AMERICAN MUSEUM
Novitates

PUBLISHED BY
THE AMERICAN MUSEUM
OF NATURAL HISTORY
CENTRAL PARK WEST AT 79TH STREET
NEW YORK, N.Y. 10024 U.S.A.

NUMBER 2604 AUGUST 19, 1976

WILLIS J. GERTSCH AND SUSAN E. RIECHERT

The Spatial and Temporal Partitioning of a Desert Spider Community, With Descriptions of New Species

AMERICAN MUSEUM
Novitates

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY
CENTRAL PARK WEST AT 79TH STREET, NEW YORK, N.Y. 10024
Number 2604, pp. 1-25, figs. 1-41, table 1 August 19, 1976

The Spatial and Temporal Partitioning of a Desert Spider Community, With Descriptions of New Species

WILLIS J. GERTSCH[1] AND SUSAN E. RIECHERT[2]

ABSTRACT

The habitat of desert spiders is characterized, and multivariate analyses are used to assess interspecific relations among spiders inhabiting a Recent lava bed area in south-central New Mexico.

General habitat types (i.e., lava bed, mixed grassland, and rangeland) account for most of the variability in species dispersion. The majority of the 90 species present in the area frequented the lava bed; the fewest species occupied the mixed grassland habitat bordering the flow. The spider community can be readily divided into eight groups within which frequent interaction is expected. Five of these groups are distinguished by general habitat association and temporal and seasonal considerations. The remaining groups consist of species that exhibit preferences toward specific habitat features (grasses and shrubs).

In most, but not all cases, closely related species are separated by spatial and temporal differences. Factors of the physical environment are thought to allow the coexistence of congeneric *Pellenes* (Salticidae) and *Dictyna* (Dictynidae) for which no niche partitioning is apparent.

Nine new species are described from the study area: *Zorocrates karli*, *Theridion leviorum*, *Drassyllus mumai*, *Zelotes chicano*, *Zelotes anglo*, *Phidippus reederi*, *Phidippus volcanus*, *Metaphidippus shaferi*, and *Sitticus juniperi*.

INTRODUCTION

Ecological studies of spider communities are confronted with problems concerning adequate sampling across taxonomic lines and identification of an incompletely known fauna. With the exception of a few papers (Tretzel, 1955; Duffey, 1962 a, b, 1968; Luczak, 1963, 1966; Almquist, 1973a, b; Van der Aart, 1973; Schaefer, 1972), our knowledge of spider communities is largely limited to species checklists with accompanying notes on relative abundance and associated habitats.

In the present paper we use multivariate analyses to describe a spider community in terms of the Hutchinsonian niche (differentiation in habitat [Grinnel, 1924] and in diurnal and seasonal activity patterns). The study was initiated to place a local population of the funnel-web spider *Agelenopsis aperta* (Gertsch) in the context of its biotic environment. However, it has proven useful in the direction it provides for future study of community structure. Principal components and cluster analyses can be applied

[1] Curator Emeritus, Department of Entomology, the American Museum of Natural History, New York, N.Y.
[2] Assistant Professor of Zoology, Department of Zoology, University of Tennessee, Knoxville, Tennessee 37916.

 ISSN 00003-00082 / Price $1.90

to data sets consisting of both quantitative and qualitative observations, alleviating some of the biases encountered when using one sampling technique for all groups.

The paper is divided into two sections. The first section deals with the spider community of the lava bed area: where various members fit in an environmental context and in relation to one another. In the second section we describe those new species which are supplementary to published revisional studies or which will not be dealt with in revisions in the forseeable future.

ACKNOWLEDGMENTS

The field work was completed on the Robert M. Shafer Ranch, Gallacher Cattle Corporation, Carrizozo, New Mexico. We are grateful for the cooperation of this family. We thank Ms. Cheryl Hughes of the Zoology Department of the University of Wisconsin for preparation of the drawings and Dr. William G. Reeder of the same department for his assistance during the course of the study. For loan of material and aid in identification of some of the difficult species, we thank the following: Drs. Bruce Cutler, St. Paul, Minnesota; Charles Dondale, Research Branch, Department of Agriculture, Ottawa, Canada; Herbert Levi, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; Martin Muma, Silver City, New Mexico; Norman Platnick, Department of Entomology, the American Museum of Natural History, New York; Jon Reiskind, Department of Zoology, University of Florida, Gainesville, Florida; and Mr. Vincent Roth, Southwestern Research Station of the American Museum of Natural History, Portal, Arizona.

Financial support to the second author during the several years of this study was provided by the National Geographic Society (Grant nos. 1090 and 1288), the American Society of University Women, and the University of Wisconsin Graduate School. Collected material is in the Zoological Museum of the University of Wisconsin and type specimens have been deposited in the American Museum of Natural History.

STUDY AREAS

Three study areas were established at the northern edge of the Carrizozo "malpais," Lincoln County, New Mexico (Gallacher Cattle Corporation; Robert M. Shafer Ranch, T6S, R10E, Alt. 5400′; fig. 1). One study area on the lava bed, one on the mixed grassland bordering the flow, and a third on surrounding rangeland (fig. 2).

Lava Study Area. The lava study area is representative of the malpais formation that is believed to have been extruded around 1000 years ago (Weber, 1964). It is barren over much of its surface and marked by ropy corrugations, sink holes, and pressure ridges. Local concentrations of shrubs occur along the flow margins and where cracks and crevices have permitted collection of wind-blown soil and moisture. The specific plot used in this study (figs. 1 and 2), a north-facing slope on a sunken plateau between two pressure ridges, was selected because of its high concentration of spiders. Total vegetative cover for the area was 78.3 percent, probably much higher than the average lava bed sample. The shrub *Fallugia paradoxa* (D. Dondl.) Endl. (apache-plume) dominates the study area. (Importance value = 12.8%; Riechert, 1973.) Vegetative diversity, however, is high and other shrubs are also important, including *Opuntia imbricata* Engelm. (staghorn cholla), *Berberis haematocarpa* (Fedde) Wooton (red hollygrape), and *Juniperus monosperma* (Engelm.) Sarge. (one-seeded juniper).

Grasses account for 43 percent of the vegetative cover on the lava bed (Riechert, 1973); dominant grasses include *Muhlenbergia porteri* Scribn. (bush muhly), which is associated with shrubs in the study area, *Sporobolus cryptandrus* (Torr.) Gray (sand dropseed), and the *Bouteloua* grasses *B. aristidoides* (H.B.K.) Griseb. (needle grama), *B. curtipendula* (Michx.) Torr. (side-oats grama), and *B. gracilis* (H.B.K.) Lab. (blue grama) which are found in more open areas.

Mixed Grassland Study Area. The second study area was selected from rich grassland at the northern margin of the lava beds (figs. 1 and 2). This grassland contains plant species frequenting both the flow and surrounding rangeland and supports a more dense growth of vegetation than either the lava bed or rangeland. It is dominated by the grass species *Sporobolus flexuosus* (Thurb.) Rydb. (mesa dropseed) (Importance value = 9.39%; Riechert, 1973). This and other grasses surround the numerous depres-

sions found along the flow margin. The depressions are straight-sided dirt holes averaging 15-30 cm. in height and 1.4m^2 in area. They probably result from the outwash of underground aquifer tubes. Following the summer rains, three flowering herbs demonstrate increased importance in this study area. *Portulaca retusa* Engelm. (notched purslane), *Gutierrezia* sp. (snakeweed), and *Cuscuta indecora* Choisy. (dodder) often exceed absolute frequencies of greater than 90 percent in vegetation samples collected at this time (Riechert, 1973).

Rangeland Study Area. Study area three is representative of the rangeland surrounding the Carrizozo lava bed and is adjacent to study area two. In this area a gravel pavement is covered with sand and sparse clumps of *Muhlenbergia arenicola* Buckl. (Muhly). Herbs of the following families are prevalent, especially following the summer rains: Compositae, Cruciferae, and Malvaceae. *Juniperus* dominates a south-facing slope included within this study area. Total vegetative cover is low (14%) and depressions are lacking on the rangeland.

Species lists of the vegetation of this malpais area have been made (Shields and Crispin, 1956; Iwen, unpubl. data) and a more detailed analysis of the habitat afforded spiders in the various areas is presented elsewhere (Riechert, 1973).

SECTION I: SPIDER COMMUNITY

METHODS

Field. Data were collected over a five-year period, 1969-1974, much of which represents quantitative collections obtained through suction sampling, after methods described by Turnbull and Nicholls (1966). Relative methods used included beating, sweep netting, and timed collections. Spider activity was determined through the use of time-sort pitfall traps (Holthaus and Riechert, 1974) and artificial sticky webs. Specific sampling procedures are outlined elsewhere (Riechert, 1973; Riechert and Tracy, 1975).

Analysis. Raw data were converted to relative frequencies of occurrence within the following categories: time (diurnal, 0800-1600 hrs.; crepuscular, 0400-0800 and 1600-2000 hrs.; nocturnal, 2000-0400 hrs.), season (by month), general habitat (lava bed, lava bed-mixed grassland interface, mixed grassland, and rangeland), physiognomic features (limestone, lava, depressions, crevices, scats, flowering plants, herbs, grasses, shrubs, litter, wood, bare ground, and water), and location (surface or under cover).

A principal components analysis was computed on a correlation coefficient matrix of these variates or characters as described by Seal (1964). In addition, Ward's method (1963) of hierarchical agglomeration with a euclidean distance measure was used to delineate subgroups of spiders in the lava bed community. The general algorithm for this analysis is as presented in Wishart (1969).

RESULTS AND DISCUSSION

Principal Components Analysis. Ninety species were found to frequent the malpais area. They are listed by family in the legend for figure 3. Figure 3 is a representation of the first two principal components. Important variates for the first vector include the lava bed habitat that drew associated spider species to the left end of the axis and mixed grassland toward the right. In the second component, rangeland occupants are separated from those occurring more often on the lava bed. The three basic habitats thus account for the greatest amount of variation among spider species inhabiting the area. Almost one-half of these species frequent one habitat to the exclusion of the others: species that exhibit relative frequencies of occurrence of 70 percent or greater in the habitats are enclosed within the lines designated in figure 3.

It is apparent from these results that the lava bed supports the greatest number of spider species. The lava bed is far more diverse topographically and in terms of vegetation composition and structure than either the mixed grassland or the rangeland. It follows that this habitat would support a greater number of spider species (MacArthur and Wilson, 1967). With the exception of *Tetragnatha laboriosa* Hentz, all the orb weavers are confined to the lava bed habitat. The numerous crevices and lava bubbles afford the orb web considerably more protection from strong winds than do the shrubs, grasses, and herbs featured elsewhere.

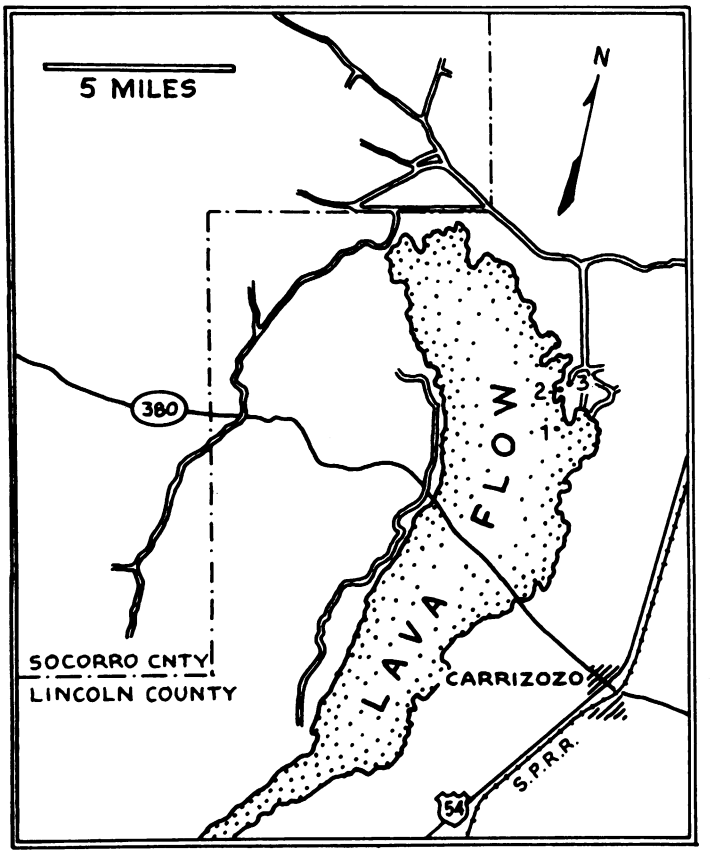


FIG. 1. Carrizozo, New Mexico. Malpais area, showing study plot locations: (1) lava bed study area; (2) mixed grassland study area.

The rangeland and lava bed habitats share a number of species (fig. 3). Both offer shrubs and rock substrates, absent from the mixed grassland, which physically separates the two habitats (fig. 2). A number of dictynids and salticids frequent shrubs in both habitats and *Steatoda variata* Gertsch, *Psilochorus utahensis* Chamberlin, and several gnaphosids utilize loose rocks in both areas. It is not clear why some species are restricted to the rangeland habitat (fig. 3). Perhaps the thermal environment offered by the lava bed is limiting to them, whereas the mixed grassland does not offer the necessary structural prerequisites.

The mixed grassland is least similar in species composition to the other habitats, as observed by its occupation of the lower right-hand side of figure 3. It is more similar to the lava bed, however, than to the rangeland. For instance, *A. aperta* rarely frequents the rangeland where *A. longistylus* is abundant, but it does build webs under shrubs on the lava bed (frequency = 29%). Those spiders that can be considered indicator species of the mixed grassland habitat (fig. 3) all exhibit significant associations with depressions (chi square; $P<0.01$). This habitat feature most closely approximates the crevices of the lava bed in structure, but offers greater prey densities than does the latter habitat (Riechert and Tracy, 1975). The fact that spider species diversity is low in the mixed grassland habitat, in part, must reflect the lesser physiognomic diversity of this

habitat, which offers spiders few shrubs and no rock outcrops. It may also reflect the result of local extinctions; the mixed grassland area is often flooded during summer rains. Only those species that have fit their life cycles to periodic flooding (Riechert, 1974) or are active dispersers can probably successfully occupy this habitat.

The cluster of species around the center of the axes represents those species that occupy two or more of the habitats (fig. 3). These include species that utilize features common to more than one habitat such as shrubs and rocks common to both the lava bed and rangeland, or the grasses abundant in all three habitats. Others might represent generalist or "weedy" species such as *Dictyna tucsona* Chamberlin and Ivie, which occupies *Juniperus* and other shrubs on the lava bed, dropseed (*Sporobolus*) and panic (*Panicum obtusum* H.B.K.) grasses on the mixed grassland, and various herbs, Cruciferae, Malvaceae, and Compositae on the rangeland. The association of *D. tucsona* with shrubs on the lava bed might reflect the inability of this species to tolerate the high temperatures existing at grass and herb height in this habitat (Riechert and Tracy, 1975).

Cluster Analysis. When one lists 90 species of spiders inhabiting an austere environment such as the Chihuahuan desert grassland, the question

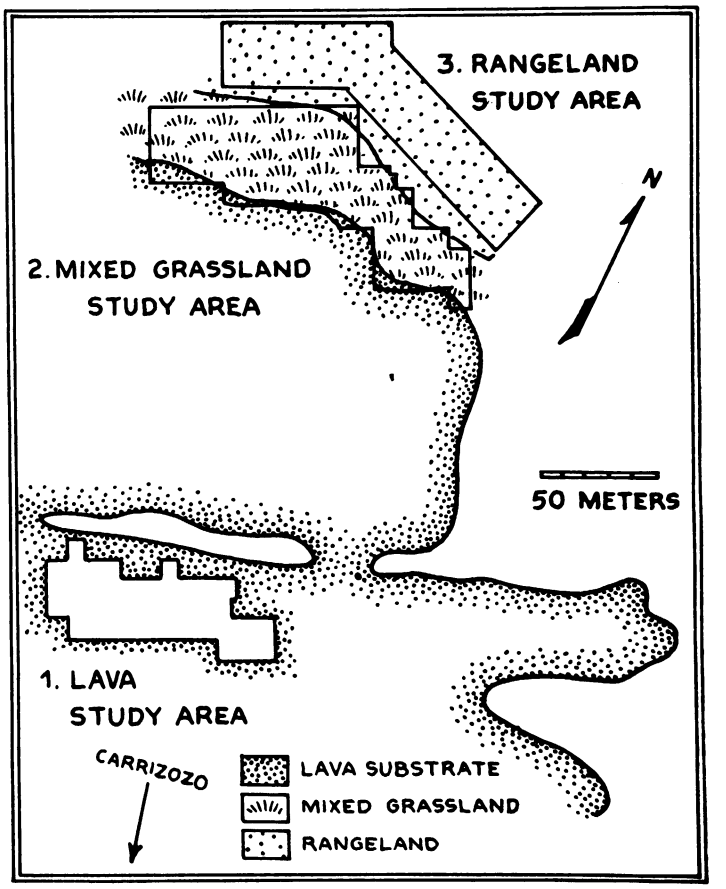


FIG. 2. Malpais Lava area, indicating size of study plots: (1) lava study plot; (2) mixed grassland study plot: A contiguous quadrat sample and sample containing lava, mixed grassland, and rangeland habitats.

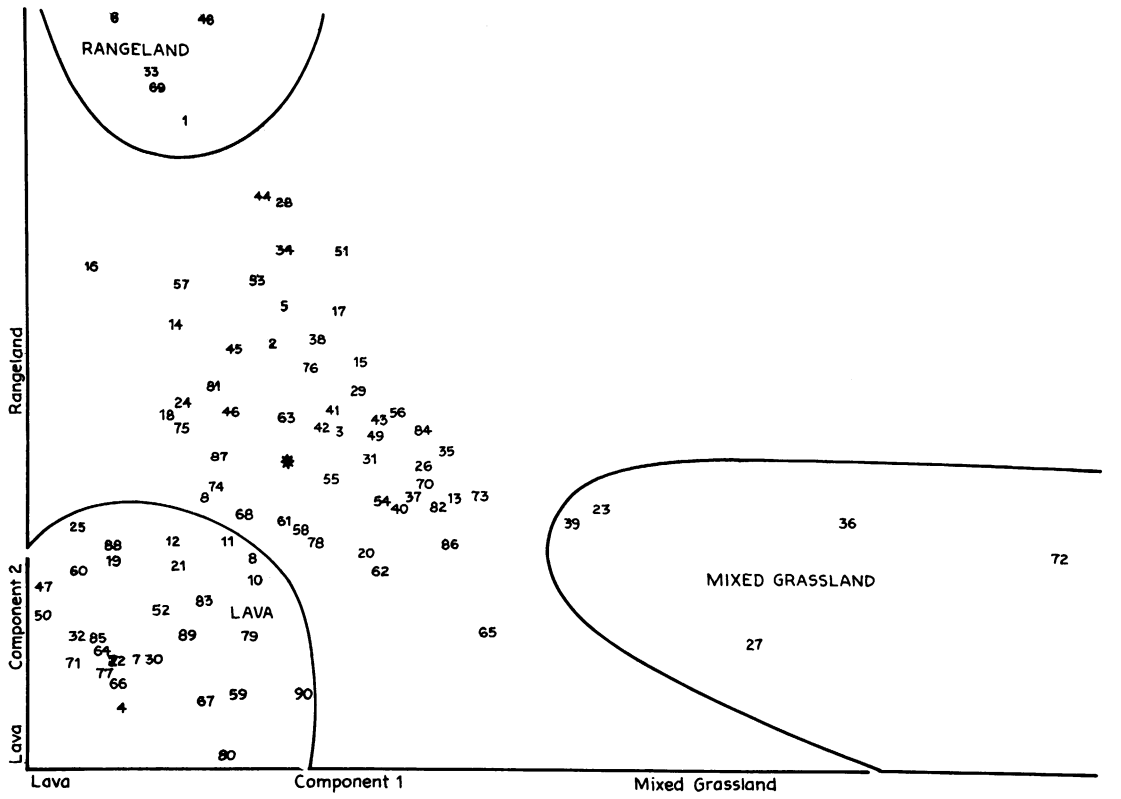


FIG. 3. First two axes of principal components analysis computed on relative frequencies of spiders within various niche-space categories. Numbers represent individual species listed below by family. Lines enclose species exhibiting frequencies of occurrence of 70% or greater within the designated habitats. Ctenizidae: *Actinoxia arizonica* Gertsch and Wallace, 1. Theraphosidae: *Dugesiella echina* Chamberlin, 2. Filistatidae: *Filistata arizonica* Chamberlin and Ivie, 3. Uloboridae: *Uloborus diversus* Marx, 4. Amaurobiidae: *Titanoeca nigrella* Chamberlin, 5. Tengellidae: *Zorocrates karli*, new species, 6. Dictynidae: *Dictyna calcarata* Banks, 7; *Dictyna reticulata* Gertsch and Ivie, 8; *Dictyna stulta* Gertsch and Mulaik, 9; *Dictyna tuscona* Chamberlin, 10; *Mallos niveus* O. Pickard-Cambridge, 11. Loxoscelidae: *Loxosceles* sp., 12. Pholcidae: *Physocyclus enaulus* Crosby, 13. *Psilochorus utahensis* Chamberlin, 14. Theridiidae: *Euryopis scriptipes* Banks, 15; *Euryopis texanus* Banks, 16; *Latrodectus hesperus* Chamberlin and Ivie, 17; *Steatoda variata* Gertsch, 18; *Theridion leviorum*, new species, 19. Araneidae: *Araneus arizonensis* (Banks), 20; *Metepeira arizonica* Chamberlin and Ivie, 21; *Neoscona oaxacensis* (Keyserling), 22. Tetragnathidae: *Tetragnatha laboriosa* Hentz, 23. Mimetidae: *Mimetus hesperus* Chamberlin, 24. Linyphiidae: *Idionella sclerata* (Ivie and Barrows), 25; *Tennesseelum formicum* (Emerton), 26. Agelenidae: *Agelenopsis aperta* (Gertsch), 27; *Agelenopsis longistylus* (Banks), 28; *Cicurina deserticola* Chamberlin and Ivie, 29. Oxyopidae: *Oxyopes apollo* Brady, 30; *Oxyopes lynx* Brady, 31; *Oxyopes salticus* Hentz, 32. Lycosidae: *Hesperocosa unica* (Gertsch and Wallace), 33; *Geolycosa rafaelana* Chamberlin, 34; *Lycosa coloradensis* Banks, 35; *Pardosa sternalis* (Thorell), 36; *Schizocosa mimula* (Gertsch), 37. Gnaphosidae: *Drassodes saccatus* (Emerton), 38; *Drassyllus mumai*, new species, 39; *Drassyllus notonus* Chamberlin, 40; *Drassyllus orgilus* Chamberlin, 41; *Gnaphosa hirsutipes* Banks, 42; *Gnaphosa utahana* Banks, 43; *Haplodrassus* sp., 44; *Herpyllus hesperolus* Chamberlin, 45; *Herpyllus propinquus* (Keyserling), 46; *Herpyllus schwartzi* (Banks), 47; *Micaria* sp., 48; *Nodocion arizonicus* (Chamberlin), 49; *Poecilochroa atomistica* (Chamberlin), 50; *Zelotes anglo*, new species, 51; *Zelotes chicano*, new species, 52; *Zelotes rusticus* (L. Koch), 53. Clubionidae: *Castianeira dorsata* (Banks), 54; *Castianeira occidens* Reiskind, 55; *Castianeira* sp., 56;

arises as to why the principle of competitive exclusion (Hardin, 1960) does not operate to eliminate the majority of these species. In actuality, spatial and temporal stratification in this community is such that interspecific interactions usually involve 10 or fewer species. The subgroup nature of this particular community is well exemplified by the results of cluster analysis (fig. 4). For instance, at an objective function of 11.0, eight subgroups of spiders are observed, each consisting of species with similar temporal activities and spatial preferences. Meaningful separation into smaller interactive units is also possible in most cases (fig. 4).

Among five of our eight subgroups, we find separation related to diel activity patterns along with further division with regard to general habitat association and seasonal abundance (left-hand side of dendrogram, fig. 4). Separation among the three remaining groups appears to be related to association with specific habitat features (grasses and shrubs) with further division occurring between groups seven and eight on the basis of association with general habitat (i.e., whether spiders occupy shrubs on the lava bed or elsewhere). Association with the ameliorated microenvironments provided by shrubs and grasses might afford members of the latter groups fairly continuous diel activity. Temperature stress is probably negligible to spiders inhabiting shrubs and the upper layers of grass clumps where thermal radiation from the substrate is reduced, shade is available and cooling by convection possible. That temperature can restrict spider activity has been shown for *Agelenopsis aperta* in this same study area (Riechert and Tracy, 1975).

In 1946 Elton postulated that similar species cannot coexist and must, therefore, act as ecotypes in different habitats. Evidence of this kind of separation of congenerics is prevalent in spider community literature (table 1), and seen in the results of this study as well. For example, *Zelotes anglo* frequents the rangeland, whereas *Z. chicano* is most often found on the lava bed with an occasional individual occupying the mixed grassland. Likewise, *Agelenopsis longistylus* is found almost exclusively on the rangeland, whereas *A. aperta* inhabits the mixed grassland and to a lesser extent the lava bed.

It is now generally accepted that intrageneric isolation is not required, in that other kinds of niche partitioning can occur that will allow for the coexistence of syntopic congeners. Examples of sources of niche partitioning demonstrated for congeneric spider species in various studies are shown in table 1. It is obvious from this table that spatial and temporal aspects of the niche account for most of the coexistence of related spider species observed. In only a few cases was the Eltonian or functional niche thought to be important in this regard (Luczak, 1963; Vogel, 1972). The coexistence of congeneric spiders through feeding specialization has not been demonstrated for spiders, although Vogel (1972) believed differences in body size, and thus size of prey taken, allowed the coexistence of two species of *Pardosa* (Lycosidae). Since spiders are considered polyphages (broad feeders), one would not expect a generic restriction of diet to specific prey types to occur.

In the present study as in that of spider distribution in marshes (Kessler-Geschiere, 1971; Schaefer, 1972, 1974, 1975), examples are found

---

Castianeira sp., 57; *Clubiona oteroana* Gertsch, 58; *Phrurotimpus woodburyi* Chamberlin and Gertsch, 59; *Scotinella apachea* Gertsch, 60. Anyphaenidae: *Anyphaena dixiana* (Chamberlin and Woodbury), 61. Thomisidae: *Apollophanes texana* Banks, 62; *Coriarachne utahensis* (Gertsch), 63; *Ebo mexicanus* Banks, 64; *Misumenops celer* (Hentz), 65; *Misumenops coloradensis* Gertsch, 66; *Philodromus marginellus* Banks, 67; *Philodromus infuscatus utus* Chamberlin, 68; *Thanatus altimontis* Gertsch, 69; *Tibellus chamberlini* Gertsch, 70; *Tmarus angulatus* (Walckenaer), 71; *Xysticus cunctator* Thorell, 72; *Xysticus lutzi* Gertsch, 73. Salticidae: *Corythalia delicatula* Gertsch and Mulaik, 74; *Icius similis* Banks, 75; *Marpissa pikei* (Peckham and Peckham), 76; *Metaphidippus arizonensis* (Peckham and Peckham), 77; *Metaphidippus manni* (Peckham and Peckham), 78; *Metaphidippus shaferi*, new species, 79; *Peckhamia scorpionia* (Hentz), 80; *Pellenes arizonensis* Banks, 81; *Pellenes clypeatus* (Banks), 82; *Pellenes coecatus* (Hentz), 83; *Pellenes fallax* Peckham and Peckham, 84; *Pellenes hirsutus* (Peckham and Peckham), 85; *Pellenes tuberculatus* Gertsch and Mulaik, 86; *Phidippus reederi*, new species, 87; *Phidippus volcanus*, new species, 88; *Sitticus juniperi*, new species, 89; *Synageles* sp., 90.

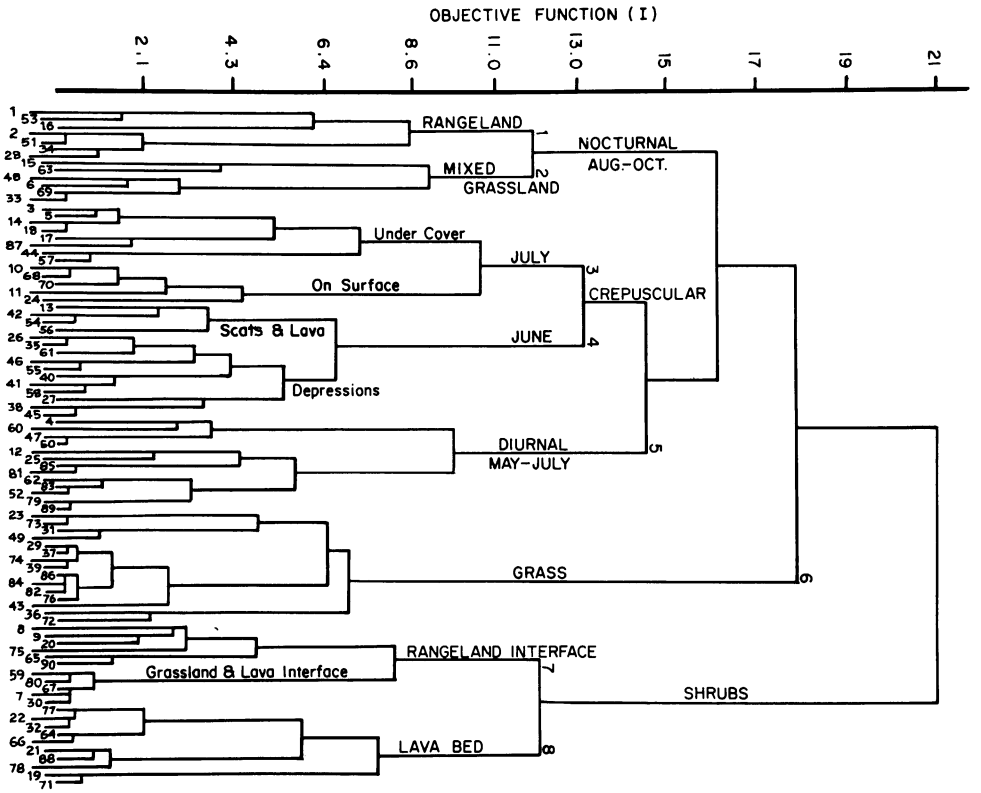


FIG. 4. Dendrogram showing results of hierarchical cluster analysis. Numbers refer to species listed in legend for figure 3. Features characterizing subgroups indicated at cluster locations.

of coinhabitance of congeners with no apparent niche partitioning. In this study, the genus *Pellenes* (Salticidae) is one group that appears to be only partially separated on the basis of spatial and temporal considerations. (The genus *Dictyna* [Dictynidae] is another.) *Pellenes hirsutus* and *arizonensis* are both found on lava substrate in the lava bed, whereas *P. coecatus* associates with grasses in the same habitat. On the other hand *P. tuberculatus*, *P. fallax*, and *P. clypeatus* are all associated with the grasses *Sporobolus flexuosus* and *Bouteloua curtipendula* on the mixed grassland. All the species mentioned here were found to be diurnal, identical in size, and within the general habitats were abundant during the same seasons. We can postulate that our three species of *Pellenes* on the grassland and two on the lava bed have become specialized in their feeding preferences, although this is unlikely for the reason mentioned above. Two other alternatives can be suggested. 1. Perhaps enough predation is occurring among the species (i.e., on each other) to keep population sizes at a level where food and space are not limiting as suggested by Schaefer (1974, 1975). 2. The physical environment might achieve the same end through favoring one species population over the others. The latter alternative at this time, at least, seems more plausible. At present, *P. tuberculatus* is far more prevalent on the mixed grassland than the other two species and *P. arizonensis* is numerically dominant on the lava bed. The unpredictability of the Chihuahuan Desert environment might allow for an unstable equilibrium that favors particular species for a time. Coexistence of congeners is, thus, allowed by alleviating the necessity of competition for limited food and space. Certainly, further study of the niche partitioning of these six species of *Pellenes* is indicated.

SECTION II. SPECIES DESCRIPTIONS

FAMILY TENGELLIDAE

Zorocrates karli, new species
Figures 5, 6

Type Data. Male holotype from New Mexico: Lincoln County: Malpais Lava Beds, Carrizozo, T6S R10E, 21 September, 1972 (B. Firstman), in the American Museum of Natural History.

Etymology. Named for the late Karl Riechert, father of the second author.

Diagnosis. Pale, long-legged species related to *mistus* O. Pickard-Cambridge of Guerrero, Mexico, and *alternatus* Gertsch and Davis of Harlingen, Texas, all with terminal apophysis of male palpus covering apical half of bulb, readily separated by position and shape of slender median apophysis and other details of the palpus (figs. 5, 6).

Description. Male: Total length 9.5 mm. Carapace 4.5 mm. long, 3.25 mm. wide. Abdomen 5 mm. long, 2.8 mm. wide.

Carapace pale yellow with faint dusky lines radiating from black linear cervical groove; eyes ringed with black. Chelicerae light reddish brown. Underside of carapace and base color of appendages whitish; sternum and coxae unmarked; legs dusky yellow, darkest apically; leg spines brownish. Abdomen whitish; dorsum with band of broken dusky chevrons running full length; venter unmarked. Tarsus of palpus and bulb brownish.

Structural typical, like that of *mistus*. Carapace low, evenly convex with median groove deep linear depression. Clypeus about third diameter of anterior median eye. Ratio of eyes: ALE:AME:PLE:PME = 26:24:25:25. Anterior eye row slightly procurved as seen from in front, recurved from above; anterior median eyes separated by about radius, about half as far from lateral eyes. Posterior eye row slightly procurved; posterior median eyes separated by less than diameter (25/14), more than full diameter from lateral eyes (25/27). Median ocular quadrangle longer than broad (63/33), as wide behind as in front. Armature of chelicera: promargin with three teeth, middle one larger; retromargin with three equal teeth. Sternum 2 mm. long, 1.65 mm. wide; labium 0.7 mm. long, 0.63 mm. wide; endite 1.25 mm. long, 0.75 mm. wide. Abdomen elongate oval; base with small brush of setae.

	I	II	III	IV	Palp
Femur	5.00	4.35	4.00	5.25	2.00
Patella	2.10	1.90	1.65	1.75	0.75
Tibia	5.07	4.40	3.65	5.25	0.75
Metatarsus	5.00	4.35	4.35	6.50	–
Tarsus	2.35	2.00	1.80	2.15	2.00
Total	19.52	17.00	15.45	20.90	5.50

Leg formula 4123. Legs long and thin: first metatarsus longer than carapace. Spination of first leg: femur, prolateral two near apex, retrolateral one at middle, dorsal 1-1-1; tibia, ventral 2-2-2(1)-2; metatarsus, ventral 2-2-2. Second leg essentially like first. Posterior legs more spinose, with dorsal and lateral spines on all segments except tarsi. Small unpaired claw present on first tarsus, obsolete on others. All trochanters notched.

Male palpus (figs. 5, 6) typical of genus: terminal apophysis heavy subtriangular sclerite covering distal half of bulb and below it weak median apophysis with trivial apical notch; embolus thin curved spine hidden behind terminal apophysis, supported by thin pale conductor; tibial apophysis rounded, notched spur.

Distribution. Known only from above specimen.

FAMILY THERIDIIDAE

Thoridion leviorum, new species
Figures 7, 8

Type Data. Male holotype from New Mexico: Lincoln County: Malpais Lava Beds, Carrizozo, T6N R10E (S. Riechert), in the American Museum of Natural History.

Etymology. Named for Dr. and Mrs. Herbert W. Levi, specialists in this spider family for many years.

Diagnosis. Small relative of *Theridion murarium* Emerton and species having embolus forming round coil (fig. 7), separated by shape of median apophysis (fig. 8) presenting in lateral view wide base and upturned sharp spur.

TABLE 1
Sources of Niche Partitioning to Congeneric Spiders

			Microhabitat			
Diel Activity	Seasonality	Macrohabitat	Physiognomic Association	Vertical Stratification	Prey Specificity (Size)	Presently Unseparable
Lycosidae 15 *Arctosa* 6 *Schizocosa* 6 Gnaphosidae *Herpyllus**	Linyphiidae *Ceratinopsis* 4 *Linyphia* 10 Araneidae *Mangora* 4 Lycosidae *Pardosa* 17 *Schizocosa* 4 Salticidae *Metaphidippus* 4	Theridiidae *Euryopis* 6 *Robertus* 9 *Theridion* 3, 12 Linyphiidae *Centromerus* 9 *Ceratinops* 3 *Grammonota* 1 *Meioneta* 3 Araneidae *Acanthepeira* 3 *Conepeira* 3 *Eustala* 3 *Mangora* 3 *Neoscona* 3 *Singa* 3 Tetragnathidae *Pachygnatha* 10 *Tetragnatha* 3 Agelenidae *Agelenopsis** Hahniidae *Neoantistea* 3 Mimetidae *Mimetus* 3 Pisauridae *Pisaurina* 3 Lycosidae *Arctosa* 3 *Lycosa* 1, 3	Tetragnathidae *Pachygnatha* 10 Lycosidae 15 *Pardosa* 16 *Pirata* 10 Oxyopidae *Oxyopes** Clubionidae *Castianeira** *Clubiona* 7 Thomisidae *Xysticus* 2, * Salticidae *Metaphidippus** *Pellenes** *Phidippus**	Theridiidae *Lactrodectus* 14 Araneidae *Argiope* 8 Lycosidae *Lycosa* 11 *Pardosa* 15, 16	Linyphiidae *Linyphia* 12 Tetragnathidae *Pachygnatha* 10 Araneidae *Araneus* 12 Lycosidae *Pardosa* 17	Linyphiidae *Bathyphantes* 10 *Ceratinella* 10 *Cornicularia* 10 *Erigone* 10 *Lepthyphantes* 10 *Meioneta* 10 Tetragnathidae *Pachygnatha* 10 Lycosidae *Pardosa* 10, 17 *Pirata* 10 Clubionidae *Clubiona* 10 Salticidae *Pellenes** Dictynidae *Dictyna**

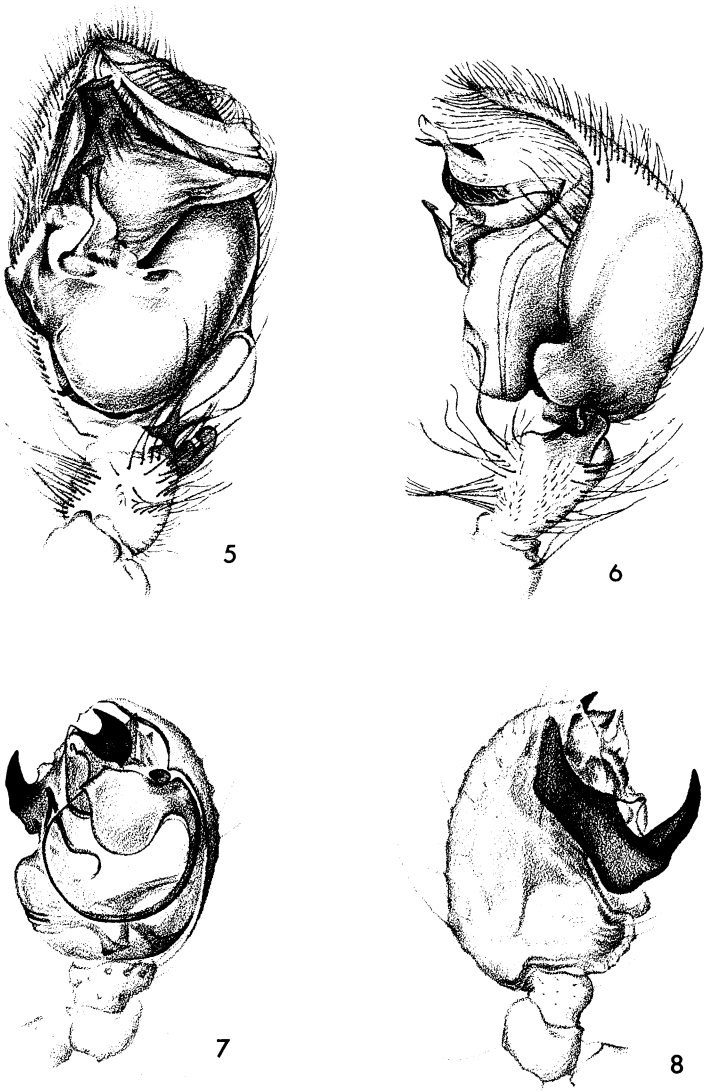
TABLE 1 – (*Continued*)

Diel Activity	Seasonality	Macrohabitat	Microhabitat: Physiognomic Association	Microhabitat: Vertical Stratification	Prey Specificity (Size)	Presently Unseparable
		Pardosa 5, 13 *Pirata* 3 *Schizocosa* 3				
		Oxyopidae *Oxyopes**				
		Gnaphosidae *Drassyllus* 3 *Gnaphosa* 3 *Zelotes* 3, *				
		Clubionidae *Castianeira** *Clubiona* 3				
		Thomisidae *Misumenops* 3, * *Philodromus* 3, * *Xysticus* 3				
		Salticidae *Metaphidippus* 3 *Paraphidippus* 3 *Pellenes* 3, * *Phidippus* 3 *Sitticus* 3 *Thiodina* 3 *Zygoballus* 3				
		Dictynidae *Dictyna* 3, *				

Numbers correspond to following publications.

1. Barnes (1953)
2. Beals, Riechert & Wolf (unpubl. ms.)
3. Berry (1970)
4. Berry (1971)
5. Bixler (1970)
6. Dondale, Redner & Semple (1972)
7. Duffey (1969)
8. Enders (1974)
9. Huhta (1965)
10. Kessler-Geschiere (1971)
11. Kuenzler (1958)
12. Luczak (1963)
13. Schaefer (1972)
14. Szlep (1966)
15. Vanderhaart (1973)
16. Vlijm & Kessler-Geschiere (1967)
17. Vogel (1972)

* Gertsch & Riechert (present study)



FIGS. 5, 6. *Zorocrates karli*, new species, left male palpus. 5. Ventral view. 6. Retrolateral view.
FIGS. 7, 8. *Theridion leviorum*, new species, left male palpus. 7. Ventral view. 8. Prolateral view.

Description. Male: Total length 1.65 mm. Carapace 0.75 mm. long, 0.62 mm. wide. Abdomen 0.9 mm. long, 0.7 mm. wide.

Carapace dusky brown, with narrow black marginal seam, indistinct dark streaks radiating from cervical groove and black eye tubercles. Sternum blackish. Coxae and legs pale yellow, with incomplete dark rings at end of femora and pair of rings on tibiae and metatarsi. Abdomen dusky brown to blackish, with scattered white flecks on dorsum and single pair of such flecks in front of spinnerets on venter.

Structure typical of *murarium* group. Pars cephalica at eye group two-thirds as wide as carapace, evenly rounded in front; clypeus 0.15 mm. long, as high as two diameters of anterior median

eye. Anterior eye row straight; anterior median eyes separated by radius, slightly nearer smaller lateral eyes. Posterior eye row gently recurved; posterior median eyes separated by two-thirds diameter, as far from subequal lateral eyes. Median ocular quadrangle broader than long (32/21), broader in front (32/26), with front eyes larger (12/10). Sternum 0.4 mm. long, 0.43 mm. wide; labium 0.11 mm. long, 0.14 mm. wide; endite 0.24 mm. long, 0.17 mm. wide.

Legs thin, of medium length: tibia and patella of first leg 0.25 mm., of fourth leg 0.8 mm. long.

Male palpus (figs. 7, 8) typical of *murarium* group: embolus thick at base, abruptly thinned to slender spine forming round coil; median apophysis broad lamina situated in distal half of bulb on prolateral side, abruptly turned to right angle behind and projecting forward as sharp spur.

Distribution. Known only from above specimen.

FAMILY THOMISIDAE

Philodromus marginellus Banks
Figures 9, 10, 11

Philodromus marginellus Banks, 1901, p. 586.

Diagnosis. Typical species of *aureolus* group, similar to *keyserlingi* Marx, distinguished by body pattern (fig. 9) and distinctive palpus (fig. 10) with embolus swollen at base into ventrolateral flange and tibia of palpus (fig. 11) with longer lateral apophysis divided into two blunt processes.

Description. Male: total length 4.7 mm. Carapace 1.9 mm. long and wide. Abdomen 2.4 mm. long, 1.7 mm. wide.

Body pattern is illustrated in figure 9. Carapace yellow brown, only posterior margin darker; eye region included in white patch extending as far as cervical groove but indistinct posteriorly. Legs yellow brown with joint regions ringed in dark brown, especially pronounced at patellar-tibial joint. Dorsum of abdomen white with distinctive dark cardiac mark in front and two narrow dark bands beginning at lateral muscle attachments and extending medially toward spinnerets; venter white.

Structure typical for *aureolus* group: carapace low; ratio of eyes: ALE:AME:PLE:PME = 6:7:11:7. Median ocular quadrangle broader than long (50/40) narrowed in front (50/35). Sternum 1.3 mm. long, 1.2 mm. wide.

	I	II	III	IV	Palp
Femur	3.2	3.8	2.7	2.7	1.4
Patella	1.1	1.3	0.9	1.1	0.5
Tibia	3.1	4.0	2.5	2.5	0.7
Metatarsus	3.2	4.0	2.5	2.3	–
Tarsus	1.1	2.3	1.4	1.4	0.9
Total	11.7	15.4	10.0	10.0	3.5

Leg formula 2132, third and fourth legs equal in length: legs long and thin; dorsal surface of femora with three prostrate spines; all tarsi slightly scopulate.

Male palpus (figs. 10, 11) with following features: embolus curved spine swollen at base with ventrolateral flange and gradually decreasing in diameter toward terminus; tibia armed laterally with apophysis divided into two blunt processes, ventral one twice as long as more dorsal process.

Distribution: Southern New Mexico, Arizona, and California.

Record: *New Mexico*: Lincoln County: Malpais Lava Beds, Carrizozo, T6S R10E, June 19, 1972 (S. Riechert), male.

FAMILY GNAPHOSIDAE

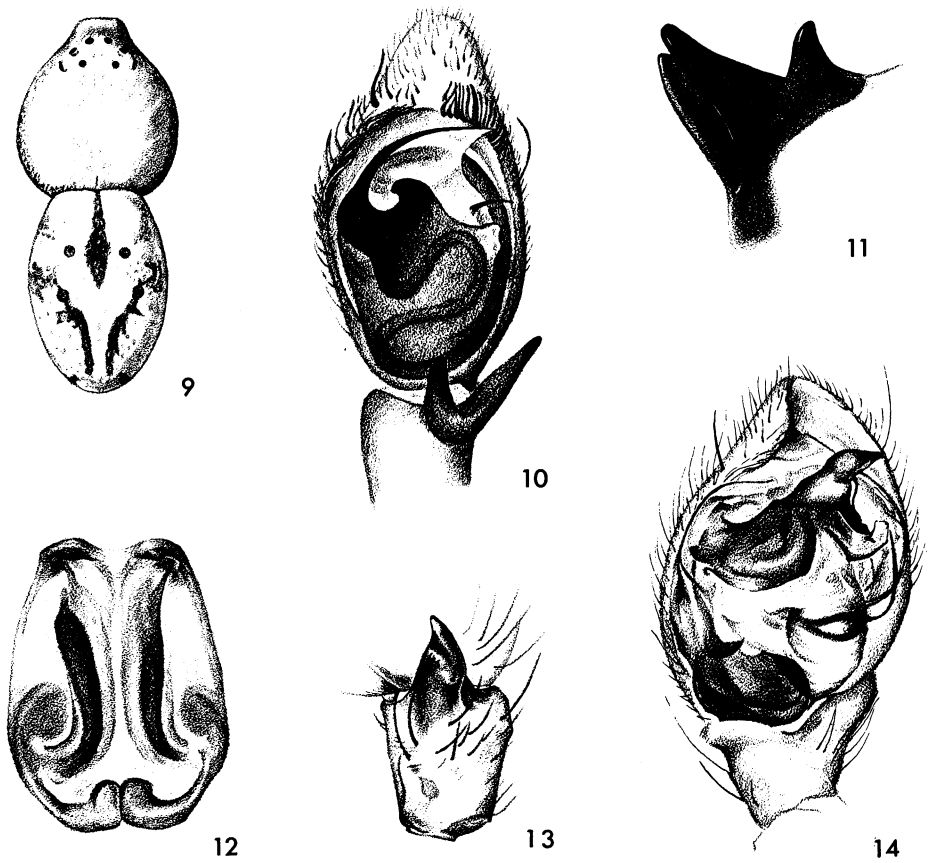
Drassyllus mumai, new species
Figures 12-14

Type Data. Female holotype from New Mexico: Lincoln County: Malpais Lava Beds, Carrizozo, July 18, 1974 (S. Riechert), in the American Museum of Natural History.

Etymology. Named for Dr. Martin Muma of Silver City, New Mexico, student of solpugids and spiders, who has collected numerous examples of this distinctive species.

Diagnosis. Pale species of *depressus* group readily identified by distinctive genitalia: epigynum (fig. 12) with orifices close together in front; male palpus (figs. 13, 14) with short tibial apophysis and small curved median apophysis on bulb.

Description. Female: Total length 4.5 mm.



FIGS. 9-11. *Philodromus marginellus* Banks, male. 9. Carapace and abdomen, dorsal view. 10. Left male palpus, ventral view. 11. Tibial apophyses of left male palpus, retrolateral view.

FIGS. 12-14. *Drassyllus mumai*, new species. 12. Epigynum, ventral view. 13. Tibia of left male palpus, retrolateral view. 14. Left male palpus, ventral view.

Carapace 2 mm. long, 1.4 mm. wide. Abdomen 2.5 mm. long, 1.25 mm. wide.

Carapace pale dusky yellow, slightly darker at sides of eye group, covered evenly with fine subprocumbent hairs and with few weak setae on midline and around posterior declivity. Sternum and coxae dull yellowish; labium, endites, and chelicerae light brown; all provided with black hairs and setae, most conspicuous around margins of sternum. Legs yellowish to pale brown, palest at base, becoming darker apically, clothed with fine black hairs, and few weak spines. Abdomen gray; dorsum with quite narrow ventral black maculation, dusky in front and blackish in posterior half; sides and venter whitish to gray, all surfaces covered thinly with fine black hairs and base with weak brush of setae above pedicel.

Structure typical, like that of *depressus* and numerous relatives. Carapace elongate oval, of average height, with thin linear groove beyond middle behind. Ratio of eyes: ALE: AME: PLE: PME = 10:9:9:13. Clypeus equal in height to radius of anterior median eye. Anterior eye row slightly procurved as seen from front; anterior median eyes separated by short radius, nearly touching lateral eyes. Posterior eye row weakly procurved; large white obliquely set median eyes

touching and only slightly separated from lateral eyes. Median ocular quadrangle broader than long, narrower in front (25/21). Armature of chelicera: promargin with three teeth and dentate carina; retromargin with two small teeth near base of fang. Sternum 1.2 mm. wide.

	I	II	III	IV	Palp
Femur	1.50	1.20	1.10	1.60	0.70
Patella	0.80	0.75	0.55	0.85	0.25
Tibia	1.10	0.85	0.70	1.25	0.35
Metatarsus	0.90	0.80	0.75	1.50	–
Tarsus	0.75	0.65	0.65	0.85	0.55
Total	5.05	4.25	3.75	6.05	1.85

Leg formula 4123. All tarsi scopulate. Metatarsi I and II with scopular hairs mostly at apex. Metatarsal combs of legs III and IV well developed. Tibia IV without dorsal spines; tibia III with single subdorsal spine on prolateral margin. Tibia I and II without spines, metatarsi I and II with one pair of ventral spines beyond base. Trochanters without notch.

Epigynum (fig. 12) oval; orifices in front, separated by width of one.

Male: from Hurley, New Mexico: Total length 3.8 mm. Carapace 1.8 mm. long, 1.35 mm. wide. Abdomen 2 mm. long, 1.3 mm. wide. Coloration and structure like those of female. Abdomen with yellowish scutum at base above. Sternum 1.2 mm. long, 0.9 mm. wide.

	I	II	III	IV	Palp
Femur	1.40	1.20	1.10	1.50	0.63
Patella	0.80	0.75	0.55	0.80	0.22
Tibia	1.15	0.90	0.70	1.20	0.23
Metatarsus	1.00	0.75	0.75	1.35	–
Tarsus	0.85	0.75	0.65	0.85	0.63
Total	5.20	4.35	3.75	5.70	1.71

Leg formula, scopulae, and spination mostly like those of female. Tibiae and metatarsi of first and second legs mostly with ventral pair of spines near middle.

Male palpus as shown in figures 13, 14.

Distribution. Southern New Mexico.

Records: *New Mexico*: Lincoln County: Malpais Lava Beds, Carrizozo, July (S. Riechert) in the University of Wisconsin Zoological Museum. Grant County: Hurley, June 1, 1972 (M. Muma), nine males, 10 females in Yucca-Allthorn-Mesquite community.

Zelotes chicano, new species
Figures 15-17

Type Data. Male holotype and female from New Mexico: Lincoln County: Malpais Lava Beds, T6S R10E, June 14-15, 1972 (S. Riechert), in the American Museum of Natural History.

Etymology. Specific name a vernacular name for Americans of Mexican extraction in the American Southwest, used in apposition with masculine generic name.

Diagnosis. Typical species of *subterraneus* group similar to *tuobus* Chamberlin, distinguished by distinctive genitalic differences: male palpus with curved embolus of medium length, broad apical apophysis bearing sharp spur above base and shorter apical spine crossing embolus (fig. 15); pattern of receptacles of epigynum (figs. 16, 17). Male palpus of *tuobus* with essentially straight, shorter embolus, narrower apical apophysis with inconspicuous spur near base and longer apical spine (fig. 18); epigynum with features as shown in figs. 19, 20.

Description. Male: Total length 5.9 mm. Carapace 2.5 mm. long, 1.8 mm. wide. Abdomen 3.8 mm. long, 2.1 mm. wide. Length of 11 other males 5.5-6.3 mm.; average 6.1 mm.

Carapace dusky brown with black infusions and dusky V in front of thoracic groove; edge of carapace and eye region black. Underside of carapace and appendages brown; legs infused with black. Abdomen nearly black dorsally, lighter ventrally except dark near spinnerets. Brown scutum on anterior third of abdomen at greatest width less than half of dorsum. Entire body clothed with black hairs.

Structure typical for *Zelotes*. Carapace convex, low, head not elevated. Clypeus almost as high as diameter of anterior median eye. Thoracic groove small longitudinal groove situated back two-thirds distance to posterior margin. Ratio of eyes: ALE:AME:PLE:PME = 15:10:20:16. Anterior eye row moderately procurved; anterior median eyes separated by two-thirds diameter, nearly touching larger lateral eyes. Posterior eye

row gently recurved; posterior median eyes suboval, set somewhat obliquely, separated by less than radius, not full diameter from subequal lateral eye. Median ocular quadrangle longer than broad (60/41), as wide in front as behind. Armature of chelicera: promargin with three teeth; retromargin with denticle near base of fang followed by distinct tooth. Sternum 1.5 mm. long, 0.8 mm. wide; labium 0.4 mm. long, 0.3 mm. wide; endite 0.7 mm. long, 0.3 mm. wide.

	I	II	III	IV	Palp
Femur	1.6	1.5	1.3	2.1	1.0
Patella	1.1	0.8	0.7	1.0	0.4
Tibia	1.3	1.1	0.8	1.7	0.3
Metatarsus	1.2	1.1	1.1	1.8	–
Tarsus	1.0	0.9	0.9	1.1	0.9
Total	6.2	5.4	4.8	7.7	2.6

Leg formula 4123. All tarsi scopulate. Metatarsi I and II with apical two-thirds scopulate; metatarsi III and IV with apical one-third scopulate. Metatarsal comb present on legs III and IV. Tibiae III and IV without dorsal spines. Metatarsi I and II with one pair of ventral spines located basally. Trochanters rounded, not notched.

Male palpus (fig. 15) of standard design for genus: embolus curved spine of medium length; terminal apophysis with small spur near base and short, thin terminal spine crossing embolus.

Female: Total length 5.7 mm. Carapace 2.4 mm. long, 1.7 mm. wide. Abdomen 3.2 mm. long, 1.9 mm. wide. Length of nine other females 4.2-7.5 mm.; average 5.76 mm.

Coloration and general structure essentially like those of male. Abdominal scutum missing.

	I	II	III	IV	Palp
Femur	1.5	1.3	1.0	1.5	0.8
Patella	0.9	0.9	0.6	1.0	0.4
Tibia	1.0	1.0	0.7	1.4	0.3
Metatarsus	0.9	0.8	0.9	1.2	–
Tarsus	0.7	0.7	0.7	0.8	0.3
Total	5.0	4.7	3.9	5.9	1.8

Epigynum (figs. 16, 17) of medium length with anterior foveae well separated.

Distribution. Southern New Mexico and Arizona.

Records. New Mexico: Lincoln County: Malpais Lava Beds, Carrizozo, males from April to September, females from June to September (S. Riechert), in University of Wisconsin Zoological Museum. Arizona: Cochise County: Southwestern Research Station, 5400 feet, June 9, 25, 1968 (V. Roth), male and female.

Zelotes tuobus Chamberlin
Figures 18-20

Zelotes tuobus Chamberlin, 1919, p. 247, pl. 16, fig. 7; 1920, p. 193, fig. 19 (2).

Diagnosis. Typical species of *subterraneus* group distinguished by features of male and female genitalia of which illustrations are offered here for comparison with *chicano* and *anglo*: male palpus (fig. 20) with curved embolus and apical spine subequal in length; epigynum (figs. 18, 19) proportionally longer than that of *chicano*.

Distribution. Utah, New Mexico, and Arizona.

Zelotes anglo, new species
Figure 21

Type Data. Male holotype from New Mexico: Lincoln County: Malpais Lava Beds, Carrizozo, T6S R10E, August 18, 1972 (S. Riechert) in the American Museum of Natural History.

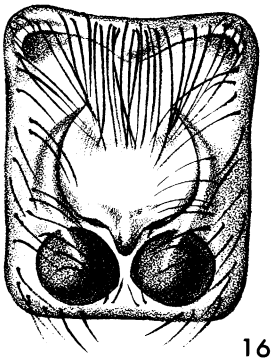
Etymology. Specific name from Latin *angli*, vernacular name for people of European descent in the American Southwest, in apposition with masculine generic name.

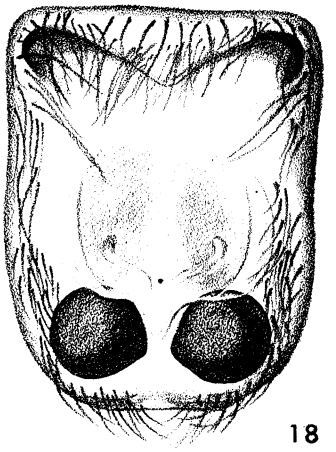
Diagnosis. Typical species of *subterraneus* group most similar to *tuobus* Chamberlin and *chicano*, new species, distinguished by genitalic differences: male palpus (fig. 21) with straight, more robust embolus bulging at base, apical apophysis bearing conspicuous recurved spine and apical spine bifid at crossing of embolus, curved at terminus.

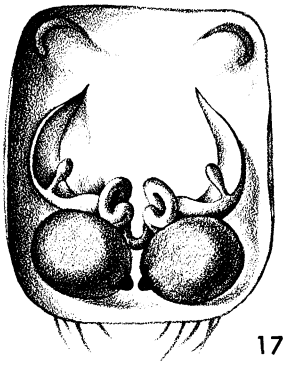
Description. Male: Total length 7.4 mm. Carapace 3.4 mm. long, 2.3 mm. wide. Abdomen 3.9 mm. long, 2.4 mm. wide. Length of other male 5.7 mm.

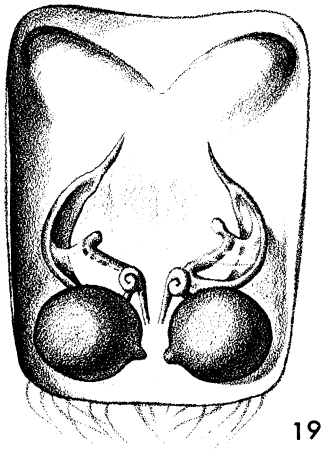
Coloration like that of *chicano* with following exceptions: carapace and sternum uniform dark brown, coxae and mandibular area light brown; legs dark, lighter at tarsi; abdominal scutum almost black.

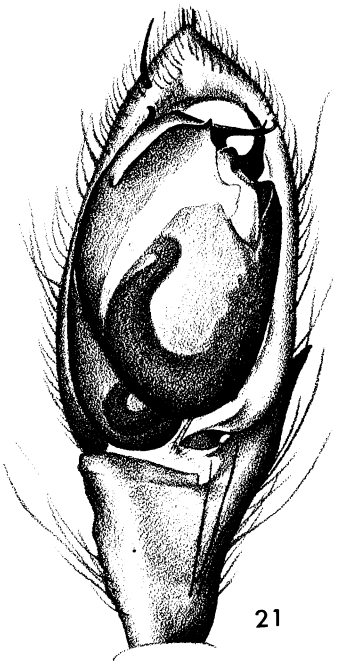
Structure similar to that of *chicano*, with following differences: Ratio of eyes: ALE:AME: PLE:PME = 39:28:30:15. Posterior eye row very slightly recurved, eyes equidistant; median ocular quadrangle longer than broad (90/60), as wide in front as behind. Armature of chelicera: pro-











FIGS. 15-17. *Zelotes chicano*, new species. 15. Left male palpus, ventral view. 16. Epigynum, ventral view. 17. Epigynum, internal view.

FIGS. 18-20. *Zelotes tuobus* Chamberlin. 18. Epigynum, ventral view. 19. Epigynum, internal view. 20. Apical part of left male palpus, ventral view.

FIG. 21. *Zelotes anglo*, new species, left male palpus, ventral view.

margin with two teeth; retromargin with one tooth. Sternum 1.8 mm. long, 1.4 mm. wide; labium 0.7 mm. long and wide; endite 0.9 mm. long, 0.5 mm. wide.

	I	II	III	IV	Palp
Femur	2.5	2.1	1.8	2.7	1.8
Patella	1.0	1.1	1.0	1.5	0.5
Tibia	2.0	1.5	1.2	2.5	0.4
Metatarsus	1.6	1.6	1.7	3.3	–
Tarsus	1.3	1.3	0.8	1.7	1.1
Total	8.4	7.6	6.5	11.7	3.8

Leg formula, spination and scopulation as in *chicano*. Male palpus (fig. 21) like those of *tuobus* and *chicano* but differing in details of apical processes.

Distribution. Southern New Mexico.

Records. New Mexico: Lincoln County: Malpais Lava Beds, Carrizozo, T6S, R10E, August (S. Riechert), males, females in University of Wisconsin Zoological Museum.

FAMILY SALTICIDAE

Phidippus reederi, new species
Figures 22-26

Type Data. Male holotype from New Mexico: Lincoln County: Malpais Lava Beds, T6N R10E, October 4, 1971 (S. Riechert), in the American Museum of Natural History.

Etymology. Named in honor of Dr. William G. Reeder, professor of zoology at the University of Wisconsin, who supports and encourages arachnid research at the institution.

Diagnosis. Blackish species with abdomen covered with red scales, similar to *johnsoni* Peckham and Peckham and other red species separated in male by details of rugose apical sclerite and thicker embolus of palpus (fig. 22); epigynum (fig. 24).

Description. Male: Total length 9.3 mm. Carapace 4 mm. long, 3.7 mm. wide. Abdomen 5.3 mm. long, 3.3 mm. wide.

Dorsal view of carapace and abdomen as shown in figure 25. Integument of carapace dark reddish brown to black, lighter above with eye tubercles broadly ringed with black; carapace evenly covered with fine procumbent black hairs and set with suberect black setae, those on front eye margin forming thin comb overhanging front eyes. Sternum yellowish brown; labium and endites dark reddish brown; coxae duller brown; all these sclerites set with fine suberect black hairs and weak erect setae. Legs dark reddish brown, covered with black hairs and setae and few white hairs; first leg with ventral black fringe of hairs on femur, patella and tibia, those on patella mixed with white. Chelicerae irridescent purplish or blue in front. Abdomen red above, with or without indication of darker pattern, covered with procumbent bright scales and evenly set with erect black setae; sides of abdomen and venter black to gray, without special markings, covered with soft hairs and few black setae.

Structure (fig. 25) typical, like that of *johnsoni*. Carapace flattened above with moderately rounded sides. Eyes typical: ratio of eyes: ALE: AME:PLE:PME = 36:60:30:10. Front eye row recurved as seen from in front and above. Small eyes of second row (posterior median) about half as far from anterior lateral eyes as to posterior lateral eyes (40/75). Posterior row (posterior lateral eyes) wider than front row (145/110). Chelicera: promargin with two unequal teeth; retromargin with coarse ridge next to claw and single large tooth. Endite with small hook at apex of outer margin.

	I	II	III	IV	Palp
Femur	3.20	2.50	2.30	2.70	1.70
Patella	2.25	1.70	1.30	1.40	0.52
Tibia	2.50	1.70	1.40	2.10	0.45
Metatarsus	2.30	1.70	1.60	2.25	–
Tarsus	1.15	1.10	0.85	1.10	1.35
Total	11.40	8.70	7.45	9.55	4.02

Leg formula 1423. First leg with femur thickened laterally to about one-third of length; patella and tibia cylindrical, much heavier than terminal segments. First tibia with 2(1)-2-2 ventral spines from middle to apex and first metatarsus with 2-2 spines in apical half.

Male palpus (figs. 22, 23) with following features: tarsus with small, transversely directed, sharp retrolateral apophysis; rugose sclerite at apex of bulb subovate; embolus short stout spine of medium thickness.

Female: Total length 15 mm. Carapace 4.8

mm. long, 4.2 mm. side. Abdomen 9.5 mm. long, 6.5 mm. wide.

Structure and color pattern (fig. 26) similar to those of male. Cephalothorax and appendages dark reddish brown to black, covered with thin black hairs. Dorsum of abdomen red, with central dark band as shown; sides and venter of abdomen gray. Eyes like those of male. First leg: femur 3.1 mm., patella 2 mm., tibia 2.15 mm., metatarsus 1.7 mm., tarsus 1 mm.; total length 9.95 mm. First leg shorter than that of male but with same spination.

Epigynum (fig. 24) typical of genus, with small emargination above genital groove and medium-sized shallow foveae near front margin.

Distribution. Southern New Mexico and Arizona.

Records. New Mexico: Lincoln County: Malpais Lava Beds, May to August (S. Riechert), male, females and immatures in the University of Wisconsin Zoological Museum. Hidalgo County: Peloncillo Mountains, off Guadalupe Canyon, December 21, 1969 (V. Roth), two females. Grant County: Silver City, October 3, 1972 (M. Muma), male. *Arizona*: Cochise County: Guadalupe Canyon, 28 mi. E Douglas, September 27, 1968, male. Portal, October 24, 1969 (W. J. Gertsch), male, female. Southwestern Research Station, 5400 feet, October 24, 1965 (V. Roth), female.

Phidippus volcanus, new species
Figures 27-29

Type Data. Male holotype from New Mexico: Lincoln County: Malpais Lava Beds, T6N R10E, July 17, 1972 (S. Riechert), in the American Museum of Natural History.

Etymology. Specific name from Latin *volcanus*, Vulcan, in reference to volcanic habitat of spider.

Diagnosis. Smaller blackish species with red abdomen, similar to *reederi*, distinguished in male by thin embolus (fig. 27) and in female by larger foveae of epigynum (fig. 29).

Description. Male: Total length 7.8 mm. Carapace 3.75 mm. long, 3.15 mm. wide. Abdomen 4 mm. long, 2.15 mm. wide.

Integument of carapace reddish brown, darker in ocular region and eye tubercles black, evenly covered with fine black hairs and series of longer setae overhanging front eye row. Sternum yellowish brown; labium and endites dark reddish brown; coxae yellowish brown; all these sclerites with fine suberect black hairs and longer setae. Legs dusky brown, with typical covering of black hairs: first leg darker than others, with femur and apical halves of terminal segments darker brown, with ventral black fringe heaviest on femur. Chelicerae dark reddish brown with indistinct purplish sheen. Abdomen with thin covering of red scales above, nearly masking pair of longitudinal dark bands on most of length; dorsum provided with scattered black setae and light brush above pedicel; sides and venter shaded with gray.

Structure typical, like that of *pinteri* unless otherwise noted. Carapace subvertical on sides, not much wider than row of posterior eyes, set 2.6 mm. apart near side margins. First leg: femur 2.5 mm., patella 1.6 mm., tibia 1.8 mm., metatarsus 1.5 mm., tarsus 0.9 mm.; total length 8.3 mm. First leg with following spines: patella 1 prolateral; tibia 2-2-2 ventral in apical half; metatarsus 2-2 ventral in apical half.

Male palpus (figs. 27, 28) with following features: tarsus with small, sharply pointed, retrolateral apophysis; rugose sclerite at apex of bulb broader than long; embolus thin apically curved spine.

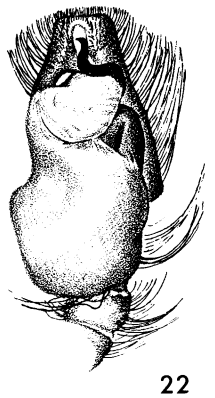
Female: Total length 9.5 mm. Carapace 4.25 mm. long, 3.5 mm. wide. Abdomen 5.5 mm. long, 4 mm. wide.

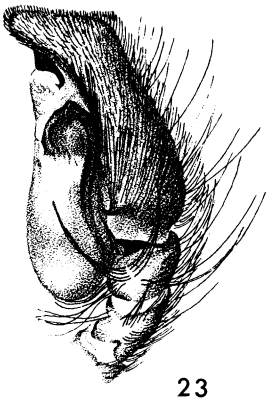
Structure and color pattern similar to those of male. Cephalothorax and appendages dark reddish brown to black, covered with fine black hairs. Dorsum of abdomen sparsely covered with golden scales along sides and with small paired golden spots flanking median dusky stripe. Eye relations like those of male. First leg: femur 2.5 mm., patella 1.75 mm., tibia 1.8 mm., metatarsus 1.4 mm., tarsus 0.85 mm.; total length 8.3 mm.

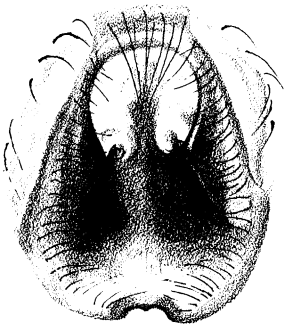
Epigynum (fig. 29) typical of genus, with small emargination at genital groove and shallow foveal depressions in front margined by distinct lateral ridges, proportionally larger than those of *reederi.*

Distribution. Southern New Mexico.

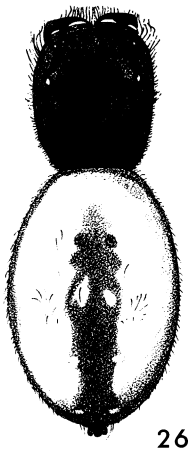
Records. New Mexico: Lincoln County: Malpais Lava Beds, July-August (S. Riechert), males and females in the University of Wisconsin Zoological Museum.

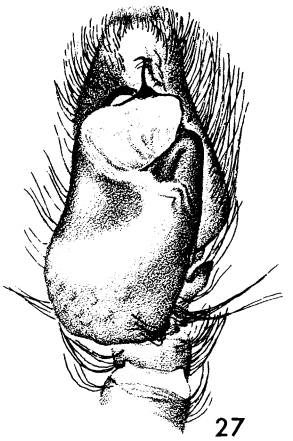

22

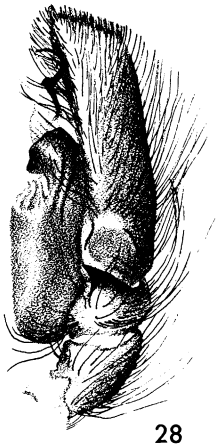

23

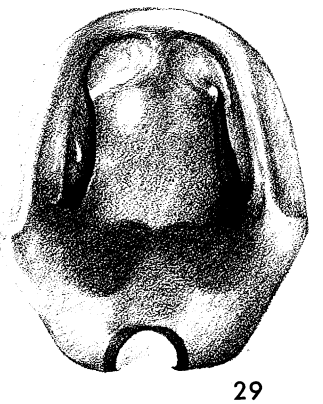

24


25


26


27


28


29

FIGS. 22-26. *Phidippus reederi*, new species. 22. Left male palpus, ventral view. 23. Left male palpus, retrolateral view. 24. Epigynum, ventral view. 25. Carapace and abdomen of male, dorsal view. 26. Carapace and abdomen of female, dorsal view.

FIGS. 27-29. *Phidippus volcanus*, new species. 27. Left male palpus, ventral view. 28. Left male palpus, retrolateral view. 29. Epigynum, ventral view.

Metaphidippus shaferi, new species
Figures 30-33

Type Data. Male holotype from New Mexico: Lincoln County: Malpais Lava Beds, T6S R10E, June 29, 1972 (S. Riechert), in the American Museum of Natural History.

Etymology. Named in honor of Robert M. Shafer and family who have facilitated biological research on their ranch for many years.

Diagnosis. Atypical species of genus allied to *unicus* Chamberlin and Gertsch, distinguished by smaller size, darker coloration and distinctive genitalic differences: Male palpus (figs. 30-33) with embolus elongated subconical process bifid at tip; tibial apophysis with sublateral and subdorsal spurs, sublateral one curved inward toward cymbium. Embolus of *unicus* elongated sinuate process truncated at apex (fig. 34).

Description. Male: Total length 2.45 mm. Carapace 1.23 mm. long, 0.91 mm. wide.

Abdomen 1.4 mm. long, 0.84 mm. wide. Average length of four other males 2.34 mm., range 2.21-2.7 mm.

Cephalothorax black, clothed in white hairs, most dense in thoracic region, eyes ringed with white hairs. Chelicerae, sternum, and other proximal appendages dark brown, endites grading to white medially, labium border white. Leg I with femur black, other segments mottled with brown; other legs darker but mottled, metatarsi and tarsi lighter. Legs sparsely covered with white hairs. Abdomen black with indistinct paired spots near spinnerets; white pubescence covering abdomen more dense near pedicel; venter gray with white pubescence.

Structure typical: cephalothorax high with sides nearly parallel. Carapace at greatest width equal to 7/10 the length. Ocular quadrangle occupying two-fifths length of carapace, slightly wider behind than in front; small eyes closer to posterior eyes, 0.13 mm., than to anterior lateral eyes, 0.18 mm. Chelicera: promargin and retromargin each armed with one large tooth. Sternum 0.63 mm. long, 0.32 mm. wide; labium 0.14 mm. long, 0.18 mm. wide; endite 0.32 mm. long, 0.21 mm. wide.

	I	II	III	IV	Palp
Femur	0.74	0.60	0.56	0.60	0.42
Patella	0.46	0.35	0.32	0.39	0.14
Tibia	0.56	0.39	0.35	0.56	0.11
Metatarsus	0.42	0.35	0.32	0.49	–
Tarsus	0.32	0.28	0.25	0.35	0.39
Total	2.50	1.97	1.80	2.39	1.06

Leg formula 1423. Spination: tibia I with 2-2-2 ventral spines in apical half; tibia II with distal pair and single spine near patella; metatarsi I and II with 2-2 ventral spines in apical half.

Male palpus (figs. 30-33) with following features: embolus elongated and robust, distal third of process bifid; tibial apophysis with subdorsal and sublateral spurs, each equal in length to width of tibia, tip of sublateral spur more heavily pigmented and curved inward toward cymbium.

Distribution. Southern New Mexico.

Records. New Mexico: Lincoln County: Malpais Lava Beds, late May through July (S. Riechert), males in University of Wisconsin Zoological Museum.

Metaphidippus unicus (Chamberlin and Gertsch)
Figures 34-36

Dendryphantes unicus Chamberlin and Gertsch, 1930, p. 143.

Diagnosis. Atypical species of genus allied to *shaferi*, illustrated here for comparison with that species, readily identified by following genitalic features of male: heavy embolus elongated sinuous process truncated at apex (fig. 34); tibia with two distinct processes (fig. 35) much like those of *shaferi.*

Type Data. Male holotype from Utah: Uintah County: October, 1928 (R. V. Chamberlin, Jr.), in the American Museum of Natural History (formerly University of Utah collection).

Distribution. Utah, New Mexico, and Arizona.

Sitticus juniperi, new species
Figures 37-41

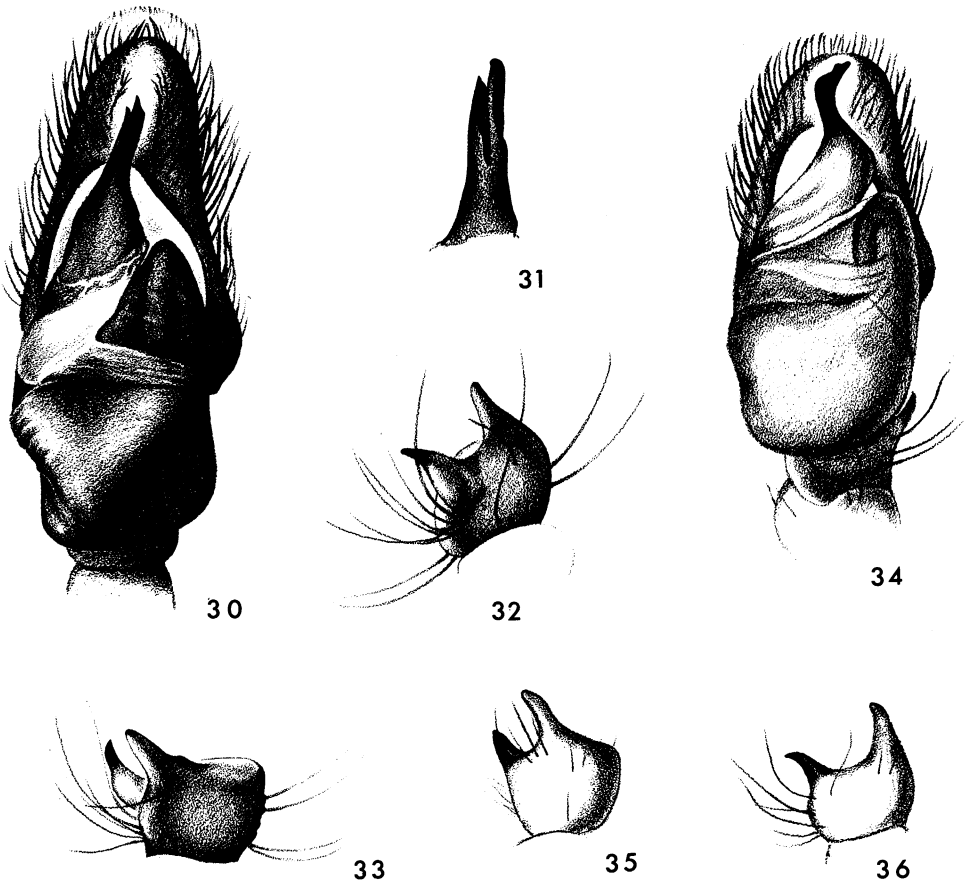
Type Data. Male holotype from New Mexico: Lincoln County: Malpais Lava Beds, Carrizozo, T6N R10, August 12, 1971 (S. Riechert), in the American Museum of Natural History.

Etymology. Named for shrub, *Juniperus monosperma*, with which this species is most often associated on the Carrizozo Lava Bed.

Diagnosis. Small species nearest *absolutus* Gertsch and Mulaik, distinguished by following features: dorsum of carapace of male covered with reddish hairs, that of female with mixed red and white hairs; epigynum as shown in figure 38; embolus of male palpus curved spine on prolateral margin of bulb (fig. 37) and tibial apophysis curved at apex.

Description. Female: Total length 3.5 mm. Carapace 1.32 mm. long, 1 mm. wide. Abdomen 1.7 mm. long, 1.3 mm. wide.

Dorsal view of carapace and abdomen as shown in figure 36. Base color carapace dusky brown; dorsum with blackish maculation from front margin to behind eyes clothed with mixed white and reddish hairs; sides brown, with black reticulations along lower margins, thickly clothed with whitish hairs. Sternum, labium, and endites dusky brown. Legs dull yellow with black rings.



FIGS. 30-33. *Metaphidippus shaferi*, new species, left male palpus. 30. Ventral view. 31. Tip of embolus enlarged. 32. Tibia, retrolateral view. 3. Tibia, subdorsal view.

FIGS. 34-36. *Metaphidippus unicus* (Chamberlin and Gertsch), left male palpus. 34. Ventral view. 35. Tibia, subdorsal view. 36. Tibia, retrolateral view.

Abdomen blackish with quite thin covering of dark hairs; dorsum with many small scattered pale flecks and venter with four rows of small spots running from genital furrow to spinnerets.

Structure like that of *absolutus* Gertsch and Mulaik. Carapace subquadrangular, flat above, sides precipitous, posterior declivity sloping. Ratio of eyes: ALE:AME:PLE:PME = 22: 35:20:4. Front eye row on margin in slightly recurved line; eyes subcontinuous. Eyes of second row very small, about midway between anterior and posterior lateral eyes. Posterior eye row on side margins, slightly narrower than front eye row. Quadrangle of eyes occupying slightly more than four-fifths length of carapace. Clypeus equal to about a third of diameter of anterior median eye. Retromargin of chelicera unarmed; promargin with four (or five) sharp teeth. Sternum suboval, 0.52 mm. long, 0.4 mm. wide; labium 0.15 mm. long and wide; endite 0.23 mm. long, 0.2 mm. wide; posterior coxae contiguous. Spination of first leg: tibia with 1-2-2 ventral spines; metatarsus with 2-2 ventral spines. Legs short: first leg: femur 0.6 mm., patella 0.36 mm., tibia 0.38 mm., metatarsus 0.3 mm., tarsus 0.26 mm.; total 1.9 mm.; tibia and patella of fourth leg 1.16 mm. Abdomen suboval.

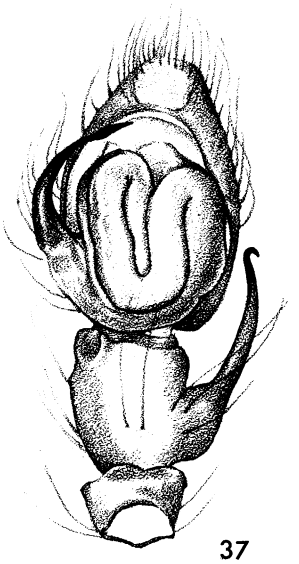
Epigynum (fig. 38) subtriangular plaque with transverse emargination above genital groove.

Male: Total length 2.75 mm. Carapace 1.25

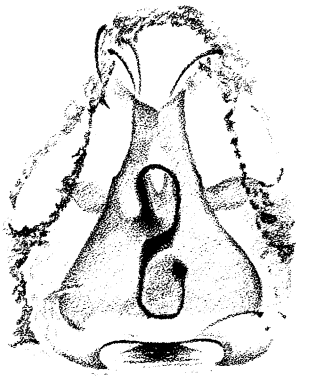
mm. long, 0.9 mm. wide. Abdomen 1.22 mm. long, 0.8 mm. wide.

Dorsal view of carapace and abdomen as shown in figure 40. Base color of carapace dusky red; dorsum with black maculation in front extending to just behind eyes thickly covered with procumbent red hairs; posterior part of dorsum and sides thickly clothed with whitish hairs; side margins with narrow black seam. Sternum dusky yellow; labium and endites blackish. Legs pale with black rings; first femur and tibia mostly black. Palpus black, covered with white hairs or scales; femur with thick dorsal brush of white hairs. Chelicerae orange. Abdomen orange; dorsum with faint herringbone lines above; covered thinly with procumbent reddish, scaly hairs; venter whitish.

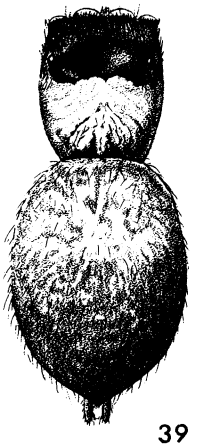
Structure like that of female unless otherwise noted. Ratio of eyes: ALE:AME:PLE:PME = 20:30:19:5. First leg: femur 0.72 mm., patella 0.4 mm., tibia 0.53 mm., metatarsus 0.4 mm., tarsus 0.3 mm.; total 2.35 mm.; tibia and patella



37

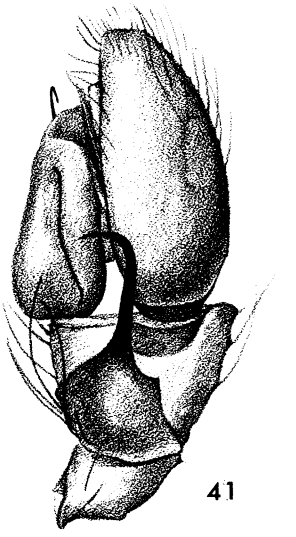


38



39

40



41

FIGS. 37-41. *Sitticus juniperi*, new species. 37. Left male palpus, ventral view. 38. Epigynum, ventral view. 39. Carapace and abdomen of female, dorsal view. 40. Carapace and abdomen of male, dorsal view. 41. Left male palpus, retrolateral view.

of fourth leg 1 mm. long. Sternum 0.48 mm. long, 0.4 mm. wide; labium 0.12 mm. long and wide; endite 0.25 mm. long, 0.2 mm. wide.

Male palpus (figs. 37, 39) similar to that of *absolutus*; embolus thin black spine originating at middle on prolateral side and curved around apex of bulb; tibial apophysis thin long spine curved at apex.

Distribution. Southern New Mexico.

Records. New Mexico: Lincoln County: Malpais Lava Beds, females and males June-July (S. Riechert) in the University of Wisconsin Zoological Museum. Grant County: Hurley, July 1, 1972 (M. Muma) female from Yucca-Allthorn-Mesquite community Silver City, June 29, 1973 (M. Muma), male from Pinyon Juniper zone.

LITERATURE CITED

Almquist, Sven
1973a. Spider associations in coastal sand dunes. Oikos, vol. 24, pp. 444-457.
1973b. Habitat selection by spiders on coastal sand dunes in Scania, Sweden. Ent. Scandinavia, vol. 4, pp. 134-154.

Banks, Nathan
1901. Some spiders and other Arachnida from southern Arizona. Proc. U.S. Natl. Mus., vol. 23, pp. 581-590.

Barnes, Robert D.
1953. The ecological distribution of spiders in non-forest maritime communities at Beaufort, North Carolina. Ecol. Monogr., vol. 23, pp. 315-337.

Berry, James W.
1970. Spiders of the North Carolina Piedmont old-field communities. Jour. Elisha Mitchell Sci. Soc., vol. 86, pp. 97-105.
1971. Seasonal distribution of common spiders in the North Carolina Piedmont. Amer. Midland. Nat., vol. 85, pp. 526-531.

Bixler, David E.
1970. A study of wolf spider ecology in Grand County, Utah (Lycosidae: Araneae). Southwestern Nat., vol. 14, pp. 403-410.

Chamberlin, Ralph V.
1919. New western spiders. Ann. Ent. Soc. Amer., vol. 12, pp. 239-260, pls. 14-19.
1920. New spiders from Utah. Canadian Ent., vol. 52, pp. 193-201, figs. 19-22.

Chamberlin, Ralph V., and Willis J. Gertsch
1930. On fifteen new North American spiders. Proc. Biol. Soc. Washington, vol. 43, pp. 137-144, pls. 2-5.

Dondale, Charles D., J. H. Redner, and R. B. Semple
1972. Diel activity periods in meadow arthropods. Canadian Jour. Zool., vol. 50, pp. 1155-1163.

Duffey, Eric
1962a. A population study of spiders in limestone grassland (The field layer fauna). Oikos, vol. 13, pp. 15-34.
1962b. A population study of spiders in limestone grassland, Jour. Animal Ecol., vol. 31, pp. 571-599.
1968. An ecological analysis of the spider fauna of sand dunes. Jour. Animal Ecol., vol. 37, pp. 641-674.
1969. The seasonal movements of *Clubiona brevipes* Blackwell and *Clubiona compta* C. L. Koch on oak trees in Monks Wood, Huntingdonshire. Bull. British Arach. Soc., vol. 1, pp. 29-32.

Elton, Charles
1946. Competition and the structure of ecological communities. Jour. Animal Ecol., vol. 15, pp. 54-68.

Enders, Frank
1974. Vertical stratification in orb-web spiders (Araneidae, Araneae) and a consideration of other methods of coexistence. Ecology, vol. 55, pp. 317-328.

Grinnel, J.
1924. Geography and evolution. Ecology, vol. 5, pp. 225-229.

Hardin, G.
1960. The competitive exclusion principle. Science, vol. 131, pp. 1292-1297.

Holthaus, Walter, and Susan E. Riechert
1974. A new time-sort pitfall trap. Ann. Ent. Soc. Amer., vol. 55, pp. 1362-1363.

Huhta, Veikko
1965. Ecology of spiders in the soil and litter of Finnish forests. Ann. Zool. Fennici, vol. 2, pp. 260-308.

Kessler-Geschiere, Annette M.
1971. Distribution and interspecific competition of congeneric species of spiders in a series of marshy habitats. Proc. Fifth Internatl. Cong. Arach., pp. 151-158.

Kuenzler, Edward J.
1958. Niche relations of three species of

lycosid spiders. Ecology, vol. 39, pp. 494-500.

Luczak, Judwar

1963. Differences in the structure of communities of web spiders in one type of environment (young pine forest). Ekol. Polska A., vol. 11, pp. 159-221.

1966. The distribution of wandering spiders in different layers of the environment as a result of interspecific competition. *Ibid.*, vol. 14, pp. 233-244.

MacArthur, Robert H., and Edward O. Wilson

1967. The theory of island biogeography. Princeton, Princeton Univ. Press, 203 pp.

Riechert, Susan E.

1973. The effects of thermal balance and prey availability on distributional patterns of the desert spider, *Agelenopsis aperta* (Gertsch). Ph.D. Thesis. Univ. Wisconsin.

1974. The pattern of local web distribution in a desert spider: mechanisms and seasonal variation. Jour. Animal Ecol., vol. 43, pp. 733-746.

Riechert, Susan E., and C. Richard Tracy

1975. Thermal balance and prey availability: bases for a model relating web-site characteristics to spider reproductive success. Ecology, vol. 56, pp. 265-284.

Schaefer, Matthias

1972. Okologische Isolation und die Bedeutung des Konkurrenzfaktors am Beispiel des verteilungsmuster der lycosiden einer Kustenlanschaft. Oecologis (Berlin), vol. 9, pp. 171-202.

1974. Experimentelle Untersuchungen Zur Bedeutung der interspezifischen Konkurrenz bei 3 Wolfspinnen-Arten (Araneida: Lycosidae) eier Salzqiese. Zool. Jahrb. Syst., vol. 101, pp. 213-235.

1975. Experimental studies on the importance of interspecies competition for the lycosid spiders in a salt marsh. Proc. 6th Internatl. Arach. Congr. pp. 86-90.

Seal, H.

1964. Multivariate Statistical Analyses for Biologists. New York, John Wiley and Sons, 207 pp.

Shields, Lorna M., and J. Crispin

1956. Vascular vegetation of a Recent Volcanic area in New Mexico. Ecology, vol. 37, pp. 341-351.

Szlep, R.

1956. The web structure of *Latrodectus variolus* Walckenaer and *Latrodectus bishopi* Kaston. Israel Jour. Zool., vol. 15, pp. 89-94.

Tretzel, E.

1955. Intragenerische Isolation und interspezifische konkurrenz bei Spinnen. Zeitschrift Morphol. Okol. Tiere., vol. 44, pp. 43-162.

Turnbull, A. L., and C. F. Nicholls

1966. A "Quick Trap" for area sampling in grassland communities. Jour. Econ. Ent., vol. 59, pp. 1100-1104.

Van der Aart, Peter J. M.

1973. Distribution analysis of wolf spiders (Araneae, Lycosidae) in a dune area by means of principal component analysis. Netherlands Jour. Zool. vol. 23, pp. 266-329.

Vlijm, L., and Annette M. Kessler-Geschiere

1967. The phenology and habitat of *Pardosa monticola*, *P. nigriceps* and *P. pullata* (Araneae, Lycosidae) Jour. Animal Ecol., vol. 35, pp. 31-56.

Vogel, Beatrice R.

1972. Sympatric occurrence of some *Pardosa* species (Araneidae; Lycosidae). Armadillo Papers, vol. 6, pp. 1-12.

Ward, James H.

1963. Hierarchical grouping to optimize an objective function. Jour. Amer. Statis. Assoc., vol. 58, pp. 236-244.

Weber, Robert H.

1964. Geology of the Carrizozo quadrangle, New Mexico. New Mexico Geol. Soc. 15th Field Conf., Guidebook of Ruidosa County, pp. 100-109.

Wishart, David

1969. An algorithm for hierarchical classifications. Biometrics, vol. 25, pp. 165-170.