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# Romerolagus diazi.

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## *Romerolagus* Merriam, 1896

*Romerolagus* Merriam, 1896:173. Type locality "Mt. Popocatepetl, Mexico."

*Lagomys* Herrera, 1897:34. Not *Lagomys* Cuvier, 1800.

**CONTEXT AND CONTENT.** Order Lagomorpha, Family Leporidae, Subfamily Palaeolaginae, Genus *Romerolagus*. The genus is monotypic (Corbet and Hill, 1980; Hall, 1981; Honacki et al., 1982).

## *Romerolagus diazi* (Ferrari Pérez *in* Díaz, 1893)

### Zacatuche

*Lepus diazi* Ferrari Pérez *in* Díaz, 1893:29. Type locality "near San Martin Texmelucan, northeastern slope of Volcán Iztaccihuatl, Puebla, México."

*Romerolagus nelsoni* Merriam, 1896:173. Type locality "Mt. Popocatepetl, Mexico (altitude 3,350 meters or 11,000 feet)."

*Romerolagus diazi* Miller, 1911:228. First use of current name combination.

**CONTEXT AND CONTENT.** Context as in generic summary above. *R. diazi* is monotypic (Hall, 1981; Ramírez-Pulido et al., 1983; Villa-R., 1952).

**DIAGNOSIS.** Size is relatively small for the family (López-Forment and Cervantes-Reza, 1981); larger only than *Sylvilagus idahoensis* among leporids (Nelson, 1909). Hind legs and feet are short; ears are small and rounded; tail so short as to be invisible externally (Fig. 1); anterior projection of supraorbital process absent and posterior extension small and divergent (Merriam, 1896, 1897; Fig. 2); jugal projects posteriorly past squamosal root of zygomatic arch about halfway to external auditory meatus. The genus *Ochotona* lacks a supraorbital process and the enlarged jugal extends much more than halfway to the meatus. In *Romerolagus*, *Pronolagus*, and *Pentalagus*, the first lower premolar (p3) is divided into an anterior and a posterior portion by two reentrant angles, one extending from the external (labial) and the other from the posterior internal (lingual) face to the center of the tooth, rather than a single external reentrant as in most other leporids (Lyon, 1904); in *Romerolagus* alone this internal reentrant forms an isolated lake (Dawson, 1981; Hibbard, 1963). The clavicle is complete and joined directly to the sternum (Merriam, 1896); the anterior presternum (manubrium) is short and wide instead of long and narrow as in most leporids; of the four segments in the mesosternum, the last two are fused. Ribs proportionally small and only six pairs (of 12) bear tubercular spines. Fifth cervical vertebra with transverse apophysis extending directly outwards rather than backwards, with ventral projection posteriorly extended; transverse processes of lumbar vertebrae triangular in outline, with wide posterior section extending along ridge of each vertebra; the last three of the nine caudal vertebrae are upturned and rudimentary. Distal end of the humerus is small and flat instead of deeply grooved as in many other leporids; navicular bone with a shortened inferior ridge that does not extend underneath the metatarsal base (Lyon, 1904). Some of these morphological features, including the dental pattern reminiscent of the late Pliocene *Nekrolagus*, resemble those of the Tertiary leporids (Dawson, 1981; Hibbard, 1963).

**GENERAL CHARACTERS.** Pelage is fairly short and dense; dorsal and lateral parts are antimony yellow mixed with black; tip and base of guard hairs are black, while middle part is yellow. Upper distal surfaces of feet are light buff and ventral surfaces mummy brown; vestigial tail is same as dorsal pelage. Side of nose and orbital region are light buff; base of ear is warm buff; underside and throat are light buff mixed with dark-gull gray of underfur (Rojas, 1951). Pectoral mane of long, soft hair present, but does not contrast in color with ventral pelage as in most other leporids (Corbet, 1982).

The means and ranges for males ($n = 31$) and females ($n = 26$), respectively, of adult *R. diazi* are (Cervantes-Reza, 1982): total length (in mm), 268.3 (234–292), 285.1 (240–321) and mass (in g), 417.4 (386.6–479.1), 535.9 (462.1–602.5). Despite some differences between sexes, females were not significantly larger than males. Average external measurements (in mm) of seven females are (Rojas, 1951): total length, 320.0 (295–350); length of tail vertebrae, 23.7 (18–31); length of hind foot, 51.3 (42–55); length of ear from notch, 43.1 (40–45). Those of two males are (Rojas, 1951): total length, 316 (275, 357); length of tail vertebrae, 16 (12, 20); length of hind foot, 47.5 (40, 55); length of ear from notch, 42.5 (41, 44). In comparison, six adults from the type locality averaged: total length, 295; length of hind foot, 52. The holotype, an adult male, was: total length, 311; length of tail, O; length of hind foot, 53; length of ear from notch (dry), 36 (Merriam, 1896, 1897).

Skull is leporine in general structure (Fig. 2), palate long, postorbital process small, and tympanic bulla "normal, equal to foramen magnum in size," and with external auditory meatus relatively larger than any other leporid (Lyon, 1904:420). Average cranial measurements and range (in mm) of three adult females are (Rojas, 1951): basilar length, 47.2 (47.1–47.2); zygomatic breadth, 29.7 (28.5–30.9); postorbital constriction, 10.6 (10.3–10.8); length of nasals, 24.6 (24.4–24.7); width of nasals, 9.9 (9.4–10.0); length of maxillary toothrow, 12.1 (11.8–12.4); diameter of external auditory meatus, 5.7 (5.2–6.4); breadth of braincase, 23.8 (23.2–24.3); length of palatal bridge, 6.9 (6.2–7.7); length of bulla, 9.9 (9.7–10.0). Corresponding measurements of an adult male are: 45.5, 25.0, 11.2, 22.4, 10.2, 11.5, 5.5, 22.8, 7.8, and 10.2.

Analysis of geographic variation failed to differentiate samples of *R. diazi* (Rojas, 1951). Differences found in measurements were due to individual variation rather than geographic variation, although Rojas (1951) suggested that larger samples were needed. The dental formula, as in other leporids, is 2/1, 0/0, 3/2, 3/3, total 28.

**DISTRIBUTION.** *Romerolagus diazi* is an endemic species restricted to the central part of the Mexican transvolcanic belt (Fig. 3). It thus has one of the most restricted ranges of any mammal in México (Granados, 1981; Hall, 1981; Ingles, 1958; Leopold, 1959; Nelson, 1909). Populations occur on the slopes of the mountains south of the Valley of México and display a highly disjunct distributional pattern (López-Forment and Cervantes-Reza, 1981).

Hoth et al. (1987) searched for other populations in the mountains of the Mexican transvolcanic belt eastwards (Volcán Malinche, Volcán Pico de Orizaba, and Volcán Cofre de Perote), and westwards (Michoacán mountains and Volcán Nevado de Colima) from the central region, but found no new localities for zacatuches. However, a specimen was collected approximately 40 km west of Coatepec, México, at Cerro Gordo on Volcán Nevado de Toluca (western part, state of México; Cervantes-Reza, 1980). The range of the zacatuche has been reduced by human activity, both through hunting and habitat destruction, but the degree of reduction is not known (Cervantes-Reza, 1979; Granados, 1980; Villa-R., 1974).

There is no fossil record for the genus. Serra and Valadez (1986), working in excavations south of the Valley of México, remarked on the absence of zacatuche fossils and the plentiful remains of *Sylvilagus cunicularius* and *S. floridanus*.

**FORM AND FUNCTION.** Females have three pairs of mammae; one pectoral, one abdominal, and one inguinal. When active, milk glands are up to 1 mm thick and form two longitudinal strips (each is 2 cm wide) connecting the three pairs of mammae, with two transverse branches connecting the two anterior pairs. Lactating females do not produce milk in every teat; a mean of four

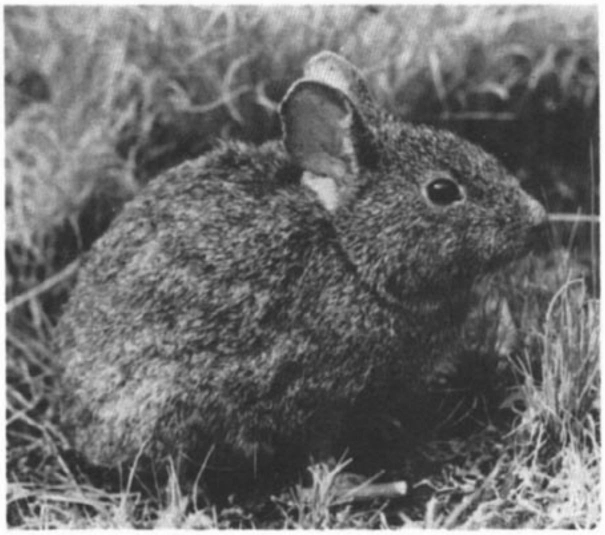

FIG. 1. A zacatuche (*Romerolagus diazi*) in its natural habitat near Parres, Distrito Federal, México. Photograph by F. A. Cervantes.

per female secretes milk and the active mammae of 14 females were never the same (Cervantes-Reza, 1982). Five lactating females also were pregnant, suggesting the presence of postpartum estrous. Zacatuches develop a discoidal placenta (Rojas, 1951), as do other lagomorphs (Harvey, 1959; Mossman, 1937).

The skull of *R. diazi* lacks anterior projections of the supraorbital process (Fig. 2) and posterior projections are small and triangular (Lyon, 1904; Rojas, 1951). The interparietal bone is conspicuous. The bony palate is relatively long, at least four times as long as the first upper molar. The palatal width is much greater than either the maximum width across the two incisive foramina, or the width of the palatine fossa (choana). The posterior palatine foramina are relatively large. The zacatuche has relatively broad, thick zygomatic arches, especially robust in the anteroventral portion. The jugal is enlarged with a relatively long posterior projection. The external auditory meatus is relatively larger than in other leporids. The posterior margin of the mandible between the angular and condylar processes is deeply concave. The anterior surfaces of the upper incisors display a deep groove not filled with cementum. The anterior face of the first upper premolar (P2) shows three conspicuous reentrant angles, one central and deep and two lateral and shallow at their distal ends. In contrast, the other upper molariform teeth (excepting M3) have just one reentrant angle, on the lingual side, which runs through most of the occlusal surface. The inner one-third of this reentrant angle is rather wide and the enamel ridges do not meet, while in the other two-thirds the angle is narrow and the ridges are in contact. The last upper molar (M3) is small and elliptic. The first lower molariform tooth has a broad shallow reentrant angle on the external surface of its anterior half. The main reentrant angle extends halfway across the tooth, while a corresponding reentrant angle meets it from the internal surface; both angles contribute to the division of the tooth into anterior and posterior portions (Lyon, 1904). The posterior sections of the other two molariform teeth are subequal in size to the anterior sections in diameter, except in m3, where the anterior section is large and elliptical and the posterior is smaller and circular (Rojas, 1951).

Cervical vertebrae of *R. diazi* are short, with costal processes projecting laterally from the centra (Rojas, 1951). Large, laterally projecting transverse processes start on the fifth cervical vertebrae. The length of the spiny apophysis (neural spine) on the dorsal part of the thoracic vertebrae is less than twice the length of the centrum, relatively shorter than in other genera of leporids. The last three thoracic vertebrae display metapophyses; the tenth vertebra is anticlinal. The transverse processes of the lumbar vertebrae are characteristically short and wide; the largest is as large as its centrum, but the process of the first lumbar vertebra is almost rudimentary (Lyon, 1904). The spiny apophyses of these vertebrae are short and triangular, while the anaphophyses are slightly developed. The first three lumbar vertebrae bear hypapophyses, that of the first being shortest, while the second and third are subequal in length. The sacrum is made up of four vertebrae, as in other Leporidae. There are only nine caudal vertebrae, one of the smallest numbers in the family (*S. idahoensis* = 9; *Nesolagus* = 8); other taxa have 11 to 17. The first caudal vertebra resembles the last sacral vertebra. The next five caudal vertebrae bear aliform processes, while the last three lack processes (Rojas, 1951).

The sternum is similar to that in the genus *Ochotona*. The anterior presternum is wide anteriorly, and flat dorsoventrally. The remainder of the presternum is long and narrow as in Leporidae, but lacks the well-defined central carina found in most other leporids. The first and second segments of the mesosternum are the same length, as are the fused third and fourth segments; however, the fourth is wider. The xiphisternum is longer than the presternum, but shorter than the complete mesosternum (Rojas, 1951).

The ribs are relatively narrow, without the distal expansion seen in *Lepus*. The widest part of the ribs is just behind the poorly developed spiny portion of the head. The spine is found on the first six pairs of ribs instead of the first seven or eight pairs, as in other leporids. In contrast to *Lepus*, but like *Ochotona*, the clavicle of *Romerolagus* is complete and joins the sternum directly (Merriam, 1896). The scapula in *Romerolagus* and *Pronolagus* is long and narrow, with the posterior border almost straight instead of concave as in other Leporidae, while the superior border tends to be straight rather than convex. The distance between the anterosuperior angle and the posterosuperior angle is twice the scapular length, measured along the inner surface of the spinous process. Other genera show a ratio of about 1.5 (Lyon, 1904).

Comparatively, the humerus of *Romerolagus* is thinner than that of most leporid genera. Relative to the clavicle, the humerus length is 3.20 (*Oryctolagus*, 3.15; *Sylvilagus*, 4; *Ochotona*, 2). The groove beneath the internal condyle is barely visible, and the external condylar process is better developed than in other leporid genera. The humerus is clearly larger than the radius. In contrast to other leporids (except *Oryctolagus* and *Pentalagus*), the radius is more slender than the ulna. Carpus, metacarpus, and phalanges are similar to other Leporidae (Rojas, 1951).

The pelvis of the zacatuche is thin. The anterior superior spine is short and well formed, with the anterior border straight and the anterosuperior angle rather straight. The horizontal part of the pelvis bends in to a greater extent than other leporids (Lyon, 1904).

The femur is typical of the family, but the tibia of *Romerolagus* is thicker than that of other leporids. The tibiofibula is formed by the fusion of the tibia and the fibula, but as in *Ochotona* and *Pentalagus*, the fibula is fused to the tibia for one-half of its length rather than more as in other leporids (Lyon, 1904; Rojas, 1951).

The basal width of the metatarsus in *Romerolagus* is one-half the third metatarsal length; in other leporids it is about one-third, reflecting the short hind foot of the zacatuche relative to other leporids. For each toe, the length of the three phalanges is nearly the length of the metatarsal bones as in all leporids except *Sylvilagus* and *Lepus* (Lyon, 1904).

Zacatuche tracks normally show the impression of four toes, although sometimes the front feet may print five toes (Colmenero et al., 1979). Size of the tracks average 3.0 cm long and 1.5 cm wide for the front feet, and 4.0 cm and 1.5 cm for the hind feet. When running, the zacatuche's track pattern is similar to other rabbits, but always with a shorter distance between track groups. In addition, one of the front feet always strikes the ground from 10 to 12 cm behind the two hind feet.

**ONTOGENY AND REPRODUCTION.** The ovaries of 12 pregnant or postpartum females contained translucent Graafian follicles; gray, dark depressions represented corpora lutea. The oviducts and uteri were swollen, vascularized, and cylindrical; the uteri were thicker than the oviducts. The uterine wall and the vagina were enlarged and well-vascularized. The young embryos were implanted in the middle of the uterus. There never were more than two embryos in the same uterine horn, nor more than three in total. The uterine scars observed in nine adult postpartum females were prominent, white, rectangular regions of the uterus as large as 16 mm long and 6 mm wide. As with embryos, there were never more than two in one uterine horn, nor more than three altogether. Mean embryo and placental scar counts for these females was 2.33, with an equal number (14) of implantation sites in each uterine horn (Cervantes-Reza, 1982).

In seven pregnant females, the smallest embryo observed was

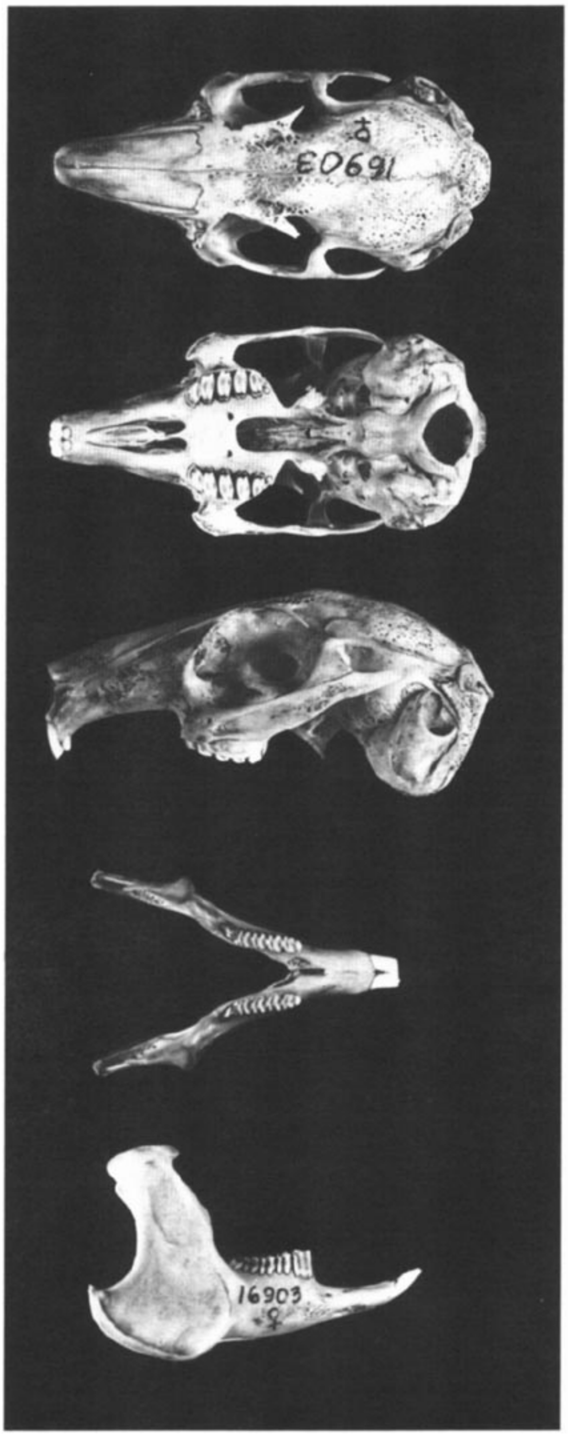

FIG. 2. Dorsal, ventral, and lateral view of the cranium, and dorsal and lateral view of the mandible of the zacatuche, *Romerolagus diazi* (male, Instituto de Biología, Universidad Nacional Autónoma de México 16903, from 400 m W Coatillo Hill, South Tlalpan, Distrito Federal, México, 3,010 m). Greatest length of cranium is 50.7 mm.

11 mm, and the largest was 45 mm in crown–rump length (Cervantes-Reza, 1982). Three near-term fetuses lacked hair except for short vibrissae, four or five eyebrow hairs, and a few isolated hairs on the rostrum. The toes had well-developed claws, upper incisors could be felt through the gums, and the small tail was well formed. Means and ranges of measurements (in mm) were: total length, 78.3 (74.0–83.0); length of tail, 3.8 (3.5–4.0); length of hind foot, 13.7 (13.0–14.0); length of ear from notch, 6.7 (6.5–7.0); Cervantes-Reza and López-Forment, 1981).

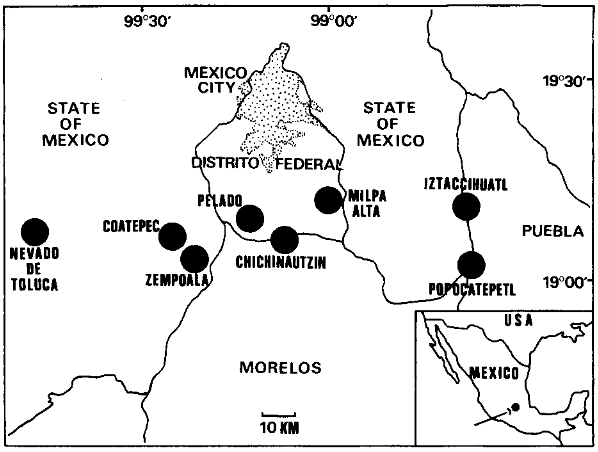

FIG. 3. Geographic distribution of the zacatuche, *Romerolagus diazi* (modified from Cervantes-Reza, 1980, and López-Forment and Cervantes-Reza, 1981). México City is stippled.

The gestation period was 38–40 days in *Romerolagus* at the Jersey Zoo in England (Durrell and Mallinson, 1968), and 40 days at the Antwerp Zoo in Belgium (De Poorter and Van der Loo, 1981). In México, three females had gestation periods of 39 days (Cervantes-Reza, 1980, 1982). Matsuzaki et al. (1982) initially estimated a gestation period of 34–38 days in zacatuches reared in captivity, but later (Matsuzaki et al., 1985) found 12 females that gave birth 20 times in total; the gestation period was 39 days in 35%, 40 days in 50%, and 41 days in 15%. Chapman (1984) suggested there is a relationship between gestation period and latitude as a function of factors related to weather in some New World rabbits; *R. diazi* was considered as a species occurring at low latitude with a long gestation period. Compared to other lagomorphs, the gestation period of the zacatuche is longer than most *Sylvilagus* (27–40 days) and *Ochotona* (30 days), but shorter than in most *Lepus* (36–50 days; Cervantes-Reza, 1980, 1982; De Poorter and Van der Loo, 1981; Matsuzaki et al., 1985). Mean litter size in *Romerolagus* is 2.1 (Cervantes-Reza, 1982). While the litter size of the zacatuche lies in the range for *Lepus*, it differs significantly from the large litters of *Oryctolagus*, *Sylvilagus*, and *Ochotona* (Cervantes-Reza, 1980, 1982).

When a male zacatuche reaches sexual maturity the testes descend into the scrotum where they remain throughout the year. The testes average 17.5 mm long (14.0–22.0) and 9.7 mm wide (7.0–13.5; $n = 33$, wild adults; Cervantes-Reza, 1982).

The breeding season of the zacatuche was thought to be only in spring and early summer (Davis, 1944; Granados, 1981; Rojas, 1951; Villa-R., 1952). However, pregnant females and females with recent uterine scars were collected from January to October; moreover, lactating females were caught from February to December, and nests with young were found from April to September. Therefore, *Romerolagus* may breed all year; there is a noticeable reproductive peak during the warm, rainy summer (Cervantes-Reza, 1982). De Poorter and Van der Loo (1981) reported change in mass in pregnant females compared with a non-pregnant female; 1 week after copulation the increase in mass was obvious.

Newborn zacatuches are completely covered with fur, but the eyes are closed. The facial vertebrae are well developed (Cervantes-Reza and López-Forment, 1981; De Poorter and Van der Loo, 1981; Durrell and Mallinson, 1968). The sides, dorsal surface of the head, and the extremities are antimony yellow. Whitish hair occurs on the flanks. The dorsal body hair is homogeneous and dusky-neutral gray. The venter has pale, dull-gray hair as dense as on any other part of the body. Newborns show an externally visible hair-covered tail; in adults the tail is enclosed beneath the skin, as in *Ochotona*. The inguinal region is almost devoid of pelage, and the umbilicus is prominent. The claws are large and gamet brown in color (Cervantes-Reza and López-Forment, 1981). Means and ranges of external measurements (in mm) of five newborns were: total length, 93.8 (83–106); length of tail, 8.0 (7–10); length of hind foot, 17.0 (16–18); length of ear from the notch, 9.3 (8.0–10.5); mass, 24.1 g (22.6–25.0).

The eyes of the young open within 4–8 days, but they remain in the nest for 14 days after birth. At this stage captive young react to observers by hiding under the hay. About the third week of age the young begin to eat apple slices, bounce, jump, preen, and gradually become independent of the nest (De Poorter and Van der Loo, 1981; Durrell and Mallinson, 1968; Matsuzaki et al., 1982). Data for 16 young wild zacatuches (mean length, 154 mm; mass, 99.4 g) showed that young are still being nursed while moving around with the female (Cervantes-Reza, 1982).

**ECOLOGY.** Zacatuches generally may be found between 2,800 and 4,250 m in elevation, inhabiting pine forests (*Pinus*) with undergrowth of tall dense bunch grasses ("zacatón") and rocky substrates (Barrera, 1968; Cervantes-Reza, 1979; Davis and Russell, 1953; Gaumer, 1913; Granados, 1980). They occupy areas of abrupt relief. Substrates consist of an abundance of basaltic rock, with patches of deep, dark soils. Summer is warm and rainy, whereas winter is cold and dry. A meteorological station in the Ajusco Mountains over a 10-year period recorded a mean annual temperature of 9.6°C and a mean annual precipitation of 1,334 mm; the hottest month was May and the coldest, January, whereas the wettest month was August and the driest was February (Cervantes-Reza, 1980).

Vegetative cover consists of open forest of *Pinus montezumae* up to 25 m tall, together with *P. rudis*, *P. teocote*, *P. patula*, and *P. pseudostrobus*. Beneath the trees there is a dense ground cover of tall (up to 1.5 m), coarse, clumped "zacatón" grasses, mainly *Muhlenbergia macroura*, *Festuca rosei*, *F. amplissima*, and *Stipa ichu*. Associated with these grasses are *Penstemon stenophyllus*, *Geranium potentillae*, *Stachys agraria*, *Lupinus montanus*, *Senecio salignus*, *Gnaphalium conoideum*, *Plantago patagonica*, *Bidens diversifolia*, *Alchemilla sebaldiaefolia*, *Museniopsis arguta*, *Dahlia*, *Salvia*, *Eryngium*, *Verbena*, *Scutelaria*, *Cyrsium*, *Draba*, and *Geranium* (Cervantes-Reza, 1980; Gaumer, 1913; Rojas, 1951).

The zacatuche also occurs in patches of dense secondary forest composed of alder (*Alnus arguta*; up to 12 m tall) with some individuals of the palm-like *Furcraea bedinghausii* (up to 6 m tall). This community possesses a shrub-layer (up to 2.5 m) of *Budleja parviflora*, *Eupatorium deltoidum*, *Symphoricarpus microphyllus*, *Senecio cineraroides*, *Senecio* sp., *Rubus*, *Ribes*, and *Fuchsia*. Cover of the "zacatón" grass-herb layer is heavy, and includes *Penstemon stenophyllus*, *Sycios angulata*, *Stachys agraria*, *Eryngium*, *Salvia*, *Verbena*, *Scutelaria*, *Cyrsium*, *Dahlia*, *Rumex*, and *Solanum*. This habitat is darker, moister, and with less temperature fluctuation that the open pine forest (Cervantes-Reza, 1980). *Romerolagus* also may temporarily colonize cultivated oat fields (*Avena sativa*) when plants are half-grown in late July and form a dense cover until harvest (early October; Cervantes-Reza, 1979).

The entrance to the burrow of *R. diazi* is hidden in the base of a grass clump, and there may be additional openings for escape (Cervantes-Reza, 1980; Gaumer, 1913; Rojas, 1951). Entrances are oblique, average 10.8 cm high and 9.3 cm wide, and do not follow any particular directional orientation. Tunnels do not follow straight lines because of the presence of rocks and roots, and may have some bifurcations. Tunnels measure (average) 10.9 cm high and 11.1 cm wide. The longest burrows are up to 5 m and the deepest up to 40 cm. During the day, ambient temperature is up to 4°C higher and the humidity is 22% less than that inside the burrow. *Romerolagus* also may use abandoned burrows of Merriam's pocket gophers (*Pappogeomys merriami*), rock squirrels (*Spermophilus variegatus*), nine-banded armadillos (*Dasypus novemcinctus*), and badgers (*Taxidea taxus*; Cervantes-Reza, 1979, 1980; Colmenero et al., 1979). However, zacatuches use any kind of refuge, such as hollows between rocks and boulders, and large boulder-strewn sink holes, as temporary retreats.

Captive females excavate a round cavity that is lined with fur as in *Sylvilagus* (De Poorter and Van der Loo, 1981). Nests of wild *Romerolagus* are found from April to September (Cervantes-Reza, 1982). The nest is a shallow hole in the ground next to the base of a clump of "zacatón" grass; thus, the nest is hidden below the dense cover of "zacatón" grass leaves. The nest averages 15 cm in diameter and 11 cm in depth. Nest materials are dry plant fragments of pine (*Pinus*), alder (*Alnus arguta*), herbs (*Penstemon stenophyllus*, *Eryngium*, and *Gnaphalium*), fragments of finely cut "zacatón" grasses, and a large mass of hair from the adult female, which lines the nest cavity and fills most of its volume; the plant fragments shape the outer layer. The entrance to the nest usually is covered with plant fragments. Nests are on fairly flat substrate with deep soils and organic matter; few nests are on rocky or steep substrates. However, two nests were found in holes between rocks and one in an abandoned pocket gopher burrow (*P. merriami*; Cervantes-Reza, 1982).

Zacatuches normally fed on "zacatón" grasses, especially *F. amplissima*, *F. rosei*, *M. macroura*, *S. ichu*, and *Epicampes* sp. (Cervantes-Reza, 1980; Gaumer, 1913; Rojas, 1951). During summer in an area of 1,225 $m^2$ where 1,321 individual clumps of *M. macroura* and 734 of *S. ichu* occurred, zacatuches fed on 42.1% of the clumps of *M. macroura* and 45.4% of *S. ichu*. The herbs *Alchemilla sebaldiaefolia* and *Museniopsis arguta* also are food items. Villa-R. (1952) suggested that the aromatic plant *Cunita tritifolium* was important in the diet of *Romerolagus*.

Zacatuches select the green and tender young leaves of the grasses. They normally bite leaves from the base and lower edges of the clump, which prunes the leaves to form a dense "roof" over the base of the clump. Cervantes-Reza (1980) observed zacatuches feeding on the young leaves of spiny herbs (*Cyrsium* and especially *Eryngium*), and suggested that seeds of the annual vine *Sycios angulata* and the outer bark of young alder trees also may be consumed. During the rainy season, *R. diazi* eats young oats (*Avena sativa*) and maize (*Zea mays*) in cultivated fields (Cervantes-Reza, 1979).

Fecal pellets of the zacatuche are discoidal with the central part swollen and average from 5 to 9 mm in diameter. Fresh pellets are ochraceous, shiny, and smooth, and become yellowish when dry. Pellets regularly are found in groups near burrows and throughout runways (Cervantes-Reza, 1980; Colmenero et al., 1979).

Gaumer (1913) and Rojas (1951) suggested that long-tailed weasels (*Mustela frenata*) and bobcats (*Lynx rufus*) might be predators of zacatuches. A long-tailed weasel was found preying on an adult zacatuche (Cervantes-Reza, 1981). The weasel, when chased, dropped the zacatuche, which was found to have conspicuous tooth marks on the right side of its neck. Cervantes-Reza (1981) reported a bobcat in dense grass carrying a dead zacatuche that later was recovered. Tooth marks were not evident but hemorrhaging was noted between skin and muscle on the dorsal part of the head and thorax. Furthermore, bone fragments and hair of *Romerolagus* were found in fecal droppings of bobcats. Coyotes (*Canis latrans*) also prey on adult zacatuches (Cervantes-Reza, 1981). Analysis of 12 fecal droppings of coyotes collected at different seasons revealed bone remains and hair balls of zacatuches in 11 samples. Cervantes-Reza (1981) recovered two zacatuche nestlings (length, 125 to 127 mm) from the digestive tract of a rattlesnake (*Crotalus triseriatus*). One was bitten on the side of the abdomen and the other on the head. Both were ingested head first. Cervantes-Reza (1981) also suggested that the red-tailed hawk (*Buteo jamaicensis*) may prey on *Romerolagus*.

*Boreostrongylus romerolagi*, a new nematode parasite, was described from the duodenum of both wild zacatuches and captives at the Antwerp Zoo (Gibbons and Kumar, 1980). Bravo (1950) examined the digestive tract of wild zacatuches and collected numerous nematode parasites (*Trichostrongylus calcaratus*, *Longistrata dubia*, *Trichuris leporis*, and *Dermatoxys veligera*). She also described, as new, *Dermatoxys romerlagi*. González (1984) described *Lamothiella romerolagi* from specimens in the stomach of a wild zacatuche; *B. romerolagi* and *D. veligera* were collected from the same individual. Eggs and adults of nematode parasites (*Trichostrongylus tatertaeformis*, *Boreostrongylus* sp., and *Trichuris* sp.) were found in the stomach, intestine, and pellets of zacatuches in captivity at the Antwerp and Jersey Zoos.

*Cittotaenia ctenoides* and *Multiceps serialis* were reported from the digestive tract of *Romerolagus* at the Antwerp Zoo (De Poorter and Van der Loo, 1981). Kamiya et al. (1979) described a new cestode, *Anoplocephaloides romerolagi*, from the bile duct of wild zacatuches. They suggested that the study of this genus will be useful in tracing the evolution of anoplocephaline cestodes and palaeolagine rabbits. There were an average of two cestode parasites (*Anoplocephaloides* sp.) per rabbit in the intestine of wild zacatuches examined (Cervantes-Reza, 1980). Adult parasites (up to 5 cm long) frequently were observed throughout the year in both sexes of the host, while larval forms were abundant and easily found in the abdominal cavity. Durrell and Mallinson (1968) found coccidia of *Eimeria perforans*, *E. coecicola*, and *E. stiedae* in samples from internal organs and pellets of *Romerolagus*. Adult zacatuches dead in captivity at the Antwerp Zoo also exhibited coccidia within their intestines (De Poorter and Van der Loo, 1981); in addition, it was suggested that the fungus *Aspergillus* was the cause of the death of some of the first new-born zacatuches at this zoo.

Zacatuches are host to the fleas *Cediopsylla inequalis, Strepsylla mina*, and *Strepsylla* sp. (Barrera, 1953); Rojas (1951) collected *Sternopsylla* sp. from *Romerolagus. Cediopsylla tepolita* and *Hoplopsyllus pectinatus* were described as new fleas by Barrera (1966). Cervantes-Reza (1980) reported that fleas remained all year on *Romerolagus* and reached peak populations during the warm and rainy summer.

The first tick found parasitic on *Romerolagus* was *Ixodes neotomae* (Hoffmann, 1962). *Cheyletiella mexicana* was a new species of mite described by Uchikawa and Suzuki (1979). *Romerolagus* also yielded another mite of the same genus, *C. parasitivorax.* These mites are the first of the genus found on a rabbit of the subfamily Palaeolaginae. Moreover, it is uncommon that two or more species of parasitic mites of this genus occur on one host animal. Since *C. mexicana* is host-specific, *C. parasitivorax* may have been accidentally transferred from its natural host. In the wild, ticks (Ixodidae) and chiggers (Trombiculidae) are present all year on zacatuches, with higher numbers in the rainy season, when larvae and nymphs are conspicuous. Ticks and chiggers primarily were observed on the face and inside the ears. Botfly larvae (Cuterebridae) have been collected from zacatuches, the largest being 2.7 cm long and 1.8 cm wide. Only one larva per host was found, between the skin and the muscle of the neck. These larval parasites were found only during the autumn and winter (Cervantes-Reza, 1980).

Although there are no reliable estimates of populations, *Romerolagus* has become so rare in recent years that it is considered an endangered species (Fisher et al., 1969; International Union for Conservation of Nature, 1972; Villa-R., 1978). This is due partly to habitat destruction caused by increasing encroachment of agriculture up the slopes of the mountains. Moreover, large areas of "zacatón" grasses are burned each dry season to improve grazing for sheep and cattle (Colmenero et al., 1979). Another factor is hunting by nearby villagers, as well as people from Mexico City (Leopold, 1959). Their nesting habits make the young particularly vulnerable to predation by dogs and man. *Romerolagus* remains relatively abundant in the Ajusco Mountains and (in decreasing order of abundance) the eastern and western slopes of the volcanoes Iztaccihuatl and Popocatépetl.

Conservation measures in Mexico consist of protection by law and prohibition from importation into the United States (De Poorter and Van der Loo, 1981), but most local inhabitants are unaware of its protected status. Part of the range of *Romerolagus* is within several national parks, but hunting and grass-burning still occur within the boundaries (Cervantes-Reza, 1979, 1980; International Union for Conservation of Nature, 1972). One conservation measure undertaken was the establishment of a breeding colony at the Chapultepec Zoo, Mexico City. Positive results showed that a long-term breeding program for *Romerolagus* in captivity was possible. Similarly, Matsuzaki et al. (1982) reported successful results in the breeding and rearing of zacatuches in captivity at Kawasaki, Japan. In contrast, the captive breeding projects initiated at Jersey Wildlife Preservation Trust and at the Antwerp Zoo were difficult to maintain (International Union for Conservation of Nature, 1972).

**BEHAVIOR.** Zacatuches live in groups of two to five individuals (Gaumer, 1913). Playing, fighting, chasing, foraging, or sleeping among the clumps of "zacatón" grass are the main aboveground daytime activities of *Romerolagus* (Leopold, 1959). They are especially active in the evening and early morning, usually resting quietly in the middle of the day. A similar pattern was observed in captive *R. diazi* (De Poorter and Van der Loo, 1981). Large numbers of zacatuches have been observed outside their burrows at 1100 and 1400 h (Cervantes-Reza and López-Forment, 1981). *Romerolagus* may be both diurnal and nocturnal (Durrell and Mallinson, 1968).

*Romerolagus diazi* frequently utters high-pitched, penetrating calls. No other member of the family Leporidae is vocal, yet pikas (Ochotonidae) have a great variety of vocalizations (Conner, 1985; Kawamichi, 1981; Leopold, 1959). Gaumer (1913) reported zacatuches calling to be more frequent after rain and compared the call to that of the rodent *Cavia cobaya.* Durrell and Mallinson (1968) recorded two calls of *R. diazi*, one a squeaking noise like someone rubbing a wet thumb over a ballon and a short, high-pitched bark. De Poorter and Van der Loo (1981) described five different vocalizations of captive *Romerolagus.* When alarmed, the wild zacatuche utters a sharp call and scuttles away along a runway to a burrow (Leopold, 1959). One zacatuche at the Antwerp Zoo slept and perched on a branch 1 m from the floor (De Poorter and Van der Loo, 1981).

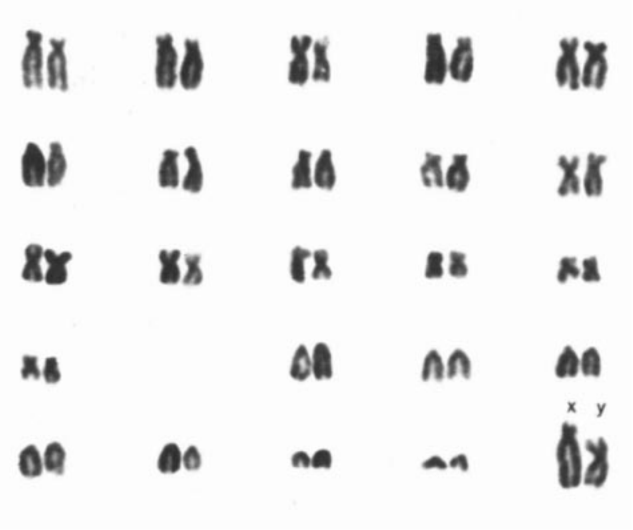

FIG. 4. Karyotype of the zacatuche, *Romerolagus diazi* (after Uribe-Alcocer, 1977).

Captive females were clearly aggressive toward both sexes, whereas males were never observed to initiate aggression toward a female (Cervantes-Reza, 1980; De Poorter and Van der Loo, 1981). Female-female aggression was much more frequent and violent than female-male aggression. The dominant individual always was a female. When males were released together, chasing occurred, but not fighting. Usually, each individual defended its own cage and chased intruders. The first trial confrontations between male and female at the Antwerp Zoo resulted in the female assaulting, biting, and plucking fur from the male. Later, conflicts generally were settled after a harmless chase. A male always selected the same female, but in her absence he became interested in a second female. Copulations were observed during the day; the male kept pace directly behind the female, occasionally nuzzling her hindquarters; the female turned back toward his flank and both rabbits circled rapidly for several turns; the male then mounted the female and engaged in a series of rapid pelvic thrusts. Parturition always took place at night (Cervantes-Reza and López-Forment, 1981; De Poorter and Van der Loo, 1981).

Mother-infant interactions seldom are seen. Once a captive female has a nest containing young, she is reluctant to go near the nest while being observed. However, distress calls from the young when handled cause the female to approach the nest. When young abandon the nest they are independent, but young at 2 months of age may still be found resting or hiding together (De Poorter and Van der Loo, 1981).

**GENETICS.** *Romerolagus diazi* has a diploid chromosome number of 48 and a fundamental number of 78 (Uribe-Alcocer et al., 1975; Van der Loo et al., 1979). Uribe-Alcocer et al. (1975) found 16 pairs of biarmed chromosomes and seven pairs of telocentric chromosomes, some of which showed short, distinct, small arms; the X and Y chromosomes were a large subtelocentric and a large metacentric, respectively (Fig. 4). However, Van der Loo et al. (1979) reported 3 metacentric pairs, 11 submetacentric pairs, and 9 acrocentric pairs; the sex chromosomes were submetacentric, the Y chromosome being small, and the X, large. No secondary constrictions occur in the chromosomes. Meiotic fields show the sex chromosomes with terminal synapsis and negative heteropyknosis (Uribe-Alcocer, 1977).

Van der Loo et al. (1979) pointed out the similarity in karyotype between zacatuches (2n = 48, FN = 78) and hares (*Lepus*, 2n = 48, FN = 72–88), and the clear differences between it and rabbits (*Sylvilagus*, 2n = 42–52, FN = 72–90; Orlov and Bulatova, 1983); they suggested that *Romerolagus* and *Lepus* may both retain an ancestral karyotype. Although such an ancestral karyotype may have evolved in association with factors such as social behavior and home range size in *Lepus*, *Romerolagus* maintained its primitive karyotype for different reasons. Van der Loo et al. (1981) suggested that, notwithstanding the somewhat "rabbit-like" behavior of the zacatuche, its chromosome evolution ended at least at the Pleistocene.

Robinson et al. (1981) found that *Lepus crawshayi* shares the same diploid number with *Romerolagus*, and demonstrated the remarkable similarity in their karyotypes. Although there were slight differences in chromosome morphology in five pairs, the agreement of G-bands between the two species showed that their genomes were largely structurally homologous. However, C-banded karyotypes showed noticeable differences in the amount of constitutive heterochromatin between the two species. Finally, Robinson et al. (1981) proposed that it is not chance that two rabbit species, *Sylvilagus bachmani* and *R. diazi*, have G-banded chromosomes almost the same as those of *Lepus*, but rather suggests an ancestral karyotype and a common evolutionary origin from which all leporids may have been derived.

Serological data showed polymorphisms at the level of the inmunoglobulin genes of *Romerolagus* (Van der Loo and Hamers-Casterman, 1981). This genetic variation was detected by using anti-allosera raised in *Oryctolagus cuniculus* against the genetic markers of the e-locus, which controls in this species the expression of the constant region genes of the immunoglobulin G heavy chain. The markers behave like codominant Mendelian alleles and appear to be related to a simple amino acid interchange. Immunoglobulin G molecules of *Oryctolagus* were either e-14 or e-15. *Romerolagus* sera reacted either with anti-e-14 or with anti-e-15 or with both types of antisera simultaneously. Most lagomorph species display cross-reactivity with anti-e-15 antisera, but e-14 specificities had not been found so far, except in *Oryctolagus* and *Sylvilagus floridanus*. Therefore, these taxa may have preserved a genetic polymorphism that already was established in the ancestral lineage.

**REMARKS.** *Romerolagus diazi* has been widely known as the volcano rabbit. However, wherever it occurs within its range it is known by its colloquial names: zacatuche (more widespread) and teporingo (Cervantes-Reza, 1980; Granados, 1981; Rojas, 1951). Zacatuche is derived from the Aztecs of central México (Martin del Campo, 1954–1955) and means grass rabbit, from zacatl (native world) = zacate (Spanish word for grass), and tochtli (native word) = conejo (Spanish word for rabbit), which agrees with the grassy habitat of *Romerolagus*. The meaning of the word teporingo is not clear.

The specific name of the zacatuche honors Agustín Díaz, while the generic name refers to Matias-Romero, Mexican Minister of the Treasury, in acknowledgment of his support to the American field collectors E. W. Nelson and E. A. Goldman in México. However, the correct describer of the specific name is a matter of controversy (Granados, 1981; International Union for Conservation of Nature, 1972; Rojas, 1955). The original description of the zacatuche by Fernando Ferrari-Pérez was written prior to 1893, but only later published (Gaumer, 1913). Meanwhile, during the 1893 Field Columbian Exposition in Chicago, specimens were exhibited and a catalog published (Díaz, 1893), wherein the specific name was given as *Lepus diazi* Ferrari-Pérez; Díaz wrote only the introduction to the catalog. Merriam (1896) next named the zacatuche *R. nelsoni*, followed by Miller (1911) who proposed the combination *R. diazi* (Díaz, 1893); this has been widely used. However, Rojas (1955) stated that the correct name must be *R. diazi* (Ferrari-Pérez *in* Díaz, 1893), according to the procedures proposed by Article 21 of the International Code of Zoological Nomenclature, and we follow that useage.

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