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Tamias ochrogenys.

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Tamias ochrogenys (Merriam, 1897)

Redwood Chipmunk

Eutamias townsendi ochrogenys Merriam, 1897:195, 206. Original description. Type locality "Mendocino, California."

Tamias townsendi ochrogenys Elliot, 1901:71. First allocation of *ochrogenys* to the genus *Tamias*.

Eutamias ochrogenys Sutton and Nadler, 1974:211. Elevation of subspecies to species rank.

CONTEXT AND CONTENT. Order Rodentia, Suborder Sciuromorpha, Family Sciuridae, Subgenus Neotamias (Honacki et al., 1982; Wilson and Reeder, 1993). *Tamias ochrogenys* is monotypic (Hall, 1981). *T. ochrogenys* differs significantly from other members of the *townsendii* species group (*T. townsendii*, *T. senex*, and *T. siskiyou*) in genital bone characters and in chip vocalizations. Based on os genitalia, Sutton and Nadler (1974) proposed elevation of *T. ochrogenys* to species rank. Hall (1981), Honacki et al (1982), Jones et al. (1992), and Wilson and Reeder (1993) accepted this arrangement. Others, however, argued that *T. ochrogenys* should be retained as a subspecies of *T. townsendii* (Levenson and Hoffmann, 1984; Levenson et al., 1985). Disagreement also exists regarding the usage of *Eutamias* for western chipmunks and *Tamias* for the eastern chipmunk (Patterson and Heaney, 1987; Gannon and Lawlor, 1989).

DIAGNOSIS. Compared to *T. sonomae* and *T. merriami*, which may be encountered along the southeastern or southern portions of its distribution, *T. ochrogenys* is larger and has a shorter tail (ca. 76% of the length of the head and body), darker and less contrasting pelage, more sharply bicolored ears (in summer pelage), greater zygomatic breadth (>21.2 mm), and a distinct post-palatal spine (Hooper, 1944).

Although this species may be difficult to distinguish from other members of the *townsendii*-group, *T. ochrogenys* differs from them in having a less bushy tail, darker dorsal coloration, a more distinctly marked dorsal stripe, greater length of head and body, and a larger adult skull that is 39–40.8 mm or more in length (Hall, 1981; Fig. 1). It also differs from other *townsendii*-group species in that the tips of the nasal bones are not separated by a median notch, the tip of the baculum is <50% the length of the shaft (Kain 1985; Fig. 2), and the height of the keel of the baculum is <25% of the length of the tip (Hall, 1981; Fig. 2).

GENERAL CHARACTERS. The redwood chipmunk is dark-colored and long-tailed, with prominent alternating dark and pale longitudinal stripes on its face and dorsum. *T. ochrogenys* is the darkest of the *townsendii*-group chipmunks (Hall, 1981). Of the five dark dorsal stripes, the mid-dorsal one is the longest, widest, and most conspicuous. Of the four pale dorsal stripes, the two lateralmost are the most prominent. Of the facial stripes, the dark one through the eye and the pale ones above and below the eye are the most prominent (Fig. 1). A pale postauricular patch nearly the size of the pinna is always present (Adams, 1967). The general color of autumn pelage of adults has been described as dark tawny olive (Howell, 1929) and as ochraceous to blue-gray (Adams, 1967). Dark-gray hairs on the ventral side of the body are white-tipped. The pelage on the sides of the body blends from the color of the venter to ochraceous. The dorsoventrally flattened tail is dark rufous to bright orange ventrally; dorsally it is of the same color as the rest of the body. Most of the guard hairs on the tail are tipped with white (Adams, 1967).

There are four pairs of mammae—one pectoral, two abdominal, and one inguinal. Internal naked cheek pouches are present (Adams, 1967).

Head and body length of *T. ochrogenys* is the largest (ca. 159 mm) in the subgenus *Neotamias* (Hall, 1981). Ranges of body measurements (in mm) of adults are: total length, 233–297; length of tail, 97–130; length of hind foot, 33–42; length of ear, 20–26 (Adams, 1967). Body masses for 18 females ranged from 78.0 to 117.5 g (mean of 94.1 g). Twenty-two males ranged in mass from 60 to 116.2 g (mean, 89.3 g; Adams, 1967).

The skull of *T. ochrogenys* averages largest of the subgenus (Hall, 1981; Fig. 3). Greatest length of skull for adult redwood chipmunks ranges from 37.9 to 42.0 mm (Adams, 1967). Kain (1985) found no significant sexual dimorphism in external or cranial characters in this species. Johnson (1943) and Adams (1967), however, reported that females were slightly larger than males in all characters. Based on examination of 34 females and 35 males, Levenson (1990) reported that female *T. ochrogenys* were significantly larger than males in length of head and body and that a dimorphism ratio of 1.042 favored females.

Ossa genitalia of chipmunks, including those in the *townsendii*-group, are distinctive and therefore useful taxonomically (Sutton, 1982; Fig. 2). The baculum of *T. ochrogenys* most closely resembles that of *T. townsendii*, but it differs in that the tip is longer than is that of *T. townsendii*, the tip and shaft are thicker, the base is wider, the keel is higher, the angle of the tip and shaft averages 22° less, a prominent keel is present on the shaft, and there is no lateral shelf on the tip (Sutton and Nadler, 1974). Measurements of 83 bacula from adults (ranges in mm, means in parentheses) are: length of shaft, 2.0–2.7 (2.5); width of shaft, 0.16–0.27 (0.23); width of base, 0.82–1.07 (0.94); height of keel, 0.2–0.4 (0.3); length of tip, 1.03–1.23 (1.14); angle formed by the tip and the shaft, 95–123° (108°; Adams and Sutton, 1968; Kain, 1985; Sutton, 1987; Sutton and Nadler, 1974; Williams, 1980).

As in all members of subgenera *Eutamias* and *Neotamias*, the baubellum of *T. ochrogenys* is generally U-shaped. The base is parallel to the body and supports two blunt projections that point caudally. In *T. ochrogenys*, the base is 44% of the length of the shaft, the shaft is vertical, there is a slight groove on the right lateral surface of the shaft, a dorsal tubercle divides the baubellum into distal and proximal portions, and the tip is broader than deep and gradually narrows to a blunt end (Adams and Sutton, 1968; Sutton, 1982). Like the baculum, the baubellum of *T. ochrogenys* most closely resembles that of *T. townsendii*, but it differs in that the base–shaft angle is more acute than is that of *T. townsendii*, the shaft is thicker, the tip is larger and thicker, and the keel is small

FIG. 1. An adult redwood chipmunk (*Tamias ochrogenys*) from near Ferndale, Humboldt County, California. Photo by Susan Smith.

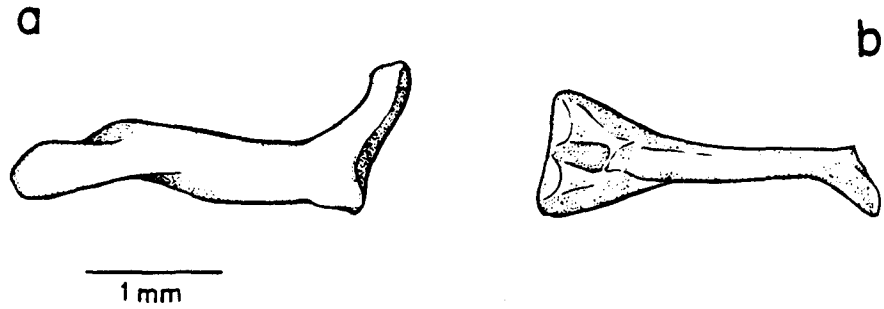

FIG. 2. Right lateral view (a) and dorsal view (b) of baculum of *Tamias ochrogenys* (Humboldt State University 2833). Illustration by D. E. Kain.

but prominent (Sutton and Nadler, 1974). Measurements of 32 baubella (ranges in mm, means in parentheses) are: length of base, 0.46–0.91 (0.69); length of shaft, 0.65–1.20 (0.99); depth of shaft, 0.36–0.46 (0.41); tip length, 0.39–0.91 (0.72); keel height, 0.20–0.33 (0.24); angle of tip to shaft, 107–137° (127°; Adams and Sutton, 1968; Kain, 1985; Sutton, 1987).

DISTRIBUTION. *T. ochrogenys* occurs along the Pacific coast of northern California in a narrow belt from the south side of the Eel River, Humboldt Co. (Gannon and Lawlor, 1989; Kain, 1985), eastward no more than 40 km from the seacoast, and southward to ca. 3 km north of Bodega and Freestone, Sonoma Co. (Fig. 4; Adams, 1967; Hooper, 1944). Altitudinal range extends from sea level to 1,280 m (Adams, 1967).

Distribution of the redwood chipmunk is correlated with the humid coastal forest of northern California. Where this forest becomes patchy, distribution of the redwood chipmunk also becomes discontinuous. Presence of vegetation such as coniferous woods with a brushy understory, rather than physical factors, may limit the distribution of *T. ochrogenys* (Adams, 1967; Hooper, 1944; Sutton, 1987). *T. ochrogenys* has not been found as a fossil.

FORM AND FUNCTION. In autumn, the redwood chipmunk begins to acquire its winter pelage which is long, silky, dense, and dull-colored. The autumn molt begins at the rump and moves anteriorly. The spring molt starts at the anterior end and moves caudally (Howell, 1929).

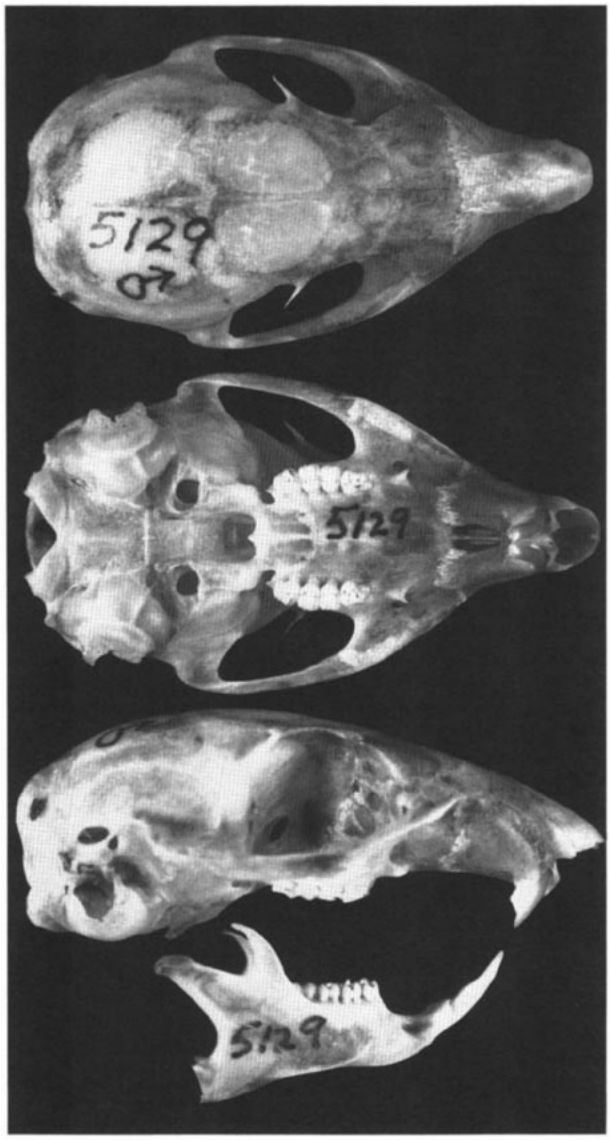

FIG. 3. Dorsal, ventral, and lateral views of cranium, and lateral view of lower jaw of *Tamias ochrogenys* (Humboldt State University 5129, male, California). Greatest length of cranium is 40.2 mm.

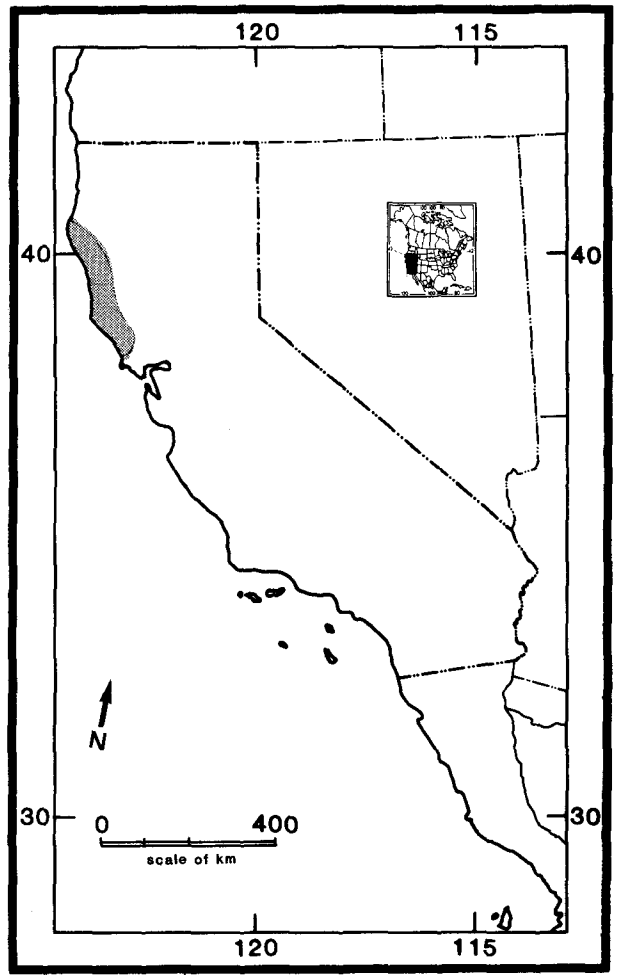

FIG. 4. Distribution of *Tamias ochrogenys* in California.

The dental formula is i 1/1, c 0/0, p 2/1, m 3/3, total = 22. In 11 *T. ochrogenys*, the basihyal and thyrohyal were found to be fused into a horseshoe-shaped structure with the sides pointing caudally. There are two linear ceratohyal–epihyal elements and two long curving stylohyals. A ligament on either side connects the tip of the stylohyoid to its place of attachment posterior to the tympanic bulla. The length of the stylohyal is nearly double that of the epihyal-ceratohyal element. A small chondrohyal bone often is near or fused to the posterior tips of the thyrohyals (Adams, 1967).

There is no significant individual variation or variation associated with age in the bacula of *T. ochrogenys* (Adams and Sutton, 1968; Kain, 1985). The tip and distal end of the shaft of the baculum protrude from the body of the penis (Kain, 1985). The urethra passes along the ventral surface of the bacular shaft. The urethral opening is located at the right posterior edge of the angle between the shaft and tip (Adams, 1967).

There is no significant individual variation or variation associated with age in the baubella of *T. ochrogenys* (Adams, 1967; Kain, 1985; Sutton, 1987). The baubellum lies anteroventrally to the vaginal opening with its tip protruding from the clitoral tissue, an orientation similar to that of the baculum within the penis (Kain, 1985).

ONTOGENY AND REPRODUCTION. In male *T. ochrogenys*, testes attain their largest size in late March and remain large through June; testicular size decreases through autumn. On 18 March, one female had four fetuses that were 43 mm in length (Adams, 1967). Larger size in female *T. ochrogenys* may increase the probability of surviving hibernation and producing a litter in the spring (Levenson, 1990).

ECOLOGY. Redwood chipmunks are commonly associated with the humid coastal redwood forest (Stephens, 1906). As do other chipmunks, *T. ochrogenys* takes a wide variety of foods. Analysis of cheek pouch contents revealed that fungi are eaten in late winter and early spring. Observations in June and July show that these chipmunks may gather grass seeds. Other food items and the season or months in which they were taken were: western raspberry (*Rubus leucodermis*) in autumn; buckthorn and blue-blossom (*Ceanothus*) in September, October, January, and March; wax myrtle (*Myrica californica*) in September; California huckleberry (*Vaccinium ovatum*) in September; poison oak (*Rhus diversiloba*) in September; bull thistle (*Cirsium*) in September; Scotch broom (*Cytisus scoparius*) in November; and acorns (*Lithospermum* or *Quercus*) in September, January, March, and April. Adams (1967) reported unidentified insect wing fragments in stomach contents.

No information is available on predators of *T. ochrogenys*. Incidence of parasitism in *T. ochrogenys* appears to be low, but stomach nematodes (*Spirura*), and a botfly larva (*Cuterebra*, found in the left inguinal area) have been reported (Adams, 1967). Kim et al. (1986) reported the louse, *Hoplopleura arboricola*, from *T. ochrogenys*. Hubbard (1947) reported the flea, *Monopsyllus eumolpi cyrturus*, to be present on chipmunks of the Cascade Mountains of coastal California, but he did not specifically mention fleas from *T. ochrogenys* in that area. Hubbard (1947) reported *Monopsyllus ciliatus protinus* from "*Eutamias townsendii ochrogenys*" from Port Orford and Chetco River, Oregon, but in that area the hosts for this flea were probably *T. townsendii townsendii*.

BEHAVIOR. *T. ochrogenys* is difficult to observe (Gannon and Lawlor, 1989; Kain, 1985) and "would be lost [in the forest] but for their shrill, whistling chipper, or chuck chuck chuck (call)" (Bailey, 1936:130). The redwood chipmunk is distinguished from *T. senex* and *T. siskiyou* by a two-syllable "chip" call of low frequency relative to the other species (Fig. 5). Calls of *T. ochrogenys* typically are paired, regular in delivery, and have a unique rhythm. The chip call of *T. ochrogenys* most resembles that of *T. townsendii*, a pattern like that reported for the ossa genitalia of these two allopatric species (Gannon and Lawlor, 1989; Patterson and Thaeler, 1982). Chip vocalizations of chipmunks from Rio Dell, south of the Eel River, Humboldt Co., California, appear to be intermediate between *T. senex* and *T. ochrogenys*. This population may include hybrid individuals (Gannon and Lawlor, 1989).

GENETICS. Although at least nine chromosomal rearrangements separate all *Neotamias* karyotypes from that of *Tamias* (sensu stricto; Nadler et al., 1977), *T. ochrogenys*, like all members of the genus, has a model diploid number of 38 chromosomes. The autosomal karyotype is known as Type B and contains four pair of large metacentric, six pair of large submetacentric, one pair of small metacentric, and three pair of small acrocentric or subterminal chromosomes. The X chromosome is a large submetacentric and the Y chromosome is a minute acrocentric (Nadler, 1964; Sutton and Nadler, 1969).

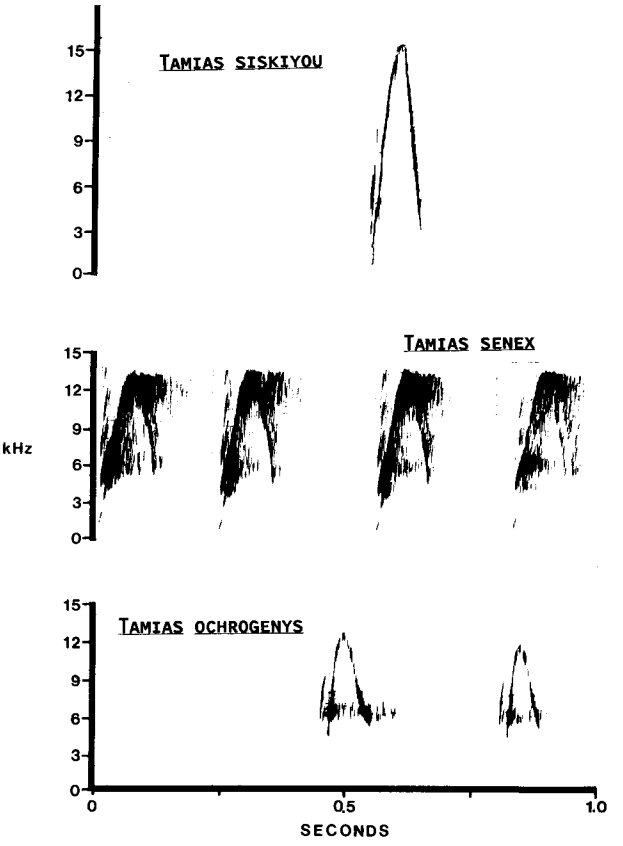

FIG. 5. Sonagrams of chip vocalizations from *Tamias siskiyou*, *T. senex*, and *T. ochrogenys*. X- and Y-axes are time (in s) and call frequency (in kHz), respectively.

REMARKS. Disagreement exists over the assignment of generic names for chipmunks of western and eastern North America. Jones et al. (1992) preferred *Tamias* over *Eutamias* for the generic designation because no one has published convincing data to show that the usage of *Tamias* is incorrect for all western chipmunks. Other recent authors have continued to use *Eutamias* for the genus of western chipmunks (Gannon and Lawlor, 1989; Patterson and Heaney, 1987; Sutton, 1987). The entire assemblage is in need of revision (Patterson and Heaney, 1987).

The northern boundary of this species was revised recently. Sutton and Nadler (1974) and Williams (1980) placed the northern boundary of the species at the Van Duzen River, Humboldt County, California. Subsequently, the northern limit was placed at the Eel River (Gannon and Lawlor, 1989; Kain, 1985; Sutton, 1987).

The Tertiary fossil record for chipmunks in North America is at best incomplete; however, fragmentary material belonging to the subgenus *Neotamias* is known from the early Miocene (Black, 1972). North America is hypothesized to be the center of origin of chipmunks; the subgenus *Eutamias* does not appear until late Pliocene in Eurasia (Black, 1972).

Tamias in Latin means storer or distributor; *ochrogenys* refers to ochre or pale yellow (Greek) and *genys* to the cheek or side of the head (Greek; Jaeger, 1955). Another vernacular name for this species is yellow-cheeked chipmunk (Adams, 1967). The type specimen was collected on 17 July 1894 at Mendocino, California, by J. E. McLellan (collector number 1015) and is housed at the U. S. National Museum (catalog number 67182; Howell, 1929).

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