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Ammospermophilus insularis.

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Ammospermophilus Merriam, 1892

Ammospermophilus Merriam, 1892:27. Type species *Tamias leucurus* Merriam.

CONTEXT AND CONTENT. Order Rodentia, Suborder Sciuromorpha, Family Sciuridae, Tribe Marmotini, Subtribe Ammospermophilina (Hafner, 1984; Hall, 1981). The genus *Ammospermophilus* contains five species. A key to the species follows (modified from Hall, 1981):

1 Underside of tail lacking white median area .... *A. harrisii*
Underside of tail having white median area 2
2 Occurring in San Joaquin Valley of California .... *A. nelsoni*
Not occurring in San Joaquin Valley of California 3
3 Occurring in Espíritu Santo Island, Baja California Sur; anterior upper premolar may be absent or rudimentary .... *A. insularis*
Not occurring on Espíritu Santo Island, Baja California Sur; anterior premolar present and normal 4
4 Occurring in Chihuahua, Coahuila, Durango, Texas, and east of the Rio Grande in New Mexico .... *A. interpres*
Not occurring in Chihuahua, Coahuila, Durango, Texas, or east of the Rio Grande in New Mexico .... *A. leucurus*

Ammospermophilus insularis Nelson and Goldman, 1909

Espíritu Santo Island Antelope Squirrel

Ammospermophilus leucurus insularis Nelson and Goldman, 1909: 24. Type locality "Espiritu Santo Island, Lower California, Mexico."

Citellus insularis: Howell, 1938:181. Name combination.

CONTEXT AND CONTENT. Context as noted in generic account above. *A. insularis* is monotypic (Hall, 1981).

DIAGNOSIS. The Espíritu Santo Island antelope squirrel (Fig. 1) is similar to *A. leucurus extimus* in color, but larger, and slightly darker on the flanks and hind legs; the tail is about the same length. The color of worn winter pelage is practically the same as in *A. l. extimus*, except on the flanks and hind legs, which are pale pinkish cinnamon. The skull is similar to that of *A. l. extimus*, but larger in all dimensions except the maxillary toothrow, in which the anterior premolar (P3) is lacking entirely in about 50% of specimens and rudimentary in the rest (Howell, 1938).

GENERAL CHARACTERS. The dental formula is i 1/1, c 0/0, p 2/0-1, m 3/3; total 20-22 (Howell, 1938; Ingles, 1965). The skull (Fig. 2) has a broad rostrum and heavy frontal area. The top of head, back, and upper part of sides are a grizzled, brownish-fawn color with a white stripe along each side of the back. The back of neck and middle of shoulders are paler and more grayish than the rest of the dorsum. The shoulders and outside of hind legs are dull-fawn in color. The under parts including lower cheeks, sides of neck, and flanks, are dull whitish. The dorsal side of the tail is blackish, thinly mixed with dull white; the ventral side is dull whitish, usually grizzled with black and with a black border (Nelson and Goldman, 1909).

Mean external measurements (in mm; range in parentheses) of seven adults are: total length, 229 (210-240); length of tail, 78 (71-83); length of hind foot, 38.3 (36-40); length of ear, 9.1 (8-11). Mean skull measurements of five adults are: greatest length, 41.8 (40.3-42.4); palatilar length, 18.4 (18-19); zygomatic breadth, 24.2 (23.9-24.7); cranial breadth, 18.9 (18.7-19.0); interorbital breadth, 10.1 (9.8-10.6); postorbital constriction, 13.8 (13.4-14.0); length of nasals, 13.6 (12.3-14.3); length of maxillary toothrow, 6.5 (6.4-6.7; Howell, 1938).

DISTRIBUTION. *Ammospermophilus insularis* is found only on Espíritu Santo Island, Baja California Sur, Mexico (Fig. 3). No specimens are known from Partida Island, although it is joined to Espíritu Santo Island by mud flats at low tide (Hafner, 1981).

FOSSIL RECORD. *Ammospermophilus* probably diverged in the Miocene and had already attained nearly modern form by Clarendonian times. No fossils of *A. insularis* are known. However, *A. fossilis* was described from the early Clarendonian of the Cuyama Valley in southern California (James, 1963), *A. hanfordi* from the early Blancan of Franklin County, Washington (Gustafson, 1978), and *A. jeffriesi* from the early Blancan of the Cape Region of Baja California Sur (Miller, 1980).

FORM AND FUNCTION. The spring molt is during March and April and the autumn molt is during September. The most abrupt color change indicative of molt is in the spring, when the softer, longer winter pelage is replaced by shorter, stiffer spring pelage (Hafner, 1981).

The proximal end of the baculum is thickened and laterally expanded. The shaft is straight and slender; the distal end is bent at right angles to the shaft, and expanded into the shape of a shallow scoop, the edges of which are crenulate (Howell, 1938). Nothing is known concerning the ontogeny and reproduction of *A. insularis.*

ECOLOGY. Espíritu Santo Island (Fig. 4) is a waterless volcanic island covered with rounded hills and mesas. It is about 16 km from north to south and 6.5 km wide in its broadest part. It is irregular in outline and almost entirely covered with rocky hills and low mountains reaching an altitude of about 600 m above sea level. The shoreline is mainly rocky and precipitous in places fronted by high cliffs. The northern 25% of the island is nearly separated from the rest by two narrow indentions formed by the sea. On the west side, near the southern end, is a small bay with a small mangrove swamp on the flat near its head. A narrow valley extends inland

FIG. 1. *Ammospermophilus insularis* on Espíritu Santo Island, Baja California Sur, Mexico. Photograph by T. L. Best.

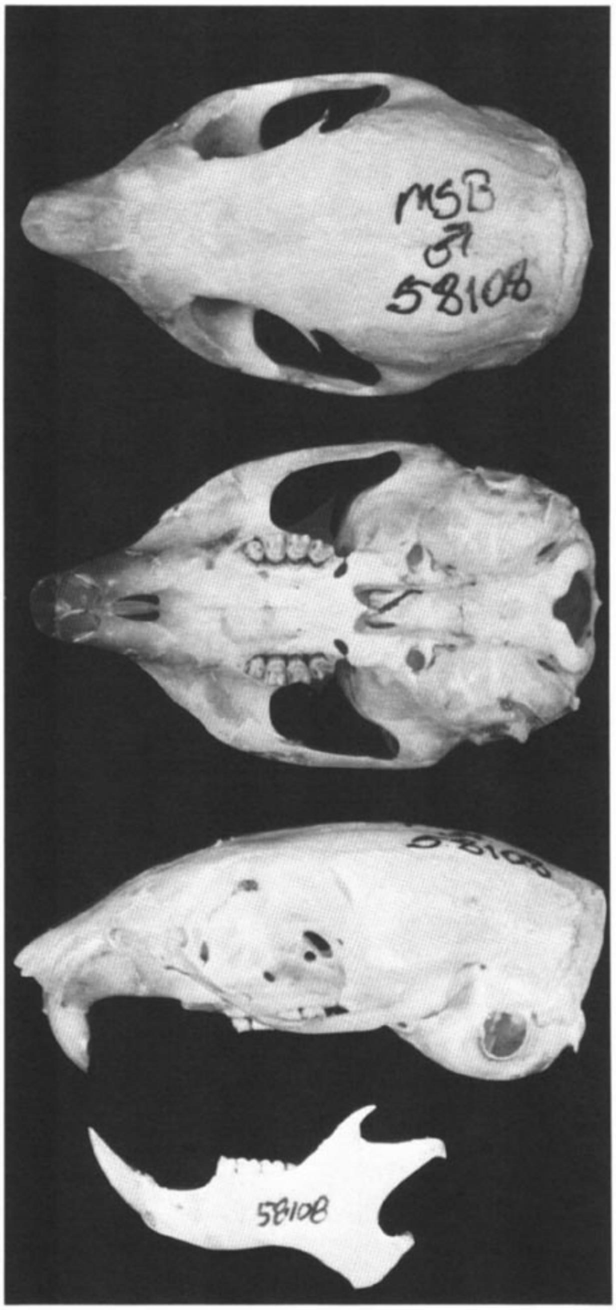

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of *Ammospermophilus insularis* (male, Museum of Southwestern Biology 58108, Espíritu Santo Island, Baja California Sur, Mexico). Greatest length of cranium is 39.4 mm. Photographs by T. L. Best and J. L. Dobie.

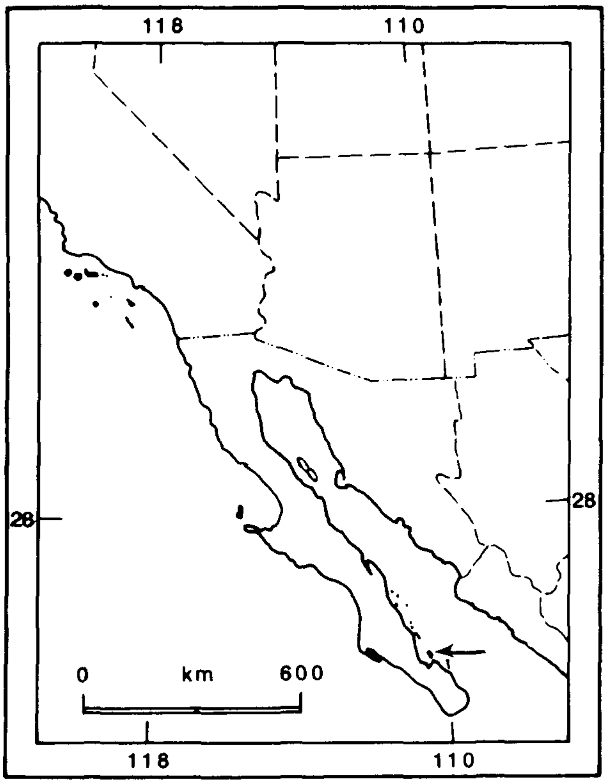

FIG. 3. The distribution of *Ammospermophilus insularis* is restricted to Espíritu Santo Island, Baja California Sur, Mexico (arrow).

from this flat and forms part of a pass across the island, extending between low rounded hills and mesas. The southern end of the island is separated from the opposite point of the peninsula by San Lorenzo Channel, a shallow straight of about 5.5 km. The geological formation of the island appears identical with that on the nearest point on the mainland, and the shallow water separating them indicates the existence of a former land connection between the two (Nelson, 1922). The last land connection ended approximately 6,900 years ago (Wilcox, 1978).

The valley leading back from the head of the bay and favorable places elsewhere on lower slopes have many scattered arid-tropical and lower-Sonoran shrubs and other plants, but the upper slopes are rocky and barren. Vegetation of the island is practically identical to that of the adjacent mainland and mostly arid-tropical in character with a mixture of giant and other cacti. Among the prominent species are *Tapirira edulis*, *Forchammeria watsoni*, *Bourreria sonorae*, *Jatropha canescens*, *Pedilanthus macrocarpus*, *Lemaireocereus gummosus*, *L. thurburi*, *Pachycereus calvus*, several opuntias, and *Pereskiopsis brandegeei* (Nelson, 1922).

Reptiles occurring with *A. insularis* on Espíritu Santo Island include *Sauromalus ater*, *Dipsosaurus dorsalis*, *Callisaurus draconoides*, *Sceloporus magister*, *S. orcutti*, *Urosaurus nigricaudus*, *Uta stansburiana*, *Cnemidophorus tigris*, *C. hyperythrus*, *C. maximus*, *Masticophis flagellum*, *Chilomeniscus punctatissimus*, and *Crotalus mitchellii* (Hafner, 1981). In addition, this island has a larger variety of mammal life than many of the other islands along the coast, probably owing to its more recent connection with the mainland (Nelson, 1922). Other mammals on Espíritu Santo Island are *Lepus insularis*, *Chaetodipus spinatus lambi*, *Peromyscus eremicus insulicola*, *Neotoma lepida vicina*, and *Bassariscus astutus saxicola* (Hall, 1981).

FIG. 4. Habitat occupied by *Ammospermophilus insularis* on Espíritu Santo Island, Baja California Sur, Mexico. Photograph by T. L. Best.

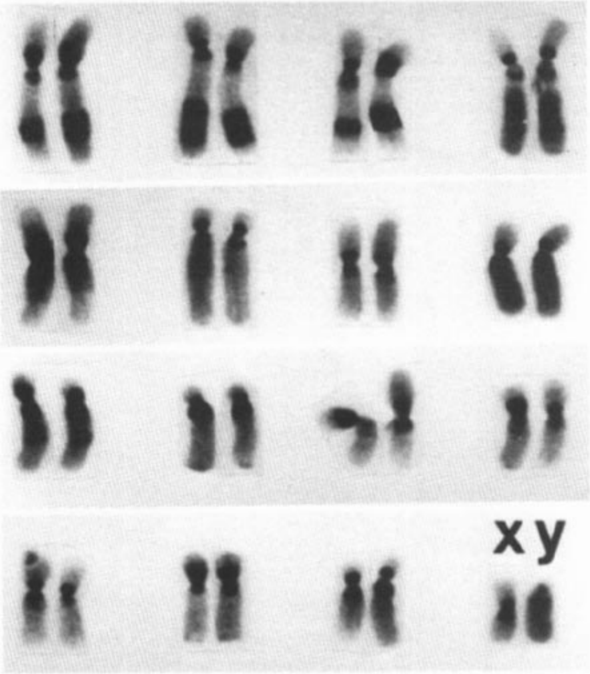

FIG. 5. C-banded karyotype of *Ammospermophilus insularis* (modified from Mascarello and Bolles, 1980).

BEHAVIOR. As in other *Ammospermophilus*, the alarm call is a trill; ontogeny, sex, temperature, or season do not affect call characters. Duration of call, band of frequencies emitted at onset, frequency of the fundamental, and lowest frequency are highly correlated with measures of the rostrum (Bolles, 1981). The short, harsh, and low-pitched trill of *A. insularis* appears to be adapted to closed (rocky) habitats. Means of characters of alarm calls are: length of call from first sound emitted to end of call, 1.35 s (range, 0.82-2.28); frequency band around trill at onset of call, 7.33 kHz (7.00-7.80); mean pulse duration, 0.044 s (0.040-0.048); frequency of main sound energy of the trill one-half way in its duration, 2.33 kHz (1.20-3.30); cascade ratio, 1.00 kHz (0.99-1.02); lowest frequency emitted, 0.15 kHz (0.00-0.30); frequency of the fundamental, 1.00 kHz (0.10-1.70); frequency of trill at beginning, 2.30 (1.20-3.22); frequency of first harmonic above main sound energy, 4.50 kHz (2.50-6.50); and length of trill from first clearly configured pulse to end of call, 1.35 s (0.82-2.28; Bolles, 1988).

Although the call of *A. insularis* is similar to that of *A. interpres* and *A. nelsoni*, its pulse rate is longer. The pulse rate and pitch of the call of *A. insularis* are not statistically different from those of *A. leucurus* and *A. harrisii*. The range of variation in these characters suggests that the calls of *A. insularis*, *A. leucurus*, and *A. harrisii* do not differ in mean pulse duration. Also, the calls of *A. insularis* and *A. interpres* may be transitional between those of *A. nelsoni* and *A. leucurus-A. harrisii* (Bolles, 1988).

GENETICS. *Ammospermophilus insularis*, like the others in the genus, has 32 chromosomes (Fig. 5), each (except the Y) with a large block of centromeric heterochromatin. Three pairs of chromosomes have large interstitial blocks of heterochromatin in their long arms. The Y chromosome and large blocks of material on the autosomes are variable with respect to differentiation by C-banding; their heterochromatic nature is not always obvious. The Y chromosome appears entirely heterochromatic. The C-banding pattern of *A. insularis* resembles that of *A. harrisii*. Like *A. harrisii*, *A. nelsoni*, and *A. interpres*, *A. insularis* has three autosomal pairs with large interstitial blocks of constitutive heterochromatin. *A. leucurus* has four such pairs. Like *A. harrisii* but unlike *A. leucurus*, the noncentrometric heterochromatin of the remaining autosomes of *A. insularis* stains darkly when G-banded, indicating that it contains an adenine- and thymine-rich sequence. Chromosome banding similarities indicate that *A. insularis* may be most closely related to *A. harrisii* (Mascarello and Bolles, 1980).

Electrophoretic data indicate relatively low levels of genetic divergence among species of *Ammospermophilus*, with a mean Nei genetic distance measure (D) of 0.05. *A. harrisii*, *A. leucurus*, and *A. insularis* are least different (D = 0.004-0.026; Bolles, 1981).

REMARKS. Phenograms constructed for cranial and alarm-call measures suggest that *A. insularis* is most similar to *A. interpres*. Cladistic analysis suggests *A. insularis* is closest to *A. leucurus* and *A. harrisii*, and electrophoretic data indicate *A. insularis* and *A. leucurus* are nearly identical. *A. insularis* appears to have diverged most recently of the five species, possibly only 6,900 years ago when change in sea level isolated it on Espíritu Santo Island (Bolles, 1981).

Ammospermophilus is derived from *ammos* referring to sand, *spermatos* alluding to seed, and *philos* meaning loving or desiring affinity. The specific epithet *insularis* comes from *insula* indicating its island range (Jaeger, 1955). The common name "Espiritu Santo Spermophile" was used by Nelson and Goldman (1909) in the original description.

H. T. Haagenstad prepared Fig. 3. We thank M. C. Belk, D. J. Hafner, G. R. Hepp, G. R. Michener, J. O. Murie, H. D. Smith, and M. C. Wooten for reviewing an early draft of the manuscript. This is journal article no. 15-902463P of the Alabama Agricultural Experiment Station.

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