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Notes on the Biology of Mexican Flying Squirrels (*Glaucomys volans*) (Rodentia: Sciuridae)

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1946; Jorgensen and Hayward, J. Mammal. 44:582, 1963) came from the extreme southeastern part of the state at elevations of 1674 m and 762 m in Mojave-Great Basin Transition. This paper represents the first report of a *Notiosorex crawfordi* from the Great Basin Desert.—BURT P. KOTLER, *Univ. of Arizona, Dept. of Ecology and Evolutionary Biology, Tucson, AZ 85721* (present address, *Univ. of Kansas, Dept. of Systematics and Ecology, Lawrence, KS 66045*).

NOTES ON THE BIOLOGY OF MEXICAN FLYING SQUIRRELS (*GLAUCOMYS VOLANS*) (RODENTIA: SCIURIDAE).—Virtually nothing is known of flying squirrels (*Glaucomys volans*) in Mexico and Central America (Dolan and Carter, *Mammalian Species* 78:1-6, 1977). Diersing (Southwestern Nat. 25:157-172, 1980), in a review of the systematics of this species in Latin America, reported specimens in Mexico from the state of Chihuahua, Tamaulipas, San Luis Potosi, Veracruz, Guerrero, Oaxaca and Chiapas. Ceballos and Galindo (Southwestern Nat. 28:375-376, 1983) reported specimens from Hidalgo and Queretaro. In Mexico these squirrels live primarily in oak forests, but they occur in mixed pine-oak and fir forests (Diersing, 1980; Ceballos and Galindo, 1983).

Recently, we obtained specimens and made notes on flying squirrels at two localities on the Mexican Highlands: 8 km SW Pinal de Amoles, Queretaro, 2550 m; and 4 km NE San Bartolo, Morelos, Mexico, 2100 m. To our knowledge, this is the first record of *Glaucomys volans* from the state of Mexico. All specimens were collected on the humid slopes of mature oak (*Quercus*) forests in which many trees were covered by epiphytes such as orchids, mosses, ferns, and lichens. In addition to oaks, other trees found were pines (*Pinus*), madronos (*Arbutus*), firs (*Abies religiosa*), and alders (*Alnus*). Tallest trees were 30 to 35 m high, the average being 20 to 25 m. Tree canopy was usually 80 to 100 percent closed.

Eleven flying squirrel nests were located at the Queretaro locality in oak trees that averaged 2.25 m DBH (range, 1.43-3.03 m) and 2.94 m in height (range, 1.5-10 m). Most nests were in natural tree cavities, but woodpecker holes and external nests were also used. Winter nests seemingly were located in the largest suitable trees available in the area. Entrances to nests usually were semicircular or elongated, and were no more than 10 cm in width and from 4 cm to 1.5 m in height. The interior was lined primarily with mosses, but a few included lichens and bark. An external nest was situated in an oak tree at a height of 2.5 m, and it was constructed exclusively of mosses. The nests examined appeared to represent both the primary (used more or less continuously) and secondary (used only for feeding and defecating) types as described by Muul (Misc. Publ. Zool. Univ. Michigan 134:1-66, 1968). Most of the nests observed and the specimens collected harbored fleas (*Orchopeas howardii bolivari*). Two stomachs contained seeds, insect remains (Coleoptera), and an unidentified material.

Flying squirrels in Mexico may exhibit a long breeding period. Animals were observed copulating in February, and a lactating female was caught in March. Males with scrotal testes were collected in February, April, August, and October. A female captured on 6 August gave birth to three young (2 females, 1 male) on 20 August. The newborn were blind, hairless, pink in color, and measured 1.2 to 2 cm in crown-rump length. The female remained in the nest with the young except when she fed and drank. After 25 days, the young were covered with a fine layer of hair and measured 10 cm in length, the tail accounting for more than 50 percent of the total length. After 32 days, their eyes were open and body surfaces were completely covered by hair (gray on the back and white on the belly). The young were weaned at approximately 55 days, and after 73 days they behaved and looked like the adults except for their smaller size. Growth data is summarized in Table 1.

Flying squirrels live alone or in pairs most of the year. However, from late November to early March they form winter aggregations, probably to aid in thermoregulation (Dolan and Carter, 1977; Muul, 1968). In Queretaro, we obtained 12 squirrels in one nest and eight in another on 10 February 1983. Activity periods vary seasonally, but flying squirrels are most active for the

TABLE 1.—Average growth in total length (mm) and weight (g) of three young *Glaucomys volans*.

Size	Age (days)				
	2	41	51	58	96
Length	10.0	144.0	174.6	193.0	213.3
Weight	3.0	23.3	27.3	31.6	51.3

first three or four hours after sunset and for a few hours before dawn. Males seem to be more active than females all year round.

The distribution of flying squirrels on the mountainous highlands of Mexico may be influenced by the availability of nesting sites. In regions still covered by oak forests, they are restricted to areas with natural tree cavities or woodpecker holes. They seem to prefer wet slopes. Their life history characteristics in Mexico are reminiscent of those known for the species in the southern United States (see Muul, 1968; and Dolan and Carter, 1977).

We thank David J. Schmidly, Daniel Navarro and two anonymous referees for correcting the manuscript. Our thanks to Livia Leon, Carlos Morales, Carlos Rios and Esther Romo, for helping us in the field. J. Carlos Morales kindly identified the fleas.—GERARDO CEBALLOS AND ALVARO MIRANDA. *Arizona, Tucson, AZ 85721. Laboratorio de Ecología, Instituto de Biología, UNAM, Mexico D.F. 04510.*

**SUPERNUMERARY DENTITION IN CARNIVORES FROM ARKANSAS.**—Number and morphology of teeth are used as taxonomic criteria in mammals. Occasionally, supernumerary teeth are observed. Some cases of this phenomenon are thought to represent teeth lost from ancestral dentitions (atavism), others are thought to represent the splitting of tooth buds. Because either of these events can indicate the course of dental evolution, studies of supernumerary teeth aid in the understanding of evolutionary processes in dentition. Examination of the dentitions of 1295 carnivore skulls (202 bobcats, *Felis rufus*; 93 river otter, *Lutra canadensis*; 150 coyotes, *Canis latrans*; 645 raccoons, *Procyon lotor*; and 205 gray foxes, *Urocyon cinereoargenteus*) revealed cases of supernumerary dentition. All specimens are preserved in the Collection of Recent Mammals, Arkansas State University Museum of Zoology (ASUMZ).

In our sample of skulls, five cases of supernumerary teeth were observed. One male coyote (ASUMZ 7246) possessed an additional tooth that was disposed lingually on the mandibular ramus between the left P<sub>2</sub> and P<sub>3</sub>. Because this tooth exceeds the primitive complement, it is not atavistic and likely represents the split of a tooth bud. Morphological similarities between P<sub>2</sub> and P<sub>3</sub> make it difficult to determine which tooth bud might have split. A male otter (ASUMZ 6702) possessed twin teeth in the position of the right P<sup>2</sup>, probably representing a bucco-lingual split of the tooth bud. The inner tooth was in normal alignment, and the primary difference between teeth was that the greatest width was on the posterior of the inner but anterior of the outer tooth. Three bobcats possessed supernumerary teeth. A male (ASUMZ 8722) possessed bilaterally represented supernumerary teeth in the position, and of the relative size, of P<sup>2</sup> in domestic cats. However, a bobcat of unknown sex (ASUMZ 8157) had the same tooth morphologically, but it occurred only on the left side. Additionally, a single extra left upper molar occurred in a female (ASUMZ 10298). No supernumerary teeth were found in the sample of raccoons or gray foxes.

Suitable explanations concerning the cause of these additional teeth are not easily reasoned. Causal mechanisms for only two of the cases mentioned above were offered. A review of literature concerning supernumerary dentitions in carnivores elucidated the difficulty of discerning causal mechanisms.

Supernumerary dentitions were explained through 1) the process of atavism, 2) splitting of an embryonic tooth bud, 3) failure to shed lactal teeth, and 4) the effect of genetic conditioning. Suggested causes of specific cases were usually derived through the process of elimination, and most cases were attributed to one of the first two processes. Morphological comparison of a supernumerary tooth with the lactal tooth from the same position in the jaw will usually indicate if the third explanation is applicable. Genetic conditioning normally represents an unlikely explanation since it invokes evolutionary reversibility. Cases in which the supernumerary addition exceeds the primitive complement are logically assumed to result from splitting of the tooth bud. However, the primitive complement is not present in the dentitions of many specialized mammals, therefore supernumerary additions are often assumed to be atavistic since they might represent teeth lost during the evolutionary history of the species. Unfortunately, evidence supporting an atavistic process is circumstantial.

Pavlinov (Acta Theriol. 20:507-519, 1975) described splitting of certain premolars in the red fox (*Vulpes vulpes*). Individual teeth in his series graded from an anomalous shallow cleft in the tooth to complete separation. Comparative morphologies of the separated teeth were similar. An almost complete split of the right P<sup>3</sup> of one fox in his sample retained the morphology of a normal P<sup>3</sup> but with only partial representation on each division of the anomalous teeth. Therefore, a supernumerary tooth resulting from the splitting of a tooth bud can, depending on