

LOUSE-HOST ASSOCIATIONS OF *GEOMYDOECUS* (MALLOPHAGA:  
TRICHODECTIDAE) WITH THE YELLOW-FACED POCKET  
GOPHER, *PAPPOGEOMYS CASTANOPS*  
(RODENTIA: GEOMYIDAE)<sup>1</sup>

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**Abstract:** The distribution of 6 taxa of lice of the genus *Geomydoecus* on *Pappogeomys castanops* appears to divide the hosts into northern and southern subspecies-groups. The northern subspecies-group of *P. castanops* has *G. expansus* and 3 morphologically similar lice of the *texanus*-complex, but lacks *G. subnubili* and *G. martini*. The southern group has *G. subnubili*, usually with *G. martini* or occasionally with *G. expansus* on the same host, but without *G. expansus* alone. Principal components analysis indicates that the northern and southern populations of *G. expansus* show slight morphological differences from which we infer isolation.

In his revision of the pocket gophers of the genus *Pappogeomys* Merriam, Russell (1968) recognized 25 subspecies of *P. castanops* (Baird). He placed these into 2 groups on the basis of morphological evidence, but noted that the groups were sometimes joined by interbreeding populations and constituted a *ras-senkreis*. This substantially differed from the previous summarization of the species (Hall & Kelson 1959), which listed only 20 subspecies and did not recognize subspecies-groups. Study of *P. castanops* by Berry & Baker (1972) revealed a diploid chromosome number of 46 for specimens collected north of the 25th parallel and 42 for those south of there. This led them to suggest that the

subspecies-groups proposed by Russell might be redefined. They also felt that these subspecies-groups might more appropriately be considered species, but because of their small number of collections chose to retain Russell's taxonomic arrangement pending additional evidence.

Price & Emerson (1971), in their revision of *Geomydoecus* Ewing, redescribed the 2 louse species associated with *P. castanops*. Subsequent studies (Price & Hellenthal 1975a, b), based on an examination of over 5500 adult lice from 320 hosts representing all of the subspecies of *P. castanops* recognized by Russell, have shown each of these species of lice to represent a complex including 2 taxa in one case and 6 in the other. We have compared the distributions of these lice with those of their hosts, and it is our intent here to describe the results and to consider the implications of these comparisons.

DISTRIBUTION AND AFFINITIES OF THE LICE

The 4 species comprising the *texanus*-complex (see Price & Hellenthal 1975b) exhibit both geographical and morphological distinctions. One of these, *G. texanus* Ewing, is restricted to the host genus *Geomys* Rafinesque and was collected primarily along the Gulf Coast of southern Texas and northern Mexico. The distributions of these together with

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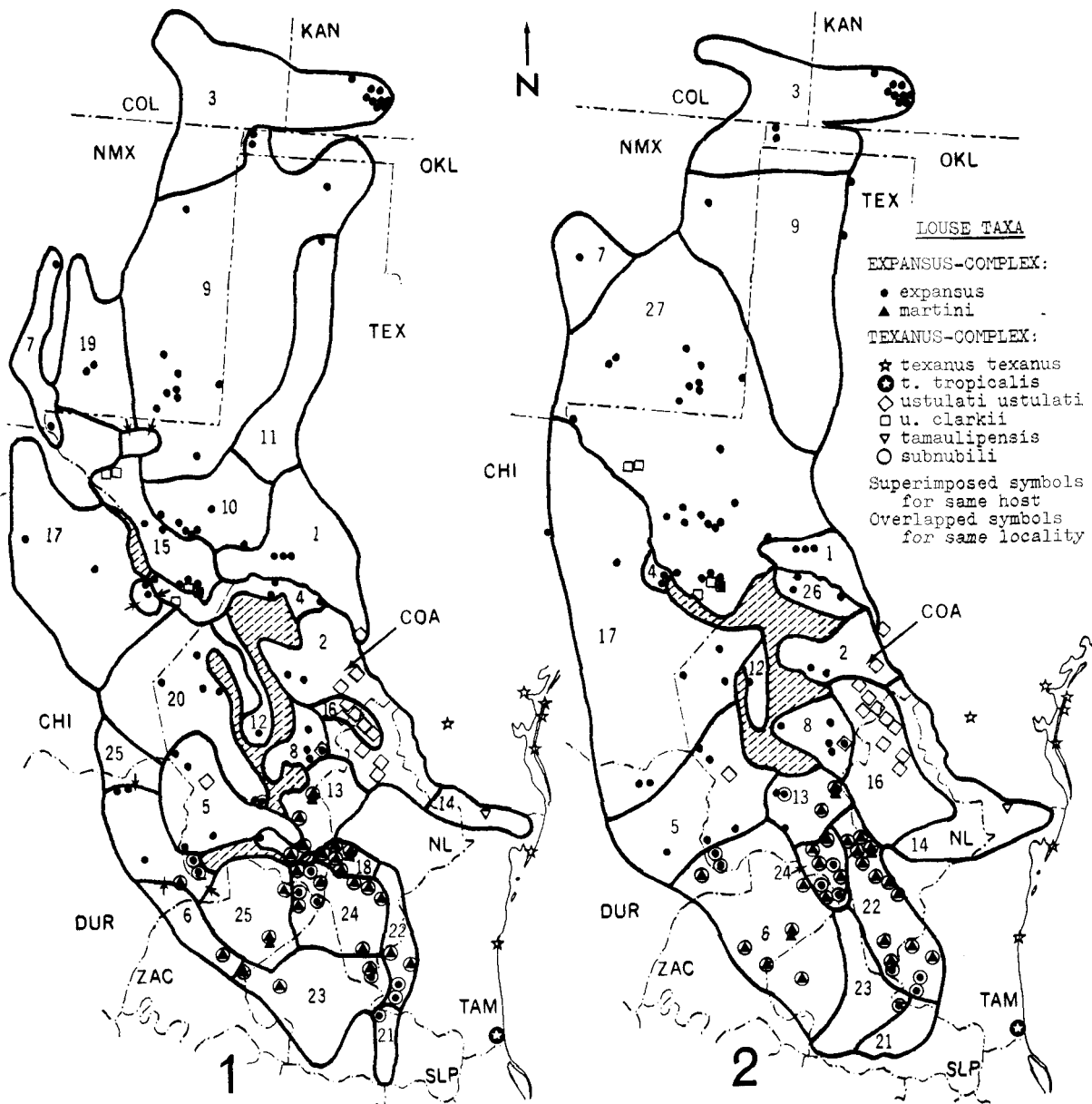


FIG. 1, 2. Distribution of collections of 8 taxa of *Geomydoecus* and host ranges of *Pappogeomys castanops* subspecies modified from: (1) Russell (1968), with arrows indicating sympatric areas, and (2) Hall & Kelson (1959). Enclosed shaded areas without *P. castanops*. Subspecies of *P. castanops*: 1, *angusticeps*; 2, *bullatus*; 3, *castanops*; 4, *clarkii*; 5, *excelsus*; 6, *goldmani*; 7, *hirtus*; 8, *jucundus*; 9, *perplanus*; 10, *pratensis*; 11, *simulans*; 12, *sordidulus*; 13, *subsimus*; 14, *tamaulipensis*; 15, *torridus*; 16, *ustulatus*; 17, *consitus*; 18, *elibatius*; 19, *parviceps*; 20, *perexiguus*; 21, *peridoneus*; 22, *planifrons*; 23, *rubellus*; 24, *subnubilis*; 25, *surculus*; 26, *convexus*; 27, *lacrimalis*.

the other collections of lice for this study are plotted in FIG. 1 and 2.

The remaining 3 species of this complex are restricted to *P. castanops*. Of these, a single collection of the possibly parthenogenetic *G. tamaulipensis* Price & Hellenthal was taken east of those of the other taxa. All collections of *G. subnubili* Price & Hellenthal, a species morphologically quite distinct

from the other *texanus*-complex taxa, were south of those of *G. ustulati* Price & Hellenthal.

The 2 subspecies of *G. ustulati* were each collected from 2 apparently isolated areas, those of *G. u. clarkii* Price & Hellenthal being north and west of those of *G. u. ustulati*. These lice were reexamined to determine if their presumed isolation was reflected morphologically. The 2 populations of *G. u. clarkii*

are separated by about 240 km and lie just north of the Rio Grande. In *G. u. ustulati*, 1 collection was obtained slightly south and about 200 km west of the main population. Some minor character differences were found between the populations within each subspecies. In *G. u. clarkii*, the southeastern population tended towards slightly smaller size and features, whereas for *G. u. ustulati*, the southwestern population showed some slightly reduced setal counts. In neither case do we feel these differences warrant taxonomic status, but we believe they suggest that the populations are truly isolated.

Gophers having *G. subnubili* always had 1 of the *expansus*-complex species (105 gophers), though these latter species also occurred alone elsewhere. In only 2 other instances were lice of the *texanus*-complex collected with other lice; these were in *G. u. ustulati* (1/33 gophers) and *G. u. clarkii* (1/12 gophers), each collected with *G. expansus* (Duges).

The 2 species of the *expansus*-complex did not show major geographic separations as did those of the *texanus*-complex. *G. expansus* was collected north, south, and west of *G. martini* Price & Hellenthal, and nearly reached the extreme *G. martini* locality to the east. Only once were both species

obtained from a single locality, and even there they were on different gophers. *G. expansus* also occurred north and west of the *texanus*-complex, being the only louse found on *Pappogeomys* north of Chihuahua (50 gophers). To the south, *G. expansus* extended throughout the range of *G. subnubili* and was never taken from hosts not having *G. subnubili* (23 gophers). *G. martini* was collected in the southeastern part of the distribution of *G. expansus* and was distributed similarly to *G. subnubili*, being either on the same hosts (82/85 gophers) or alone. In the central part of its range, *G. expansus* was generally alone, rarely being found on a host with *G. u. ustulati* (1/92 gophers) or *G. u. clarkii* (1/92 gophers).

To determine whether the *G. expansus* collected within the ranges of *G. subnubili* and *G. martini* differed from those collected alone farther north, we used principal components analysis, as was done for lice of the *texanus*-complex (see Price & Hellenthal 1975b). For 28 female characters and 18 male characters, the first 3 components were found to account for 50% of the variation in females and 61% of the variation in males. Scattergrams with coordinates representing the 1st and 2nd principal axes in reduced character space for each sex both

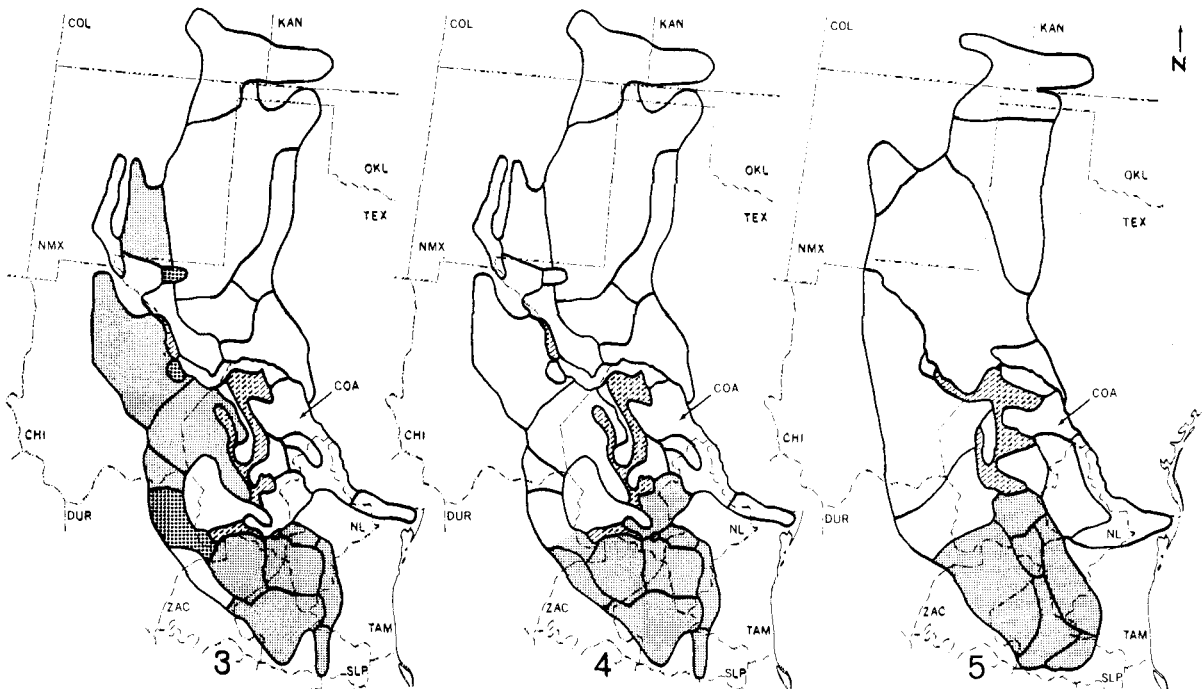


FIG. 3-5. *Pappogeomys castanops* ranges modified from: (3) Russell (1968) showing distribution of his *excelsus*-group (unshaded) and *subnubili*-group (light dots), with sympatric areas (heavy dots); (4) Russell (1968) altered to show how *Geomydoecus* distribution would define *excelsus*-group (unshaded) and *subnubili*-group (light dots); (5) Hall & Kelson (1959) altered to show how *Geomydoecus* distribution would define *excelsus*-group (unshaded) and *subnubili*-group (light dots).

showed some distinctions between *G. expansus* from the 2 regions. The best separation was achieved by graphing the 1st and 2nd axes for females (FIG. 6). As with the geographically isolated populations of each of the subspecies of *G. ustulati*, our inability to find good discriminating characters has discouraged us from assigning taxonomic status to the groups of lice, but again we believe these populations to be isolated.

#### HOST-LOUSE DISTRIBUTION COMPARISON

To compare the louse and pocket gopher distributions, we superimposed the distribution map of gophers presented by Russell (1968) on our host locality map (FIG. 1). Russell's distribution map was slightly modified to incorporate the eastern extension of the range of *P. c. castanops* into Kansas (Birney et al. 1971). In all cases, the host locality fell within the range on Russell's map in agreement with the host identifications. Of the 25 subspecies recognized by Russell, 10 (40%) contained only 1 louse taxon, 9 (36%) had 1 taxon from each louse complex, and 6 (24%) had the 2 *expansus*-complex taxa and *G. subnubili*. The only louse from *P. castanops* that never occurred on a subspecies of gopher having other louse taxa was *G. tamaulipensis*, collected from *P. c. tamaulipensis* (Nelson & Goldman).

In considering Russell's subspecies-groups (FIG. 3), we found that each was to some extent definable by its lice. In the *excelsus*-group, 12 of the 16 host subspecies contained either *G. expansus* alone or with *G. ustulati*, 1 host subspecies had *G. ustulati* or *G. tamaulipensis* alone, and 2 had *G. subnubili*, *G. expansus*, and *G. martini*. In the last case, these 2 subspecies were the most southern of this host group. In the *subnubilus*-group, 7 of the 9 host subspecies had *G. subnubili* plus *G. expansus* and/or *G. martini*. The remaining 2 subspecies had *G. expansus* alone, these hosts being the most northern of the group.

In a single locality for each of the gopher subspecies *P. c. perexiguus* Russell, *P. c. subsimus* (Nelson & Goldman), and *P. c. goldmani* (Merriam), the lice were inconsistent with the other collections from the respective subspecies (FIG. 1), as follows.

(1) For *P. c. perexiguus*, we collected only *G. expansus* from all but the southernmost locality, which had 4 gophers with both *G. subnubili* and *G. expansus* and 1 gopher with a single specimen of *G. expansus*. From the paucity of lice on this last gopher, we cannot infer the absence of *G. subnubili*. The locality approaches the distribution of *P. c. subsimus*.

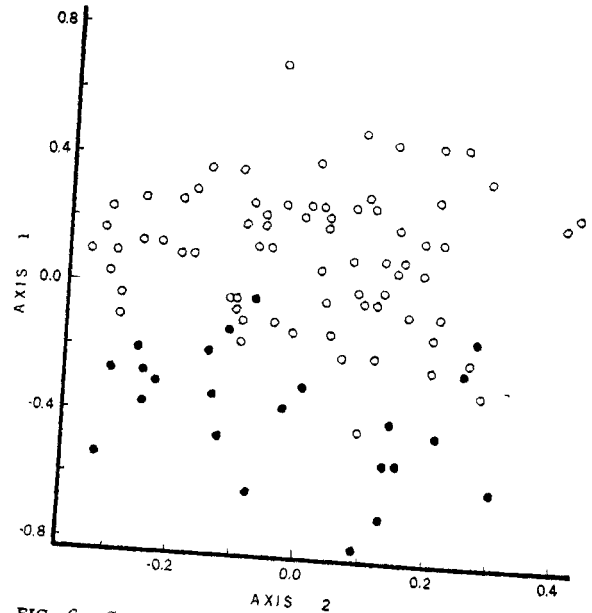


FIG. 6. Scattergram of principal components axes for *Geomydoecus expansus* individuals occurring alone (open circles) or with *G. subnubili* (solid circles).

(2) All localities of *P. c. subsimus* except 1 had *G. subnubili*. From 1 gopher collected at the most western locality, we obtained only *G. expansus*. This site was bordered on the west by an area said to lack *Pappogeomys*, and with *P. c. excelsus* (Nelson & Goldman) distributed just to the north. *G. subnubili* was not collected from *P. c. excelsus*, and at the 4 localities where *G. expansus* occurred, it was always alone.

(3) We obtained lice from gophers collected at 6 localities in an area indicated by Russell's map to be sympatric between *P. c. goldmani* and *P. c. surculus* Russell. The 2 northernmost collections had gophers identified as *P. c. surculus* with only *G. expansus*. Gophers identified as *P. c. goldmani* from the 3 southernmost localities had *G. subnubili* along with either *G. expansus* or *G. martini*. Originating from between these northern and southern localities was a single collection of gophers identified as *P. c. goldmani* having only *G. expansus*. These were the only *P. c. goldmani* not having *G. subnubili*.

Aside from the 3 collections discussed above, the lice appeared to combine the subspecies of *P. castanops* into 2 groups that differed somewhat from those of Russell (FIG. 4). The *excelsus*-group is characterized by gophers lacking *G. subnubili* and *G. martini*, and having *G. expansus* or 1 of the 3 morphologically similar species of the *texanus*-complex or both. The *subnubilus*-group consists of gophers having *G. subnubili* usually with *G. martini*, and occasionally with *G. expansus*, but with *G.*

*expansus* not occurring alone. This combination results in a relatively sharp north-south break between the 2 groups, and separates the northern and southern allopatric populations of *P. c. surculus*.

A distribution map of Hall & Kelson (1959), modified similarly to that of Russell, was also superimposed on the host locality map (FIG. 2). In this case, we used host locations rather than their identifications as criteria for subspecific inclusion. Where collections were from outside overall gopher distributional boundaries, we included them in the nearest subspecies. Of the 20 subspecies, 9 (45%) contained only 1 taxon of louse, 6 (30%) had 1 taxon from each louse complex, 4 (20%) had both the 2 *expansus*-complex louse species and *G. subnubili*, and we had no collections from the remaining subspecies (5%). As with the scheme proposed by Russell, *G. tamaulipensis* was the only louse taxon from *P. castanops* occurring on only a single host subspecies.

Hall & Kelson did not combine gopher subspecies into groups, but, when we applied the louse-based grouping criteria used with Russell's subspecies, we again obtained a well defined north-south division into 2 groups of subspecies (FIG. 5). In this case, only 1 of the 3 previously described inconsistencies appeared. This was the collection of *G. expansus* alone from 1 gopher identified as *P. c. subsimus*. As on Russell's distribution map, in gopher subspecies having *G. subnubili*, all individuals with *G. expansus* also had *G. subnubili*. Another feature of Hall & Kelson's distribution was the placement of both populations of *G. u. clarkii* near the southern border of their host subspecies, *P.* (= *Cratogeomys* Merriam) *c. lacrimalis* (Nelson & Goldman), rather than Russell's 2 subspecies, *P. c. torridus* Russell and *P. c. clarkii* (Baird).

The subspecies-groups of *P. castanops* suggested by Berry & Baker (1972) based on chromosome numbers would transfer *P. c. consitus* (Nelson & Goldman), *P. c. parviceps* Russell, *P. c. perexiguus*, and part of *P. c. surculus* to the *excelsus*-group of Russell, and would transfer part of *P. c. goldmani* to his *subnubilis*-group. In every case, our louse-defined gopher subspecies-groups agreed with the data of Berry & Baker (1972).

#### DISCUSSION

Our results substantially support the conclusions of Berry & Baker (1972). In addition, our numerous collections may help to define more precisely the boundaries of the subspecies-groups and suggest that it might be appropriate to transfer *P. c. subsimus* and all of *P. c. goldmani*, as plotted by Hall & Kelson

(1959), to the *subnubilis*-group. We must also conclude that either the general distribution of louse taxa does not correspond well with that of many host subspecies, or that some subspecies of *Pappogeomys* may be inaccurately defined. Only 1 louse taxon of 6 was restricted to a single subspecies as recognized by Russell, and only 2 of 6 with those of Hall & Kelson. Other than in the northern range of *G. expansus*, the distribution of lice is not readily explainable through parasite conservatism, but seems to show a distributional pattern quite independent of the hosts. We find it interesting that the subspecies summarized by Hall & Kelson seem to match the distribution of lice more easily than those presented by Russell. The smaller areas of Russell's subspecies would lead us to expect the opposite. That 4 of 7 of the new subspecies described by Russell (1968) show louse-gopher inconsistencies may help to explain this apparent contradiction.

Thus far we have ignored the affinities of *G. texanus*, the only member of the *texanus*-complex not occurring on *P. castanops*. It is morphologically most similar to *G. ustulati* but unlike all other known *Geomys* lice. This host-louse association remains another enigma.

Studies of ectoparasites have often aided in the recognition of host relationships (e.g., see Rothschild & Clay 1952). Yet, applying the generalities of parasite conservatism and host specificity to any particular case without strong supporting evidence bears an unacceptable risk. We are not mammalogists and thus are not equipped to judge pocket gopher taxonomists or their works, nor are we the appropriate ones to study the hosts in search of additional characters to verify these conclusions. The potential which lice have for assisting in the determination of the taxonomic relationships in pocket gopher taxa is, in our opinion, exceedingly great. Lice are easily collected from museum skins of hosts long dead, poorly prepared, or even with skulls missing. They can, therefore, help answer questions of distributional changes through time and assist in solving problems of identification as well as relationship.

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