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BATS OF THE GENUS *PLECOTUS* IN MEXICO: DISCRIMINATION AND DISTRIBUTION

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Three taxa of the genus *Plecotus* occur in México. Allen (1916) described *Plecotus mexicanus*, a species endemic to that country, and Handley (1955) described *Plecotus townsendii australis*, an endemic subspecies that intergrades with *P. t. pallescens* (Miller, 1897) in northern Coahuila. Since Handley's (1959) revision of the North American Plecotini, essentially all published information on big-eared bats from México has dealt with their distribution. Many range extensions have been published for various Mexican states, yet several important records represented in museums have not been reported in the literature. Further, some published records are based on misidentified specimens. The purposes of this paper are: 1) to provide additional morphological information useful in identification of these bats; 2) to consolidate information on distribution and co-occurrence of *Plecotus* taxa in México; 3) to correct some misidentifications in the literature; and 4) to document new records that expand considerably our understanding of the distribution of Mexican *Plecotus*.

MATERIALS AND METHODS

Morphology

I borrowed 235 museum specimens of *Plecotus* collected in México and identified them on the basis of hair color, size, and occurrence of an accessory cusp on the first incisor (Allen, 1916; Handley, 1959). Eighteen skull characters (Fig. 1) were measured with a Lasico digitizer and recorded to the nearest 0.1 mm. Cranial measurements were total length (TL), zygomatic breadth (ZB), cranial breadth (CB), mastoid breadth (MB), postorbital constriction (POC), length of

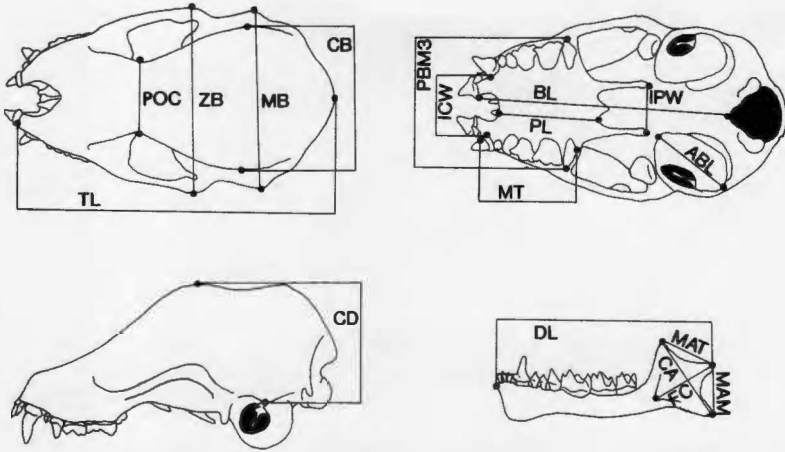


FIG. 1.—Skull variables used in the analysis of taxa of *Plecotus* from México. Refer to text for explanation of characters.

maxillary tooththrow (MT), palatal length (PL), basicranial length (BL), length of auditory bulla (ABL), intercanine width (ICW), palatal breadth across third molars (PBM3), interpterygoid width (IPW), cranial depth (CD), length of dentary (DL), moment arm of temporal (MAT), moment arm of masseter (MAM), coronoid to angle distance (CA), and mandibular fossa to condyle distance (FC). Nine measurements were taken with dial calipers from museum skins and recorded to the nearest 0.1 mm. External measurements (Fig. 2) were forearm length (FA), tibia length (TIB), length of third metacarpal (M3), length of first phalanx off third metacarpal (M3P1), length of second phalanx off third metacarpal (M3P2), length of fourth metacarpal (M4), length of first phalanx off fourth metacarpal (M4P1), length of fifth metacarpal (M5), and length of first phalanx off fifth metacarpal (M5P1). Data were collected only from adults, that is, specimens having fused epiphyses in wing bones. Damaged specimens that could not be measured for all characters were excluded from multivariate analyses. Sex was recorded from specimen labels. A list of museums in which specimens are housed is given in the acknowledgments.

I performed a two-way analysis of variance (ANOVA) on each character, stratified by taxon and sex. The two-way analysis was selected because sexual dimorphism is known to occur in this genus (Handley, 1959). I treated sexes separately and used pairwise comparisons—protected least significant difference (LSD) tests, Sokal and Rohlf (1981:244)—to identify variables that would help distinguish the three taxa.

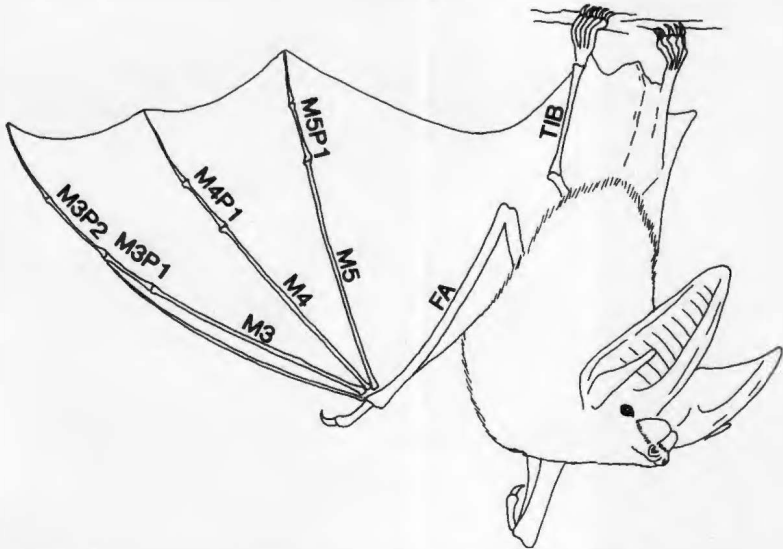


FIG. 2.—Skin variables used in the analysis of taxa of *Plecotus* from México. Refer to text for explanation of characters.

Discriminant function analysis was used to provide objective identifications of specimens examined. Because sexual dimorphism could reduce the power of discrimination of taxa, the “zwitzer” approach of Schnell *et al.* (1985) was used to reduce the effect of sex. Correction terms used to factor out the effect of sex on cranial and external measurements were based on differences between sexes assessed within taxa. One-half the difference between means for each character was added to the smaller sex (males) and subtracted from the larger sex (females). A two-way analysis of variance for taxon and sex completed after application of correction terms indicated that this procedure had removed sex effects from all variables ($P > 0.62$), whereas leaving differences between taxa unaffected.

Sex-adjusted data were transformed to \log_{10} values and principal components (PC) were extracted from the variance-covariance matrices of cranial and external characters. Skulls and skins were treated separately in the multivariate analyses to allow evaluation of specimens represented only by a skull or skin, and because the two data sets may not provide equal levels of discrimination. Because the assumption of equal covariance matrices was violated, within-group covariance matrices were used in the discriminant function analyses.

Distribution

Identification of all specimens was checked in discriminant function analyses, and all records were plotted on a map of México. Misidentified specimens and those not reported previously were noted, and collections containing both *P. mexicanus* and *P. townsendii* were identified.

RESULTS AND DISCUSSION

Fifteen of the 18 cranial characters were sexually dimorphic ($P < 0.01$); the exceptions were cranial breadth, cranial depth, and postorbital constriction. All external variables were sexually dimorphic ($P < 0.004$). The contribution of sex to the model variance was generally an order of magnitude less than the contribution of taxon.

Means for all skull variables except cranial depth were significantly different (ANOVA, $P < 0.05$) across taxa for females, and all variables except cranial depth and moment arm of masseter were different for males. *Plecotus mexicanus* was smallest for most skull measurements and most closely approached *Plecotus townsendii pallescens* in size; *P. t. australis* was overall the largest (Table 1). *Plecotus mexicanus* and *P. t. australis* are partially sympatric, but size alone was generally sufficient to distinguish individuals. Handley (1959:137) used length of skull and length of maxillary tooththrow (more than 15.7 and more than 4.9 mm, respectively, for *P. townsendii*) in his key to distinguish the species, and noted (p. 143) that *P. mexicanus* has a smaller auditory bulla and shorter rostrum, although no measurements were provided. These characters are particularly good for univariate discrimination: in regions of sympatry, specimens with bullar lengths of less than 4.0 mm and palatal lengths less than 5.2 mm usually represented *P. mexicanus*, whereas those with larger measurements represented *P. townsendii*. I stress sympatry because *P. t. pallescens* is smaller than *P. t. australis* and not as easily distinguished from *P. mexicanus* by measurements alone. However, sympatry of *P. mexicanus* and *P. t. pallescens* is not known to occur except in northern Chihuahua (Anderson, 1972).

All external variables were significantly different across taxa for both sexes ($P < 0.0001$). In contrast to skull data, skins of *P. t. pallescens* typically were smallest, whereas those of *P. mexicanus* were of intermediate size (Table 1). The first phalanx off the fifth metacarpal provided the only major contrast (*P. mexicanus* was smallest).

The effect of sexual dimorphism was factored out using correction terms calculated for each taxon (Table 2), producing a "sexless" data set. Principal components analysis indicated structure in those data for both skulls and skins (Fig. 3), and subsequent multivariate analysis of

variance (MANOVA) demonstrated that all taxa were different ($P < 0.0001$). The first three principal component axes for skulls accounted for 54.7 percent, 10.0 percent, and 7.7 percent of the total sample variance, respectively. The PC I axis is interpreted to represent size because all character loadings were positive and small to moderate in magnitude (Table 2). Clusters corresponding with each of the three taxa are evident on Figure 3, although some overlap exists, especially between the subspecies of *P. townsendii*. Overlap of *P. t. pallescens* with *P. mexicanus* is due to similarity in overall body size.

Palatal length, intercanine width, coronoid-angle distance, and especially moment arm of masseter distance contributed most to PC II. The contrast between the first two characters probably indicates a differently shaped rostrum, whereas the latter two reflect a longer angular process on the dentary. PC II helps distinguish *P. mexicanus* from *P. townsendii*, due primarily to differences in the masticatory apparatus.

The first three principal components for skins accounted for 64.9 percent, 17.2 percent, and 4.7 percent, respectively, of the total sample variance. Three clusters were again apparent, but overlap was greater than in the analysis of skulls. PC I reflects size, with *P. mexicanus* being intermediate (Fig. 3). Character loadings for PC II suggest a contrast between metacarpals and first phalanxes, with greater emphasis on the first phalanx of the fifth digit. PC II separates *P. mexicanus* from both subspecies of *P. townsendii*.

Discriminant analysis assigned 98.1 percent of 216 skulls and 84.5 percent of 219 skins into taxa to which they were initially allocated on the basis of hair color and morphological characters (Allen, 1916; Handley, 1959). No skulls identified *a priori* as *P. t. australis* were misclassified, but three specimens treated as *P. t. pallescens* were grouped with *P. t. australis*. All of the misclassified specimens were from Sonora, and inspection of the posterior probabilities of group membership indicated that, for each subspecies, specimens with greater than 10 percent probability of belonging to the alternative subspecies typically were from northern México. Handley (1959:188) suggested that *P. t. australis* and *P. t. pallescens* exhibited a zone of intergradation in northern Coahuila and western Texas. Thus, specimens from these areas may be intermediate between the larger *P. t. australis* and the smaller *P. t. pallescens*. In my analyses, both skulls and skins from eastern México clustered with *P. t. australis*, although variation was greater for skins. Specimens of *P. t. pallescens* from Baja California were not available at the time of Handley's study. Skulls I examined were smaller than those of specimens referable to *P. t. pallescens* from northern Sonora and Chihuahua.

TABLE 1.—Means and standard deviations (in parentheses) by sex for cranial and external measurements of *Plecotus mexicanus* (PMX), *Plecotus townsendii australis* (PTA), and *P. t. pallescens* (PTP) from México. Means with different letters (A, B, or C) are significantly different (LSD, $P < 0.05$). Comparative measurements for *P. t. pallescens* from Arizona and New Mexico, also are given. See text for explanation of character abbreviations.

FEMALES				
Skulls				
	PMX (N = 40)	PTA (N = 50)	PTP (N = 36) (México)	PTP (N = 70) (United States)
TL	15.13(0.22)A	16.09(0.21)B	15.46(0.28)C	15.85(0.28)
ZB	8.29(0.15)A	8.92(0.19)B	8.51(0.20)C	8.83(0.22)
CB	7.53(0.15)A	7.73(0.15)B	7.48(0.17)A	7.65(0.16)
MB	8.84(0.16)A	9.26(0.18)B	8.88(0.18)A	9.17(0.17)
POC	3.39(0.11)A	3.62(0.12)B	3.45(0.10)C	3.57(0.10)
MT	4.75(0.10)A	5.10(0.13)B	5.02(0.12)C	5.06(0.13)
PL	5.02(0.13)A	5.50(0.15)B	5.35(0.18)C	5.42(0.23)
BL	11.99(0.22)A	12.90(0.22)B	12.54(0.23)C	12.76(0.30)
ABL	3.78(0.07)A	4.14(0.10)B	3.99(0.09)C	4.11(0.09)
ICW	2.21(0.09)A	2.25(0.10)B	2.16(0.07)C	2.25(0.09)
PBM3	5.70(0.12)A	5.90(0.16)B	5.68(0.11)A	5.87(0.14)
IPW	2.32(0.06)A	2.42(0.11)B	2.34(0.10)A	2.43(0.12)
CD	5.78(0.14)A	5.78(0.22)A	5.73(0.15)A	5.72(0.23)
DL	9.44(0.22)A	10.05(0.29)B	9.68(0.21)C	9.90(0.28)
MAT	2.55(0.09)A	2.82(0.11)B	2.66(0.11)C	2.78(0.13)
MAM	2.36(0.10)A	2.29(0.10)B	2.24(0.12)C	2.31(0.11)
CA	3.80(0.17)A	4.07(0.15)B	3.89(0.13)C	4.05(0.13)
FC	3.03(0.13)A	3.30(0.17)B	3.16(0.11)C	3.27(0.14)
Skins				
	N = 40	N = 54	N = 38	N = 66
FA	41.53(1.20)A	42.81(0.99)B	40.24(1.08)C	42.20(1.27)
TIB	19.00(0.84)A	19.05(0.59)A	18.01(0.66)B	18.72(0.68)
M3	37.86(1.30)A	38.30(0.99)A	35.03(1.21)B	37.24(1.02)
M3P1	12.45(0.67)A	13.20(0.42)B	12.24(0.63)A	13.05(0.57)
M3P2	17.57(0.79)A	18.28(0.61)B	16.79(0.61)C	17.87(0.72)
M4	36.87(1.28)A	37.35(1.07)A	34.44(1.30)B	36.57(1.05)
M4P1	9.97(0.38)A	10.44(0.46)B	9.55(0.54)C	10.27(0.43)
M5	38.20(1.32)A	38.86(1.03)B	35.94(1.27)C	38.04(1.10)
M5P1	8.80(0.38)A	9.66(0.43)B	9.12(0.46)C	9.65(0.40)

TABLE 1.—Continued.

MALES				
<i>Skulls</i>				
	PMX (<i>N</i> = 34)	PTA (<i>N</i> = 36)	PTP (<i>N</i> = 23) (México)	PTP (<i>N</i> = 43) (United States)
TL	15.07(0.26)A	15.84(0.26)B	15.23(0.31)C	15.73(0.31)
ZB	8.18(0.18)A	8.77(0.18)B	8.40(0.28)C	8.73(0.24)
CB	7.48(0.15)A	7.65(0.18)B	7.55(0.18)A	7.62(0.16)
MB	8.72(0.17)A	9.10(0.15)B	8.80(0.23)A	9.05(0.19)
POC	3.38(0.13)A	3.59(0.09)B	3.42(0.18)A	3.54(0.12)
MT	4.71(0.11)A	5.08(0.11)B	4.95(0.11)C	5.01(0.12)
PL	4.95(0.14)A	5.46(0.10)B	5.32(0.12)C	5.36(0.12)
BL	11.85(0.22)A	12.77(0.19)B	12.34(0.29)C	12.66(0.21)
ABL	3.75(0.10)A	4.11(0.09)B	3.94(0.12)C	4.10(0.09)
ICW	2.15(0.09)A	2.21(0.12)B	2.08(0.09)C	2.18(0.10)
PBM3	5.57(0.13)A	5.82(0.16)B	5.58(0.15)A	5.76(0.13)
IPW	2.25(0.09)A	2.36(0.14)B	2.25(0.12)A	2.36(0.13)
CD	5.78(0.18)A	5.72(0.15)A	5.70(0.18)A	5.69(0.17)
DL	9.22(0.25)A	9.87(0.21)B	9.53(0.22)C	9.79(0.27)
MAT	2.53(0.10)A	2.72(0.10)B	2.59(0.11)C	2.69(0.11)
MAM	2.27(0.14)A	2.25(0.10)A	2.20(0.11)A	2.26(0.13)
CA	3.71(0.13)A	3.96(0.15)B	3.77(0.15)A	3.93(0.14)
FC	2.99(0.15)A	3.19(0.15)B	3.05(0.13)A	3.17(0.13)
<i>Skins</i>				
	<i>N</i> = 34	<i>N</i> = 37	<i>N</i> = 18	<i>N</i> = 42
FA	40.19(0.99)A	41.62(0.88)B	39.13(1.13)C	41.16(1.01)
TIB	18.73(0.60)A	18.70(0.60)A	17.92(0.56)B	18.60(0.59)
M3	36.68(1.02)A	37.07(0.89)A	33.85(1.46)B	35.96(3.27)
M3P1	12.06(0.48)A	12.85(0.49)B	12.10(0.54)A	12.79(0.43)
M3P2	16.95(0.69)A	17.66(0.53)B	16.73(0.67)A	17.50(0.67)
M4	35.74(1.065)A	36.19(0.91)A	33.21(1.48)B	35.80(0.96)
M4P1	9.61(0.43)A	10.08(0.47)B	9.49(0.33)A	10.00(0.39)
M5	37.19(1.18)A	37.58(0.91)A	34.82(1.21)B	37.13(1.05)
M5P1	8.59(0.32)A	9.42(0.42)B	9.16(0.36)C	9.33(0.40)

I reevaluated taxonomic affinity of specimens of *P. townsendii* from northern Sonora, Chihuahua, Coahuila, and northern Durango. Skulls of *P. t. pallescens* from southern Arizona and New Mexico (*N* = 114) and of *P. t. australis* from southern México (Zacatecas and south, *N* =

TABLE 2.—Correction factors for removal of sex effects, and loadings of morphological variables on the first three principal components (PCs) in the analysis of *Plecotus taxa* from México.

	Correction Factor			Principal Component		
	PMX	PTA	PTP	I	II	III
	<i>Skulls</i>					
TL	0.026	0.125	0.115	0.199	-0.064	-0.012
ZB	0.053	0.075	0.055	0.259	-0.023	0.034
CB	0.025	0.040	-0.035	0.114	0.050	0.085
MB	0.065	0.080	0.040	0.186	0.036	0.074
POC	0.005	0.015	0.015	0.255	0.016	0.135
MT	0.020	0.010	0.035	0.254	-0.161	-0.070
PL	0.035	0.020	0.015	0.318	-0.244	-0.159
BL	0.070	0.065	0.100	0.248	-0.147	-0.063
ABL	0.015	0.015	0.025	0.310	-0.141	-0.063
ICW	0.030	0.020	0.040	0.179	0.301	0.549
PBM3	0.065	0.040	0.045	0.162	0.068	0.159
IPW	0.035	0.030	0.045	0.213	0.150	0.547
CD	0.000	0.030	0.015	0.037	0.158	0.131
DL	0.110	0.090	0.075	0.245	-0.055	-0.039
MAT	0.010	0.050	0.045	0.332	0.005	-0.287
MAM	0.045	0.020	0.020	0.012	0.804	-0.349
CA	0.045	0.055	0.060	0.282	0.256	-0.279
FC	0.020	0.055	0.055	0.322	0.086	-0.057
	<i>Skins</i>					
FA	0.670	0.595	0.555	0.266	0.076	0.067
TIB	0.135	0.175	0.045	0.222	0.257	0.279
M3	0.590	0.615	0.590	0.358	0.357	-0.114
M3P1	0.195	0.175	0.070	0.368	-0.315	-0.660
M3P2	0.310	0.310	0.030	0.325	0.070	0.520
M4	0.565	0.580	0.615	0.356	0.318	-0.065
M4P1	0.180	0.180	0.030	0.403	-0.233	-0.150
M5	0.505	0.640	0.560	0.332	0.287	-0.058
M5P1	0.105	0.120	-0.020	0.335	-0.677	0.410

61) were used as reference specimens. Discriminant function correctly identified 90.1 percent of the 171 reference skulls—82.0 percent of the *P. t. australis* and 94.6 percent of the *P. t. pallescens*. A similar analysis of skins (108 *P. t. pallescens*, 68 *P. t. australis*) resulted in correct

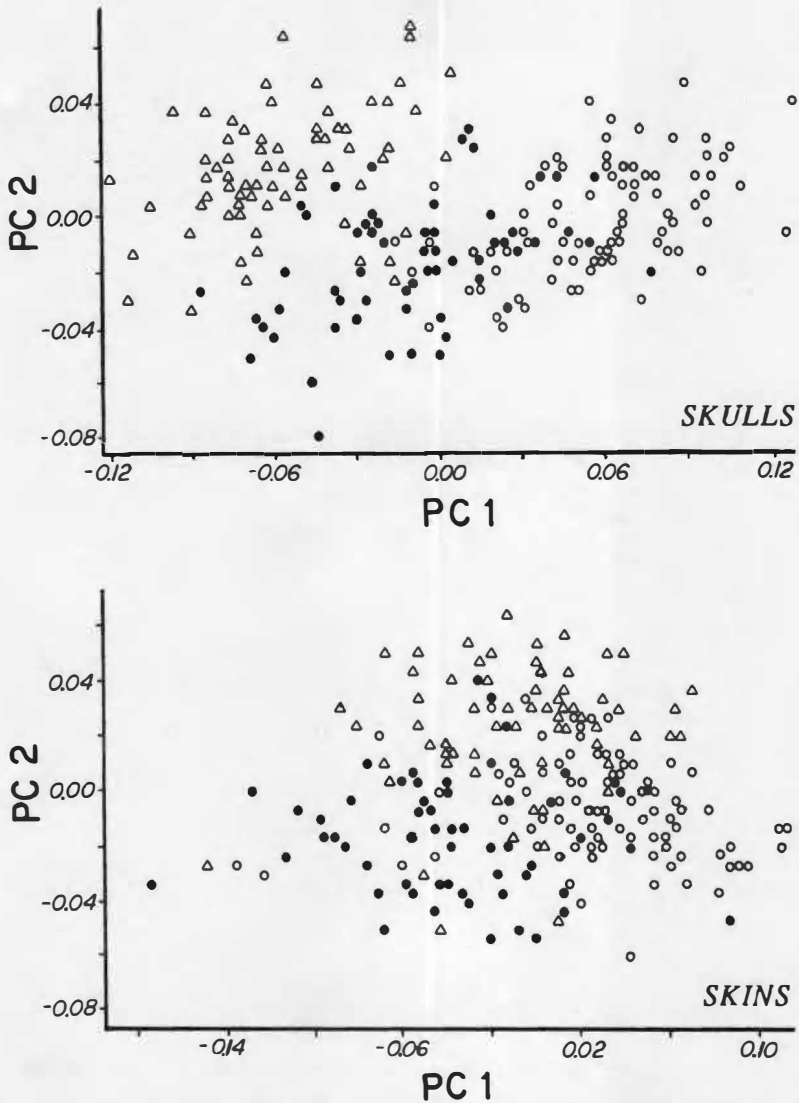


FIG. 3.—Principal components analysis of skulls (upper) and skins (lower) of specimens of *Plecotus* from México. Open circles, *P. t. australis*; closed circles, *P. t. pallescens*; triangles, *P. mexicanus*.

identification of 72.7 percent of the reference skins (97.1 percent of the *P. t. australis* but only 57.4 percent of *P. t. pallescens*). Thus, skulls of *P. t. pallescens* but skins of *P. t. australis* are most likely to be accurately identified. Analysis of skins and skulls from Sonora, Chihuahua, Coahuila, and Durango indicated that specimens from

northern Sonora and Chihuahua were typical *P. t. pallescens*, whereas specimens from southern Chihuahua, northern Durango, and central Coahuila often had skins that more closely resembled *P. t. australis* and skulls more like those of *P. t. pallescens*. The zone of intergradation through northern Coahuila and western Texas indicated by Handley (1959:188) apparently extends westward to include southern Chihuahua and northern Durango.

Plecotus mexicanus occurs primarily in higher, relatively humid mountain areas between 4800 and 10,500 feet (usually above 6000 feet), whereas *P. t. australis* occurs in the arid interior mountain ranges between 1800 and 9500 feet (but most collections have been between 4000 and 7000 feet) in central and northern México (Handley, 1959:141,185). Still, some sampling locations provided specimens of both species. Burt (1938) treated a series of nine specimens from Saric (Sonora) as *P. t. pallescens*. One of these specimens "agrees in both skin and skull characters with Allen's description of *mexicanus*," prompting Handley (1959:148) to suggest that both species might have been present. Handley (1959) also noted both species in samples from Sonora (El Tigre Mountains, p. 148), Guanajuato (Santa Rosa, pp. 151, 189), and Zacatecas (Sierra del Valparaíso, pp. 151, 189). Further, Wilson *et al.* (1985) documented both species from Coahuila (Sierra del Carmen), as did Matson and Patten (1975) and Matson and Baker (1986) from Zacatecas (3 mi. N Ciudad Cuauhtémoc, 8 mi. NW Nochistlán). Jones and Webster (1976) reported *P. townsendii* from Zacatecas (Laguna Valderrama), but my analysis indicated that both species were present in their sample. The range in elevation of collection sites producing both species is 6600 to 9500 feet (2010 to 2900 meters).

SPECIES ACCOUNTS

Plecotus mexicanus (G. M. Allen, 1916)

Specimens referable to *P. mexicanus* previously were reported from Chihuahua (Knobloch, 1942; Anderson, 1972), Coahuila (Wilson *et al.*, 1985), Jalisco (Watkins *et al.*, 1972), México (Davis, 1944), Michoacán (Miller, 1897; Hall and Villa-R., 1949), Puebla (Koopman, 1974), Isla Cozumél, Quintana Roo (Koopman, 1974), Queretaro (Baumgardner *et al.*, 1977), San Luis Potosí (Wilson *et al.*, 1985), Sonora (Burt, 1938), Veracruz (Ward, 1904; Hall and Dalquest, 1963), Yucatán (Koopman, 1974), and Zacatecas (Matson and Patten, 1975; Matson and Baker, 1986). Handley (1959) listed specimens from Chihuahua, Guanajuato, México, Michoacán, Morelos, Nuevo León, Puebla, Sonora, Veracruz, and Zacatecas, and Villa-R. (1967) added

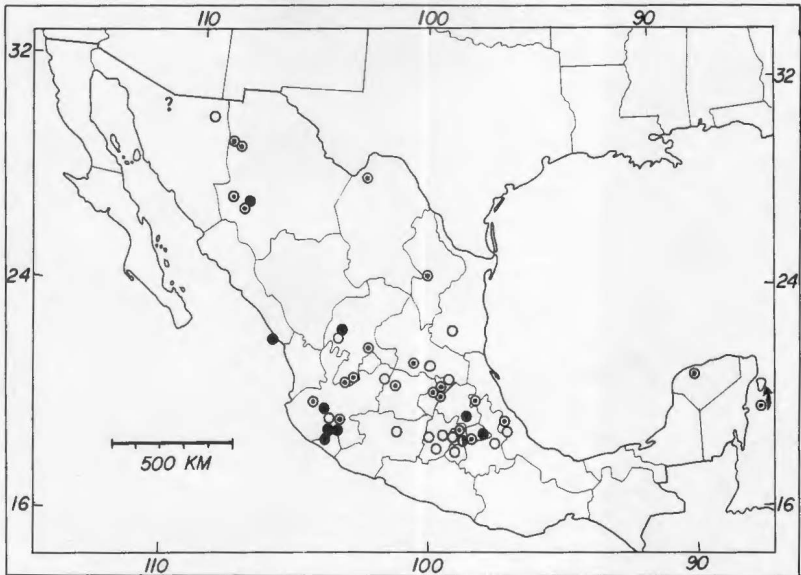


FIG. 4.—Distribution of *Plecotus mexicanus*. Filled circles, new records; open circles, literature records; circled dots, previously published records examined during this study, and half-filled circles, previously unpublished museum records not examined. Some symbols are slightly offset to avoid undue crowding.

material from Distrito Federal, México, and Morelos. Additional records are herein reported (see specimens examined) for Chihuahua, Jalisco, Queretaro, and Zacatecas (Fig. 4). The new Zacatecan record was published by Jones and Webster (1976) as *P. townsendii*, but I found specimens representing both species in their sample. In addition, I report here the first state records for Colima, Hidalgo, Sinaloa, and Tlaxcala. The Colima records extend the range slightly from western Jalisco (Watkins *et al.*, 1972), and those from Sinaloa represent an even greater range extension westward from Zacatecas. The location of, 2 mi. NW Palmito, is on an island and represents not only a significant extension of range but also a significant extension of habitat into lower elevations and coastal zones. Handley (1959) noted distribution toward the interior mountain ranges and a lower elevational limit of 4800 feet. Supplemental field data do not exist (Y. Petryszyn, personal correspondence) to further evaluate these records.

Specimens examined.—Total 77 (* indicates previously unpublished records). CHIHUAHUA: Barranca del Cobre, 23 mi. S, 1.5 mi. E Creel, 2 (KU); near Pacheco (Sierra de Breña, 8000 ft.), 2 (USNM); Sisoguichic, 8500 ft., 1 (OU)*; Mojarachic (=Mafuarachic), 1 (USNM). COAHUILA: Sierra del Carmen, 1 mi. N of summit, 1 (USNM). COLIMA: Cerro Grande, 7800 ft., 16 (LACM)*; 10 mi. NW Comala, 6800 ft., 1 (LACM)*. GUANAJUATO: Santa Rosa, 9500 ft., 1 (USNM). HIDALGO: 12 mi. W Tulancingo, 8850 ft., 5

(KU)*. JALISCO: Volcán de Colima, N slope Cerro Nevado, 8500 ft., 3 (LACM)*; Cueva del Aquacate, 4 km. E Soyatlán del Oro, 3 (UA)*; N slope Nevado de Colima (Volcán de Nieve), 8000 ft., 2 (UA)*; 15 mi. S, 9 mi. E Talpa de Allende, 6900 ft., 1 (KU); 7 mi. S Tapalpa, 6800 ft., 1 (KU). MEXICO: Monte Río Frío, 55 km. ESE Mexico City, 10,500 ft., 1 (TCWC). NÚEVO LEÓN: 33 km. SE Monterrey, 2 (MCZ). PUEBLA: between Mexico City and Puebla, E side Continental Divide, 10,300 ft., 3 (AMNH). QUERETARO: Piñal de Amoles, 1 (TCWC); 20 km. NW (by road) San Joaquín, 3 (TCWC); Rancho Agua Frío, 9.5 mi. W Maconi, 5 (TCWC)*. SAN LUIS POTOSÍ: 14 mi. S San Francisco, Cueva de la Joya de Lapuente, 1 (USNM). SINALOA: ca. 2 mi. NW Palmito, 3 (UA)*. TLAXCALA: 5 km. E, 3 km. N Tlaxcala, 2300 m., 1 (TTU)*. VERACRUZ: 4 km. E Las Vigas, 8500 ft., 6 (KU); 6 km. WSW Zacualpilla, 6500 ft., 1 (KU). YUCATÁN: 8 km. from Tixpehual on Hwy. to Tixkokob, 1 (AMNH). ZACATECAS: 3 mi. N Ciudad Cuauhtémoc, 6600 ft., 4 (LACM); 8 mi. NW Nochistlán, 6600 ft., 1 (LACM); 10 mi. NW Yahualica (Jalisco), 7100 ft., 1 (LACM); 40 mi. W Fresnillo, Laguna Valderrama, 2 (CAS)*.

Additional records.—CHIHUAHUA: 3 mi. S, 10 mi. E Pacheco (Anderson, 1972). DISTRITO FEDERAL (Villa-R., 1967): Cañada de San Bernabé, Contreras, 2280 m.; Facultad de Ciencias, Ciudad Universitaria, 2260 m. JALISCO (Watkins *et al.*, 1972): 4.5 mi. NE Comanja de Corona, 8000 ft.; 12 mi. S Toliman, 7700 ft. MEXICO (Villa-R., 1967): Criadero de Fauna Cinegética, San Cayetano; Cueva en el Paso Oyamecalco, 25 km. N Cuatepec Harinas; Barranca de los Idolos, 35 km. W México, D.F.; an unpublished record (TCWC) was obtained 5.5 mi. E Amecameca, on the road to Paso de Cortes. MICHOACÁN: 2 mi. N Pátzcuarco (Miller, 1897; Hall and Villa-R., 1949). MORELOS: no exact locality (Handley, 1959); Cueva del Murciélago, Cerro El Fraile, 6.5 km. NW Tres Cumbres, 3400 m. (Villa-R., 1967). PUEBLA: Hacienda de Miguel Sesma, 2 mi. NW Esperanza (Handley, 1959). QUERETARO: 3.8 km. W El Madrono, near El Lobo (Baumgardner *et al.*, 1977). QUINTANA ROO: Isla Cozumél; on geographic grounds, Koopman (1959) discredited a specimen collected by Gaumer (housed at KU and listed as collected on Isla Cozumél off the Yucatán Peninsula), but later he (Koopman, 1974) noted that a specimen from Yucatán supports the Cozumél record. SAN LUIS POTOSÍ: 12 km. W, 6.4 km. N Río Verde (Wilson *et al.*, 1985). SONORA: Santa María Mine, El Tigre Mountains (Handley, 1959); Saric (Burt, 1938; Handley 1959). TAMAULIPAS: Cueva Chica de la Perra, 8 mi. NW Gómez Farías, Sierra de Guatemala, 7000 ft. (Mollhagen, 1971). VERACRUZ: Jico, 5500 ft., (Handley, 1959). ZACATECAS: Sierra del Valparaíso, 13 mi. W Valparaíso, 8200 ft., (Handley, 1959; Matson and Baker, 1986).

Plecotus townsendii australis (Handley, 1955)

Specimens referable to *P. t. australis* previously were reported from Aguascalientes (Urbano-Vidales *et al.*, 1987), Chihuahua (Anderson, 1972), Coahuila (Baker, 1956; Easterla and Baccus, 1973; Wilson *et al.*, 1985), Durango (Baker and Greer, 1962; Gardner, 1965), Guerrero (Davis and Carter, 1962), Hidalgo (Davis, 1944; Hooper, 1955; Carter and Jones, 1978), Jalisco (Allen, 1890; Watkins *et al.*, 1972), Nuevo León (Wilson *et al.*, 1985), Oaxaca (Goodwin, 1969), Queretaro (Baumgardner *et al.*, 1977), San Luis Potosí (Dalquest, 1953; Wilson *et al.*, 1985), Tamaulipas (Alvarez and Ramírez-P., 1972; Baumgardner *et al.*, 1977; Schmidly and Hendricks, 1984), and Zacatecas (Jones and Webster, 1976; Matson and Patten, 1975; Matson and Baker, 1986). Handley (1955, 1959) listed specimens from Coahuila,

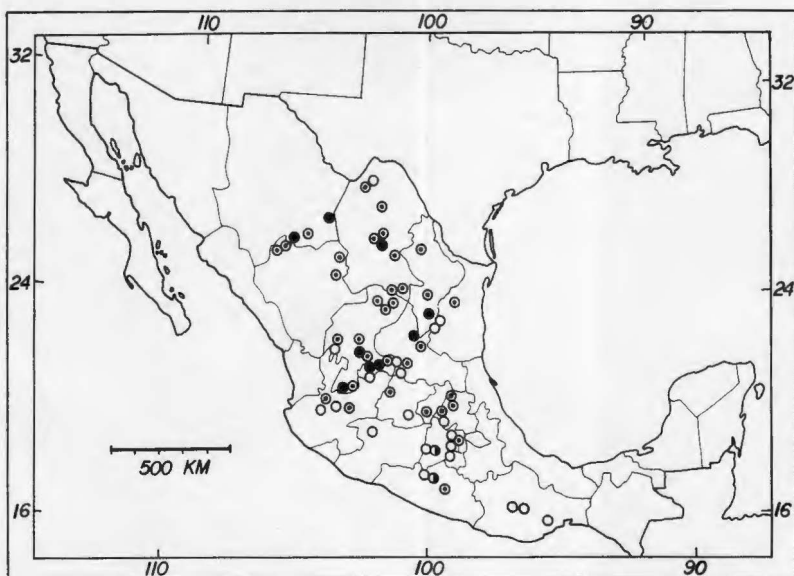


FIG. 5.—Distribution of *Plecotus townsendii australis*. Symbols are as in Figure 4.

Distrito Federal, Durango, Guanajuato, Hidalgo, Jalisco, México, Morelos, Oaxaca, San Luis Potosí, and Zacatecas, and Villa-R. (1967) added material from Distrito Federal, Guanajuato, Guerrero, Hidalgo, Jalisco, México, and Michoacán. Additional records are herein reported for Aguascalientes, Chihuahua, Coahuila, Nuevo León, San Luis Potosí, and Zacatecas (Fig. 5). The new Zacatecan records were reported by Matson and Baker (1986) as *P. mexicanus* based on three specimens housed in the Oklahoma Museum of Natural History. These specimens are referable to *P. t. australis* on the basis of size, absence of the accessory cusp on the first incisor, and discriminant analysis.

A specimen from near La Mariposa, Coahuila (KU 44759), was mentioned by Handley (1959) as a possible intergrade because it possessed many characteristics of *P. mexicanus*. Discriminant analysis assigned the skull of this specimen to *P. mexicanus* with a posterior probability of membership of 1.0000, but the skin was relegated to *P. townsendii* by the same analysis. The specimen was taken northwest of the nearest records of *P. mexicanus* from Nuevo León but lies intermediate in geographic position with a record from northern Coahuila (Wilson *et al.*, 1985). This record would lower the elevational limit from 4800 feet (Handley, 1959) to 2300 feet (700 meters) for *P. mexicanus*. I suggest that the skin is probably the correct specimen associated with the locality data, and that the skull does not belong with the skin.

Specimens examined.—Total 96 (* indicates previously unpublished records). AGUASCALIENTES: mine above San Pedro de Cobre, 0.2 mi. S, 12 mi. E Rincón de Romos, 1 (MVZ)*. CHIHUAHUA: 3 mi. E San Francisco del Oro, 6900 ft., 1 (TCWC)*; 14.3 mi. S Santa Elena, 1 (ROM)*; 1 mi. N, 1 mi. W Saltaices, 2 (KU). COAHUILA: 4 mi. W Hacienda La Mariposa, 2300 ft., 1 (KU); Cuatro Ciénegas, 2250 ft., 1 (TCWC); 8 mi. W Nadadores, 2100 ft., 1 (MSU)*; 1 mi. S, 4 mi. W Bella Unión, 7000 ft., 1 (KU); 0.5 mi. N Muralla, 4500 ft., 2 (KU); 9 mi. W, 4 mi. S San Buenaventura, 2000 ft., 2 (KU); Sierra Guadalupe, 10 mi. S, 5 mi. W General Cepeda, 7800 ft., 1 (KU); 1 mi. N, 2.5 mi. W El Cedrito, 2400 m., 1 (USNM); 1 mi. N Cuatro Ciénegas, 1 (USNM); Sierra del Carmen, 1 mi. N Summit, 1 (USNM). DURANGO: 7 mi. N Campaña, 3750 ft., 1 (MSU); San Juan, 12 mi. W Lerdo, 3800 ft., 2 (UMMZ); near Ojito, ca. 50 km. W on Vergel Road from Hidalgo de Parral, 7600 ft., 2 (LACM); ca. 72 km. W on Vergel Road from Hidalgo de Parral, 6100 ft., 5 (3 LACM, 2 UA). GUANAJUATO: Santa Rosa (9500 ft.), 1 (USNM); Charcas, 1 (USNM). GUERRERO: 1 mi. SSE Almolonga, ca. 5600 ft., 2 (TCWC). HIDALGO: Jacala, 1 (YPM); 3 km. W Jacala, 5500 ft., 1 (USNM); Río Tasquillo, 26 km. E Zimapán, 5200 ft., 1 (TCWC); Grutas Xoxaff, 11 km. SE Yoltepec, 1 (KU). JALISCO: San Andrés, 10 mi. W Magdalena, 4900 ft., 3 (UMMZ); San Pedro, Guadalajara, 1 (AMNH). MEXICO: Lago Texcoco, 7500 ft., 1 (USNM). NUEVO LEÓN: Grutas de García, 1 (MWSU)*; Mina del Taco, 3.5 mi. N Aramberri, 3900 ft., 3 (KU)*; 5 mi. W Sabinas Hidalgo, Cueva sin Nombre, 1 (USNM); 0.5 mi. W La Joya, Cerro Potosí, 1 (USNM). QUERETARO: Río Galindo, 1 (TCWC). SAN LUIS POTOSÍ: 21.5 km. N Huizache, 1 (TTU)*; Presa de Guadalupe (4000 ft.), 1 (LSUMZ); San Pedro, 1 (USNM). TAMAULIPAS: 2 mi. ESE San Carlos, San Carlos Mountains, 3 (TCWC). ZACATECAS: 6 km. W San Rafael, 2170 m., 1 (MSU); 12 mi. SE Concepción del Oro, 7450 ft., 3 (MSU); 16 km. SW Concepción del Oro, near La Laja, 2400 m., 1 (MSU); 10 mi. SW Concepción del Oro, 7600 ft., 15 (LACM); 9.7 mi. NW Cuauhtémoc, 7100 ft., 1 (OU)*; 3 mi. N Ciudad Cuauhtémoc, 6600 ft., 18 (LACM); 6 mi. NNW Pinos, 7900 ft., 1 (MSU); 8 mi. NW Nochistlán, 6600 ft., 1 (LACM); Laguna Valderrama, 40 mi. W Fresnillo, 7800 ft., 1 (CAS); Hacienda El Lobo, 10 km. ENE Loreto, 7350 ft., 1 (OU)*; 7 mi. E Moyahua, 5500 ft., 1 (OU)*.

Additional records.—AGUASCALIENTES: Cerro de los Gallos, 14 km. S, 6 km. E Aguascalientes (Urbano-Vidales *et al.*, 1987). COAHUILA: mina abandonada de flourita, Sierra del Carmen (Wilson *et al.*, 1985); Fronteriza Mountains, 28° 58' N, 102° 26' W, northwestern Coahuila (Easterla and Baccus, 1973). DISTRITO FEDERAL: Desierto de los Leones (Handley, 1959); Osario Común, Pantéon de Dolores, 2260 m. (Villa-R., 1967). GUANAJUATO: Apaseo, 1805 m. (Villa-R., 1967). GUERRERO: Cueva Tecabra, Aguacatitlán, 1400 m. (Villa-R., 1967); an unpublished record (USNM) was obtained 5 mi. E Omilteme, 6200 ft. HIDALGO: Barranca Punta Rosa, 1 km. from Escandon (Villa-R., 1967). JALISCO: El Salto, 24 mi. W Guadalajara, 4500 ft. (Watkins *et al.*, 1972); Cueva de las Garrochas, 17 km. NNW Soyatlán del Oro (Villa-R., 1967). MEXICO: Convento de Acolmán, 9 mi. N México, Distrito Federal (Handley, 1959); Cueva del Diablo, 1880 m., La Peña, Valle de Bravo (Villa-R., 1967); an unpublished record (USNM) was obtained 5 mi. S Raices, Nevado de Toluca. MICHOACAN: Cueva de la Arena, 5 km. SW Jacona (Villa-R., 1967). MORELOS: Cuernavaca, 4900 ft., (Handley, 1955, 1959). OAXACA (Goodwin, 1969): Tlacolula, Mitla; Tehuantepec, Tehuantepec; Oaxaca, Motne Albán, 3 mi. SW Oaxaca, 6500 ft. SAN LUIS POTOSÍ: Bledos, 6200 ft. (Dalquest, 1953; Handley, 1955, 1959); Hacienda La Parada, 6000 ft. (Miller, 1897; Handley, 1959). TAMAULIPAS (Alvarez and Ramirez-P., 1972): 7 km. S Marcela, 2400 m.; 5 km. S Miquihuana, 2150 m. ZACATECAS: Sierra de Valparaíso, 13 mi. W Valparaíso, 8200 ft. (Handley, 1955, 1959).

originating from Baja and the northern population from Arizona and New Mexico.

Specimens examined.—Total 62 (* indicates previously unpublished records). BAJA CALIFORNIA: 11 mi. N San Antonio de Mar, cave on sea coast, 1 (LACM)*; 14 mi. NNE Punta Prieta, Desengaño Mine, 16 (CAS); mine de San Juan, 18 km. NE San Gregorio, 4000 ft., 1 (UA)*; Mina La Republica, 31° 51'N, 116° 04'W, 4000 ft., 10 (MVZ)*; Valladares, 2700 ft., 4 (MVZ)*; Arroyo San Luis, 9 mi. W Calmallí, 800 ft., 2 (MVZ)*; El Carrizalito, 5 mi. N Santiago, 1400 ft., 2 (MVZ)*. CHIHUAHUA: 25 mi. SW Santa Elena, SE slope Santa Elena Mountains, 1 (USNM)*. SONORA: Isla Tiburón, Tecomaté, 10 (MSB)*; 5 mi. NW San Carlos, 1 (MSB)*; Bahía San Carlos, N of Guaymas, 4 (LACM)*; 0.5 mi. E cemetery at Alamos, 1 (MSB)*; 5 mi. W Alamos, Minas Nuevas, 1600 ft., 1 (UA); 0.25 mi. E Bacerac, 3268 ft., 1 (UA)*; Pilares, 1 (UMMZ); 5 mi. S Naco, 1 (CSULB)*; Sierra los Cenizas, 11 mi. SE Agua Prieta, 1 (USNM)*; 11 mi. E Imuris, Hwy. 2, 1 (MSB)*; El Tigre Mts., Santa María Mine, 3 (UMMZ).

Additional records.—BAJA CALIFORNIA: Isla San José (Sánchez-H., 1986); Isla Santa Catalina (Orr and Banks, 1964); Calmallí (Huey, 1963); 25 mi. N Punta Prieta (Huey, 1963); Las Cuevas, Santiago (Villa-R., 1967); Sierra de La Laguna (Woloszyn and Woloszyn, 1982). Unpublished records (MVZ) were collected at Los Gavilanes, 23 mi. N Laguna Hanson, Sierra Juárez, and at San Antonio mine, 10 mi. SE San José, near latitude 31° N. CHIHUAHUA: La Republica, 3900 ft. (Anderson, 1972); Tinaja de Ponce, 2600 ft., Sierra de Ponce, 12 mi. SW Santa Helena (Handley, 1959); Casas Grandes (Handley, 1959). SONORA: Saric (Burt, 1938).

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APPENDIX

Specimens examined of *P. t. pallescens* (N= 114) from southern Arizona and New Mexico, used for comparison with *P. townsendii* from northern México.

ARIZONA: *Cochise Co.*: Huachuca Mts., Ramsey Canyon, 1 (OSUFW); Huachuca Mts., Hunter Canyon, Short Mine, 2 (FMNH); Huachuca Mt. foothills, Anderson Mine, Canelo, 1 (JMM); Huachuca Mts., 0.8 mi. N Montezuma Pass, 1 (UA); Chiricahua Mts., 1.5 mi. N Portal, 1 (TTU); mine NW Portal, 4 (MSU); Guadalupe Canyon at Arizona-Mexico border, 1 (MSB); Davis Mt., 6 mi. N Portal, Cochise Mine, 1 (LACM); Cochise, 7 (LACM); 3 mi. E, 17 mi. S San Simon, base of Chiricahua Mts., 2 (ASUMZ); 13 mi. S Bowie, 1 (ISUVC); 0.5 mi. NW Portal, 1 (UMMZ); El Tigre Mine, Piney Canyon, Chiricahua Mts., 1 (LSUMZ) 2 (UA); Cochise, Redbird Mine, 4 (LACM); 2.1 mi. E Portal, 1 (TTU); mine 1 mi. N Paradise, 1 (UA); Commonwealth Mine, 0.5 mi. E Pierce, 1 (UA); Crystal Cave, 2 (1 AMNH, 1 UA); Virture Mine, near Portal, 1 (UA); W Turkey Creek, El Coronado Ranch, Chiricahua Mts., 1 (UA); Barfoot Park, Chiricahua Mts., 1 (UA); location unknown, 2 (YPM).

NEW MEXICO: *Doña Ana Co.*: 3.9 mi. N, 10.1 mi. W Las Cruces, 1 (FSM); 1.8 mi. W, 0.4 mi. N Picacho Mt., vic. Las Cruces, 6 (NMSU); W side Organ Mts., 1 (NMSU); Ruby Hayner Mine, 4.2 mi. S Organ, 1 (NMSU); Dripping Spring, 1 (NMSU); Organ Mts., 0.5 mi. W Rabbit Ears, 1 (NMSU). *Eddy Co.*: McKittrick Hill, Dry Cave, 1 (UTEP); 18 mi. SW Carlsbad, 1 (KU). *Grant Co.*: 14 mi. S, 6.5 mi. W Glenwood, 3 (MSB); NW American Mine, sec. 35, T. 27 S, R. 16 W, 8 (MSB); 1 mi. S Georgetown, 3 (UTEP); 13.5 mi. S, 0.5 mi. W Cliff, mouth of Bear Canyon on Gila River, 1 (MSB); 2.5 mi. N jct. NM 527 and NM 61, 1 (MSB); 4 mi. E, 6 mi. N San Lorenzo, Silver Creek, Teal Mine, 1 (WNMU); 2 mi. S Cliff, 1 (WNMU); 7 mi. NE Silver City, Cleveland Mine, 1 (WNMU). *Hidalgo Co.*: 12.6 mi. N Steins, Peloncillo Mts., 1 (UTEP); Thicket Spring, sec. 23, T. 33 S, R. 15 W, 1 (NMSU); 7.1 mi. W, 4.2 mi. S Cloverdale, Guadalupe Canyon, 2 (NMSU); 17 mi. E Hilo Park, 1 (NMSU); NW $\frac{1}{4}$, sec. 34, T. 30 S, R. 16 W, 1 (MSB); Alamo Hueco Mts., Peterson Well, sec. 7, T. 33 S, R. 14 W, 1 (WNMU); Aspen Spring, 0.9 mi. S, 0.4 mi. E Animas Peak, 1 (NMSU); Sycamore Well, SW $\frac{1}{4}$, sec. 31, T. 33 S, R. 14 W, 2 (MSB); W side Hachita Peak, sec. 34, T. 28 S, R. 16 W, 1 (MSB); Occidental Mines, Sierra Rica, sec. 25, T. 29 S, R. 14 W, 1 (MSB); Clanton Canyon, SW $\frac{1}{4}$, sec. 16, T. 32 S, R. 21 W, 1 (MSB); Howell's Well, sec. 24, T. 28 S, R. 16 W, 1 (MSB); Dog Springs, sec. 13, T. 34 S, R. 15 W, 1 (WNMU). *Luna Co.*: 15.4 mi. S, 8.7 mi. E Deming, 1 (NMSU); 12.2 mi. S, 9.0 mi. E Deming, 1 (NMSU); 29.9 mi. S, 2.2 mi. W Deming, 1 (CSULB); 10 mi. SE Deming, 4 (WNMU). *Otero Co.*: Mayhill Community Center, 1 (MSB); 3 mi. NW Oro Grande, 1 (UTEP); 2 mi. W, 0.5 mi. N Oro Grande post office, 1 (UTEP); mines W Oro Grande, 2 (UTEP); Oro Grande, 9 (UTEP); Jarilla Mts., 2 (UTEP); Ruidoso, Fort Stanton Cave, 2 (NMSU); Sacramento Mts., Hubell Canyon, T. 18 S, R. 12 E, 1 (MSB); Alamo Mt., T. 26 S, R. 31 E, 1 (MSB).

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