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SYNOPSIS OF THE RICE RATS (GENUS *ORYZOMYS*)  
OF NICARAGUA

J. KNOX JONES, JR., AND MARK D. ENGSTROM

Rice rats of the cricetine genus *Oryzomys* occur from the southeastern United States southward to southern South America; they represent a taxonomically complex group in which a varying number of subgenera are recognized, depending on authority consulted. The genus evidently first was reported from Nicaragua by Oldfield Thomas (1895:57), who recorded both *Oryzomys couesi* and *O. gracilis* (= *O. alfaroi*) from Managua. Later, C. Hart Merriam (1901:284) named and described *Oryzomys richmondi*, now a synonym of *O. couesi*, and Thomas (1905:586) described the distinctive *O. dimidiatus* from the Escondido River near Rama. Subsequently (see especially J. A. Allen, 1908, 1910), five additional species of *Oryzomys* have been found to occur in the country, and we here provide a synopsis of the distribution, systematics, and natural history of those taxa currently known from Nicaragua.

Although there is a diversity of rice rats in Nicaragua (eight species representing at least four subgenera), no species, with the possible exception of *O. dimidiatus*, is endemic to the country. Nicaraguan *Oryzomys* comprise a mixture of taxa that are distributed primarily in northern Middle America (*O. alfaroi*, *O. couesi*, *O. fulvescens*, and *O. melanotis*) with others that occur primarily in southern Central America and adjacent South America (*O. alfari*, *O. bombycinus*, *O. caliginosus*, and possibly *O. dimidiatus*). Other than *dimidiatus*, only one species, *melanotis*, might reach distributional limits (southern) in Nicaragua.

All but one of the specimens listed as examined below are in the collections of the Museum of Natural History at The University of Kansas; many of these resulted from field work in Nicaragua in the 1960s under the aegis of a contract (DA-49-193-MD-2215) from the U. S. Army Medical Research and Development Command. One specimen, the holotype of *Oryzomys dimidiatus*, from the British Museum (Natural History) also was examined. In the following accounts (wherein species are treated alphabetically), all measurements are in millimeters and weights are in grams. Localities of record are listed alphabetically by departments and from north to south within each department. Those in italic type are not plotted on distribution maps because undue crowding of symbols would have resulted.

We thank Hugh H. Genoways for earlier work on some of the material reported here, and both him and Robert D. Owen for reviewing a draft of this manuscript.

#### ACCOUNTS OF SPECIES

##### *Oryzomys alfari alfari* (J. A. Allen, 1897)

##### Allen's Rice Rat

This large, long-tailed rice rat is known only in Central America—from extreme northeastern Honduras to central Panamá. It was first recorded from Nicaragua by Allen (1908:655), who proposed for it the name *Oryzomys ochraceus* on the basis of four specimens from Río Grande, Matagalpa. Later (1910:99), he reported an additional individual from Río Tuma, Matagalpa. *O. ochraceus* subsequently was synonymized with *O. a. alfari* by Goldman (1916:127). Hershkovitz (1944:75) examined the five specimens mentioned above, recorded measurements for them, and listed another from Río Siquia, near Rama (see Fig. 6). *O. alfari*, a member of the subgenus *Sigmodontomys*, was for many years assigned to the genus *Nectomys* until Gardner and Patton (1976:11) transferred *Sigmodontomys* to *Oryzomys*.

Aside from its large size, this rat can be distinguished from other members of the genus in Nicaragua by its long, thick dorsal pelage, heavily built skull, and large cheekteeth with rather simple crowns. Like many other mammals obtained for the American Museum of Natural History by W. B. Richardson in the early 1900s, this species now may be rare or absent in the northwestern part of the Caribbean drainage (where Richardson

collected), owing to destruction of pristine habitats and current agricultural practices.

*Oryzomys alfaroi alfaroi* (J. A. Allen, 1891)

Alfaro's Rice Rat

*Specimens examined* (21).—BOACO: Santa Rosa, 17 km. N, 15 km. E Boaco, 300 m., 3. MATAGALPA: Santa María de Ostuma, 1250 m., 1; *Hda. Tepeyac*, 10.5 km. N, 9 km. E Matagalpa, ca. 960 m., 3; 2 km. N, 6 km. E Esquipulas, 960 m., 7; *La Danta*, 1 km. N, 5 km. E Esquipulas, 780 m., 4. ZELAYA: *Cara de Mono*, 50 m., 1; S side Río Mico, El Recreo, 25 m., 2.

*Additional records* (Allen, 1908:655, 1910:99; Goldman, 1918:61).—BOACO: *Chontales*. JINOTEGA: Peña Blanca. MADRIZ: San Juan Telpaneca; *Río Coco*. MANAGUA: Managua (Thomas, 1895:57). MATAGALPA: Tuma; Río Tuma; Uluse; *Río Grande*. NUEVO SEGOVIA: Jalapa; Jicaró.

This rice rat is known from north-central Nicaragua, south and east to El Recreo in Zeleya (see Fig. 1). It occupies a variety of habitats, from grasslands to woodlands and riparian situations, but appears to be nowhere especially common. The species first was reported from Nicaragua by Thomas (1895:57) as *Oryzomys gracilis*. Later, Allen (1908:655) named a new subspecies, *O. a. incertus*, with type locality at Río Grande, Matagalpa. In 1910, however, Allen (p. 99) opined that *incertus* did not differ from *O. a. alfaroi*, a point of view shared by Goldman (1918:59-60) and by us.

In our sample, adult males had testes averaging 9 (6-10) in length in March (six animals), and measuring 9 and 10 in single animals taken in June and July. A female obtained at Santa Rosa on 21 March carried three fetuses that measured 4 in crown-rump length.

Average and extreme external measurements of eight adults (five males, three females) from Matagalpa are: total length, 227.3 (225-234); length of tail, 116.7 (112-124); length of hind foot, 26.7 (25-29); length of ear, 17.8 (17-19). Three males and two nonpregnant females weighed 39.6, 36.7, 36.5, 44.3, and 33.6, respectively. See Table 1 for cranial measurements.

*Oryzomys bombycinus alleni* Goldman, 1915

Long-whiskered Rice Rat

The long-whiskered rice rat is known from Nicaragua only from four specimens (USNM 392860-63) taken at three neighboring localities (Fig. 6) "in the vicinity of a campsite on the Kurinwas [also Curinhuás] River at "12°52'30"N, 84°05'W,

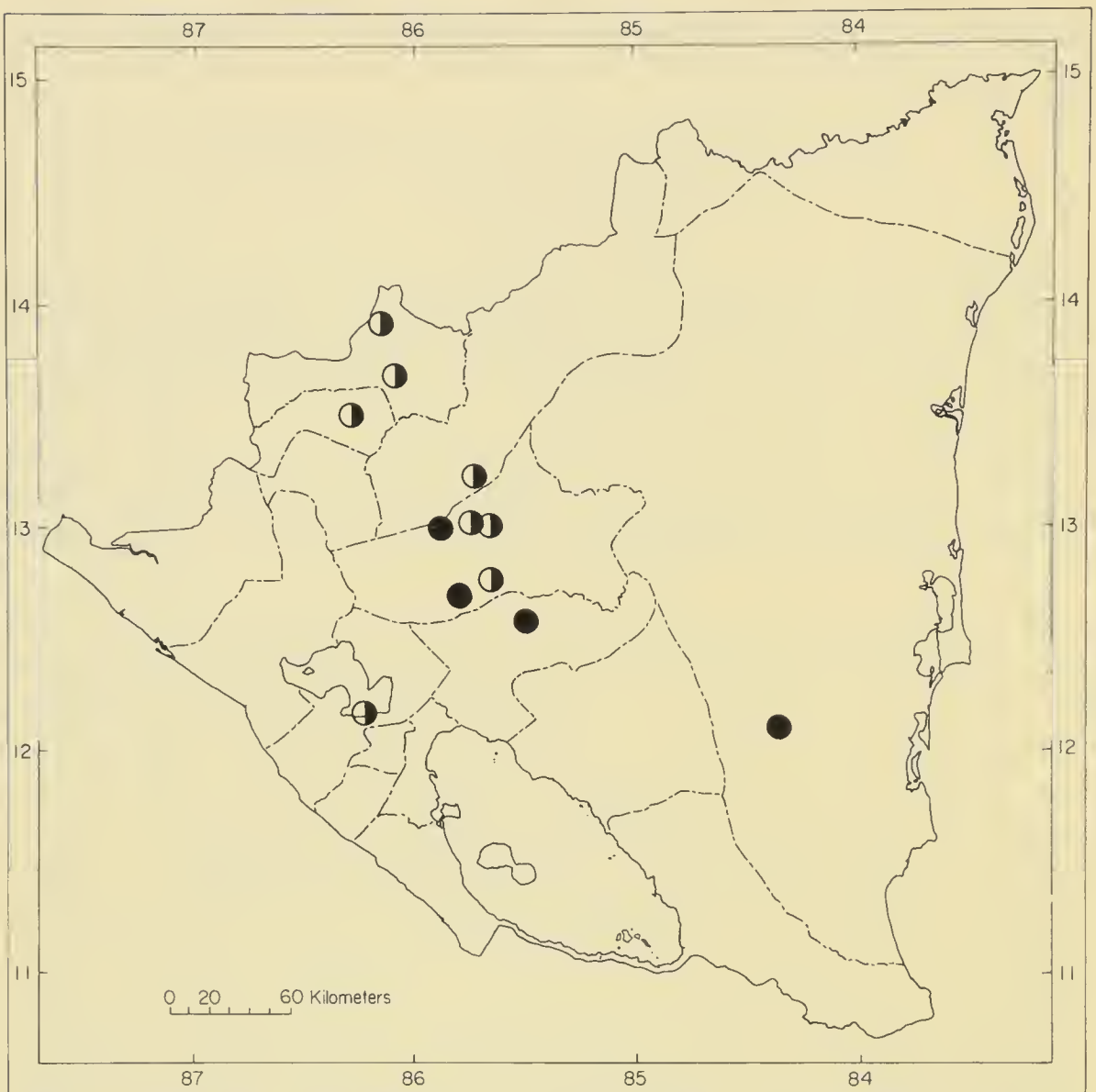


FIG. 1.—Records in Nicaragua of *Oryzomys alfaroi* (solid symbols represent specimens examined; half-solid symbols represent records from the literature).

and at a place 5½ miles down river from the campsite” (Pine, 1971:591), at elevations of “less than 10 to about 25 meters.” On maps and in gazetteers consulted by us, these specimens appear to have come from near the settlement of Ayamlapia (also Ayanlapia), Zelaya. When initially reported, the Nicaraguan locality constituted the northernmost limit for the species, but *O. bombycinus* since has been recorded from northeastern Honduras (Benshoof *et al.*, 1984:512).

According to Pine (1971:592), the terrain along the Río Kurinwás downstream from the campsite was “extremely low and frequently flooded and is composed almost entirely of dense palm swamp. . . .” The camp was located on higher ground at the edge of “high forest, partially cut over for mahogany some 15-20 years previously.” *Oryzomys couesi* also was taken near the campsite,

TABLE 1.—Cranial measurements of adults of three species of *Oryzomys* from Nicaragua.

Sample and statistics, or specimen number	Greatest length of skull	Zygomatic breadth	Postorbital constriction	Mastoid breadth	Length of rostrum	Length of nasals	Breadth of rostrum	Depth of cranium	Length of maxillary toothrow
<i>Oryzomys alfaroi</i> , Matagalpa									
Sample size	8	8	8	8	8	8	8	8	8
Mean	27.9	14.1	4.8	10.9	10.8	11.1	5.4	9.1	3.8
Minimum	26.5	13.4	4.4	10.3	10.0	10.2	4.8	8.5	3.5
Maximum	28.9	15.0	5.1	11.5	11.4	11.7	5.8	9.5	4.1
1 SE	0.25	0.17	0.08	0.16	0.15	0.19	0.12	0.12	0.07
CV	2.5	3.4	4.5	4.0	3.8	4.8	6.1	3.6	5.2
<i>Oryzomys caliginosus</i> , vicinity El Recreo, Zelaya									
Sample size	13	12	13	13	13	13	13	13	12
Mean	28.7	15.4	6.6	12.2	10.2	10.3	5.9	10.2	4.3
Minimum	28.0	14.8	6.2	11.9	9.8	9.7	5.5	9.9	4.0
Maximum	29.6	16.0	7.0	12.6	11.0	11.1	6.6	11.1	4.6
1 SE	0.12	0.11	0.07	0.07	0.09	0.13	0.08	0.10	0.04
CV	1.5	2.5	4.2	2.1	3.1	4.6	4.7	3.3	3.6
<i>Oryzomys melanotis</i>									
KU 110472, ♂	30.1	15.7	4.8	12.0	11.6	11.7	6.3	9.3	4.1
KU 106593, ♀	30.9	15.0	4.4	11.6	12.1	12.2	5.9	9.3	4.0
KU 106594, ♂	29.9	15.0	4.7	11.4	11.5	12.2	6.0	9.4	3.9

and *O. caliginosus* was trapped at the downstream locality. A female *O. bombycinus* taken on 15 September carried two fetuses, whereas one captured on 24 September was lactating. See Pine (1971) for external and cranial measurements.

### *Oryzomys caliginosus chrysomelas* J. A. Allen, 1897

#### Dusky Rice Rat

*Specimens examined* (44).—JINOTEGA: Hda. La Trampa, 16 km. E, 5.5 km. N Jinotega, ca. 1100 m. 5. RIO SAN JUAN: La Esperanza, 5 km. S, 3.5 km. E San Carlos, ca. 40 m., 1. ZELAYA: Bonanza, 4; *Cara de Mono*, 50 m., 2; *El Recreo*, ca. 25 m., 8; S side Río Mico, El Recreo, 25 m., 24.

*Additional records* (Allen, 1908:654, 1910:98, unless otherwise noted).—BOACO: Chontales. JINOTEGA: *Peña Blanca*. MADRIZ: Río COCO. MATAGALPA: *Vijagua* (Bijagua); *Lavala* (Savala); Tuma; Río Tuma; Río Grande. RIO SAN JUAN: Greytown (Goldman, 1918:98). ZELAYA: Río Kurinwás, 5.5 mi. downstream from 12°51'30"N, 84°05'W, ca. 10 m. (Pine, 1971:592); Río Escondido, 45-50 miles above Bluefields (Goldman, 1918:98—see Appendix).

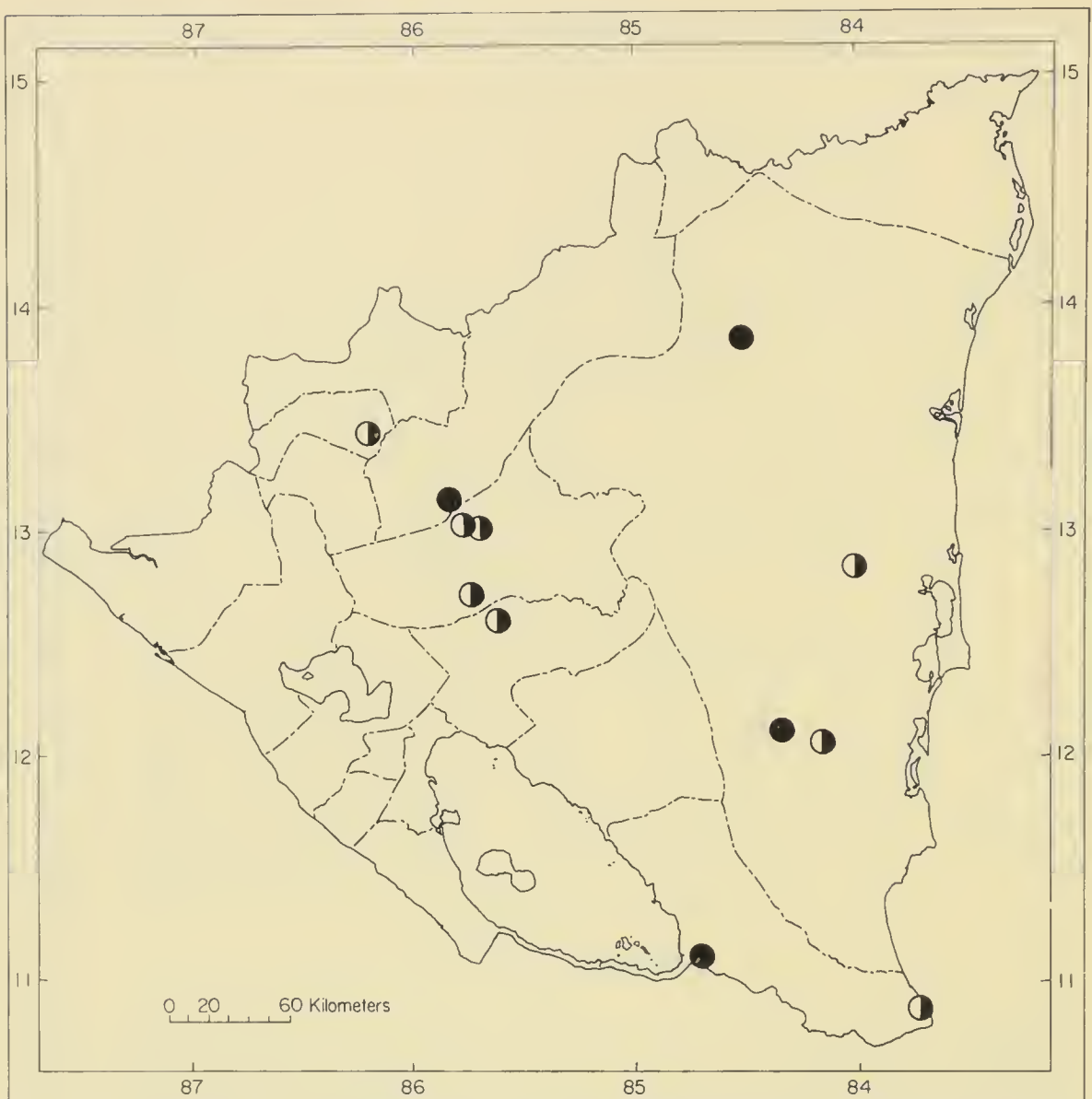


FIG. 2.—Records in Nicaragua of *Oryzomys caliginosus* (solid symbols represent specimens examined; half-solid symbols represent records from the literature).

This dark-colored species probably occurs throughout most of eastern Nicaragua (Fig. 2), westward in the northern part to the limits of the Caribbean drainage. It apparently was more commonly distributed in north-central areas prior to initiation of intense agricultural practices, although specimens were taken in southwestern Jinotega in 1964. *O. caliginosus* reaches the northern limit of its distribution in northeastern Honduras (Benshoof *et al.*, 1984:513). Our rats from El Recreo were taken in riparian situations near the Río Mico. The two from Cara de Mono were caught in second growth forest near a small tributary of the Río Mico.

The sample from El Recreo contains juveniles taken both in June and July. A female captured on 18 June carried two fetuses (crown-rump length, 14), whereas one trapped on 28 July carried



three (length, 6) and was lactating; a lactating animal was caught on 25 June. A female obtained at Cara de Mono on 24 April also contained three fetuses (length, 6). Testes of adult males from Zelaya measured 7 and 11 in February (two specimens), 10 in June (one), and 7-13 in July (six).

Means (and extremes) of external measurements of 13 adults from Zelaya (eight males, five females) are: total length, 205.8 (193-228); length of tail, 88.3 (85-95); length of hind foot, 25.2 (22-27); length of ear, 15.5 (14-17). Weights of six males averaged 48.6 (42.1-57.1), whereas three nonpregnant females weighed 40.2, 48.5, and 52.3. For cranial measurements, see Table 1.

### *Oryzomys couesi couesi* (Alston, 1877)

#### Coues' Rice Rat

*Specimens examined* (155).—BOACO: Santa Rosa, 17 km. N, 15 km. E Boaco, 300 m., 14. CARAZO: 3 mi. NNW Diriamba, 1. CHINANDEGA: Hda. San Isidro, 10 km. S Chinandega, 1; *San Antonio*, 35 m., 56. ESTELI: 8 mi. S Condega, 4. GRANADA: Hda. Mecatepe, 2 km. N, 11.5 km. E Nandaime, ca. 40 m., 1. JINOTEGA: Yalí, 860 m., 1; 1 mi. NW Jinotega, 4. MADRIZ: Daraili, 6 km. N, 15 km. E Condega, 1100 m., 1; *Daraili*, 5 km. N, 14 km. E Condega, 940 m., 2. MANAGUA: 2 mi. N Sabana Grande, 4; Hda. Azacualpa, 5 km. N, 2 km. W Villa El Carmen, ca. 90 m., 2. MATAGALPA: Santa María de Ostuma, 1250 m., 9; *Finca Tepeyac*, 10.5 km. N, 9 km. E Matagalpa, 960 m., 1; 1 km. N, 5 km. E Esquipulas, 780 m., 2; 1 km. NE Esquipulas, 420 m., 4; 11 mi. SE Dario, 3. NUEVO SEGOVIA: 4.5 km. N, 2 km. E Jalapa, 680 m., 2; 1.5 km. N, 1 km. E Jalapa, 660 m., 2. RIO SAN JUAN: La Esperanza, 5 km. S, 3.5 km. E San Carlos, ca. 40 m., 1. RIVAS: 4 km. S, 1.5 km. E Alta Gracia, 40 m., Isla de Ometepe, 3; *Finca Amayo*, 13 km. S, 14 km. E Rivas, 40 m., 5; 3 km. N, 4 km. W Sapoá, 40 m., 2. ZELAYA: *Cara de Mono*, 50 m., 1; *El Recreo*, ca. 25 m., 14; S side Río Mico, El Recreo, 25 m., 15.

*Additional records*. (Allen, 1908:655, 1910:98, unless otherwise noted).—BOACO: *Chontales*. JINOTEGA: Peña Blanca; San Rafael del Norte. MADRIZ: San Juan Telpaneca (Goldman, 1918:31); *Río Coco*. MANAGUA; *Managua* (Thomas, 1895:57). MATAGALPA: Vijagua (Bijagua); Tuma; *Río Tuma*; Matagalpa (Goldman, 1918:31); *Uluce* (Goldman, 1918:31); *Río Grande* (Goldman, 1918:31). NUEVO SEGOVIA: Ocotal; Quilalí (Goldman, 1918:31). ZELAYA: Río Kurinwás, 12°51'30"N, 81°05'W, ca. 40 m. (Pine, 1971:592); Río Escondido, 16, 25, 40, 45, and 50 mi. above Bluefields (Goldman, 1918:32—see Appendix).

This widely distributed species probably occurs throughout Nicaragua (see Fig. 3). It is found in a variety of habitats, excepting forested mountainous areas, and thus may be absent locally in parts of the north-central region of the country. Specimens available to us have been taken at altitudes ranging from nearly sea level to 1250 meters.

To analyze geographic variation in *O. couesi* in Nicaragua, adult specimens were assigned to one of six geographic samples

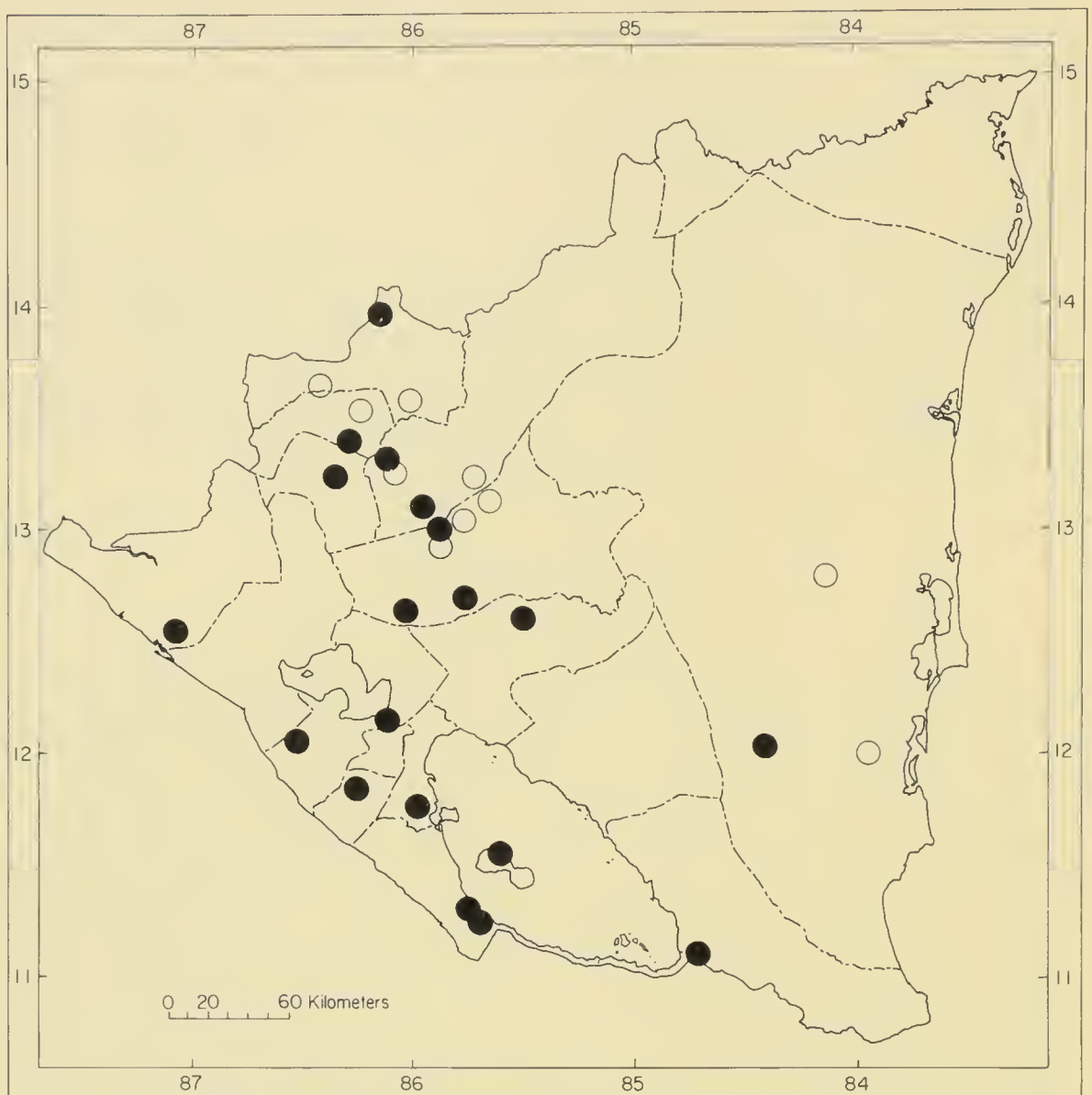


FIG. 3.—Records in Nicaragua of *Oryzomys couesi* (solid symbols represent specimens examined; half-solid symbols represent records from the literature).

(see Table 2), none of which crossed major physiographic or previously recognized taxonomic boundaries. A Principal Component Analysis (PCA) then was performed on the character correlation matrix derived from sample means and character values from the one specimen in sample 6. A Minimum Spanning Tree (MST) was calculated from the taxonomic distance matrix and superimposed on the PCA plot to indicate nearest neighbors in the total character space. Calculations were made using the NT-SYS package of computer programs (Rohlf *et al.*, 1979).

Results of the PCA and MST analyses (Fig. 4) emphasize the relative homogeneity of rats in samples 1-5 and the distinctiveness of the one specimen (from Isla de Ometepe) in sample 6. Samples segregated mainly along the first principal component, which

TABLE 2.—Cranial measurements of *Oryzomys couesi* from six geographic samples in Nicaragua.

Sample and statistics, or specimen number	Greatest length of skull	Zygomatic breadth	Postorbital constriction	Mastoid breadth	Length of rostrum	Length of nasals	Breadth of rostrum	Depth of cranium	Length of maxillary toothrow
<b>Sample 1, San Antonio, Chinandega</b>									
Sample size	24	27	27	26	26	26	27	26	26
Mean	30.4	16.0	4.8	11.9	11.1	11.8	5.9	10.3	4.4
Minimum	29.1	15.3	4.4	11.2	10.1	10.7	5.6	9.8	4.2
Maximum	31.9	16.6	5.3	12.4	12.2	12.8	6.3	11.0	4.6
1 SE	0.15	0.09	0.04	0.06	0.09	0.09	0.04	0.06	0.02
CV	2.4	2.7	4.5	2.5	4.0	4.0	3.6	2.7	2.8
<b>Sample 2, southern Rivas</b>									
Sample size	5	5	5	5	5	5	5	5	5
Mean	30.4	16.0	5.2	12.1	11.3	11.6	5.9	10.5	4.4
Minimum	29.5	15.4	5.0	11.8	10.5	11.2	5.8	10.2	4.1
Maximum	31.5	16.6	5.4	12.6	12.4	12.7	6.2	10.7	4.5
1 SE	0.36	0.20	0.07	0.14	0.32	0.27	0.08	0.10	0.07
CV	2.7	2.7	3.2	2.5	6.3	5.2	3.0	2.2	3.8
<b>Sample 3, northern Nicaragua</b>									
Sample size	9	10	11	9	11	11	11	9	16
Mean	30.8	16.4	5.0	12.1	11.4	11.8	6.1	10.5	4.5
Minimum	28.4	15.6	4.7	11.5	10.6	11.0	5.7	10.1	4.2
Maximum	32.9	17.2	5.4	12.7	12.2	12.3	6.7	11.1	4.8
1 SE	0.43	0.13	0.07	0.12	0.17	0.12	0.08	0.12	0.04
CV	4.1	2.6	4.6	3.0	5.1	3.3	4.4	3.4	3.7
<b>Sample 4, Boaco and southern Matagalpa</b>									
Sample size	6	8	8	7	7	7	8	7	12
Mean	30.9	16.2	4.9	12.3	11.2	11.7	5.9	10.6	4.5
Minimum	29.9	15.6	4.6	12.0	10.6	11.1	5.5	10.1	4.2
Maximum	31.9	16.8	5.3	12.5	11.8	12.3	6.1	10.9	4.8
1 SE	0.38	0.16	0.08	0.07	0.16	0.17	0.07	0.11	0.05
CV	3.0	2.7	4.8	1.5	3.8	3.8	3.3	2.8	4.1
<b>Sample 5, vicinity El Recreo, Zelaya</b>									
Sample size	5	6	6	5	6	6	6	6	10
Mean	30.7	16.8	5.0	12.3	11.3	11.6	6.1	10.6	4.5
Minimum	29.7	16.3	4.7	12.1	10.1	10.1	5.8	10.3	4.3
Maximum	31.4	17.9	5.3	12.6	12.2	12.5	6.4	10.8	4.9
1 SE	0.34	0.24	0.10	0.09	0.33	0.42	0.09	0.09	0.07
CV	2.5	3.5	4.6	1.7	7.2	8.9	3.8	2.0	4.5
<b>Sample 6, Isla de Ometepe, Rivas</b>									
KU 115476, ♂	31.3	16.1	5.3	12.6	11.9	12.7	6.2	10.9	4.8

represents a contrast between external (excepting length of hind foot) and cranial measurements (Table 3). Consequently, the one adult male from Isla de Ometepe is set apart from the cluster of other samples because it has relatively small external measurements (especially length of tail) and relatively large cranial dimensions. The specimen is phenetically divergent from, and does not appear as the nearest neighbor to, geographically adjacent samples 2 and 4 from mainland Rivas and Boaco, respectively. Sample 5 (Zelaya) is separated slightly along the second and third principal components based mainly on relatively broad zygoma (Table 2); however, the mean value for zygomatic breadth in sample 5 is inflated because one old adult had unusually broad zygomatic arches (17.9). As indicated by its position on the first principal component and by branch lengths of the MST (Fig. 4), sample 5 (representing *O. c. richmondi*) is not divergent in mensural characters from other noninsular Nicaraguan samples.

Merriam (1901:284) described *Oryzomys richmondi* from specimens taken on the "Escondido River (50 miles above Bluefields)." Goldman (1918:32) reduced it to subspecific status under *O. couesi*, noting that it was similar to the nominate subspecies "but decidedly darker, more regularly ochraceous-tawny, the back and upper parts of sides more heavily darkened by admixture of black hairs; underparts light ochraceous buff." We have examined a large series of *O. couesi* from just west of the type locality of *richmondi* in Zelaya. While it is true that these specimens average slightly darker dorsally than rats from elsewhere in Nicaragua and have ochraceous venters, these colors can be matched in animals from other localities, even from the northwest coastal region. As noted previously, we find no distinctive cranial features that set *richmondi* apart from *couesi* (see also Table 2) nor do they differ in external dimensions. Therefore, we regard the former as inseparable from *O. c. couesi*.

Actually, as noted, the most distinctive population of this species in Nicaragua may be on Isla de Ometepe in Lago de Nicaragua. Unfortunately, we have only three specimens from the island and only one of these is fully adult. Thus we feel it inappropriate to propose a new subspecific name for the Ometepe rats at this time. Nevertheless, they differ from mainland populations, in addition to the external and cranial dimensions mentioned above, in having a softer pelage that is rich, orangish brown dorsally, with a heavy suffusion of buff ventrally (even

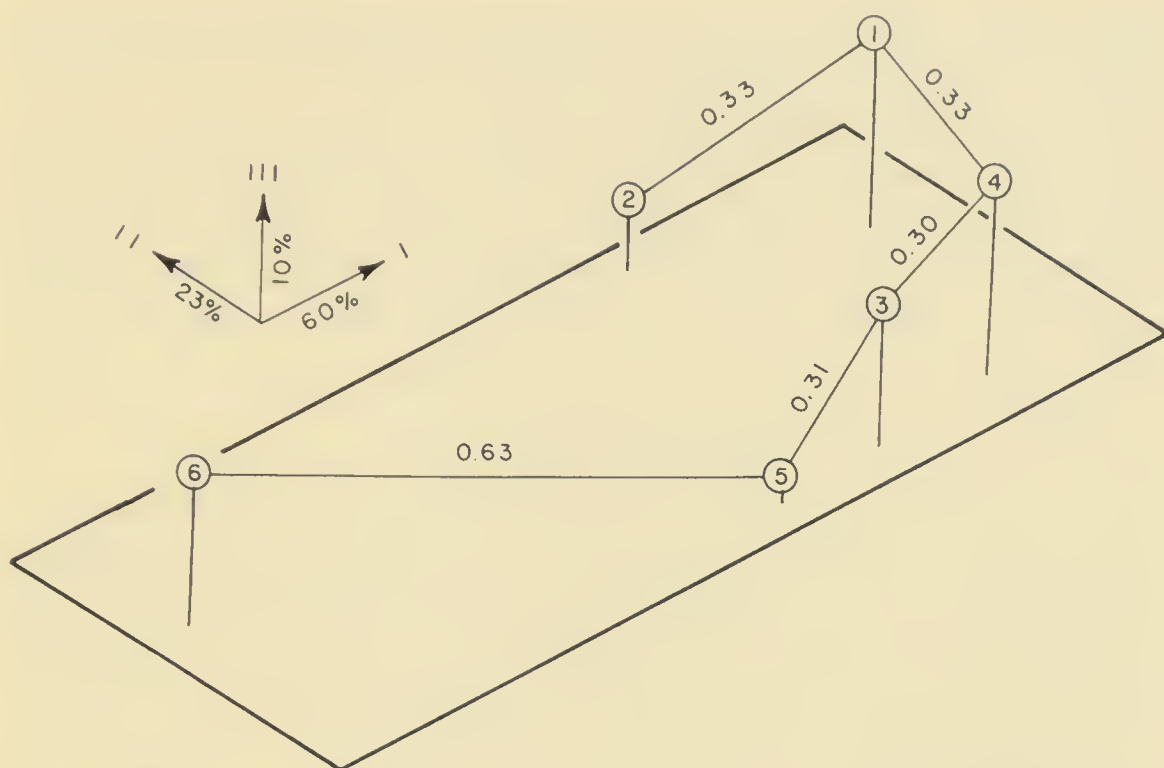


FIG. 4.—Projections of geographic samples of *Oryzomys couesi* from Nicaragua (Table 2) onto the first three component axes resulting from a Principal Components Analysis of the correlation matrix among 13 external and cranial measurements. A Minimum Spanning Tree (and corresponding branch lengths), derived from a taxonomic distance matrix, is superimposed on the projection.

TABLE 3.—Eigenvalues, percentage of total variance (cumulative), and character loadings resulting from a Principal Component Analysis of six geographic samples of *Oryzomys couesi*.

Statistics and characters	Principal components		
	1	2	3
Eigenvalue	7.82	3.02	1.31
Cumulative percent total variance	60.13	80.35	93.39
Total length	0.52	-0.75	0.40
Length of tail	0.87	-0.44	0.19
Length of hind foot	-0.34	-0.84	-0.39
Length of ear	0.77	-0.50	0.34
Greatest length of skull	-0.82	-0.43	0.37
Zygomatic breadth	-0.09	-0.80	-0.57
Postorbital constriction	-0.79	0.34	-0.26
Mastoid breadth	-0.83	-0.37	0.10
Length of rostrum	-0.97	0.16	0.12
Length of nasals	-0.84	0.14	0.50
Breadth of rostrum	-0.83	-0.21	-0.11
Depth of cranium	-0.97	-0.19	0.05
Length of maxillary toothrow	-0.92	-0.34	0.16

more than in most specimens formerly assigned to *richmondi*), and in lacking sphenopalatine vacuities.

We have specimens of *O. couesi* from Nicaragua taken in every month from February through August; pregnant females were collected in each month during that period except April (when no females were obtained). Twenty-eight females in our sample carried an average of 4.4 (1-8) fetuses. Testes of adult males averaged 10 (9-11, three specimens) in February, 12 (8-15, eight) in March, 10 (8-12, two) in June, and 12 (8-15, 30) in July, and measured 11 each in single males taken in April and August.

Average (and extreme) external measurements of 25 adults (nine males, 16 females) from San Antonio, Chinandega, are as follows: total length, 264.9 (242-292); length of tail, 135.6 (127-150); length of hind foot, 28.8 (27-31); length of ear, 16.1 (14-18). Ten males from San Antonio weighed an average of 63.7 (50.4-72.6), whereas five nonpregnant females averaged 51.5 (43.1-59.0).

Corresponding measurements of five adults (four males, one female) from El Recreo, Zelaya, are: 265.6 (248-283); 131.2 (122-139); 31.0 (28-33); 15.5 (four only, 13-18); 65.9 (53.7-85.0). External measurements for an adult male and two young adult females from Isla de Ometepe are, respectively: 260, 229, 204; 121, 118, 92; 30, 29, 27; 15, 15, 14. The male weighed 75.4.

### *Oryzomys dimidiatus* (Thomas, 1905)

#### Nicaraguan Rice Rat

*Specimens examined* (2).—ZELAYA: Río Escondido, 7 mi. below Rama, 1 (BM, holotype); S side Río Mico, El Recreo, 25 m., 1. Not mapped.

This rare species originally was described on the basis of a single individual from the Río Escondido, seven miles below Rama, Zelaya, that was obtained by W. G. Palmer on 5 November 1904. Our rat, a young adult male trapped by R. W. Turner on 26 July 1966 and previously reported by Genoways and Jones (1971), represents the only other known specimen of *O. dimidiatus*. It was taken in a dense stand of cane, eight to 10 feet tall, along the south bank of the Río Mico. The cane was nearly impenetrable except for two paths through it to the river, and it was along these paths that traps were set. *Oryzomys caliginosus*, *O. couesi*, *O. fulvescens*, *Sigmodon hispidus*, and *Sylvilagus brasiliensis* were taken at the same place. El Recreo is approximately 15 kilometers west of the type locality.

Selected measurements of our specimen (see also Genoways and Jones, 1971), followed in parentheses by those available for the

holotype (Hershkovitz, 1970:791), are: total length, 228 (240); length of tail, 110 (115); length of hind foot, 28 (27, dry); length of ear, 15 (13); greatest length of skull, 29.0 (29.8); zygomatic breadth, 15.0 (16.8); postorbital constriction, 4.5 (5.2); mastoid breadth, 11.5; breadth of rostrum, 5.6 (6.1); length of rostrum, 10.1; length of nasals, 10.7 (11.7); length of maxillary toothrow, 4.4 (4.7). The male weighed 46.0 and had testes 11 in length.

### *Oryzomys fulvescens*

#### Pygmy Rice Rat

This species first was reported from Nicaragua by J. A. Allen (1910:100) who described "*Oryzomys (Oligoryzomys) nicaraguae*" based on an adult male from Vijagua. He also listed one specimen (skin only) from San Rafael del Norte. No additional material has been reported from the country except incidental to other studies. *O. fulvescens*, nonetheless, is broadly distributed in Nicaragua, occurring at least as far east as El Recreo in Zelaya (Fig. 5), albeit apparently nowhere especially common.

Most of our specimens were taken in grassy areas, along weedy fencerows, and in woodland edge situations. At San Antonio, for example, specimens were trapped in vegetation along a stream; those from the vicinity of Jalapa were taken in traps set in grassy habitats, in one instance in a grassy fencerow bordering a cornfield; specimens from El Recreo were captured in riparian habitats along the Río Mico, some along trails in a dense stand of cane.

Pregnant females are available among our specimens from March, June, July, and August. Number of fetuses ranged from three to six (average 4.0) in eight individuals. Juvenile and subadult animals were taken in the same months. One subadult female, not fully in adult pelage, carried five fetuses on 15 August.

The systematics of *O. fulvescens* is poorly understood and in need of detailed study. Two fairly well-defined subspecies occur in Nicaragua—a larger (cranially and somewhat externally) and more darkly colored race from the northern highlands southward at least to Isla de Ometepe and eastward at least to El Recreo, and a smaller, paler-colored subspecies with a whitish to pale buffy venter, which occurs in the Pacific drainage of the western part of the country. There is some question, however, as to the correct identity of these two races. After considerable deliberation, we tentatively assign the larger, dark-colored, highland and eastern

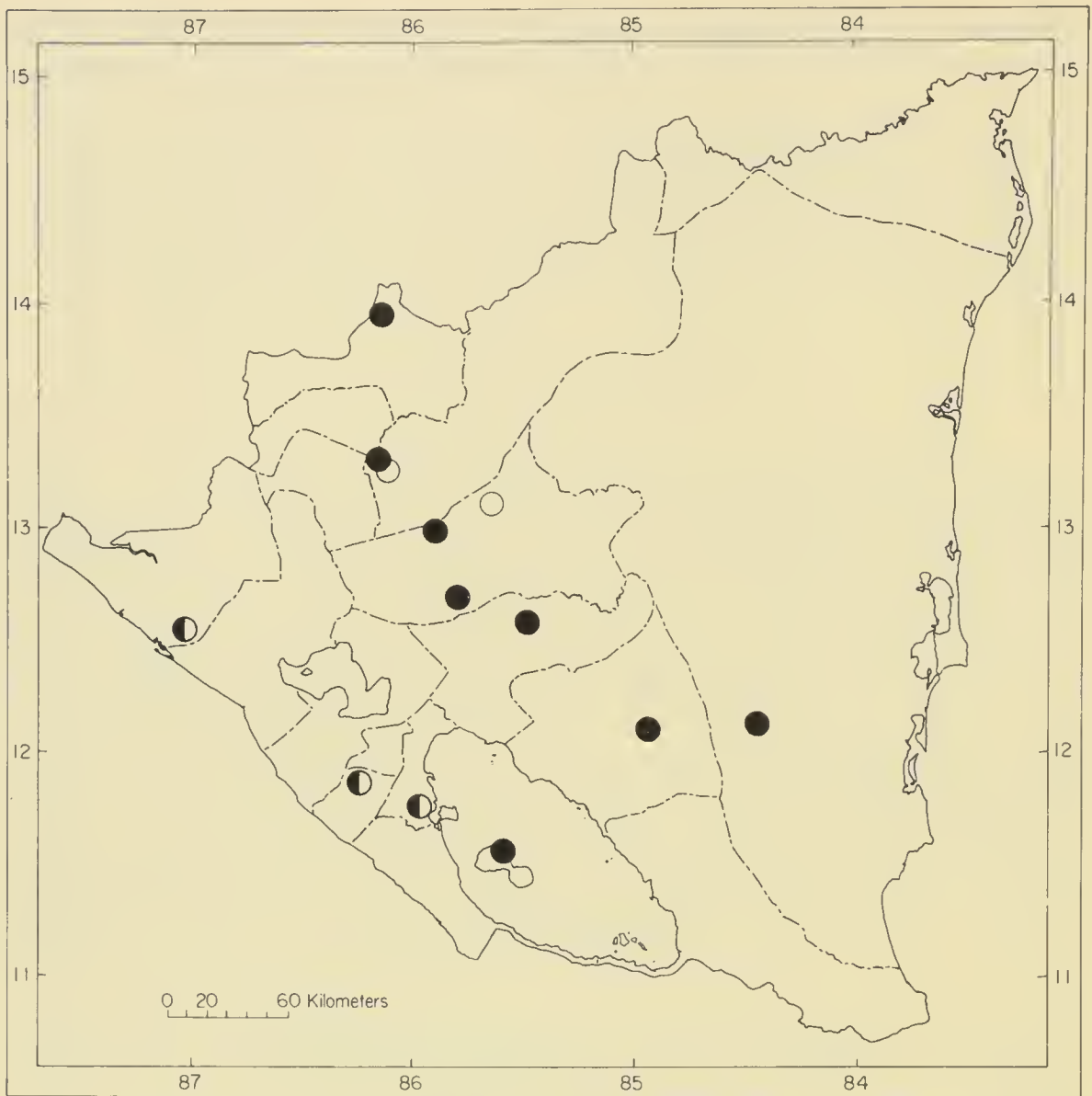


FIG. 5.—Records in Nicaragua of *Oryzomys fulvescens*: *O. f. costaricensis* (half-solid symbols); *O. f. nicaraguae* (solid symbols represent specimens examined; open symbols represent records from the literature).

mouse to *O. f. nicaraguae* and the smaller, paler, western animal to *O. f. costaricensis* as explained in the subspecific accounts below.

### *Oryzomys fulvescens costaricensis* J. A. Allen, 1893

*Specimens examined* (10)—CHINANDEGA: San Antonio, 35 m., 2. CARAZO: 3 km. N, 4 km. W Diriamba, 600 m., 2; 3 mi. NNW Diriamba, ca. 600 m., 4. GRANADA: Finca El Progreso, 10 km. SE Guanacaste, 1000 m., 2.

Pygmy rice rats from western Nicaragua are smaller, especially cranially (see Table 4), and paler, especially in ventral color, which is whitish to pale buff, than are those referred to *O. f. nicaraguae* from farther to the east. While the characteristics of these specimens do not coincide exactly with those claimed for



TABLE 4.—Cranial measurements of *Oryzomys fulvescens* from four geographic areas in Nicaragua.

Sample and statistics, or specimen number	Greatest length of skull	Zygomatic breadth	Postorbital constriction	Mastoid breadth	Length of rostrum	Length of nasals	Breadth of rostrum	Depth of cranium	Length of maxillary toothrow
<b>Neuva Segovia, Jinotega, Matagalpa</b>									
Sample size	7	9	9	7	8	8	9	8	9
Mean	21.6	11.4	3.5	9.8	7.4	7.8	4.2	8.1	2.9
Minimum	20.8	10.8	3.3	9.5	6.9	7.3	3.9	7.8	2.8
Maximum	22.8	12.0	3.6	10.1	7.8	8.6	4.4	8.5	3.2
1 SE	0.28	0.14	0.04	0.08	0.17	0.17	0.06	0.09	0.05
CV	3.4	3.7	3.4	2.0	6.5	6.2	2.3	3.1	5.2
<b>Zelaya and Chontales</b>									
Sample size	7	7	8	8	8	8	8	7	8
Mean	21.3	11.4	3.4	9.6	7.1	7.6	3.9	8.1	2.8
Minimum	20.9	10.9	3.0	9.2	6.7	7.2	3.7	7.9	2.6
Maximum	22.1	11.8	3.7	10.0	7.4	7.9	4.3	8.6	2.9
1 SE	0.21	0.12	0.09	0.10	0.08	0.09	0.07	0.09	0.05
CV	2.6	2.8	7.5	2.8	3.2	3.4	5.1	2.9	5.1
<b>Isla de Ometepe, Rivas</b>									
KU 115439, ♂	21.5	11.6	3.8	9.6	7.2	7.6	4.1	8.4	3.0
<b>Chinandega, Carazo, Granada</b>									
Sample size	5	5	5	4	5	4	5	5	5
Mean	20.1	10.4	3.5	9.0	6.5	7.0	3.9	7.7	2.9
Minimum	19.2	10.1	3.3	8.7	6.3	6.9	3.6	7.5	2.8
Maximum	20.8	11.0	3.7	9.3	6.9	7.2	4.0	7.8	3.0
1 SE	0.28	0.17	0.07	0.13	0.14	0.07	0.08	0.06	0.04
CV	3.1	3.7	4.5	2.8	4.8	2.0	4.6	1.7	3.1

*costaricensis*, our material seems best assignable at this time to that subspecies. Our specimens also seem to fit the description of material from El Salvador that was assigned by Felton (1958:6) to *O. f. fulvescens* and that Burt and Stirton (1961:62) thought "probably" represented the nominate race. In our opinion, however, pygmy rice rats from western Nicaragua are not referable to the subspecies *fulvescens*. There is a possibility, given additional material, that they will prove assignable to *O. f. pacificus* (Hooper, 1952:23, type locality Mapastepec, Chiapas) and that this subspecies will be found to occur through the dry

Pacific lowlands from southern México southward to Nicaragua—a distributional pattern found in some other rodents.

External measurements of seven adults (three males, four females) are: total length, 169.6 (151-196); tail, 98.6 (86-115); hind foot, 20.3 (19-21); ear, 12.8 (10-15); weights of two males and a nonpregnant female are, respectively, 11.7, 9.5, and 10.2.

*Oryzomys fulvescens nicaraguae* J. A. Allen, 1910

*Specimens examined* (28).—BOACO: Santa Rosa, 17 km. N, 15 km. E Boaco, 300 m., 1. CHONTALES: 1 km. N, 2.5 km. W Villa Somoza, 330 m., 1. JINOTEGA: Yalí, 860 m., 4. MATAGALPA: Santa María de Ostuma, 1250 m., 2; La Danta, 1 km. N, 5 km. E Esquipulas, 760-780 m., 2. NUEVO SEGOVIA: 4.5 km. N, 2 km. E Jalapa, 680 m., 2; 1.5 km. N, 1 km. E Jalapa, 660 m., 3; 3.5 km. S, 2 km. W Jalapa, 660 m., 1. RIVAS: 4 km. N, 1.5 km. E Alta Gracia, 40 m., Isla de Ometepe, 1. ZELAYA: *Cara de Mono*, 50 m., 2; S side Río Mico, El Recreo, 9.

*Additional records* (Allen, 1910:100).—JINOTEGA: San Rafael del Norte. MATAGALPA: Vijagua (Bijagua), the type locality.

*O. f. nicaraguae* was, as noted, named by Allen (1910:100) from a locality in Departamento de Matagalpa. Goldman (1918:92-93) placed *nicaraguae* in synonymy with the earlier-named *O. f. costaricensis* (Allen, 1893:239), noting that it “was based on scanty material from Nicaragua which is not satisfactorily separable from *costaricensis*. The type, apparently full grown but with molars rather slightly worn, is not so tawny as most examples of *costaricensis*, but this color element is usually less distinct in younger individuals. The toothrows are long, as in *costaricensis*.”

For reasons that, at least on the surface, are obscure, Goodwin (1946:397) resurrected *nicaraguae* with the simple statement that it “appears to be a recognizable geographic form.” He had available from Nicaragua only the two specimens originally reported by Allen, as did Goldman.

With more abundant material than that available to previous investigators, we tentatively recognize *nicaraguae*. To us, rats from northern and central Nicaragua more closely resemble *O. f. fulvescens*, reported from Honduras (Goodwin, 1942:165) and from which they eventually may prove inseparable, than they do *costaricensis*. They evidently are somewhat darker in color than are the latter and, despite statements to the contrary, have a consistently shorter maxillary toothrow (averaging less than 3.0—see Table 4) than claimed as characteristic of *costaricensis* by Goldman (1918:93).

Average and extreme external measurements of 11 adults (eight males, three females) from north-central Nicaragua are: total length, 180.5 (171-194); length of tail, 103.5 (95-113); length of hind foot, 21.2 (19-23); length of ear, 13.2 (11-15). Weights of six males averaged 16.0 (13.1-18.5), whereas one nonpregnant female weighed 16.0.

*Oryzomys melanotis megadon* Merriam, 1901

Black-eared Rice Rat

*Specimens examined* (3).—GRANADA: Finca Santa Cecilia, 6.5 km. SE Guanacaste, 660 m., 1. MATAGALPA: Santa María de Ostuma, 1250 m., 1. RIVAS: Finca Amayo, 13 km. S, 14 km. E Rivas, 40 m., 1.

This species first was reported from Nicaragua by Jones and Engstrom (1986) based on the specimen listed above from Santa María de Ostuma. Subsequently, two additional specimens were found, both originally catalogued as *O. couesi*. This material represents the southernmost record for the species; the specimen from Finca Amayo is from but a few kilometers north of the Costa Rican border, suggesting that *O. melanotis* probably occurs also in at least the northwestern part of that country (see Fig. 6). As currently understood, the specimens listed here are referable to *O. m. megadon*, but the systematics of this group has been studied by one of us (Engstrom, 1984) and nomenclatorial changes are anticipated upon publication of that work.

All of our specimens are adults. The specimen from Granada, a nonpregnant female, was trapped in a wooded, rocky ravine where *Peromyscus mexicanus* was abundant. A male from Santa María de Ostuma (testes 8 in length) was taken along with *Oryzomys alfaroi*, *O. couesi*, *O. fulvescens*, *P. mexicanus*, and several species of *Reithrodontomys*. A male (testes 8) from Finca Amayo was caught in riparian vegetation along the southwest shore of Lago de Nicaragua. In the order listed above, external measurements of the three rats are: total length, 262, 247, 258; length of tail, 142, 132, 132; length of hind foot, 28, 30, 29; length of ear, 20, 17, 17; weight, 57.7, 44.4, 47.0. For cranial measurements, see Table 1.

APPENDIX

Some of the localities from which mammals were obtained in the early 1900s for the American Museum of Natural History, British Museum (Natural History), and the U. S. National Museum of Natural History are not now shown on available

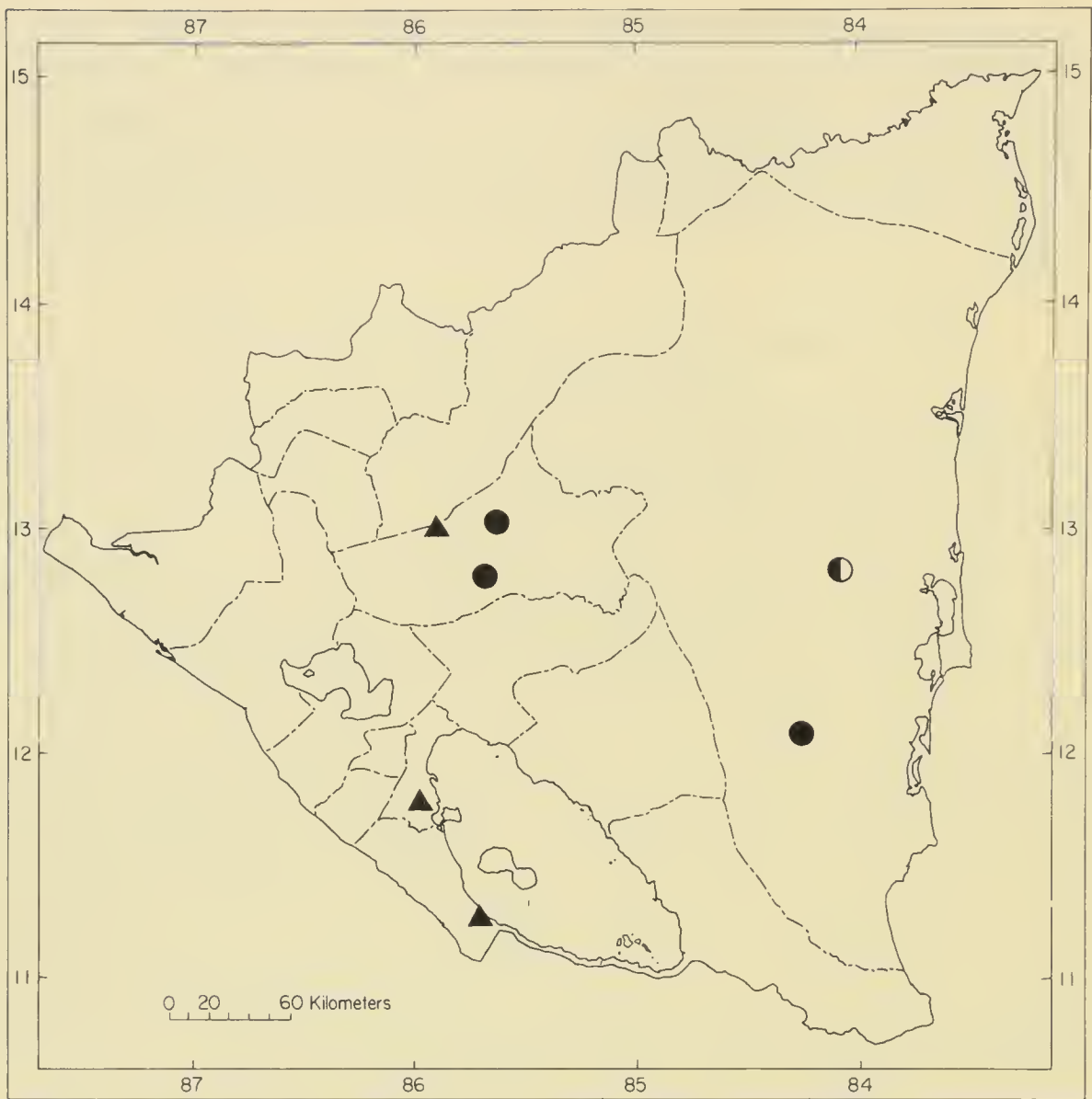


FIG. 6.—Records in Nicaragua of *Oryzomys alfari* (solid circles), *O. bombycinus* (half-solid circle), and *O. melanotis* (triangles).

maps or, in other cases, were located with reference to distance along a river rather than with reference to a named place. In our studies on Nicaraguan mammals, as well as those of Jones and Genoways (1970, 1971), Jones and Yates (1983), Yates *et al.* (1979), and Buchanan and Howell (1965), it has been necessary to track down, whenever possible, the locations of early collecting sites. To the extent that these cartographic researches may be useful to others, we here summarize notes on the probable locations of some lesser known places. In our work, we had available modern highway and other maps of Nicaragua as a whole, the American Geographical Society of New York's 1:1,000,000 map series, the extremely valuable 1:50,000 quadrangles issued by the Ministerio de Fomento, Oficina de Geodesia, Managua, and the NIS gazetteer for Nicaragua, published by the U. S. Central Intelligence Agency in 1956.

*Localities of William B. Richardson*

W. B. Richardson, who made his home for many years in the city of Matagalpa, collected birds and mammals in the early 1900s for the American Museum of Natural History, the British Museum (Natural History), and the Field Museum of Natural History. Specimens collected by Richardson formed the basis of Allen's (1908, 1910) contributions to Nicaraguan mammalogy.

Some of Richardson's localities—Jicaro, Muy Muy, Quilalí, Telpaneca, and Tuma, for example—are established towns and appear on modern road maps. Others, such as Uluse (12°53'N, 85°37'W), can be found on maps of smaller scale with greater detail. Fortunately, Allen recorded dates of collection for most mammals, making it possible in some cases to trace Richardson's movements with respect to known places. Some of his locality names do not appear on modern maps, however, and several of these are discussed below.

*Chontales*.—Allen (1908:647) erroneously located "Chontales" as in "lowlands east of Lake Nicaragua, altitude about 500 to 1000 feet." Later, however, he (1910:87-88) corrected the location of this site by listing it as on the "east slope of the highlands" and indicated that it actually was at an altitude of 1000 to 1500 feet and in the general vicinity of other localities in Matagalpa at which Richardson collected. He (p. 87) specifically corrected the earlier designation by noting that Richardson made no collections in "the lowlands, including the borders of Lakes Managua and Nicaragua and the southern and coast regions below 500 feet."

We have been unable to locate any specific place bearing the name "Chontales" on maps available to us. The modern department by that name probably is too far south to have been visited by Richardson. However, the present-day department of Boaco, which borders Matagalpa on the south, was part of Chontales in the early part of this century. Richardson collected at Chontales in February 1908; all of his other collecting localities in the winter and spring of that year were in north-central Nicaragua. Thus we think it likely that his locality "Chontales" was within the border of the old department by that name, just to the south of places in Matagalpa such as Uluse, Río Grande, and Muy Muy, where he is known to have collected mammals. This would place it in the general vicinity of the village of Tierra Azul, approximately 30 km. NNE Boaco and at the approximate coordinates 12°41'N, 85°30'W.

*Peña Blanca*.—Allen (1910:88) recorded Peña Blanca as “a high point in the low Atlantic coast forests, having an elevation of 1500 feet.” We have located several places with this name in eastern Matagalpa, and, of course, there is the prominent mountain by the same name in southern Jinotega, just north of several localities known to have been visited by Richardson. Thus, we are content to assume that he collected on the lower slope of the latter ( $13^{\circ}15'N$ ,  $85^{\circ}41'W$ ); the summit is much higher (about 1700 meters) than the altitude listed by Allen.

*Río Coco*.—Allen (1910:88) simply noted that this locality was on the eastern (Caribbean) slope of the northern Nicaraguan highlands, listing it as “Río Coco, 800 feet.” Buchanan and Howell (1965:558) reported that Río Coco is (or was) “a small village near the headwaters of the Río Coco near the town of Quilali . . . . The locality is near the western limit of the Caribbean slope habitat and is at a fairly high elevation.” These authors estimated the location of Río Coco as about 10 km. SE Quilalí. While we have no information that clearly refutes the location of Río Coco as suggested by Buchanan and Howell, we think it more likely that the village still known in full as San Juan de Río Coco represents Richardson’s old collecting locality. San Juan de Río Coco is in the Departamento de Madriz and lies on the old trail between San Juan Telpaneca and Quilalí, both of which were localities at which Richardson obtained mammals. While our location lies only about 15 kilometers west of the one plotted by Buchanan and Howell, it places Río Coco in Madriz rather than in Nuevo Segovia or Jinotega.

*Río Grande*.—Allen (1908:647) noted that this locality was “south of Tuma, and at a somewhat lower altitude.” Later (1910:88), he recorded the elevation as 700 feet. This collecting site evidently was on the Río Grande [de Matagalpa] near the mouth of the Río Upa, approximately equidistant between two of Richardson’s other stations—Muy Muy and Uluse. Río Grande has been placed erroneously in Zelaya by some recent authors.

*Río Tuma*.—This place was reported by Allen (1910:88) to be at an elevation of 500 feet, at a “rubber hunter’s camp” presumably along the river presently bearing the same name. Taking elevation into account, we regard this locality as near the present village of Sardinal, Matagalpa ( $13^{\circ}03'N$ ,  $85^{\circ}35'W$ ).

*Savala* (also recorded as Lavala).—According to Buchanan and Howell (1965:549) this place is approximately 45 km. ENE Matagalpa, at an approximate altitude of 260 m. We have not found Savala on maps available to us.

*Vijagua* (also *Bijagua*).—Buchanan and Howell (1965:550), after carefully tracing Richardson's movements in 1909, thought it "probable that *Vijagua* was the name of a small village or hacienda near the Río Tuma, about 35 km. north-east of the town of Matagalpa." We concur with Buchanan and Howell as to the approximate location of *Vijagua* and, in fact, have found two small settlements by that name on old maps that are eight and 10 kilometers south of Peña Blanca (Jinotega), just within the border of Matagalpa and near Guasaca (13°07'N, 85°41'W).

#### *Localities in Zelaya*

Charles W. Richmond collected birds and some mammals for the U. S. National Museum of Natural History in eastern Nicaragua from February 1892 to January 1893. In the early months, he worked at Greytown (San Juan del Norte) and on the Río Frio, "which flows into the [Río] San Juan opposite San Carlos" (Richmond, 1893:480). From May 1892 until he left Nicaragua, however, Richmond worked along the Río Escondido, based at the International Planting Company's plantation (frequently simply "I. P." on maps) "50 miles from Bluefields." Using a curvimeter to plot mileage along the winding course of the Escondido, we calculated the following placement of localities from which rice rats and other mammals have been reported:

*Fifty miles above Bluefields*.—Location of International Planting Company's plantation and approximately 3 km. S, 13 km. E Rama.

*Forty-five miles above Bluefields*.—Approximately 6.5 km. S, 18 km. E Rama.

*Forty miles above Bluefields*.—Approximately 6 km. S, 21 km. E Rama.

*Thirty-five miles above Bluefields*.—Approximately 9 km. N, 25 km. W Bluefields.

*Twenty-five miles above Bluefields*.—Approximately 11 km. N, 18 km. W Bluefields, near the mouth of the Río Cama.

*Sixteen miles above Bluefields*.—Approximately 16 km. N, 7 km. W Bluefields.

The holotype of *Oryzomys dimidiatus* was obtained by W. G. Palmer on 5 November 1904 along the "Escondido River, 7 miles below Rama," which would place the type locality approximately 1 km. S, 8.5 km. E Rama at an elevation of about 20 meters.

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POST-PLEISTOCENE MAMMALS OF THE  
APACHE MOUNTAINS, CULBERSON COUNTY, TEXAS,  
WITH COMMENTS ON ZOOGEOGRAPHY OF THE  
TRANS-PECOS FRONT RANGE

WALTER W. DALQUEST AND FREDERICK B. STANGL, JR.

In 1979, Mr. J. M. Fowlkes of Pecos, Texas, showed us a sinkhole-type cave (since named Fowlkes Cave) on his ranch in the Apache Mountains north of the small town of Kent, Texas. Subsequent excavation in the cave yielded a large collection of vertebrate remains from the stratified cave deposits of the lowest chamber, dating from late Pleistocene to modern times. The deeper, yellow calcareous sediments contained remains of some extinct mammals, fossils of extant mammalian species that no longer occur in Texas, as well as species that still occur in the vicinity of the Apache Mountains. The black silts above the yellow calcareous sediments contained abundant remains of the modern mammalian fauna of the region. In order to interpret the chronological succession of mammalian species from Fowlkes Cave, it was necessary to make a comprehensive survey of the modern fauna of the Apache Mountains, because the living mammals of the area had not been studied in detail.

Bailey's (1905) faunal survey of Texas included the Apache Mountains area, but concentrated on the Guadalupe Mountains to the northwest, and the Davis Mountains to the southeast. Later workers likewise collected more intensively in the Davis and Guadalupe mountains (for example, Blair, 1940; Cornely *et al.*, 1979; and Genoways *et al.*, 1979), although Davis and Robertson (1944) did trap mammals for one week just north of Kent (at the

