J. Med. Entomol. Vol. 17, no. 4: 298–313 31 July 1980

A REVIEW OF THE *GEOMYDOECUS MINOR* COMPLEX (MALLOPHAGA: TRICHODECTIDAE) FROM *THOMOMYS* (RODENTIA: GEOMYIDAE)[1]

By **Roger D. Price[2] and Ronald A. Hellenthal[3]**

Abstract. Nine species of the *Geomydoecus* (*Thomomydoecus*) *minor* complex are described and illustrated: *G.* (*T.*) *minor* from 43 subspecies of *Thomomys bottae* and 3 of *T. umbrinus* (type-host: *T. b. tularosae*); *G.* (*T.*) *birneyi*, n. sp. from 2 subspecies of *T. bottae* and 3 of *T. umbrinus* (type-host: *T. u. sonoriensis*); *G.* (*T.*) *zacatecae*, n. sp. from 11 subspecies of *T. umbrinus* and 5 of *T. bottae* (type-host: *T. u. zacatecae*); *G.* (*T.*) *timmi*, n. sp. from 27 subspecies of *T. bottae* (type-host: *T. b. nigricans*); *G.* (*T.*) *dickermani* from 2 subspecies of *T. umbrinus* (type-host: *T. u. tolucae*); *G.* (*T.*) *markhafneri*, n. sp. from *T. u. umbrinus*; *G.* (*T.*) *williamsi*, n. sp. from *T. umbrinus* subsp. from Tlaxcala, Mexico; *G.* (*T.*) *orizabae*, n. sp. from 2 subspecies of *T. umbrinus* (type-host: *T. u. orizabae*); and *G.* (*T.*) *johnhafneri*, n. sp. from *T. u. vulcanius*. A key is given for the identification of the males of the complex.

Following the revision of *Geomydoecus* Ewing by Price & Emerson (1971), the new subgenus *Thomomydoecus* was erected by Price & Emerson (1972) to include 6 species of pocket gopher lice. Of these, 5 are restricted in their host distribution to subspecies of *Thomomys bottae* (Eydoux & Gervais) and *T. umbrinus* (Richardson). Extensive collecting of lice since then from these host groups has revealed that members of *Thomomydoecus* occur much more widely than previously thought and that they include a number of undescribed taxa. The *Thomomydoecus* from the *bottae-umbrinus* complex of hosts can be separated into the *neocopei* complex containing species whose males have tergites II–III with long clustered setae and the *minor* complex whose males have tergites II–III with short, widely spaced setae. We treat the taxonomy of the latter complex here. This consists of the redescription of the 2 species now recognized in the *minor* complex, the description of 7 new species, and the presentation of a key for the identification of the males of these species.

We have restricted the scope of this paper to the presentation of louse descriptions and associated distributional host and locality data. No attempt is made to discuss the significance of these distributions, as we feel that can best be done after the taxa of all louse complexes on *T. bottae* and *T. umbrinus* have been delineated.

Quantitative data for lice of the *minor* complex combined with their host and locality information are included as part of a computerized pocket gopher louse data base maintained at the University of Minnesota. The retrieval and analysis of these data were performed with an integrated group of computer programs that we developed and called the BUG system. A description and explanation of our data handling and analysis procedures may be found in Price & Hellenthal (1979).

In the following descriptions, counted or measured characters are followed by the minimum and maximum observed values, then the sample size, mean, and standard deviation in parentheses. Measurements are in millimetres. Illustrations are for specimens from the type-host. In evaluating character usefulness for specific discrimination, critical values for each character were calculated at the point where the likelihood of single character misidentification of the 2 compared taxa was equal, given normality and equal variance, and ignoring probability of collection. For characters offering moderately good discriminating ability, these critical values and the corresponding probabilities of misidentification are given. Comparative descriptions for closely related species are abbreviated, with quantitative data given only for those characters whose means differ at a significance level of $P \leq 0.01$. In the "Specimens examined" section, a number in parentheses following a locality represents the total number of gophers from which lice were taken. Original locality data expressed in miles are followed parenthetically by the metric equivalent to 0.1 km; the English figure, rather than the metric, expresses the precision of the location estimate. Full locality information including latitude, longitude and in many cases elevation for

[1]Paper No. 11,032, Scientific Journal Series, Minnesota Agricultural Experiment Station, St. Paul, Minnesota 55108, USA. Partial support for this study was supplied by a grant to the University of Minnesota from the National Science Foundation (Grant No. DEB77-10179).

[2]Department of Entomology, Fisheries, and Wildlife, University of Minnesota, St. Paul, Minnesota 55108, USA.

[3]Department of Biology, University of Notre Dame, Notre Dame, Indiana 46556, USA.

any host collection is available from the authors. Although most paratypes will be retained in the collection of the University of Minnesota, representatives will be deposited in the U.S. National Museum of Natural History, British Museum (Natural History), and occasionally other major collections.

The discriminant functions given in this paper were calculated using the U.C.L.A. Biomedical Computer Program BMD04M (Discriminant Analysis for Two Groups), as described in Dixon (1973). The principal components analysis used a computer program adapted from program PCFLOR in Goldstein & Grigal (1972).

The species within the *minor* complex may be separated into 2 groups based largely on the shape of the male genitalia; these are called the *minor* group and the *dickermani* group. The following 4 species form the *minor* group based on the male genitalia having relatively straight parameral arch (Fig. 6–8,B) and endomeral plate (Fig. 6–8,C) elements. For males, the best quantitative characters between the *minor* and *dickermani* groups and their critical values for discrimination and probabilities of misidentification were the width of the genitalic endomeral plate 0.029 (0.059), the length of the antennal scape 0.095 (0.162), and the number of setae on tergite II 10.29 (0.184). There are no known qualitative or quantitative features for distinguishing between the females of the 2 groups.

Geomydoecus (Thomomydoecus) minor Werneck Fig. 1–6, 9

Geomydoecus chapini minor Werneck, 1950, Os Malofagos de Mamiferos, Parte II: 16. *Type-host. Thomomys bottae tularosae* Hall.

♂. As in Fig. 1. Temple width (TW) 0.315–0.390 (475: 0.358 ± 0.0109); head length (HL) 0.220–0.290 (476: 0.263 ± 0.0093); submarginal and inner marginal temple setae (STS, MTS: Fig. 2) 0.015–0.035 (446: 0.025 ± 0.0035) and 0.025–0.050 (427: 0.037 ± 0.0035) long, respectively, with STS lateroanterior to inner MTS. Antenna (Fig. 3) with scape length (SL) 0.085–0.120 (455: 0.108 ± 0.0050), scape width (SW) 0.060–0.080 (456: 0.070 ± 0.0045). Prothorax width (PW) 0.215–0.280 (482: 0.247 ± 0.0104). *Tergal setae.* I, 2; II, 7–12 (477: 9.0 ± 0.95); III, 11–20 (474: 14.1 ± 1.50); IV, 9–20 (480: 14.1 ± 1.56); V, 8–16 (475: 12.4 ± 1.33); VI, 6–13 (478: 9.5 ± 1.33); tergal and pleural setae on VII, 10–15 (473: 11.8 ± 0.76). Dorsal terminalia as in Fig. 9, with broad terminal setose portion preceded anteriorly by paired long lateral setae on each side, pair of sensilla (SN) more or less posterior to these setae, then short and medium seta anterior to these. *Sternal setae.* II, 5–12 (478: 8.2 ± 1.16); III, 8–16 (479: 11.6 ± 1.23); IV, 9–19 (481: 14.3 ± 1.56); V, 9–17 (476: 11.9 ± 1.23); VI, 8–15 (482: 11.0 ± 0.97); VII, 7–12 (481: 9.7 ± 0.95); VIII, 4–9 (474: 6.2 ± 1.09). Total length (TL) 0.970–1.270 (452: 1.145 ± 0.0524). *Genitalia.* As in Fig. 6A; parameral arch (PA) as in Fig. 6B, width (PAW) 0.045–0.065 (463: 0.057 ± 0.0036); endomeral plate (EP) tapered to point (Fig. 6C) with deep medioanterior indentation bounded laterally by 1 side extending further anterior than other, width (EPW) 0.020–0.030 (463: 0.024 ± 0.0025), length (EPL) 0.060–0.090 (453: 0.078 ± 0.0050).

♀. As in Fig. 5. Temple width 0.345–0.430 (471: 0.395 ± 0.0120); head length 0.235–0.305 (471: 0.275 ± 0.0103); submarginal and inner marginal temple setae 0.015–0.040 (434: 0.024 ± 0.0037) and 0.025–0.055 (425: 0.038 ± 0.0044) long, respectively. Prothorax width 0.255–0.325 (478: 0.284 ± 0.0107). *Tergal setae.* I, 2; II, 10–18 (476: 13.2 ± 1.46); III, 15–27 (474: 20.3 ± 2.01); IV, 17–32 (470: 24.5 ± 2.21); V, 18–32 (466: 24.1 ± 2.25); VI, 16–29 (469: 22.3 ± 2.01); tergal and pleural setae on VII, 20–35 (471: 26.5 ± 2.24); medial setae on VIII, 2. Longest seta of medial 10 on tergite VI, 0.080–0.120 (465: 0.102 ± 0.0068); on tergite VII, 0.085–0.125 (444: 0.106 ± 0.0078), with 0–8 (439: 1.8 ± 2.00) of these longer than 0.100. Longest seta of medial pair on tergite VIII, 0.075–0.130 (431: 0.095 ± 0.0088). Last tergite (Fig. 4) with pair of medial setae and 2 longer setae (LS) laterally on each side; outer seta 0.085–0.140 (407: 0.111 ± 0.0092), middle seta 0.075–0.130 (382: 0.104 ± 0.0095), inner seta 0.050–0.100 (440: 0.069 ± 0.0077) long. *Sternal setae.* II, 8–16 (472: 11.2 ± 1.44); III, 10–19 (471: 14.3 ± 1.55); IV, 13–25 (467: 18.2 ± 1.95); V, 12–24 (469: 17.6 ± 1.86); VI, 12–22 (470: 16.6 ± 1.67); VII, 8–18 (473: 12.9 ± 1.32). *Subgenital plate.* As in Fig. 4 (SGP), with 19–36 (473: 27.2 ± 2.84) setae, with distribution and lengths as shown. Total length 0.935–1.380 (460: 1.175 ± 0.0678).

Remarks. The best qualitative feature for recognizing the males of *G. minor* from those of the other 3 species in the group is the deep medioanterior indentation of the genitalic endomeral plate and the asymmetry of the adjacent lateroanterior projections; we know of no qualitative or quantitative characteristics that will separate the females. For males, the best quantitative characters separating them from other taxa in the group and their critical values for discrimination and probabilities of misidentification were the length of the antennal scape 0.102 (0.162) and the length of the endomeral plate 0.073 (0.194).

Specimens examined. USA: 5♂,5♀, *T. b. tularosae*, New Mexico: Otero Co.: 0.5 mi. (0.8 km) W of Tularosa (3), Alamogordo (1). 100♂,101♀, *T. b. actuosus* Kelson, New Mexico: Bernalillo Co.: La Madera Ski Run (1); Lincoln Co.: 0.3 mi. (0.5 km) E (1), 2.7 mi. (4.3 km) N, 6.5 mi. (10.5 km) W (1), 7.2 mi. (11.6 km) N, 6.8 mi. (10.9 km) E (3), 1.2 mi. (1.9 km) S, 7 mi. (11.3 km) E (1), 4 mi. (6.4 km) S, 11 mi. (17.7 km) E (1), 5.5 mi. (8.8 km) S, 4.5 mi. (7.2 km) E (1) of Capitan, 5 mi. (8.0 km) S, 5 mi. (8.0 km) W of Glencoe (1), 1.4 mi. (2.3 km) S, 1.3 mi. (2.1 km) E (3), 2 mi. (3.2 km) S (1) of Nogal, 2 mi. (3.2 km) S of Rough Mt (4), 5.7 mi. (9.2 km) N, 15 mi. (24.1 km) E (1), 2.4 mi. (3.9 km) N, 9 mi. (14.5 km) E (1) of Ruidoso; San Miguel Co.: 3.0 mi. (4.8 km) N of Pecos (5); Sierra Co.: 32

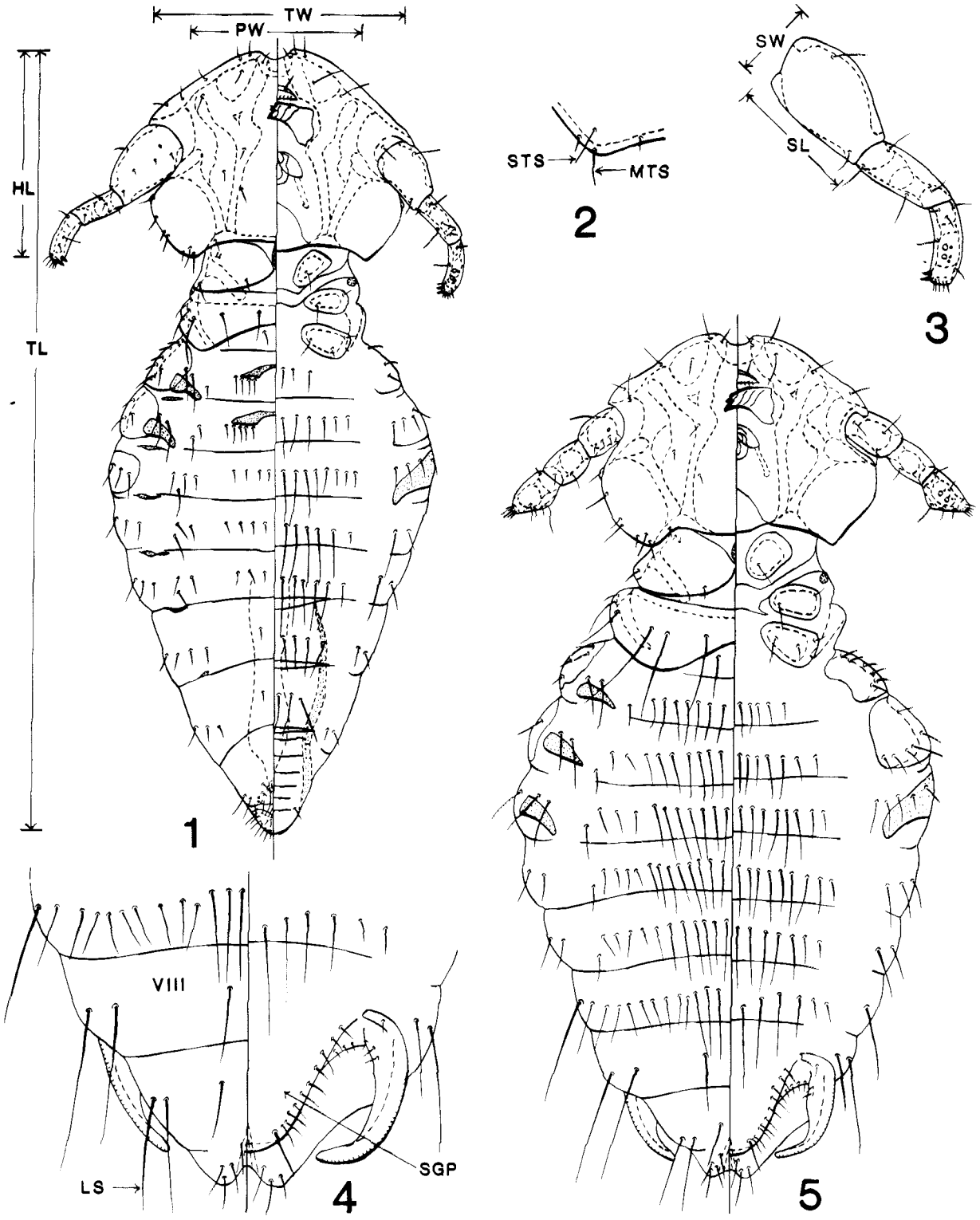

FIG. 1–5. *Geomydoecus minor*: (1) ♂ (TW, temple width; PW, prothorax width; HL, head length; TL, total length); (2) ♂ temple margin (MTS, marginal temple seta; STS, submarginal temple seta); (3) ♂ ventral antenna (SL, scape length; SW, scape width); (4) ♀ terminalia (*LS*, lateral setae of last tergite; *SGP*, subgenital plate); (5) ♀.

mi. (51.5 km) W, 10 mi. (16.1 km) N of Tularosa (1); Torrance Co.: 7 mi. (11.3 km) NW of Tajique (4). 22♂,25♀, *T. b. alexandrae* Goldman, Arizona: Coconino Co.: 5 mi. (8.0 km) S of Summit, Navajo Mts (4), 2 mi. (3.2 km) SE of Endische Spring (1), Rainbow Lodge (2). 46♂, 37♀, *T. b. alienus* Goldman, Arizona: Cochise Co.: 1 mi. (1.6 km) N (1), at (1) St. David, 5 mi. (8.0 km) SE of Casabel (1), Fairbank (5); Graham Co.: Safford (2), 0.8 mi. (1.3 km) E of Solomon (1); Pima Co.: Redington (6); Pinal Co.: Mammoth (1). 71♂,69♀, *T. b. apache* V. Bailey, Colorado: La Plata Co.: 7 mi. (11.3 km) N (1), at (3) Florida; New Mexico: Rio Arriba Co.: 1 mi. (1.6 km) S of Lake La Jara (2). 122♂,146♀, *T. b. aureus* J. A. Allen, Arizona: Navajo Co.: Polacca (1); Colorado: La Plata Co.: Bayfield (3); Montezuma Co.: 15 mi. (24.1 km) W (1), 4.5 mi. (7.2 km) S (1) of Cortez, 1 mi. (1.6 km) E of Cahone (3), Park Point, Mesa Verde National Park (1); San Miguel Co.: 19 mi. (30.6 km) N of Dove Creek (1); New Mexico: Rio Arriba Co.: 1 mi. (1.6 km) N, 1 mi. (1.6 km) W of Llaves (2); San Juan Co.: Aztec (1); Utah: San Juan Co.: Bluff (4), Monticello (1). 1♂,2♀, *T. b. baileyi* Merriam, Texas: Hudspeth Co.: Sierra Blanca (2). 6♂,2♀, *T. u. burti* Huey, Arizona: Pima Co.: Santa Rita Mts (1). 19♂,18♀, *T. b. catalinae* Goldman, Arizona: Pima Co.: Summerhaven (3), Soldier Camp, Spencer Mt (3), Santa Catalina Mts (4). 26♂,23♀, *T. b. collinus* Goldman, Arizona: Cochise Co.: Rustlers Park (7), Turkey Creek Canyon (3), Upper Pinery Canyon (1). 26♂,19♀, *T. b. confinalis* Goldman, Texas: Sutton Co.: 7 mi. (11.3 km) E of Sonora (4); Crockett Co.: 4 mi. (6.4 km) N of Ozona (1). 57♂,66♀, *T. b. connectens* Hall, New Mexico: Bernalillo Co.: 5 mi. (8.0 km) N (2), 4.5 mi. (7.2 km) S (1), at (2) Albuquerque, Pajarito (1); Sandoval Co.: Sandoval (2); Socorro Co.: 1 mi. (1.6 km) S (1), 1.2 mi. (1.9 km) E (1) of Bernardo. 1♂,4♀, *T. b. contractus* Durrant, Utah: Beaver Co.: Beaver (2), 2 mi. (3.2 km) E of Adamsville (1). 16♂,28♀, *T. b. cultellus* Kelson, New Mexico: Colfax Co.: Cimarroncito (1); Union Co.: 5.9 mi. (9.5 km) SE of Des Moines (7). 2♂,6♀, *T. u. emotus* Goldman, New Mexico: Hidalgo Co.: Guadalupe Canyon (1), 5 mi. (8.0 km) E of Cloverdale (1), Animas Peak (1). 17♂,18♀, *T. b. extenuatus* Goldman, Arizona: Cochise Co.: El Coronado Ranch (3), 2.7 mi. (4.3 km) W of State Highway 181 and Turkey Creek Road (1), Willcox (2); Graham Co.: Bonita (4). 409♂,323♀, *T. b. fulvus* (Woodhouse), Arizona: Apache Co.: W Fork of Black River (4), N Fork of White River (2), 2 mi. (3.2 km) N (1), at (1) Phelps Botanical Area, 30 mi. (48.3 km) SSW (1), at (2) Springerville, 7 mi. (11.3 km) N of Big Lake (2); Coconino Co.: 3 mi. (4.8 km) S, 4 mi. (6.4 km) E of Clints Well (4), Little Spring (5), 2 mi. (3.2 km) W (3), at (1) Bismark Lake, 3 mi. (4.8 km) E of Mormon Lake (2), Fern Mt (3), Whitehorse Lake (1), Pivot Rock Spring (1), San Francisco Mt (1); Gila Co.: 7.4 mi. (11.9 km) S of Colcord Lookout (1); Greenlee Co.: 2 mi. (3.2 km) N of Blue (1), Hannagan Creek (1), 8.2 mi. (13.2 km) N of Hannagan Meadows (2), Rose Peak (4); Navajo Co.: 7.3 mi. (11.7 km) W (1), 4 mi. (6.4 km) W (2) of Show Low, 2.8 mi. (4.5 km) SW of Heber (2); Yavapai Co.: 5 mi. (8.0 km) SW of Jerome (3), Prescott (2), 0.5 mi. (0.8 km) E of Ponderosa Park (2); New Mexico: Catron Co.: 4.5 mi. (7.2 km) E, 2 mi. (3.2 km) S of Madre Mt (1), 15.8 mi. (25.4 km) N of Apache Creek (2), Davenport Spring (2), 6.7 mi. (10.8 km) S of Luna (2), 9 mi. (14.5 km) E of State Line and Highway 60 (1), Willow Creek (3), 2.5 mi. (4.0 km) N of Glenwood (1); Grant Co.: Rocky Canyon (3), 1 mi. (1.6 km) S of Cliff (1), Trout Creek (1), 7 mi. (11.3 km) E of Silver City (1), Iron Creek (3); McKinley Co.: Sawmill Canyon (3); Socorro Co.: Bear Trap (2). 48♂,38♀, *T. b. grahamensis* Goldman, Arizona: Graham Co.: Hospital Flat (7), Arcadia Campground (2), Turkey Flat (2), Marijilda Canyon (1). 17♂,26♀, *T. b. guadalupensis* Goldman, New Mexico: Eddy Co.: 1 mi. (1.6 km) N, 23.3 mi. (37.5 km) W of White City (5); Texas: Culberson Co.: McKittrick Canyon (1), Guadalupe Mts (1). 35♂,39♀, *T. b. hualpaiensis* Goldman, Arizona: Mohave Co.: Hualpai Peak (2), Democrat Mine (2). 19♂,26♀, *T. b. hueyi* Goldman, Arizona: Cochise Co.: Miller Canyon (2), Huachuca Mts (1); Pima Co.: Rincon Mts (3). 3♂,2♀, *T. u. intermedius* Mearns, Arizona: Cochise Co.: Ramsey Canyon (2); Santa Cruz Co.: Sycamore Canyon (1). 31♂,26♀, *T. b. internatus* Goldman, Colorado: Custer Co.: 2.5 mi. (4.0 km) S of Wetmore (1); Fremont Co.: 1 mi. (1.6 km) E of Coaldale (1); Huerfano Co.: Gardner (1), 4.1 mi. (6.6 km) W of Walsenburg (4). 17♂,25♀, *T. b. latirostris* Merriam, Arizona: Navajo Co.: Keams Canyon (1), Zuni Well (2), Winslow (1), 11 mi. (17.7 km) NW of Kayenta (1). 3♂,2♀, *T. b. limitaris* Goldman, Texas: Brewster Co.: Mt Emory (1). 21♂,27♀, *T. b. limpiae* Blair, Texas: Jeff Davis Co.: 1 mi. (1.6 km) N (3), 11.6 mi. (18.7 km) NNE (1), 8.2 mi. (13.2 km) N, 6.5 mi. (10.5 km) E (4) of Fort Davis. 23♂,19♀, *T. b. mearnsi* V. Bailey, New Mexico: Hidalgo Co.: Gray's Ranch, Animas Valley (5), 4 mi. (6.4 km) NW of San Luis Pass (1). 48♂,77♀, *T. b. modicus*

Goldman, Arizona: Pima Co.: 10 mi. (16.1 km) E, 6 mi. (9.7 km) N (1), at (5) Tucson; Santa Cruz Co.: 5 mi. (8.0 km) NE (1), 4 mi. (6.4 km) N (1) of Nogales, 0.5 mi. (0.8 km) E of Amado (1), 1 mi. (1.6 km) SW (1), 7 mi. (11.3 km) N (3) of Patagonia, 2 mi. (3.2 km) W of Lochiel (1), Tubac (1). 35♂,33♀, *T. b. mutabilis* Goldman, Arizona: Gila Co.: South Fork of Workman Creek (1), Peterson Ranch (1), Rose Creek (2); Yavapai Co.: Camp Verde (4), Oak Creek at Cornville (2). 6♂,4♀, *T. b. operosus* Hatfield, Arizona: Yavapai Co.: Kirkland Jct (1), 6 mi. (9.7 km) N of Yarnell (1). 28♂,26♀, *T. b. opulentis* Goldman, New Mexico: Dona Ana Co.: 0.8 mi. (1.3 km) S of Radium Springs (6); Socorro Co.: San Marcial (2), Socorro (1). 19♂,16♀, *T. b. parvulus* Goldman, Arizona: Cochise Co.: 30 mi. (48.3 km) E of Tucson (1); Pima Co.: 14 mi. (22.5 km) E of Tucson (3). 46♂,46♀, *T. b. pervagus* Merriam, Colorado: Conejos Co.: 5 mi. (8.0 km) W of Antonito (1), 3.1 mi. (5.0 km) W of Las Mesitas (2); New Mexico: Rio Arriba Co.: Alcalde (2), 4.5 mi. (7.2 km) N of El Rito (1), 2 mi. (3.2 km) N of Espanola (1); Santa Fe Co.: Santa Fe (1); Taos Co.: 3 mi. (4.8 km) NE of Questa (1). 3♂,1♀, *T. b. pervarius* Goldman, Texas: Presidio Co.: 35 mi. (56.3 km) S of Marfa (1). 4♂,3♀, *T. b. proximus* Burt & Campbell, Arizona: Pima Co.: 1 mi. (1.6 km) N of Greaterville (2). 5♂,11♀, *T. b. rubidus* Youngman, Colorado: Fremont Co.: 3 mi. (4.8 km) E of Canon City (2). 10♂,6♀, *T. b. rufidulus* Hoffmeister, New Mexico: McKinley Co.: Gallup (2). 51♂,54♀, *T. b. ruidosae* Hall, New Mexico: Lincoln Co.: 14 mi. (22.5 km) N (3), 1 mi. (1.6 km) S (1), at (3) Ruidoso, 2.8 mi. (4.5 km) S, 2.0 mi. (3.2 km) W of Nogal (1), 4 mi. (6.4 km) W of Alto (2); Otero Co.: Jct Willie White & Penasco Canyons (2), 4 mi. (6.4 km) E, 3.25 mi. (5.2 km) N of Mescalero (3). 4♂,14♀, *T. b. scotophilus* Davis, Texas: Hudspeth Co.: Diablo Mts (3). 4♂,2♀, *T. b. texensis* V. Bailey, Texas: Jeff Davis Co.: 5 mi. (8.0 km) E of Mt Livermore (2), Davis Mts (1). 2♂,4♀, *T. b. toltecus* J. A. Allen, New Mexico: Grant Co.: Fort Webster (1); Hidalgo Co.: Upper Corner Monument 40 (1). MEXICO: 2♂,2♀, *T. b. angustidens* Baker, Coahuila: 5 mi. (8.0 km) S, 3 mi. (4.8 km) W (1), 6 mi. (9.7 km) N, 6 mi. (9.7 km) W (1) of Acebuches. 1♂,4♀, *T. b. basilicae* Benson & Tillotson, Sonora: 2 mi. (3.2 km) W of Magdalena (2). 2♂, *T. b. divergens* Nelson & Goldman, Sonora: 13.25 mi. (21.3 km) S of Esqueda (1). 16♂,3♀, *T. b. modicus*, Sonora: 2 mi. (3.2 km) S of La Casita (1), 40 km S of Nogales (1), Santa Cruz (1). 7♂,6♀, *T. b. retractus* Baker, Coahuila: 1 mi. (1.6 km) N (1), at (1) Las Margaritas. 6♂,5♀, *T. b. sturgisi* Goldman, Coahuila: Piedra Blanca, Sierra del Carman (1), 38 mi. (61.1 km) S, 23 mi. (37.0 km) E of Boquillas del Carman (1). 1♂,4♀, *T. b. toltecus*, Chihuahua: Casas Grandes Viejo (2).

Geomydoecus (Thomomydoecus) birneyi Price & Hellenthal, **new species** FIG. 7, 10, 12

Type-host. Thomomys umbrinus sonoriensis Nelson & Goldman.

♂. Much as for *G. minor*, except as follows. Temple width 0.325–0.365 (56: 0.343 ± 0.0086); head length 0.230–0.265 (56: 0.249 ± 0.0075). Antenna with scape length 0.075–0.095 (54: 0.088 ± 0.0040), scape width 0.055–0.065 (54: 0.063 ± 0.0029). Prothorax width 0.225–0.270 (56: 0.242 ± 0.0085). *Tergal setae.* IV, 9–17 (54: 13.1 ± 1.11); V, 8–14 (55: 11.5 ± 1.30). Dorsal terminalia as in FIG. 10, with paired sensilla on line with to anterior to lateral paired setae. *Sternal setae.* III, 8–13 (56: 10.9 ± 1.24); IV, 9–17 (56: 13.7 ± 1.89); V, 9–15 (54: 11.4 ± 1.26); VI, 8–12 (55: 10.5 ± 0.90); VIII, 4–7 (53: 5.6 ± 0.80). Total length 1.030–1.165 (54: 1.092 ± 0.0338). *Genitalia.* As in FIG. 7A; parameral arch as in FIG. 7B, width 0.045–0.055 (56: 0.051 ± 0.0027); endomeral plate shaped as in FIG. 7C, without deep medioanterior indentation and with symmetrical lateroanterior corners, width 0.015–0.025 (55: 0.020 ± 0.0020), length 0.060–0.075 (52: 0.069 ± 0.0039).

♀. Much as for *G. minor*, except as follows. Temple width 0.350–0.410 (75: 0.384 ± 0.0133); head length 0.245–0.290 (75: 0.265 ± 0.0092); inner marginal temple seta 0.035–0.050 (69: 0.040 ± 0.0039) long. Tergal and pleural setae on VII, 22–33 (74: 27.9 ± 2.62); medial setae on tergite VIII, 2–6 (138: 3.6 ± 0.91) (FIG. 12). Last tergite with outer seta 0.090–0.120 (60: 0.104 ± 0.0077), middle seta 0.070–0.110 (62: 0.092 ± 0.0091), inner seta 0.050–0.105 (70: 0.065 ± 0.0080) long. *Sternal setae.* II, 8–16 (74: 11.8 ± 1.43); VI, 12–20 (74: 17.1 ± 1.59); VII, 11–17 (75: 13.4 ± 1.37). Total length 1.020–1.285 (74: 1.153 ± 0.0663).

Remarks. Qualitatively, the male of *G. birneyi* is easily separated from that of *G. minor* by the symmetry of the anterior portion of the endomeral plate and the absence of a deep medioanterior indentation. There are no known qualitative features for separating the females of these taxa. For males, the best quantitative characters separating *G. birneyi* from *G. minor* and their critical values for discrimination and probabilities of misidentification were the length of the antennal scape 0.098 (0.021), the width of the parameral arch 0.054 (0.186), and the length of the endomeral plate 0.074 (0.190). For females, the larger number of median tergal setae on VIII will separate most individuals; *G. minor* had 2 setae in this position whereas *G. birneyi* had 87% of the specimens with 3 or more setae.

This species is named for Dr Elmer C. Birney, Bell Museum of Natural History, University of

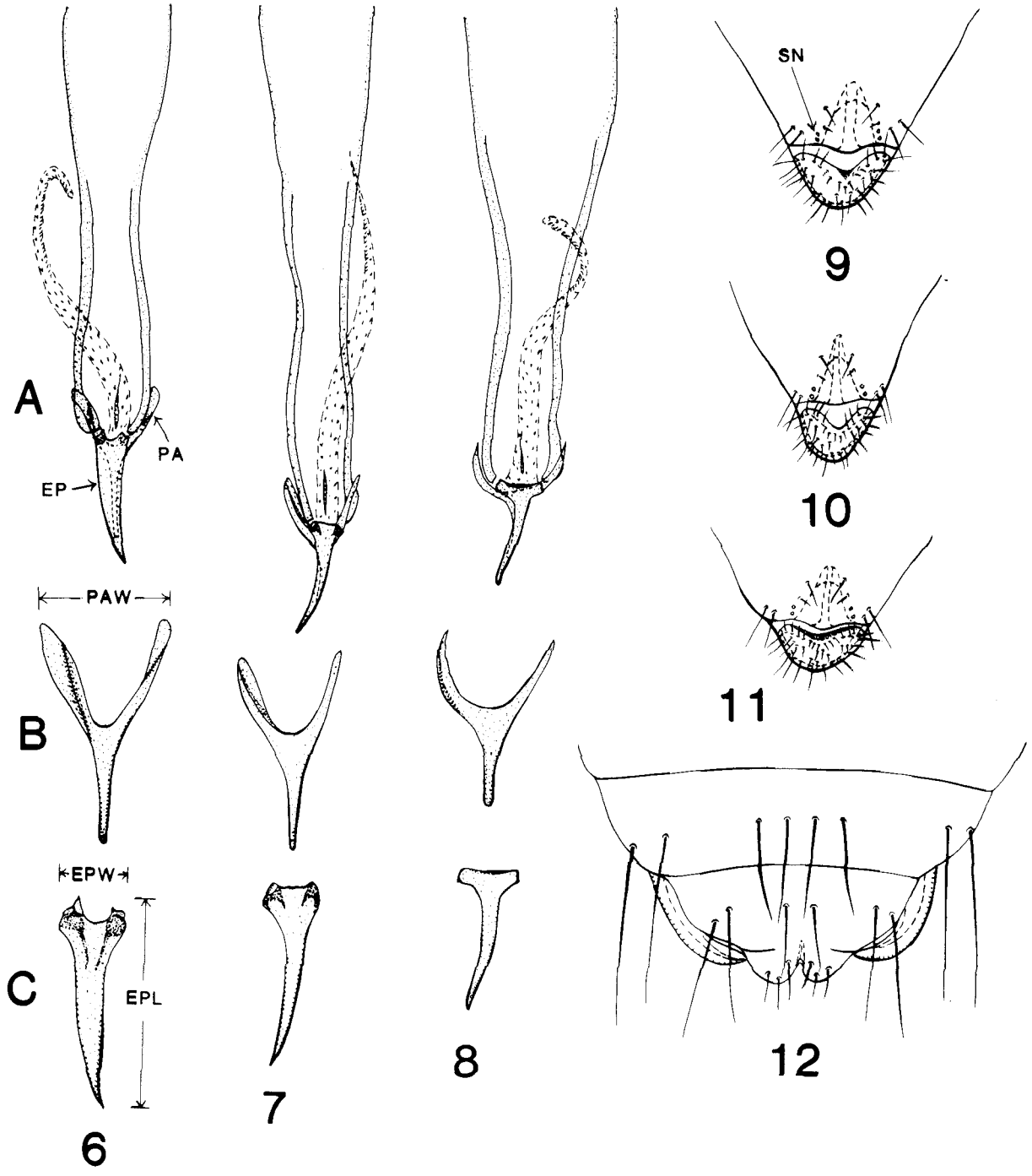

FIG. 6–12. 6–8. ♂ genitalia (A) entire; (B) parameral arch; (C) endomeral plate: (6) *Geomydoecus minor* (EP, endomeral plate; PA, parameral arch; PAW, parameral arch width; EPL, endomeral plate length; EPW, endomeral plate width); (7) *G. birneyi*; (8) *G. timmi*. 9–11. ♂ dorsal terminalia: (9) *G. minor* (SN, sensilla); (10) *G. birneyi*; (11) *G. timmi*. (12) *G. birneyi*, ♀ dorsal terminalia.

Minnesota, in recognition of his interest and support of mammal-ectoparasite studies.

Holotype ♂, *T. u. sonoriensis* (University of California Museum of Vertebrate Zoology-148909), MEXICO: Sonora: 1 mi. (1.8 km) N of Sahuaripa, 19.VII.1975, J. L. Patton; in collection of University of Minnesota. Paratypes: 52♂,71♀, *T. u. sonoriensis*, MEXICO: Sonora: 3 km NE (2), 1 mi. (1.6

km) S (3), at (3) Moctezuma, Mina San Eufraci, 10 mi. (16.1 km) NE of Chinapa (3).

Other specimens examined. USA: 6♂,8♀, *T. u. burti* Huey, Arizona: Pima Co.: Madera Canon (2), Santa Rita Mts (2). 29♂,41♀, *T. u. intermedius,* Arizona: Cochise Co.: 2 mi. (3.2 km) N (2), at (2) Sunnyside; Santa Cruz Co.: Sycamore Canyon (8), Italian Canyon (1). 4♂,15♀, *T. b. modicus,* Arizona: Pima Co.: 35 mi. (56.3 km) S of Tucson (3); Santa Cruz Co.: Sycamore Canyon (4). MEXICO: 1♂,6♀, *T. b. divergens* Nelson & Goldman, Sonora: 1 mi. (1.6 km) N of Huachinera (1). 6♂,13♀, *T. umbrinus* subsp., Sonora: 1 mi. (1.6 km) W of Yecora (2).

Geomydoecus (Thomomydoecus) zacatecae Price & Hellenthal, new species

Type-host. Thomomys umbrinus zacatecae Nelson & Goldman.

♂. Much as for *G. minor,* except as follows. Temple width 0.300–0.380 (169: 0.343 ± 0.0151); head length 0.225–0.275 (169: 0.249 ± 0.0116); submarginal and inner marginal temple setae 0.015–0.035 (157: 0.024 ± 0.0030) and 0.025–0.045 (135: 0.034 ± 0.0037) long, respectively. Antenna with scape length 0.080–0.115 (163: 0.099 ± 0.0059), scape width 0.055–0.075 (161: 0.066 ± 0.0044). Prothorax width 0.210–0.265 (173: 0.239 ± 0.0105). *Tergal setae.* II, 6–11 (172: 8.7 ± 0.97); III, 10–18 (172: 13.3 ± 1.34); IV, 9–16 (169: 12.4 ± 1.48); V, 7–14 (167: 10.9 ± 1.47); VI, 6–12 (169: 8.4 ± 1.25); tergal and pleural setae on VII, 9–14 (169: 11.5 ± 0.91). Dorsal terminalia as for *G. birneyi* (FIG. 10), but with sensilla often posterior to lateral setae. *Sternal setae.* II, 6–12 (172: 7.9 ± 1.02); III, 8–14 (168: 10.5 ± 1.05); IV, 9–17 (171: 12.8 ± 1.41); V, 8–15 (168: 10.8 ± 1.28); VI, 8–13 (171: 10.2 ± 0.91); VII, 6–11 (170: 9.1 ± 1.05); VIII, 3–8 (169: 5.2 ± 0.86). *Total length* 0.935–1.250 (158: 1.104 ± 0.0578). *Genitalia.* Close to *G. birneyi* (FIG. 7); parameral arch width 0.035–0.060 (165: 0.052 ± 0.0047); endomeral plate width 0.015–0.025 (167: 0.021 ± 0.0023), length 0.060–0.080 (162: 0.072 ± 0.0042).

♀. Much as for *G. minor,* except as follows. Temple width 0.355–0.430 (167: 0.384 ± 0.0147); head length 0.240–0.295 (168: 0.265 ± 0.0110); submarginal and inner marginal temple setae 0.020–0.030 (152: 0.023 ± 0.0027) and 0.025–0.050 (152: 0.035 ± 0.0039) long, respectively. Prothorax width 0.255–0.310 (167: 0.278 ± 0.0117). *Tergal setae.* II, 9–16 (166: 12.2 ± 1.17); III, 14–24 (165: 19.0 ± 1.71); IV, 17–29 (165: 22.8 ± 2.15); V, 16–29 (168: 22.2 ± 2.12); VI, 14–27 (169: 20.9 ± 2.21); tergal and pleural setae on VII, 19–33 (169: 25.4 ± 2.25); medial setae on VIII, 2–4 (100: 2.1 ± 0.26). Longest seta of medial pair on tergite VIII, 0.060–0.105 (148: 0.090 ± 0.0092). Last tergite with middle seta 0.070–0.130 (143: 0.100 ± 0.0127) long. *Sternal setae.* II, 7–14 (166: 10.5 ± 1.29); III, 8–17 (166: 13.5 ± 1.50); IV, 11–22 (164: 16.8 ± 1.81); V, 12–22 (165: 16.7 ± 1.79); VI, 11–21 (168: 15.9 ± 1.61); VII, 10–16 (169: 12.5 ± 1.05). *Subgenital plate.* With 18–33 (169: 24.7 ± 3.09) setae.

Remarks. The male genitalia of *G. zacatecae* are similar to those of *G. birneyi* and thereby enable separation from *G. minor*; however, the placement of the sensilla on the dorsal terminalia is as in *G. minor.* The females are close to those of *G. minor*; most (96%) had only 2 medial setae on tergite VIII. For males, the best quantitative character separating *G. zacatecae* from *G. minor* and *G. birneyi,* respectively, and the critical values for discrimination and probabilities of misidentification were the antennal scape length 0.103 (0.194) and 0.093 (0.158).

The fact that *G. zacatecae* occurs in 2 isolated populations, 1 in Mexico and the other in the USA (Colorado, Utah, and northern New Mexico and Arizona) caused us some concern. These lice appeared to us to be qualitatively inseparable, and analyzed quantitative characters gave us similar results. We, therefore, regard both populations as the same taxon.

Holotype ♂, *T. u. zacatecae* (University of California Museum of Vertebrate Zoology-153764), MEXICO: Zacatecas: 3 km N of Ojocaliente, 23.VII.1977, J. C. Hafner; in collection of University of Minnesota. Paratypes: 53♂,56♀, *T. u. zacatecae,* MEXICO: Zacatecas: 3 km N of Ojocaliente (4), Berriozabal (1), 2 mi. (3.2 km) ESE of Trancoso (1), 5 mi. (8.0 km) NW (2), 8 mi. (12.9 km) SE (2), 9 mi. (14.5 km) W (1) of Zacatecas; Aguascalientes: 12 mi. (19.3 km) N of Rincon de Romos (2).

Other specimens examined. MEXICO: 10♂,6♀, *T. u. arriagensis* Dalquest, San Luis Potosi: 1 km S (2), 11 km N, 12 km E (2), 4 mi. (6.4 km) E (1) of Arriaga. 11♂,5♀, *T. u. atrodorsalis* Nelson & Goldman, San Luis Potosi: Alvarez (3). 123♂,141♀, *T. u. chihuahuae* Nelson & Goldman, Durango: 3 mi. (4.8 km) NW (6), 15 mi. (24.1 km) W (1), 6 mi. (9.7 km) SW (2) of El Salto, 3 mi. (4.8 km) E of Las Adjuntas (1), 1 mi. (1.6 km) E (6), 7.7 mi. (12.4 km) W (5) of La Ciudad, 1.3 mi. (2.1 km) NE of Mil Dios (5), 83 km WSW of Durango (2). 45♂,63♀, *T. u. crassidens* Nelson & Goldman, Zacatecas: 3 mi. (4.8 km) NW of Monte Escobedo (4), 3 mi. (4.8 km) SW (1), 10 km S, 1 km W (1), 10 km S, 2 km W (2) of Sombrerete. 34♂,26♀, *T. u. durangi* Nelson & Goldman, Durango: 22 mi. (35.4 km) WSW (2), at (1) Durango, 1.5 mi. (2.4 km) S of Morcillo (2). 25♂,19♀, *T. u. enixus* Nelson & Goldman, Aguascalientes: 3 mi. (4.8 km) N of Cerro del Jaguey (6); Zacatecas: 11 mi. (17.7 km) NW of Jalpa (4), El Plateado (1). 1♂,4♀, *T. u. goldmani* Merriam, Coahuila: 3 mi. (4.8 km) SE of Torreon (1); Durango: 4 mi. (6.4 km) WSW of Lerdo (1).

11♂,17♀, *T. u. newmani* Dalquest, Jalisco: 10 mi. (16.1 km) NW (3), 2 mi. (3.2 km) SW (1) of Matanzas, 4.5 mi. (7.2 km) NE of Comanja de Corona (2); San Luis Potosi: Palma Pegada (1). 9♂,5♀, *T. u. potosinus* Nelson & Goldman, San Luis Potosi: La Tinaja (3), Ventura (2). 1♂, *T. u. pullus* Hall & Villa, Michoacan: 6.5 km S of Patzcuaro (1). USA: 2♂,3♀, *T. b. dissimilis* Goldman, Utah: Garfield Co.: Henry Mts (2). 3♂,3♀, *T. b. internatus*, Colorado: Chaffee Co.: 2 mi. (3.2 km) N of Salida (1); El Paso Co.: 1.25 mi. (2.0 km) S of Colorado Springs (1). 6♂,11♀, *T. b. optabilis* Goldman, Colorado: Montrose Co.: Coventry (1). 26♂,41♀, *T. b. osgoodi* Goldman, Utah: Carbon Co.: 0.5 mi. (0.8 km) NW (1), at (1) Spring Glen; Emery Co.: 5 mi. (8.0 km) S of Castle Dale (2), Green River (1), 32.5 mi. (52.3 km) NE of Hanksville (1); Wayne Co.: Notom (1). 20♂,16♀, *T. b. peramplus* Goldman, Arizona: Apache Co.: Tunicha Mts (1); New Mexico: San Juan Co.: Chuska Mts (3).

Geomydoecus (Thomomydoecus) timmi Price & Hellenthal, **new species** FIG. 8, 11

Type-host. Thomomys bottae nigricans Rhoads.

♂. Much as in FIG. 1. Temple width 0.325–0.380 (110: 0.350 ± 0.0094); head length 0.250–0.295 (110: 0.266 ± 0.0076); submarginal and inner marginal temple setae 0.020–0.040 (92: 0.029 ± 0.0039) and 0.025–0.045 (92: 0.034 ± 0.0046) long, respectively. Antennal scape length 0.075–0.110 (105: 0.097 ± 0.0058), scape width 0.055–0.080 (105: 0.070 ± 0.0047). Prothorax width 0.225–0.275 (116: 0.248 ± 0.0092). *Tergal setae.* II, 8–14 (114: 10.8 ± 1.09); III, 12–18 (115: 14.6 ± 1.46); IV, 10–17 (113: 13.3 ± 1.48); V, 8–14 (111: 10.9 ± 1.38); VI, 5–12 (110: 8.0 ± 1.28); tergal and pleural setae on VII, 10–14 (112: 11.9 ± 0.73). Dorsal terminalia as in FIG. 11, with broad terminal setose portion, pair of sensilla on each side generally on line with to slightly anterior to lateral paired setae. *Sternal setae.* II, 5–11 (115: 7.3 ± 0.99); III, 8–15 (114: 11.5 ± 1.26); IV, 10–17 (115: 14.3 ± 1.43); V, 9–15 (115: 11.6 ± 1.13); VI, 9–13 (114: 10.9 ± 1.05); VII, 6–12 (114: 9.1 ± 1.09); VIII, 3–8 (113: 5.3 ± 0.99). Total length 0.980–1.245 (103: 1.101 ± 0.0489). *Genitalia.* As in FIG. 8A; parameral arch as in FIG. 8B, width 0.040–0.065 (113: 0.053 ± 0.0045); endomeral plate T-shaped (FIG. 8C), width 0.025–0.035 (111: 0.028 ± 0.0027), length 0.050–0.075 (107: 0.061 ± 0.0053).

♀. Much as in FIG. 5. Temple width 0.340–0.415 (111: 0.389 ± 0.0127); head length 0.265–0.305 (111: 0.282 ± 0.0084); submarginal and inner marginal temple setae 0.020–0.035 (97: 0.027 ± 0.0033) and 0.025–0.050 (91: 0.037 ± 0.0047) long, respectively. Prothorax width 0.260–0.320 (114: 0.287 ± 0.0113). *Tergal setae.* II, 12–18 (111: 14.6 ± 1.54); III, 17–26 (111: 20.3 ± 1.97); IV, 18–30 (109: 24.4 ± 2.30); V, 19–30 (111: 23.8 ± 2.09); VI, 17–28 (109: 22.0 ± 1.96); tergal and pleural setae on VII, 21–33 (109: 26.3 ± 2.24); medial setae on VIII, 2. Longest seta of medial 10 on tergite VI, 0.080–0.125 (112: 0.105 ± 0.0067); on tergite VII, 0.090–0.130 (108: 0.109 ± 0.0078), with 0–8 (102: 2.4 ± 2.01) of these longer than 0.100. Longest seta of medial pair on tergite VIII, 0.060–0.120 (97: 0.094 ± 0.0102). Last tergite with outer seta 0.080–0.115 (81: 0.097 ± 0.0072), middle seta 0.075–0.105 (74: 0.091 ± 0.0072), inner seta 0.045–0.075 (103: 0.059 ± 0.0058) long. *Sternal setae.* II, 7–14 (111: 10.5 ± 1.46); III, 11–18 (110: 14.8 ± 1.53); IV, 15–24 (113: 19.3 ± 1.86); V, 13–22 (112: 17.7 ± 1.77); VI, 13–21 (111: 16.9 ± 1.94); VII, 8–16 (110: 12.4 ± 1.42). *Subgenital plate.* Much as in FIG. 4, with 19–34 (115: 25.9 ± 2.88) setae. Total length 1.030–1.360 (110: 1.189 ± 0.0703).

Remarks. The shape of the male genitalic endomeral plate easily distinguishes the male of *G. timmi* from those of all other members of the *minor* group. We know of no qualitative or quantitative means for facilitating identification of the female. For males, the best quantitative characters separating them from the other taxa in the group and their critical values for discrimination and probabilities of misidentification were the length of the endomeral plate 0.068 (0.091), the width of the endomeral plate 0.025 (0.169), and the number of setae on tergite II 9.88 (0.180).

This species is named for Dr Robert M. Timm, University of Minnesota, in recognition of his interest and research on ectoparasites of vertebrates.

Holotype ♂, *T. b. nigricans* (San Diego Natural History Museum-1489), USA: California: San Diego Co.: Witch Creek, 25.VII.1925, F. Stephens; in collection of San Diego Natural History Museum. Paratypes: 18♂,26♀, *T. b. nigricans*, USA: California: San Diego Co.: Witch Creek (4), Laguna Mts (2); MEXICO: Baja California: Agua Hechicera (1).

Other specimens examined. USA: 11♂,9♀, *T. b. absonus* Goldman, Arizona: Coconino Co.: 0.5 mi. (0.8 km) W of Fredonia (1), Jacobs Pools (1); Utah: Garfield Co.: 8 mi. (12.9 km) E of Boulder (1); Kane Co.: 2.2 mi. (3.5 km) N of Kanab (2). 16♂,7♀, *T. b. affinis* Huey, California: San Diego Co.: Jacumba (5). 18♂,9♀, *T. b. alpinus* Merriam, California: Inyo Co.: Cottonwood Lakes (2); Tulare Co.: Jackass Meadow (1), Kennedy Meadows (2), Taylor Meadow (1). 5♂,13♀, *T. b. altivallis* Rhoads, California: San Bernardino Co.: Fawnskin Valley (1), Bluff Lake (1), Holcomb Valley (1), Sugarloaf (3), Big Pine Flat (1). 7♂,23♀, *T. b. awahnee* Merriam, California: Tulare Co.: Halstead Meadow (3), Big Meadow (1), Giant Forest (1). 3♂,7♀, *T. b. birdseyei* Goldman, Utah: Washington Co.: Pine Valley (5), Mountain Meadows (1). 12♂,11♀, *T. b. bottae*, California: Kern Co.: Old Fort Tejon (1); Los Angeles Co.: South Gate (1), North Long Beach (1), Long Beach (1); Ventura Co.: 0.5 mi. (0.8 km) W of Fillmore (1). 1♂, *T. b. cabezonae* Merriam, California: Riverside Co.: Ban-

ning (1). 1♂,3♀, *T. b. centralis* Hall, Nevada: Lincoln Co.: Panaca (1). 15♂,7♀, *T. b. cinereus* Hall, Nevada: Lyon Co.: Wichman (1); Mineral Co.: 8 mi. (12.9 km) NW (2), 3 mi. (4.8 km) S (1) of Schurz, 5 mi. (8.0 km) NW of Morgan's Ranch (1). 8♂,5♀, *T. b. curtatus* Hall, Nevada: Nye Co.: San Antonio (1). 2♂,3♀, *T. b. diaboli* Grinnell, California: Contra Costa Co.: 2.25 mi. (3.6 km) NNW of Clayton (1). 1♂,1♀, *T. b. fumosus* Hall, Nevada: Nye Co.: 7 mi. (11.3 km) N of San Antonio (1). 4♂,3♀, *T. b. jacinteus* Grinnell & Swarth, California: Riverside Co.: Round Valley (2), Fullers Mill (1), Garner Valley (2). 10♂,1♀, *T. b. mewa* Merriam, California: Fresno Co.: Shaver Ranger Station (5). 3♂,9♀, *T. b. minor* V. Bailey, California: Marin Co.: Dillon Beach (1), 1 mi. (1.6 km) SE of Inverness (1). 2♂, *T. b. mohavensis* Grinnell, California: Los Angeles Co.: Fairmont (1). 1♂, *T. b. navus* Merriam, California: Sutter Co.: Rio Oso, Sacramento Valley (1). 5♂,2♀, *T. b. neglectus* V. Bailey, California: Kern Co.: 6 mi. (9.7 km) W of Lebec (1); Los Angeles Co.: 5 mi. (8.0 km) SE of Valyermo (1); Ventura Co.: Mt Pinos (2). 3♂,7♀, *T. b. pallescens* Rhoads, California: Los Angeles Co.: Covina (1), San Gabriel (1); Riverside Co.: Riverside (1), 5 mi. (8.0 km) SW of Arlington (1). 3♂,2♀, *T. b. perpes* Merriam, California: Kern Co.: Rosamond (1). 1♂,1♀, *T. b. planirostris* Burt, Utah: Washington Co.: Zion National Park (1). 4♂,10♀, *T. b. vescus* Hall & Davis, Nevada: Nye Co.: Meadow Creek Ranger Station (1), 1.5 mi. (2.4 km) E of Jefferson (1). MEXICO: Baja California: 2♂, *T. b. jojobae* Huey, Sangre de Cristo (1). 2♂,1♀, *T. b. juarezensis* Huey, Laguna Hanson (1), El Rayo (1). 13♂,16♀, *T. b. martirensis* J. A. Allen, La Grulla (5), Concepcion (2), Vallecitos (1).

The following 5 species are included in the *dickermani* group of the *minor* complex. They are placed there on the basis of the males having a relatively pronounced flection of the genitalic parameral arch (FIG. 13–17,B) and endomeral plate (FIG. 13–17,C). The presence of several differentiating quantitative characters discussed earlier for the *minor* group further supports this grouping.

Geomydoecus (Thomomydoecus) dickermani Price & Emerson FIG. 13, 19

Geomydoecus (Thomomydoecus) dickermani Price & Emerson, 1972, J. Med. Entomol. **9**: 467. *Type-host. Thomomys umbrinus tolucae* Nelson & Goldman.

♂. Much as in FIG. 1. Temple width 0.320–0.360 (39: 0.337 ± 0.0092); head length 0.230–0.275 (39: 0.250 ± 0.0073); submarginal and inner marginal temple setae 0.020–0.030 (28: 0.026 ± 0.0026) and 0.025–0.035 (24: 0.030 ± 0.0021) long, respectively. Antenna with scape length 0.080–0.090 (39: 0.084 ± 0.0032), scape width 0.055–0.065 (39: 0.061 ± 0.0026). Prothorax width 0.220–0.265 (39: 0.241 ± 0.0107). *Tergal setae.* II, 9–15 (38: 11.2 ± 1.13); III, 12–19 (38: 15.3 ± 1.44); IV, 10–15 (37: 11.9 ± 1.34); V, 8–11 (36: 9.7 ± 0.91); VI, 5–9 (38: 7.0 ± 0.91); tergal and pleural setae on VII, 10–13 (39: 11.5 ± 0.68). Dorsal terminalia as in FIG. 19, with broad terminal setose portion, paired sensilla anterior to paired lateral setae. *Sternal setae.* II, 7–11 (39: 9.2 ± 1.17); III, 10–15 (39: 12.4 ± 1.41); IV, 11–19 (39: 15.3 ± 1.60); V, 9–15 (39: 12.4 ± 1.31); VI, 8–13 (39: 11.5 ± 1.07); VII, 9–11 (38: 10.1 ± 0.66); VIII, 4–8 (39: 5.9 ± 0.92). Total length 0.990–1.165 (34: 1.058 ± 0.0412). *Genitalia.* As in FIG. 13A; parameral arch as in FIG. 13B, width 0.050–0.065 (35: 0.059 ± 0.0030); endomeral plate (FIG. 13C) tapered to narrow point, width 0.035–0.045 (35: 0.039 ± 0.0028), length 0.050–0.070 (32: 0.063 ± 0.0051).

♀. Much as in FIG. 5. Temple width 0.360–0.420 (32: 0.393 ± 0.0134); head length 0.255–0.285 (32: 0.266 ± 0.0107); submarginal and inner marginal temple setae 0.020–0.035 (26: 0.026 ± 0.0029) and 0.030–0.040 (24: 0.035 ± 0.0039) long, respectively. Prothorax width 0.275–0.320 (33: 0.290 ± 0.0117). *Tergal setae.* II, 12–17 (31: 14.7 ± 1.24); III, 16–24 (30: 20.2 ± 1.78); IV, 21–30 (33: 25.3 ± 2.08); V, 20–29 (33: 24.5 ± 2.11); VI, 19–27 (33: 22.3 ± 2.09); tergal and pleural setae on VII, 22–31 (33: 27.0 ± 2.01); medial setae on VIII, 1–4 (71: 2.4 ± 0.67). Longest seta of medial 10 on tergite VI, 0.095–0.115 (33: 0.107 ± 0.0061); on tergite VII, 0.100–0.125 (32: 0.110 ± 0.0076), with 0–8 (31: 3.1 ± 2.58) of these longer than 0.100. Longest of medial setae on tergite VIII, 0.070–0.105 (29: 0.094 ± 0.0076). Last tergite with outer seta 0.085–0.125 (30: 0.106 ± 0.0104), middle seta 0.060–0.100 (21: 0.088 ± 0.0089), inner seta 0.050–0.075 (31: 0.064 ± 0.0058) long. *Sternal setae.* II, 9–13 (32: 11.3 ± 1.33); III, 12–17 (31: 14.3 ± 1.49); IV, 14–25 (31: 18.6 ± 2.59); V, 15–22 (32: 18.8 ± 1.60); VI, 15–22 (32: 17.8 ± 1.59); VII, 12–17 (33: 14.4 ± 1.08). *Subgenital plate.* Much as in FIG. 4, with 22–35 (32: 27.8 ± 2.64) setae. Total length 1.085–1.315 (30: 1.193 ± 0.0663).

Remarks. The male of *G. dickermani* is recognized from the other members of the group by the shape of the genitalic endomeral plate and parameral arch; there are no known qualitative features for recognizing the female. Quantitatively, there is little to aid in separating *G. dickermani.* For males, the best quantitative character and its critical value for discrimination and probability of misidentification were the width of the endomeral plate 0.036 (0.200). For females, 66% of the specimens had only 2 medial setae on tergite VIII and only 6 of 71 had 4 setae.

Specimens examined. MEXICO: Mexico: 18♂,15♀, *T. u. tolucae,* Ojo de Agua (1), N slope of Nevado de Toluca (2), 18 km S, 12 km W (1), 10 km S, 16 km W (3) of Toluca. 37♂,57♀, *T. u. peregrinus* Merriam, 1.5 mi. (2.4 km) S (3), 10 mi.

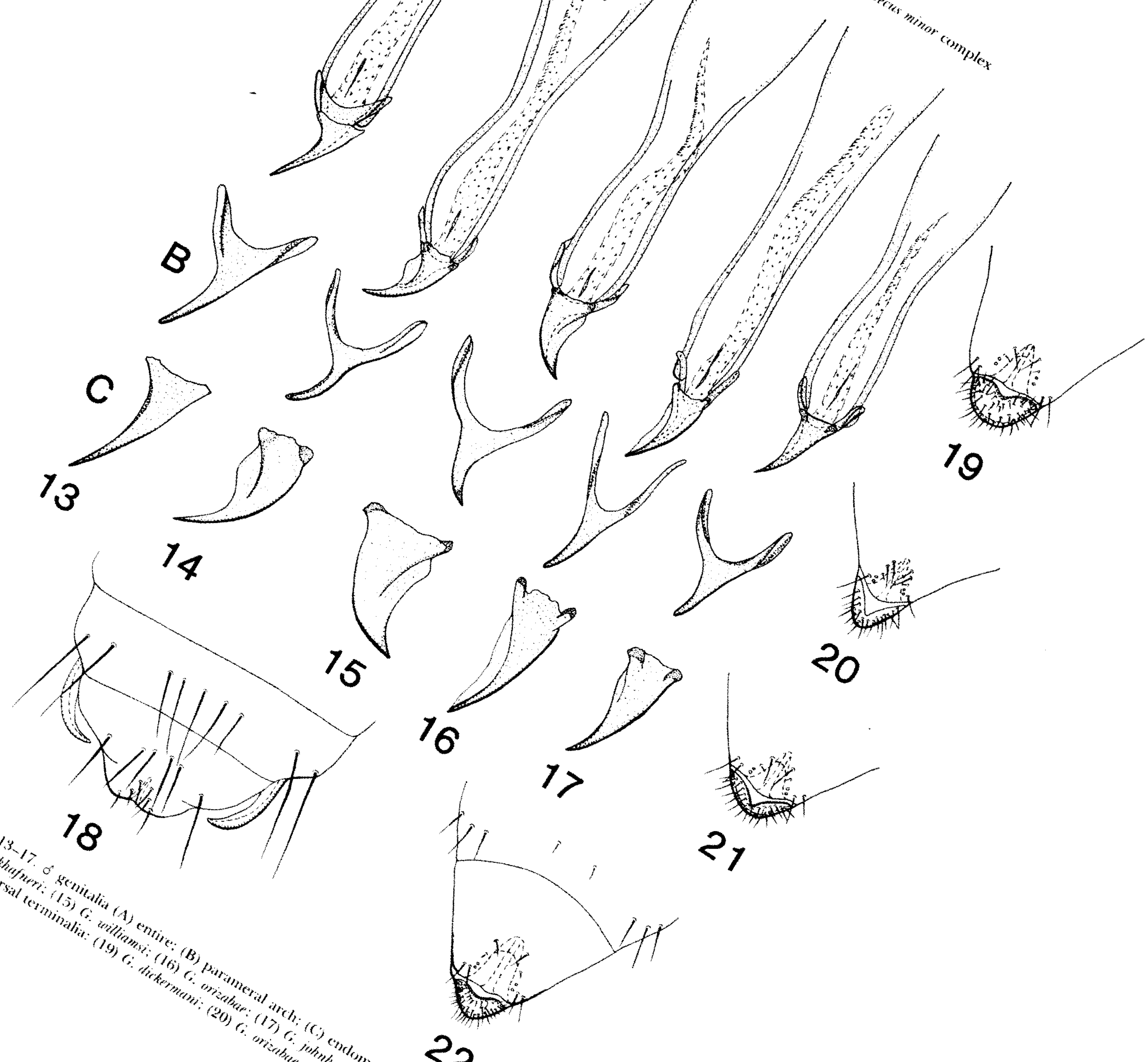

FIG. 13–22. 13–17. ♂ genitalia (A) entire; (B) parameral arch; (C) endomeral plate; (13) *Geomydoecus dick-*
mani; (14) *G. markhafneri*; (15) *G. williamsi*; (16) *G. orizabae*; (17) *G. johnhafneri*. (18) *G. orizabae*, ♀ dorsal
nalia. 19–22. ♂ dorsal terminalia: (19) *G. dickermani*; (20) *G. orizabae*; (21) *G. johnhafneri*; (22) *G. will*

(16.1 km) N, 6 mi. (9.7 km) E (3) of Valle de Bravo, 1 mi. (1.6 km) W (1), at (4) Salazar.

Geomydoecus (Thomomydoecus) markhafneri Price & Hellenthal, **new species** FIG. 14

Type-host. Thomomys umbrinus umbrinus (Richardson).

♂. Close to *G. dickermani*, differing as follows. *Sternal setae.* II, 6–11 (20: 8.3 ± 1.16); III, 9–13 (19: 11.2 ± 0.96); VI, 9–12 (20: 10.6 ± 0.94); VIII, 4–5 (20: 4.6 ± 0.50). *Genitalia.* As in FIG. 14A; parameral arch as in FIG. 14B, with more deeply indented anterior portion; endomeral plate (FIG. 14C) with sharper flection and pronounced convexity on flection side, width 0.025–0.030 (20: 0.029 ± 0.0022), length 0.065–0.080 (17: 0.071 ± 0.0045).

♀. Close to *G. dickermani*, differing as follows. Setae on sternite VII, 11–14 (14: 12.7 ± 0.99); on subgenital plate, 20–30 (14: 25.4 ± 2.68).

Remarks. The shape of the genitalic parameral arch and endomeral plate offer excellent means for separating males of *G. markhafneri* from *G. dickermani.* There are no known qualitative features for distinguishing females of these 2 species. For males, the best quantitative characters and their critical values for discrimination and probabilities of misidentification were the width of the endomeral plate 0.034 (0.024), the length of the endomeral plate 0.067 (0.208), and the number of setae on sternite VIII 5.24 (0.216). For females, the only quantitative character of possible value was the number of setae on sternite VII 13.54 (0.218).

This species is named for Mr Mark S. Hafner, Museum of Vertebrate Zoology, University of California, Berkeley, in recognition of his interest in mammalian ectoparasites and his efforts in collecting many important gopher specimens.

Holotype ♂, *T. u. umbrinus* (University of California Museum of Vertebrate Zoology-153880), MEXICO: Puebla: 3.5 km S, 3 km E of Esperanza, Boca del Monte, 13.VIII.1977, M. S. Hafner; in collection of University of Minnesota. Paratypes: 43♂,43♀, *T. u. umbrinus*, MEXICO: Puebla: 3.5 km S, 3 km E of Esperanza, Boca del Monte (6), Boca del Monte (3).

Geomydoecus (Thomomydoecus) williamsi Price & Hellenthal, **new species** FIG. 15, 22

Type-host. Thomomys umbrinus subspecies.

♂. As for *G. dickermani*, except as follows. Temple width 0.350–0.375 (12: 0.360 ± 0.0065); head length 0.255–0.270 (12: 0.260 ± 0.0045). Antenna with scape length 0.095–0.105 (12: 0.101 ± 0.0037), scape width 0.070–0.075 (12: 0.073 ± 0.0026). Prothorax width 0.230–0.270 (12: 0.251 ± 0.0107). *Tergal setae.* IV, 12–16 (10: 14.1 ± 1.20); V, 11–14 (12: 12.4 ± 0.90); VI, 8–10 (11: 9.0 ± 0.89); tergal and pleural setae on VII, 11–14 (10: 12.5 ± 1.08). Dorsal terminalia as in FIG. 22, with somewhat smaller terminal setose portion. *Sternal setae.* V, 11–15 (12: 13.8 ± 1.19); VI, 11–15 (12: 12.6 ± 1.31); VII, 10–14 (12: 11.5 ± 1.17). Total length 1.145–1.245 (12: 1.184 ± 0.0320). *Genitalia.* As in FIG. 15A; parameral arch as in FIG. 15B, width 0.065–0.075 (12: 0.068 ± 0.0040); endomeral plate as in FIG. 15C.

♀. As for *G. dickermani*, except as follows. Tergal setae on II, 12–15 (11: 13.3 ± 1.10); medial setae on VIII, 2–5 (19: 3.3 ± 0.95). Longest seta of medial 10 on tergite VII, 0.110–0.125 (10: 0.118 ± 0.0053), with 2–9 (10: 6.3 ± 2.16) of these longer than 0.100. Total length 1.185–1.360 (11: 1.261 ± 0.0563).

Remarks. The shapes of the male genitalic parameral arch and endomeral plate of *G. williamsi* are close to those of *G. markhafneri*, and, therefore, are quite different from those of *G. dickermani.* The broader appearance of the endomeral plate of *G. williamsi* affords separation from *G. markhafneri.* For males, the best quantitative characters between *G. williamsi* and *G. markhafneri* and their critical values for discrimination and the probabilities of misidentification were the width of the endomeral plate 0.034 (0.001), the length of the antennal scape 0.092 (0.026), and the width of the head 0.347 (0.028). For females, the best character was the number of setae on tergite II 14.34 (0.189). There are no known qualitative or quantitative means for consistently recognizing the female of *G. williamsi* from the other 2 taxa, although over 50% of *G. williamsi* have 4 or 5 medial setae on tergite VIII as contrasted to less than 10% of the females of the others.

This species is named for Mr Stephen L. Williams, Carnegie Museum of Natural History, in recognition of the numerous valuable gopher specimens he has collected.

Holotype ♂, *T. umbrinus* subsp. (R. Traub No. B-94094), MEXICO: Tlaxcala: 9 km N, 8 km E of Apizaco, 23.III.1978, S. L. Williams; in collection of U.S. National Museum of Natural History. Paratypes: 12♂,19♀, *T. umbrinus* subsp., MEXICO: Tlaxcala: 9 km N, 8 km E (2), 9 km N, 7 km E (3), 10 km N, 9 km E (4) of Apizaco, 19 km W of Tlaxcala (5).

Geomydoecus (Thomomydoecus) orizabae Price & Hellenthal, **new species** FIG. 16, 18, 20

Type-host. Thomomys umbrinus orizabae Merriam.

♂. Grossly as in FIG. 1. Temple width 0.310–0.345 (16: 0.333 ± 0.0110); head length 0.240–0.260 (16: 0.249 ± 0.0062); submarginal and inner marginal temple setae 0.025–0.030 (15:

0.027 ± 0.0024) and 0.030–0.040 (14: 0.034 ± 0.0039) long, respectively. Antenna with scape length 0.085–0.100 (16: 0.093 ± 0.0035), scape width 0.060–0.070 (16: 0.064 ± 0.0035). Prothorax width 0.235–0.260 (16: 0.248 ± 0.0063). *Tergal setae.* II, 8–11 (16: 9.9 ± 0.81); III, 11–16 (16: 13.9 ± 1.26); IV, 10–14 (16: 11.8 ± 1.24); V, 8–13 (16: 10.6 ± 1.41); VI, 5–9 (15: 7.6 ± 1.06); tergal and pleural setae on VII, 10–12 (16: 11.8 ± 0.58). Dorsal terminalia as in FIG. 20, with tapered terminal setose portion having deep medioanterior indentation; only 1 seta on each side lateral to paired sensilla; pair of longer setae on each side anterior to very short seta. *Sternal setae.* II, 6–10 (16: 8.4 ± 1.02); III, 10–13 (16: 11.3 ± 1.00); IV, 13–16 (15: 14.3 ± 1.16); V, 10–14 (16: 12.0 ± 1.21); VI, 10–13 (16: 11.1 ± 0.81); VII, 7–11 (15: 9.1 ± 0.92); VIII, 3–6 (15: 4.5 ± 0.99). Total length 1.050–1.170 (16: 1.114 ± 0.0322). *Genitalia.* As in FIG. 16A; parameral arch as in FIG. 16B, width 0.045–0.055 (16: 0.052 ± 0.0035); endomeral plate (FIG. 16C) with lighter area along concave side, width 0.030–0.035 (16: 0.033 ± 0.0024), length 0.075–0.090 (15: 0.084 ± 0.0041).

♀. Grossly as in FIG. 5. Temple width 0.370–0.410 (15: 0.387 ± 0.0121); head length 0.255–0.290 (15: 0.266 ± 0.0088); submarginal and inner marginal temple setae 0.025–0.030 (15: 0.027 ± 0.0025) and 0.035–0.050 (14: 0.042 ± 0.0044) long, respectively. Prothorax width 0.270–0.305 (15: 0.290 ± 0.0090). *Tergal setae.* II, 12–16 (15: 13.5 ± 1.25); III, 16–20 (15: 18.5 ± 1.19); IV, 20–24 (14: 21.9 ± 1.07); V, 18–26 (14: 21.9 ± 1.96); VI, 17–24 (14: 20.4 ± 1.99); tergal and pleural setae on VII, 21–33 (15: 26.3 ± 3.01); medial setae on VIII, 3–9 (31: 4.6 ± 1.18) (FIG. 18). Longest seta of medial 10 on tergite VI, 0.090–0.120 (15: 0.108 ± 0.0079); on tergite VII, 0.095–0.125 (15: 0.112 ± 0.0072), with 0–8 (15: 3.9 ± 2.13) of these longer than 0.100. Longest of medial setae on tergite VIII, 0.085–0.115 (14: 0.100 ± 0.0081). Last tergite with setae distributed in 1 + 4 + 1 arrangement (FIG. 18); each side with outer seta 0.075–0.095 (15: 0.086 ± 0.0068), middle seta 0.060–0.080 (13: 0.072 ± 0.0058), inner seta 0.050–0.075 (14: 0.062 ± 0.0063) long. *Sternal setae.* II, 9–11 (15: 10.1 ± 0.88); III, 11–16 (15: 13.3 ± 1.35); IV, 16–20 (15: 17.9 ± 1.30); V, 14–20 (15: 17.7 ± 1.50); VI, 14–19 (15: 16.7 ± 1.40); VII, 11–14 (15: 12.5 ± 0.92). *Subgenital plate.* Much as in FIG. 4, with 21–28 (15: 24.2 ± 1.70) setae. Total length 1.085–1.300 (15: 1.226 ± 0.0574).

Remarks. The shape of the genitalic endomeral plate in conjunction with the chaetotaxy and structure of the dorsal terminalia affords ready separation of males of *G. orizabae* from those of the foregoing 3 species of this group. The unique positioning of 4 medial setae on the last tergite and the consistent presence of more than 2 medial setae on tergite VIII separate females of *G. orizabae* from all other members of the group and complex.

Holotype ♀, *T. u. orizabae* (California Academy of Sciences-14871), MEXICO: Veracruz: S slope of Mt Orizaba, vicinity of Maltrata, 12.VII.1965, C. E. Wemmer; in collection of California Academy of Sciences. Paratypes: 15♂,24♀, *T. u. orizabae*, MEXICO: Veracruz, S slope of Mt Orizaba, vicinity of Maltrata (3), Pico de Orizaba (2).

Other specimens examined. MEXICO: 4♂,3♀, *T. u. albigularis* Nelson & Goldman, Hidalgo: 5 mi. (8.0 km) E (2), at (1) Tulancingo. 1♂,5♀, *T. umbrinus* subsp., Tlaxcala: 9 km N, 7 km E of Apizaco (1), 8 km S, 7 km W of Calpulalpan (3).

Geomydoecus (Thomomydoecus) johnhafneri Price & Hellenthal, new species FIG. 17, 21

Type-host. Thomomys umbrinus vulcanius Nelson & Goldman.

♂. Close to *G. orizabae*, except as follows. Antennal scape length 0.075–0.090 (21: 0.085 ± 0.0032). *Tergal setae.* II, 9–15 (21: 12.0 ± 1.36); III, 14–18 (20: 15.6 ± 1.39); IV, 11–16 (21: 13.2 ± 1.08). Dorsal terminalia as in FIG. 21, with setose terminal portion shorter, wider, but with deep medioanterior indentation; paired sensilla on line with to posterior to lateral paired setae; only 1 longer seta on each side anterior to sensilla. Total length 0.915–1.060 (21: 0.995 ± 0.0464). *Genitalia.* As in FIG. 17A; parameral arch as in FIG. 17B; endomeral plate (FIG. 17C) without evident lighter area along concave side, width 0.025–0.035 (21: 0.030 ± 0.0022), length 0.055–0.070 (18: 0.066 ± 0.0040).

♀. Close to *G. orizabae*, except as follows. Inner marginal temple seta 0.030–0.040 (18: 0.035 ± 0.0034) long. *Tergal setae.* II, 12–17 (20: 14.8 ± 1.47); III, 17–26 (19: 21.1 ± 2.25); IV, 22–30 (19: 25.0 ± 1.91); V, 21–28 (19: 24.4 ± 1.92); VI, 19–25 (19: 22.6 ± 1.74); medial setae on VIII, 2–6 (63: 3.3 ± 0.90). Last tergite with outer seta 0.085–0.120 (19: 0.102 ± 0.0096), middle seta 0.075–0.115 (19: 0.087 ± 0.0098) long. *Subgenital plate.* With 22–31 (19: 26.8 ± 2.72) setae. Total length 1.085–1.270 (19: 1.161 ± 0.0522).

Remarks. The shapes of the genitalic parameral arch and endomeral plate and the structure and chaetotaxy of the dorsal terminalia separate males of *G. johnhafneri* from those of the other species of the group. The distribution of the setae on the last tergite distinguishes the female of *G. johnhafneri* from that of *G. orizabae*. For males, the best quantitative characters between *G. johnhafneri* and *G. orizabae* and their critical values for discrimination and the probabilities of misidentification were the length of the endomeral plate 0.075 (0.015), the total length 1.055 (0.073), and the length of the antennal scape 0.089 (0.117). For females, the best characters were the number of setae on tergite IV (STG4) 23.46 (0.171), the length of the outer seta on the last tergite 0.094 (0.177), and the length of the middle seta on the last tergite (MSLTG) 0.080 (0.185). Because of high probability of female misidentification using any 1 of these quantitative characters, discriminant functions were calculated using these 3 and each combination of 2 of these 3 characters. An explanation of the use of discriminant functions for louse identification is given in Price & Hellenthal (1975). The use of STG4 and MSLTG in combination provided much improved discrimination, giving a probability of misidentifi-

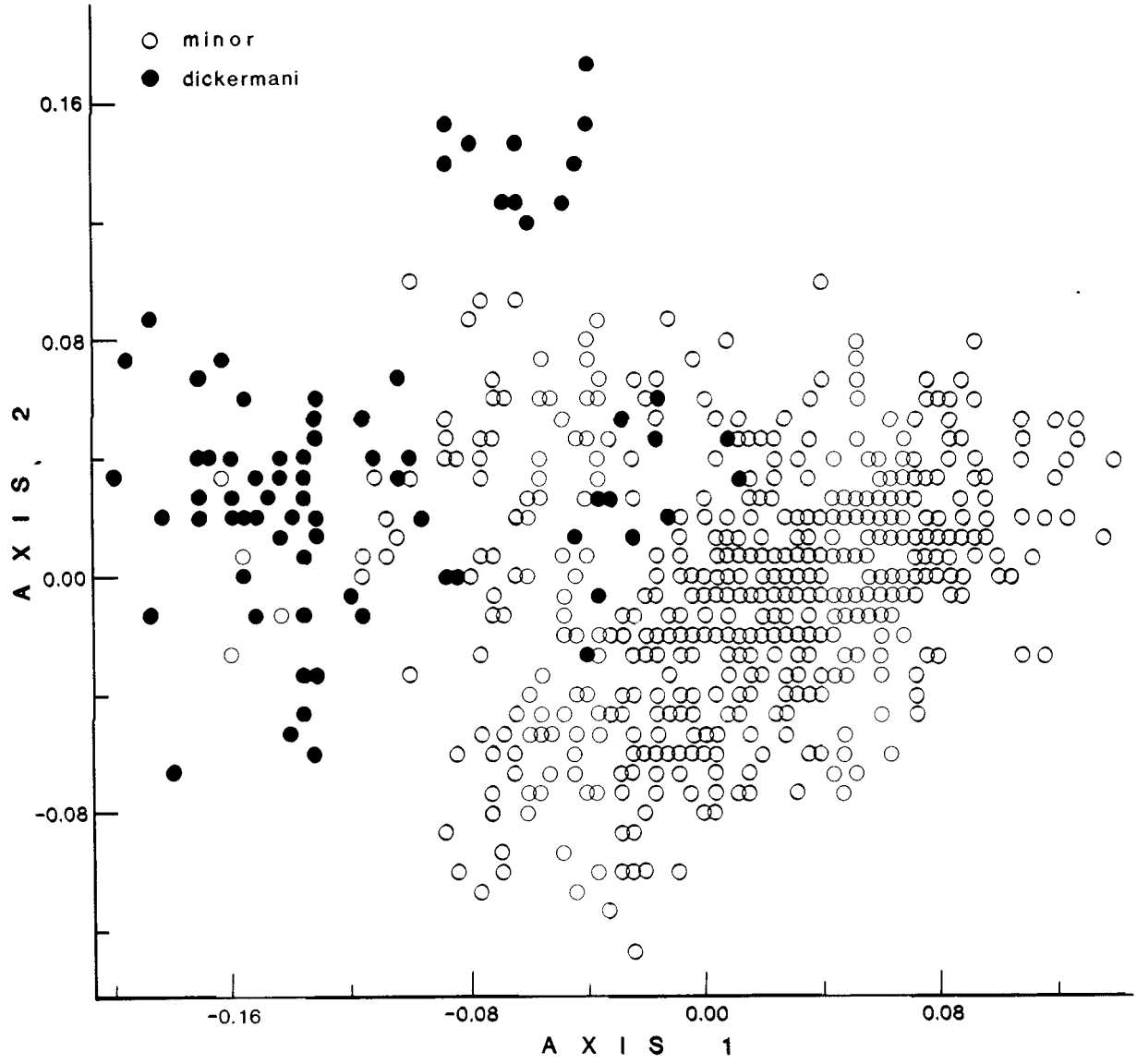

FIG. 23. Scattergram of principal components axes for ♂ of the *Geomydoecus minor* and *G. dickermani* groups.

cation of 0.060, with respective discriminant function coefficients of 0.0582 and 0.0107 and a critical value of 2.218 (discriminant means and standard deviations for *G. johnhafneri* were 2.396 ± 0.1296 and for *G. orizabae* 2.041 ± 0.0888).

This species is named for Mr John C. Hafner, Museum of Vertebrate Zoology, University of California, Berkeley, in recognition of his interest in mammalian ectoparasites and his efforts in collecting many important gopher specimens.

Holotype ♂, *T. u. vulcanius* (University of California Museum of Vertebrate Zoology-153850), MEXICO: Mexico: 5.5 km S, 13 km E of Amecameca, 5.IV.1977, J. C. Hafner; in collection of University of Minnesota. Paratypes: 46♂,65♀, *T. u. vulcanius*, MEXICO: Mexico: 5.5 km S, 13 km E of Amecameca (5), Timberline, N slope of Popocatepetl (5).

Although the taxa included in the *minor* complex generally demonstrated sufficient character differences to enable their separation, even the best quantitative characters showed some overlap. However, this overlap is not unexpected given the individual variability and moderate sample sizes. Because of this variability, we felt it desirable to find further supporting evidence for recognition

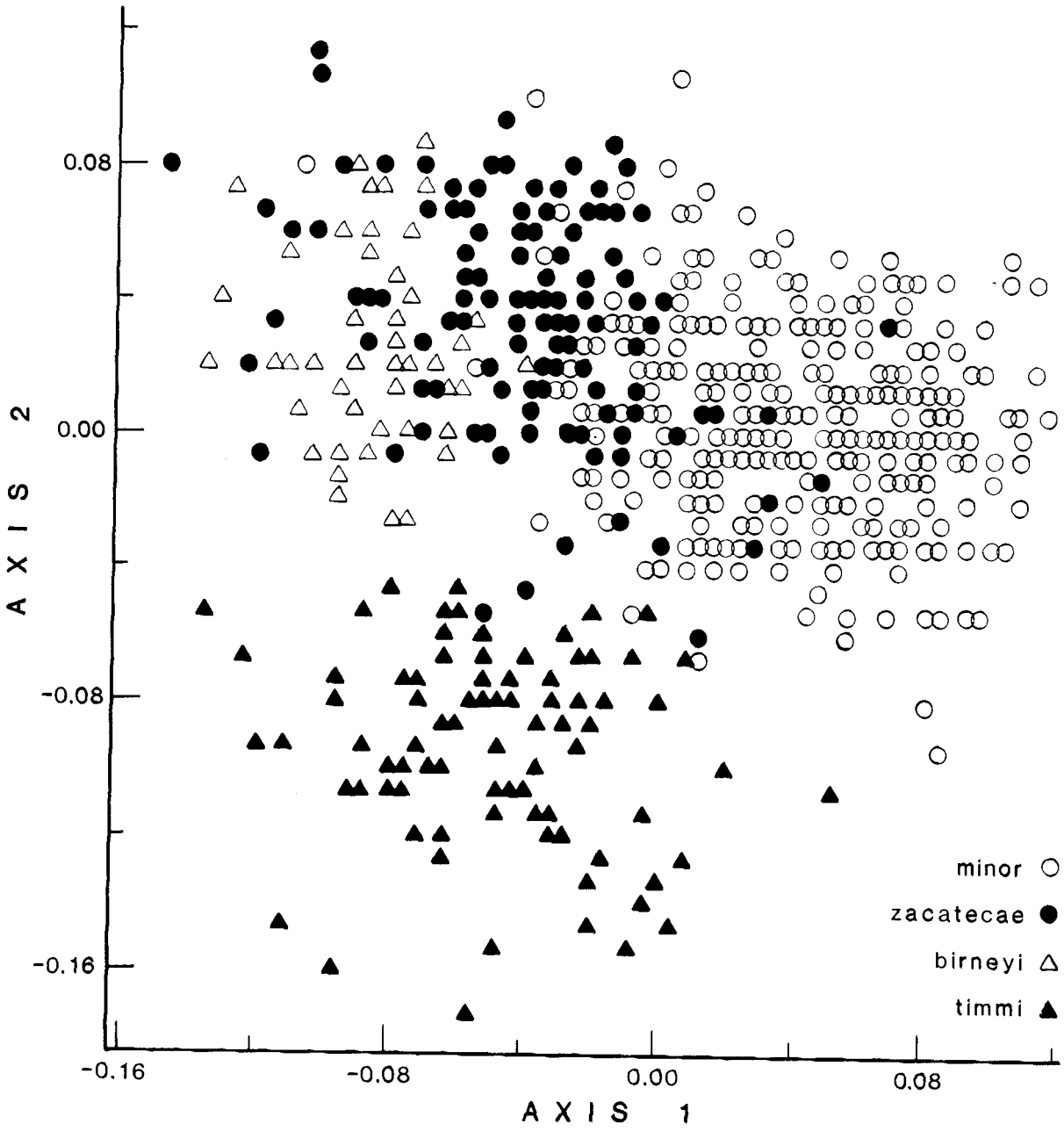

FIG. 24. Scattergram of principal components axes for ♂ of the 4 species of the *Geomydoecus minor* group.

of taxa. Principal components analysis of pooled quantitative data offers added support for our separations. Using the centered R-technique, as described by Orloci (1967), for 7 characters for males of the *minor* and *dickermani* groups, the first 3 components were found to account for 72% of the variation. Scattergrams with coordinates representing the 1st, 2nd, and 3rd principal axes in reduced character space generally supported our separation into the 2 groups, with the best separation achieved by graphing the 1st and 2nd axes (FIG. 23). Applying the same technique to the taxa within each of the 2 groups, using 6 characters for the *minor* group and 11 characters for the *dickermani* group, the first 3 components accounted for 77% of the variation of the former and 69% of the latter. The best separation for each of these was again achieved by graphing the 1st and 2nd axes. Within

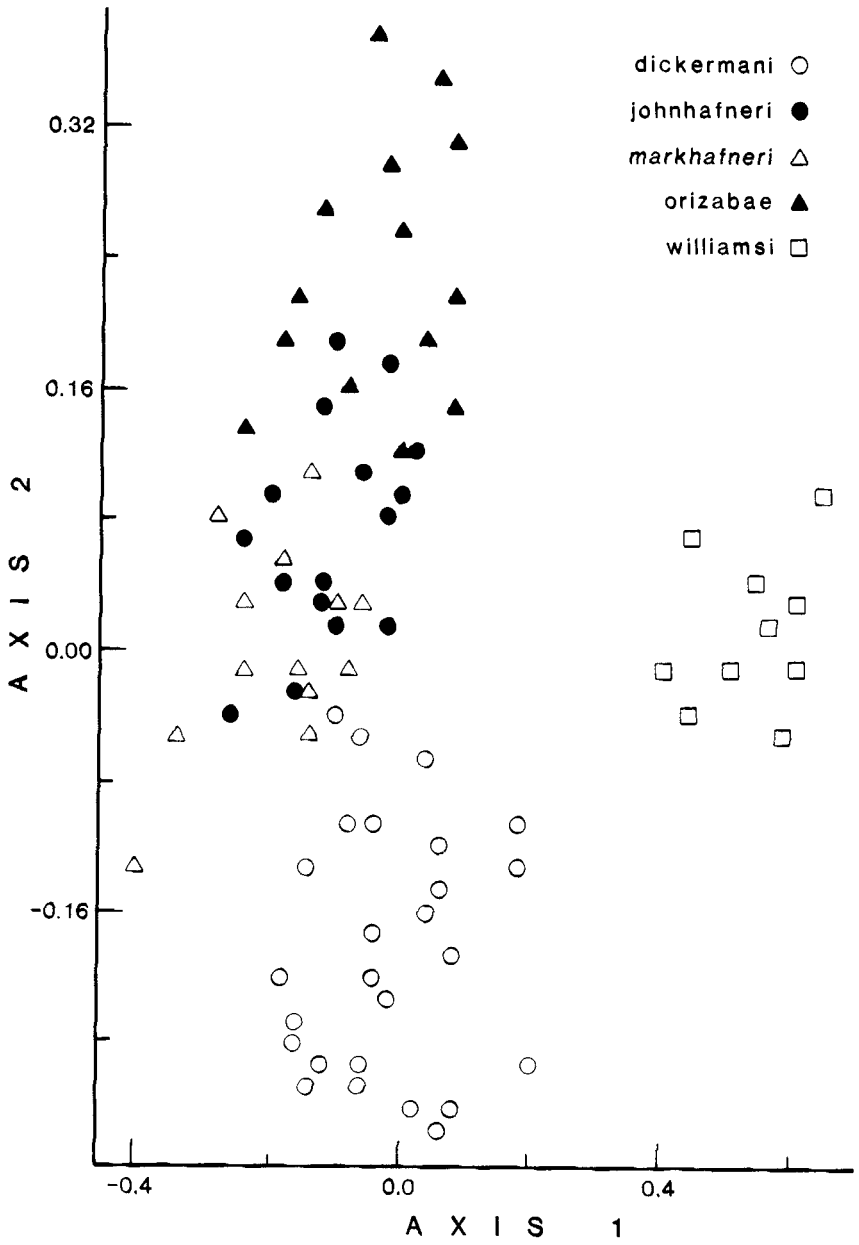

FIG. 25. Scattergram of principal components axes for ♂ of the 5 species of the *Geomydoecus dickermani* group.

the *minor* group (FIG. 24), *G. timmi* showed almost perfect separation, *G. minor* was next, and the greatest mix was demonstrated between *G. zacatecae* and *G. birneyi*; these are consistent with the qualitative similarities that we had noted. Within the *dickermani* group (FIG. 25), *G. williamsi* was clearly separated; *G. dickermani* and *G. orizabae* were fairly distinct at the lower and upper levels; the greatest mix was found between *G. johnhafneri* and *G. markhafneri*.

The males of the *minor* complex will all be identified as *G. minor* in the 1st half of couplet 12 of the key to males given by Price & Emerson (1971). From there, they may be identified by the following modification:

12a. *With relatively straight terminal portion of parameral arch and endomeral plate (FIG. 6–8); width of endomeral plate usually under 0.029 . . . minor group* 12b

With flection of terminal portion of parameral arch

and endomeral plate (FIG. 13–17); width of endomeral plate usually over 0.029 . . . *dickermani* group 12e

12b. Endomeral plate with deep medioanterior concavity and asymmetrical lateroanterior projections (FIG. 6C) ..... **minor**

Endomeral plate anteriorly symmetrical and without deep medioanterior concavity (FIG. 7C, 8C) 12c

12c. Endomeral plate roughly T-shaped (FIG. 8C) .... **timmi, n. sp.**

Endomeral plate as in FIG. 7C 12d

12d. Dorsal terminalia as in FIG. 10, with sensilla on line with to anterior to lateral paired setae . . . **birneyi, n. sp.**

Dorsal terminalia close to FIG. 10, but with sensilla often posterior to lateral paired setae . . **zacatecae, n. sp.**

12e. Dorsal terminalia as in FIG. 20, with each side having 2 longer setae anterior to sensilla and only 1 lateral seta ..... **orizabae, n. sp.**

Dorsal terminalia (FIG. 19, 21, 22) with each side having 2 setae lateral to sensilla and only 1 longer anterior seta 12f

12f. Endomeral plate with pronounced convexity on flexed side (*FIG. 14C, 15C*) *12g*

Endomeral plate without such well-developed convexity (FIG. 13C, 17C) 12h

12g. *Width of endomeral plate usually under 0.034* (FIG. 14C); antennal scape length usually under 0.092 . . . (ex *T. u. umbrinus*, Puebla, Mexico) .... **markhafneri, n. sp.**

Width of endomeral plate usually over 0.034 (FIG. 15C); antennal scape length usually over 0.092 . . . (ex *T. umbrinus* subsp., Tlaxcala, Mexico) . . . . **williamsi, n. sp.**

12h. Parameral arch with deep medioanterior concavity (FIG. 17B); dorsal terminalia (FIG. 21) with relatively short terminal setose portion shaped as shown . . . (ex *T. u. vulcanius*) ..... **johnhafneri, n. sp.**

Parameral arch without such deep medioanterior concavity (*FIG. 13B*); *dorsal terminalia (FIG. 19)* with longer terminal setose portion shaped as shown . . . (ex *T. u. tolucae, T. u. peregrinus*) .... **dickermani**

Because of their unique 1 + 4 + 1 setal distribution across the last tergite, females of *G. orizabae* will fit neither portion of couplet 1 of the key to females given by Price & Emerson (1971). Females of the other 8 species will all come out in the 2nd half of couplet 6. Whereas males of the *minor* complex offer excellent morphological features for specific recognition, these females are for the most part inseparable; those of *G. birneyi, G. williamsi,* and *G. johnhafneri* do often have 3 or more median setae on tergite VIII. However, other than this, females are at best difficult to distinguish morphologically and should be placed to species by association with identified males and/or by host association.

Acknowledgments. We thank the following individuals for permitting us to brush pocket gopher skins or for otherwise assisting in the preparation of this paper: Dr E. Lendell Cockrum, University of Arizona; Dr Robert E. Elbel, University of Utah; Dr K. C. Emerson, U.S. National Museum of Natural History; Dr Robert S. Hoffmann, University of Kansas; Dr Robert T. Orr, California Academy of Sciences; Dr James L. Patton, University of California, Berkeley; Dr Amadeo M. Rea, San Diego Natural History Museum; and Dr Fred S. Truxal, Los Angeles County Museum of Natural History. We also thank the staff of the University of Minnesota University Computer Center for the use of its facilities and Dr Frank B. Martin, Director of the University of Minnesota Statistical Center, for his advice throughout our study.

LITERATURE CITED

Dixon, W. J., ed. 1973. *BMD biomedical computer programs.* 3rd ed. Univ. of California Press, Berkeley. 773 p.

Goldstein, R. A. & D. F. Grigal. 1972. *Computer programs for the ordination and classification of ecosystems.* Oak Ridge National Laboratory, Tennessee. Ecological Sciences Division Publication No. 417. 125 p.

Orloci, L. 1967. Data centering: a review and evaluation with reference to component analysis. *Syst. Zool.* **16:** 208–12.

Price, R. D. & K. C. Emerson. 1971. A revision of the genus *Geomydoecus* (Mallophaga: Trichodectidae) of the New World pocket gophers (*Rodentia: Geomyidae*). *J. Med. Entomol.* **8:** 228–57.

1972. A new subgenus and three new species of *Geomydoecus* (Mallophaga: Trichodectidae) from *Thomomys* (Rodentia: Geomyidae). *J. Med. Entomol.* **9:** 463–67.

Price, R. D. & R. A. Hellenthal. 1975. A reconsideration of *Geomydoecus expansus* (Duges) (Mallophaga: Trichodectidae) from the yellow-faced pocket gopher (Rodentia: Geomyidae). *J. Kans. Entomol. Soc.* **48:** 33–42.

1979. A review of the *Geomydoecus tolucae* complex (Mallophaga: Trichodectidae) from *Thomomys* (Rodentia: Geomyidae), based on qualitative and quantitative characters. *J. Med. Entomol.* **16:** 265–74.