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Tamias rufus.

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Tamias rufus (Hoffmeister and Ellis, 1980)

Hopi Chipmunk

Eutamias quadrivittatus rufus Hoffmeister and Ellis, 1980:656. Type locality "10 mi SW Page, Coconino County, Arizona."
Tamias rufus: Levenson et al., 1985:242. First use of current name combination.

CONTEXT AND CONTENT. Order Rodentia, Suborder Sciuromorpha, Family Sciuridae. The genus *Tamias* contains 25 species (Wilson and Reeder, 1993). *T. rufus* (Fig. 1) is monotypic (Patterson, 1984).

DIAGNOSIS. In areas of sympatry, the bright tawny color and large size of *T. rufus* distinguish it from *T. minimus*. Also, the dark dorsal stripes of *T. rufus* are tawny in contrast to the fuscous or fuscous-black stripes of *T. minimus* (Sutton, 1953). The long tail of *T. rufus* is carried more nearly horizontally, even when it is running, than is that of *T. minimus*. This habit, together with the graceful downward curve of the tail near the tip, also serves to distinguish *T. rufus* from *T. minimus* (Cary, 1911). *T. minimus* usually is found at higher elevations than *T. rufus*, but the ranges may overlap considerably (Sutton, 1953).

Tamias rufus and *T. quadrivittatus* are narrowly allopatric or parapatric in western Colorado and northern Arizona. Although their sympatric occurrence has not been demonstrated, the two approach one another in the Gunnison River Valley, Colorado (Patterson, 1984). *T. rufus* differs from *T. quadrivittatus* as follows: externally smaller, especially in length of hind foot and total length; skull shorter, but not especially narrower except in interorbital region; auditory bullae relatively longer; nasals markedly shorter (Hoffmeister, 1986). Color is variable, but *T. rufus* usually is paler and redder, with less black in the dark dorsal stripes. *T. rufus* is small-sized, and most are orangish red, which is more evident because of the reduction of black in the stripes (Hoffmeister, 1986). Although *T. rufus* averages smaller in cranial characters than *T. quadrivittatus*, especially in southwestern populations, extensive overlap exists. Despite this broad overlap, average size differences are statistically significant in most cranial characters (Patterson, 1984).

In areas of juxtaposition, *T. rufus* and *T. quadrivittatus* show no evidence of intergradation in bacular morphology (Patterson, 1984). Bacula of *T. rufus* average smaller in all dimensions than those of *T. quadrivittatus* (Fig. 2). There is no overlap in total length, but there is limited overlap in length of the tip (the shortest *T. quadrivittatus* was 1.25 mm compared with 1.32 mm for the longest *T. rufus*). Baubella of *T. rufus* (average length, 0.706 mm) are significantly smaller than baubella of *T. quadrivittatus* (average length, 0.795 mm for *T. q. australis* and 0.838 mm for *T. q. quadrivittatus*—Patterson, 1984).

GENERAL CHARACTERS. Color of the upperparts has a marked reduction of black in the stripes, resulting in a general tone of buffy to pale orangish-red. The sides are buffy and interspersed with gray, the crown is pale gray, and the postauricular patch is large and white (Hoffmeister and Ellis, 1980). The dark medial stripe is chestnut or rufous, with the middle part of the posterior portion black. The inner pair of dark stripes is similar, but lacks the black, or at most it is faintly indicated. The outer pair of dark stripes is nearly obsolete, just a shade darker than the color of the flanks. The inner pair of pale stripes is grayish white, but is not distinct; the outer pair is whiter and clearer. The rump and flanks are grayish, and the sides of the body and upper surfaces of the feet are pale bright-rufous. There is a large white postauricular spot, and the posterior one-half of the ear is whitish. The pale facial stripes are white and the dark ones are rufous, with the lower ones extending under the ear. The top of the head is mixed grayish and rusty, with some black hairs intermixed; ventrally, the head is grayish white. The tail is mixed black and chestnut dorsally, and it is bright chestnut with an indistinct black border ventrally (Barnes, 1922). In winter pelage (November), coloration is similar to summer, but the head and rump are darker. The median dorsal stripe is tawny and shaded with fuscous, and the undersurface of the tail is cinnamon (Howell, 1929).

The skull (Fig. 3) is large, the braincase is long and narrow (Durrant, 1952), and the auditory bullae are relatively large, especially as indicated by length (Hoffmeister and Ellis, 1980). Average of cranial measurements (in mm—range of averages of 10 populations are in parentheses) are: greatest length of cranium, 35.1 (34.5-35.7); zygomatic breadth, 19.6 (19.1-20.3); cranial breadth, 14.4 (14.0-14.6); length of mandible, 20.4 (19.9-20.7); nasal length, 10.2 (9.7-10.4); length of maxillary toothrow, 5.5 (5.4-5.7); interorbital breadth, 7.8 (7.8-8.0); nasal width, 2.7 (2.5-2.9); diagonal length of orbit, 9.3 (9.2-9.4); length of premaxilla, 11.2 (10.7-11.5); depth of cranium, 14.1 (13.8-14.4—Patterson, 1984). Average and range of external measurements (in mm) are: length of body, 120 (93-148); length of hind foot, 33 (30-35); length of ear, 20 (16-23—Sutton, 1953). In eastern Utah, average mass was 59.3 g on 23 September and 47.9 g on 11 March (Wadsworth, 1972).

Females average slightly larger than males, but no overall significant differences occur between sexes (Hoffmeister and Ellis, 1980). Populations in close proximity are similar morphologically. Bacula exhibit significant geographic variation in total length, length of tip, height of keel, width of tip, width of neck, bend of shaft, and angle of tip (Patterson, 1984).

DISTRIBUTION. *Tamias rufus* occurs in northcentral Arizona as far east as Monument Valley, eastern Utah, and western Colorado, including Mesa Verde National Park (Fig. 4; Hoffmeister and Ellis, 1980; Patterson, 1984). It inhabits the upper Sonoran and transition life zones (Sutton, 1953) at elevations of ca. 1,290-2,700 m (Patterson, 1984). No fossils of *T. rufus* are known.

FORM AND FUNCTION. As in all members of the subgenus *Neotamias*, the dental formula is i 1/1, c 0/0, p 2/1, m 3/3, total 22 (Hoffmeister, 1986; Howell, 1929). There is at least one annual molt. On 9-21 May at Bluff, San Juan Co., Utah, *T. rufus* was mostly in worn, transition pelage, showing a mixture of prebreeding and postbreeding pelages. One had nearly completed the molt to the new pelage (Allen, 1893). In mid-June, a female in worn pelage and a male in fresh summer pelage were observed in Colorado (Cary, 1911).

FIG. 1. A female *Tamias rufus* foraging at the Devil's Garden parking area in Arches National Park, Grand Co., Utah. Photograph by T. L. Best.

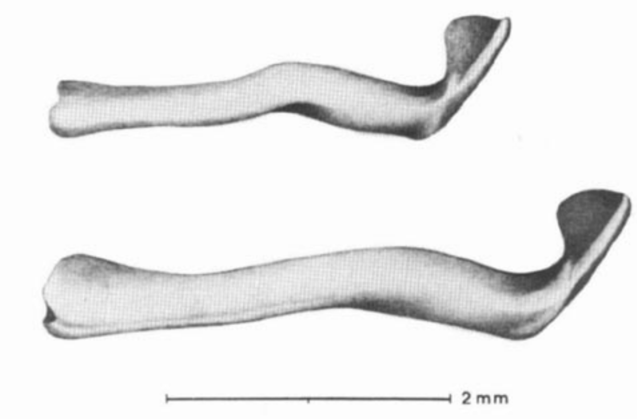

FIG. 2. Right lateral views of bacula of *Tamias rufus* (upper) from Bedrock, Montrose Co., Colorado, and *T. quadrivittatus* (lower) from Keam Canyon, Navajo Co., Arizona (Patterson, 1984).

Tamias rufus is a hibernator (Levenson, 1979), but does not hibernate for a great length of time (Wadsworth, 1969, 1972). The difference between average mass in autumn (59.3 g) and spring (47.9 g) is 11.4 g. This together with the observation that some animals remain active until late November indicates that some fat may be accumulated. The Hopi chipmunk stores food that may be used between short periods of torpidity. Because seeds of Indian ricegrass (*Oryzopsis hymenoides*) and Russian thistle (*Salsola kali*) are available on the plants and on the surface of the ground during all seasons of the year, it also may leave the nest to gather food on some warm winter days (Wadsworth, 1972).

Four pair of mammae are present; one pectoral, two abdominal, and one inguinal. All mammae secrete milk during lactation (Wadsworth, 1969).

Average and range of means of bacular measurements (in mm) for six populations of *T. rufus* are: total length, 3.54 (3.35–3.86); length of tip, 1.16 (1.09–1.23); height of keel, 0.45 (0.42–0.48); width of tip, 0.39 (0.35–0.45); width of neck, 0.22 (0.20–0.23); width of base, 0.65 (0.63–0.68); bend of shaft, 0.56 (0.50–0.62); angle of tip (in degrees), 122 (120–127—Patterson, 1984).

ONTOGENY AND REPRODUCTION. Males are sexually active from February until the middle of April, when the testes regress into the abdomen. Mating occurs in late February and March. However, chipmunks held in captivity do not breed during the usual breeding season or after the young are weaned (Wadsworth, 1969).

In Arches National Park, Grand Co., Utah, one litter is born each year following a gestation period of 30–33 days. Parturition dates and litter size were: 2 April, 6; 7 April, 5; 11 April, 7; 17 April, 4. Not all females are pregnant during this time period. Females lactate from early April to late May (Wadsworth, 1969). However, one female was lactating in mid-June in southwestern Colorado (Cary, 1911).

At birth, the head is disproportionately large, prominently rounded, and soft to the touch. By the end of week 2 (sometimes week 4), the head becomes flattened and no longer is soft to the touch. The lower incisors irrupt in 10–12 days, upper incisors in 20–22 days, and cheekteeth at 34–37 days of age (Wadsworth, 1969).

Young do not feel warm to the touch for at least 1 week after birth. Presumably they do not gain thermal control until that time (Wadsworth, 1969).

At 3 days of age, the only hairs that clearly are visible are the vibrissae around the mouth and nose. Hairs on top of the head and along the back can be seen with the aid of a 9×-hand lens. On day 8, the body hairs on top of the head, the back, and the sides can be distinguished by the unaided eye. Within 10 days, a sparse growth of hair appears on the legs and ventral surface. Hair does not become evident on the tail until days 12–13. The four pale dorsal stripes and the three dark dorsal stripes appear at 10 days of age. By the end of week 2, the color of adult facial patterns and dorsal body patterns is evident, and by week 3 the hair takes on a sleek appearance. At this stage, the hair is smooth over the body and is closely appressed to the tail, which lacks the bushy appearance of the adult. The anterior one-half of the ventral surface is closely covered with hair in 25 days, whereas the posterior area is sparsely furred. The smooth, sleek appearance of the young disappears at the age of 10 weeks when they assume the appearance of young adults (Wadsworth, 1969).

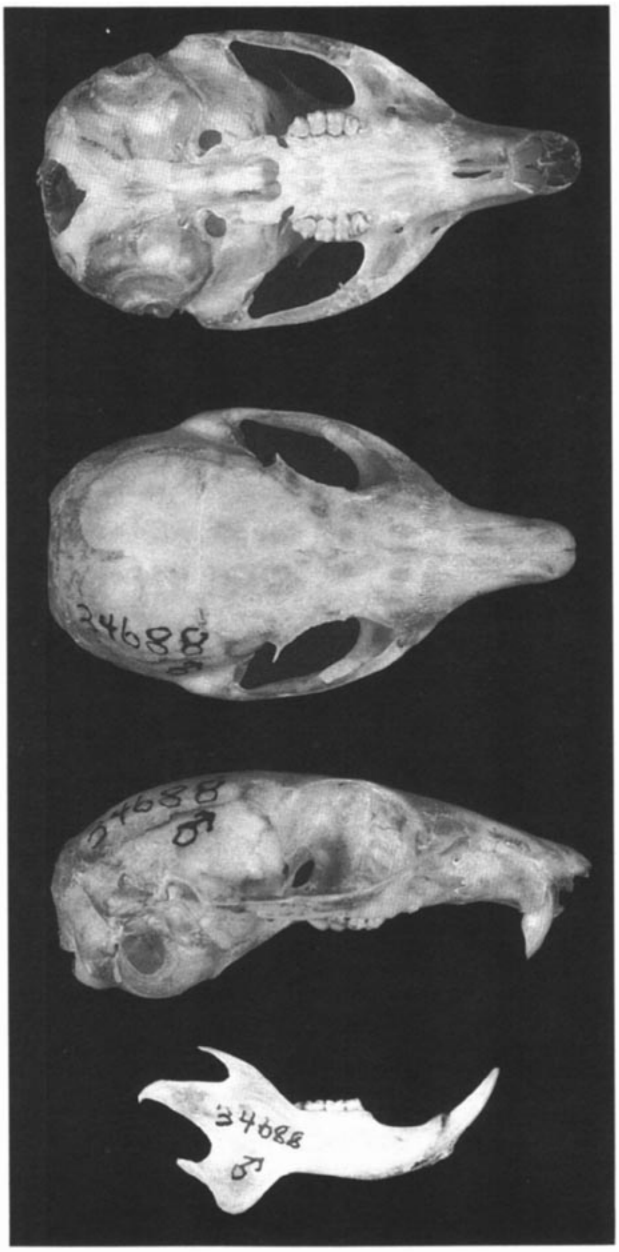

FIG. 3. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of *Tamias rufus* from near Loma, 1,380 m, Mesa Co., Colorado (male, The University of Kansas Museum of Natural History 34688). Greatest length of cranium is 35.3 mm. Photographs by T. H. Henry.

The skin of the head, back, rump, and joints between the legs and body becomes somewhat dry and scaly at the age of 10–12 days and remains in that condition until ca. day 24. The dry scaly skin is much more pronounced on young of some litters. Each day, the skin becomes darker and the pigmented areas of dorsal dark stripes are recognizable in 5 days (Wadsworth, 1969).

Grooves marking the future eye slits are noticeable at 3 days of age. The eyes become increasingly prominent and bulging until the lids open 29–33 days after birth. The lids become fully opened within 24 h after forming narrow slits. At birth, the pinnae of the ears are folded over the region of the future ear openings, but on days 2–3 they become erect. On some animals, one pinna unfolds

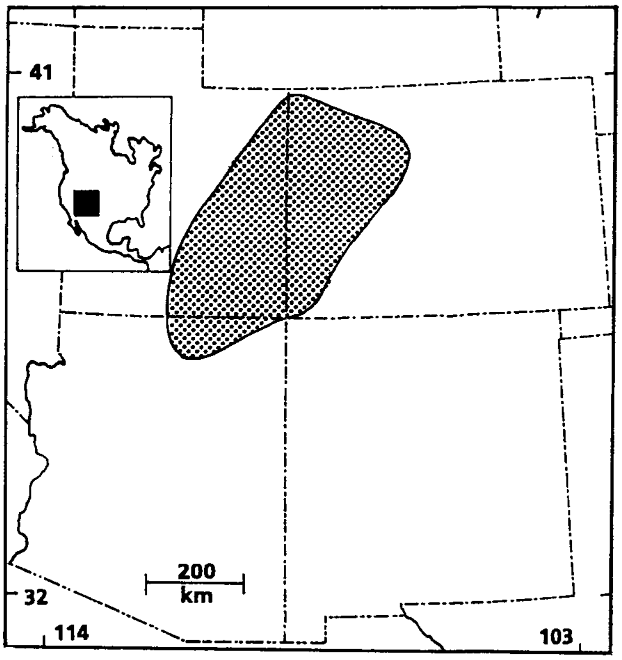

FIG. 4. Distribution of *Tamias rufus* in western North America (modified from Patterson, 1984).

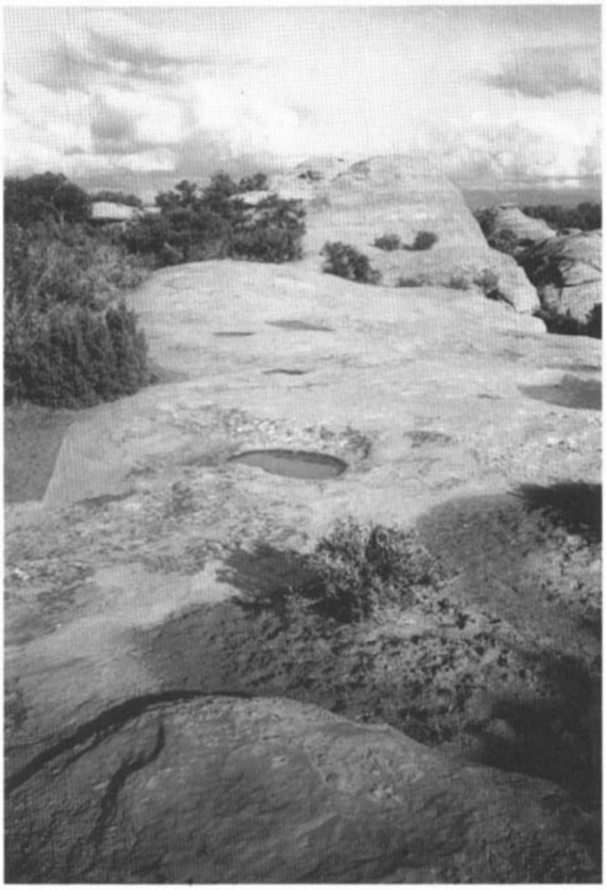

FIG. 5. Habitat occupied by *Tamias rufus* in Arches National Park, Grand Co., Utah. The small depressions in the sandstone rocks contain water after rainstorms. Photograph by T. L. Best.

1 day before the other. The auditory meatus opens at 28–29 days of age (Wadsworth, 1969).

The front toes begin separating at 10 days, and their division is completed at ca. 22–24 days. The development of the hind feet is completed 4–5 days later than that of the front feet. The claws are clear and soft at birth and bleed when cut. The proximal end of the claw begins to turn black within 4 days and at the end of 2 weeks those on the forefeet are entirely black, whereas those on the hind feet require 3–5 more days to become completely black (Wadsworth, 1969).

Young begin their first molt when ca. 60 days old. All animals (subadults and adults) molt in June and July. The earliest and latest molts, respectively, were of a subadult female that was molting from 8 June to 14 July and an adult female that was molting from 23 June to 20 July. The molt of subadults progresses from the head to the tail, whereas adults lack a definite molt line. On the ventral surface of all animals, the molt begins on the lateral portions and progresses inward until complete at the midventral line (Wadsworth, 1969).

Subadults molt a second time in their 1st year beginning in mid-September and ending in mid-October. This second molt begins on the rump near the base of the tail and progresses forward in a definite pattern. The molting of the ventral surface is the last to be completed and follows the same pattern as on animals molting in June and July. Adults show evidence of molting in September and October (Wadsworth, 1969).

The young are well cared for until they are capable of leading an independent existence. Weaning is a gradual process and is completed when the young are 6–7 weeks old. From the time of birth until the young are weaned, the female spends most of her time in the nest. Young may nurse while the female lies on her side, back, or abdomen. The general activity of the young noticeably increases during the 1st 24 h. In 8–10 days, they can drag themselves on their abdomens, primarily using their front legs. By 16 days of age, they are able to hold their bodies off the ground for short periods of time. Movements at 3 weeks of age are jerky and spasmodic, although at this age they begin to scratch their ears with the hind feet. They become active outside the nest at 5 weeks of age. By 6 weeks, they eat solid foods. After eating, they will sit on their haunches and wash their faces in the adult manner. When at rest or asleep, the forepaws are held over the face, and the body and tail are curled into a ball (Wadsworth, 1969).

Compared with *T. townsendii*, which is an occasional hibernator, *T. rufus* has a lower growth-rate constant (Levenson, 1979). For the 1st 3 months, the growth rate is fairly uniform; the average daily increment is 0.50 g (Wadsworth, 1969). In mid-June, the young are one-half to two-thirds grown (Cary, 1911).

The baculum reaches adult size before complete tooth emergence. Animals in which replacement of P3 and P4 have reached occlusal level are considered adult, whereas those with a fully erupted M3 and deciduous premolars are considered subadults (Patterson, 1984). Subadults with a deciduous P4 fully erupted can be distinguished from adults by the presence of a small hole in the bone lingual to this tooth. This is not found in adults. Also, the anterior root of P4 is more slanted in subadults than adults (Hoffmeister, 1986). Both genders are sexually mature when 10–11 months old. Females give birth to their first litter of young when ca. 1 year old (Wadsworth, 1969).

In captivity, Hopi chipmunks do not become accustomed to the presence of humans or handling. When being handled, the young invariably buzz, try to bite, and attempt to ward off the person with their forepaws (Wadsworth, 1969).

ECOLOGY. In Canyonlands National Park, Utah, *T. rufus* most often occurs on bare or vegetated rocky substrate. The most conspicuous plants in its habitat are Utah juniper (*Juniperus osteosperma*), pinyon pine (*Pinus edulis*), blackbrush (*Coleogyne ramosissima*), and Morman tea (*Ephedra viridis*). Other plants in the same habitat are bigelow sage (*Artemisia bigelovii*), mountain mahogany (*Cercocarpus intricatus*), alderleaf (*C. montanus*), rabbitbush (*Chrysothamnus*), cliff rose (*Cowania mexicana*), simple-leafed ash (*Fraxinus anomala*), matchweed (*Gutierrezia*), cactus (*Opuntia*), threeawn (*Aristida longiseta*), bigelow aster (*Machaeranthera bigelovii*), galleta grass (*Hilaria jamesii*), Indian ricegrass, needle-and-thread grass (*Stripa comata*), alkali sacaton (*Sporobolus airoides*)—Johnson, 1981), dropseed (*Sporobolus cryptandrus*), four-wing saltbush (*Atriplex canescens*), Fremont's bareberry (*Berberis fremontii*), Russian thistle, sunflower (*Helianthella uniflora*), and cheatgrass (*Bromus tectorum*—Clevenger and Workman, 1977).

The Hopi chipmunk occurs in an area with large formations

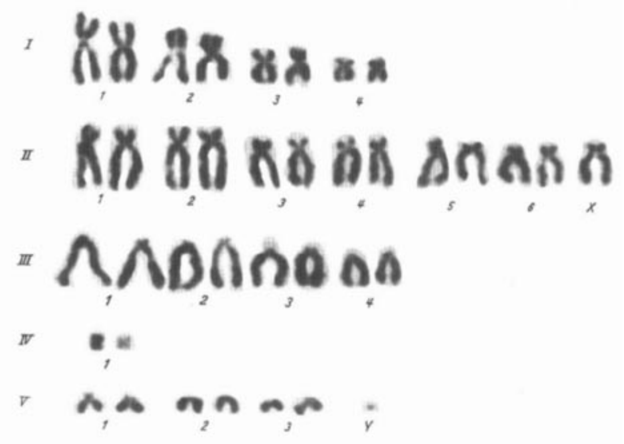

FIG. 6. Karyotype of a male *Tamias rufus* from Mesa Verde National Park, Montezuma Co., Colorado. Roman numerals indicate the type of chromosome: I, large metacentric; II, submetacentric; III, large acrocentric; IV, small metacentric; V, small acrocentric. The number of chromosomes of each type is noted (Nadler and Block, 1962).

of sandstone in Arches National Park (Fig. 5). Scattered among Utah juniper and pinyon pine, are cliff rose, blackbrush, matchweed, Harriman yucca (*Yucca harrimanii*), cheatgrass, Indian ricegrass, Morman tea, false horsemint (*Poliomentha incana*), and sagebrush (*Artemisia*—Clevenger and Workman, 1977). It regularly occurs in the pinyon-juniper community, in the ecotone between the pinyon-juniper community and the sandy flats, and a short distance into the blackbrush-Indian ricegrass community of the sandy flats. Two were observed in the blackbrush-Indian ricegrass community at least 0.4 km from any pinyon-juniper area or ledge and accompanying rock piles. No others were seen >60 m from ledges or the pinyon-juniper community (Wadsworth, 1972).

Tamias rufus is restricted to rocky areas where there are stands of pinyon-juniper and associated shrubs in Colorado (Sutton, 1953). It appears equally at home among the rocks in the precipitous canyons and in the dense juniper and pinyon growth that cover the bordering mesas (Cary, 1911). In Colorado National Monument, Mesa Co., Colorado, it is conspicuously absent from areas with mature sagebrush (*Artemisia tridentata*—Miller, 1964); although, sagebrush may be an important food (Sutton, 1953).

The Colorado River in Glen Canyon, Utah, is a tremendous barrier to the distribution of other kinds of sciurids, but seems not to be an effective barrier to *T. rufus*. This species may have been able to circumvent the river, or more probably to cross it. However, it is doubtful that much intermixing occurs in the region of Glen Canyon (Durrant and Dean, 1959).

In Arches National Park, nest sites always were associated with piles of broken rock or crevices in solid rock (Wadsworth, 1972). In Colorado, one *T. rufus* occurred in a rock crevice within which a quantity of mountain mahogany seeds were stored, and several chipmunks had shelled immature seeds of immature pinyon pine in their cheekpouches (Sutton, 1953).

Tamias rufus feeds extensively on berries of one-seeded juniper (*Juniperus monosperma*) in Utah (Cary, 1911). In Arches National Park, its diet in June is almost exclusively immature and mature seeds of Indian ricegrass. The fruits or seeds of juniper, cliff rose, squawberry (*Rhus trilobata*), and mountain mahogany are added to the diet in small quantities in July and August. During September and October, seeds or nuts from Russian thistle, pinyon pine, and Gambel and wavy leaf oaks (*Quercus gambelii*, *Q. undulata*) along with Indian ricegrass are eaten. No *T. rufus* ate leaves or stems of any plant in the field, but in captivity it selected the ripening flower parts of dandelions to the leaves and stems (Wadsworth, 1972).

The Hopi chipmunk primarily feeds on green vegetation in late spring and summer in southeastern Utah. Nuts of pinyon pine are eaten when they become available in late August. It seems quite adaptable to campground situations and often is seen foraging around campsites seemingly oblivious to human activity in the immediate area (Fig. 1). It appears to be an opportunistic herbivore and granivore that will consume some insects when available. This type of dietary adaptability may enable this species to exploit the food resource provided by camping activity. The ability to utilize this additional food supply may be one of the reasons for higher populations of this species in campgrounds than in areas away from campgrounds (Clevenger and Workman, 1977).

In Colorado National Monument, food habits vary depending upon development of seeds of various shrubs. *T. rufus* feeds on seeds of mountain mahogany, juniper, pinyon pine, saltbush (*Atriplex*), rabbitbush (*Chrysothamnus nauseosus*), serviceberry (*Amelanchier*), and cliff rose (*Cowania*). The blossoms of Harriman yucca also are eaten. Yucca is harvested by cutting the flowering stalk off just below the blossoms and then dragging off the entire stalk, or by removing the flowers one at a time for transport to the cache (Miller, 1964).

When in captivity, *T. rufus* will eat flies, beetles, and seeds of sweet clover (*Melilotus*), lupine (*Lupinus*), and sneezeweed (*Helenium*—Sutton, 1953), and a mixture of commercial hamster food with extra sunflower seeds, rolled oats, and millet added. It also will eat apples and dandelion flowers, stems, and leaves (Wadsworth, 1969).

Tamias rufus may have a center of activity, but its home range cannot be accurately presented in two-dimensional space because it is an avid climber. It often is in trees and on vertical sandstone cliffs within its home range. Home ranges are from 0.36 to 1.28 ha. These vary in size and shape, presumably due to reproductive activity and availability of food in different seasons. The projected summer home range for an adult male and an adult female was 1.28 and 1.04 ha, respectively; for three subadults it was 0.36, 0.48, and 0.96 ha. The Hopi chipmunk also makes movements that seem to be of an exploratory nature that are ≥90 m beyond the limits of the home range (Wadsworth, 1972).

Tamias rufus and *T. minimus* occur in the same areas of Mesa Verde National Park, Montezuma Co., Colorado. *T. rufus* is more abundant than *T. minimus* in stands of pinyon and juniper, along cliffs, and at low elevations (Anderson, 1961). In Canyonlands National Park, Utah, *T. rufus* occupies habitat similar to that of *Peromyscus crinitus* and *P. truei*. These taxa occur in rough and broken terrain. Other mammals occurring in the same habitat as *T. rufus* are *Ammospermophilus leucurus*, *Perognathus flavescens*, *Dipodomys ordii*, *Peromyscus maniculatus*, *Onychomys leucogaster*, *Neotoma cinerea*, *N. lepida* (Armstrong, 1979; Johnson, 1981), *N. stephensi*, and *Chaetodipus intermedius* (Hayward et al., 1958).

Several species of predatory snakes, birds, and mammals may prey on *T. rufus*. Gopher snakes (*Pituophis melanoleucus*) ate young chipmunks that were being held in captivity. It is likely that these snakes also enter the nests and eat the young in the field (Wadsworth, 1972). Other possible predators are coyotes (*Canis latrans*), Swainson's hawks (*Buteo swainsoni*—Clevenger and Workman, 1977), and long-tailed weasels (*Mustela frenata*—Quick, 1951).

One *T. rufus* had a large botfly larva (probably *Cuterebra*) embedded under the skin of the abdomen (Sutton, 1953). Other parasites include the mites *Hirstionyssus utahensis* and *Dermanyssus becki* (Allred and Beck, 1966) and the fleas *Epitedia stanfordi*, *Malaraeus sinomus*, *M. telchinum*, *Megaroglossus procus*, *Monopsyllus eumolpi*, *M. wagneri*, and *Peromyscopsylla hesperomys* (Beck, 1966).

Sherman live-traps (8 by 9 by 23 cm) baited with birdseed have been used to capture *T. rufus* (Clevenger and Workman, 1977). The Hopi chipmunk has been marked by toe clipping and by Nyanzol-A dye on the pelage (Wadsworth, 1969, 1972).

BEHAVIOR. *Tamias rufus* is diurnal (Clevenger and Workman, 1977) and occurs on cliffs along the warm sides of canyons during the early morning hours; it may be seen running along the rocky ledges in the bright sunlight in family groups of four or five (Cary, 1911). In early spring and late autumn, it is active from shortly after sunrise until shortly before sunset, with peak activity ca. 1 h after sunrise and again ca. 1 h before sunset. With increased temperatures, midday activity tapers off; by July, activity during midday has ceased. On cool and cloudy summer days, the activity pattern generally is the same as in early spring or late autumn. Although it is not active during rainstorms, it is active just before and immediately after daytime rains or thundershowers (Wadsworth, 1972). When alarmed, it may leap up a tree and hide on the opposite side of a branch from the perceived threat (Cary, 1911).

In Arches National Park, seasonal activity indicates that *T. rufus* does not hibernate any great length of time. It is active in warm weather from late February to late November and usually is not observed again until late February or early March of the following year (Wadsworth, 1969, 1972).

Tamias rufus obtains seeds of Indian ricegrass and Russian thistle by climbing into the plants or by gathering the seeds on or just beneath the surface of the ground. In bushy plants, seeds or fruits are obtained by climbing the plants to where the seeds are located; the Hopi chipmunk was not observed gathering seeds or fruits that had fallen from any bushy plant even though they were continuously on the ground beneath the plants from middle summer until autumn. *T. rufus* was observed eating pinyon nuts and acorns, but it was not determined how they were obtained. Food items are not eaten at the time or place gathered, but are carried in the cheekpouches to a vantage point (usually on a large rock) to eat, or to the den to eat or store the food (Wadsworth, 1972).

In southeastern Utah, *T. rufus* gathers nuts of pinyon pine throughout the day in August (Clevenger and Workman, 1977). In Colorado on 12 September, ca. 12 Hopi chipmunks were actively engaged in carrying oats from a stack along the White River and storing them in caches among the rocky ledges nearby (Cary, 1911).

Tamias rufus seems to have a definite need for free water if its diet is exclusively dry seeds; it will die if deprived of water for 2 days. The only free water available in most areas is that collected in depressions on rocks after rainstorms. This source of water may have an important influence on the habitat selected, because *T. rufus* is found in greater numbers associated with sandstone formations where rainwater is most likely to collect in the many natural depressions. A portion of the water requirements may be met by the inclusion in its diet of the immature seeds and flower parts of plants that have a high moisture content, such as Indian ricegrass and Russian thistle (Wadsworth, 1972).

GENETICS. *Tamias rufus* has the type B karyotype of *Tamias* (Fig. 6). The diploid karyotype contains 38 chromosomes including four pair of large metacentric, six pair of large submetacentric, four pair of large acrocentric, one pair of small metacentric, and three pair of small acrocentric chromosomes. The X chromosome is submetacentric and the Y is acrocentric (Sutton and Nadler, 1969).

REMARKS. Because of its smaller baculum (Fig. 2) and average smaller size, *T. rufus* is regarded as a species distinct from *T. quadrivittatus* (Patterson, 1984). The distribution of the previously recognized taxon *T. quadrivittatus hopiensis* in Colorado (Armstrong, 1972) and Utah (Durrant, 1952) corresponds closely to that of *T. rufus* (Patterson, 1984). The name *T. rufus* was proposed to replace an earlier name, *T. hopiensis*, because of presumed intergradation between *T. quadrivittatus quadrivittatus* and *T. quadrivittatus hopiensis* at the type locality of *T. q. hopiensis* (Keam Canyon, 80 miles N Holbrook, Navajo Co., Arizona). In 1980, only typical *T. q. quadrivittatus* was found at Keam Canyon. Baubella obtained from paratypes of *T. q. hopiensis* indicate that the population is a composite of both *T. quadrivittatus* and *T. rufus*; both species apparently were present at Keam Canyon in 1894. Because the holotype of *T. hopiensis* cannot be reliably referred to either species, the name *T. hopiensis* is considered a *nomen dubium*, either a junior synonym of *T. q. quadrivittatus* or a senior synonym of *T. rufus* (Patterson, 1984).

Currently, chipmunks previously assigned to the genus *Eutamias* are included in the genus *Tamias* (Levenson et al., 1985; Nadler et al., 1969, 1977; Wilson and Reeder, 1993). However, there are indications that *Eutamias* and *Tamias* may be distinct genera, e.g., divergence in the late Miocene (Ellis and Maxson, 1979; Hafner, 1984), differences in pattern of dorsal stripes, structure of the hyoid, chromosomes, dental formulas, bacula (Hoffmeister, 1986), microcomplement-fixation reactions, and allozymes (Ellis and Maxson, 1979; Hafner, 1984).

Tamias is from the Greek *tamias* meaning a storer or distributor. The specific epithet is from the Latin *rufus* meaning reddish (Jaeger, 1955). The common name of Hopi chipmunk was applied to *T. rufus* by Patterson (1984); probably because most of the populations now considered to be *T. rufus* were referred to as *T. quadrivittatus hopiensis* (the Hopi chipmunk) for many years.

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