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Sorex pacificus.

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Sorex Linnaeus, 1758

Sorex Linnaeus, 1758:53. Type species *Sorex araneus* Linnaeus.
Musaraneus Brisson, 1762:126. Type species *Musaraneus* (type); included also *M. aquaticus* from Europe and *M. brasiliensis* from Brazil. Pomel placed *Sorex longirostris* Bachman in this genus (Jackson, 1928).
Oxyrhin Kaup, 1829:120. Type species *Sorex tetragonurus* Hermann.
Crossopus Wagler, 1832:275. Type species *Sorex fodiens* Beckstein (=*Sorex fodiens* Schreber).
Amphisorex Duvernoy, 1835:23. Type species *Sorex hermanni* Duvernoy (=*Neomys fodiens* (Pennant) skull plus *Sorex araneus tetragonurus* Hermann skin).
Corsira Gray, 1837:123. Type species *Sorex araneus* Linnaeus.
Otisorex De Kay, 1842:22. Type species *Otisorex platyrhinus* De Kay (=*Sorex cinereus* Kerr).
Hydrogale Pomel, 1848:248. Type species *Sorex fimbripes* Bachman (=*Sorex cinereus* Kerr). Not *Hydrogale* Kaup, 1829.
Neosorex Baird, 1858:11. Type species *Neosorex navigator* Baird.
Microsorex Coues, 1877:646. Type species *Sorex hoyi* Baird. Synonomized with *Sorex* by Diersing (1980).
Atophyrax Merriam, 1884:217. Type species *Atophyrax bendirii* Merriam.
Homalurus Schulze, 1890:28. Type species *Sorex alpinus* Schinz.
Soricidus Altobello, 1927:6. Type species *Soricidus monsvairani* Altobello (=*Sorex araneus tetragonurus* Hermann).

CONTEXT AND CONTENT. Order Insectivora, Superfamily Soricoidea, Family Soricidae, Subfamily Soricinae, Tribe Soricini, Genus *Sorex*. Honacki et al. (1982) recognized 64 living species.

Sorex pacificus Coues, 1877

Pacific Shrew

Sorex pacificus Coues, 1877:650. Type locality Fort Umpqua, mouth Umpqua River, Douglas Co., Oregon.
Sorex yaquinae Jackson, 1981:127. Type locality Yaquina Bay, Lincoln Co., Oregon.

CONTEXT AND CONTENT. Context same as for genus. Junge and Hoffmann (1981) distinguished three subgenera, with *S. pacificus* assigned to *Otisorex*. Three subspecies currently are recognized (Bailey, 1936; Hennings and Hoffmann, 1977; Jackson, 1928):

S. p. pacificus Coues, 1877:650, see above.
S. p. sonomae Jackson, 1921:162. Type locality Sonoma Co. side of Gualala River, Gualala, Sonoma Co., California.
S. p. yaquinae Jackson, 1918:127, see above.

DIAGNOSIS. *Sorex pacificus* may be distinguished from all other brownish soricids within and adjacent to its known geographic range by the absence of median tines (Fig. 1, top) on the first upper incisors (Junge and Hoffmann, 1981). However, some specimens collected in the northern portion of the known range, near the area of contact with *S. monticolus*, may have a small squarish ridge (Fig. 1, bottom) on the median margin of the first upper incisors (Hennings and Hoffmann, 1977).

GENERAL CHARACTERS. The Pacific shrew, like other members of the genus, has pentadactyl plantigrade feet, a long pointed snout, small eyes, and ears that, in life, are conspicuous (Fig. 2). The tail averages greater than 75% of head and body length. It is the largest soricid with typically cinnamon-brown pelage in the Pacific coast region of the United States, and the second largest soricid in the region (Jackson, 1928). Pelage color (names according to Munsell soil color chart, 1975; hue, value, and chroma in parenthesis) in *S. pacificus* ranges from dark yellowish brown (10YR 3/4) to dark grayish brown (10YR 4/2) on the dorsum and brown (10YR 5/3) on the venter in summer. The winter pelage is characterized by a very dark gray (10YR 3/1) dorsum and a grayish brown (10YR 5/2) venter. The tail is indistinctly bicolored.

The skull, lacking zygomata, is shaped, in dorsal view, like an arrowhead set on a circle, which is typical also of other *Sorex* (Fig. 3). Dark red pigment is present high on the anterior face of the

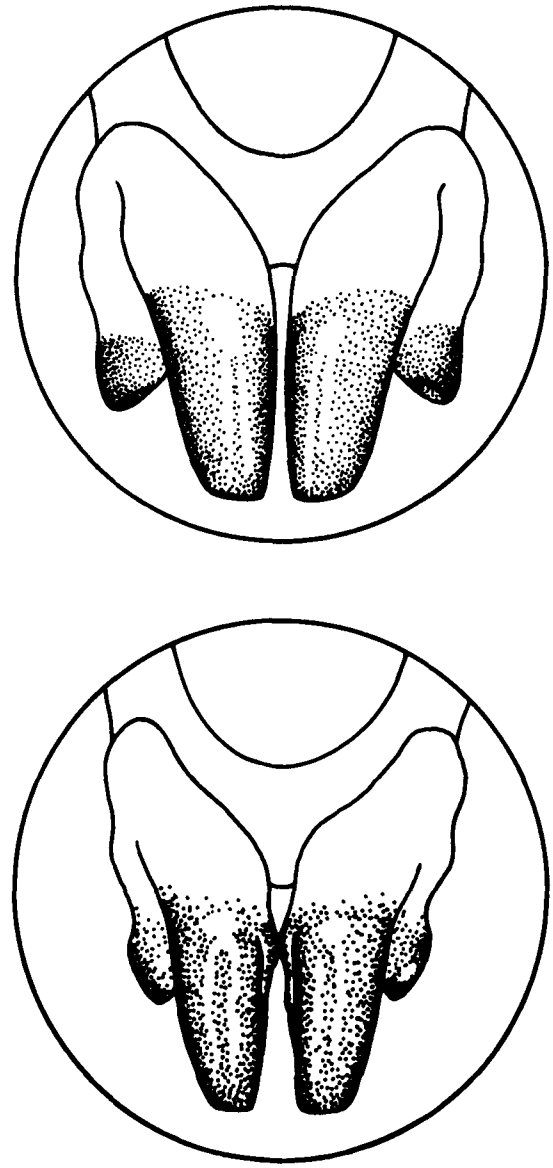

FIG. 1. Anterior views of I1 of *Sorex pacificus*: top, OSUFW 4604, adult male *S. p. pacificus*, from 5 mi N Alpha, Lane Co., Oregon, without median ridge; bottom OSUFW 4832, adult female *S. p. yaquinae*, from 3 mi S, 8 mi W Philomath, Benton Co., Oregon, with median ridge. Greatest width of bicuspid incisors is 2 mm. Illustration by G. L. Milton.

FIG. 2. Photograph of a living *Sorex pacificus* (adult female, from Oxbow Burn, T20S, R8W, Douglas Co., Oregon). Photo courtesy of R. B. Smith.

bicuspid incisors (Fig. 1). In lateral view, the third unicuspid tooth is distinctly smaller than the fourth (Junge and Hoffmann, 1981), and the fifth is distinctly smaller than the third (Coues, 1877); in ventral view, the unicuspids are wider than long (Fig. 3). The mandible is L-shaped with a spine-like angular process (Fig. 3).

DISTRIBUTION. Pacific shrews occur along the Pacific coast (Fig. 4) from the northern boundary of Lincoln Co., Oregon, southeastward to Lane Co., Oregon, thence southward to Hilt, Siskiyou Co., California, Gasquet, Del Norte Co., California, and Inverness, Marin Co., California, (Hennings and Hoffmann, 1977; Hall, 1981). The stratigraphic range of the Soricinae in the New World extends from the late Miocene to the Recent; there are no Pleistocene records of soricids within the present range of *Sorex pacificus* (Kurtén and Anderson, 1980).

FORM. Means and ranges (in parentheses) of external measurements (in mm), in order of total length, tail length, and hindfoot length, for 11 specimens of *S. p. yaquinae* from Lane Co., Oregon, (Findley, 1955) were: 125.3 (110 to 136); 55.1 (49 to 61); 14.9 (14 to 16). The range in ear length was reported as 9 to 12 (Maser et al., 1981). *S. p. pacificus* averages larger; measurements of a sample of eight from Orick, Humboldt Co., California, (Findley, 1955) were: 143.1 (134 to 154); 65.5 (59 to 72); 17.5 (16 to 19). A sample of five from Eureka, Humboldt Co., California (Jackson, 1928), were: 144.8 (137 to 153); 64.2 (62 to 67); 17.2 (17 to 17.5). The range in ear length was reported as 8 to 13 (Maser et al., 1981). External measurements of three *S. p. sonomae* topotypes fall within the range of those of *S. p. pacificus*: 141.7 (141 to 143); 59 (54 to 63); 17 (Jackson, 1928). Maser et al. (1981) reported body masses of 10 to 18 g for *S. p. pacificus* and 5.5 to 15 g for *S. p. yaquinae*.

Cranial measurements (in mm) for the type specimen of *S. p. yaquinae* (a female) were: condylobasal length, 20.7; palatal length, 8.3; cranial breadth, 9.7; interorbital breadth, 4.3; maxillary breadth, 5.9; maxillary toothrow, 7.6. The same dimensions for an adult male from Gardiner, Douglas Co., Oregon, were: 20.0; 8.0; 9.9; 4.2; 6.1; 7.4 (Jackson, 1928). An adult female *S. p. pacificus* from Gardiner, Douglas Co., Oregon, measured: 21.6; 9.0; 10.4; 4.7; 6.4; 8.1; means and ranges for five adult males from Eureka, Humboldt Co., California, (Jackson, 1928) were: 22.1 (21.4 to 23.0); 9.3 (9.0 to 9.5); 10.6 (10.4 to 11.2); 4.5 (4.4 to 4.7); 6.6 (6.5 to 6.9); 8.5 (8.3 to 8.8). The adult female type specimen of *S. p. sonomae* measured: 21.1; 8.9; 10.3; 4.5; 6.3; 8.1; means and ranges for three adult males from the type locality (Jackson, 1928) were: 21.4 (21.0 to 21.7); 9.1 (8.9 to 9.2); 10.5 (10.3 to 10.8); 4.5 (4.4 to 4.6); 6.4 (6.3 to 6.5); 8.2 (8.0 to 8.4).

The dental formula for *Sorex* commonly is reported as i 3/1, c 1/1, p 3/1, m 3/3, total 32 (Hall, 1981; Ingles, 1965), but the homologies of unicuspid teeth in soricids (second through sixth upper teeth) are not clear (Repenning, 1967). These teeth often are referred to as U1 to U5; the four molariform teeth posterior to them are P4 through M3 (Junge and Hoffmann, 1981).

Seemingly, no information is available on function in *S. pacificus*.

REPRODUCTION. Male Pacific shrews are reproductively active primarily from February to August, although sexually mature

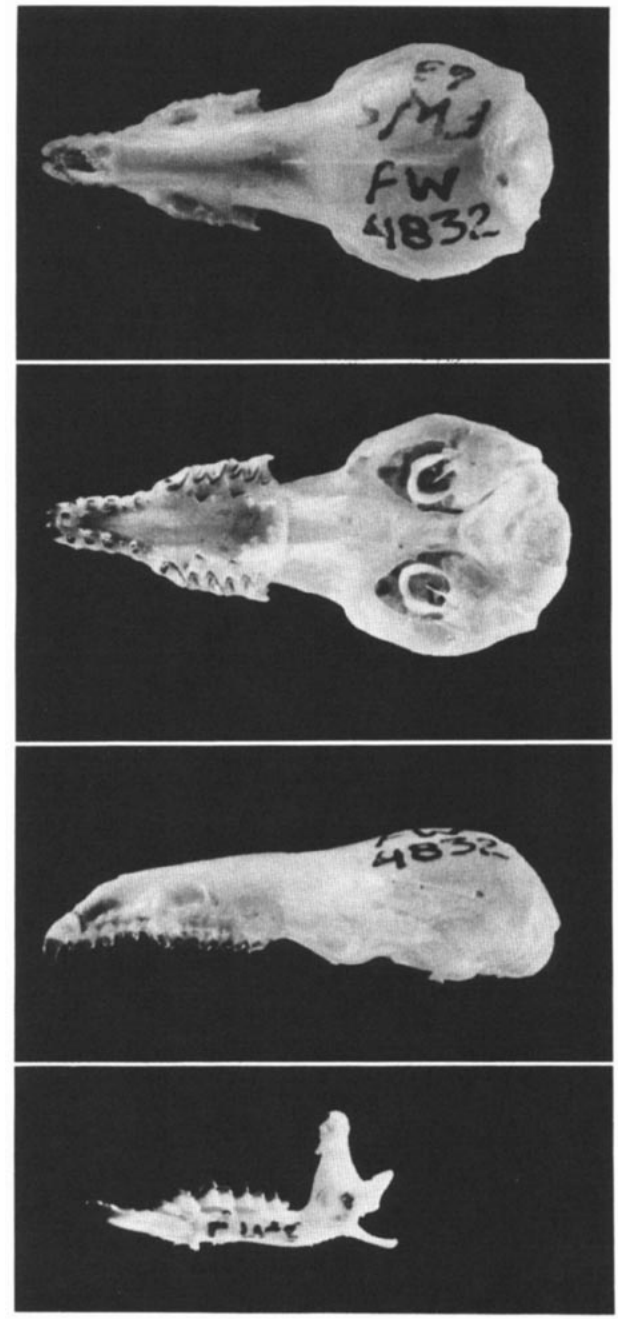

FIG. 3. Dorsal, ventral, and lateral views of skull and lateral view of mandible of *Sorex pacificus* (OSUFW 4832). Greatest length of skull is 19.6 mm. Photo by B. J. Verts.

males may be found throughout the year; females are reproductively active from March to August and occasionally to November (Maser et al., 1981). Two to six young/litter may be produced although the usual number is four or five (Maser et al., 1981). Two females collected on 22 August 1983 and on deposit in the Oregon State University, Department of Fisheries and Wildlife Collection (OSUFW) were parous; one contained two sets of pigmented implantation sites (two left, three right and three left, three right) and one had five (three left, two right) embryos (crown-rump length = 10 mm).

ECOLOGY. Pacific shrews commonly are found in moist areas that contain fallen decaying logs and brushy vegetation (Bailey, 1936). Maser et al. (1981) reported Pacific shrews often were associated with alder (*Alnus* sp.), salmonberry (*Rubus spectabilis*), or skunk cabbage (*Lysichitum americanum*), in Oregon. Sherrell (1970:27) took Pacific shrews "along a stream in a shady area, . . . in a moist ditch, and . . . in moist grass under an alder thicket."

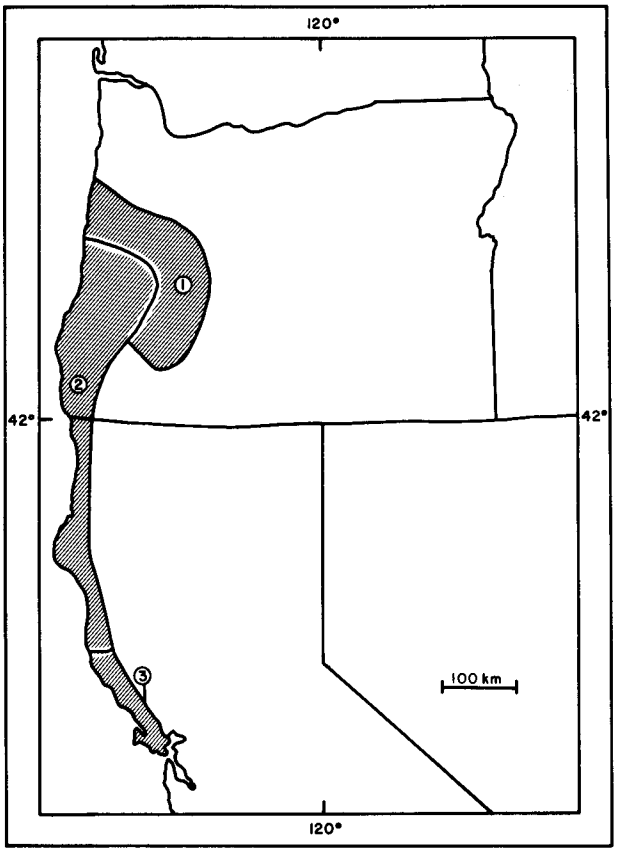

FIG. 4. Geographical distribution of *Sorex pacificus*. Subspecies are: 1, *S. p. yaquinae*; 2, *S. p. pacificus*; 3, *S. p. sonomae*. Map modified after Hall (1981) and Hennings and Hoffmann (1977).

In California, this shrew was trapped in redwood, *Sequoia sempervirens*, or dense spruce, *Picea* sp., forests, and "under old logs or stumps in dense chaparral or in the marshes and muddy bottoms" (Bailey, 1936:363). Maser and Hooven (1969) captured 4 *S. pacificus* among 243 small mammals collected in the Coast Range of Oregon on a forested area burned 2 years earlier; vegetation on the area included bracken fern (*Pteridium aquilinum*), vine maple (*Acer circinatum*), dogwood (*Cornus nuttallii*), rhododendron (*Rhododendron macrophyllum*), ceanothus (*Ceanothus* sp.), salal (*Gaultheria shallon*), hazel (*Corylus cornuta*), evergreen huckleberry (*Vaccinium ovatum*), Oregon grape (*Berberis nervosa*), cudweeds (*Gnaphalium* sp.), fireweeds (*Epilobium* sp.), and thistles (*Cirsium* sp.). Hooven and Black (1976), in a study of the effect of forest-cutting practices on populations of small mammals in western Oregon, combined data for *S. yaquinae* (= *S. p. yaquinae*) with those for *S. vagrans* because so few of the former were caught; possibly, other investigators of the ecology of small mammals in the region deliberately or inadvertently included *S. pacificus* in similar groupings.

Whitaker and Maser (1976) listed 29 items in the diet of *S. p. pacificus* from western Oregon; slugs and snails (Gastropoda), centipedes (Chilopoda), amphibian flesh, unidentified insect larvae, and unidentified invertebrates occurred most frequently and constituted the greatest volume of contents of 30 stomachs examined. Insects (Coleoptera, Hemiptera, and Diptera, of which 18% were larval forms), vegetative material (moss, fungi, and seeds), and miscellaneous invertebrates [ant (Hymenoptera) eggs, ticks (Arachnida), and earthworms (Oligochaeta)] composed the remainder of foods eaten. Whitaker and Maser (1976) listed 30 food items among 27 stomachs of *S. p. yaquinae* examined; almost one-third of the volume was composed of the internal organs of invertebrates. Insects (Coleoptera, Hemiptera, Diptera, Hymenoptera) and vegetation, including fungi, constituted a large proportion of remaining food items. Maser (1975) reported that Pacific shrews preyed on the coleopterans *Omus audouini* and *O. dejeani*.

Mammalian associates of Pacific shrews are *Sorex trowbridgii, S. monticolus, Neurotrichus gibbsii, Sylvilagus bachmani, Tamias townsendii, Glaucomys sabrinus, Peromyscus maniculatus, Arborimus albipes, Microtus longicaudus, M. oregoni, Clethrionomys californicus, Zapus trinotatus*, and *Mustela erminea* (Beer, 1959; Maser and Hooven, 1969; Moore, 1942; Sherrell, 1969). Other small mammals within the range of the species include *Sorex vagrans, S. bendirii, Scapanus townsendii, S. orarius, Aplodontia rufa, Tamiasciurus douglasii, Thomomys mazama, T. bottae, Arborimus longicaudus, Microtus townsendii, Neotoma cinerea*, and *Mustela frenata* (Hall, 1981).

Investigators of food habits of carnivorous mammals (Nussbaum and Maser, 1975) and raptorous birds (Forsman and Maser, 1970; Maser and Brodie, 1966) within the range of *S. pacificus* did not distinguish among soricids, but *S. pacificus* likely constituted some of those listed.

Recorded ectoparasites are Acarina: *Amorphacarus hengererorum, Androlaelaps fahrenholzi, Eucheyletia bishoppi, Euryparasitus* sp., *Glycyphagus hypudaei, Haemogamasus occidentalis, Hirstionyssus obsoletus, Laelaps alaskensis, Orycteroxenus soricis*, and *Pygmephorus* sp. (Whitaker et al., 1980), *Ixodes angustus* and *I. soricis* (Easton and Goulding, 1974), and *Protomyobia brevisetosa* (Jameson and Dusbabek, 1971; Whitaker et al., 1980), *Comatacarus americanus* (Easton, 1975); Coleoptera: *Leptinus testaceus* (Maser and Hooven, 1971); Siphonoptera: *Doratopsylla jellisoni, Epitedia jordani*, and *E. stewarti* (Hubbard, 1940), *Catallagia sculleni chamberlini, Corypsylla kohlsi, Epithedia scapani, Hystrichopsylla o. occidentalis, Malaraeus telchinus*, and *Peromyscsopsylla selenis* (Lewis and Maser, 1981). Whitaker et al. (1980) also reported an unidentified mite of the family Anoetidae.

BEHAVIOR. Based on observations of three captive individuals, Maser and Hooven (1974) concluded that *S. pacificus* was not active during the day, but awakened periodically to eat food items cached near their nests. During periods of inactivity these shrews used nest boxes or nests they built themselves with materials carried in their mouths. Nests were built of natural materials provided, but wood, string, and paper were not used. Nocturnal activity was characterized by sudden movements associated with frequent vocalizations and constant smelling of the air.

Grooming was frequent and, except when cleaning the urogenital area, was performed in a crouched position (Maser and Hooven, 1974). Scratching with a hindfoot after stretching the skin by bowing the body to spread the hairs was the usual mode of grooming; even the back and chest were groomed in this manner. The face was cleaned by licking the forefeet and rubbing them over the face. The tail, held by the forefeet, was cleaned in the mouth. The urogenital area was cleaned by licking while the shrews lay on their sides; the feet were not used. After grooming the hindfeet were cleaned by licking.

The observed hunting behavior of captive Pacific shrews indicated that prey was located by use of smell and hearing; terrestrial prey seemed to be located by odor, but flying prey was located by sound and occasionally was caught in flight (Maser and Hooven, 1974). When presented with several prey items, Pacific shrews commonly immobilized and cached some but not all; orthopterans were immobilized by biting at the junction of the head and thorax, coleopterans by biting near the attachment of the elytra, and, on rare occasions, hymenopterans were bitten through the thorax. Other prey was eaten where it was found. When shrews were not hungry they ignored prey even when it moved close to them (Maser and Hooven, 1974).

In captivity, *S. pacificus* maintained a midden separate from the nest area for deposit of excretory material (Maser and Hooven, 1974).

GENETICS. A diploid chromosome number of 54 was reported for Pacific shrews (Brown, 1974). The fundamental number is 58 (6 metacentrics and 46 acrocentrics) in *S. p. pacificus* and 58 or 59 (6 metacentrics and 46 acrocentrics or 6 metacentrics, 1 submetacentric, and 45 acrocentrics) in *S. p. yaquinae* (Brown, 1974). On the basis of inspection of published idiograms (Brown, 1974), *S. p. pacificus* has an X-chromosome that is submetacentric and a Y-chromosome that is a very tiny acrocentric, and *S. p. yaquinae* has an X-chromosome that is submetacentric, whereas the Y is either a dot-like metacentric or a submetacentric. Seemingly, no information on the karyotype of *S. p. sonomae* is available.

REMARKS. Findley (1955) believed that *Sorex pacificus* was the largest end member of a *Sorex vagrans* rassenkreis, and reduced it to subspecific status under *S. vagrans*. However, Johnson and Ostenson (1959:576) believed that the association was "too complex to be settled on the basis of simple morphologic relationships; further work and interpretation are necessary with this group before excepting any gross combination into a single species." Hennings and Hoffmann (1977) showed that *S. pacificus* was distinct from *S. vagrans* on the basis of morphology and re-elevated *S. pacificus* to specific standing. Maser et al. (1981) adhered to the taxonomy of Jackson (1928) by recognizing *S. yaquinae* as a separate species, not as a subspecies of *S. pacificus*.

Bobrinskii et al. (1944) designated *S. mirabilis* Ognev from the Kiskinka River Valley, Ussuri Region, Eastern Siberia, as a subspecies of *S. pacificus* on the basis of comparisons with the published photograph of the anterior portion of the skull of *S. pacificus* in Jackson (1928). Johnson and Ostenson (1959) questioned the validity of this conspecific designation on the basis of such an indirect comparison. Hoffmann (1971) believed that present evidence indicated that *S. pacificus* and *S. mirabilis* were distinct species.

The generic name *Sorex* is from the Latin *soric* meaning "shrew mouse" and the specific name *pacificus* is from the Pacific Ocean (Jaeger, 1955). The subspecific names *yaqinae* and *sonomae* are from local Indian tribes.

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