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Scalopus aquaticus.

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Scalopus É. Geoffroy St.-Hilaire, 1803

Scalopus E. Geoffroy St.-Hilaire 1803:77. Type species *Sorex aquaticus* Linnaeus. (=*Scalopus aquaticus*)

CONTEXT AND CONTENT. Order Insectivora, Family Talpidae, Subfamily Scalopinae. The genus *Scalopus* has one species.

Scalopus aquaticus (Linnaeus, 1758)

Eastern Mole

[*Sorex*] *aquaticus* Linnaeus, 1758:53. Type locality, eastern United States (fixed by Jackson, 1915:33, at Philadelphia, Pennsylvania).
Scalopus virginianus É. Geoffroy St.-Hilaire, 1803:78. Type locality Virginia (?)
Talpa cupreata Rafinesque, 1814:14. Type locality, "Atlantic States."
Scalops pennsylvania Harlan, 1825:33. Type from unknown locality.
Talpa machrina Rafinesque, 1832:62. Type locality near Lexington, Fayette Co., Kentucky.
Talpa sericea Rafinesque, 1832:62. Type locality near Nicholasville and Harrodsburgh, Kentucky.
Scalops argentatus Audubon and Bachman, 1842:292. Type locality in southern Michigan.
Scalops texanus Allen, 1893:200. Type locality Presidio County, Texas.
Scalops parvus Rhoads, 1894:157. Type locality Tarpon Springs, Pinellas Co., Florida.
Scalops anastasae Bangs, 1898:212. Type locality Point Romo, Anastasia Island, St. John Co., Florida.
Scalopus aquaticus Oberholser, 1905:3. First use of name combination.
Scalopus inflatus Jackson, 1914:21. Type locality 45 mi. from Brownsville, Texas.
Scalopus montanus Baker, 1951:19. Type locality Club Sierra del Carmen, 2 mi. N, 6 mi. W Piedra Blanca, Coahuila.

CONTEXT AND CONTENT. See generic summary above. Sixteen subspecies are currently recognized (Hall and Kelson, 1959; Yates and Schmidly, 1977):

S. a. aereus (Bangs, 1896:138). Type locality Stilwell, Adair Co., Oklahoma (*pulcher* Jackson and *intermedius* Elliot are synonyms).
S. a. alleni Baker, 1951:22. Type locality Rockport, Aransas Co., Texas.
S. a. anastasae (Bangs, 1898), see above.
S. a. aquaticus (Linnaeus, 1758), see above.
S. a. australis (Chapman, 1893:339). Type locality Gainesville, Alachua Co., Florida.
S. a. bassi Howell, 1939:363. Type locality Englewood, Sarasota Co., Florida.
S. a. caryi Jackson, 1914:20. Type locality Neligh, Antelope Co., Nebraska.
S. a. howelli Jackson, 1914:19. Type from Autaugaville, Autauga Co., Alabama.
S. a. inflatus Jackson, 1914, see above.
S. a. machrinus (Rafinesque, 1832), see above.
S. a. machrinoides Jackson, 1914:19. Type locality Manhattan, Riley Co., Kansas.
S. a. montanus Baker, 1951, see above.
S. a. nanus Davis, 1942:383. Type locality 13 mi. E Centerville, Leon Co., Texas. (*cryptus* Davis a synonym).
S. a. parvus (Rhoads, 1894), see above.
S. a. porteri Schwartz, 1952:381. Type locality Uleta, Dade Co., Florida.
S. a. texanus (Allen, 1893), see above.

DIAGNOSIS. Since the genus is monotypic, the following diagnosis applies to both genus and species: body robust and depressed; tail short, round, and scantily haired, although appearing essentially naked; tail less than a fourth of total length; nose elongated into distinct snout; apical portion naked to line of anterior edge of nasals; nostrils superior, crescentic, with concavities turned in laterally; eyes small, with no external opening, of little use except possibly to detect light (Slonaker, 1902). External ears are lacking; ear openings are tiny holes buried in fur. Feet are large, fleshy, scantily haired above and naked below; forefeet modified for digging, palms wider than long; toes on both front and hind feet webbed. Fur is dense, soft, silky, velvetlike; color variable, from nearly black to silver. There are six mammae. In the skull, the braincase is relatively broad and flattened (figure 1); mastoids are heavy and prominent; frontal region is flat; frontal sinuses are swollen; anterior nares are directed forward; auditory bullae are complete; zygomatic arches are present although thin and curved. The dentition has: first incisor long and broad, second and third tiny; canine two-thirds as long as I1; m1 and m2 subequal; no persistent lower canine; lower premolars increasing in size posteriorly; lower molars decreasing in size posteriorly; functional dentition, i 3/2, c 1/0, p 3/3, m 3/3, total 36.

GENERAL CHARACTERS. Males of *Scalopus aquaticus* average generally larger in size than do females. The largest individuals are found in the north-central part of the range; size decreases gradually both to the east and west, and rather abruptly to the south.

Measurements for two adult males and two adult females from the type locality of the nominate subspecies (from Jackson,

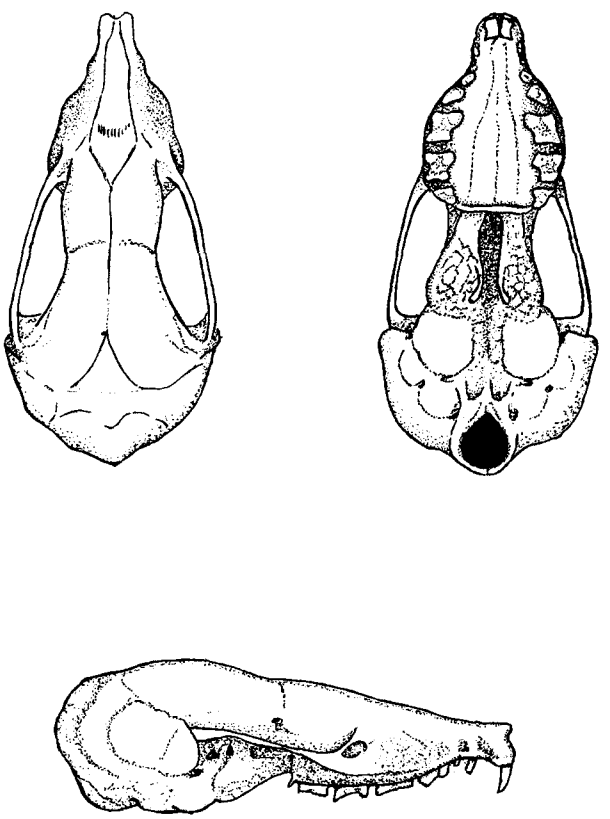

FIGURE 1. Dorsal ventral, and lateral views of skull of *Scalopus aquaticus nanus* (TCWC 28053).

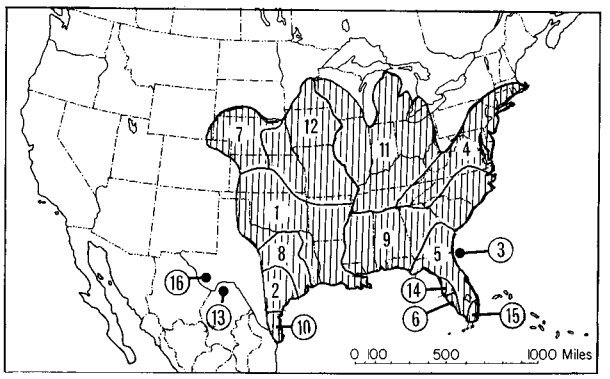

FIGURE 2. Geographic distribution of *Scalopus aquaticus* and subspecies: (1) *S. a. aereus*, (2) *S. a. alleni*, (3) *S. a. anastasae*, (4) *S. a. aquaticus*, (5) *S. a. australis*, (6) *S. a. bassi*, (7) *S. a. caryi*, (8) *S. a. cryptus*, (9) *S. a. howelli*, (10) *S. a. inflatus*, (11) *S. a. machrinus*, (12) *S. a. machrinoides*, (13) *S. a. montanus*, (14) *S. a. parvus*, (15) *S. a. porteri*, (16) *S. a. texanus*.

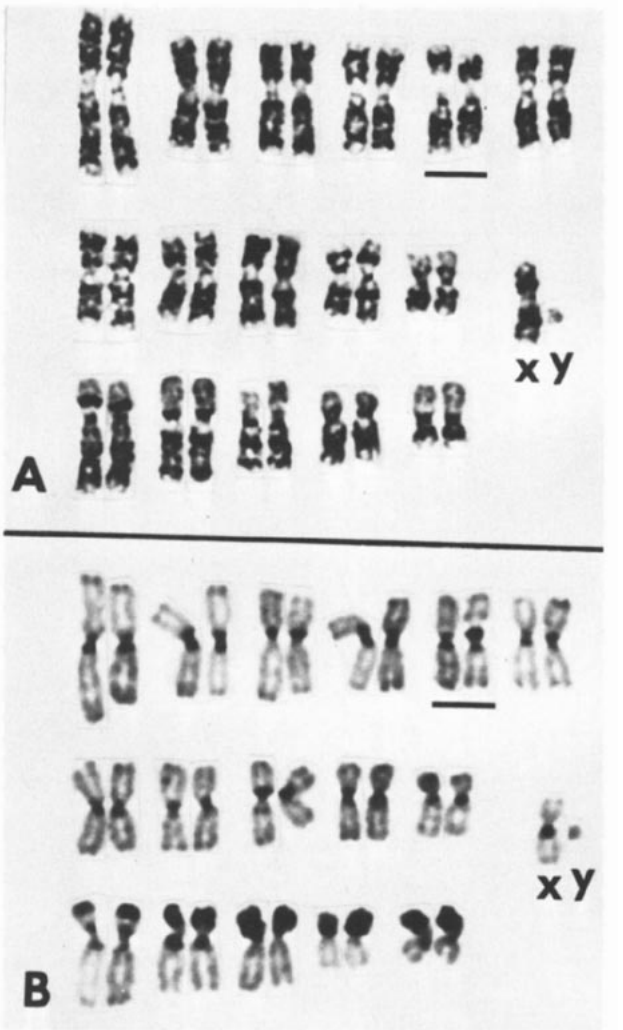

FIGURE 3A. G-banded karyotype of a male *Scalopus aquaticus* from Tyler County, Texas, showing secondary constriction in heteromorphic chromosome pair 5 (underlined). FIGURE 3B. C-banded karyotype of a male *Scalopus aquaticus* from Tyler County, Texas, showing heterochromatic polymorphism in chromosome pair 5 (underlined).

1915) are: total length, 180 to 185, 154 to 155; tail vertebrae, 28 to 31, 23; and hind foot, 21, 19 to 20. Means of 15 adult males and eight adult females from Washington, D.C. (Jackson, 1915), are: 163.4 (154 to 175), 152.6 (146 to 168); 26.5 (22 to 29), 26 (21 to 28); 19.8 (18 to 21), 19 (18 to 20). Means and extremes of 21 skulls of adult males and 15 skulls of adult females from Washington, D.C., and vicinity (Jackson, 1915) are, respectively: greatest length, 34.3 (33.2 to 35.6), 32.9 (32.3 to 34.2); palatilar length, 14.7 (14.3 to 15.2), 13.9 (13.5 to 14.7); mastoidal breadth, 17.7 (17.0 to 18.3), 17.1 (16.3 to 17.5); interorbital breadth, 7.4 (7.2 to 7.8), 7.4 (7.0 to 7.6); maxillary toothrow, 10.8 (10.4 to 11.3), 10.4 (10.1 to 10.8); and mandibular molar-premolar row, 10.4 (10.1 to 10.8), 10.2 (9.8 to 10.4).

Measurements for 21 adult males and 21 adult females from Conroe, Texas, as listed by Yates and Schmidly (1977) are as follows: total length, 152.1 (142 to 164), 140.2 (129 to 148); tail, 25.1 (18 to 31), 23.3 (20 to 26); hind foot, 19.5 (17 to 22), 18.5 (17 to 20); greatest length of skull, 32.8 (31 to 33.8), 31.7 (30.9 to 32.9); mastoidal breadth, 17.3 (16.2 to 18), 16.8 (16.5 to 17.2); interorbital breadth, 7.1 (6.5 to 7.5), 7.0 (6.7 to 7.2); length of maxillary toothrow, 10.1 (9.6 to 10.7), 9.7 (9.2 to 10.2); length of palate, 14.3 (13.3 to 15.5), 13.7 (13.3 to 14.4); width across M2-M2, 8.9 (8.3 to 9.6), 8.5 (8.2 to 9.1); width across canines, 3.7 (3.5 to 4.1), 3.7 (3.5 to 3.9); depth of skull, 9.8 (9.5 to 10.2), 9.4 (9.2 to 9.8).

Hall and Kelson (1959) listed the following range in external and cranial measurements for the genus: total length, 128 to 208; tail, 18 to 38; hind foot, 15 to 22; and greatest length of skull, 29.3 to 39.5.

DISTRIBUTION. *Scalopus aquaticus* has the largest range of any North American mole, occurring throughout much of the eastern United States where soils are favorable (see figure 2). It ranges from northern Tamaulipas northward to southeastern South Dakota, Minnesota and Michigan, eastward to Massachusetts and much of southern New England, hence south to the southernmost tip of Florida.

Lowery (1974) reported that the eastern mole occurs throughout the upland portions of Louisiana but is not common in coastal situations. Two relict populations have been reported, one from northern Coahuila (Baker, 1951) and another from Presidio County, Texas (Allen, 1893).

FOSSIL RECORD. Fossil remains of *Scalopus aquaticus* have been reported from the upper Ohio Valley of Pennsylvania and West Virginia (McKeever, 1954; Guilday, 1961; Guilday and Parmalee, 1965; Guilday and Tanner, 1969; Guilday, 1972). Remains of *S. aquaticus* also have been reported from Pleistocene cave faunas of Texas (Dalquest, Roth, and Judd, 1969; Frank, 1964).

FORM AND FUNCTION. Doran (1876) and Stroganov (1945) described the morphological characters of the auditory ossicles in *Scalopus aquaticus*. Eadie (1954) discussed pelage and skin gland activity, whereas Ziegler (1971) described dental homologies of Recent Talpidae. The shoulder anatomy of *S. aquaticus* was detailed by Campbell (1939). Slonaker (1920) and Reed (1954) described adaptive morphological changes and origin of familial characters, respectively, and Slonaker (1902) described the eye of *S. a. machrinus*.

ECOLOGY. Due to a need for large quantities of food, moles range over larger areas than do most other fossorial mammals, thereby increasing gene flow and reducing the likelihood of inbreeding. Thus, the island model type of distribution common in pocket gophers is rare in moles. The home range of the eastern mole exceeds that of many rodents. The home range of male *S. aquaticus* (Harvey, 1976) averaged 1.09 hectares, almost 23 times that of male *Geomys bursarius* (Wilks, 1963), 42 times that of male *Thomomys bottae* (Howard and Childs, 1959), and five times that of male *Dipodomys elator* (Roberts and Packard, 1973). Males of *S. aquaticus* have considerably larger home ranges than do females (Harvey, 1976) so that a trap placed on a given mole runway is more likely to take a male than a female.

The tunnels of the eastern mole are of two distinct types (Hisaw, 1923*a*): surface runways or ridges, which are used for food collecting, and more permanent deep passages, which are used as living quarters and as thoroughfares to feeding grounds. Hisaw (1923*a*) described the method by which each type of tunnel is excavated.

The fossorial niche tends to limit dispersal and reduce gene flow between populations. Soil type, condition, and moisture are among the most important limiting factors (Arlton, 1936; Silver and Moore, 1941; Glass, 1943; Davis, 1966). *Scalopus aquaticus* prefers moist, loamy or sandy soils and is scarce or absent in

heavy clay, stony, or gravelly soils (Jackson, 1915; Arlton, 1936; Davis, 1942). Likewise, soil types that may be suitable for habitation but are exceedingly moist or exceedingly dry are often avoided by these animals (Davis, 1942; Glass, 1943). Eastern moles seem to be absent altogether from arid lands (Silver and Moore, 1941).

It is doubtful that rivers present barriers to dispersal because the eastern mole supposedly is a good swimmer (Arlton, 1936). Probably the heavy clay soils associated with certain river systems form the real barrier to *Scalopus aquaticus* rather than the rivers themselves.

The eastern mole has a voracious appetite and daily consumes food equal to 25 to 100% of its weight (Hisaw, 1923*b*; Christian, 1950; Davis 1974). It eats primarily earthworms and insects, although vegetable matter is eaten occasionally and, in captivity, it eats almost anything from ground beef (Hisaw, 1923*b*) to mice and small birds (Christian, 1950). Factors such as soil acidity, which limit the availability of food items, therefore, present barriers to dispersal. Yates and Schmidly (1977) reported that the eastern mole does well in captivity on Alpo dog food.

REPRODUCTION. The eastern mole has but one litter annually, of two to five young (Scheffer, 1949; Conaway, 1959). The exact gestation period is not known. Arlton (1936) and Jackson (1961) gave the gestation period as 42 and 45 days, respectively, whereas Conaway (1959) believed it to be four weeks or less. Conaway (1959) reported that the breeding season of *S. aquaticus* is restricted to three or four weeks in the spring, the peak in late March and early April. Yates and Schmidly (1977) believed that the breeding season in Texas and Louisiana may begin as early as January.

BEHAVIOR. Little has been published regarding behavior in the eastern mole. Christian (1950) described behavior of one captive mole on a daily basis.

GENETICS. *Scalopus aquaticus* has a diploid chromosome number (2N) of 34 and a fundamental number (FN) of 64. All autosomes are metacentric or submetacentric (figure 3). The sex chromosomes are the expected XX in females and XY in males. The Y chromosome is minute and similar to that reported for other species of talpids (Yates and Schmidly, 1975). A distinctive secondary constriction is evident on a pair of metacentric autosomes. This secondary constriction corresponds to the nucleolar organizer region (NOR) as indicated by AgAs techniques (Yates *et al.*, 1976).

REMARKS. The last comprehensive revision of the genus *Scalopus* was by Jackson (1915). Yates and Schmidly (1977) revised the moles of Texas and adjacent states. They reduced *Scalopus montanus* and *Scalopus inflatus* to subspecific status under *S. aquaticus*.

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