NOTES ON THE HABITS OF THE LONG-TAILED HARVEST MOUSE

By Clarence F. Smith

The following notes comprise the more important observations made during a study of the long-tailed harvest mouse (*Reithrodontomys megalotis longicaudus*) during the spring of 1935, while the writer was a graduate student at the Museum of Vertebrate Zoology, University of California, Berkeley, California. The writer desires to express his appreciation for advice and assistance received from Dr. Joseph Grinnell, Dr. E. Raymond Hall, and Mr. Lawrence V. Compton. He is indebted also to Mr. Gerrit S. Miller, Jr., and Dr. H. H. T. Jackson for permission to examine specimens in the National Museum and Biological Survey collections. The study was carried on in the field and in the laboratory. The area selected as typical of the habitat of this species in the vicinity of Berkeley is located just below the summit of Skyline Ridge, between Claremont Canyon and the head of Bancroft Way. (U. S. Geological Survey topographic map, Concord, California, quadrangle, 1897, edition of 1910.)

Nesting.—In the area under consideration, the harvest mouse inhabits either level or steeply sloping ground, and may be found in grass meadows or in fairly heavy chaparral of the *Artemisia-Baccharis* association. No nests were found in burrows, although two systems of burrows, into which harvest mice were traced, were excavated. No evidence was obtained to show whether the burrows actually were excavated by these mice, or by other rodents of the area. Two nests were found upon the surface of the ground: one under a board in a grassy meadow, and the other under a *Baccharis* plant. Both were constructed of plant fiber and "cotton", the latter probably from the seeds of *Baccharis*, they were well-woven structures about three inches in diameter, and were semi-globular in shape. The single opening of each was about one-half inch in diameter and was lined with the material that lined the interior of the nest. The cup of the nest was about the diameter of a golf ball, and the outer portion consisted of a woven mass of plant fiber.

In the laboratory, plentiful supplies of cotton and plant fiber were available to the mice, but only the cotton was used. Some of the mice showed highly developed acquisitive instincts, and stole material from adjoining cages even when there was a plentiful supply of their own. In one case, two mice occupying adjoining cages, separated only by one-quarter inch mesh screen, carried on a thieving duel for several days. Both mice built their nests in adjacent corners, and during this time the material, weighing about 7 ounces, was pulled through the screen 18 times before the investigator finally removed the nests to opposite corners.

Nests were removed from cages upon several occasions, with the result that the mice attempted to find a hiding place by burrowing into the sawdust and shavings covering the floors of the cages. No attempt to use the forepaws was noticed, but instead the digging was done by rooting with the snout.

When more than one mouse occupied a cage, the same nest was used by both. This tolerance even permitted the introduction of a strange mouse into a cage which the other mouse already had occupied for several weeks, and the placing of individuals in a cage entirely new to both. No apparent difference existed with regard to the treatment of one sex by the other. None of the mice seemed to resent to the slightest extent inva-

sion by a strange mouse, and both always would be found together inside the nest. Even at the time of the birth of young, the mother tolerated not only her mate, but a completely strange male, in the same nest with the babies.

The process of nest construction was commenced with the accumulation of bits of cotton which were pulled in and up to form the sides, roof, and floor, all at the same time. After the cup was formed into a closed sphere, enlargement was accomplished by pulling bits of cotton into the nest, patting them into position with the forepaws, and where resistance was met, with the teeth. These operations were accompanied by continual turnings of the body. The construction of a nest, when uninterrupted, occupied about 15 minutes in the laboratory where the material for construction was immediately available.

Home instinct was noticed in the laboratory, where it was learned that an escaped animal used regularly to sleep in a tin can filled with cotton.

Reproduction.—One pair of mice bred under laboratory conditions, but no observations were made upon mating activities. The mice showed no apparent change in their attitude toward each other, and a strange male, placed in the cage just 12 hours prior to the birth of the young, was at once accepted by the mated pair, and the next morning was found in the nest together with the parents and young.

The mated pair were placed together on February 9, after they had shown their interest in one another by leaving their respective nests and going to the screen which separated their cages, where they rested.

At 9.30 A.M. on May 2, two babies were found in the nest, together with the parents and the strange male. The mother had shown no external signs of pregnancy when closely examined on April 30. At 10.19 A.M., only the two young were present, but a third was born between that time and 10.22, when the mother was licking the third baby. The umbilical cord still was attached to the latest arrival.

At birth the young are quite helpless; the eyes and ears are closed and they cannot lift their heads. The vibrissae are the sole hair structures visible at birth, and are quite well developed and functional. The voice at this time is a shrill insistent screech, partially audible to the investigator as sound, and partly as an impact upon the ear drum. The skin is perfectly smooth and quite pink with a membrane-like appearance. The length of the body at birth, measured in the curled position, was 21 mm.

The following dated notes show the sequence of development from birth until the young were weaned:

May 3.—The skin had become noticeably darker and more wrinkled, and the voice was slightly lower in pitch. The effect of impact upon the ear drum, so noticeable 24 hours earlier, now was not apparent. The young spent most of their time fastened to the mother's nipples, all of which appeared to be functional, but the mother left the babies in the nest when she emerged.

May 4.—The ear pinnae were open, although the auditory meatus remained closed. The abdomen remained pink, but the other skin areas had become bluish in color. The young were beginning to crawl.

May 5.—The call of the young now consisted of about seven syllables decreasing in volume. The eyelids now showed a line at their juncture, and close examination of the body revealed the faintest traces of hair. The skin, except for the abdomen, was nearly black.

May 6.—The first signs of the mandibular incisors appeared. At this age, the babies are able to stand, although they do not walk. The mode of progression is with the forefeet working alternately and the hind feet working together. Coloration of the hair was first noticeable. Hair on the tail first appeared, although the abdomen is still bare, and only the back and sides show much hair.

May 11.—The babies began to walk at about this time, with the hind feet functioning alternately. The auditory meatus was open for the first time, and there was a noticeable reaction to squeaks, which caused the young to contract their bodies as much as possible. The use of the tail as a balancing organ at this early stage of walking was quite pronounced. A rufous-colored area of hair was beginning to show at the posterior margin of the vibrissae, and a similar area at the auditory opening.

May 12.—The eyes first opened, but apparently were of little use for another 48 hours. Until this time the young showed no resistance to the mother when she picked them up, but now they struggled when she attempted to pick them up in her mouth.

The babies were fully weaned at about three weeks of age. Their weight at birth was 1.2 grams in two individuals, and 1.0 gram in the third. The growth curve, as outlined by weight and length measurements, shows that growth is not apparent until 24 hours after birth, after which it is even and constant. Comparison of the two curves shows that minor fluctuations occur in inverse ratio.

The young mice consistently were much wilder from the first than the adults and required to be handled with great care to prevent their escape.

Breeding season.—Statistical analysis of breeding data accompanying skins in the Museum of Vertebrate Zoology sheds some light upon the duration of the breeding season. There were examined 304 females, all, with one exception (from Jackson County, Oregon) from 35 California counties, representing the entire range in California of this subspecies. Pregnant females occurred in all months of the year except January and March, and they indicate the existence of two important breeding seasons. One occurs in April, and a less important one in October.

The accompanying chart shows the numbers of females recorded for each month, and indicates the pregnancy percentage of each monthly total. Although only 6 specimens are recorded in August, and 8 in February, the remainder of the collection is sufficiently representative to be of significance. Only a single pregnant female was recorded in three of the months, February, August, and December. Only 2 pregnant animals were reported in September, 5 in June, 6 in November, 7 each in July and October, 10 in May, and 14 in April.

Food Habits.—Owing to the low level of *Reithrodontomys* population over the period covered by these investigations, very limited numbers of animals were taken, and as most of these were kept alive for laboratory examinations, only two stomach examinations were made. One of these, taken March 30, contained seeds and bits of stems of the grass genera *Festuca, Bromus,* and *Avena.* The stomach of the second mouse, taken March 31, held seeds and bits of stem and leaves of *Astragalus, Festuca,* and *Bromus.* In addition to these items both stomachs held a certain amount of plant food indistinguishable except as pulp.

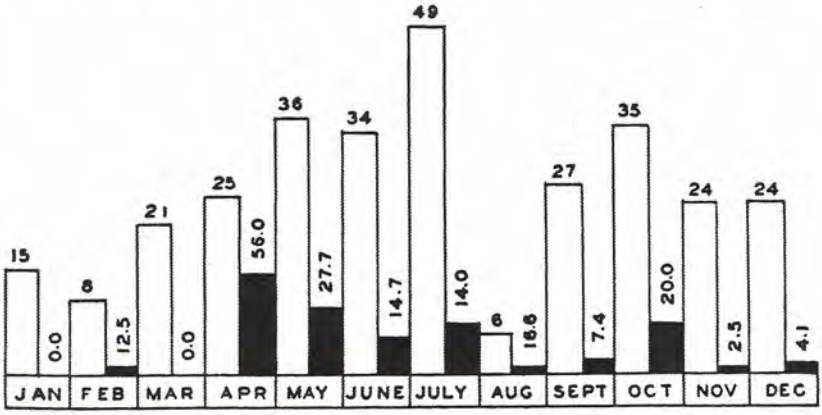
Laboratory investigation of food preferences was made by offering, to captive wild mice, plants taken from the localities in which the mice were trapped. These items included most of the plants found in the immediate vicinity of the trapping sites, and represent an area of about 2,500 square feet of sage-chaparral flora.

Plants accepted and eaten	*Plants not eaten*
Avena fatua—wild oats	*Artemisia tridentata*—sagebrush
Bromus sp.—brome grass	*Eschscholtzia californica*—California poppy
Hordeum murinum—foxtail	*Baccharis pilularis*—coyote brush
Erodium moschatum—white-stem filaree	
Medicago hispida—burr clover	

The mice ate only the green portions of these plants, and made no attempt to utilize the woody parts or roots.

All evidence concerning the supposed habit of hoarding was negative. In none of the excavated burrows were there found any signs of storage, although at the same time *Microtus* burrows in the immediate vicinity regularly contained stored food. None of the laboratory animals showed any desire to accumulate reserve food, except for two or three isolated instances in which a single item of food was buried. The mice were consistent in this respect, and no individual showed any marked difference from any other. Only in a single case was a mouse seen to dig up a buried food item.

The mice showed a decided reaction to living moths (*Autografa californica*) placed in the cage. This moth is common in the region, and has a wing-spread of about two inches. The body is thick and short. The moths apparently were recognized as food, although in some cases the mouse showed uncertainty regarding the method of procedure. Before attacking, the mouse first crouched motionless with attention riveted upon the moth for a few seconds. Then it made a quick dash, seized the moth, and in a tussle lasting about a second, killed its prey and gulped down the soft parts, leaving only the wings, legs, and one or two other hard parts. The mouse sometimes varied the at-



INCIDENCE OF PREGNANCY IN *Reithrodontomys*

Open blocks show total number of females captured in each month. Solid blocks show percentage of pregnant females in each month.

tack by making a short preliminary stalk, exactly in the manner of a cat stalking a bird. The rapidity with which the moth was eaten contrasted in a high degree with the leisurely manner of eating inanimate food. No interest was shown in moths unless they were alive, and dead moths left in cages overnight invariably remained untouched. The moths seemed at times to be able to hold their own, as not always did the attacks end in victory for the mouse. On these occasions the mouse made no second attempt to attack the moth, and showed no further interest in it.

Cannibalism was not practiced, so far as laboratory evidence indicated, and all individuals lived together amicably, as mentioned above. Individuals of *Peromyscus truei gilberti* and *P. maniculatus gambeli* also were accepted by *Reithrodontomys* exactly as they accepted others of their own species, and the mice walked over and under each other with neither showing the slightest sign of resentment. This reaction lasted for periods of at least 24 hours, beyond which time experiments were not continued.

Laboratory diet was based upon two balanced rations in common use at the University of California, supplemented by fresh plant food, and by rolled oats and water.

The use of green food made little apparent difference in the amount of water used. The mice drank frequently, and usually finished a meal by washing face and paws, grooming themselves, and then by drinking. The free moisture in the food offered, and metabolic water, was sufficient to meet the needs of the mice, and one individual had no other source of water for over a month. This mouse apparently had no desire for moisture, as it showed no interest in water placed just out of reach.

The average per capita consumption of oats by eight mice for an eleven-day period was 1.63 (1.46–2.32) grams per day. During this period, fresh plant food twice was supplied, and an average of 3.0 grams for each two-day period was eaten. Volumetric estimates of the amount of water consumed were not made, but the approximate consumption is six to eight drops per day.

The passage of food through the digestive tract requires approximately 24 hours, as indicated by the change in color of the feces from light brown to greenish-black.

The favorite time for feeding seemed to be after sundown, whether or not the laboratory was lighted. During the first few days of captivity, the mice were not seen, except for a single individual that emerged several times from its nest in daylight. After a week or so of captivity, the mice emerged during the daytime, or when the room was lighted at night, almost as readily as in complete darkness. Under normal conditions in the field no evidence of daylight activity was found.

Some individuals ate at the spot where the food was found, while others went to the "feeding-ground," took a bit of food, and retired inside the nest to eat. This difference was constant with the individual, and may have been caused by the light. Following a meal, the mice invariably stretched, yawned, and proceeded to wash and groom their fur. Each individual had regular times for feeding, and in general it seemed that each made a periodic meal of five to ten minutes duration between sundown and 10.00 P.M. Although food was taken at the last-mentioned time with a high degree of regularity, any of the mice might appear for a minute or two at almost any time of day and partake of a short meal. Between midnight and 8.00 A.M. some feeding was done, and there may have been additional periodic meals, but observations between these hours are too meager to be of significance. One individual never was seen outside the nest at any time, and always fed during this period of quiet.

Other observations.—The harvest mouse does not become gentle, and dislikes handling even when not alarmed. The mice used in my experiments were handled nearly every day, and only one or two of them ever became gentle enough to permit them safely to remain free outside their cages. One of these would sit in my palm for a moment or two, then walk to the edge of my hand, seek for some easy means of getting into the cage, and would then jump into its cage. When my hand was raised more than three or four inches above the floor or sides of the cage to which the mouse might jump, this animal several times deliberately sunk its teeth into my skin and tried to chew my finger. Then, it again looked to see if the cage were nearer; if so, the mouse jumped into the cage, but if not, it again tried to bite me. All during this time, the mouse was quite free to move exactly as it wished. As long as my hand was in motion, no attempt to jump was made, but when the hand became still, the mouse began to seek a means of escape.

This behavior was in decided contrast to that of *Peromyscus*, which could be handled with impunity almost immediately after capture. The deer mouse often will be tame enough to feed upon the hand within 24 hours after capture, and I never have had even an alarmed *Peromyscus* attempt to bite me.

The young mice, raised in the laboratory and handled at least once daily, were wilder even than the parents, and objected frantically to capture. All the *Reithrodontomys* remained quiet enough when actually captured, but watched alertly for, and took every chance, to escape from my grasp.

U. S. Biological Survey, Washington, D. C.