern Wisconsin, and similar to skulls from Elk River, Minn.

The subspecies *hoyi* intergrades with both *M. h. thompsoni* and *M. h. intervectus*. Specimens from Locust Grove, N. Y., which are referred to *thompsoni*, show a strong tendency toward *M. h. hoyi*. Two of the specimens from Red River Settlements, Manitoba, are easily referable to *M. h. hoyi*, while a third [3] has a skull that is as broad as that of typical *intervectus*, but tends to be depressed as in the subspecies *hoyi*. Specimens from Aweme, Manitoba, are indistinguishable from those from Elk River, Minn.

Specimens examined.—Total number 31, as follows:

Alberta: Blindman and Red Deer River (forks of), 1 [4]; Red Deer River, 1.[4]
British Columbia: Cariboo, 1.
Manitoba: Aweme, 3 [5]; Red River Settlement, 3.
Minnesota: Elk River, 14; Steele County, 1.[6]
North Dakota: Devils Lake, 1; Pembina, 2.
Ontario: Coldstream, 2.[7]
South Dakota: Fort Sisseton, 1.
Wisconsin: Racine (type locality), 1.

MICROSOREX HOYI THOMPSONI (Baird)

Thompson Pigmy Shrew

(Pl. 4, n)

Sorex thompsoni Baird, Rept. Pacific R. R. Survey 8: pt. 1, Mammals, p. 34, 1857.
Sorex thomsoni Gilpin, Proc. and Trans. Nova Scotian Inst. Nat. Sci. 1: pt. 2, p. 1, 1867.
Microsorex hoyi thompsoni Jackson, Proc. Biol. Soc. Washington 38: 126, November 13, 1925.

Type specimen.—Lectotype, No. $\frac{1686}{38838}$, U. S. Nat. Mus.; ♂ adult (teeth slightly worn); alcoholic with skull removed (skull badly crushed, incomplete, and in several pieces; practically useless for comparative purposes except for rostrum, mandibles, and denition); collected by Zadock Thompson (no date), and entered in Museum catalogue, October 23, 1856.

Type locality.—Burlington, Chittenden County, Vt.

Geographic range.—Prince Edward Island, Nova Scotia, New Brunswick, southwesterly across Maine, Vermont, northern New York to eastern Ohio. (Fig. 23.)

Diagnostic characters.—Slightly smaller than *Microsorex h. hoyi*, color averaging a shade more grayish in summer pelage, skull and palate shorter, dentition weaker. Larger than *M. h. winnemana*, the skull larger and with more depressed brain case.

Color.—Averaging somewhat paler than in *M. h. hoyi*, and in summer pelage a trifle more grayish. *Winter pelage:* Upper parts hair brown or slightly

[3] No. $\frac{1686}{38838}$, U. S. Nat. Mus.
[4] Mus. Comp. Zool.
[5] Stuart Criddle coll., Treesbank, Manitoba.
[6] Acad. Nat. Sci. Philadelphia.
[7] Royal Ontario Mus. Zool.

darker; underparts pale smoke gray, or between pale smoke gray and smoke gray, tinged slightly with light buff; tail as in *M. h. hoyi*. *Summer pelage:* Upper parts between hair brown and clove brown, sometimes tending toward olive-brown; underparts about as in winter, a shade more buffy; tail as in winter.

Skull.—Relatively small, depressed, with narrow rostrum and rather weak dentition. Shorter and with narrower rostrum and somewhat smaller teeth than in *M. h. hoyi;* larger in all dimensions than that of *M. h. winnemana*, with more depressed brain case and noticeably longer tooth row.

Measurements.—Two adult males from Brunswick, Me.: Total length, 84, 87; tail vertebrae, 28, 30; hind foot, 9.5, 9.0. Two adult females from Brunswick, Me.: Total length, 81.5, 83.5; tail vertebrae, 27, 31; hind foot, 8.5, 9.5. *Skull:* Type specimen (adult male, teeth slightly worn): Maxillary tooth row, 4.6.[8] Skulls of two adult males (teeth moderately worn) from Brunswick, Me.: Condylobasal length, 14.0, 14.2; palatal length, 5.1, 5.1; cranial breadth, 6.3, 6.3; interorbital breadth, 3.1, 3.1; maxillary breadth, 3.9, 4.0; maxillary tooth row, 4.9, 4.7. Skulls of two adult females (teeth respectively much worn and moderately worn) from Brunswick, Me.: Condylobasal length, 14.2, 13.6; palatal length, 5.0, 5.0; cranial breadth, 6.4, 6.3; interorbital breadth, 3.0; maxillary breadth, 4.1, 4.0; maxillary tooth row, 4.6, 4.8.

Remarks.—In the original description of *Sorex thompsoni* Baird (1857, p. 34–35) listed and described three specimens from the United States National Museum collection, namely, No. 1686, an alcoholic, which has since then had the skull removed, from Burlington, Vt.; No. $\frac{247}{3099}$, a skin with skull from Zanesville, Ohio; and No. $\frac{2062}{3098}$, a skin with skull, from Halifax, Nova Scotia. He gave measurements and rather detailed descriptions of the first two specimens, and illustrated the external characters of the Burlington specimen (Baird, 1857, pl. 27), the illustration of the skull (Baird, 1857, pl. 27) apparently being that of the Zanesville specimen, since the Burlington skull was in the alcoholic and the Halifax skull, even to-day, is more complete than Baird indicates in his drawing. Lyon and Osgood (1909, p. 250) considered No. 1686 the type. It, with its removed skull number 38838, is herewith made the lectotype of *Sorex thompsoni* Baird.

Intergradation of *M. h. thompsoni* with *M. h. hoyi* is clearly indicated. The skulls from Locust Grove, N. Y., can about as well be referred to the subspecies *hoyi* as to *thompsoni*. One [9] is almost like typical *M. h. hoyi*, with even slightly broader skull; another [10] is somewhat intermediate between *M. h. hoyi* and *thompsoni;* while a third [11] is like typical *thompsoni*. Intergradation of *thompsoni* with *M. h. winnemana* is suggested in the skull of *winnemana* from Alta Vista, Va.

Specimens examined.—Total number, 33, as follows:

Maine: Brassua Lake, 3 [12]; Brunswick, 9 [13]; East Andover, 1 [14]; Grace Pond, Somerset County, 1 [12]; Norway 1; Waterville, 1.
New Brunswick: Bathurst (15 miles from Miramichi Road), 1 [15]; Trousers Lake, 1.[16]
New York: Canton, 1 [17]; Locust Grove, 3; Northwood, 1.[16]
Nova Scotia: Digby, 1 [18]; Halifax, 2; Ingonish Centre, Cape Breton Island, 1 [15]; Little River, Digby Neck, 1.
Ohio: Zanesville, 1.
Prince Edward Island: Alberton, 1 [19]; Georgetown, 2.[20]
Vermont: Burlington (type locality), 1.

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[8] The only measurement available.
[9] No. 186995, U. S. Nat. Mus.
[10] No. 186994, U. S. Nat. Mus.
[11] No. 186993, U. S. Nat. Mus.
[12] E. C. and A. S. Pope coll., Chicago, Ill.
[13] Lee Mus. Biol., Bowdoin College, 3; Manton Copeland coll., Brunswick, Me., 6.
[14] Manton Copeland coll.
[15] Nat. Mus. Canada.
[16] Amer. Mus. Nat. Hist.
[17] Lee Mus. Biol.
[18] Mus. Comp. Zool.
[19] Field Mus. Nat. Hist.
[20] Field Mus. Nat. Hist., 1; Amer. Mus. Nat. Hist., 1.

MICROSOREX HOYI WINNEMANA Preble

Winnemana Pigmy Shrew

(Pl. 4, o)

Microsorex winnemana Preble, Proc. Biol. Soc. Washington 23: 101, June 24, 1910.

Mierosorex hoyi winnemana Jackson, Proc. Biol. Soc. Washington 38: 126, November 13, 1925.

Type specimen.—No. 126320. U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected April 25, 1903, by Edward A. Preble.

Type locality.—Bank of Potomac River near Stubblefield Falls, 4 miles below Great Falls of the Potomac, Fairfax County, Va.

Geographic range.—Maryland in the vicinity of the District of Columbia to south-central Virginia.[a] (Fig. 23.)

Diagnostic characters.—Smallest of the genus; most nearly like *Microsorex h. thompsoni*, but smaller, the skull with relatively higher and more rotund brain case.

Color.—*Winter pelage:* Unknown. *Summer pelage:* Upper parts between sepia and olive-brown; underparts and tail as in *M. h. thompsoni.*

Skull.—Smallest of the genus; compared with that of *M. h. thompsoni* smaller, with higher and more rotund brain case, and distinctly shorter palate and tooth row.

Measurements.—Type specimen (adult female): Total length, 78; tail vertebrae, 28; hind foot, 9. *Skull:* Type specimen (adult female, teeth slightly worn): Condylobasal length, 13.0; palatal length, 4.8; breadth of cranium, 6.1; interorbital breadth, 2.7; maxillary breadth, 3.8; maxillary tooth row, 4.1.

Remarks.—The Winnemana pigmy shrew is the smallest American mammal known and, with the possible exception of *Pachyura etrusca* Savi, is the smallest known mammal in the world. Apparently it is about the same size as *P. etrusca* of Italy; but compared with *Sorex minutus* Linnaeus of Europe, another midget species, it averages about 10 per cent less in both condylobasal length of skull and in external total length, and in head and body length is about equal to the smallest specimens of *S. minutus.* Only three specimens of this shrew have been examined: The type specimen, and one from Berwyn, Md., which closely resembles the type specimen; and the third from Alta Vista, Va., which has a broken skull, but appears to approach *M. h. thompsoni* in size.

Specimens examined.—Total number, 3, as follows:

Maryland: Berwyn, 1.
Virginia: Alta Vista, 1; Stubblefield Falls, 4 miles below Great Falls of the Potomac, Fairfax County (type locality), 1.

MICROSOREX HOYI INTERVECTUS Jackson

Northwestern Pigmy Shrew

(Pls. 4, p; 6, x; 10, i; 11, o; 13, f, h)

Mierosorex hoyi intervectus Jackson, Proc. Biol. Soc. Washington 38: 125, November 13, 1925.

Type specimen.—No. 226979, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected August 17, 1917, by Hartley H. T. Jackson. Original number 820.

Type locality.—Lakewood, Oconto County, Wis.

[a] Since this was written, a male (skin with fragmentary skull) was collected April 23, 1928, by A. H. Howell, at Bent Creek Experiment Station, Pisgah National Forest, N. C.

Geographic range.—Northwest territories (Fort Franklin), northern British Columbia, southeasterly to western Ontario, thence east and north to Labrador and northern Quebec.

Diagnostic characters.—Size about that of *Microsorex h. hoyi*, averaging very slightly more grayish in summer pelage; skull more angular than that of *M. h. hoyi*, with distinctly higher and broader brain case. Smaller, somewhat darker and more grayish than *M. h. eximius*, with smaller skull, relatively shorter rostrum and palate, and weaker dentition. Smaller than *M. h. alnorum*, with brain case less inflated, palate shorter, and teeth smaller.

Color.—Winter pelage: Essentially like that of *M. h. hoyi*. *Summer pelage:* Essentially like that of *M. h. thompsoni*.

Skull.—Medium size, relatively high through brain case, with moderately broad rostrum, and medium dentition. More angular, higher and broader brain case than in the skull of *M. h. hoyi*, with on the average slightly heavier dentition. Smaller than that of *M. h. eximius* or *M. h. alnorum* with relatively shorter rostrum and palate, and weaker dentition; brain case less inflated than in *alnorum*.

Measurements.—Type specimen and topotype (adult females): Total length, 92, 97; tail vertebrae, 31, 30; hind foot, 10, 10. *Skull:* Type specimen and topotype (adult females, teeth slightly worn): Condylobasal length, 14.8, 14.3; palatal length, 5.3, 5.2; cranial breadth, 7.1, 6.8; interorbital breadth, 3.1, 2.9; maxillary breadth, 4.4, 4.2; maxillary tooth row, 4.9, 4.7. Skull of adult male (teeth very slightly worn) from Fort Chimo, Quebec: Condylobasal length, 15.4; palatal length, 5.8; cranial breadth, 7.2; interorbital breadth, 3.3; maxillary breadth, 4.5; maxillary tooth row, 5.1.

Remarks.—Externally *M. h. intervectus* is scarcely distinguishable from *M. h. hoyi*, but cranially it displays considerable contrast. It intergrades with the subspecies *hoyi* in Manitoba, as it also probably does in other regions from which specimens are lacking. It also intergrades with *M. h. eximius* as is indicated by certain specimens of *eximius* from interior Alaska. The specimen from Cumberland District, Saskatchewan, shows a tendency toward *M. h. hoyi* in the flatness of its skull; however, it has the broad cranium of *intervectus* and on the whole is nearer to this form. The fragmentary skull from Echimamish River, Manitoba, referred with some doubt to *M. h. alnorum* by Preble (1902, p. 72–73) seems more clearly referable to *intervectus;* the cranium is entirely gone, but the rostrum and palate are shorter than in *alnorum* and the molariform teeth are smaller.

The skull extracted from the alcoholic specimen from Fort Chimo, Quebec, is larger than that of typical *M. h. intervectus*, and has a longer palate and tooth row and heavier dentition. In some respects it inclines toward that of *M. h. alnorum* from Robinson Portage, Manitoba; but, until more specimens are available from these localities and the intervening region, the meaning of these variations can only be conjectured.

Specimens examined.—Total number, 58, as follows:

Alberta: Fort Chipewyan, 1; Muskeg Creek (15 miles from mouth), 1; Smith Landing, Slave River, 1.

British Columbia: Fort St. James, 1; Hazelton (altitude 950 feet), 1[21]; McDame Post, Dease River, 1; Telegraph Creek (near, Sawmill Lake), 1.[21]

Labrador: Hopedale, 1.[22]

Manitoba: Echimamish River, 1.

Michigan: Fish Hawk Lake, Gogebic County, 2[23]; Porcupine Mountains (T. 51 N., R. 43 W., S. 14), Ontonagon County, 2.[23]

[21] Mus. Vert. Zool. [22] Mus. Comp. Zool. [23] Univ. Mich.

Northwest Territories: Big Island, Great Slave Lake, 1; Fort Franklin, Great Bear Lake, 1; Fort Rae, 1; Fort Resolution, 6; Fort Simpson, 1; Fort Smith, 5.
Ontario: Algonquin Park, 1[24]; Macdiarmid, Lake Nipigon, 1.[25]
Quebec: Fort Chimo, 1; Godbout, 9; Grand Cascapedia, 1[24]; Lake Edward, 1[22]; Ste. Anne des Monts, Gaspé, 9.[26]
Saskatchewan: Cumberland District, 1.
Wisconsin: Crescent Lake, 1; Lac Vieux Desert, 2[27]; Lakewood (type locality), 2; Rhinelander, 1.[28]

MICROSOREX HOYI ALNORUM (Preble)

Alder Pigmy Shrew

(Pl. 4, q)

Sorex (*Microsorex*) *alnorum* Preble, North Amer. Fauna No. 22, p. 74, October 31, 1902.
Microsorex alnorum Elliot, Field Columb. Mus. Publ. 105 (zool. series 6): 457, 1905.
Microsorex hoyi alnorum Jackson, Proc. Biol. Soc. Washington 38: 126, November 13, 1925.

Type specimen.—No. 107014, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected June 27, 1900, by Edward A. Preble.

Type locality.—Robinson Portage, Manitoba, Canada.

Geographic range.—Known only from type locality. (Fig. 23.)

Diagnostic characters.—Size large for the species, about equal to *Microsorex h. eximius* or larger, somewhat darker and more grayish; skull deeper inferosuperiorly, both through cranium and rostrum, the molariform teeth a trifle heavier, the unicuspidate teeth more crowded. Larger than *M. h. intervectus*, with brain case more inflated, palate longer, and dentition heavier.

Color.—*Winter pelage:* Unknown. *Summer pelage:* General tone of upper parts mummy brown or slightly more grayish; underparts smoke gray tinged with light buff; tail mummy brown above, light buff below basally, gradually darkening to mummy brown apically.

Skull.—Large, with brain case inflated, rostrum relatively high, molariform dentition heavy, and unicuspidate teeth somewhat crowded. Larger than the skull of *M. h. intervectus*, with brain case more inflated, longer palate, and heavier molariform teeth. Higher than the skull of *M. h. eximius*, with heavier molariform teeth, and more crowded unicuspids.

Measurements.—Type specimen (adult female): Total length, 98; tail vertebrae, 35; hind foot, 12. *Skull:* Type specimen (adult female, teeth slightly worn): Condylobasal length, 15.8; palatal length, 5.9; cranial breadth, 7.3; interorbital breadth, 3.1; maxillary breadth, 4.4; maxillary tooth row, 5.0.

Remarks.—The type specimen of *M. h. alnorum* is unique, and until additional material is obtained it will be impossible to determine the exact status of the subspecies and its relationship to *M. h. intervectus*. It appears not improbable that *alnorum* may occupy an area bordering Hudson Bay and extending northeastwardly into Quebec. The Fort Chimo specimen, referred to *intervectus*, seems to indicate such a condition.

Specimen examined.—One, the type specimen.

MICROSOREX HOYI EXIMIUS (Osgood)

Alaska Pigmy Shrew

(Pls. 4, r; 10, j)

Sorex (*Microsorex*) *eximius* Osgood, North Amer. Fauna No. 21, p. 71, September 26, 1901.

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[22] Mus. Comp. Zool. [24] Nat. Mus. Canada. [25] Royal Ontario Mus. Zool. [26] Amer. Mus. Nat. Hist. [27] Field Mus. Nat. Hist. [28] Univ. Wis. Zool. Mus.

Microsorex eximius Elliot, Field Columb. Mus. Publ. 105 (zool. series 6): 457, 1905.

Microsorex hoyi eximius Jackson, Proc. Biol. Soc. Washington 38: 125, November 13, 1925.

Type specimen.—No. 107126, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected September 14, 1900, by W. H. Osgood.

Type locality.—Tyonek, Cook Inlet, Alaska.

Geographic range.—Western Alaska from the Yukon River south to Kenai Peninsula and the base of the Alaska Peninsula. (Fig. 23.)

Diagnostic characters.—Size comparatively large, color in summer paler and more reddish than *Microsorex h. hoyi*, *M. h. intervectus*, or *M. h. alnorum*. Skull larger than that of *M. h. hoyi* or *intervectus*, with longer palate and heavier dentition. Skull somewhat more depressed both through brain case and rostrum, than that of *alnorum*, with the dentition a trifle weaker.

Color.—Winter pelage: Essentially like that of *M. h. hoyi* in corresponding pelage, less tinged with buff ventrally. *Summer pelage:* Upper parts sepia or slightly paler; underparts smoke gray tinged with avellaneous or vinaceous-buff; tail sepia to mummy brown above, pinkish buff to almost avellaneous below, nearly to tip.

Skull.—Large, with relatively long rostrum and heavy dentition. Larger than the skull of *M. h. intervectus*, with longer rostrum, and correspondingly longer tooth row, and heavier dentition. Brain case not so much inflated as in *M. h. alnorum*, and dentition somewhat weaker.

Measurements.—Type specimen (adult female): Total length, 98; tail vertebrae, 31; hind foot, 11. *Skull:* Type specimen (adult female, teeth slightly worn): Condylobasal length, 15.5; palatal length, 5.9; cranial breadth, 7.1; interorbital breadth, 3.2; maxillary breadth, 4.4; maxillary tooth row, 5.2.

Remarks.—Representatives of Microsorex referable to *M. h. eximius* have been examined from several localities in southwestern Alaska west of Kenai Peninsula and Tanana. The specimens from the more interior regions of Alaska—Tanana and Mount McKinley—show a slight approach cranially toward *M. h. intervectus*.

Specimens examined.—Total number, 11, as follows:

Alaska: Barabori, Kenai Peninsula, 1[29]; Bear Creek, Mount McKinley, 1; Chalitna River (head), 1; Kakwok River (80 miles up), 1; Moose Camp, Kenai Peninsula, 1[29]; Nulato, 2; Tanana, 3; Tyonek (type locality), 1.

MICROSOREX HOYI WASHINGTONI Jackson

Washington Pigmy Shrew

(Pl. 4, s)

Microsorex hoyi washingtoni Jackson, Proc. Biol. Soc. Washington 38: 125, November 13, 1925.

Type specimen.—No. 91007, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth moderately worn), skin and skull (posterior and basal portion of cranium broken); collected September 26, 1897, by Vernon Bailey. Original number 6293.

Type locality.—Loon Lake, Stevens County, Wash.

Geographic range.—Known only from type locality. (Fig. 23.)

Diagnostic characters.—Size small, about the size of *Microsorex h. thompsoni*, slightly larger than *M. h. winnemana;* color more reddish brown (less grayish) than in any other subspecies; skull about the size of that of *thompsoni* but with slightly broader and higher cranium.

[29] Amer. Mus. Nat. Hist.

Color.—*Winter pelage:* Unknown. *Summer pelage:* Upper parts between cinnamon-brown and Prout's brown, grading into snuff brown on the flanks; underparts smoke gray heavily tinged with avellaneous; tail sepia above, between drab and avellaneous below.

Skull.—Size rather small, moderately depressed, relatively broad, dentition weak. About the size of the skull of *M. h. thompsoni* with actually and relatively broader cranium.

Measurements.—Type specimen (adult female): Total length, 89; tail vertebrae, 27; hind foot, 9. *Skull:* Type specimen (adult female, teeth moderately worn): Condylobasal length, 13.9; palatal length, 5.2; cranial breadth, 6.6; interorbital breadth, 3.0; maxillary breadth, 4.1; maxillary tooth row, 4.6.

Remarks.—The reddish color and the small and flattened, but relatively broad, skull of *M. h. washingtoni* show the form to be well differentiated. Unfortunately but one specimen, the type, is available, but it seems highly probable that intergradation occurs between true *M. h. hoyi* and *washingtoni.*

Specimen examined.—One, the type specimen.

TABLE 15.—*Cranial measurements of adult specimens of* Microsorex hoyi

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
M. h. hoyi:										
Minnesota—Elk River.	186996	♀	15.0	5.3	6.4	3.1	4.3	4.8	Slight	
Do	187001	♀	14.3	5.2	6.4	3.1	4.3	4.9	do	
Do	187008	♀	14.7	5.3	6.6	3.0	4.2	4.9	Moderate	
M. h. thompsoni:										
Vermont—Burlington.	38838	♂	-----	-----	-----	-----	-----	4.6	Slight	Type specimen.
Maine—Brunswick	[1] 456	♂	14.2	5.1	6.3	3.1	4.0	4.7	Moderate	
Do	[1] 730	♂	14.0	5.1	6.3	3.1	3.9	4.9	do	
Do	[1] 451	♀	14.2	5.0	6.4	3.0	4.1	4.6	Much	
Do	[1] 776	♀	13.6	5.0	6.3	-----	4.0	4.8	Moderate	
M. h. winnemana:										
Virginia—4 miles below Great Falls.	126320	♀	13.0	4.8	6.1	2.7	3.8	4.1	Slight	Do.
M. h. intervectus:										
Wisconsin—Lakewood.	226978	♀	14.3	5.2	6.8	2.9	4.2	4.7	do	Type locality.
Do	226979	♀	14.8	5.3	7.1	3.1	4.4	4.9	do	Type specimen.
Quebec—Fort Chimo.	38848	♂	15.4	5.8	7.2	3.3	4.5	5.1	Very slight.	Approaching *alnorum*?
M. h. alnorum:										
Manitoba—Robinson Portage.	107014	♀	15.8	5.9	7.3	3.1	4.4	5.0	Slight	Type specimen.
M. h. eximius:										
Alaska—Tyonek	107126	♀	15.5	5.9	7.1	3.2	4.4	5.2	do	Do.
M. h. washingtoni:										
Washington—Loon Lake.	91007	♀	13.9	5.2	6.6	3.0	4.1	4.6	Moderate	Do.

[1] Manton Copeland coll., Brunswick, Me.

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PLATE 2

[Natural size]

A. *Sorex cinereus cinereus* Kerr; ♂ adult; Elkhart Lake, Wis. (No. 227412, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex cinereus miscix* Bangs; type specimen; ♂ adult; Black Bay, Labrador. (No 8651, Mus. Comp. Zool., Harvard College, Bangs collection.)

C. *Sorex cinereus haydeni* Baird; ♀ adult; Ekalaka, Mont. (No. 213832, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex cinereus streatori* Merriam; ♂ adult, Sitka, Alaska. (No. 73799, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex cinereus hollisteri* Jackson; type specimen; ♀ adult; St. Michael, Alaska. (No. 99305, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex fontinalis* Hollister; ♂ adult; Hyattsville, Md. (No. 76593, U. S. Nat. Mus.; Biological Survey collection.)

G. *Sorex lyelli* Merriam; type specimen; ♂ young adult; Mount Lyell, Calif. (No. 109530, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex preblei* Jackson; type specimen; ♂ adult; Jordan Valley, Malheur County, Oreg. (No. 208032, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex fumeus fumeus* Miller; topotype; ♀ adult; Peterboro, N. Y. (No. 111122, U. S. Nat. Mus.)

J. *Sorex arcticus arcticus* Kerr; ♂ adult; South Edmonton, Alberta. (No. 69163, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex arcticus laricorum* Jackson; type specimen; ♂ adult; Elk River, Minn. (No. 186837, U. S. Nat. Mus., Merriam collection.)

L. *Sorex tundrensis* Merriam; type specimen; ♂ adult; St. Michael, Alaska. (No. 99,286, U. S. Nat. Mus., Biological Survey collection.)

M. *Sorex pribilofensis* Merriam; topotype; ♂ adult; St. Paul Island, Pribilof group, Alaska. (No. 206182, U. S. Nat. Mus., Biological Survey collection.)

N. *Sorex merriami* Dobson; type specimen; ♀ adult; Fort Custer, Bighorn County, Mont. (No. 186441, U. S. Nat. Mus., Merriam collection.)

O. *Sorex leucogenys* Osgood; type specimen; ♀ adult; 3 miles east of Beaver, Utah. (No. 157952, U. S. Nat. Mus., Biological Survey collection.)

P. *Sorex sclateri* Merriam; type specimen; ♀ adult; Tumbala, Chiapas, Mexico. (No. 75872, U. S. Nat. Mus., Biological Survey collection.)

Q. *Sorex longirostris longirostris* Bachman; adult, sex unknown; Butler, Ga. (No. 38425, U. S. Nat. Mus.)

R. *Sorex longirostris fisheri* Merriam; topotype; ♀ adult; Lake Drummond, Dismal Swamp, Va. (No. 75167, U. S. Nat. Mus., Biological Survey collection.)

S. *Sorex dispar* Batchelder; ♀ adult; Hunter Mountain, Catskill Mountains, N. Y. (No. 83159, U. S. Nat. Mus.)

T. *Sorex trowbridgii trowbridgii* Baird; topotype; ♀ adult; Astoria, Oreg. (No. 89021, U. S. Nat. Mus., Biological Survey collection.)

U. *Sorex trowbridgii montereyensis* Merriam; ♀ adult; Pacific Grove, Calif. (No. 107920, U. S. Nat. Mus., Biological Survey collection.)

V. *Sorex vagrans vagrans* Baird; ♂ adult; Aberdeen, Wash. (No. 24339, U. S. Nat. Mus., Biological Survey collection.)

W. *Sorex vagrans nevadensis* Merriam; type specimen; ♂ adult; Reese River, at line between Lander and Nye Counties, Nev. (No. 32302, U. S. Nat. Mus., Biological Survey collection.)

X. *Sorex vagrans halicoetes* Grinnell; topotype; ♀ adult; Palo Alto, Calif. (No. 3635, Mus. Vert. Zool., Univ. California.)

Y. *Sorex vagrans monticola* Merriam; ♂ young adult; Mount Thomas, White Mountains, Ariz. (No. 208664, U. S. Nat. Mus., Biological Survey collection.)

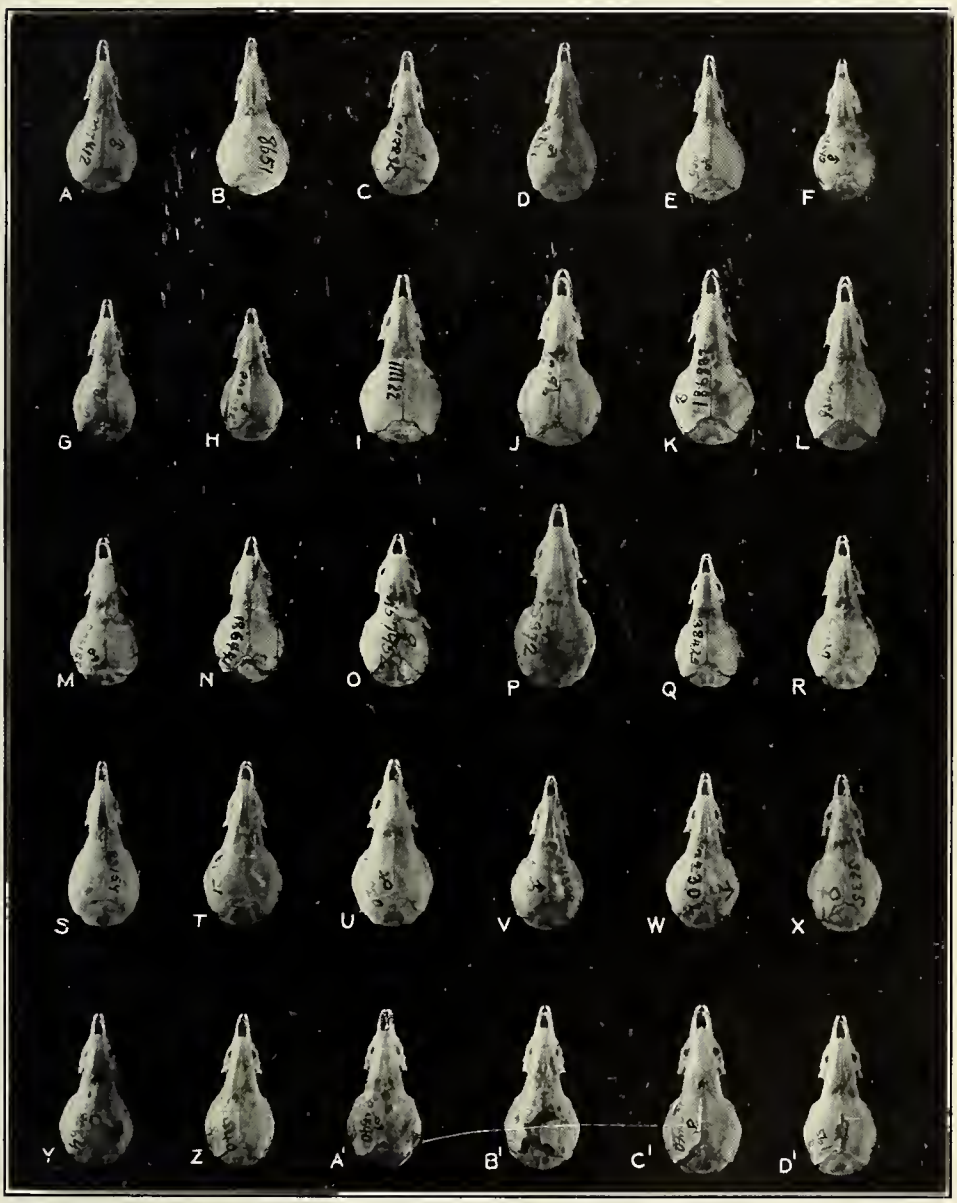
Z. *Sorex vagrans orizabae* Merriam; ♀ adult; Cofre de Perote, Vera Cruz, Mexico. (No. 54440, U. S. Nat. Mus., Biological Survey collection.)

A'. *Sorex durangae* Jackson; type specimen; ♂ adult; El Salto, Durango, Mexico. (No. 94540, U. S. Nat. Mus., Biological Survey collection.)

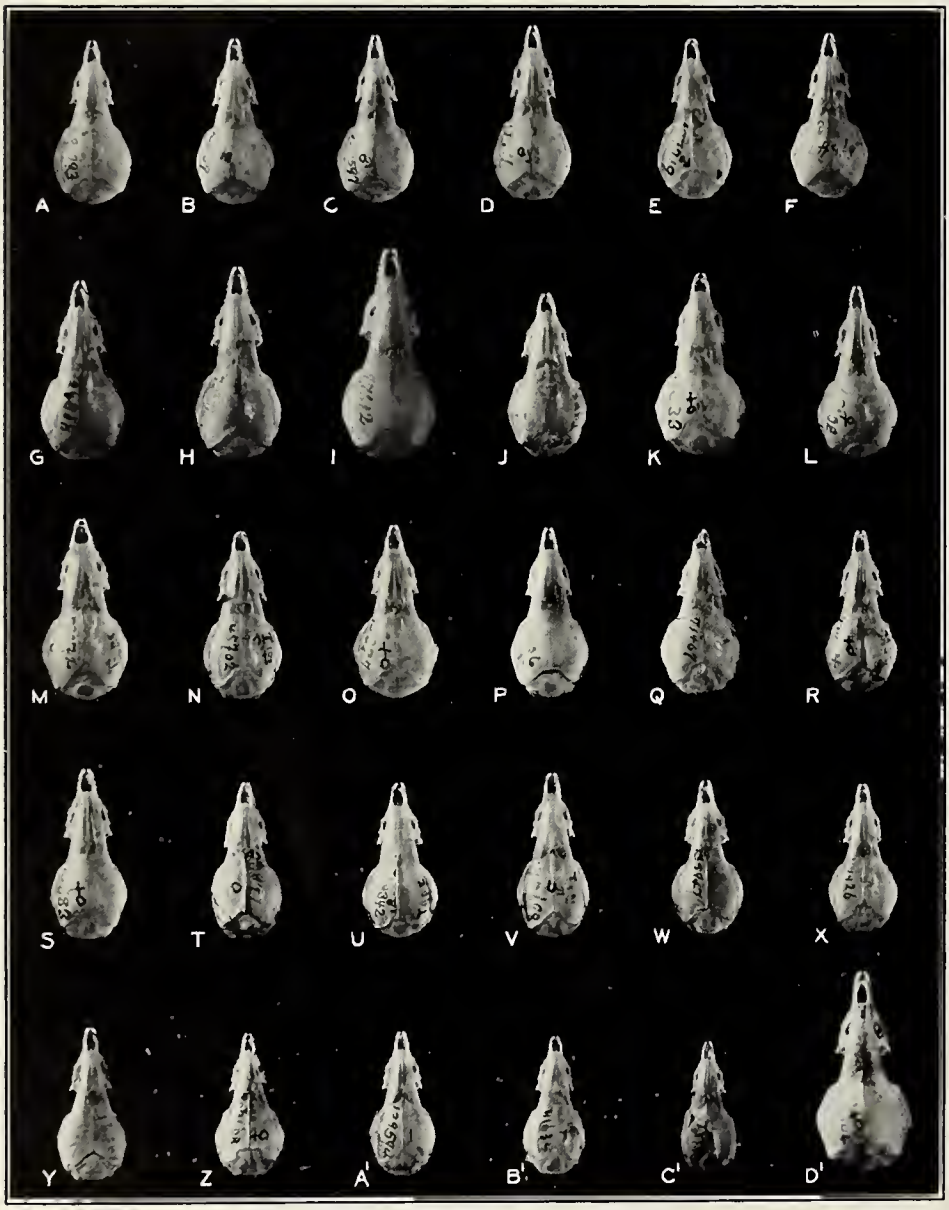
B'. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

C'. *Sorex obscurus neomexicanus* Bailey; type specimen ♂ adult; Cloudcroft, Sacramento Mountains, N. Mex. (No. 100440, U. S. Nat. Mus., Biological Survey collection.)

D'. *Sorex obscurus parvidens* Jackson; type specimen; ♂ adult; Bluff Lake, San Bernardino Mountains, Calif. (No. 56561, U. S. Nat. Mus., Biological Survey collection.)



SKULLS OF SOREX



SKULLS OF SOREX

PLATE 3

[Natural size]

A. *Sorex obscurus shumaginensis* Merriam; type specimen; ♀ adult; Popof Island, Shumagin Islands, Alaska. (No. 97993, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex obscurus alascensis* Merriam; type specimen; ♀ adult; Yakutat, Alaska. (No. 73539, U. S. Nat. Mus., Biological Survey collection.)

C. *Sorex obscurus elassodon* Osgood; type specimen; ♂ adult; Cumshewa Inlet, Moreshy Island, Queen Charlotte Islands, British Columbia. (No. 100597, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex obscurus longicauda* Merriam; type specimen; ♂ adult; Wrangell, Alaska. (No. 74711, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex obscurus isolatus* Jackson; type specimen; ♂ adult; mouth of Millstone Creek, Nanaimo, Vancouver Island, British Columbia. (No. 177719, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex obscurus setosus* Elliot; ♂ adult; Quinault Lake, Wash. (No. 89647, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex obscurus bairdi* Merriam; type specimen; ♀ adult; Astoria. Oreg. (No. 24318, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex yaquinae* Jackson; type specimen; ♀ adult; Yaquina Bay, Lincoln County, Oreg. (No. 73051, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex pacificus pacificus* Coues; adult, sex unknown; Crescent City, Calif. (No. 97612, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex stizodon* Merriam; type specimen; ♀ adult; San Cristobal, Chiapas, Mexico. (No. 75885, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex veraepacis veraepacis* Alston; ♀ adult; Todos Santos, Guatemala. (No. 77033, U. S. Nat. Mus., Biological Survey collection.)

L. *Sorex veraepacis mutabilis* Merriam; topotype; ♀ adult; Reyes (near Cuicatlan), Oaxaca, Mexico. (No. 69602, U. S. Nat. Mus., Biological Survey collection.)

M. *Sorex macrodon* Merriam; type specimen; ♂ adult; Orizaba, Vera Cruz, Mexico. (No. 58272, U. S. Nat. Mus., Biological Survey collection.)

N. *Sorex saussurei saussurei* Merriam; type specimen; ♀ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45702, U. S. Nat. Mus., Biological Survey collection.)

O. *Sorex saussurei saussurei* Merriam; ♀ young adult; San Cristobal, Chiapas, Mexico. (No. 75877, U. S. Nat. Mus., Biological Survey collection.)

P. *Sorex saussurei veraecrucis* Jackson; type specimen; ♀ adult; Xico, Vera Cruz, Mexico. (No. 55106, U. S. Nat. Mus., Biological Survey collection.)

Q. *Sorex saussurei oaxacae* Jackson; type specimen; ♀ adult; mountains near Ozolotepec, Oaxaca, Mexico. (No. 71467, U. S. Nat. Mus., Biological Survey collection.)

R. *Sorex saussurei godmani* Merriam; type specimen; ♀ adult; Volcan Santa Maria, Quezaltenango, Guatemala. (No. 77044, U. S. Nat. Mus., Biological Survey collection.)

S. *Sorex saussurei cristobalensis* Jackson; type specimen; ♀ adult; San Cristobal, Chiapas, Mexico. (No. 75883, U. S. Nat. Mus., Biological Survey collection.)

T. *Sorex emarginatus* Jackson; type specimen; ♀ young adult; Sierra Madre near Bolanos, Jalisco, Mexico. (No. 90847, U. S. Nat. Mus., Biological Survey collection.)

U. *Sorex ventralis* Merriam; type specimen; ♂ adult; Cerro San Felipe, Oaxaca, Mexico. (No. 68342, U. S. Nat. Mus., Biological Survey collection.)

V. *Sorex oreopolus* Merriam; type specimen; ♂ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45698, U. S. Nat. Mus., Biological Survey collection.)

W. *Sorex ornatus ornatus* Merriam; ♂ adult; Tebachapi, Calif. (No. 135947, U. S. Nat. Mus., Biological Survey collection.)

X. *Sorex ornatus californicus* Merriam; type specimen; ♂ adult; Walnut Creek, Contra Costa County, Calif. (No. 44426, U. S. Nat. Mus., Biological Survey collection.)

Y. *Sorex sinuosus* Grinnell; topotype; ♂ adult; Grizzly Island, near Suisun, Solano County, Calif. (No. 16469, Mus. Vert. Zool., Univ. California.)

Z. *Sorex trigonirostris* Jackson; type specimen; ♀ adult; Ashland, Jackson County, Oreg. (No. 203608, U. S. Nat. Mus., Biological Survey collection.)

A′. *Sorex juncensis* Nelson and Goldman; type specimen; ♀ young adult; Socorro, 15 miles south of San Quintin, Lower California. (No. 139594, U. S. Nat. Mus., Biological Survey collection.)

B′, *Sorex myops* Merriam; type specimen; ♀ adult; Piper's Creek (Cottonwood Creek), White Mountains, Mono County, Calif. (No. 41634, U. S. Nat. Mus., Biological Survey collection.)

C′, *Sorex nanus* Merriam; type specimen; ♀ young adult; Estes Park, Larimer County, Colo. (No. 73733, U. S. Nat. Mus., Biological Survey collection.)

D′. *Sorex palustris palustris* Richardson; ♀ adult; Robinson Portage, Manitoba. (No. 107044, U. S. Nat. Mus., Biological Survey collection.)

PLATE 4

[Natural size]

A. *Sorex palustris hydrobadistes* Jackson; ♀ adult; Lac Vieux Desert, Wis. (No. 18348, Field Mus. Nat. Hist.)

B. *Sorex palustris albibarbis* (Cope); type specimen; ♀ adult; Profile Lake, Franconia Mountains, Grafton County, N. H. (No. 38743, U. S. Nat. Mus.)

C. *Sorex palustris gloverallcni* Jackson; type specimen; ♀ adult; Digby, Nova Scotia. (No. 2046, Mus. Comp. Zool., Harvard College, Bangs collection.)

D. *Sorex palustris navigator* (Baird); ♂ adult; Mount St. Helens, Wash. (No. 90751, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex palustris navigator* (Baird); ♀ adult; Pryor Mountains, Mont. (No. 66493, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex palustris navigator* (Baird); ♀ adult; Pryor Mountains, Mont. (No. 66495, U. S. Nat. Mus., Biological Survey collection.) Figs. E and F show individual variation.

G. *Sorex palustris navigator* (Baird); ♂ adult; Mount Whitney, Calif. (No. 42545, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex palustris navigator* (Baird); ♂ old adult; Mount Whitney, Calif. (No. 42547, U. S. Nat. Mus., Biological Survey collection.) (Figs. G and H show age variation.)

I. *Sorex alaskanus* Merriam; type specimen; ♂ adult; Point Gustavus, Glacier Bay, Alaska. (No. 97713, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex bendirii bendirii* (Merriam); ♂ adult; Fort Klamath, Oreg. (No. 79941, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex bendirii palmeri* Merriam; type specimen; ♀ adult; Astoria, Oreg. (No. 24263, U. S. Nat. Mus., Biological Survey collection.)

L. *Sorex bendirii albiventer* Merriam; type specimen; ♂ adult; Lake Cushman, Olympic Mountains, Wash. (No. 66198, U. S. Nat. Mus., Biological Survey collection.)

M, T. *Microsorex hoyi hoyi* (Baird); ♀ adult; Elk River, Minn. (No. 187008, U. S. Nat. Mus., Merriam collection.)

N. *Microsorex hoyi thompsoni* (Baird); adult, sex unknown; Brunswick, Me. (No. 284, Lee Mus. Biol. Bowdoin College, Brunswick, Me.)

O. *Microsorex hoyi winnemana* Preble; type specimen; ♀ adult; 4 miles below Great Falls of the Potomac, Fairfax County, Va. (No. 126320, U. S. Nat. Mus., Biological Survey collection.)

P. *Microsorex hoyi intervectus* Jackson; type specimen; ♀ adult; Lakewood, Oconto County, Wis. (No. 226979, U. S. Nat. Mus., Biological Survey collection.)

Q. *Microsorex hoyi alnorum* (Preble); type specimen; ♀ adult; Robinson Portage, Manitoba. (No. 107014, U. S. Nat. Mus., Biological Survey collection.)

R. *Microsorex hoyi eximius* (Osgood); type specimen; ♀ adult; Tyonek, Cook Inlet, Alaska. (No. 107126, U. S. Nat. Mus., Biological Survey collection.)

S. *Microsorex hoyi washingtoni* Jackson; type specimen; ♀ adult; Loon Lake, Stevens County, Wash. (No. 91007, U. S. Nat. Mus., Biological Survey collection.)

U. *Sorex cinereus cinereus* Kerr; ♂ adult; Elkhart Lake, Wis. (No. 227412, U. S. Nat. Mus., Biological Survey collection.)

V. *Sorex fontinalis* Hollister; ♂ adult; Hyattsville, Md. (No. 76593, U. S. Nat. Mus., Biological Survey collection.)

W. *Sorex fumeus fumeus* Miller; topotype; ♀ adult; Peterboro, N. Y. (No. 111122, U. S. Nat. Mus.)

X. *Sorex arcticus arcticus* Kerr; ♂ adult; South Edmonton, Alberta. (No. 69163, U. S. Nat. Mus., Biological Survey collection.)

Y. *Sorex tundrensis* Merriam; topotype; ♀ adult; St. Michael, Alaska. (No. 99276, U. S. Nat. Mus., Biological Survey collection.)

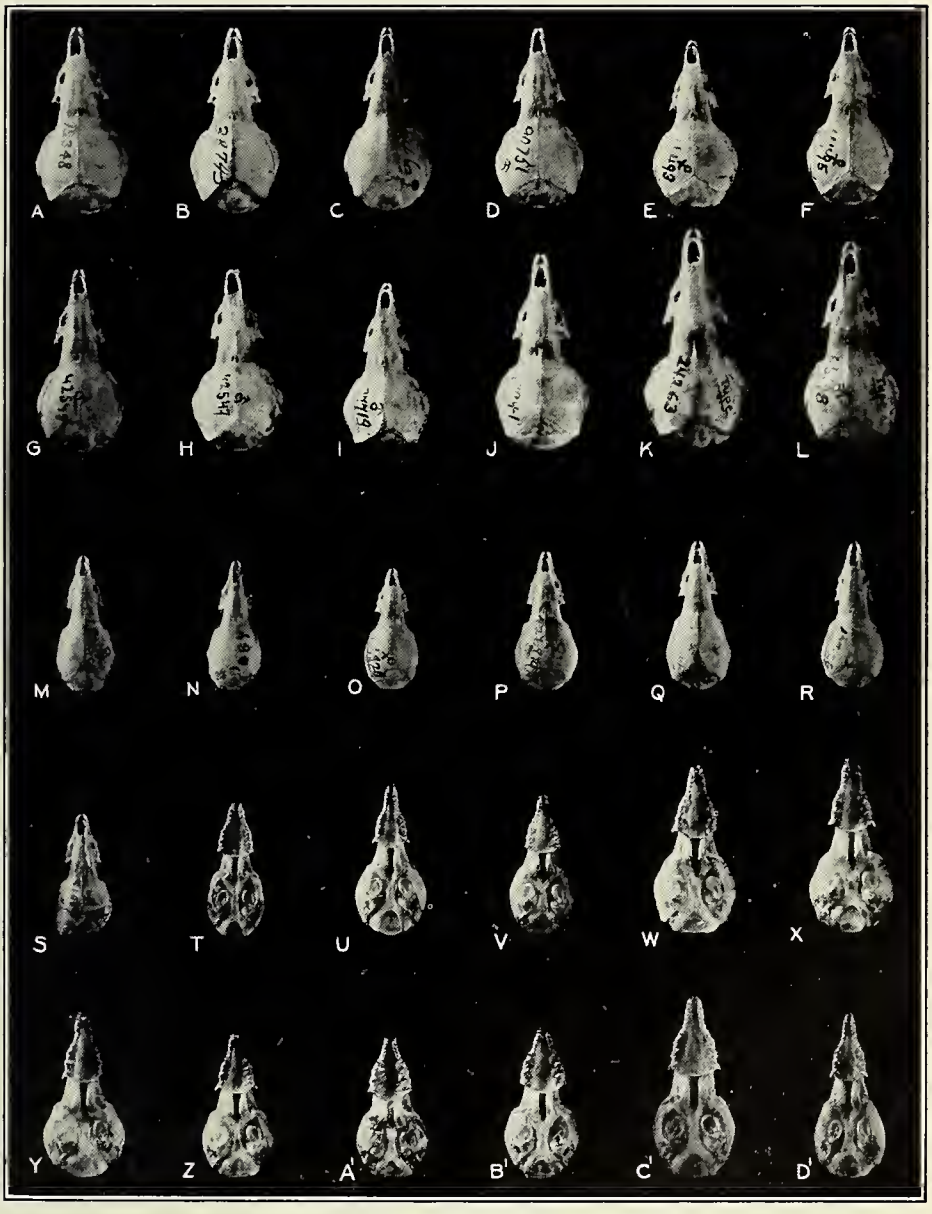
Z. *Sorex pribilofensis* Merriam; topotype; ♂ adult; Saint Paul Island, Pribilof Group, Alaska. (No. 206182, U. S. Nat. Mus., Biological Survey collection.)

A′. *Sorex merriami* Dobson; type specimen; ♀ adult; Fort Custer, Bighorn County, Mont. (No. 186441, U. S. Nat. Mus., Merriam collection.)

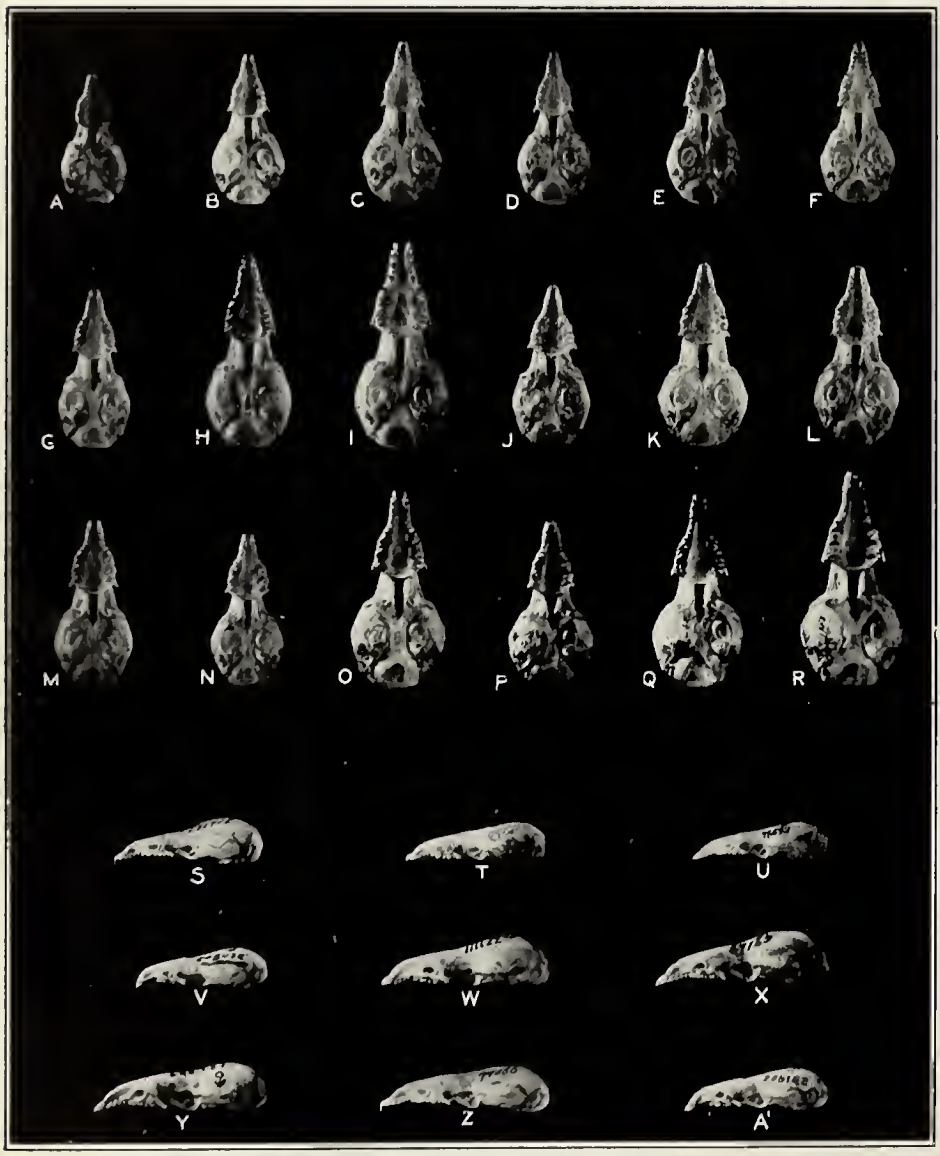
B′. *Sorex leucogenys* Osgood; type specimen; ♀ adult; 3 miles east of Beaver, Utah. (No. 157952, U. S. Nat. Mus., Biological Survey collection.)

C′. *Sorex sclateri* Merriam; type specimen; ♀ adult; Tumbala, Chiapas, Mexico. (No. 75872, U. S. Nat. Mus., Biological Survey collection.)

D′. *Sorex dispar* Batchelder; ♀ adult; Hunter Mountain, Catskill Mountains, N. Y. (No. 83159, U. S. Nat. Mus.)



SKULLS OF SOREX AND MICROSOREX



SKULLS OF SOREX

PLATE 5

[Natural size]

A. *Sorex longirostris longirostris* Bachman; adult; sex unknown; Butler, Ga. (No. 38425, U. S. Nat. Mus.)

B. *Sorex longirostris fisheri* Merriam; topotype; ♀ adult; Lake Drummond, Dismal Swamp, Va. (No. 75167, U. S. Nat. Mus., Biological Survey collection.)

C. *Sorex trowbridgii trowbridgii* Baird; topotype; ♀ adult; Astoria, Oreg. (No. 89021, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex vagrans vagrans* Baird; ♂ adult; Aberdeen, Wash. (No. 24339, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex durangae* Jackson; type specimen; ♂ adult; El Salto, Durango, Mexico. (No. 94540, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex obscurus parvidens* Jackson; type specimen; ♂ adult; Bluff Lake, San Bernardino Mountains, Calif. (No. 56561, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex yaquinae* Jackson; type specimen; ♀ adult; Yaquina Bay, Lincoln County, Oreg. (No. 73051, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex pacificus pacificus* Coues; adult, sex unknown; Crescent City, Calif. (No. 97612, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex stizodon* Merriam; type specimen; ♀ adult; San Cristobal, Chiapas, Mexico. (No. 75885, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex veraepacis veracpacis* Alston; ♀ adult; Todos Santos, Guatemala. (No. 77033, U. S. Nat. Mus., Biological Survey collection.)

L. *Sorex macrodon* Merriam; type specimen; ♂ adult; Orizaba, Vera Cruz, Mexico. (No. 58272, U. S. Nat. Mus., Biological Survey collection.)

M. *Sorex saussurei saussurei* Merriam; type specimen; ♀ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45702, U. S. Nat. Mus., Biological Survey collection.)

N. *Sorex ornatus ornatus* Merriam; ♂ adult; Tehachapi, Calif. (No. 135947, U. S. Nat. Mus., Biological Survey collection.)

O. *Sorex palustris palustris* Richardson; ♀ adult; Robinson Portage, Manitoba. (No. 107044, U. S. Nat. Mus., Biological Survey collection.)

P. *Sorex alaskanus* Merriam; type specimen; ♂ adult; Point Gustavus, Glacier Bay, Alaska. (No. 97713, U. S. Nat. Mus., Biological Survey collection.)

Q. *Sorex bendirii bendirii* (Merriam); ♂ adult; Fort Klamath, Oreg. (No. 79941, U. S. Nat. Mus., Biological Survey collection.)

R. *Sorex bendirii palmeri* Merriam; type specimen; ♀ adult; Astoria, Oreg. (No. 24,263, U. S. Nat. Mus., Biological Survey collection.)

S. *Sorex cinereus cinereus* Kerr; ♂ adult; Elkhart Lake, Wis. (No. 227412, U. S. Nat. Mus., Biological Survey collection.)

T. *Sorex fontinalis* Hollister; ♂ adult; Hyattsville, Md. (No. 76593, U. S. Nat. Mus., Biological Survey collection.)

U. *Sorex lyelli* Merriam; type specimen; ♂ young adult; Mount Lyell, Calif. (No. 109530, U. S. Nat. Mus., Biological Survey collection.)

V. *Sorex preblei* Jackson; type specimen; ♂ adult; Jordan Valley, Malheur County, Oreg. (No. 208032, U. S. Nat. Mus., Biological Survey collection.)

W. *Sorex fumeus fumeus* Miller; topotype; ♀ adult; Peterboro, N. Y. (No. 111122, U. S. Nat. Mus.)

X. *Sorex arcticus arcticus* Kerr; ♂ adult; South Edmonton, Alberta. (No. 69163, U. S. Nat. Mus., Biological Survey collection.)

Y. *Sorex arcticus laricorum* Jackson; type specimen; ♂ adult; Elk River, Minn. (No. 186837, U. S. Nat. Mus., Merriam collection.)

Z. *Sorex tundrensis* Merriam; type specimen; ♂ adult; Saint Michael, Alaska. (No. 99286, U. S. Nat. Mus., Biological Survey collection.)

A'. *Sorex pribilofensis* Merriam; topotype; ♂ adult; St. Paul Island, Pribilof Group, Alaska. (No. 206182, U. S. Nat. Mus., Biological Survey collection.)

PLATE 6

[Natural size]

A. *Sorex merriami* Dobson; type specimen: ♀ adult; Fort Custer, Bighorn County, Mont. (No. 186441, U. S. Nat. Mus., Merriam collection.)

B. *Sorex leucogenys* Osgood; type specimen; ♀ adult; 3 miles east of Beaver, Utah. (No. 157952, U. S. Nat. Mus., Biological Survey collection.)

C. *Sorex sclateri* Merriam; type specimen; ♀ adult; Tumbala, Chiapas, Mexico. (No. 75872, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex longirostris longirostris* Bachman; adult, sex unknown; Butler, Ga. (No. 38425, U. S. Nat. Mus.)

E. *Sorex dispar* Batchelder; ♀ adult; Hunter Mountain, Catskill Mountains, N. Y. (No. 83159, U. S. Nat. Mus.)

F. *Sorex trowbridgii trowbridgii* Baird; topotype; ♀ adult; Astoria, Oreg. (No. 89021, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex vagrans vagrans* Baird; ♂ adult; Aberdeen, Wash. (No. 24339, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex durangae* Jackson; type specimen; ♂ adult; El Salto, Durango, Mexico. (No. 94540, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex obscurus shumaginensis* Merriam; type specimen; ♀ adult; Popof Island, Shumagin Islands, Alaska. (No. 97993, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex yaquinae* Jackson; type specimen; ♀ adult; Yaquina Bay, Lincoln County, Oreg. (No. 73051, U. S. Nat. Mus., Biological Survey collection.)

L. *Sorex pacificus pacificus* Coues; adult, sex unknown; Crescent City, Calif. (No. 97612, U. S. Nat. Mus., Biological Survey collection.)

M. *Sorex stizodon* Merriam; type specimen; ♀ adult; San Cristobal, Chiapas, Mexico. (No. 75885, U. S. Nat. Mus., Biological Survey collection.)

N. *Sorex veraepacis veraepacis* Alston; ♀ adult; Todos Santos, Guatemala. (No. 77033, U. S. Nat. Mus., Biological Survey collection.)

O. *Sorex saussurei saussurei* Merriam; type specimen; ♀ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45702, U. S. Nat. Mus., Biological Survey collection.)

P. *Sorex ornatus ornatus* Merriam; ♂ adult; Tehachapi, Calif. (No. 135947, U. S. Nat. Mus., Biological Survey collection.)

Q. *Sorex tenellus* Merriam; type specimen; adult, sex unknown; Lone Pine, Calif. (No. 32495, U. S. Nat. Mus., Biological Survey collection.)

R. *Sorex myops* Merriam; type specimen; ♀ adult; Pipers Creek (Cottonwood Creek), White Mountains, Mono County, Calif. (No. 41634, U. S. Nat. Mus., Biological Survey collection.)

S. *Sorex palustris palustris* Richardson; ♀ adult; Robinson Portage, Manitoba. (No. 107044, U. S. Nat. Mus., Biological Survey collection.)

T. *Sorex palustris gloveralleni* Jackson; type specimen; ♀ adult; Digby, Nova Scotia. (No. 2046, Mus. Comp. Zool., Harvard College, Bangs collection.)

U. *Sorex bendirii bendirii* (Merriam); ♂ adult; Fort Klamath, Oreg. (No. 79941, U. S. Nat. Mus., Biological Survey collection.)

V. *Sorex bendirii palmeri* Merriam; type specimen; ♀ adult; Astoria, Oreg. (No. 24263, U. S. Nat. Mus., Biological Survey collection.)

W. *Microsorex hoyi hoyi* (Baird); ♀ adult; Elk River, Minn. (No. 187008, U. S. Nat. Mus., Merriam collection.)

X. *Microsorex hoyi intervectus* Jackson; type specimen; ♀ adult; Lakewood, Oconto County, Wis. (No. 226979, U. S. Nat. Mus., Biological Survey collection.)

SKULLS OF SOREX AND MICROSOREX

PLATE 8

[Enlarged five diameters]

A. *Sorex sclateri* Merriam; type specimen; ♀ adult; Tumbala, Chiapas, Mexico. (No. 75872, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex longirostris longirostris* Bachman; adult, sex unknown; Young Harris, Ga. (No. 159415, U. S. Nat. Mus., Biological Survey collection.)

C. *Sorex dispar* Batchelder; ♀ adult; Hunter Mountain, Catskill Mountains, N. Y. (No. 83159, U. S. Nat. Mus.)

D. *Sorex trowbridgii trowbridgii* Baird; topotype; ♀ adult; Astoria, Oreg. (No. 89021, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex vagrans vagrans* Baird; ♂ adult; Aberdeen, Wash. (No. 24339, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex durangae* Jackson; type specimen; ♂ adult; El Salto, Durango, Mexico. (No. 94540, U. S. Nat. Mus., Biological Survey collection.)

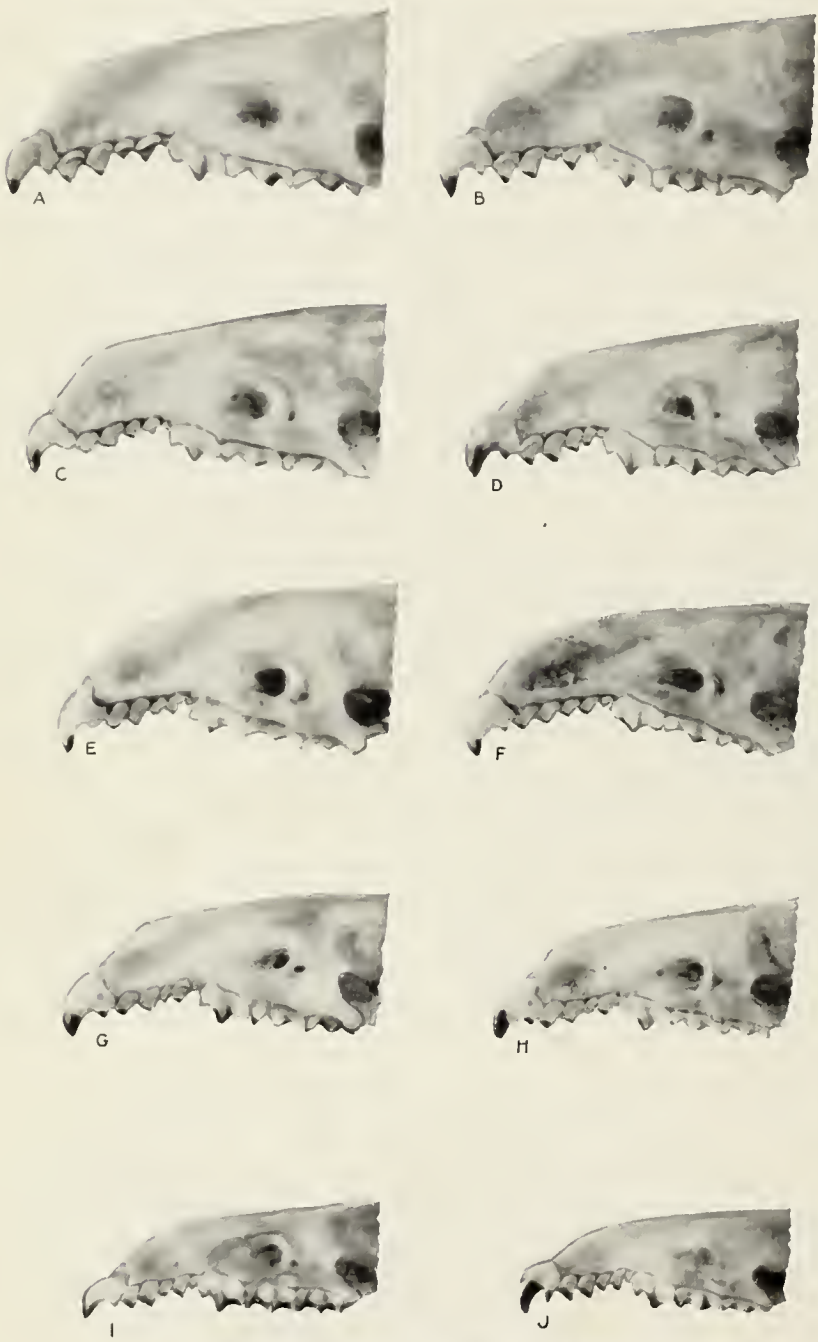
G. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex yaquinae* Jackson; type specimen; ♀ adult; Yaquina Bay, Lincoln County, Oreg. (No. 73051, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex pacificus pacificus* Coues; adult, sex unknown; Crescent City, Calif. (No. 97612, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex stizodon* Merriam; type specimen; ♀ adult; San Cristobal, Chiapas, Mexico. (No. 75885, U. S. Nat. Mus., Biological Survey collection.)

ROSTRA AND UPPER TEETH OF SOREX



ROSTRA AND UPPER TEETH OF SOREX

PLATE 9

[Enlarged five diameters]

A. *Sorex veraepacis veraepacis* Alston; ♀ adult; Todos Santos, Guatemala. (No. 77033, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex macrodon* Merriam; type specimen; ♂ adult; Orizaba, Vera Cruz, Mexico. (No. 58272, U. S. Nat. Mus., Biological Survey collection.)

C. *Sorex saussurei saussurei* Merriam; type specimen; ♀ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45702, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex emarginatus* Jackson; type specimen; ♀ young adult; Sierra Madre near Bolanos, Jalisco, Mexico (No. 90847, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex ventralis* Merriam; type specimen; ♂ adult; Cerro San Felipe, Oaxaca, Mexico. (No. 68342, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex oreopolus* Merriam; type specimen; ♂ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico (No. 45698, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex ornatus ornatus* Merriam; ♂ adult; Tehachapi, Calif. (No. 135947, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex ornatus californicus* Merriam; type specimen; ♂ adult; Walnut Creek, Contra Costa County, Calif. (No. 44426, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex tenellus* Merriam; type specimen; adult, sex unknown; Lone Pine, Calif. (No. 32495, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex nanus* Merriam; type specimen; ♀ young adult; Estes Park, Larimer County, Colo. (No. 73733, U. S. Nat. Mus., Biological Survey collection.)

PLATE 10

[Enlarged five diameters]

A. *Sorex palustris palustris* Richardson; ♀ adult; Robinson Portage, Manitoba. (No. 107044, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex palustris albibarbis* (Cope); type specimen; ♀ adult; Profile Lake, Franconia Mountains, Grafton County, N. H. (No. 38743, U. S. Nat. Mus.)

C. *Sorex palustris navigator* (Baird); ♂ adult; Mount Whitney, Calif. (No. 42545, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex palustris navigator* (Baird); ♂ old adult; Mount Whitney, Calif. (No. 42547, U. S. Nat. Mus., Biological Survey collection.) Figs. G and H show age variation.

E. *Sorex alaskanus* Merriam; type specimen; ♂ adult; Point Gustavus, Glacier Bay, Alaska. (No. 97713, U. S. Nat. Mus., Biological Survey collection.)

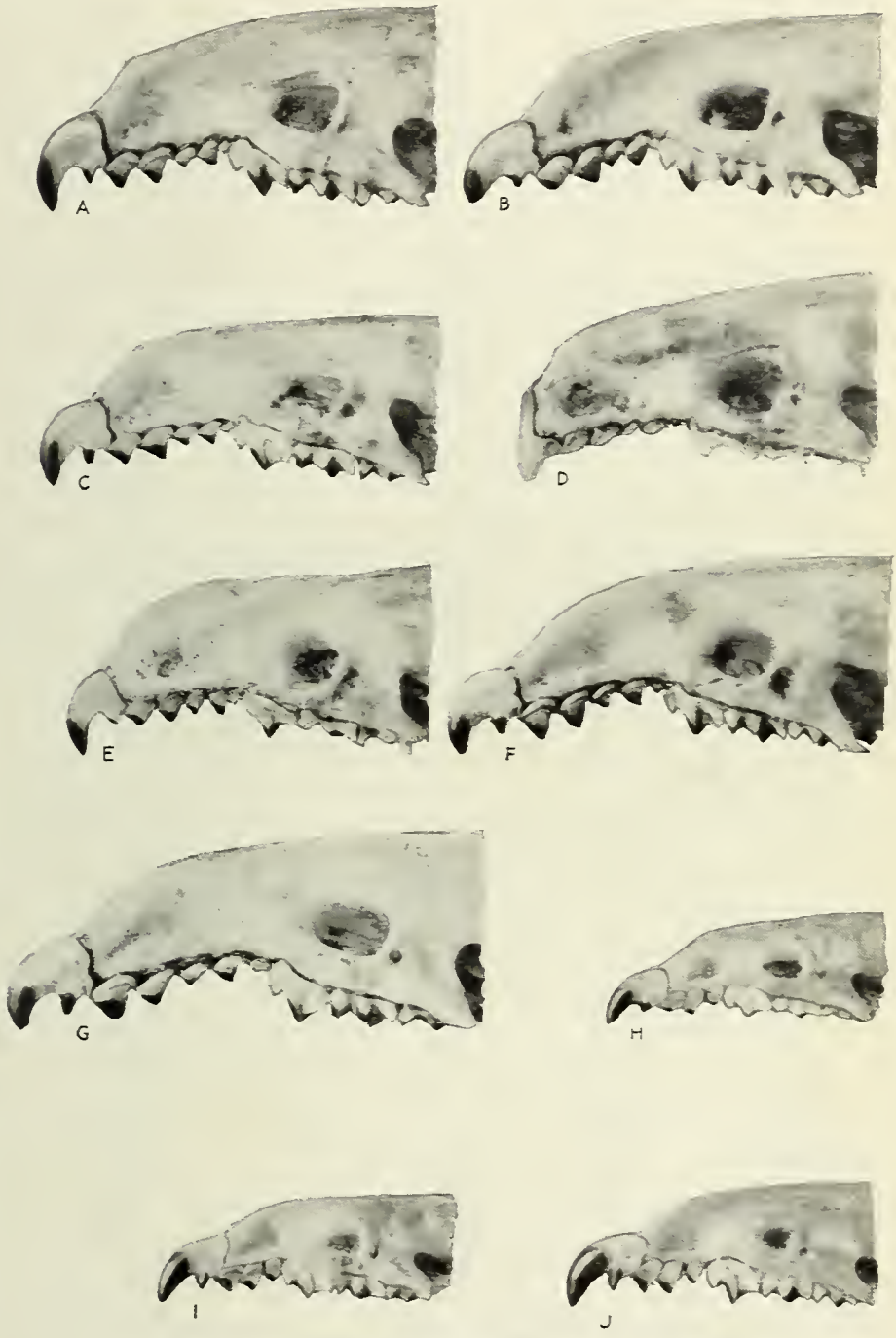
F. *Sorex bendirii bendirii* (Merriam); ♂ adult; Fort Klamath, Oreg. (No. 79941, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex bendirii palmeri* Merriam; ♂ adult; Eugene, Oreg. (No. 204482, U. S. Nat. Mus., Biological Survey collection.)

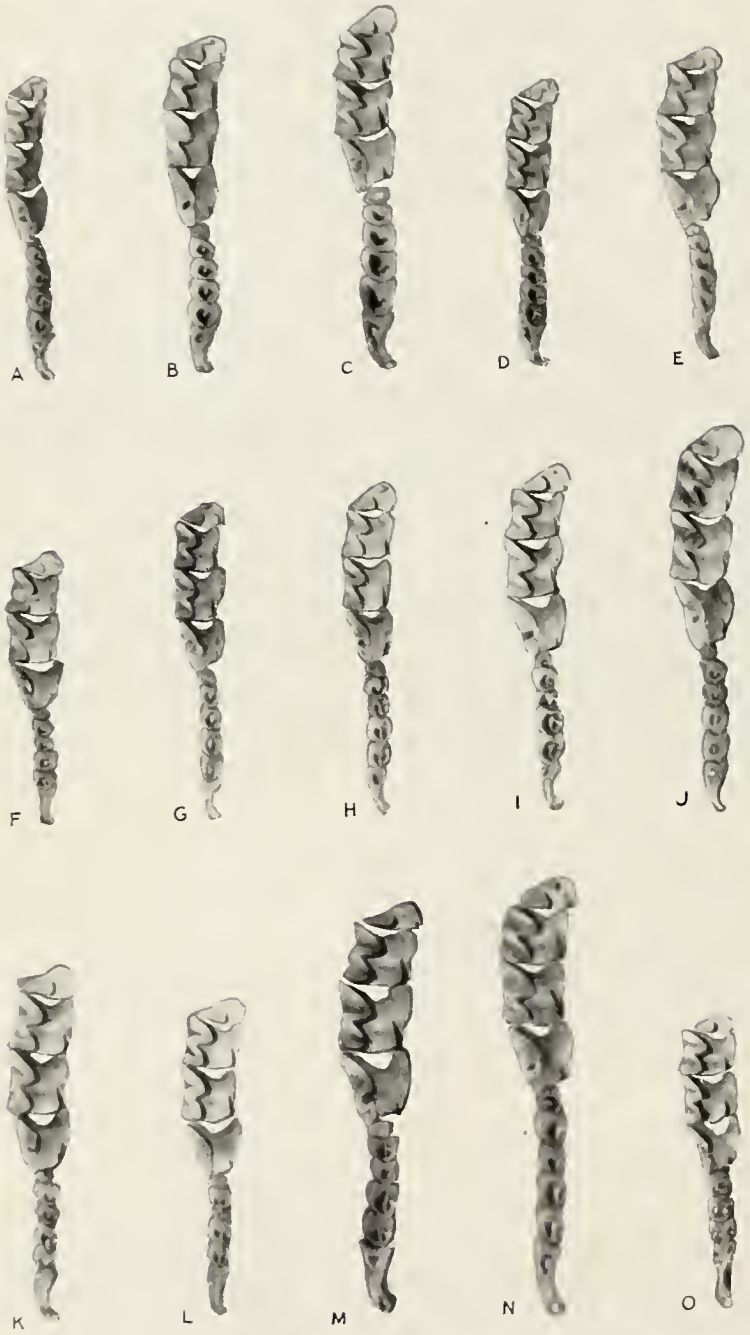
H. *Microsorex hoyi hoyi* (Baird); ♀ adult; Elk River, Minn. (No. 18700S, U. S. Nat. Mus., Merriam collection.)

I. *Microsorex hoyi intervectus* Jackson; type specimen; ♀ adult; Lakewood, Oconto County, Wis. (No. 226979, U. S. Nat. Mus., Biological Survey collection.)

J. *Microsorex hoyi eximius* (Osgood); type specimen; ♀ adult; Tyonek, Cook Inlet, Alaska. (No. 107126, U. S. Nat. Mus., Biological Survey collection.)



ROSTRA AND UPPER TEETH OF SOREX AND MICROSOREX



UPPER TEETH OF SOREX AND MICROSOREX

PLATE 11

[Enlarged five diameters]

A. *Sorex cinereus cinereus* Kerr; ♂ adult; Elkhart Lake, Wis. (No. 227412, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex fumeus fumeus* Miller; topotype; ♀ adult; Peterboro, N. Y. (No. 111123, U. S. Nat. Mus.)

C. *Sorex arcticus arcticus* Kerr; ♂ adult; South Edmonton, Alberta. (No. 69163, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex pribilofensis* Merriam; topotype; ♂ adult; St. Paul Island, Pribilof Group, Alaska. (No. 206182, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex merriami* Dobson; type specimen; ♀ adult; Fort Custer, Bighorn County, Mont. (No. 186441, U. S. Nat. Mus., Merriam collection.)

F. *Sorex longirostris longirostris* Bachman; ♂ adult; Falls Church, Va. (No. 87190, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex dispar* Batchelder; ♀ adult; Hunter Mountain, Catskill Mountains, N. Y. (No. 83159, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex trowbridgii trowbridgii* Baird; topotype; ♀ adult; Astoria, Oreg. (No. 89021, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex veraepacis veraepacis* Alston; ♀ adult; Reyes (near Cuicatlan), Oaxaca, Mexico. (No. 77033, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex saussurei saussurei* Merriam; type specimen; ♀ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45702, U. S. Nat. Mus., Biological Survey collection.)

L. *Sorex ornatus ornatus* Merriam; ♂ adult; Tehachapi, Calif. (No. 135947, U. S. Nat. Mus., Biological Survey collection.)

M. *Sorex palustris hydrobadistes* Jackson; ♀ adult; Lac Vieux Desert, Wis. (No. 18348, Field Mus. Nat. Hist.)

N. *Sorex bendirii bendirii* (Merriam); ♂ adult; Fort Klamath, Oreg. (No. 79941, U. S. Nat. Mus., Biological Survey collection.)

O. *Microsorex hoyi intervectus* Jackson; type specimen: ♀ adult; Lakewood, Oconto County, Wis. (No. 226979, U. S. Nat. Mus., Biological Survey collection.)

PLATE 12

[Enlarged five diameters]

A. *Sorex cinereus cinereus* Kerr; ♂ adult; Elkhart Lake, Wis. (No. 227412, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex fumeus fumeus* Miller; topotype; ♀ adult; Peterboro, N. Y. (No. 111123, U. S. Nat. Mus.)

C. *Sorex arcticus arcticus* Kerr; ♂ adult; South Edmonton, Alberta. (No. 69163, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex tundrensis* Merriam; type specimen; ♂ adult; St. Michael, Alaska. (No. 99286, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex pribilofensis* Merriam; topotype; ♂ adult; St. Paul Island, Pribilof Group, Alaska. (No. 206182, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex merriami* Dobson; type specimen; ♀ adult; Fort Custer, Bighorn County, Mont. (No. 186441, U. S. Nat. Mus., Merriam collection.)

G. *Sorex longirostris longirostris* Bachman; adult, sex unknown; Young Harris, Ga. (No. 159415, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex dispar* Batchelder; ♀ adult; Hunter Mountain, Catskill Mountains, N. Y. (No. 83159, U. S. Nat. Mus.)

I. *Sorex trowbridgii trowbridgii* Baird; topotype; ♀ adult; Astoria, Oreg. (No. 89021, U. S. Nat. Mus., Biological Survey collection.)

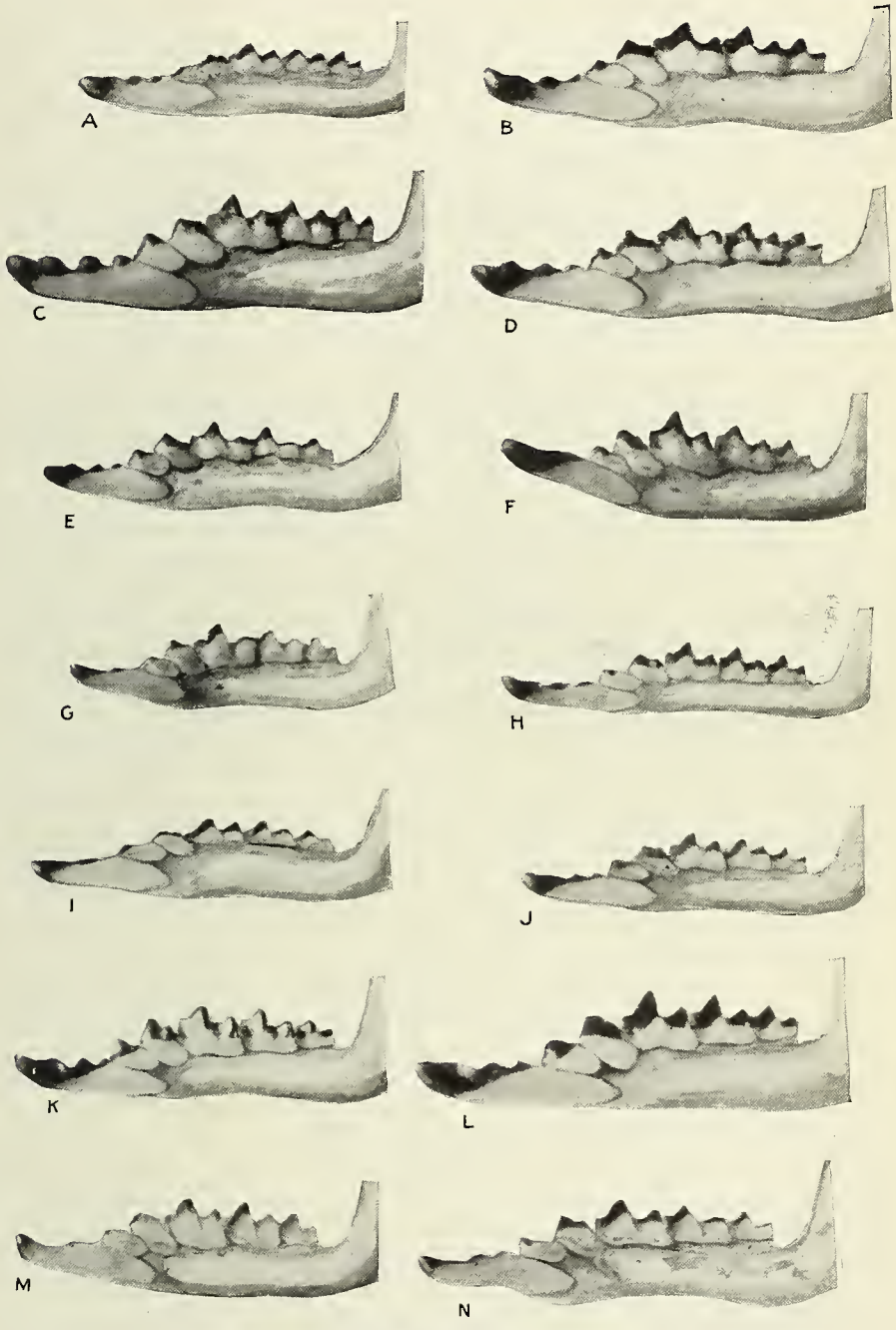
J. *Sorex vagrans vagrans* Baird; ♂ adult; Aberdeen, Wash. (No. 24339, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

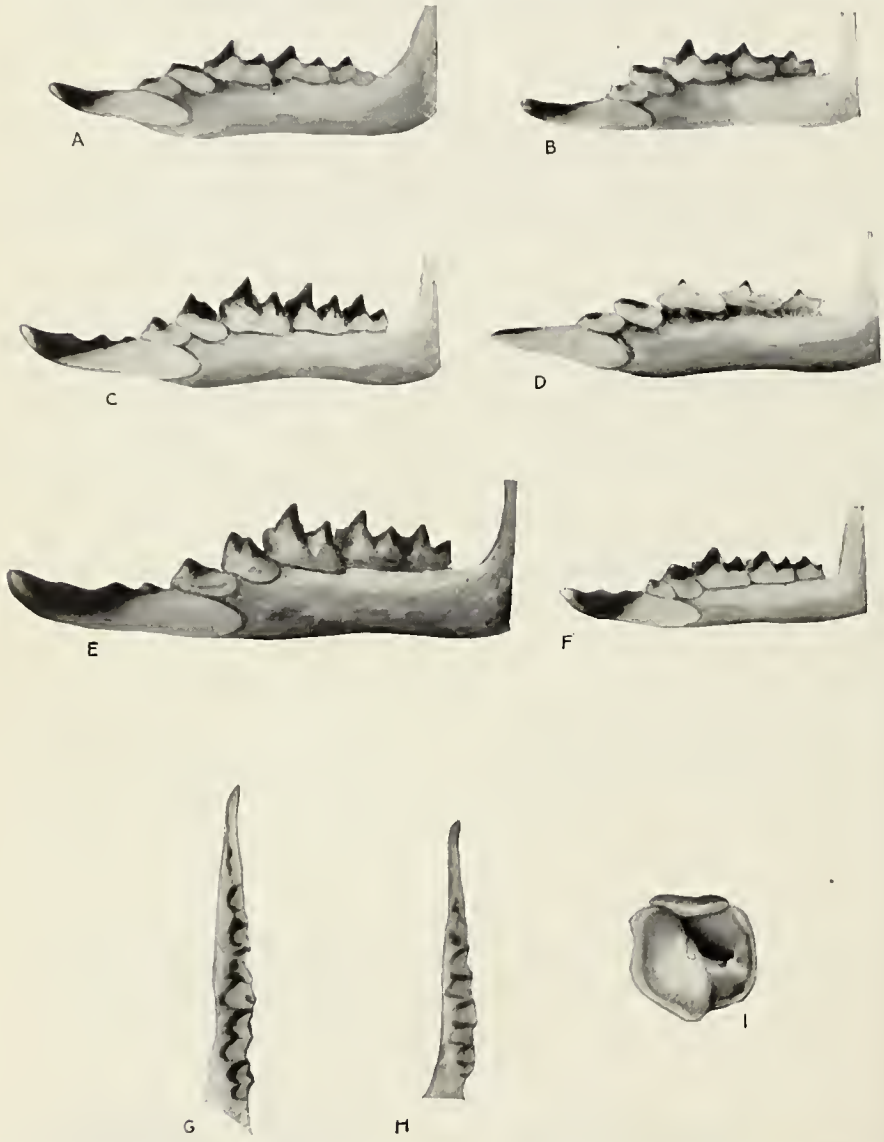
L. *Sorex yaquinae* Jackson; type specimen; ♀ adult; Yaquina Bay, Lincoln County, Oreg. (No. 73051, U. S. Nat. Mus., Biological Survey collection.)

M. *Sorex stizodon* Merriam; type specimen; ♀ adult; San Cristobal, Chiapas, Mexico (No. 75885, U. S. Nat. Mus., Biological Survey collection.)

N. *Sorex veraepacis veraepacis* Alston; ♀ adult; Todos Santos, Guatemala. (No. 77033, U. S. Nat. Mus., Biological Survey collection.)



LOWER TEETH OF SOREX



LOWER TEETH OF SOREX AND MICROSOREX AND UPPER TEETH OF MICROSOREX

PLATE 13

[A to H enlarged 5 diameters; I enlarged about 25 diameters]

A. *Sorex saussurei saussurei* Merriam; type specimen; ♀ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45702, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex ornatus ornatus* Merriam; ♂ adult; Tehachapi, Calif. (No. 135947, U. S. Nat. Mus.., Biological Survey collection.)

C. *Sorex palustris navigator* (Baird); ♂ adult; Mount Whitney, Calif. (No. 42545, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex palustris navigator* (Baird); ♂ old adult; Mount Whitney, Calif. (No. 42547, U. S. Nat. Mus., Biological Survey collection.) Figs. G and H show age variation.

E. *Sorex bendirii bendirii* (Merriam); ♂ adult; Fort Klamath, Oreg. (No. 79941, U. S. Nat. Mus., Biological Survey collection.)

F. H. *Microsorex hoyi intervectus* Jackson; type specimen; ♀ adult; Lakewood, Oconto County, Wis. (No. 226979, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

I. *Microsorex hoyi hoyi* (Baird); ♀ adult; Elk River, Minn. (No. 187008, U. S. Nat. Mus., Merriam collection.)

INDEX

[Synonyms in *italics;* principal references in **boldface figures**]