Spermophilus Cuvier, 1825


Anisonyx Rafinesque, 1817:45. Type species Anisonyx brachiarum Rafinesque (=Arctomys columbianus Ord). Preoccupied by Anisonyx Latreille, 1807, a coleopteran.

Spermophilus Cuvier, 1825:255. Type species Mus citellus Linnaeus by original designation.


Urocitellus Obolenskii, 1927:188. Type species Spermophilus eversmanni Lichtenstein by original designation. Proposed as a subspecies.

Policotilella A. H. Howell, 1938:42. Type species Arctomys franklini Sabine by original designation. Proposed as a subspecies.

Notocitellus A. H. Howell, 1938:44. Type species Spermophilus annulatus Audubon and Bachman by original designation. Proposed as a subspecies.

CONTEXT AND CONTENT. Order Rodentia, Suborder Sciurochorda, Family Sciuridae, Subfamily Sciurinae, Tribe Marmottini, Subtribe Spermophilinae (Black, 1965; Hafner, 1984; Hall, 1981; Moore, 1959). Hall (1981) recognized the subgenus Spermophilus, Callospermophilus, Leptomys (including Otospermophilus), Lactidomys (including Lactidomys), Urocitellus, Citellus. (in the subgenus Spermophilus by Nadler et al., 1968, and considered Otorospermophilus (including Callospermophilus), Indidomys (including Policitellus), and Xeromysphus distinct genera. Ammospermophilus, named as a subspecies of Spermophilus, was recognized as a distinct genus by Bryant (1945) and is now regarded as such by most workers (Hafner, 1984). The prairie dogs (Cynomys Rafinesque, 1817) may be a sister group to the subgenus Spermophilus, and the genus Spermophilus as defined here may be paraphyletic (Dobson, 1985; Hafner, 1984). Hanouchi et al. (1982) listed 36 species worldwide. The following key (based on Corbet, 1978; Gronov et al., 1965; Hall, 1981; Nadler et al., 1982, 1984; Ognev, 1947) will aid in distinguishing the species.

1 Molars brachydont; parastyle ridge on M1 and M2 joining protocone without an abrupt change of direction; confined to Nearctic region

2 Molars hypsodont; parastyle ridge on M1 and M2 joining protocone with an abrupt change of direction; occurring in Nearctic or Palearctic regions

2 (1) P3 with cusps and a functional cutting edge, crown area >25% that of P4

3 (2) Tail >128 mm; upper parts of variegated black, white and buff

3 3

4 Tail <128 mm; upper parts plain or striped

4 (3) Supraorbital foramen closed; pelage with some rufous areas; confined to subtropics

5 Supraorbital foramen open; pelage without distinct rufous areas; not occurring in subtropics

6 (5) Tail >175 mm and ringed

7 S. annulatus

6 Tail <175 mm and not ringed

8 S. adovetus

7 (6) Median area equally dark on head and back; south of 28° in Baja California

9 S. atricapillus

8 Median area darker on back than on head; north of 28° in Baja California

10 S. beechei

9 (8) Dorsum with white or gray stripe on each side; greatest width of nasals >20% of zygomatic width; greatest length of skull >39 mm

11 S. lateralis

10 (9) Golden mantle on head and neck and median dark stripes well defined; hind foot <44 mm; not occurring in Cascade Range of Washington and British Columbia

12 S. madrensis

11 (10) Golden mantle on head and neck and median dark stripes poorly defined; hind foot >44 mm; confined to Cascade Range of Washington and British Columbia

13 S. sartorius

12 (11) Metapophysis on P4 not continuous; dorsal pelage with stripes, spots, or plain yellowish-brown; confined to Nearctic region

14 S. leucurus

13 (12) Metapophysis on P4 continuous; dorsal pelage plain, or with white or buffy spots; occurring in Nearctic or Palearctic regions

15 S. mohavensis

14 (13) Dorsum with spots in linear series

16 S. mexicanus

15 (14) Dorsum plain or with non-linear spots

17 S. perotensis

16 (15) Ventral furry, dorsal plain or with buffy spots

18 S. spilosoma

17 (16) Dorsum with fine white spots; tail length >40% length of head and body

19 S. parvii

18 (17) Tail length >35% length of head and body

20 Sole of hind foot entirely hairy or nearly so

21 S. suslicus

19 (18) Sole of hind foot naked, except on side and tip of heel

22 Dorsum with bold white spots; tail length >40% length of head and body; diphloid number 32; occurring in central and northeastern Asia west of the Lena River

23 S. sandalus

20 (19) Dorsum with conspicuous spots; confined to eastern Europe

24 S. suslicus

21 Dorsum plain, or with faint spots or speckles

22 Dorsum with well developed black-and-white edging at its tip; occurring in eastern Asia

Published 12 April 1991 by The American Society of Mammalogists
Fig. 1. *Spermophilus washingtoni* from near Snake River, Franklin Co., Washington. Photograph by B. J. Betts.

Tail length 25–33% length of head and body; black-and-white edging at tail tip weakly developed; occurring in Europe or Asia Minor .................................................. 23

22 (21) Interorbital distance >9 mm; dorsum brownish, unspeckled; diploid number 36; *S. alaskanus*

Interorbital distance <9 mm; dorsum yellowish with dark speckling; diploid number 36; *S. dauricus*

23 (21) Tail length ca. 25% of length of head and body; dorsum yellowish-brown with faint, diffuse white spots; diploid number 40; occurring in eastern Europe .......... *S. citellus*

Tail length <25% of length of head and body; dorsum yellowish-brown with dark speckling; narrow bare stripe in middle of hind foot; diploid number 42; occurring in Asia Minor .......... *S. xanthopyrys*

24 (19) Dorsum yellowish with dark speckles, without light motting; color of venter not markedly lighter than dorsum .......................................................... *S. fulvus*

Dorsal pelage various, often with light motting; venter markedly lighter than dorsum .......................................................... 25

25 (24) Cheek with distinct ginger, chestnut, yellowish, or rusty patch below eye .......................................................... 26

Check patch indistinct or absent .......................................................... 27

26 (25) Larger; tail >65 mm; hind foot usually >42 mm; cheek yellowish with rusty patch; occurring in eastern Europe and western Asia .......... *S. major*

Smaller; tail <65 mm; hind foot usually <42 mm; cheek white with rusty or chestnut-brown patch; occurring in central Asia .......... *S. erythrogenys*

27 (25) Dorsum pinkish-gray; tail length 23–32% length of head and body; maxillary toothrow longer than diastema .......... *S. reticulus*

Dorsum yellowish-gray or brownish-gray; tail length 16–20% length of head and body; maxillary toothrow shorter than diastema .......... 28

28 (27) Dorsum yellowish-gray; no dark subapical band on tail; occurring north of Cascade Mountains .......... *S. pygmaeus*

Dorsum dark brownish-gray; dark subapical band on tail; confined to Cascade Mountains .......... *S. musicus*

29 (18) Dorsum plain ................. 30

Dorsum spotted .......... 34

30 (29) Hind foot <39 mm; ear pinnae inconspicuous .......... 31

Hind foot >39 mm; ear pinnae conspicuous .......... 31

31 (30) Underside of tail buffy .......... 32

Underside of tail grayish or reddish .......... 33

32 (31) Hind foot <43 mm; diploid number 34; occurring in extreme southwestern Montana and areas south .......... *S. elegans*

Hind foot >43 mm; diploid number 36; occurring in areas north and east of extreme southwestern Montana .......... *S. richardsonii*

33 (31) Underside of tail grayish .......... *S. armatus*

Underside of tail reddish .......... *S. beldingi*

34 (29) Hind foot >43 mm .......... *S. columbianus*

Hind foot <43 mm .......... 35

35 (34) Dorsum brownish; ear pinnae conspicuous .......... *S. brunneus*

Dorsum grayish; ear pinnae inconspicuous .......... *S. washingtoni*

**Spermophilus washingtoni**

(A. H. Howell, 1938)

*Washington Ground Squirrel*


**CONTEXT AND CONTENT.** Context noted in generic summary. *S. washingtoni* is in the subgenus *Spermophilus*. Howell (1938:71) described the subspecies *S. w. loringi*, which was synonymized with the nominate form by Dalquest (1948). A phenetic and karyotypic study by Hill (1978) also indicated that the species is monotypic.

**DIAGNOSIS.** The Washington ground squirrel (Fig. 1) differs from members of the subgenus *Callotypospermophilus* and *Ictidomys* in the lack of stripes or linear arrangements of large spots on the dorsum. It is distinguishable from the subgenus *Poliaciellus* and *Otospermophilus* by its smaller size (<250 mm total length) and relatively shorter tail (<33% of the length of head and body).

Members of the subgenus *Xerocitellus* have relatively longer tails and molars that are more brachydont. No members of the subgenus *Ictidomys*, *Otospermophilus*, *Poliaciellus*, or *Xerocitellus* are sympatric with *S. washingtoni* (Hall, 1981; Howell, 1938).

Among Nearctic species of the subgenus *Spermophilus*, *S. washingtoni* is distinguishable from *S. armatus*, *S. beldingi*, *S. columbianus*, *S. elegans*, *S. parryii*, and *S. richardsonii* by its smaller size (length of hind foot <39 mm). It differs from *S. brunneus* in having smaller pinnae, grayish dorsal pelage with more conspicuous spots, a more distinct lateral line, a tail that is pinkish-cinnamon beneath without black and white guard hairs, a longer auditory bullae, and a longer rostrum. Its distinct dorsal spotting, more bushy tail, and larger, narrower skull distinguish it from *S. armatus*. With *S. armatus*, the subgenus *Spermophilus*, only *S. beldingi* and *S. columbianus* occur sympatrically with *S. washingtoni* (Hall, 1981; Howell, 1938; Scheffer, 1941).

**GENERAL CHARACTERISTICS.** *Spermophilus washingtoni* is one of the smallest members of the subgenus *Spermophilus*. Ranges for external measurements (in mm) are: total length, 185–245; length of tail, 32–65; length of hind foot, 30–38 (Hall, 1938).

Dorsal coloration of spring pelage is pale smoke-gray, faintly washed with pinkish-buff. Worn pelage is more brown. The dorsum is flecked with grayish-white spots that are roughly square and 3–4 mm in breadth. Underparts are grayish-white washed with pinkish-buff. The feet are white, tinged with pinkish-buff. The tail is gray mixed with fuscous above, pinkish-cinnamon beneath, and edged with buffy white (Howell, 1938).

The skull (Fig. 2) is similar to that of *S. townsendii*, but is narrower through the braincase and interorbital region. Ranges for cranial measurements (in mm) are: greatest length of skull, 35.0–41.8; palatine length, 17.0–20.0; zygomatic breadth, 6.4–8.2; post-orbital constriction, 8.0–11.0; length of nasals, 12.3–15.6; and length of maxillary toothrow, 7.3–8.2 (Howell, 1938).

**DISTRIBUTION.** *Spermophilus washingtoni* is restricted to that portion of the Columbia Plateau lying south and east of the Columbia River in Washington, and between the John Day River
and the Blue Mountains in adjacent northeastern Oregon (Fig. 3). In southern Washington, *S. washingtonii* is separated from its ecological counterpart, *S. townsendii*, by the Columbia River (Howell, 1938; Scheffer, 1941). There is a possible historical restriction in range in eastern Washington due to competition with *S. columbianus* (Shaw, 1921). The range has been reduced in recent years through habitat loss to agriculture (Bettis, 1990; Hill, 1978). Documented elevational range is from 90 to 450 m, within the upper Sonoran life zone (Bailey, 1936; Scheffer, 1941).

**FOSSIL RECORD.** Late Holocene specimens from eastern Washington identified as *S. townsendii* (Deavers and Greene, 1978), fall within the present range of *S. washingtonii* and probably represent the latter species (Rickett, 1987).

**FORM AND FUNCTION.** Washington ground squirrels have five pairs of mammae; one inguinal, two pectoral, and two abdominal (Bailey, 1936). Pelage is fresh in March, and worn in May and June (Howell, 1938). Timing of molt is unknown. As in other hibernating ground squirrels, weight fluctuates seasonally as a function of body fat content. Average body weights for adult males were 158 g in late February, and 257 g in late May (Scheffer, 1941). A hibernating captive male had a mean weight loss of 1.05 g/day, and rectal temperatures ranging from 3.3 to 9.4°C (Shaw, 1925).

**ONTogeny and reproduction.** *Spermophilus washingtonii* breed in late January or early February, soon after emergence from hibernation. A lengthy mating period of several weeks is indicated by the simultaneous presence in a local population of post-partum females and others in early pregnancy. One litter is produced each year, with births occurring in February and early March. At high elevations, emergence and breeding occur as much as a month later than at lower elevations (Bailey, 1936; Scheffer, 1941; Shaw, 1921). For 26 females, uterine litter size averaged 8, with a range from 5 to 11 (Scheffer, 1941). There is no information on age at first reproduction or age-specific fecundity.

By late March, young with body weights ranging from 22 to 44 g are weaned and appear above ground. By late April they are half-grown (189–193 g), and by late May they are nearly full-sized and are difficult to distinguish from adults (Scheffer, 1941).

**ECOLOGY.** Washington ground squirrels inhabit dry, open sagebrush (*Artemisia*) or grassland habitat. They occur in areas with sandy soils along hillsides, in ravines, and on river bottoms (Bailey, 1936; Howell, 1938). They are most numerous in areas of high grass cover, on deep, weaker soil with less clay (Bettis, 1990). In favorable habitat, estimated total population densities range from 120 to 250 individuals/ha (Bailey, 1936; Dalvynest, 1948).

The diet consists of succulent vegetation, flowers, roots, bulbs, seeds, seed pods, and insects. Documented food plants include a broad range of forbs and grasses; *Erodium sp.*, *Sphaeralcea man- roana*, *Plantago purshii*, *Bromus tectorum*, *Agropyron pacificgo- rum*, *Oryzopsis hymenoides*, and *Sisymbrium altissima*. Cultivated plants, including cabbage, green peas, corn, oats, wheat, rye, barley, and alfalfa also are eaten (Bailey, 1936; Howell, 1938).

Badgers (*Taxidea taxus*) are considered to be the most important...
of 150 badger-excavated burrows were reported in an area with a density of approximately 1,500 squirrel burrows/ha (Bailey, 1936). The eotaric species *Andrellopus fahnenholzi* and *Macroctenoides* have been reported from Washington ground squirrels (Whittaker and Masar, 1985).

Because of their diet and occurrence in an important grain-producing region, Washington ground squirrels have been considered agricultural pests and have been the subject of control programs (Bailey, 1936; Howell, 1938). They no longer occur at many localities where they were formerly abundant, primarily because of loss of habitat to agriculture. In 1988, squirrels were absent at 68 of 148 historically occupied sites in Oregon and Washington. Twenty-three vacated sites had lost squirrels during the previous decade, and 25 additional sites were considered vulnerable (Bets, 1990).

Washington ground squirrels have been trapped with live traps baited with apples, and with snap traps baited at burrow entrances (Hill, 1978; Scheffer, 1941). Captives have been maintained on diets of wheat, oats, sunflower seeds, carrots, and apples (Shaw, 1925).

**BEHAVIOR.** Washington ground squirrels have a protracted period of seasonal dormancy that encompasses the temperature extremes of both winter and summer. Adults emerge in late winter (late January to March) with males preceding females. Local timing of seasonal activity varies with elevation by as much as a month. Juvenile animals are born early in the active season and first emerge from natal burrows in late March. Squirrels enter dormancy in late spring and early summer. Adults emerge from late May to early June after an active season of 4–5 months duration, whereas juveniles remain active until late June or early July (Bailey, 1936; Scheffer, 1941; Shaw, 1921). A dormancy period of 244 days was recorded for a captive animal without access to food or water (Shaw, 1925).

*Spermophilus washingtoni* is strictly diurnal. During the late active season, animals avoid the heat of midday and are most active in the morning (Scheffer, 1941).

Burrows of *S. washingtoni* are simple and unbranched, reaching depths of up to 170 cm and lengths >7 m (Bailey, 1936; Howell, 1938). Fenced burrow systems and artificial nest boxes have been used to study hibernation in captivity (Shaw, 1925).

Captive squirrels have reduced appetites just before entering dormancy, and again immediately following emergence. During deep torpor, animals assume a rigid, curled posture (Shaw, 1925).

There are no studies dealing directly with social behavior of Washington ground squirrels. However, in favorable habitats they form colonies of up to 250 individuals/ha (Bailey, 1936). The alarm call is a soft, lisp-wailing whistle, similar to that of *S. townsendii mollaris*. In responding to an alarm, animals generally assume an alert, upright posture ("picket pin") while calling, and quickly retreat to burrows if threatened (Bailey, 1936; Howell, 1938).

**GENETICS.** The diploid karyotype of *S. washingtoni* consists of 16 metacentric, 16 submetacentric, and 2 acrocentric autosomes, a submetacentric X chromosome, and a small acrocentric Y chromosome (2n = 36; FN = 66; Nadler, 1966). However, Hill (1978) described the 34 autosomes as biarmed. No significant karyotypic differences were found between populations separated by the Snake River in southeastern Washington (Hill, 1978). Both chromosomally and biochemically, *S. watsoni* is similar to the Nearctic "big-eared" species, including *S. armatus*, *S. seldingi*, *S. elegans*, and *S. richardsonii* (Nadler, 1966; Nadler et al., 1982, 1984). This is in contrast to its apparent morphological similarities to Nearctic "small-eared" taxa that form the *S. townsendi* complex (Howell, 1938; Nadler et al., 1982).

**REMARKS.** Prior to the generic revision of Howell (1938), squirrels of this species were known under the name of *S. townsendi*. That was because the type locality originally associated with that name is imprecise (Hill, 1958; Rickart, 1987).

The generic name *Spermophilus* is derived from the Greek roots *sperm* (seed) and *philos* (loving). The specific epithet *wash-ingtoni* refers to the state of Washington, where the species is primarily distributed. The vernacular name sage rat has also been applied to this species (Dalquest, 1948).

We thank B. J. Betts for providing a copy of his unpublished paper and the photograph for Fig. 1. R. S. Hoffmann, D. R. Johnson, and J. O. Murie reviewed the manuscript and provided many helpful comments. This is contribution no. 89-5 of the Utah Museum of Natural History.

**LITERATURE CITED**


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