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Marmosa robinsoni.

By Margaret A. O'Connell

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Marmosa Gray, 1821

Marmosa Gray 1821:308. Type species *Didelphis murina* Linnaeus.

CONTEXT AND CONTENT. Order Marsupialia. Superfamily Didelphoidea, Family Didelphidae, Subfamily Didelphinae. Approximately 44 species (Kirsch, 1977; Kirsch and Calaby, 1977) are recognized in the genus *Marmosa.*

Marmosa robinsoni Bangs, 1898

South American Mouse Opossum

Marmosa robinsoni Bangs, 1898*a*:95. Type locality Isla Margarita, Nueva Esparta, Venezuela.
Marmosa mitis Bangs, 1898*b*:162. Type locality Pueblo Viejo, Santa Marta region, Colombia.
Marmosa simonsi Thomas, 1899:287. Type locality Puna Island, Ecuador.
Marmosa chapmani Allen, 1900:197. Type locality Caura, head of Caura Valley, 500 ft, northern range, Trinidad.
Marmosa fulviventer Bangs, 1901:632. Type locality San Miguel Island, Golfo de Panama, Panama.
Marmosa grenadae Thomas, 1911:514. Type locality Annandale, Grenada.
Marmosa tobagi Thomas, 1911:515. Type locality Waterloo, Tobago.
Marmosa nesaea Thomas, 1911:515. Type locality Savanna Grande, Trinidad.
Marmosa ruatanica Goldman, 1911:237. Type locality Ruatan (=Roatan) Island, Caribbean Ocean off north coast of Honduras.
Marmosa isthmica Goldman, 1912:1. Type locality Rio Indio, near Gatun, Canal Zone, Panama.
Marmosa casta Matschie, 1916:270. Type locality San Esteban, near Puerto Cabello, Carabobo, Venezuela.
Marmosa mimetra Thomas, 1921:521. Type locality Santa Domingo de los Colorados, 1,600 ft, Ecuador.

CONTEXT AND CONTENT. Context noted above; nine subspecies are recognized (Cabrera, 1958; Goodwin, 1961; Hall, 1981; Handley, 1966).

M. r. chapmani (Allen, 1900:197), see above.
M. r. fulviventer (Bangs, 1901:632), see above.
M. r. grenadae (Thomas, 1911:514), see above.
M. r. isthmica (Goldman, 1912:1), see above.
M. r. luridavolta (Godwin, 1961:5). Type locality Speyside, Tobago.
M. r. mimetra (Thomas, 1921:521), see above.
M. r. robinsoni (Bangs, 1898*a*:95), see above.
M. r. ruatanica (Goldman, 1911:237), see above.
M. r. simsonsi (Thomas, 1899:287), see above.

DIAGNOSIS. The genus *Marmosa* was divided into five groups by Tate (1933); *M. robinsoni* was included in the *murina* group. Species in this group are distinguished from the other *Marmosa* species by the following external characteristics: body size moderate to large; ears with large, lobate, reflected spina helicis; scales of tail spirally arranged with scale spirals ≥16 per cm of tail length; pelage never with tricolor pattern (as in *elegans* group) or woolly (as in *cinerea* group); mammae abdominal, never pectoral. Cranial characteristics which distinguish the *murina* group include: bullae widely separated, rounded, with no processes; palate never strongly fenestrated.

Marmosa robinsoni is distinguished from the other species in the *murina* group (Tate, 1933) by its relatively large body size; large scarcely pigmented ears (Fig. 1); thick, relatively short, and rather densely pilose tail; and proportionately short and broad hindfoot. Diagnostic cranial characteristics (Fig. 2) include: supraorbital ridges well developed, moderately pointed, and with pronounced dorsal grooves; posterior border of nasals rounded; a pronounced constriction postorbitally (Hall, 1981; Tate, 1933).

GENERAL CHARACTERS. *Marmosa robinsoni* is typically cinnamon brown above with buffy yellow underparts. Dorsal color varies from russet to pale brown or gray. Hairs on the venter are unicolor but on sides and dorsum can be gray at base. Top of the head is generally paler in color than the dorsum. The black facial mask, typical of the genus, is always present but varies in size. Prehensile tail (Fig. 3) is approximately 1.3 times the head and body length. Tail is finely scaled with 16 to 22 scales per cm and is covered with short, fine, white hairs. The proximal 10 to 20 mm of the tail has general body fur. All four feet are well modified for grasping, having plantar pads and an opposable hallux. Plantar pads between the second and third digits are the same size as those between the third and fourth digits.

The following measurements (in mm) were compiled from Allen and Chapman (1893), Barnes (1977), Goldman (1911), Hall and Kelson (1959), and Tate (1933): total length, 339.8 (282 to 376); length of tail, 186.7 (152 to 210.8); length of hindfoot, 22.8 (20 to 25); length of ear, 25.5 (22 to 32); basal length of skull, 36.1 (30.5 to 41.7); zygomatic breadth, 21.8 (20.5 to 23); inter-

FIGURE 1. A male *Marmosa robinsoni* in agonistic stance. Photograph by author.

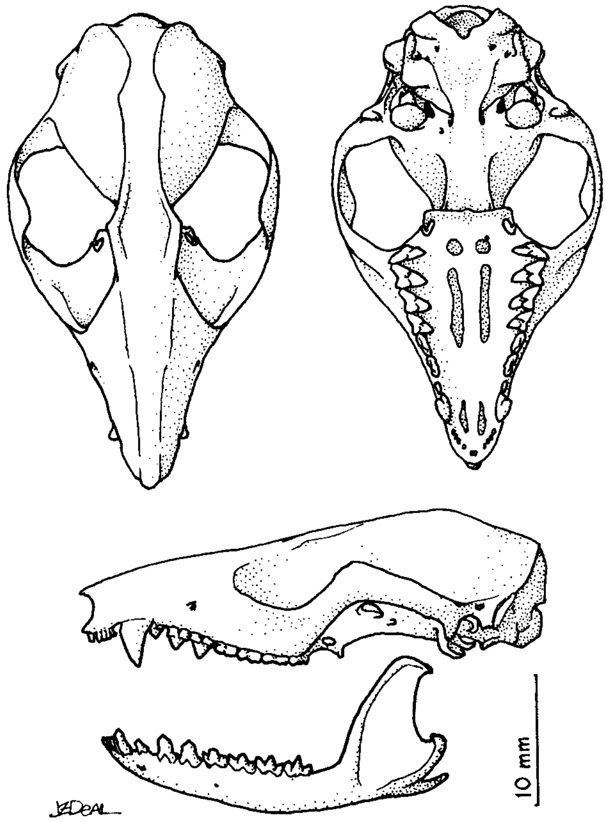

FIGURE 2. Dorsal, ventral, and lateral views of a skull of a female *Marmosa robinsoni.* Drawing by Julie Deal.

orbital breadth, 6.6 (5.1 to 8.5); nasal length, 16.4 (15 to 18.6); nasal width, 4.8 (4.4 to 5.2); palatal length, 20.1 (18.2 to 21). Males are larger than females. Measurements of 16 male *M. r. chapmani* were: total length, 361 (340 to 395); length of tail, 190 (175 to 218); length of hindfoot, 24.4 (20 to 28); length of ear, 25 (22 to 29). Four females of the same subspecies measured, respectively, 324 (302 to 365); 176 (163 to 197); 22 (20 to 24); 22 (20 to 23) (Allen and Chapman, 1893). The weight of mature males ranges from 80 to 110 g and that for mature females from 40 to 60 g.

DISTRIBUTION. *Marmosa robinsoni* is known from the northern Neotropics (Fig. 4). In Central America, it has a discontinuous range; one subspecies is found on the island of Roatan off the coast of Honduras and on the coast of Belize; two more insular taxa are known from the islands of San Miguel and Saboga in the Gulf of Panama and from the island of Grenada; on the mainland the species is known from Panama. In South America, *M. robinsoni* ranges from Trinidad and Tobago, across northern Venezuela to Colombia, where it is found to the west of the Andes extending as far south as northern Peru.

FIGURE 3. Ventral view of a female *Marmosa robinsoni* with 15 young attached. Note prehensile tail. Photograph by author.

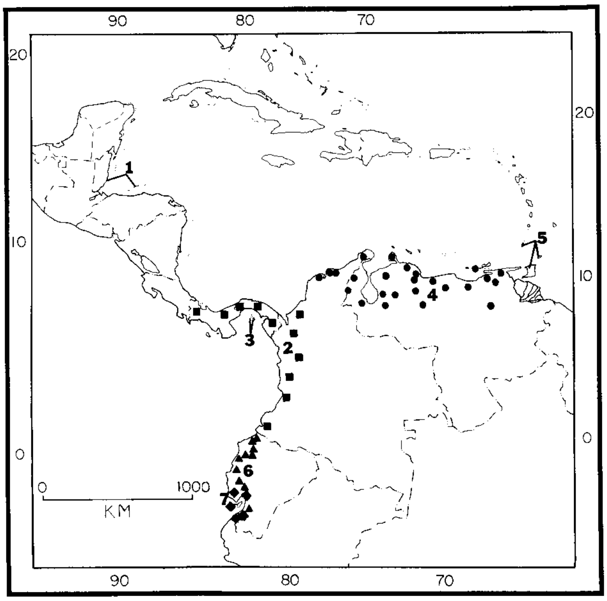

FIGURE 4. Geographic distribution of *Marmosa robinsoni* in Central and South America. Numbers correspond to the following subspecies: 1, *M. r. ruatanica*; 2, *M. r. isthmica*; 3, *M. r. fulviventer*; 4, *M. r. robinsoni*; 5, *M. r. grenadae* (Grenada), *M. r. luridavolta* (Tobago), *M. r. chapmani* (Trinidad); 6, *M. r. mimetra*; 7, *M. r. simonsi.*

The nine subspecies are distributed as follows (Fig. 4): *M. r. robinsoni* is known from northern Venezuela (J. A. Allen, 1904, 1911; Handley, 1976) and northeastern Colombia (Cabrera, 1958; Tate, 1933). *M. r. chapmani* is found on the island of Trinidad and *M. r. luridavolta* on the island of Tobago (Goodwin, 1961). *M. r. grenadae* is known only from Grenada in the West Indies (Goodwin, 1961; Hall, 1981). *M. r. ruatanica* is recorded from the island of Roatan off the north coast of Honduras and on the coast of Belize (Hall, 1981; Hershkovitz, 1951). *M. r. fulviventer* is found on the islands of San Miguel and Saboga off the west coast of Panama (Hall, 1981). *M. r. isthmica* ranges from northeastern Panama through the Canal Zone and the Darien region into Colombia, where it is found on the west coast (Allen, 1916; Anthony, 1916; Cabrera, 1958; Hall, 1981; Handley, 1966; Tate, 1933). *M. r. mimetra* is found west of the Andes in Ecuador from the northern boundary as far south as Santa Rosa in the Guayas Province (Cabrera, 1958; Tate, 1933; Thomas, 1880). The range of *M. r. simonsi* extends from around Guayaquil through southwestern Ecuador to extreme northeastern Peru (Cabrera, 1958; Grimwood, 1968; Tate, 1933).

Handley (1976) collected *M. robinsoni* from 1- to 1,260-m elevation in Venezuela but generally (62% of captures) found this species below 500 m. In northeastern Colombia, it has been collected at 2,670 m near Pueblo Viejo in the Santa Marta region (Bangs, 1898*b*).

FOSSIL RECORD. Fossil material of *Marmosa* is known from several areas: the caves of Lagoa Santa, Minas Geraes, Brazil, and limestone caves in Yucatán (Tate, 1933) and Argentina (Reig, 1968). None of these sites is within the present range of *M. robinsoni* and none of the fossils has been identified as that species.

FORM. There is considerable information available on the anatomy of *M. robinsoni* resulting from interest in this marsupial as an experimental animal in problem-oriented research. The anatomy of *M. robinsoni* has been described in detail by Barnes (1977). Unless otherwise noted, the following description is based on his account.

The skin, which constitutes 10 to 15% of body weight, has several associated glands. In males there is a patch of stained hair extending 10 to 15 mm from the throat to sternum, which darkens from yellow to orange with age. The gland field associated with this patch is composed of hypertrophied apocrine sudoriferous glands and sebaceous glands. This gland field can only be discerned histologically in females. Mammary nipples are surrounded by glands, the secretions of which stain the fur orange-brown to rust. Sudoriferous and sebaceous glands are found in association with simple hair follicles.

The mammae of female *M. robinsoni* are arranged in a circle in the posterior abdominal region. The nipples are small and are hidden except in reproductive females, which groom most of the hair away from the vicinity of the mammae. Striated muscle is located between the deep fascia and base of each nipple. Three lactiferous ducts supply each nipple.

The skeleton of one animal was reported to be 6.46% of body weight.

Laboratory-raised *M. robinsoni* were examined monthly from weaning to adulthood in order to measure several hematologic parameters (Wolf et al., 1971). The following trends were observed as age increased: reticulocyte values decreased; the percentage of lymphocytes decreased corresponding to an increase in percentage of neutrophils; red and white blood cell count increased. No change with respect to age was reported for eosinophils, monocytes, and basophils. Electrophoretic analysis showed that α-globulins remained constant with age.

The spleen of *M. robinsoni* is actively hematopoietic throughout life, but shows variation in response to hematopoietic stress. The splenic red pulp is characterized by a lack of venous sinuses, resembling that of *Didelphis*. Bryant (1977) reviewed the development of the lymphatic and immunohematopoietic systems of marsupials.

The respiratory system begins functioning early in its ontogeny. The lungs of neonate *M. robinsoni* are somewhat primitive, with five to seven compartments per lobe. The air spaces of neonate and adult lungs, however, have the same dimensions. The upper respiratory tract of adult *M. robinsoni* is characterized by well-developed mucous and serous glands in the nasal walls. Paired vomeronasal organs that are lined by sensory epithelium are present.

The digestive system of neonate *Marmosa* differs both in cellular and tissue structures from adults. In the neonate there is no differentiation of glands in the gastric mucosa, which is a simple cuboidal epithelium. The duodenal glands are undeveloped. The adult digestive tract is monogastric, with a short, simple, small intestine that is divided into duodenal and ileal regions. A short cecum is present. The colon is also short with no haustra or other specialization. A 46-g *M. robinsoni* was reported having a small intestine 46 mm long, a cecum of 10 mm, and a colon 30 mm long. The liver constituted an average of 5.72% of the body weight of 50 adult male *M. robinsoni* (ranging from 60 to 105 g body weight). The pancreas resembles that of other small mammals in its position and extent, but there is no special concentration of endocrine tissue. Laboratory-raised animals show a high frequency of idiopatric pancreas atrophy in older (>150 days) individuals. There is no apparent morphological cause of the atrophy.

The urinary system of *M. robinsoni* is characterized by two interesting features: 1) an elongated urinary papilla which suggests that the kidneys are capable of producing a urine of high osmolarity, and 2) a large kidney in proportion to body size. Based on morphological criteria, the kidney of *M. robinsoni* resembles that of a desert animal and it is interesting that such a kidney should be found in an animal of tropical origin. Barnes (1977) suggested that the large size and efficiency of the kidney may be in response to a carnivorous diet.

The female urinary and genital systems have a common terminus; the urethra and the two vaginal canals join internally to form the urogenital sinus. The two vaginae function only in sperm transport and young are born via a median connective tissue bridge through which the young seem to actively tunnel to reach the urogenital sinus. The uteri are separated from each other and the median vaginal cul-de-sac is divided until the birth of the first litter. The myometrium of the uterus is thinner than the muscle layers of the lateral vaginal canals. The endometrium has many conspicuous uterine glands opening on its surface and is villous. These glands become cystic in older females.

The glans penis of *M. robinsoni* is bifid and split for part of its length. These are two pairs of bulbourethral glands present, the largest of which gives rise to a relatively large semen plug when catalyzed by secretions of the prostate. The size of the prostate gland is relatively large; in sexually active males it represents 3.59% of the body weight. There is little storage of spermatozoa in any portion of the epididymis.

FUNCTION. As in other opossums, young of *M. robinsoni* are born in a relatively underdeveloped state (Fig. 3). During the first few days, there is no digestion; milk proteins and lipids are absorbed directly; carbohydrates, except for galactose (which is also absorbed directly) are not present (Barker et al., *in* Barnes, 1977). Nursing young are able to continue respiration uninterrupted by swallowing because a seal is formed by the tight-fitting nasopharyngeal orifice grasping the tubular glottis. Evidence from experiments with inhalation anesthesia suggests that the glottis may be inserted in the nasopharynx in adults as well because the adult's mouth may be open and not affect ventilation (Barnes, 1977).

Much of the work on the physiology of *M. robinsoni* has been done by Hunsaker (1977). He reported a mean body temperature of 31.9°C with a range from 28 to 35°C. The body temperatures, T_b, of resting *M. robinsoni* was 30.7°C and that of active animals 33.2°C. Hunsaker (1977) found that the maximum rate of change of T_b was 0.7°C per min when an animal was excited or moving. *M. robinsoni*, as other didelphids, effects thermoregulation in a variety of ways: behavioral avoidance, evaporative cooling, vasoregulation, shivering, piloerection, and torpor. In response to T_b above its level of thermoneutrality (35.2°C), *M. robinsoni* will use active body movements and saliva spreading. In males, the scrotum, which is darkly pigmented, perhaps to radiate heat, is extended from the body during heat stress. As the T_b increases, animals ceased their escape movements and began panting. Hunsaker (1977) estimated that ambient temperatures, T_a, 43 to 44°C, are lethal for *M. robinsoni*. In response to low T_a, *M. robinsoni* enters torpor.

As mentioned, the kidney of *M. robinsoni* is capable of producing a urine of high osmolarity (Barnes, 1977). Consequently, *M. robinsoni* is able to maintain its water balance at a lower level of water intake than *Didelphis* (Hunsaker, 1977).

ONTOGENY AND REPRODUCTION. *Marmosa robinsoni* females were reported to enter their first estrous at 265 to 275 days (Hunsaker, 1977) or when they weighed 27 to 42 g (Barnes, 1968*a*). Spermatozoa were observed in 60-g males, but full breeding behavior was not seen until about 1 year of age (Barnes and Wolf, 1971). Females appear polyestrous (Enders, 1966; Barnes, 1968*a*) and have an interestrous interval of 18 to 31 days, averaging 23 days (Hunsaker, 1977). Estrous lasts approximately 2 to 3 days (Eisenberg and Maliniak, 1967; Hunsaker, 1977) with peak estrous lasting less than 8 h (Eisenberg, in litt.). During estrous there is noticeable vascularization of the pouch area of the female.

Field studies indicate that *M. robinsoni* breeds during the latter part of the dry season (February to May) in Panama (Fleming, 1973) and Venezuela (O'Connell, 1979). A second peak in reproduction may occur during the wet season (July to December) (Hunsaker, 1977; O'Connell, 1979). Fleming (1973) reported an average litter size of 10 (range 6 to 13) for *M. robinsoni* from Panama. In northern Venezuela the average litter size was 14 (range 13 to 15) (O'Connell, 1979). Hunsaker (1977) estimated that litter size in the wild ranged from 7 to 9. Litter size in captivity may be lower; Hunsaker (1977) reported an average size of 6.0 from several laboratories.

The gestation period in *M. robinsoni* is approximately 14 days (Barnes and Barthold, 1969; Hunsaker, 1977). During this time females show increased nest-building activity. Parturition lasts at least 1.5 h (Eisenberg, in litt.). At birth, young measure 8 to 12 mm in total length and weigh 60 to 100 mg (Hunsaker, 1977). Young remain attached to the mammae until 30 days, at which time they may spontaneously detach from the female and begin eating solid food at 50 to 58 days of age. They are completely weaned at 65 days (Eisenberg, in litt.). Weight at weaning averages 10 g (Hunsaker, 1977). The eyes of young *M. robinsoni* open at 39 to 40 days, at which time the auditory meatus also opens. At 29 days of age, the dorsal pelage first appears and is complete by 47 days (Eisenberg, in litt.; Eisenberg and Maliniak, 1967). Young are able to walk with their body off the substrate at 33 to 39 days of age and at 40 days begin to leave the nest either alone or following the female (Eisenberg, in litt.).

The average life span of *M. robinsoni* in nature is estimated at about 1 year (Hunsaker, 1977; O'Connell, 1979). A captive *Marmosa* of the *mexicana* group was reported to have lived more than 5 years (Enders, 1966). Females appear able to breed only during the first 18 months of life; after this time they enter physical senescence (Eisenberg, in litt.). The total generation time may be as short as 120 days (Eisenberg, in litt.). In captive males, degenerative changes that lead to aspermia appear in individuals older than 800 days (Barnes, 1977).

ECOLOGY. *Marmosa robinsoni* occupies a variety of habitats. Although generally associated with mesic areas, the species can be found in the arid regions of south Ecuador and northern Peru, and near Santa Marta, Colombia, it is found with *Opuntia* cactus (Hunsaker, 1977). This species also occupies an altitudinal range of more than 2,000 m. Field observations of Fleming (1972), Hunsaker (1977), and O'Connell (1979) indicated that *Marmosa robinsoni* preferred secondary forest and disturbed farmlands to undisturbed areas. It was often associated with vines and bushes adjacent to cleared areas and was often locally abundant. Like other didelphids, *M. robinsoni* is basically nocturnal. Although well-adapted for arboreal life, this species also can be readily captured on the ground. Handley (1976) and O'Connell (1979) reported that 66% and 41% of their captures, respectively, were obtained in ground traps. Escape behavior, however, is usually via vines and trees (O'Connell, 1979). Individuals generally do not have a permanent nest site, but use whatever suitable shelter is available at daybreak. Females with young have been reported occupying wooden nest boxes for varying lengths of time (Enders, 1966; O'Connell, 1979). *Marmosa* can build nests for shelter or use abandoned bird nests and holes in trees. Banana stalks are often used as nesting sites and there are several reports of *Marmosa* being transported to the United States in banana shipments (Adams, 1928; Enders, 1930*a*; Kraatz, 1930; Wagner, 1928).

Marmosa robinsoni is mainly insectivorous, although fruit is also important in the diet. However, captive individuals died when fed only fruit (Enders, 1935). Enders (1935) reported that the species has a varied diet of bananas, peaches, grapes, larvae-infected figs, bat carcasses, viscera of mice and birds, earthworms, grasshoppers, and moths, but has a preference for insects. O'Connell (1979) found that *M. robinsoni* rejected moths with bright aposematic coloration. This mouse opossum has been observed attacking and consuming weaker conspecifics (Enders, 1935).

Densities of *M. robinsoni* vary among different habitats (Fleming, 1972) and during different seasons of the year (Fleming, 1972; O'Connell, 1979). In Panama, Fleming (1972) found an average density of 0.31 to 2.25 per ha. During a 1-year study he trapped an average of 5.6 (range 1 to 15) individuals per month. During a 2-year study in northern Venezuela, O'Connell (1979) also trapped an average of 5.6 (range 0 to 22) individuals per month. Estimates of density for *M. robinsoni* from northern Venezuela ranged from 0.25 to 4.25 adults per ha. In both Panama and Venezuela densities are highest at the end of the wet season and during the dry season.

Field studies indicate that *M. robinsoni* is basically solitary and nomadic (Enders, 1935; Fleming, 1972; O'Connell, 1979). Fleming (1972) and O'Connell (1979) found that males tended to be more nomadic than females. The average distance between consecutive captures was greater for males than for females and males remained on the grid much less time than did females.

Thrasher et al. (1971) described the internal parasites of *M. robinsoni*. Six species of helminths were found in 84 wild *M. robinsoni*, only two of which were considered deleterious to the health of the animals. Fifty-five of the 84 individuals had more than one species of helminth and 20 had more than four species. Protozoan infections also are common. Thrasher et al. (1971) identified five different genera that infected different regions of the alimentary tract, skeletal and cardiac muscle, and the blood. Common bacterial infections of *M. robinsoni* include focal suppurations, urogenital infections of females, and septicemias. Thrasher et al. (1971) isolated 21 types of bacteria from eight typical cases. Severe pasteurellosis has led to many deaths in captive *M. robinsoni*. Pucak et al. (1969) reported on an acute form of this disease. Barnes and Wolf (1971) discussed common diseases of captive *M. robinsoni* and treatments that have proven successful. A comprehensive review of diseases known to marsupials can be found in Potkay (1977).

Collecting expeditions in Panama and Venezuela (Handley, 1966, 1976) have yielded much information on the ectoparasites of *M. robinsoni* in the wild. Wenzel et al. (1966) found six species of chiggers, two species each of ticks, suckling mites, and fleas, and one species of laelapid mite on *M. robinsoni* collected in Panama. Collections of this species in Venezuela revealed that *M. robinsoni* was a common host for chiggers (20 species), ticks (7 species), fleas (3 species), and laelapid mites (3 species) (Brennan and Reed, 1975; Furman, 1972; Herrin and Yunker, 1975; Jones et al., 1972; Saunders, 1975; Tipton and Machado-Allison, 1972).

BEHAVIOR. *Marmosa robinsoni* generally first appears at sunset and is active intermittently until sunrise. Captive animals exhibit a bimodal pattern of activity (Hunsaker and Shupe, 1977). Both laboratory and field data indicate an increase in activity period during the reproductive season (Enders, 1935; Hunsaker and Shupe, 1977). Nightly activity periods usually begin with a grooming session. Grooming in *M. robinsoni* resembles that described for *Didelphis* by McManus (1970), except that duration of grooming is longer (Hunsaker and Shupe, 1977). Special attention is given to the facial and snout areas by both males and females, and females clean their abdomen regularly (Hunsaker and Shupe, 1977).

In the wild, *M. robinsoni* appears to be basically solitary (Fleming, 1972). Boggs (*in* Hunsaker and Shupe, 1977) found that in captivity they formed social hierarchies. Experience, rather than size or age, determined social dominance in males. Dominant males marked their cages with the oily secretion of their sternal glands. However, conspecifics of either sex do not appear to react to these markings. During agonistic encounters, individuals assume a bipedal stance (Enders, 1930*b*).

The mating behavior of *M. robinsoni* in captivity was described by Barnes (1968*b*) and Barnes and Barthold (1969), Eisenberg and Maliniak (1967), and Thrasher (1969). Upon encounter with a male, females exhibit various behavioral patterns: 1) if not receptive, a female will be actively aggressive against the male, biting his snout and emitting bursts of high pitched chatter; 2) if the female is receptive, she often is passive, making no attempt to discourage the male; however, 3) if the male is indifferent the female may initiate a response by sniffing his anal region. Prior to mating in captivity, a male will drive a receptive female in a head-to-tail chase about the cage for several minutes. The male will then grab the female's shoulders with his forefeet and bite the back of her neck. At this time, the male grasps the nearest object with his prehensile tail. Barnes and Barthold (1969) suggested that the male may be unable to complete copulation unless he secures his tail; when placed in smooth-walled cages, males were able to assume the mounted position, but insertion did not take place. The extent to which the attachment of the tail is anatomically or behaviorally necessary for erection of the penis is not known. Mating sometimes involved total suspension of the pair from a branch or the top of the cage; pairs remained in this position for up to 40 min. During intromission, the male massages the shoulder, sides, and abdomen of the female. Pelvic thrusts, which are relatively shallow, occur for 15 to 20 min, at which time ejaculation takes place. Duration of mounting is extremely long; active and quiet phases may alternate for up to 389 min. Postcopulatory behavior is simple: the pair separates and each begins to groom itself.

Female mouse opossums assume a birth posture that is typical of marsupials. The female sits with her back propped against the side of the cage with the tail extended forward between her legs. In this position she will actively groom her mammary region. Females do not appear to be in pain during birth. After birth, females make no initial attempt to retrieve dislodged young. Barnes and Barthold (1969) reported that a female stepped on a newborn young with a forefoot, but made no sign of recognition or attempt to recover it, even though it wriggled. There is a change in the walking posture of females following birth (Beach, 1939). The sacral region is elevated and this lumbo-sacral posture protects the young from abrasion against the substrate. In effect, this posture compensates for the lack of a pouch.

After the young have nursed a few days a female will actively retrieve them if separated from her. The female responds to a high frequency, rapid, clicking sound made by the young. She will approach the young, grasp them in her forepaws, and tuck them under her. Thrasher et al. (1971) tested the retrieval behavior of five female *M. robinsoni* by removing their young and placing them in a pan with young brown and albino mice. Four of the females retrieved only their own young. One female also retrieved the brown mice, but refused the white ones; however, when the experiment was repeated 24 h later, she retrieved only her own young.

Initially, young are contact prone, but after 2 months they will begin to nest alone. Play behavior toward littermates is difficult to discern. However, between about 55 and 60 days the young have been observed chasing each other and exhibiting open-mouth threats (Eisenberg, in litt.). If litters are not weaned in time, this agonistic behavior will result in cannibalism (Barnes and Wolf, 1971).

GENETICS. Curcuru-Giordano et al. (1974), Fisher (1973), Reig (1968), and Reig et al. (1977) provided information on the karyotype of *M. robinsoni*. The diploid number is 14 (Fig. 5) and the number of autosomal arms (NF) is 24. The autosomes consist of a pair of medium metacentrics, three pairs of large submetacentrics, and two pairs of smaller subtelocentrics. The X chromosome is submetacentric and smaller than the autosomes; the Y chromosome is a minute acrocentric, smaller than the X. An analysis of banding of the chromosomes of *M. robinsoni* was provided by Curcuru-Giordano et al. (1974).

REMARKS. *Marmosa mitis* Bangs is a junior synonym (Cabrera, 1958) of *Marmosa robinsoni* and includes the four species of the "*mitis* section" of Tate (1933).

The subspecies from the West Indies, Trinidad, and Tobago need clarification. Tate (1933) considered the forms from Trinidad (*M. chapmani*; Allen, 1900; G. M. Allen, 1911), Tobago (*M. tobagi*; Thomas, 1911), and Grenada (*M. grenadae*; Thomas, 1911) to represent a single species, *M. chapmani*. *M. chapmani* was later included as a subspecies of *Marmosa mitis* (Hershkovitz, 1951;

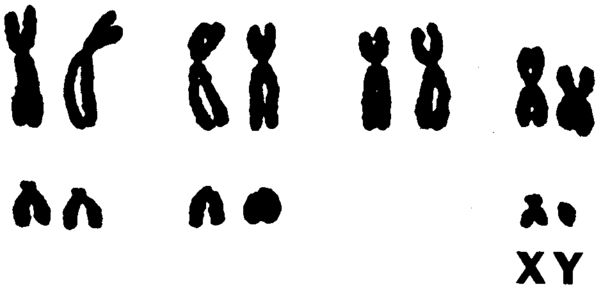

FIGURE 5. Standard karyotype of a female *Marmosa robinsoni.*

Hall and Kelson, 1959). However, Goodwin (1961) examined additional material from these islands and concluded that *M. r. chapmani* from Trinidad, *M. r. luridovolta* from Tobago, and *M. r. grenadae* from Grenada were distinct subspecies. Goodwin (1961) further proposed that a second species of *Marmosa* from Tobago, which had previously been recognized as *M. tobagi* (Thomas, 1911), then *M. chapmani* (Tate, 1933), and later *M. mitis chapmani* (Hershkovitz, 1951), represented a subspecies of *Marmosa murina.*

The disjunct distribution of *M. r. ruatanica* with respect to other *M. robinsoni* in Central America raises some questions as to its status. Tate (1933) suggested that further collecting from the region between northern Honduras and Panama would reveal the presence of this species, but this has not been the case.

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Editors of this account were DANIEL F. WILLIAMS and SYDNEY ANDERSON. Managing editor was TIMOTHY E. LAWLOR.

M. A. O'CONNELL, DEPARTMENT OF BIOLOGICAL SCIENCES, TEXAS TECH UNIVERSITY, LUBBOCK 79409 and DEPARTMENT OF ZOOLOGICAL RESEARCH, NATIONAL ZOOLOGICAL PARK, WASHINGTON, D.C. 20008.