

THE TAXONOMY OF *GEOMYDOECUS* (MALLOPHAGA: TRICHODECTIDAE)
FROM THE *GEOMYS BURSARIUS* COMPLEX
(RODENTIA: GEOMYIDAE)¹

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Abstract. A revision was undertaken of the members of the genus *Geomydoecus* parasitizing Plains Pocket Gophers of the *Geomys bursarius* complex. Prior to this revision, 5 specific and subspecific taxa of lice were recognized from *Geomys bursarius*. Approximately 20,000 lice were obtained and examined; these were from all described subspecies of *G. bursarius* and represented 590 individual hosts from 427 localities. In addition to a study of qualitative features, 28 morphological characters were quantified for both adult male and female lice. The measured or counted characters that proved useful taxonomically are reported along with their ranges, means, and standard deviations. Three programs in the BMDP series were used for the multivariate statistical analysis: principal components analysis (BMDP4M), discriminant function analysis (BMDP7M), and cluster analysis (BMDP2M). The *Geomydoecus* on *Geomys bursarius* proved to be quite variable geographically; however, there was little intrapopulation variability. This geographical variation is best represented taxonomically by recognizing 8 distinct monotypic species of lice. The previously described species, *Geomydoecus geomydis*, *G. ewingi*, *G. illinoensis*, and *G. oklahomensis*, are all recognized as valid species. A population previously described as a subspecies of *G. geomydis* is elevated to specific status, *G. subgeomydis*, and 3 new species are described: *G. heaneyi* on *Geomys bursarius illarensis* and *G. b. texensis*; *G. nebrathkensis* on *Geomys bursarius lutescens*; and *G. spickai* on *Geomys bursarius missouriensis*. These 8 species of lice cluster as 2 distinct groupings; the 1st, here termed the "northern" group, is composed of *G. geomydis*, *G. illinoensis*, *G. nebrathkensis*, *G. oklahomensis*, and *G. spickai*; the 2nd, the "southern" group, is composed of *G. ewingi*, *G. heaneyi*, and *G. subgeomydis*. In no case did a single population of pocket gophers have more than 1 species of *Geomydoecus* parasitizing it. Two species of *Geomydoecus* were obtained on Long-tailed Weasels, *Mustela frenata*; these host records are considered primary contamination, a result of the weasel's obtaining the lice directly from pocket gophers. A key is presented to the 15 specific and subspecific taxa of *Geomydoecus* that parasitize pocket gophers of the genus *Geomys*.

Osborn (1891) was the first to mention finding lice on pocket gophers; he described *Trichodectes geomydis* [= *Geomydoecus geomydis* (Osborn)] on the basis of several specimens off the Plains Pocket Gopher, *Geomys bursarius* (Shaw), from Ames, Iowa. Over the next 80 years, 10 more taxa of pocket gopher lice were described and the genus

Geomydoecus Ewing was erected to contain all known species. Price & Emerson (1971) completed the first revision of the genus *Geomydoecus* and described 3 new species and 1 additional subspecies of lice from *Geomys bursarius*. Thus, prior to this study, the lice parasitizing the *Geomys bursarius* complex were divided into 4 species, 3 considered monotypic and *G. geomydis* with 2 subspecies.

Geomys currently is divided into 8 species, with *Geomys bursarius* consisting of 15 subspecies (Baker & Genoways 1975, Baker & Williams 1974, Hall & Kelson 1959, Honeycutt & Schmidly 1979, Jones 1964, McLaughlin 1958). However, this classification has not been universally accepted because the status of several species and subspecies is uncertain. Pocket gophers of the *Geomys bursarius* complex are found throughout much of the midwestern and southern United States. They range from Illinois and Indiana west to Colorado and New Mexico, and from extreme southern Manitoba to southern Texas. Recent studies have shown that there is little to no gene flow between several of the "supposed" subspecies of *Geomys bursarius* (Heaney 1979, Honeycutt & Schmidly 1979). Thus, some populations of *G. bursarius* form genetically distinct species; hence, in this paper we refer to these pocket gophers as the *Geomys bursarius* complex.

Price & Emerson (1971) had available to them only a few hundred lice from about ½ the described subspecies of *Geomys bursarius*. For this study, we have examined approximately 20,000 lice from some 590 individual hosts, representing 427 localities. This abundance of material has allowed a thorough review of the *Geomydoecus* on the *Geomys bursarius* complex and resulted in the re-description of the 4 previously recognized species, the description of 4 additional species, and refinements of our knowledge of the distribution of lice on Plains Pocket Gophers.

Lice were obtained from all 15 subspecies of *Geomys bursarius* that currently are recognized and from populations of 8 previously recognized subspecies. Whenever possible, large samples of lice

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were obtained from numerous localities throughout the range of each subspecies of pocket gopher. In addition to obtaining lice from prepared skins in collections, several hundred pocket gophers were trapped from critical areas.

Lice collected during this study, including holotypes, are deposited in the entomology collection of the University of Minnesota, St. Paul. Paratypes of new species described also will be deposited in the British Museum (Natural History) and the U.S. National Museum of Natural History. Pocket gophers collected during this study are deposited in the Bell Museum of Natural History of the University of Minnesota and the Museum of Natural History of the University of Kansas.

In the species descriptions, measured or counted characters are followed by the minimum and maximum values observed; the number of observations, mean, and standard deviation are enclosed within parentheses. All measurements are in millimetres. In the species accounts, when a character on one species is referred to as "significantly" different from that of another species, significance was defined as $P \leq 0.01$.

In the section on specimens examined, the order of listing is alphabetically by subspecies of host; the first set of numbers represents the number of adult female and male lice examined; no immatures are included in this figure even though later developmental stages are sexable. Next follows the locality data; if distances were originally obtained in miles, the metric equivalents have been calculated to the nearest 0.1 km and follow parenthetically. In these cases, the English figure represents the correct degree of precision. The last figure is the number of hosts from which lice were obtained from that locality. All lice are deposited in the entomology collection of the University of Minnesota unless otherwise noted. Abbreviations for specimens examined in other collections are as follows: KU = University of Kansas, OSU = Ohio State University, RW = collection of Ronald A. Ward, UC = University of California at Berkeley, UN = University of Nebraska, USNM = United States National Museum of Natural History.

Three programs in the BMDP series were used for the multivariate statistical analyses reported here; they were run on a Honeywell 66-60 computer at the Academic Computation Center, University of Kansas. The principal components analyses (BMDP4M) reported here used only those measurements which earlier analyses had shown were not redundant. The discriminant function

analyses (BMDP7M) were based on data series in which missing data points were generated by BMDPAM using linear regression. The discriminant function analyses used F's to enter and remove of 1.0 and 0.9, respectively; the number of steps was not limited. The F-matrices generated for groups were considered significant if they had $P \leq 0.05$ (Seal 1964). Classification matrices were the bases for statements regarding the ability of the analyses to properly identify individuals. The cluster analyses (BMDP2M) used a sum of squares, unweighted pair-group mean analysis method; input data were standardized.

Geomydoecus geomydis (Osborn) FIG. 1-2, 11

Trichodectes geomydis Osborn, 1891, U.S. Dep. Agric. Div. Entomol. Bull. No. 7: 54.

Geomydoecus geomydis: Ewing, 1929, Man. Ext. Parasites: 121, 193.

Geomydoecus geomydis geomydis: Price & Emerson, 1971, J. Med. Entomol. 8: 236.

Type-locality: USA: Iowa: Ames.

Type-host: *Geomys bursarius* (Shaw).

♀. Head length 0.295-0.350 (49: 0.316 ± 0.0119); temple width 0.420-0.490 (50: 0.461 ± 0.0156); submarginal temple seta (FIG. 2) 0.045-0.070 (36: 0.059 ± 0.0052); marginal temple seta (FIG. 2) 0.035-0.050 (46: 0.042 ± 0.0048). Total length 1.185-1.430 (47: 1.320 ± 0.0592). Tergal setae: II, 10-18 (50: 14.5 ± 1.83); III, 16-25 (50: 21.7 ± 2.08); IV, 19-30 (50: 24.2 ± 2.58); V, 18-27 (50: 22.5 ± 2.39); VI, 16-26 (50: 21.4 ± 2.30); tergal and pleural setae on VII, 27-37 (50: 31.9 ± 2.47). Longest seta of medial 10 on tergite VI, 0.080-0.105 (50: 0.092 ± 0.0070) long; on tergite VII, 0.065-0.120 (49: 0.095 ± 0.0097); of median pair on tergite VIII, 0.045-0.090 (48: 0.068 ± 0.0091). Last tergite with 3 lateral setae close together on each side; outer seta generally shortest, 0.060-0.095 (41: 0.078 ± 0.0078) long; middle seta, 0.075-0.105 (44: 0.091 ± 0.0076); inner seta, 0.085-0.105 (44: 0.092 ± 0.0056). Sternal setae: II, 9-17 (50: 12.6 ± 1.99); III, 9-15 (50: 11.9 ± 1.16); IV, 10-15 (44: 12.7 ± 1.30); V, 8-14 (45: 10.9 ± 1.28); VI, 8-12 (50: 9.7 ± 1.01); VII, 7-11 (50: 9.4 ± 0.87). Subgenital plate (FIG. 4) with 20-30 (49: 24.9 ± 2.67) setae. Genital sac (FIG. 11) length 0.195-0.265 (45: 0.229 ± 0.0196); total number of complete loops in genital sac 8-18 (48: 12.0 ± 2.20); last complete loop extending back 0.115-0.175 (47: 0.154 ± 0.0138) from anterior margin.

♂. Head length 0.300-0.360 (54: 0.332 ± 0.0138); temple width 0.385-0.455 (54: 0.425 ± 0.0146); submarginal temple seta (FIG. 1) 0.035-0.070 (40: 0.056 ± 0.0079); marginal temple seta (FIG. 1) 0.025-0.030 (52: 0.026 ± 0.0023). Total length 1.210-1.600 (48: 1.383 ± 0.0787). Antennal scape length 0.160-0.190 (51: 0.178 ± 0.0079); scape medial width 0.100-0.130 (51: 0.116 ± 0.0074), distal width 0.110-0.150 (51: 0.127 ± 0.0089). Tergal setae: II, 7-15 (53: 12.5 ± 1.50); III, 16-26 (52: 19.1 ± 1.79); IV, 17-26 (53: 21.6 ± 1.91); V, 16-24 (53: 20.4 ± 1.84); VI, 12-18 (52: 15.1 ± 1.43); tergal and pleural setae on VII, 16-24 (47: 20.1 ± 1.88). Sternal setae: II, 9-16 (51: 12.4 ± 1.80); III, 9-17 (53: 12.1 ± 1.54); IV, 10-19 (51: 12.9 ± 1.74); V, 8-13 (49: 10.0 ± 1.37); VI, 6-12 (50: 9.4 ±

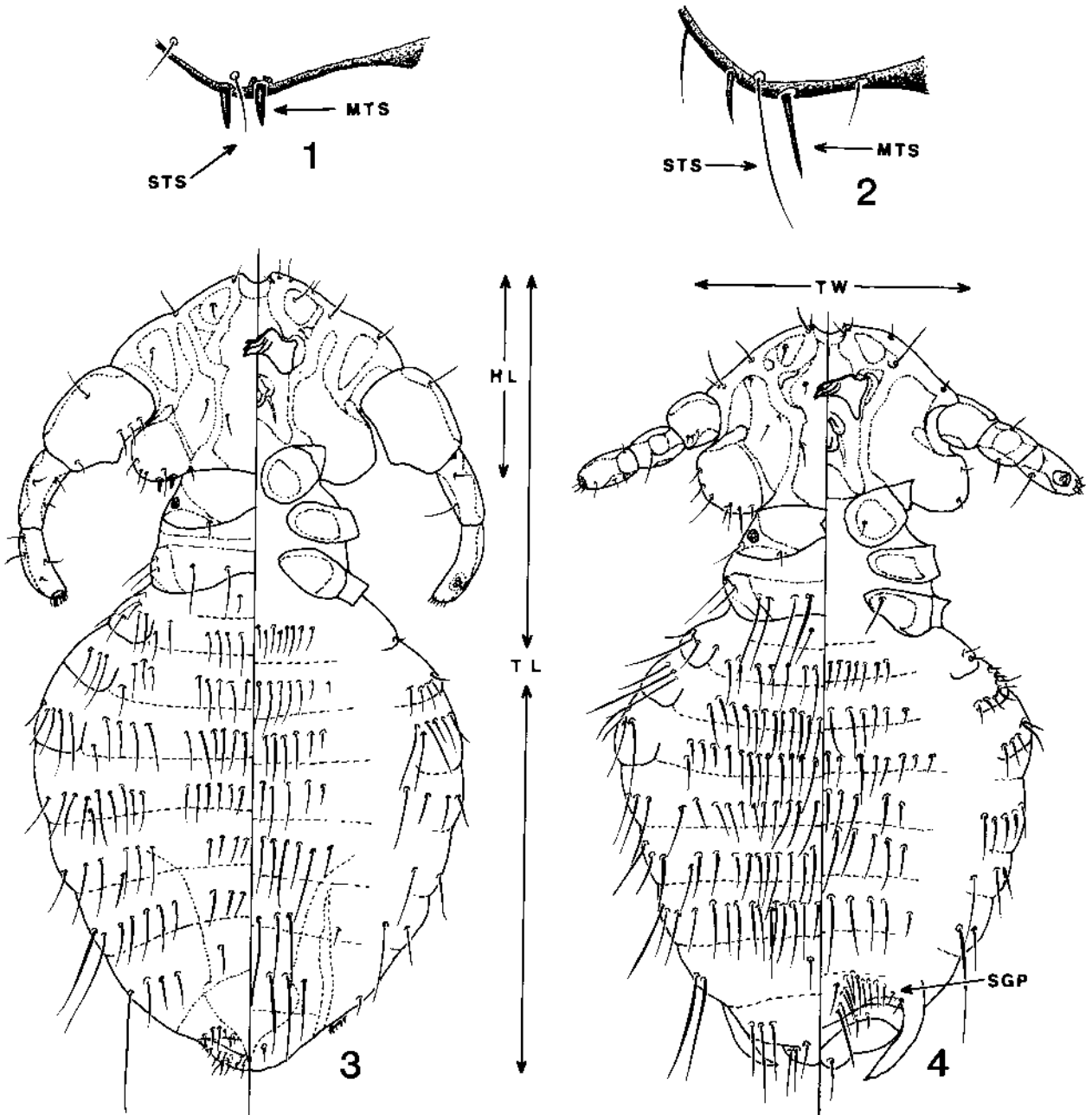


FIG. 1-4. 1-2, *Geomydoecus geomydis*: (1) ♂ temple margin (MTS, marginal temple seta; STS, submarginal temple seta); (2) ♀ temple margin (MTS, marginal temple seta; STS, submarginal temple seta). 3-4, *G. nebrathkensis*: (3) ♂ (HL, head length; TL, total length); (4) ♀ (TW, temple width; SGP, subgenital plate).

1.23); VII, 6-10 (51: 8.3 ± 1.03); VIII, 5-8 (54: 6.2 ± 0.59). Genitalia with sac having 6 large spines; parameral arch width 0.145-0.180 (52: 0.166 ± 0.0075); endomerale plate width 0.070-0.090 (53: 0.084 ± 0.0044), length 0.060-0.095 (53: 0.085 ± 0.0062), triangular, apically tapered with distinct cleft 0.020-0.040 (53: 0.028 ± 0.0040) deep.

Geomydoecus geomydis is found on the subspecies of *Geomys bursarius* that occur northward from eastern Kansas and northern Missouri. These in-

clude *G. bursarius bursarius*, *G. b. majusculus* Swenk, and *G. b. wisconsinensis* Jackson. No other species of lice were found parasitizing these 3 subspecies of pocket gophers. The original description of "*Trichodectes geomydis*" by Osborn (1891) and the associated illustration were vague. In fact, they could apply equally to many members of the family Trichodectidae. However, Osborn did assign a

type-host and type-locality: *Geomys bursarius* from Ames, Iowa. The entomology collection at Ohio State University, Columbus, Ohio, has 1 slide of *Geomydoecus* from Osborn's type-series. This slide contains 6 specimens: 2 males and 4 females. We have examined this series and, although they are mounted poorly, all are consistent with what we now consider *G. geomydis*. Emerson (1960) designated a male from this slide as the lectotype. In his original species description, Osborn also mentioned that he had seen specimens of *G. geomydis* from "the western gopher, *Thomomys*" (see APPENDIX). Herein, we consider *G. geomydis* a monotypic species, restricted to 3 subspecies of pocket gophers, *G. b. bursarius*, *G. b. majusculus*, and *G. b. wisconsinensis*, and occurring on pocket gophers in Minnesota, Wisconsin, Iowa, northern Missouri, the eastern portions of Kansas, Nebraska, South Dakota, and North Dakota, and extreme southern Manitoba (FIG. 13). Price & Emerson (1971) recognized 2 subspecies of *G. geomydis*, *G. g. geomydis* and *G. g. subgeomydis*. The taxon that Price & Emerson (1971) named as *G. g. subgeomydis* we now recognize as a distinct species (for comparisons of *G. geomydis* and *G. subgeomydis*, see the discussion of *G. subgeomydis*).

On 4 separate occasions, *G. geomydis* was found on Long-tailed Weasels [*Mustela frenata primulina* Jackson and *M. f. spadix* (Bangs)] (also see account of *G. oklahomensis*). This is an interesting host record, but one that is not totally unexpected. We know of several instances of Long-tailed Weasels preying on pocket gophers and utilizing their burrow systems. We have also collected the pocket gopher flea, *Dactylopsylla ignota* (Baker), on Long-tailed Weasels and in some instances it was the most abundant flea found on the weasels (Timm, unpubl.). It is doubtful that *Geomydoecus* could complete its life cycle on Long-tailed Weasels; only a single adult louse was obtained on 4 of 5 weasels, and the fifth had 2 lice.

The name *G. geomydis* has appeared numerous times in the literature of both pocket gophers and lice; however, in most cases the louse under discussion was not *G. geomydis* (sensu stricto) as presently understood (see APPENDIX). Other than the original species description, the only papers that present new data on this species are Rissky (1962) and Price & Emerson (1971).

Specimens examined. *Geomys bursarius bursarius*, 161 ♀, 150 ♂, USA: Minnesota: Anoka Co.: Carlos Avery Game Management Area (2), Goodhue Co.: (1), Houston Co.: LaCrescent (1) (USNM), 3½ mi

(5.6 km) W of (1) and at (1) Caledonia, Hubbard Co.: ½ mi (0.8 km) N and 6½ mi (10.5 km) E of Hubbard (1), Kittson Co.: Karlstad (1), Outertail Co.: (1), Pine Co.: 3 mi (4.8 km) S and 7 mi (11.3 km) E of Pine City (1), Ramsey Co.: (2), St. Anthony Park (10), St. Paul (1), Redwood Co.: 2 mi (3.2 km) N and 3 mi (4.8 km) E of Lucan (1), Rock Co.: 2½ mi (4.0 km) S and 5 mi (8.0 km) E of Luverne (1), Sherburne Co.: Elk River (1), Swift Co.: 5 mi (8.0 km) S and 1 mi (1.6 km) W of Benson (1); North Dakota: Grand Forks Co.: Grand Forks (3) (USNM); South Dakota: Grant Co.: (1), Marshall Co.: (1). *Geomys bursarius majusculus*, 220 ♀, 202 ♂, USA: Iowa: Butler Co.: 3 mi (4.8 km) E of Greene (1), Dickenson Co.: Spring Run (1), Emmet Co.: 4 mi (6.4 km) SE of Wallingford (1), Fremont Co.: 3½ mi (5.6 km) S of Sidney (1), Johnson Co.: Iowa City (3), Linn Co.: (1), Lyon Co.: 2 mi (3.2 km) SE of Granite (1), Mahaska Co.: New Sharon area (1), Marshall Co.: 3 mi (4.8 km) W of Green Mountain (1), Monroe Co.: (1), Story Co.: Ames (3) (OSU, USNM); Kansas: Douglas Co.: 3 mi (4.8 km) N of (1) and 6 mi (9.7 km) W of (1) Lawrence, Greenwood Co.: (1), Hamilton (2), Jackson Co.: Birmingham (1), ½ mi (0.8 km) S and 2 mi (3.2 km) E of Holton (1) (USNM), Leavenworth Co.: (1), Marion Co.: 1½ mi (2.4 km) NE Lincolnville (1), Marshall Co.: (2), Blue Rapids (1) (USNM), Mitchell Co.: 3½ mi (5.6 km) W of Beloit (2), Republic Co.: 2 mi (3.2 km) N of Scandia (1), Riley Co.: (1), Manhattan (1) (USNM); Missouri: Holt Co.: Squaw Creek (1), Lewis Co.: Wakonda State Park (1) (USNM); Nebraska: Antelope Co.: 0.2 mi (0.32 km) S and 0.5 mi (0.8 km) W of Oakdale (3), ¼ mi (0.4 km) S and ¾ mi (1.2 km) W of Oakdale (4), 5 mi (8.0 km) W of Tilden (1), Butler Co.: 4–5 mi (6.4–8.0 km) E of Rising City (1), Clay Co.: Saronville (1) (USNM), Cuming Co.: West Point (1), Douglas Co.: Omaha (2), Gage Co.: 2 mi (3.2 km) S of Barneston (1), Knox Co.: 1½ mi (2.4 km) N and 3 mi (4.8 km) W of Center (1), Niobrara (1), Lancaster Co.: 6 mi (9.7 km) E of (1) and at (4) (USNM) Lincoln, Otoe Co.: 4 mi (6.4 km) SE of Nebraska City (1), Richardson Co.: 4 mi (6.4 km) E of Barada (1), Washington Co.: 1 mi (1.6 km) E of Blair (1); South Dakota: Bon Homme Co.: (1), Union Co.: (1). *Geomys bursarius wisconsinensis*, 373 ♀, 354 ♂, USA: Wisconsin: Richland Co.: Lone Rock (10). *Mustela frenata primulina*, 1 ♂, USA: Kansas: Douglas Co.: Lawrence (1). *Mustela frenata spadix*, 3 ♂, USA: Minnesota: Dakota Co.: Rosemount (2), Scott Co.: 2½ mi (4.0 km) N and 2½ mi (4.0 km) E of New Market (1).

Geomydoecus illinoensis Price & Emerson

FIG. 12

Geomydoecus illinoensis Price & Emerson, 1971, J. Med. Entomol. 8: 238.

Type-locality: USA: Indiana: Tippecanoe Co.

Type-host: *Geomys bursarius illinoensis* Komarek & Spencer.

♀. Much as for *G. geomydis*, except *G. illinoensis* larger in certain characters and with distinct differences in genital chamber sac. Head length 0.310–0.335 (15: 0.320 ± 0.0070); temple width 0.460–0.485 (18: 0.470 ± 0.0097); submarginal temple seta 0.055–0.080 (18: 0.065 ± 0.0062); marginal temple seta 0.045–0.055 (17: 0.049 ± 0.0057). Total length 1.300–1.460 (16: 1.375 ± 0.050). Tergal setae: V, 19–29 (19: 23.7 ± 2.08); tergal and pleural setae on VII, 27–38 (19: 33.6 ± 2.61). Longest seta of medial 10 on tergite VI, 0.080–0.110 (19: 0.098 ± 0.0078). Sternal setae: III, 11–17 (15: 13.3 ± 1.40); IV, 13–16 (18: 14.4 ± 1.04); V, 10–15 (17: 12.4 ± 1.41); VI, 9–12 (20: 10.3 ± 0.88). Subgenital plate with 25–37 (20: 28.3 ± 2.54) setae. Genital sac (FIG. 12) length 0.220–0.270 (20: 0.245 ± 0.0150); total number of complete irregular loops in genital sac 2–6 (20: 3.6 ± 1.14); last complete loop extending back 0.115–0.185 (20: 0.153 ± 0.0146).

♂. Much as for *G. geomydis*, except for distinct differences in the antennal scape, temple setae, and genitalia. Head length 0.325–0.360 (19: 0.339 ± 0.0097); temple width 0.415–0.450 (19: 0.429 ± 0.0088); submarginal temple seta 0.055–0.070 (18: 0.064 ± 0.0061). Total length 1.310–1.480 (16: 1.394 ± 0.0543). Antennal scape length 0.175–0.195 (18: 0.187 ± 0.0065); scape medial width 0.110–0.130 (18: 0.121 ± 0.0051), distal width 0.110–0.143 (18: 0.128 ± 0.0094). Tergal setae: V, 20–25 (19: 22.9 ± 1.33); tergal and pleural setae on VII, 19–25 (16: 21.7 ± 1.70). Sternal setae: II, 10–13 (18: 11.5 ± 0.99); V, 10–13 (19: 11.1 ± 0.88). Genitalia with sac having 6 large spines; parameral arch width 0.140–0.180 (19: 0.170 ± 0.0097); endomeran plate width 0.080–0.095 (19: 0.088 ± 0.0037), length 0.070–0.095 (19: 0.083 ± 0.0072), triangular, apically tapered with distinct cleft 0.020–0.035 (19: 0.027 ± 0.0036) deep.

Price & Emerson (1971) described *G. illinoensis* on the basis of the distinct differences in the genital chamber sac of the female alone. Examination of a large series of specimens has shown that there are several characters in which *G. geomydis* and *G. illinoensis* differ. *Geomydoecus illinoensis* is consistently larger and has longer setae than *G. geomydis*, with this latter character especially noticeable in females. The best character for separating these 2 species remains the female genital chamber sac, *G. illinoensis* having 2–6 (usually 3 or 4) complete but irregular loops (see FIG. 12) and *G. geomydis* having 8–18 complete smooth loops (see FIG. 11).

Geomydoecus illinoensis is restricted to *Geomys bursarius illinoensis*, the easternmost subspecies of *G. bursarius*. This pocket gopher subspecies occurs throughout central Illinois and extreme northwestern Indiana (see FIG. 13) and is isolated geo-

graphically from the more western subspecies by major river systems, the Mississippi and Illinois rivers on the west and the Kankakee River on the north.

Previous reports of *Geomydoecus* on pocket gophers in Illinois and Indiana include those of Malecki (1949) and Tuszynski & Whitaker (1972).

Specimens examined. *Geomys bursarius illinoensis*, 308 ♀, 286 ♂, USA: Illinois: Cass Co.: 2.8 mi (4.5 km) ESE of Bluff Springs (2), DeWitt Co.: (2), Kankakee Co.: Hopkins Park (1), Pembroke Township (2), Madison Co.: Collinsville (1), Marshall Co.: ½ mi (0.8 km) S of Varna (1), Mason Co.: 4½ mi (7.2 km) S of Bath (1), 3 mi (4.8 km) E of Havana (1), McLean Co.: 2 mi (3.2 km) SE of Bloomington (2), St. Clair Co.: O'Fallon (3), Will Co.: Custer Park (1); Indiana: Newton Co.: (1), Tippecanoe Co.: (1).

Geomydoecus oklahomensis Price & Emerson*Geomydoecus oklahomensis* Price & Emerson, 1971, J. Med. Entomol. 8: 242.

Type-locality: USA: Oklahoma: Cleveland Co.

Type-host: *Geomys bursarius major* Davis [originally given as *G. b. dutcheri* Davis by Price & Emerson (1971)].

♀. Head length 0.285–0.335 (108: 0.306 ± 0.0100); temple width 0.380–0.480 (107: 0.443 ± 0.0182); submarginal temple seta 0.045–0.065 (70: 0.056 ± 0.0054); marginal temple seta 0.030–0.055 (98: 0.041 ± 0.0062). Total length 1.100–1.370 (104: 1.259 ± 0.0507). Tergal setae: II, 9–20 (107: 15.2 ± 1.66); III, 18–26 (108: 21.5 ± 1.65); IV, 17–30 (108: 23.6 ± 2.11); V, 16–27 (107: 22.1 ± 2.18); VI, 16–28 (107: 21.0 ± 2.08); tergal and pleural setae on VII, 26–38 (108: 32.8 ± 2.35). Longest seta of medial 10 on tergite VI, 0.060–0.115 (108: 0.090 ± 0.0076); on tergite VII, 0.075–0.115 (106: 0.095 ± 0.0080); of median pair on tergite VIII, 0.050–0.090 (101: 0.070 ± 0.0088). Last tergite with 3 lateral setae close together on each side, outer seta generally shortest, 0.050–0.100 (82: 0.074 ± 0.0100) long; middle seta, 0.060–0.105 (84: 0.086 ± 0.0086); inner seta, 0.060–0.105 (86: 0.088 ± 0.0087). Sternal setae: II, 10–17 (108: 12.5 ± 1.36); III, 9–15 (107: 12.2 ± 1.37); IV, 10–16 (107: 13.1 ± 1.4); V, 8–15 (107: 11.0 ± 1.36); VI, 8–13 (108: 9.7 ± 1.0); VII, 7–12 (108: 9.2 ± 1.0); long median seta on VII, 0–7 (73: 3.8 ± 1.20). Subgenital plate with 16–28 (107: 21.4 ± 2.65) setae. Genital sac length 0.150–0.215 (99: 0.183 ± 0.0160); total number of complete loops in genital sac 0–5 (106: 1.6 ± 1.00); last complete loop extending back 0.0–0.110 (100: 0.068 ± 0.0260) from anterior margin.

♂. Head length 0.290–0.340 (72: 0.312 ± 0.0085); temple width 0.370–0.420 (72: 0.392 ± 0.0107); submarginal temple seta 0.045–0.070 (49: 0.058 ± 0.0064); marginal temple seta 0.020–0.035 (69: 0.025 ± 0.0025). Total length 1.160–1.330 (68: 1.246 ± 0.0386). Antennal scape length 0.160–0.190 (67: 0.171 ± 0.0067); scape medial width 0.100–0.130 (66: 0.111 ± 0.0056), distal width 0.125–0.155 (67: 0.140 ± 0.0070). Tergal setae: II, 9–15 (72: 12.1 ± 1.28); III, 16–21 (72: 18.1 ± 1.26); IV, 17–24 (72: 20.2 ± 1.65); V, 16–23 (71: 19.3 ± 1.66); VI, 10–17 (70: 13.6 ± 1.51); tergal and pleural setae on VII,

16–24 (70: 20.3 ± 1.83). Sternal setae: II, 10–16 (72: 12.3 ± 1.42); III, 9–15 (72: 12.1 ± 1.37); IV, 9–15 (72: 12.7 ± 1.40); V, 7–13 (72: 10.1 ± 1.35); VI, 7–11 (72: 8.9 ± 0.87); VII, 5–9 (70: 7.4 ± 0.99); VIII, 4–8 (72: 6.0 ± 0.69). Genitalia with sac having 6 large spines; parameral arch width 0.135–0.160 (70: 0.149 ± 0.0057); endomerale plate width 0.050–0.080 (69: 0.072 ± 0.0045), length 0.060–0.085 (69: 0.072 ± 0.0045), triangular, apically tapered with distinct cleft 0.015–0.035 (70: 0.021 ± 0.0039) deep.

Geomydoecus oklahomensis differs from *G. geomydis* and *G. illinoensis* in several respects for both males and females. The most conspicuous differences are size, the genitalia of both sexes, and the male antennal scape. *Geomydoecus geomydis* and *G. illinoensis* are much larger in head length, temple width, and total length. In females, the genital sac is shortest in *G. oklahomensis*, there are fewer complete loops ($\bar{x} = 1.6$ for *G. oklahomensis*), the last loop does not extend back as far, and there are fewer setae on the subgenital plate. In males, the length and width of the endomerale plate and its cleft are larger in both *G. geomydis* and *G. illinoensis*. Additionally, the antennal scape of *G. oklahomensis* has a distinctive thumblike process that is not present in either *G. geomydis* or *G. illinoensis*.

Geomydoecus oklahomensis is a widely distributed louse, being found from southern Nebraska southward to central Texas. It occurs on the following subspecies of pocket gophers: *Geomys bursarius industrius* Villa & Hall, *G. b. jugossicularis* Hooper, *G. b. knoxjonesi* Baker & Genoways, *G. b. lutescens* Merriam (in part, see discussion in following species account), and *G. b. major* Davis.

Geomydoecus oklahomensis is one member of a larger species complex that is termed the "oklahomensis" complex here, as this was the first species described in the group. This complex has caused a great deal of confusion in the past and it is hoped that the conclusions drawn here will clarify the situation. Lice now referable to *Geomydoecus oklahomensis* were first reported as *G. californicus* (Chapman) (see Miller & Ward 1960) because they share with that species the prominent thumbed antennal scape of males. Miller & Ward (1960) also noted several populations of *Geomydoecus* "along the front range of the Rocky Mountains" that they considered intergrades between *G. geomydis* and *G. oklahomensis* (*G. californicus* was the name used by them). After we examined large series of specimens from throughout this region, it is now apparent that the lice they considered intergrades are in fact not hybrids but represent a previously unrecognized but widespread species. We have examined the specimens collected by Miller & Ward

and find them consistent with other representatives of this new species from throughout its range. *Geomydoecus californicus* is restricted to the *Thomomys bottae-umbrinus* complex.

Specimens examined. *Geomys bursarius industrius*, 40 ♀, 15 ♂, USA: Kansas: Barber Co.: Aetna (1), Clark Co.: (1), Comanche Co.: 15 mi (24.1 km) E of (1) and 8 mi (12.9 km) E of (1) Coldwater, Edwards Co.: 4 mi (6.4 km) SSW of Kinsley (1), Ford Co.: (1), Meade Co.: (1), Pawnee Co.: (1), Pratt Co.: Pratt (3), Stafford Co.: 14 mi (22.5 km) NE of Stafford (1). *Geomys bursarius jugossicularis*, 57 ♀, 75 ♂, USA: Colorado: El Paso Co.: 4 mi (6.4 km) SE of (1) and 3.5 mi (5.6 km) SW of (3) Colorado Springs, Fremont Co.: 3½ mi (5.6 km) NE of (3) and 4 mi (6.4 km) SE of (1) Canon City, Prowers Co.: (2); Kansas: Gray Co.: 2 mi (3.2 km) S of Cimarron (1), Finney Co.: 4½ mi (7.2 km) S of Garden City (1), Hamilton Co.: (2), Haskell Co.: 5 mi (8.0 km) SW of Satanta (1), Kearny Co.: 2 mi (3.2 km) E of Lakin (1), Morton Co.: 1 mi (1.6 km) N of Elkhart (1), Seward Co.: 9 mi (14.5 km) NE of (1), and 1½ mi (2.4 km) SW of (1) Liberal, Stanton Co.: 6 mi (9.7 km) W of Manter (1); Oklahoma: Texas Co.: (1). *Geomys bursarius knoxjonesi*, 172 ♀, 181 ♂, USA: New Mexico: Chavez Co.: 0.7 mi (1.1 km) N and 12.6 mi (20.3 km) W of (1), and 9.1 mi (14.6 km) W of (1) Caprock, Eddy Co.: 5.7 mi (9.2 km) E of Loco Hills (2), Lea Co.: 0.6 mi (1.0 km) S and 2.5 mi (4.0 km) W of Maljamar (1); Texas: Andrews Co.: ½ mi (0.8 km) N of Andrews (1), Cochran Co.: 1 mi (1.6 km) W of Lehman (1), 3.4 mi (5.5 km) N and 3.3 mi (5.3 km) W of Whiteface (1), Gaines Co.: 5 mi (8.0 km) SE of Seagraves (1), Terry Co.: (1) (USNM), 6 mi (9.7 km) W of (2) and at (2) Brownfield, 4 mi (6.4 km) N of Gomez (2), Ward Co.: 3½ mi (5.6 km) E of (1) and 3.5 mi (5.6 km) E of (1) Monahans, Winkler Co.: 10 mi (16.1 km) NE of (1), 4.1 mi (6.6 km) N and 5.1 mi (8.2 km) E of (4), and 5 mi (8.0 km) E of (1) Kermit, Yoakum Co.: 7.3 mi (11.7 km) E of Plains (1). *Geomys bursarius lutescens*, 185 ♀, 209 ♂, USA: Colorado: Adams Co.: 1 mi (1.6 km) E of Bennett (2), Douglas Co.: D'Arcy Ranch, 2 mi (3.2 km) N of Parker (2), Morgan Co.: (2), Washington Co.: Cope (1), Yuma Co.: 2 mi (3.2 km) W of Hale (1); Kansas: Decatur Co.: Oberlin (1), Ellis Co.: 12 mi (19.3 km) SW of Hays (1), Graham Co.: (1), 14 mi (22.5 km) W of Hill City (1), Kearny Co.: 17 mi (27.4 km) SSE of Leoti (1), Logan Co.: 18 mi (29.0 km) N of Leoti (1), Ness Co.: 16 mi (25.8 km) W of Ness City (1), Norton Co.: (1), Osborn Co.: Al-

ton (1), Rawlins Co.: (1), Sherman Co.: 16 mi (25.8 km) NNE of Edson (1), Thomas Co.: 8 mi (12.9 km) NNE of Colby (1), Trego Co.: (1), Wallace Co.: 4 mi (6.4 km) S of Wallace (1), Wichita Co.: 17 mi (27.4 km) W of Scott City (1); Nebraska: Dundy Co.: 6 mi (9.7 km) NNW of Parks (1), Franklin Co.: 1 mi (1.6 km) SE of Franklin (1), Harlan Co.: 1 mi (1.6 km) S of Alma (1), Hitchcock Co.: Trenton (1), Kearney Co.: 4 mi (6.4 km) S of Kearney (1). *Geomys bursarius major*, 259 ♀, 266 ♂, USA: Kansas: Barber Co.: 1 mi (1.6 km) W of (1) and at (1) Aetna, 1 mi (1.6 km) W of Medicine Lodge (1), 3 mi (4.8 km) S of Sun City (1), Barton Co.: 8 mi (12.9 km) N of Ellingwood (1), Butler Co.: 8 mi (12.9 km) W of Rosalia (1), Cowley Co.: 3 mi (4.8 km) SE of (1) and 3½ mi (5.6 km) E of (1) Arkansas City, Harvey Co.: Halstead (1), 1¼ mi (2.0 km) N and 1¾ mi (21.3 km) W of Newton (1), Harper Co.: 1 mi (1.6 km) N of Harper (1), Stafford Co.: Little Salt Marsh (2); New Mexico: Curry Co.: 4 mi (6.4 km) S of Melrose (2), Guadalupe Co.: 1 mi (1.6 km) SW of (1) and 1 mi (1.6 km) S of (1) Santa Rosa, Roosevelt Co.: 1½ mi (2.4 km) W of Dora (2), 2.8 mi (4.5 km) E of Elida (1), 1.8 mi (2.9 km) S and 1.1 mi (1.8 km) E of Lingo (1); Oklahoma: Blaine Co.: 1½ mi (2.4 km) N of Hydro (1), Cleveland Co.: (1), Norman (1), Cotton Co.: 3 mi (4.8 km) N of Burkburnett (1), Custer Co.: Weatherford (1), Dewey Co.: 5 mi (8.0 km) W of Canton (1), Oklahoma Co.: Oklahoma City (1), Woodward Co.: Woodward (1) (USNM); Texas: Bailey Co.: 2 mi (3.2 km) SE of (2) and 3.6 mi (5.8 km) SE of (2) Muleshoe, Briscoe Co.: 6 mi (9.7 km) N of Quitaque (1), Clay Co.: Thornberry (1), Cochran Co.: 5 mi (8.0 km) W of Morton (1), Collingsworth Co.: 2 mi (3.2 km) N and 0.9 mi (1.4 km) W of (1), ½ mi (0.8 km) N of (1), 0.1 mi (0.2 km) W of (1), and 0.2 mi (0.3 km) W of (1) Wellington, Crosby Co.: 5 mi (8.0 km) SE of Crosbyton (1), Silver Falls (1), Dickens Co.: 17 mi (27.4 km) E of Dickens (1), Garza Co.: 4 mi (6.4 km) E of Justiceburg (1), 3 mi (4.8 km) NW of Post (1), Hill Co.: 5.8 mi (9.3 km) SW of Aguilla, Willis Camp (1), 21 mi (33.2 km) NW of Waco (1), Howard Co.: 2 mi (3.2 km) N of (1) and at (1) Big Spring, Knox Co.: 5 mi (8.0 km) SE of Benjamin (2), Lubbock Co.: 4 mi (6.4 km) E of (1) and 11 mi (17.7 km) S of (2) Idalou, 2½ mi (4.0 km) SE of (1), 3 mi (4.8 km) SE of (1), and 6 mi (9.7 km) SE of (1) Lubbock, Midland Co.: 3 mi (4.8 km) N of (1) and at (1) Midland, 5 mi (8.0 km) S of Stanton (2), Montague Co.: 3.1 mi (5.0 km) E of Jct. Texas Highw. 59–Farm Road 1758 (3), Wheeler Co.: 3 mi (4.8 km) W of Wheeler

(1), Wichita Co.: (1), 6 mi (9.7 km) N of Iowa Park (1), Highw. 281 at Red River (1), 10 mi (16.1 km) NE of (1) and at (1) Wichita Falls, Wilbarger Co.: (1), 6 mi (9.7 km) E of Vernon (1). *Mustela frenata longicauda* Bonaparte, 1 ♀, USA: Kansas: Cheyenne Co.: 4 mi (6.4 km) N and 1 mi (1.6 km) E of St. Francis (1).

Geomys nebrathkensis Timm & Price, new species

FIG. 3–5, 9

Type-locality: USA: Nebraska: Lincoln Co.: Birdwood Creek, 6 mi (9.7 km) N and 2 mi (3.2 km) E Sutherland, SE ¼ sec. 27, T. 15 N, R. 33 W.

Type-host: *Geomys bursarius lutescens* Merriam.

♀. As in FIG. 4. Head length 0.285–0.330 (39: 0.308 ± 0.0106); temple width 0.405–0.470 (39: 0.443 ± 0.0154); submarginal temple seta 0.045–0.060 (25: 0.055 ± 0.0048); marginal temple seta 0.035–0.050 (38: 0.042 ± 0.0041). Total length 1.160–1.345 (37: 1.263 ± 0.0522). Tergal setae: II, 11–20 (39: 15.5 ± 1.73); III, 19–28 (38: 22.3 ± 1.83); IV, 20–28 (38: 24.5 ± 2.19); V, 18–26 (38: 22.8 ± 1.95); VI, 19–26 (39: 22.0 ± 1.80); tergal and pleural setae on VII, 29–39 (39: 33.2 ± 2.47). Longest seta of medial 10 on tergite VI, 0.075–0.100 (38: 0.089 ± 0.0060) long; on tergite VII, 0.075–0.105 (37: 0.091 ± 0.0077); of median pair on tergite VIII, 0.050–0.095 (38: 0.071 ± 0.0088). Last tergite with 3 lateral setae close together on each side; outer seta generally shortest, 0.060–0.095 (32: 0.080 ± 0.0073); middle seta, 0.075–0.095 (35: 0.087 ± 0.0066); inner seta, 0.065–0.105 (34: 0.090 ± 0.0072). Sternal setae: II, 10–16 (39: 13.0 ± 1.39); III, 10–16 (39: 12.5 ± 1.43); IV, 11–17 (39: 13.4 ± 1.35); V, 9–13 (37: 10.8 ± 1.33); VI, 8–12 (37: 10.0 ± 0.99); VII, 9–12 (39: 10.0 ± 0.90). Subgenital plate with 20–31 (39: 25.6 ± 2.75) setae. Genital sac (FIG. 9) length 0.170–0.250 (37: 0.203 ± 0.0155); total number of complete loops in genital sac 0–4 (38: 1.6 ± 0.95); last complete loop extending back 0.0–0.110 (38: 0.079 ± 0.0228).

♂. As in FIG. 3. Head length 0.290–0.350 (21: 0.319 ± 0.0146); temple width 0.385–0.425 (21: 0.404 ± 0.0124); submarginal temple seta 0.050–0.070 (20: 0.060 ± 0.0061); marginal temple seta 0.020–0.030 (18: 0.025 ± 0.0028). Total length 1.210–1.420 (20: 1.308 ± 0.0585). Antennal scape length 0.155–0.185 (20: 0.172 ± 0.0100); scape medial width 0.100–0.135 (20: 0.115 ± 0.0097), distal width 0.105–0.150 (20: 0.128 ± 0.0125). Tergal setae: II, 9–16 (21: 12.3 ± 1.59); III, 17–22 (21: 19.2 ± 1.25); IV, 18–28 (21: 21.9 ± 2.19); V, 19–23 (21: 21.0 ± 1.43); VI, 12–18 (21: 14.5 ± 1.47); tergal and pleural setae on VII, 18–26 (21: 20.8 ± 1.72). Sternal setae: II, 11–17 (21: 13.5 ± 1.54); III, 11–16 (21: 12.7 ± 1.32); IV, 9–15 (21: 12.9 ± 1.53); V, 9–13 (21: 10.5 ± 1.08); VI, 8–12 (21: 9.7 ± 1.06); VII, 7–11 (21: 8.3 ± 1.06); VIII, 5–7 (21: 6.1 ± 0.54). Genitalia as in FIG. 5, with sac having 6 large spines; parameral arch width 0.145–0.170 (21: 0.158 ± 0.0072); endomeral plate width 0.055–0.085 (21: 0.076 ± 0.0061), length 0.060–0.085 (21: 0.074 ± 0.0063), triangular, apically tapered with distinct cleft 0.015–0.030 (21: 0.022 ± 0.0031) deep.

Geomys nebrathkensis is a member of the "oklahomensis" species complex. The males of *G. nebrathkensis* and *G. oklahomensis* are strikingly distinct from each other in several characters, where-

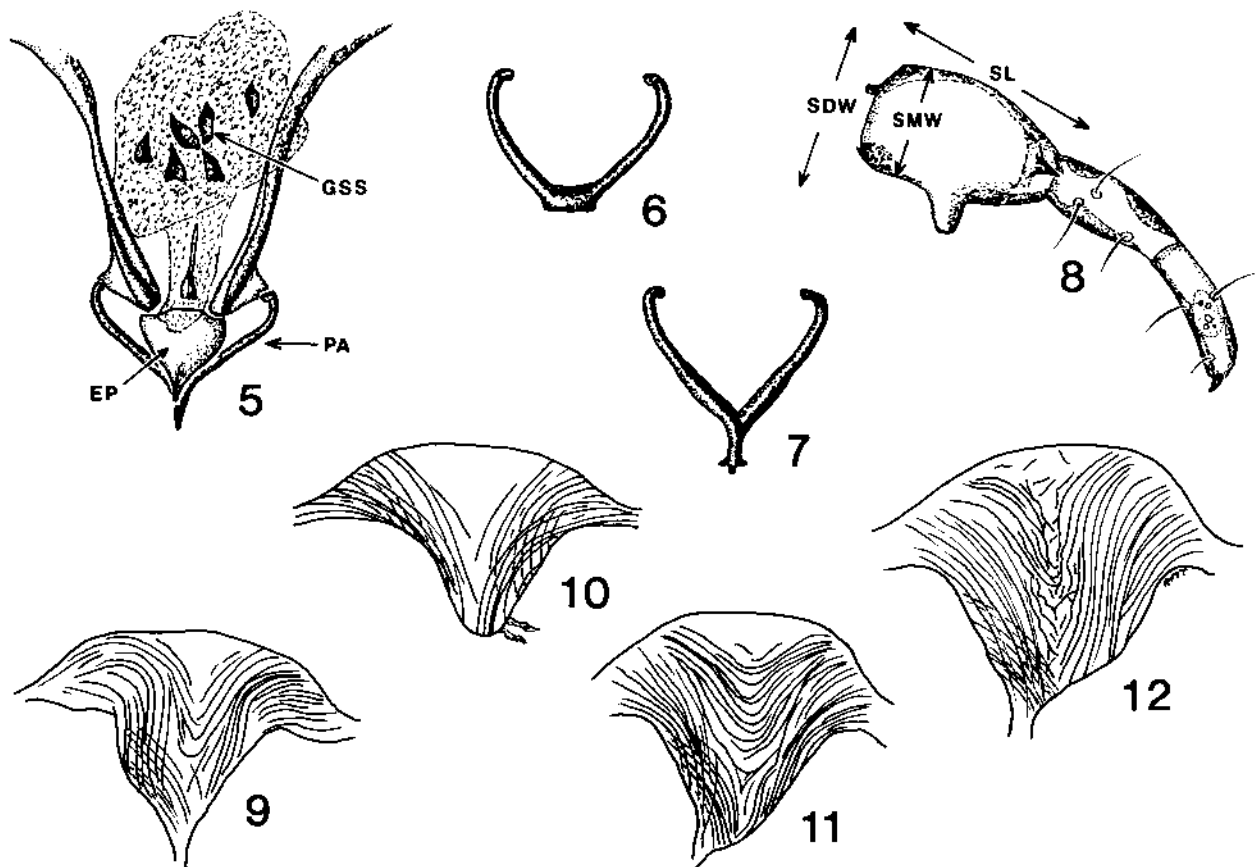


FIG. 5-12. 5, *Geomydoecus nebrathkensis*, ♂ genitalia (EP, endomerale plate; GSS, genital sac spines; PA, parameral arch). 6-7, ♂ parameral arch: (6) *G. truncatus*; (7) *G. sclerivus*. 8, *G. heaneyi*, ♂ antenna (SDW, scape distal width; SL, scape length; SMW, scape medial width). 9-12, ♀ genital sac: (9) *G. nebrathkensis*; (10) *G. dalgleishi*; (11) *G. geomydis*; (12) *G. illinoensis*.

as the females of these 2 species are difficult to distinguish. The antennal thumb, so prominent in *G. oklahomensis*, is represented only by a slight projection in *G. nebrathkensis* (FIG. 3); this is best quantified by the differences in the distal scape width ($\bar{x} = 0.128$ for *G. nebrathkensis* and $\bar{x} = 0.140$ for *G. oklahomensis*). All other members of the "oklahomensis" species complex have a large thumblike process on the antennal scape. In addition, males of *G. nebrathkensis* are larger in total length, head width, parameral arch width, and endomerale plate width. In females, size, the genital chamber sac, and most setal counts are similar for *G. nebrathkensis* and *G. oklahomensis*. The best character to separate females is the number of setae on the subgenital plate, *G. nebrathkensis* having a mean of 25.6 setae and *G. oklahomensis* having a mean of 21.4, but there is some overlap among individuals.

Geomydoecus nebrathkensis differs from *G. geomydis*, the species bordering it to the east, in numerous characteristics. The most conspicuous differ-

ences are size and genitalia of both males and females. *Geomydoecus nebrathkensis* is significantly smaller in head length, temple width, and total length. In males, the widths of the parameral arch and endomerale plate and the total length of the endomerale plate are smaller in *G. nebrathkensis* than in *G. geomydis*. In females, these species can easily be distinguished by the configuration of the genital chamber sac, *G. nebrathkensis* averaging 1.6 complete loops and *G. geomydis* averaging 12.0 complete loops. The distance the last loop extends posteriorly and the total length of the genital sac are similarly smaller in *G. nebrathkensis*.

Geomydoecus nebrathkensis is found in Nebraska north of the Platte River and west of the 98th meridian, in extreme northeastern Colorado, southeastern Wyoming, and southern South Dakota (FIG. 13). It is found only on 1 subspecies of Plains Pocket Gopher, *Geomys bursarius lutescens*. In all other species of *Geomydoecus* on the northern Plains Pocket Gophers, a single louse species is

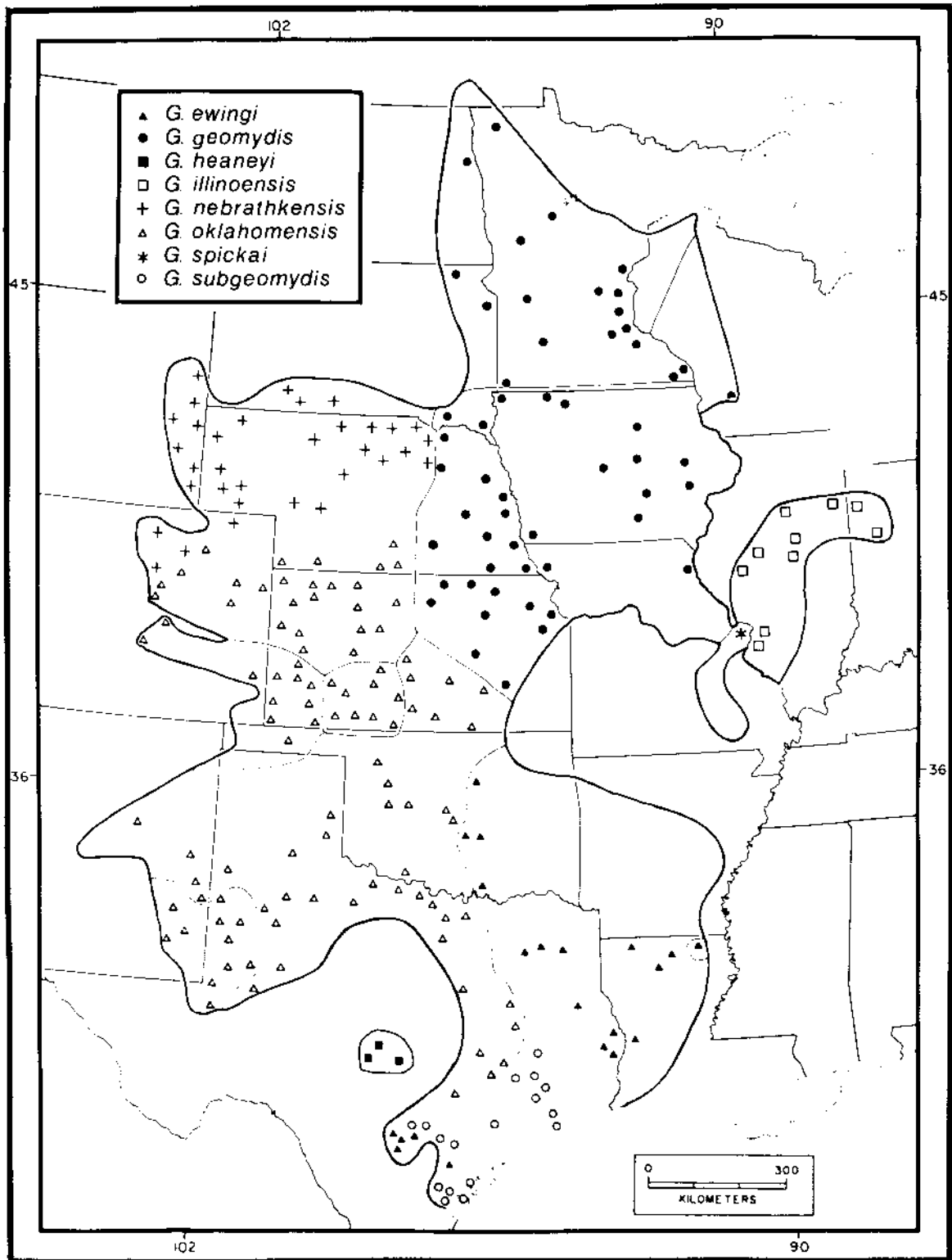


FIG. 13. Distribution of the 8 species of *Geomydocus* that parasitize pocket gophers of the *Geomys bursarius* complex. The inner boundary lines represent the boundaries between subspecies of pocket gophers. For information concerning the individual subspecies of pocket gophers, consult the text.

found throughout the entire range of 1 or more subspecies of pocket gophers.

The specific name "*nebrathkensis*" is derived from the Oto Indian word "Nebrathka," meaning "flat water." It is the Oto name applied to the Platte River.

Specimens examined. Holotype ♂, *Geomys bursarius lutescens*, USA: Nebraska: Lincoln Co.: Birdwood Creek, 6 mi (9.7 km) N and 2 mi (3.2 km) E of Sutherland, SE ¼ sec. 27, T. 15 N, R. 33 W, 2.X.1977, R. M. Timm, RMT-1761 (in University of Minnesota collect.). Paratypes (all from type-host): 14 ♀, 18 ♂, same data as holotype, 4 ♀, 4 ♂, same, except RMT-1762; 322 ♀, 318 ♂, Colorado: Adams Co.: 2 mi (3.2 km) E of Brighton (KU-74578), Logan Co.: 14 mi (22.5 km) W of Peetz (KU-49648); Nebraska: Antelope Co.: ½ mi (0.8 km) S and ½ mi (0.8 km) W of Neligh (KU-133928), 1¼ mi (2.0 km) W of (KU-133923, 133887), and 2 mi (3.2 km) W of (KU-133922) Oakdale, Banner Co.: 5½ mi (8.8 km) S of McGrew (KU-101967), Boyd Co.: 1 mi (1.6 km) S of Butte (KU-77965), 1 mi (1.6 km) NW of Spencer (KU-77962), Cherry Co.: Kennedy (UC-6681), Valentine National Wildlife Refuge (KU-86419), Cheyenne Co.: 15 mi (24.1 km) S of Dalton (KU-15199), Sidney (USNM, Bishopp-8960), Dawes Co.: 6 mi (9.7 km) S of (KU-83521), 7 mi (11.3 km) S and ¾ mi (1.2 km) E of (UN-5022, 5032-5033), 24 mi (38.6 km) S and 11 mi (17.7 km) E of (1), 25 mi (40.2 km) S and 9 mi (14.5 km) E of (UN-5028-5029, 5035, 5038), 25 mi (40.2 km) S and 7½ mi (12.1 km) E of (UN-5039-5047, 5054-5063) Chadron, Crawford (USNM), Meadow Creek Pasture, T. 29 N, R. 47 W (UN-6027-6029, 6033, 6045-6052), Holt Co.: 6 mi (9.7 km) N of Midway (KU-77967), Keith Co.: 4 mi (6.4 km) NW of Keystone (KU-76924), Keya Paha Co.: 12 mi (19.3 km) N of (KU-77953), and 10 mi (16.1 km) N of (KU-77955) Springview, Lincoln Co.: 9 mi (14.5 km) NW of Hershey (KU-15222), Scotts Bluff Co.: 12 mi (19.3 km) S of Scotts Bluff (KU-15195), Sioux Co.: 3 mi (4.8 km) E of Agate (KU-3459), Thomas Co.: 4 mi (6.4 km) SW of Halsey (KU-73258); South Dakota: Bennett Co.: 8 mi (12.9 km) E of (KU-113057) and 9 mi (14.5 km) S of (KU-113063) Martin, Fall River Co.: 1 mi (1.6 km) E of Edgemont (KU-101963-101964), Todd Co.: 4 mi (6.4 km) NW of Rosebud (KU-101042, 101044), Washabaugh Co.: 11 mi (17.7 km) NNE of Potato Creek (KU-101039-101040); Wyoming: Converse Co.: 6 mi (9.7 km) NE of Orlin (KU-41808, 41810), Goshen Co.: 8 mi (12.9 km) SE of Torrington (KU-91137), Laramie

Co.: 6½ mi (10.5 km) W of Meriden (KU-15144, 15158), Niobrara Co.: 10 mi (16.1 km) N of Hat Creek (KU-20307, 20318), 2 mi (3.2 km) S of (KU-41814), 12 mi (19.3 km) S of (KU-32548), and at (KU-3927) Lusk, Platte Co.: 3 mi (4.8 km) W of Guernsey (KU-91140), Weston Co.: 23 mi (37.0 km) SW of Newcastle (KU-2030).

Geomys *spickai* Timm & Price, new species

Type-locality: USA: Missouri: St. Louis Co.: 2 mi (3.2 km) NW of Cross Keys.

Type-host: *Geomys bursarius missouriensis* McLaughlin.

♀. Head length 0.300–0.335 (18: 0.314 ± 0.0079); temple width 0.435–0.490 (20: 0.455 ± 0.0147); submarginal temple seta 0.045–0.065 (18: 0.055 ± 0.0060); marginal temple seta 0.035–0.055 (20: 0.045 ± 0.0064). Total length 1.240–1.395 (20: 1.321 ± 0.0381). Tergal setae: II, 11–17 (20: 15.1 ± 1.76); III, 19–26 (19: 21.3 ± 1.63); IV, 21–28 (19: 24.4 ± 2.14); V, 21–27 (19: 23.1 ± 1.85); VI, 19–25 (20: 21.7 ± 1.81); tergal and pleural setae on VII, 28–36 (20: 32.9 ± 2.42). Longest seta of medial 10 on tergite VI, 0.080–0.105 (20: 0.093 ± 0.0064) long; on tergite VII, 0.070–0.115 (20: 0.097 ± 0.0092); of medial pair on tergite VIII, 0.055–0.095 (20: 0.072 ± 0.0092). Last tergite with 3 lateral setae close together on each side; outer seta generally shortest, 0.070–0.110 (18: 0.083 ± 0.0088) long; middle seta, 0.075–0.105 (17: 0.092 ± 0.0086); inner seta, 0.080–0.110 (18: 0.097 ± 0.0075). Sternal setae: II, 11–16 (20: 12.6 ± 1.50); III, 10–14 (18: 11.9 ± 1.13); IV, 12–15 (16: 13.3 ± 0.95); V, 9–14 (16: 11.8 ± 1.28); VI, 8–11 (20: 9.7 ± 0.80); VII, 8–11 (20: 9.1 ± 0.99). Subgenital plate with 19–27 (20: 21.8 ± 2.26) setae. Genital sac length 0.170–0.225 (14: 0.205 ± 0.0159); total number of complete loops in genital sac 0–3 (19: 1.6 ± 0.90); last complete loop extending back 0.0–0.125 (14: 0.092 ± 0.0198) from anterior margin.

♂. Head length 0.315–0.350 (20: 0.330 ± 0.0089); temple width 0.385–0.430 (20: 0.410 ± 0.0131); submarginal temple seta 0.048–0.065 (20: 0.058 ± 0.0053); marginal temple seta 0.025–0.030 (20: 0.025 ± 0.0020). Total length 1.210–1.370 (20: 1.309 ± 0.0396). Antennal scape length 0.165–0.195 (20: 0.183 ± 0.0076); scape medial width 0.110–0.125 (20: 0.116 ± 0.0039), distal width 0.130–0.155 (20: 0.140 ± 0.0060). Tergal setae: II, 9–15 (20: 11.9 ± 1.50); III, 15–22 (19: 18.9 ± 1.75); IV, 19–25 (19: 21.7 ± 1.79); V, 18–25 (19: 21.6 ± 1.92); VI, 11–17 (18: 14.8 ± 1.34); tergal and pleural setae on VII, 17–24 (19: 19.7 ± 2.00). Sternal setae: II, 9–14 (20: 11.8 ± 1.44); III, 11–13 (19: 12.1 ± 0.81); IV, 11–16 (19: 13.1 ± 1.18); V, 8–12 (19: 10.2 ± 1.13); VI, 7–10 (20: 9.2 ± 0.88); VII, 6–9 (20: 7.8 ± 0.79); VIII, 5–7 (20: 6.1 ± 0.45). Genitalia with sac having 6 large spines; parameral arch width 0.150–0.160 (20: 0.155 ± 0.0049); endomerteral plate width 0.060–0.080 (20: 0.073 ± 0.0045), length 0.070–0.085 (20: 0.077 ± 0.0040), triangular, apically tapered with distinct cleft 0.020–0.030 (20: 0.023 ± 0.0033) deep.

Geomys *spickai* is the most similar morphologically to *G. oklahomensis* and is here considered a member of the "*oklahomensis*" complex. It differs from *G. oklahomensis* in having a longer genital sac and greater distance that the last loop extends back; however, the number and shape of loops in

the genital sac are similar. In both males and females, *G. spickai* has a greater head length, temple width, and total length.

Geomydoecus spickai differs from *G. geomydis* in several characters of both males and females. The female genital sac of *G. spickai* averages 1.6 (range 0–3) complete loops, whereas *G. geomydis* has 12.0 (8–18) complete loops. Both the length of the genital sac and the distance the last loop extends back is greater in *G. geomydis*. The principal difference in males is the shape of the antennal scape; *G. spickai* has a long thumblike process on the scape, similar to that in *G. oklahomensis*, whereas *G. geomydis* does not. *Geomydoecus spickai* differs from *G. illinoensis* in several respects in both males and females, the most conspicuous being size, the female genital sac, and scape and genitalia of males. In both males and females, *G. spickai* is smaller in head length, temple width, and total length. The female genital sac of *G. illinoensis* has more complete loops ($\bar{x} = 3.7$), the loops are irregular in *G. illinoensis* and smooth in *G. spickai*, and the last loop extends back further in *G. illinoensis*.

Geomydoecus spickai is found on only 1 subspecies of Plains Pocket Gopher, *G. b. missouriensis*. This pocket gopher occurs only in extreme eastern and southeastern Missouri; the floodplain of the Missouri River forms the northern boundary of its range, and the Mississippi River forms the eastern boundary (McLaughlin 1958).

This new species is named in honor of Edwin J. Spicka.

Specimens examined. Holotype δ , *Geomys bursarius missouriensis*, USA: Missouri: St. Louis Co.: 2 mi (3.2 km) NW of Cross Keys, 7.II.1973, E. J. Spicka, EJS-236 (in University of Minnesota collect.). Paratypes (all from type-host): 34 f , 21 m , same data as holotype; 37 f , 45 m , same, except EJS-235; 154 f , 164 m , St. Charles Co.: 3.5 mi (5.6 km) S of Orchard Farm (EJS-232, 233, and 234), St. Louis Co.: Bridgetown (EJS-223), 1.25 mi (2.0 km) NW of Cross Keys (EJS-239), Hazelwood (EJS-229).

Other material. *Geomys bursarius missouriensis*, 17 f , 27 m , USA: Missouri: Crawford Co.: Steelville (1).

***Geomydoecus heaneyi* Timm & Price, new species**

FIG. 8

Type-locality: USA: Texas: Mason Co.: 1 mi (1.6 km) SE of Mason.

Type-host: *Geomys bursarius texensis* Merriam.

f . Head length 0.285–0.310 (20: 0.296 ± 0.0059); temple width 0.420–0.465 (20: 0.439 ± 0.0123); submarginal temple seta 0.050–0.055 (12: 0.052 ± 0.0038); marginal temple seta 0.035–0.050 (18: 0.039 ± 0.0054). Total length 1.100–1.360 (20: 1.203 ± 0.0608). Tergal setae: II, 13–19 (20: 15.1 ± 1.41); III, 19–23 (20: 21.0 ± 1.12); IV, 20–26 (20: 22.7 ± 1.49); V, 19–23 (19: 20.7 ± 1.60); VI, 15–23 (20: 19.6 ± 2.32); tergal and pleural setae on VII, 24–35 (21: 29.8 ± 2.83). Longest seta of medial 10 on tergite VI, 0.070–0.100 (21: 0.086 ± 0.0078); on tergite VII, 0.085–0.125 (21: 0.108 ± 0.0088); of medial pair on tergite VIII, 0.050–0.075 (18: 0.062 ± 0.0058). Last tergite with 3 lateral setae close together on each side; outer seta generally shortest, 0.070–0.090 (16: 0.080 ± 0.0069) long; middle seta, 0.080–0.105 (17: 0.091 ± 0.0083); inner seta, 0.090–0.105 (19: 0.096 ± 0.0051). Sternal setae: II, 11–18 (20: 12.6 ± 1.84); III, 9–13 (20: 11.5 ± 0.89); IV, 9–15 (18: 12.3 ± 1.71); V, 9–13 (19: 10.3 ± 1.29); VI, 7–10 (20: 8.6 ± 0.68); VII, 6–10 (21: 8.3 ± 0.97). Subgenital plate with 16–25 (21: 21.0 ± 2.48) setae. Genital sac length 0.160–0.190 (18: 0.175 ± 0.0104); total number of complete loops in genital sac 0–3 (19: 1.3 ± 0.89); last complete loop extending back 0.0–0.090 (18: 0.060 ± 0.0295) from anterior margin.

m . Head length 0.285–0.320 (11: 0.304 ± 0.0109); temple width 0.380–0.405 (11: 0.393 ± 0.0081); submarginal temple seta 0.040–0.060 (4: 0.056 ± 0.0119); marginal temple seta 0.025 (10: 0.025 ± 0.0). Total length 1.140–1.290 (11: 1.224 ± 0.0449). Antennal scape (Fig. 8) length 0.160–0.170 (9: 0.163 ± 0.0052); scape medial width 0.090–0.120 (9: 0.109 ± 0.0098); distal width 0.125–0.170 (9: 0.141 ± 0.0100). Tergal setae: II, 8–13 (14: 10.6 ± 1.50); III, 14–20 (14: 17.1 ± 1.90); IV, 15–23 (14: 18.9 ± 1.86); V, 16–19 (14: 17.3 ± 1.16); VI, 11–14 (14: 12.3 ± 0.99); tergal and pleural setae on VII, 16–20 (14: 18.1 ± 1.29). Sternal setae: II, 9–15 (14: 11.7 ± 1.68); III, 9–14 (14: 11.0 ± 1.47); IV, 10–14 (14: 12.0 ± 1.36); V, 8–12 (14: 9.4 ± 1.15); VI, 6–10 (14: 8.1 ± 1.14); VII, 6–9 (14: 7.0 ± 0.96); VIII, 4–7 (14: 5.7 ± 0.83). Genitalia with sac having 6 large spines; parameral arch width 0.135–0.155 (14: 0.142 ± 0.0057); endomerale plate width 0.065–0.075 (14: 0.070 ± 0.0036), length 0.045–0.070 (13: 0.066 ± 0.0080), triangular, apically tapered with distinct cleft 0.015–0.025 (13: 0.021 ± 0.0035) deep.

Geomydoecus heaneyi is similar to *G. oklahomensis* in that it has a large thumblike process on the antennal scape of males and the genital sac has 6 large spines. *Geomydoecus heaneyi* differs from *G. oklahomensis* primarily in size. In both females and males, head length and total length of *G. oklahomensis* are larger than in *G. heaneyi*. Other characters for separating these 2 species are the genitalia of males; *G. heaneyi* has a narrower parameral arch than *G. oklahomensis*, whereas the endomerale plate is longer in *G. heaneyi*. *Geomydoecus oklahomensis* also has a longer antennal scape. The female genital sac of *G. heaneyi* and *G. oklahomensis* are indistinguishable.

Geomydoecus heaneyi is found only on *Geomys bursarius llanensis* V. Bailey and *G. b. texensis*. These 2 subspecies of pocket gophers occur in a restricted

area of the Edwards Plateau of central Texas known as the Central Basin. The Central Basin is a relatively small region with sandy clay and sandy loam soils (Pedernales and Tishomingo soils, see Carter 1931), which support a mesquite-oak savanna (*Prosopis-Quercus-Andropogon*) vegetational community. *Geomys bursarius texensis* is found in a limited area in Mason and McCulloch counties and *G. b. llanensis* is found just to the east in a restricted area of Llano and San Saba counties (Dalquest & Kilpatrick 1973). Pocket gophers in the Central Basin are isolated from other populations of *Geomys* by clay soils that are unsuitable for *Geomys* and by the Colorado River (see Davis 1940).

This new species is named in honor of Lawrence R. Heaney, who has contributed much to systematics of the *Geomys bursarius* complex and who has directly aided this study in many facets.

Specimens examined. Holotype ♂, *Geomys bursarius texensis*, USA: Texas: Mason Co.: 1 mi (1.6 km) SE of Mason, 23.VII.1948, W. K. Clark, KU-27210 (in University of Kansas collect.). Paratypes (all from type-host): 2 ♀, 2 ♂, same data as holotype; 2 ♂, same, except KU-27213; 42 ♀, 53 ♂, USA: Texas: Mason Co.: ½ mi (0.8 km) W of Castell (KU-27207), 1 mi (1.6 km) E of (TAM-556, UC-84178, UC-84179), 1 mi (1.6 km) W of (KU-17931), 9.4 mi (15.0 km) W of (TT-7548), 10 mi (16.1 km) W of (KU-35163, 35166), 11 mi (17.7 km) SW of (KU-35173) and at (UC-84174, 84176, 84177) Mason.

Other material. 51 ♀, 21 ♂, *Geomys bursarius llanensis*, USA: Texas: Llano Co.: Castell (2), 1 mi (1.6 km) N of and 3 mi (4.8 km) W of Kingsland (3), 7 mi (11.3 km) E of (2), 3 mi (4.8 km) S of (3), Enchanted Rock, 12 mi (19.3 km) S of and 8 mi (12.9 km) W of (1), and at (1) Llano, San Saba Co.: 1 mi (1.6 km) N of Pontotoc (1).

Geomydoecus subgeomydis Price & Emerson, new status

Geomydoecus geomydis subgeomydis Price & Emerson, 1971, J. Med. Entomol. 8: 236.

Type-locality: USA: Texas: Walker Co.: Huntsville.

Type-host: *Geomys bursarius sagittalis* Merriam [originally given as *G. b. brazensis* Davis by Price & Emerson (1971)].

♀. Head length 0.275–0.315 (34: 0.297 ± 0.0087); temple width 0.405–0.445 (34: 0.430 ± 0.0085); submarginal temple seta 0.045–0.060 (26: 0.053 ± 0.0052); marginal temple seta

0.035–0.050 (34: 0.041 ± 0.0053). Total length 1.100–1.290 (33: 1.215 ± 0.0500). Tergal setae: II, 12–19 (34: 14.8 ± 1.51); III, 15–24 (35: 19.9 ± 1.92); IV, 18–27 (35: 22.1 ± 2.13); V, 15–26 (33: 19.8 ± 2.16); VI, 14–23 (35: 18.7 ± 2.00); tergal and pleural setae on VII, 25–34 (34: 29.9 ± 2.19). Longest seta of medial 10 on tergite VI, 0.070–0.100 (36: 0.085 ± 0.0075) long; on tergite VII, 0.085–0.110 (34: 0.097 ± 0.0061); of median pair on tergite VIII, 0.045–0.080 (35: 0.060 ± 0.0087). Last tergite with 3 lateral setae close together on each side; outer seta generally shortest, 0.055–0.090 (25: 0.070 ± 0.0093) long; middle seta, 0.070–0.120 (29: 0.087 ± 0.0110); inner seta, 0.070–0.115 (31: 0.089 ± 0.0097). Sternal setae: II, 9–15 (36: 10.9 ± 1.04); III, 9–14 (33: 11.4 ± 0.99); IV, 10–14 (34: 12.1 ± 0.97); V, 9–13 (33: 10.7 ± 0.88); VI, 7–12 (34: 9.0 ± 1.07); VII, 7–11 (34: 8.5 ± 0.83). Subgenital plate with 18–28 (36: 21.8 ± 2.48) setae. Genital sac length 0.175–0.220 (30: 0.204 ± 0.0120); total number of complete loops in genital sac 2–8 (35: 5.2 ± 1.19); last complete loop extending back 0.085–0.125 (30: 0.105 ± 0.0090).

♂. Head length 0.250–0.315 (36: 0.300 ± 0.0116); temple width 0.345–0.410 (36: 0.385 ± 0.0125); submarginal temple seta 0.050–0.060 (26: 0.055 ± 0.0049); marginal temple seta 0.020–0.030 (33: 0.026 ± 0.0027). Total length 1.140–1.345 (26: 1.223 ± 0.0452). Antennal scape length 0.150–0.165 (32: 0.158 ± 0.0052); scape medial width 0.085–0.110 (32: 0.102 ± 0.0053); distal width 0.100–0.125 (32: 0.114 ± 0.0060). Tergal setae: II, 10–15 (39: 12.0 ± 1.10); III, 14–21 (39: 17.2 ± 1.67); IV, 17–23 (38: 19.1 ± 1.47); V, 14–22 (38: 18.1 ± 1.57); VI, 11–16 (38: 13.0 ± 1.28); tergal and pleural setae on VII, 16–23 (36: 18.7 ± 1.43). Sternal setae: II, 9–15 (38: 10.9 ± 1.27); III, 9–15 (38: 11.4 ± 1.54); IV, 9–15 (38: 11.6 ± 1.57); V, 7–11 (37: 9.1 ± 1.06); VI, 5–9 (38: 8.0 ± 1.00); VII, 5–8 (38: 6.3 ± 0.63); VIII, 5–7 (40: 6.0 ± 0.42). Genitalia with sac having 6 large spines; parameral arch width 0.125–0.160 (36: 0.145 ± 0.0068); endomerical plate width 0.065–0.085 (36: 0.075 ± 0.0046); length 0.060–0.085 (36: 0.076 ± 0.0054), triangular, apically tapered with distinct cleft 0.020–0.030 (35: 0.026 ± 0.0029) deep.

Price & Emerson (1971) described "*subgeomydis*" as a subspecies of *Geomydoecus geomydis*; at that time they had 15 specimens of this taxon available from only 1 locality. It is now apparent that the taxon they described as "*subgeomydis*" deserves specific recognition. Both males and females of *Geomydoecus subgeomydis* are smaller than *G. geomydis* in head length, temple width, and total length. In the female genital sac, *G. subgeomydis* has fewer complete loops (\bar{x} = 5.2 vs 12.0) and the total genital sac length and distance the last loop extends back is correspondingly smaller than in *G. geomydis*.

Geomydoecus subgeomydis differs from the 2 adjacent *Geomydoecus* to the west and north, *G. oklahomensis* and *G. heaneyi*, in that males of both *G. oklahomensis* and *G. heaneyi* have large thumblike processes on the antennal scape, whereas those of *G. subgeomydis* do not. This is best quantified by the scape distal width (\bar{x} = 0.114 for *G. subgeomydis*, \bar{x} = 0.140 for *G. oklahomensis*, and \bar{x} = 0.141 for *G. heaneyi*). In females, both *G. heaneyi* and *G. oklahomensis* have fewer loops in the genital chamber sac (\bar{x} =

5.2 for *G. subgeomydis*, $\bar{x} = 1.6$ for *G. oklahomensis*, and $\bar{x} = 1.3$ for *G. heaneyi*) and the total sac length and distance the last loop extends back is greatest in *G. subgeomydis*.

Geomydoecus subgeomydis is found on *Geomys bursarius attwateri* Merriam and *G. b. sagittalis*. These populations of pocket gophers previously were referred to as *G. b. attwateri*, *G. b. brazensis*, *G. b. ludemani* Davis, *G. b. sagittalis*, and *G. b. terricolus* Davis (see Hall & Kelson 1959). Pocket gophers from the type-locality of *G. subgeomydis* (Huntsville, Walker Co., Texas) were originally referred to as *G. b. brazensis* but are now considered *G. b. sagittalis* (see Honeycutt & Schmidly 1979). Thus, the type-host of *G. subgeomydis* is *G. b. sagittalis* instead of *G. b. brazensis* as listed by Price & Emerson (1971).

Specimens examined. *Geomys bursarius attwateri*, 57 ♀, 80 ♂, USA: Texas: Aransas Co.: ½ mi (0.8 km) SW of (1) and 1½ mi (2.4 km) SW of (1) Rockport, Bee Co.: Skidmore (1), Bexar Co.: 4½ mi (7.2 km) E of Sayers (1), Colorado Co.: Eagle Lake (1), DeWitt Co.: Cuero (1), Gonzales Co.: 1 mi (1.6 km) N of Nixon (1), Guadalupe Co.: 12 mi (19.3 km) S of Seguin (1), San Patricio Co.: 1 mi (1.6 km) NW of Aransas Pass (2), 2.7 mi (4.3 km) NE of (1) and 1.9 mi (3.0 km) NE of (1) Odem, 2 mi (3.2 km) NW of (1), 9 mi (14.5 km) E of (1), and at (3) Sinton, 3.6 mi (5.8 km) SSW of Taft (1), Welder Wildlife Refuge (2). *Geomys bursarius sagittalis*, 136 ♀, 170 ♂, USA: Texas: Galveston Co.: 4 mi (6.4 km) S of Altoloma (2), 1 mi (1.6 km) N of (7) and 2 mi (3.2 km) N of (1) Texas City, Virginia Point (1), Grimes Co.: 2 mi (3.2 km) E of Carlos (1), Jefferson Co.: 7 mi (11.3 km) SW of Fannett (1), Montgomery Co.: 5 mi (8.0 km) W of (2), 2 mi (3.2 km) S of (2), and 5 mi (8.0 km) S of (2) Conroe, 1.6 mi (2.6 km) E of Decker (2), 5 mi (8.0 km) W of (1) and 7 mi (11.3 km) W of (1) Willis, Walker Co.: 2 mi (3.2 km) NE of Huntsville (2).

Geomydoecus ewingi Price & Emerson

Geomydoecus ewingi Price & Emerson, 1971, J. Med. Entomol. 8: 238.

Type-locality: USA: Oklahoma: Payne Co.: Stillwater.

Type-host: *Geomys bursarius sagittalis* Merriam [originally given as *G. b. major* Davis by Price & Emerson (1971)].

♀. Head length 0.265–0.330 (75: 0.297 ± 0.0143); temple width 0.385–0.469 (75: 0.422 ± 0.0176); submarginal temple seta 0.045–0.070 (54: 0.054 ± 0.0065); marginal temple seta 0.025–0.055 (71: 0.038 ± 0.0069). Total length 1.065–1.370

(67: 1.211 ± 0.0742). Tergal setae: II, 10–19 (74: 14.4 ± 1.94); III, 13–23 (77: 19.8 ± 1.81); IV, 18–26 (77: 21.5 ± 2.02); V, 16–25 (77: 19.8 ± 1.82); VI, 11–26 (77: 18.4 ± 3.06); tergal and pleural setae on VII, 17–35 (75: 28.9 ± 4.80). Longest seta of medial 10 on tergite VI, 0.070–0.160 (73: 0.090 ± 0.0230) long; on tergite VII, 0.065–0.110 (76: 0.092 ± 0.0106); of median pair on tergite VIII, 0.045–0.090 (61: 0.061 ± 0.0088). Last tergite with 3 lateral setae close together on each side; outer seta generally shortest, 0.055–0.090 (56: 0.069 ± 0.0094) long; middle seta, 0.060–0.095 (49: 0.080 ± 0.0087); inner seta, 0.070–0.135 (67: 0.090 ± 0.0146). Sternal setae: II, 8–14 (79: 10.9 ± 1.26); III, 9–14 (74: 11.5 ± 1.08); IV, 10–17 (72: 12.0 ± 1.45); V, 8–14 (69: 10.1 ± 1.18); VI, 7–10 (76: 8.6 ± 0.97); VII, 5–11 (77: 8.1 ± 1.17). Subgenital plate with 17–29 (66: 21.2 ± 2.05) setae. Genital sac length 0.145–0.240 (55: 0.191 ± 0.0164); total number of complete loops in genital sac 1–6 (74: 3.5 ± 1.60); last complete loop extending back 0.070–0.125 (55: 0.097 ± 0.0185) from anterior margin.

♂. Head length 0.275–0.330 (51: 0.301 ± 0.0117); temple width 0.365–0.415 (48: 0.382 ± 0.0115); submarginal temple seta 0.045–0.070 (33: 0.056 ± 0.0068); marginal temple seta 0.025–0.030 (48: 0.025 ± 0.0017). Total length 1.130–1.340 (45: 1.235 ± 0.0446). Antennal scape length 0.155–0.170 (46: 0.162 ± 0.0057); scape medial width 0.090–0.120 (44: 0.105 ± 0.0058); distal width 0.105–0.135 (46: 0.119 ± 0.0079). Tergal setae: II, 9–16 (55: 11.8 ± 1.22); III, 15–20 (53: 17.6 ± 1.34); IV, 17–23 (53: 19.5 ± 1.64); V, 15–22 (52: 18.0 ± 1.73); VI, 10–15 (52: 12.9 ± 1.04); tergal and pleural setae on VII, 14–23 (51: 18.9 ± 1.78). Sternal setae: II, 8–13 (55: 10.9 ± 1.19); III, 9–15 (55: 11.3 ± 0.99); IV, 9–15 (54: 11.8 ± 1.24); V, 6–13 (52: 9.4 ± 1.27); VI, 5–10 (53: 8.1 ± 1.06); VII, 5–8 (54: 6.5 ± 0.69); VIII, 4–7 (53: 5.8 ± 0.68). Genitalia with sac having 4 large spines; parameral arch width 0.135–0.160 (40: 0.147 ± 0.0061); endomerical plate width 0.070–0.085 (46: 0.075 ± 0.0037), length 0.055–0.080 (46: 0.076 ± 0.0062), triangular, apically tapered with distinct cleft 0.020–0.030 (42: 0.025 ± 0.0036) deep.

Geomydoecus ewingi was described by Price & Emerson (1971) as 1 of the few species of *Geomydoecus* to possess 4 large spines in the male genital sac. It is the only *Geomydoecus* on the *Geomys bursarius* complex to possess 4 spines; all others have 6. The type-host listed by Price & Emerson (1971) is not consistent with our current understanding of louse distributions and herein we reassign the type-host to be *G. b. sagittalis*. The original confusion stems from the fact that the area around Stillwater, Oklahoma, is a contact zone between the midwestern subspecies of *Geomys*, *G. b. major*, and the southeastern subspecies, *G. b. sagittalis*. Originally these 2 subspecies were described as different species, *Geomys lutescens* [= *G. b. major*] and *Geomys breviceps* [= *G. b. sagittalis*]. Baker & Glass (1951) examined specimens of *Geomys* from Cleveland and Pottawatomie counties, Oklahoma, and concluded that the 2 taxa did not merit specific recognition. However, recent studies (Heaney 1979) have shown that there is little to no gene flow between the northern and southern populations of gophers. We assign the type-host of *Geomydoecus*

ewingi to *G. b. sagittalis* because we have numerous collections of *G. ewingi* from throughout the range of the southeastern subspecies of pocket gophers and no other records of *G. ewingi* from *G. b. major*, whereas *G. oklahomensis* is known from throughout the range of *G. b. major*.

The most distinctive character that separates *G. ewingi* from all other species of *Geomydoecus* on *G. bursarius* is the presence of only 4 spines in the genital sac of males. The antennal scape in *G. ewingi* is variable, but does not have the enlarged thumblike process found in *G. oklahomensis* and *G. heaneyi*. In the genital chamber sac of females, *G. ewingi* has fewer complete loops than *G. subgeomydis*, but more than *G. oklahomensis*. Additionally the genital chamber sac length and distance the last loop extends back is less in *G. ewingi* than in *G. subgeomydis*; however, it is greater than in *G. oklahomensis*.

Geomydoecus ewingi is by far the most variable species of louse on any *Geomys*; however, splitting it into 2 or more species or subspecies does not appear warranted at this time. This decision was made in part because each population of lice differed slightly from other populations of lice. Although 180 adult lice from 33 localities were examined, larger sample sizes from additional localities are needed to properly assess geographic variation in *G. ewingi*.

The soils of southeastern Texas and adjacent areas are complex (Carter 1931, Honeycutt & Schmidly 1979) and, correspondingly, populations of pocket gophers have been isolated for varying degrees of time. This isolation is reflected in the fact that 9 subspecies of *Geomys bursarius* have been described from this area.

Geomydoecus ewingi is found on *Geomys bursarius attwateri* Merriam, *G. b. breviceps* Baird, and *G. b. sagittalis*.

Specimens examined. *Geomys bursarius attwateri*, 32 ♀, 38 ♂, USA: Texas: Atascosa Co.: 9 mi (14.5 km) N of (2), and 2 mi (3.2 km) N of (1) Pleasanton, Bexar Co.: 13 mi (20.9 km) S of San Antonio (1), 7 mi (11.3 km) SW of Somerset (3), Goliad Co.: 3½ mi (5.6 km) N of Goliad (2), Wilson Co.: 4 mi (6.4 km) W of LaVernia (1). *Geomys bursarius breviceps*, 19 ♀, 14 ♂, USA: Louisiana: Morehouse Par.: 1 mi (1.6 km) W of (1), 1 mi (1.6 km) S of (4), 2½ mi (4.0 km) S of (1), and 3½ mi (5.6 km) S of (1) Mer Rouge. *Geomys bursarius sagittalis*, 87 ♀, 97 ♂, USA: Louisiana: Lincoln Par.: 4 mi (6.4 km) E of Choudrant (1), Ruston (1), Vernon Par.: 4.2 mi (6.8 km) NE of (1), and 2 mi (3.2 km) E of

(1) Texas-Louisiana border, Webster Par.: 5 mi (8.0 km) E of Minden (2); Oklahoma: Cleveland Co.: 1 mi (1.6 km) N and 12 mi (19.3 km) E of (1), 17½ mi (28.2 km) E of (1), 7 mi (11.3 km) E of (1), 3½ mi (5.6 km) E of (1), and 1½ mi E of (1) Norman, Payne Co.: Stillwater (1), Pottawatomie Co.: 6.5 mi (10.5 km) W Tecumseh (1); Texas: Jasper Co.: Kirbyville (1), Nacogdoches Co.: 5 mi (8.0 km) S of (2), 6 mi (9.7 km) SE of (1), 11 mi (17.7 km) SW of (1), and 11½ mi (18.5 km) SE of (1) Nacogdoches, Newton Co.: 12 mi (19.3 km) NE of Burkville (1), 2 mi (3.2 km) SE of (1), and at (2) Newton, Rains Co.: 5½ mi (8.8 km) E of Emory (2), Upshur Co.: 1 mi (1.6 km) NW of Gilmer (1), Wood Co.: Mineola (1).

Results of statistical analysis

Many of the taxonomic conclusions on which the preceding classification was built were based on a series of multivariate analyses. The results of these analyses are presented here in order to further document morphological variation and relationships between the species of lice. In each of these analyses, up to 24 operational taxonomic units (OTU's) were entered (see methods in introductory pages). The 24 OTU's included all species of lice, most of which were broken into 3 or more geographic units. Specimens included were collected from all previously named subspecies of *Geomys bursarius*.

The first of these analyses was a principal components analysis of males using all 24 OTU's; the results are shown in FIG. 14. There are 2 main groupings of OTU's, and both of these subdivide into groups. The most distinctive division of OTU's is into what we will term the "northern" group and the "southern" group. The "northern" group is composed of *G. geomydis*, *G. illinoensis*, *G. oklahomensis*, *G. nebrathkensis*, and *G. spickai*. Within this group 3 species, *G. oklahomensis*, *G. nebrathkensis*, and *G. spickai*, consistently cluster closer to each other than any other species-groups examined and are herein considered the *G. oklahomensis* complex. A second grouping evident in this "northern" group includes *G. geomydis* and *G. illinoensis*. The "southern" group is composed of 3 species, *G. ewingi*, *G. heaneyi*, and *G. subgeomydis*. The populations of *G. ewingi* form a rather variable grouping and *G. heaneyi* forms a distinct OTU in the *G. ewingi*-*subgeomydis* cluster. In this analysis, the characters found to be most useful in distinguishing between OTU's were the genitalia, size, and antennal scape.

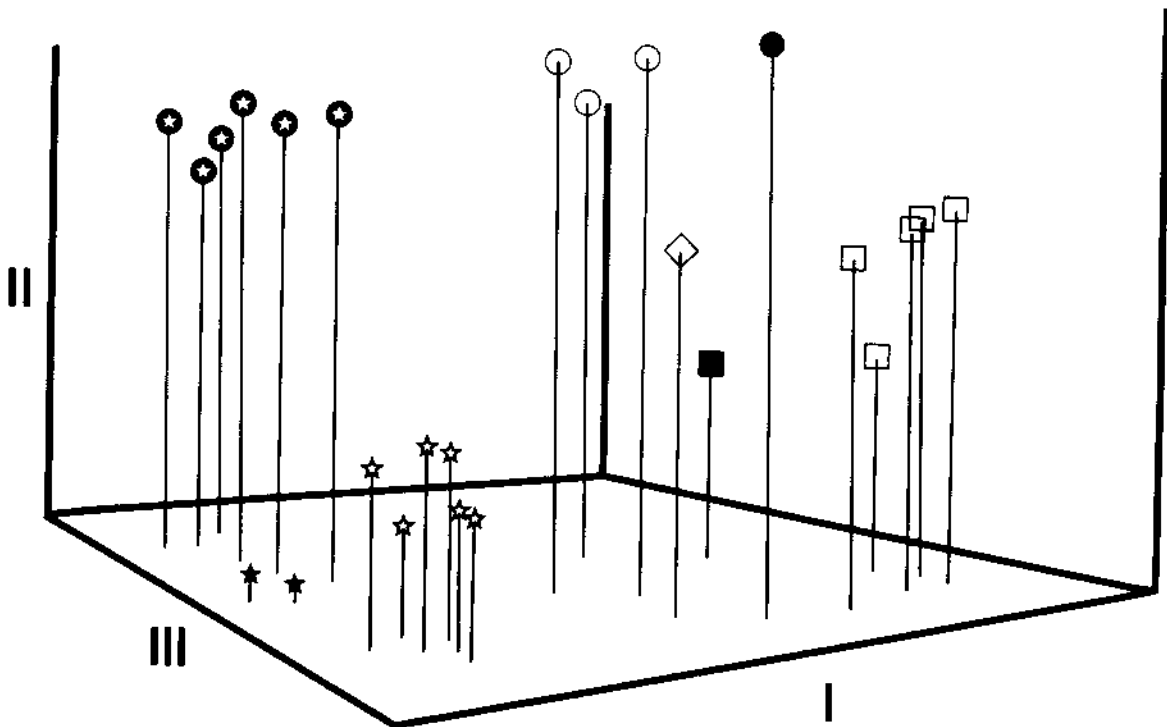


FIG. 14. Three-dimensional projection of the 8 species of *Geomydoecus* on the *Geomys bursarius* complex based on the results of a principal components analysis. The open stars represent *Geomydoecus subgeomydis*; solid stars, *G. heaneyi*; open stars within the solid circle, *G. ewingi*; open circles, *G. geomydis*; solid circle, *G. illinoensis*; open squares, *G. oklahomensis*; solid square, *G. spickai*; and open diamond, *G. nebrathkensis*.

A principal components analysis was also conducted on females from the same OTU's; these results supported the above conclusions drawn from males. The characters found to be most useful in distinguishing between OTU's were the genitalia and size.

Once the major groups of OTU's had been established, further analyses were done to investigate variation within and similarities between OTU's. This was done using discriminant function analyses in which individual lice were identified as to the OTU in which they belonged, and maximum discrimination between all OTU's was calculated.

The analysis of the *G. geomydis* group showed significant but minor differences between lice from *Geomys b. bursarius*, *G. b. majusculus*, and *G. b. wisconsinensis*. The analysis consistently identified lice from these gophers as distinct from all other lice but could not consistently identify on which of the 3 taxa they originated. This suggests that a single louse species, *G. geomydis*, occurs on these gophers. Lice on *Geomys bursarius illinoensis* are significantly different and consistently recognizable and so are considered to be a distinct species, *Geomydoecus illinoensis*.

Lice from the *G. subgeomydis* and *G. ewingi* groups were analyzed together; they were broken down into 14 OTU's. The results indicate 2 completely distinct groups, which are here considered to be the species *G. subgeomydis* and *G. ewingi*. It should be noted that 1 population of *G. ewingi* is geographically isolated in south-central Texas from other populations on the eastern edge of the state; this population is not statistically distinguishable from some of the eastern populations. *Geomydoecus ewingi* is a variable species, as noted above, but no consistent geographic pattern of variation is recognizable based on the specimens available, so no subspecific splitting currently is justified.

Analysis of the *G. oklahomensis* complex showed a more complicated pattern than in the previous analyses. Lice from *Geomys bursarius missouriensis* were consistently and highly different from other lice and so are considered to comprise a distinct species, *Geomydoecus spickai*. Lice from *Geomys bursarius jugossicularis*, *G. b. industrius*, *G. b. knoxjonesi*, *G. b. major*, and *G. b. lutescens* from south of the Platte River in Nebraska and Colorado were not distinguishable from one another and clearly are conspecific. The population north of the Platte

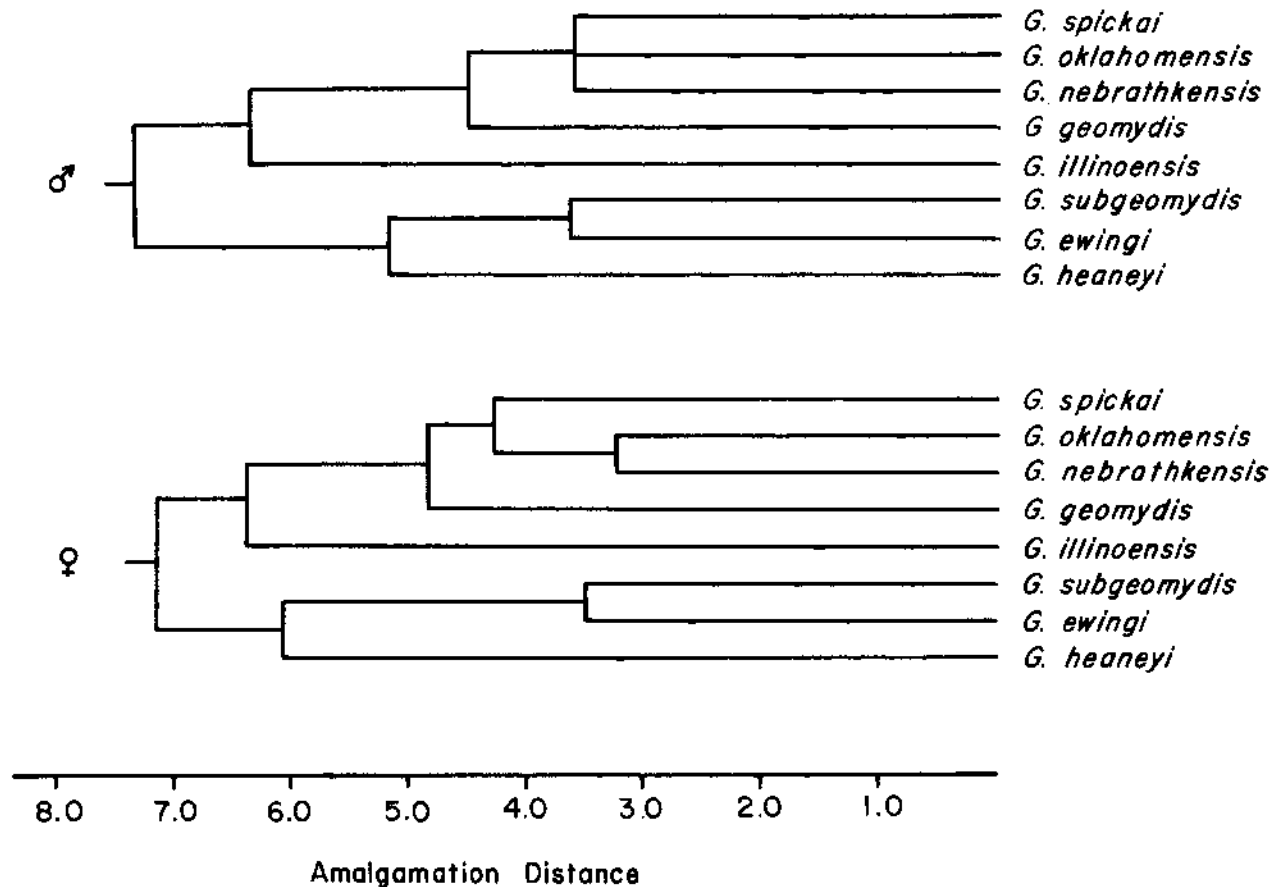


FIG. 15. Distance phenogram resulting from the cluster analysis of the 8 species of *Geomydoecus* on the *Geomys bursarius* complex.

River showed little overlap with lice from the southern portion of the range. This problem deserves additional study; for now, the patterns of variation within the lice seem best represented by recognizing those from north of the Platte River as a species, *G. nebrathkensis*, distinct from those south of the Platte River, *G. oklahomensis*.

A final analysis of the lice was conducted using a cluster analysis; data used for this were means for all adult individuals of a given sex in each of the species identified in the earlier analyses. The results are shown in FIG. 15. In both males and females there are 2 major groups. The first of these, composed of *G. subgeomydis*, *G. ewingi*, and *G. heaneyi*, is restricted to southeastern Texas and adjacent areas. *Geomydoecus subgeomydis* and *G. ewingi* are more similar to each other than either is to *G. heaneyi*. The second major cluster includes the *G. geomydis* and *G. oklahomensis* complexes discussed above. *Geomydoecus oklahomensis*, *G. nebrathkensis*, and *G. spickai* form a single cluster in the males; females indicate a closer relationship be-

tween *G. oklahomensis* and *G. nebrathkensis*. *Geomydoecus geomydis* and *G. illinoensis* are peripheral to this group, with little similarity between the 2 taxa being indicated.

The following key should enable workers to identify the lice found on *Geomys*. For descriptions of species not discussed in this paper, see Price & Emerson (1971), Price (1975), Price & Hellenthal (1975), Price & Timm (1979), and Timm & Price (1979). It should be noted that there are no known males of *Geomydoecus mobilensis*.

KEY TO THE KNOWN SPECIES AND SUBSPECIES OF
Geomydoecus ON *Geomys*

♂

1. Genitalia with sac having only 4 spines 2
- Genitalia (FIG. 5) with sac having 6 spines 6
- 2 (1). Antennal scape with definite thumblike process on posterior margin (FIG. 8) 3
- Antennal scape without such process (FIG. 3) 4
- 3 (2). On *Geomys bursarius attoateri* (in part), *G. b. breviceps*, and *G. b. sagittalis* (in part) ... **ewingi** (in part)
- On *G. arenarius* **quadridentatus**

- 4 (2). Temple setae with submarginal seta extending well beyond apex of inner marginal seta; head width 0.41 or less; genitalia width 0.15 or less; on *G. b. altwateri* (in part), *G. b. breviceps*, and *G. b. sagittalis* (in part) **ewingi** (in part)
 Temple setae with submarginal seta occasionally extending to or slightly beyond apex of inner marginal seta; temple width greater than 0.41; genitalia width 0.16 or more **texanus** ... 5
- 5 (4). Prothorax width 0.34 or greater; total length 1.37 or more; on *G. personatus* (in part) **texanus texanus**
 Prothorax width under 0.34; total length under 1.37; on *G. tropicalis* **texanus tropicalis**
- 6 (1). Genitalia with flattened medioposterior margin of parameral arch (FIG. 6); on *G. personatus* (in part) **truncatus**
 Genitalia with either pointed or trifurcated medio-posterior process of parameral arch 7
- 7 (6). Apical portion of parameral arch terminating with blunt trifurcated process (FIG. 7); on *G. colonus*, *G. cumberlandius*, *G. fontanelus*, and *G. pinetis* (in part) **scleritus**
 Apical portion of parameral arch terminating in a single pointed process 8
- 8 (7). Antennal scape with definite thumblike process on posterior margin (FIG. 8) 9
 Antennal scape without such process (FIG. 3) 12
- 9 (8). Total body length usually greater than 1.30; temple width usually 0.41 or more; and scape length usually greater than 0.18; on *G. b. missouriensis* **spickai**, n. sp.
 Usually smaller than above 10
- 10 (9). Temple width generally 0.40 or more; on *G. personatus fuscus* **dalgleishi**
 Temple width generally less than 0.40 11
- 11 (10). Length of endomerale plate usually less than 0.070; length of antennal scape usually under 0.165; on *G. b. llanensis* and *G. b. texanus* **heaneyi**, n. sp.
 Length of endomerale plate usually greater than 0.070; length of antennal scape usually greater than 0.170; on *G. b. industrius*, *G. b. jugossicularis*, *G. b. knoxjonesi*, *G. b. lutescens* (in part), and *G. b. major* **oklahomensis**
- 12 (8). Temple width 0.41 or less; width of parameral arch usually less than 0.16 13
 Temple width greater than 0.41; width of parameral arch usually greater than 0.16 14
- 13 (12). Total body length, with rare exceptions, under 1.30; temple width usually less than 0.39; on *G. b. altwateri* (in part) and *G. b. sagittalis* (in part) **subgeomydis**
 Total body length generally 1.30 or more; temple width usually greater than 0.39; on *G. b. lutescens* (in part) **nebrathkensis**, n. sp.
- 14 (12). Length of antennal scape generally greater than 0.18; on *G. b. illinoensis* **illinoensis**
 Length of antennal scape generally less than 0.18; on *G. b. bursarius*, *G. b. majuscultus*, and *G. b. wisconsinensis* **geomydis**
- ♀
1. Setae across central 1/2 of tergite VII distinctly longer than comparable setae on tergite VI, usually 2x longer or more 2
 Setae across center of tergite VII approximately same size or only slightly longer than those on tergite VI 6
- 2 (1). Temple with submarginal seta closer to outer marginal seta; genital chamber sac with posteriorly directed converging diagonal lines and few incomplete anterior loops; on *Geomys personatus* (in part) **truncatus**
 Temple with submarginal seta from midway between marginal setae to being closer to inner seta; genital chamber sac not as above 3
- 3 (2). Genital chamber sac with prominent lines converging medially **texanus** ... 4
 Genital chamber sac with broken faint lines and loops, and without lines so obviously converging 5
- 4 (3). Head length 0.33 or more; prothorax width over 0.35; on *G. personatus* (in part) .. **texanus texanus**
 Head length under 0.33; prothorax width under 0.35; on *G. tropicalis* **texanus tropicalis**
- 5 (3). Most (6-8) of medial 10 setae on tergite VII longer than 0.10; on *G. colonus*, *G. cumberlandius*, *G. fontanelus*, and *G. pinetis* (in part) **scleritus**
 Usually 0-1 of medial 10 setae on tergite VII longer than 0.10; on *G. pinetis mobilensis* . **mobilensis**
- 6 (1). Genital chamber sac with medioanterior portion containing no loops, diagonal lines, or coarse wavy lines (FIG. 10); on *G. personatus fuscus* **dalgleishi**
 Genital chamber sac with medioanterior portion containing either complete loops, partial broken loops, diagonal lines, or coarse wavy lines 7
- 7 (6). Genital chamber sac (FIG. 12) with irregular lines in central area forming at most 2-6 coarse loops; on *G. bursarius illinoensis* **illinoensis**
 Genital chamber sac with all lines fairly regular and with smooth posteriorly directed loops or partial loops 8
- 8 (7). Genital chamber sac as in FIG. 11, typically with 10-18 complete, smooth loops in medioanterior portion; on *G. bursarius bursarius*, *G. b. majuscultus*, and *G. b. wisconsinensis* **geomydis**
 Genital chamber sac with up to 8 complete loops, usually 6 or less 9
- 9 (8). Temple margin with submarginal seta not extending beyond apex of longer adjacent marginal seta; on *G. arenarius* **quadridentatus**
 Temple margin with submarginal seta extending well beyond apex of longer adjacent marginal seta 10
- 10 (9). Genital chamber sac usually with 4-8 complete loops; on *G. bursarius altwateri* (in part) and *G. b. sagittalis* (in part) **subgeomydis**
 Genital chamber sac usually with less than 4 complete loops 11
- 11 (10). Genital chamber sac usually with 2-4 complete loops; total length of genital chamber sac usually 0.18-0.24; on *G. b. altwateri* (in part), *G. b. breviceps*, and *G. b. sagittalis* (in part) **ewingi**
 Genital chamber sac usually with 0-2 complete loops (FIG. 9), often 1 or more pairs of posteriorly directed curved lines not meeting to form loop 12
- 12 (11). Subgenital plate usually with 24 or more setae; on *G. b. lutescens* (in part) **nebrathkensis**, n. sp.
 Subgenital plate usually with fewer than 24 setae 13
- 13 (12). Total length of genital chamber sac extending back usually over 0.085; and total body length usually over 1.30; on *G. b. missouriensis* **spickai**, n. sp.
 Not as above 14

- 14 (13). Total body length usually 1.20 or less; head length usually under 0.30; on *G. b. llanensis* and *G. b. texanus* **heaneyi, n. sp.**
Usually larger than above; on *G. b. industrius*, *G. b. jugossicularis*, *G. b. knoxjonesi*, *G. b. lutescens* (in part), and *G. b. major* **oklahomensis**

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APPENDIX

Geomydoecus geomydis was the first louse described from pocket gophers and for several years was

thought to be the only louse parasitizing geomyids. Hence, *G. geomydis* has been recorded in the literature as occurring on several species (and subspecies) of mammalian hosts other than its true ones. We consider all literature records of this louse occurring on hosts other than *Geomys bursarius bursarius*, *G. b. majusculus*, and *G. b. wisconsinensis* to be erroneous records. However, we have several valid records of small numbers of *G. geomydis* occurring on Long-tailed Weasels, but have no evidence that pocket gopher lice are able to breed successfully on weasels (see accounts of *G. geomydis* and *G. oklahomensis*).

Erroneous host records for *G. geomydis*

The following list of hosts contains records that are all considered erroneous; papers are arranged chronologically and the host names are listed as presented in the original citation by the author(s). If the original host name used is no longer valid, we have added the current name in brackets. Judging from the localities given, most of these cases are probably due to incomplete understanding of louse taxonomy; however, later contamination cannot be ruled out.

- (1) *Thomomys*—Osborn (1891).
- (2) *Thomomys bottae*—Osborn (1896).
- (3) tuza (*Geomys mexicanus*, Licht.) [=?] & (*Platygeomys gymnurus*, Merr.) [= *Pappogeomys gymnurus* (Merriam)]—Dugés (1902).
- (4) *Thomomys bottae*—Morse (1903).
- (5) *Thomomys bottae*; *Thomomys bulvivarius* [= *T. bulbivorus* (Richardson)]; "ground squirrel"—Paine (1912).
- (6) *Macrotomys heterodus* Ptrs. [= *Macrogeomys heterodus* Peters]; *Echinasciurus rigidus* Ptrs. [= *Sciurus variegatoides rigidus* Peters]—Stobbe (1913).
- (7) *Thomomys bottae laticeps*; *Thomomys* sp.—Kellogg & Ferris (1915).
- (8) *Thomomys monticola*; *Geomys cumberlandius*—Ferris (1916).
- (9) *Geomys breviceps breviceps* [= *Geomys bursarius breviceps* Baird]—English (1932).
- (10) *Leptonxteris nivalis* (Sauss.)—Gerberg & Goble (1941).
- (11) *Geomys bursarius illinoensis* Komarek & Spencer; *Geomys lutescens* [= *Geomys bursarius lutescens* Merriam]; *Geomys breviceps breviceps* [= *Geomys bursarius sagittalis*]; *Thomomys bottae bottae* Eydoux & Gervais—Werneck (1945).
- (12) *Thomomys talpoides* (Richardson)—Tryon (1947).
- (13) *Geomys lutescens* [= *G. bursarius lutescens*]; *Geomys breviceps* [= *G. bursarius breviceps*]; *Cratogeomys castanops* [= *Pappogeomys castanops* (Baird)]—Hopkins (1949).
- (14) *Geomys bursarius illinoensis*—Malecki (1949).
- (15) *Cratogeomys castanops* [= *Pappogeomys castanops*]—Eads & Hightower (1950).
- (16) *Thomomys bottae newa* Merriam—Howard & Childs (1959).
- (17) *Cratogeomys castanops* [= *Pappogeomys castanops*]—Miller & Ward (1960).
- (18) *Cratogeomys merriami* [= *Pappogeomys merriami* (Thomas)]; *Cratogeomys merriami irolonis* [= *Pappogeomys irolonis* (Nelson & Goldman)]; *Cratogeomys perotensis estor* [= *Pappogeomys perotensis estor* (Merriam)]; *Cratogeomys* sp. [= *Pappogeomys*]—Barrera (1961).
- (19) *Geomys bursarius lutescens*; *Geomys bursarius major*—Price & Emerson (1971).
- (20) *Geomys bursarius illinoensis*—Tuszynski & Whitaker (1972).

Erroneous louse records for *Geomys* spp.

In addition to erroneous records of pocket gopher lice on other species of mammals, there are incorrect reports of other species of lice occurring on pocket gophers of the genus *Geomys*. Some of the earlier cases are due to incomplete understanding of louse taxonomy and some are due to incomplete understanding of pocket gopher taxonomy. The following list contains records that are considered erroneous.

- (1) *Haematopinoides squamosus* Osborn (Anoplura: Hoplopleuridae)—Osborn (1891) described *H. squamosus* as a new genus and species from "Two specimens, both females, collected from the pocket or pouched gopher, *Geomys bursarius*, at Ames, Iowa." This species, although rare in collections, is a parasite of moles; it has been collected from both *Parascalops* and *Scalopus* (Ferris 1951). Osborn's record of *H. squamosus* from *Geomys bursarius* undoubtedly was either a case of contamination or misidentification of the host.
- (2) *Geomydoecus expansus* (Dugés)—described from "*Geomys mexicanus*" [=?] by Dugés (1902); true host probably *Pappogeomys castanops excelsus* (Nelson & Goldman) (see Price & Emerson 1971).
- (3) *Geomydoecus chapini* Werneck—described from *Geomys personatus tropicalis* [= *Geomys tropicalis* Goldman] by Werneck (1945); true host

probably *Orthogeomys hispidus chiapensis* (Nelson & Goldman) or possibly *O. h. teapensis* (Goldman) (see Price & Hellenthal 1976).

(4) *Geomydoecus copei* Werneck—described from “*Geomys mexicanus*” [=?] by Werneck (1945);

true host probably *Orthogeomys hispidus torridus* (Merriam).

(5) *Geomydoecus californicus* (Chapman)—reported on *Geomys bursarius* by Miller & Ward (1960); true host *Thomomys bottae*.