

## STUDIES ON SPECIES OF HOLARCTIC *PARDOSA* GROUPS (ARANEAE, LYCOSIDAE).

### V. REDESCRIPTION OF *PARDOSA WASATCHENSIS* GERTSCH AND DESCRIPTION OF A NEW SPECIES FROM UTAH

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**ABSTRACT.** Two North American *Pardosa* species assigned to the *modica* group are treated and illustrated. *Pardosa wasatchensis* Gertsch (Montana, Wyoming, Colorado, Utah, Idaho, Washington; with *Pardosa subra* Chamberlin & Ivie from Oregon placed as junior synonym) is redescribed, and the male is described for the first time. *Pardosa vogelae*, new species, is described on material from Leidy Peak and vicinity in the Uintah Mountains (Utah).

Species of the *modica* group within the wolf spider genus *Pardosa* have previously been treated by Kronestedt (1975, 1981, 1986, 1988) and Dondale & Redner (1990). This paper deals with another two species assigned to this group of species.

*Pardosa wasatchensis* was described from the female by Gertsch (1933) and since then little has been added to the knowledge of this species, which seems to be restricted to western U. S. (Fig. 22). *P. subra*, described by Chamberlin & Ivie (1942), regrettably also from the female sex only, seems to be conspecific with *P. wasatchensis*. The male of *P. wasatchensis* is described here for the first time.

The new species *Pardosa vogelae* has so far been found only in the eastern parts of the Uintah Mountains of Utah. Whether or not it has a restricted distribution remains to be explored. [This discovery is paralleled by the find at a single locality in Colorado of a high altitude species in the *nigra* group, *P. gothicana* Lowrie & Dondale (1981), calling for more intense studies of Cordilleran *Pardosa*.]

#### METHODS

Material is deposited in the following collections: AMNH—American Museum of Natural History, New York; BRV—private collection of B. R. Vogel; CNC—Canadian National Collection of Insects and Arachnids, Ottawa; MCZ—Museum of Comparative Zoology, Cambridge, Massachusetts; NRS—Swedish Museum of Natural History, Stockholm (material gratefully donated by D. C. Lowrie and B. R. Vogel).

Terminology and methods of study follow Kronestedt (1975, 1986). Measurements refer to specified individuals. Eyepiece micrometer units (as given for eyes) can be converted to mm by dividing by 80.

#### *Pardosa wasatchensis* Gertsch

Figs. 1, 3, 5, 6, 9, 10, 12, 14, 15, 17, 19, 21a, 22;  
Table 1

*Pardosa wasatchensis* Gertsch, 1933: 25, fig. 37 (female holotype from United States: Utah, Sevier County, Fish Lake, in AMNH, examined). Roewer 1954: 195. Bonnet 1958: 3431.

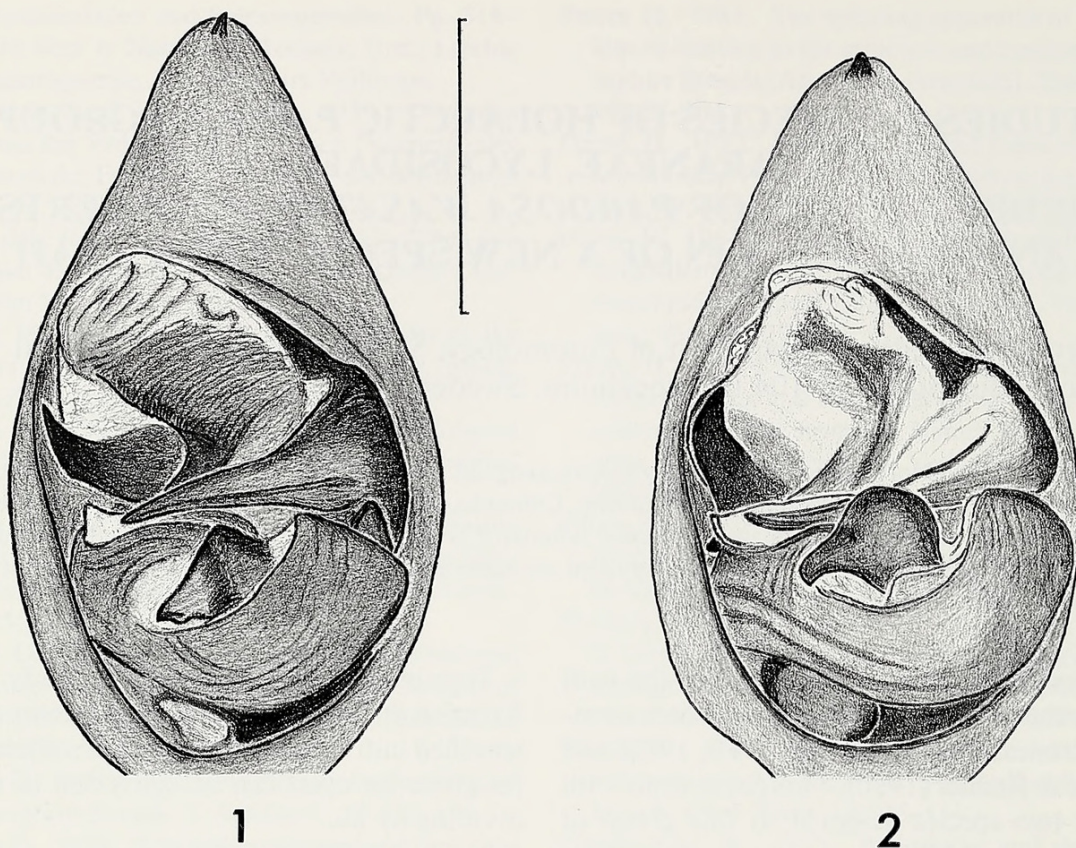
*Pardosa subra* Chamberlin & Ivie, 1942: 30, fig. 71 (female holotype from United States: Oregon, Harney County, Malheur Lake, in AMNH, examined). Roewer 1954: 194. **Syn. n.**

**Diagnosis.**—Males may be distinguished by the short, only slightly curved embolus, somewhat widened toward its tip, the latter with a small incision on its inner side (Fig. 5), as well as by the configuration of the conductor (Fig. 3) and the retrolateral grooved process of the terminal apophysis (Fig. 10); females by the proportions of the flask-shaped epigyne, with a narrow septum widened posteriorly like an inverted “T”, and with anterior transverse pockets well separated and extending more or less laterad (Figs. 14, 15).

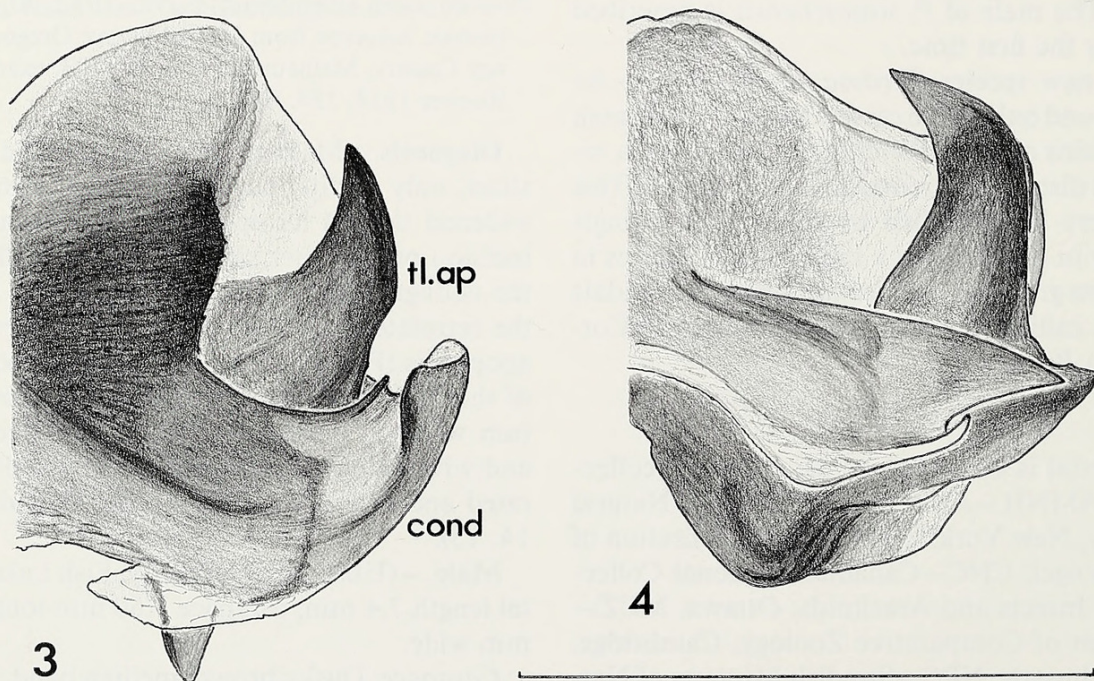
**Male.**—(Utah, Sevier County, Fish Lake). Total length 7.4 mm; carapace 3.60 mm long, 2.65 mm wide.

**Carapace:** Dusky brown, median band in thoracic part yellowish, lateral bands light brownish to yellowish. Lateral bands broken into (2–)3 parts



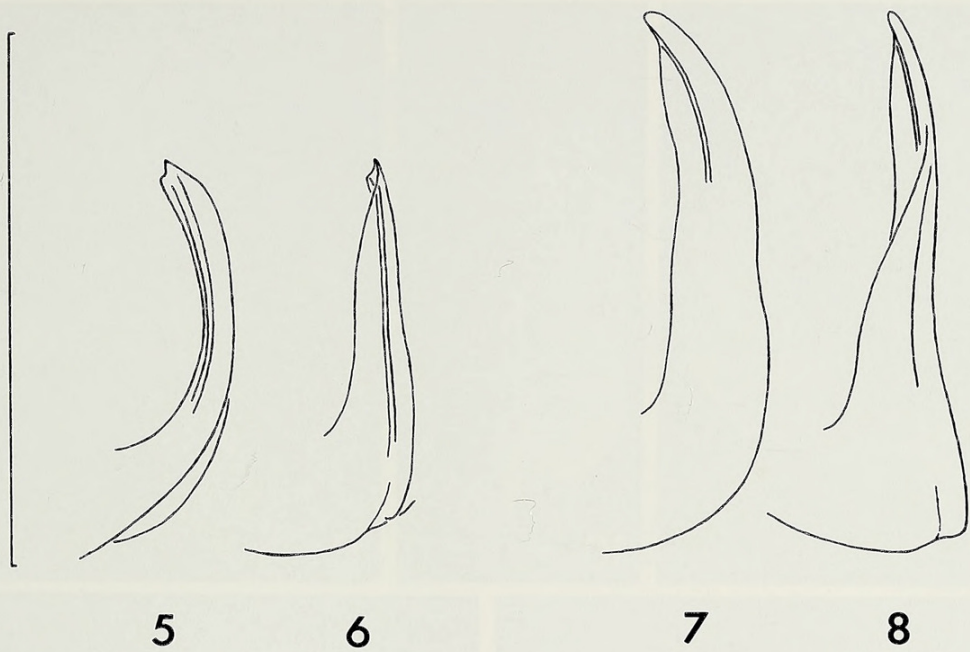


Figures 1, 2.—Right male palp, ventral view. 1. *Pardosa wasatchensis* Gertsch from Fish Lake, Utah; 2. *P. vogelae* sp. n. from Leidy Peak, Utah. Scale: 0.5 mm.



Figures 3, 4.—Terminal part of left palp with conductor (*cond*) and terminal apophysis (*tl.ap*). 3. *Pardosa wasatchensis* Gertsch from 8 mi. N Fish Lake, Utah; 4. *P. vogelae* sp. n. from Leidy Peak, Utah. Scale: 0.5 mm.





Figures 5–8.—Emboli seen in frontal (5, 7) and ventral (6, 8) views. 5–6. *Pardosa wasatchensis* Gertsch from 8 mi. N Fish Lake, Utah; 7–8. *P. vogelae* sp. n. from Leidy Peak, Utah. Scale: 0.5 mm.

Table 1.—Leg I–IV measurements (mm) of *Pardosa wasatchensis* Gertsch and *Pardosa vogelae* sp. n. Fe = femur, Pa = patella, Ti = tibia, Mt = metatarsus, Ta = tarsus.

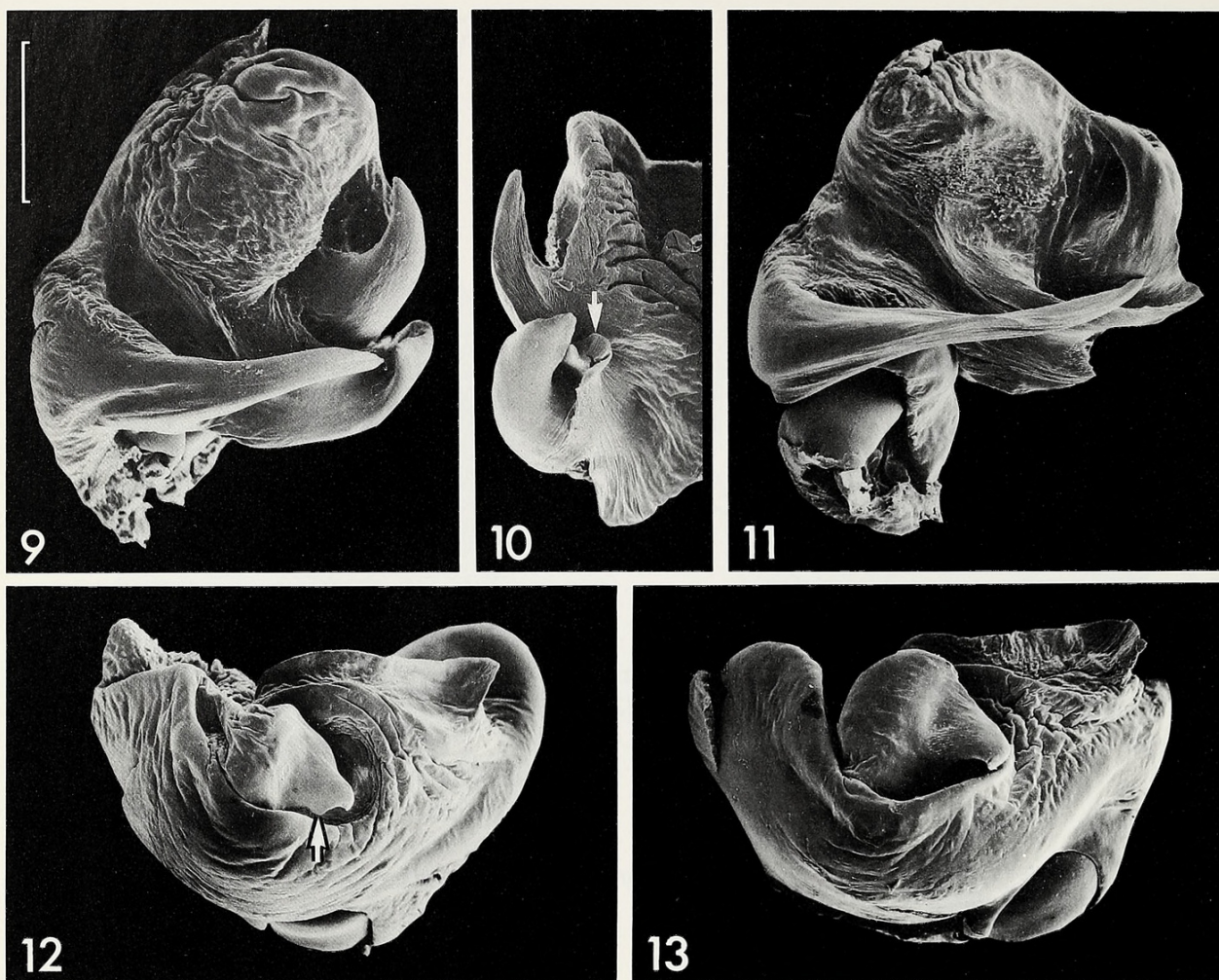
	Fe	Pt	Ti	Mt	Ta	Total
<i>Pardosa wasatchensis</i>						
Male						
I	2.80	1.30	2.35	2.40	1.65	10.50
II	2.70	1.25	2.15	2.40	1.60	10.10
III	2.65	1.20	2.10	2.80	1.55	10.30
IV	3.40	1.40	2.90	4.20	2.00	13.90
Female						
I	2.70	1.30	2.05	2.05	1.45	9.55
II	2.65	1.30	1.90	2.10	1.45	9.40
III	2.55	1.20	1.90	2.55	1.40	9.60
IV	3.50	1.40	2.90	4.35	2.00	14.15
<i>Pardosa vogelae</i>						
Male						
I	2.30	1.10	1.85	2.10	1.55	8.90
II	2.30	1.10	1.75	2.05	1.50	8.70
III	2.25	1.00	1.70	2.45	1.45	8.85
IV	2.95	1.20	2.40	3.70	1.90	12.15
Female						
I	2.25	1.10	1.75	1.75	1.30	8.15
II	2.25	1.05	1.60	1.75	1.30	7.95
III	2.20	1.00	1.65	2.15	1.25	8.25
IV	2.95	1.20	2.45	3.55	1.75	11.90

by transverse brownish streaks. Postocular spots in cephalic part brownish. Sides of thoracic part with numerous short dark and recumbent grayish hairs. Median band with whitish hairs, in preserved specimens usually remaining behind fovea; around fovea in addition with short dark (and at midline with few long dark) erect hairs. Lateral bands with dark and light hairs. Clypeus yellowish, with long forwardly directed dark hairs medially. Chelicerae yellowish to brownish with grayish brown streaks, furnished with dark hairs. Sternum dark brown, furnished with erect dark and recumbent grayish hairs.

*Eyes:* Width of row I 52 (slightly procurved as seen from front), row II 71, row III 94, row II–III 70. Diameter of AME 12, ALE 10, PME 26, PLE 21. Distance between AME 8, between AME and ALE 2.

*Abdomen:* Dorsally grayish brown, with light brownish to yellowish, dark-bordered lanceolate stripe in front. Posteriorly on each side of median part a dark irregular line interrupted at intervals by light dots (with white hair tufts). Median part with two separate spots at end of lanceolate stripe, rearwards followed by two close spots and more posteriorly by a few bars, all brownish to yellowish (pattern sometimes hardly discernible), each spot with one dark dot, bars with two dark dots, each carrying long dark hair. Dorsum and sides with long erect and short dark as well as recumbent light hairs, venter brownish to yellowish with recumbent white pubescence and numerous





Figures 9–13.—Terminal part (9, 11 in ventral view; 10 in retrolateral view) and tegulum with tegular apophysis (12, 13 in ventral view), left male palp (for arrows see text). 9–10, 12. *Pardosa wasatchensis* Gertsch from 8 mi. N Fish Lake, Utah; 11, 13. *P. vogelae* sp. n. from Leidy Peak, Utah. Scale: 200 $\mu$ m.

longer erect grayish to light hairs (latter seen only in some males examined).

**Legs:** (Table 1) Yellowish. Femora with darker blotches dorsally (“pseudoannulation”), outer segments with very faint grayish tinge, on tibiae and metatarsi arranged like the more distinct annulation in female. Tibia I with two or only distal retrolateral spine(s) present. Hairiness of leg I as in rest of legs.

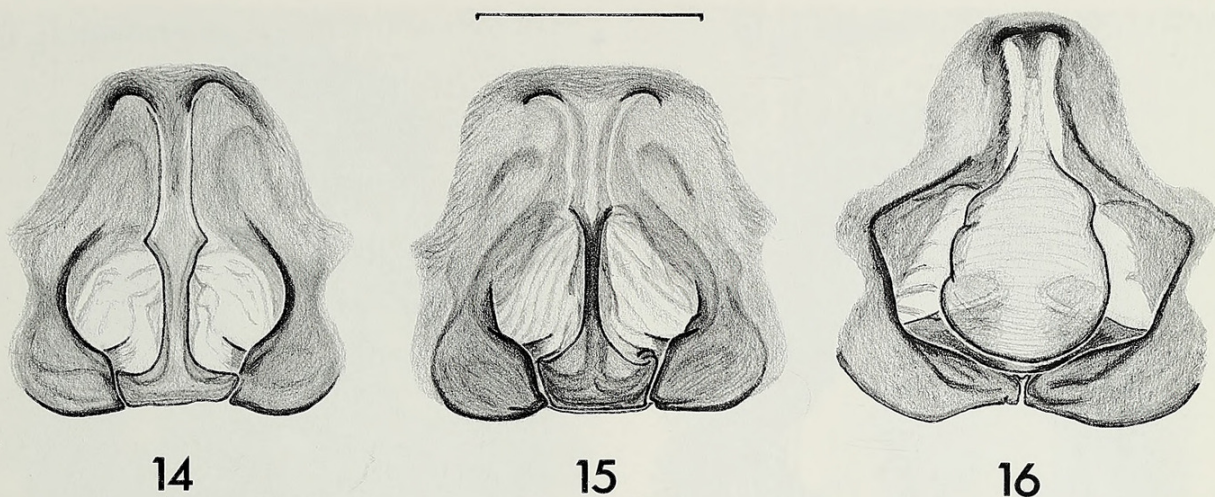
**Palp:** Patella 0.70 mm, tibia 0.65 mm, cymbium 1.35 mm. Femur, patella and tibia yellowish; femur with dark markings, patella and tibia less so, sometimes even unicolorous. Cymbium brown to blackish brown, lighter apically. Femur, patella and tibia with dark and whitish hairs, latter dominating on tibia; cymbium with dark hairs except distally. Tegulum comparatively protruding. Tegular apophysis as seen in ventral view (Figs. 1, 12) with subtriangular basal part (including anteriorly directed branch); lateral

process basally almost as wide as length of basal part and tapering toward ventrally directed slightly hook-shaped tip; posterior (lower in figures) rim of lateral process with more or less distinct denticle-like projection at some distance from tip (arrow in Fig. 12). Terminal apophysis (as seen in ventral view: Figs. 3, 9) with heavily sclerotized tooth-like process protruding forward, and with small, grooved retrolateral process (arrow in Fig. 10; hidden below conductor in ventral view). Conductor with distal part curved dorsad (Fig. 10); its posterior rim folded towards rounded tip, forming groove (Figs. 3, 9); anterior rim more or less incised before rounded tip. Embolus (Figs. 5, 6) short, in frontal view slightly widening distally, incised at tip.

**Female.**—(Utah, Sevier County, Fish Lake). Total length 6.7 mm (carried egg sac); carapace 3.70 mm long, 2.70 mm wide.

Similar to male in color pattern and hairiness.





Figures 14–16.—Epigyne, ventral view. 14. *Pardosa wasatchensis* Gertsch, holotype; 15. holotype of *P. subra* Chamberlin & Ivie; 16. *P. vogelae* sp. n. from Leidy Peak, Utah. Scale: 0.5 mm.

Carapace lighter brownish than in male, and with yellowish, sometimes unbroken, lateral bands with more light hairs. Chelicerae usually lighter than in male and furnished with light hairs in addition to dark ones.

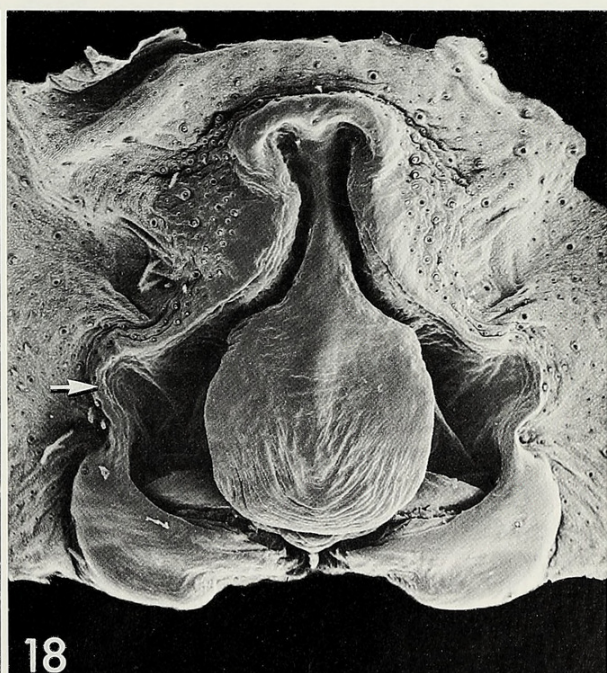
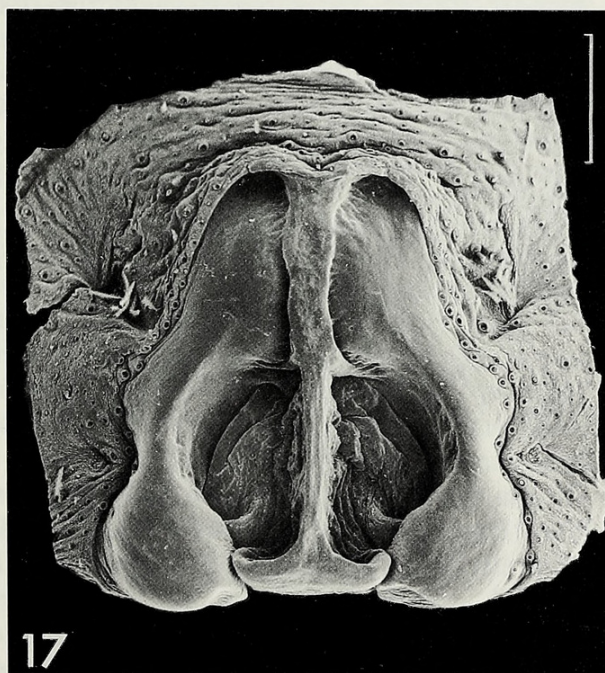
**Legs:** (Table 1) Femora yellowish to light brownish with darker brownish “pseudoannulation,” tibiae and metatarsi brownish, often with very indistinct lighter brown to yellowish annulation. Tibia I with two, only distal, or no retrolateral spine(s) present.

**Epigyne:** Flask-shaped (Figs. 14, 15, 17; cleared Fig. 19). Anterior transverse pockets well sepa-

rated, extending laterad. Septal ridge as wide as or slightly wider than narrow septum. Septum posteriorly widened. Lateral elevations sometimes sloping smoothly into anterior part of cavities (i. e., without distinct rim). Receptacles comparatively inflated (Fig. 19).

One female (carapace length 3.40 mm) carried an egg sac with diameter of 4.7 mm and height of 3.7 mm, containing 67 pulli (larvae).

**Size variation.**—Carapace lengths of material measured: males 3.00–3.60 mm ( $n = 15$ ), females 2.75–3.70 mm ( $n = 15$ ); tibia I length vs. carapace length in Fig. 21a.



Figures 17, 18.—Epigyne. 17. *Pardosa wasatchensis* Gertsch from 8 mi. N Fish Lake, Utah; 18. *P. vogelae* sp. n. from Leidy Peak, Utah (for arrow see text). Scale: 200  $\mu$ m.





19



20

Figures 19, 20.—Epigyne (cleared), ventral view. 19. *Pardosa wasatchensis* Gertsch from 8 mi. N Fish Lake, Utah; 20. *P. vogelae* sp. n. from Leidy Peak, Utah.

**Material examined.**—UNITED STATES. *Colorado*. Eagle County: 2 mi. S Burns, 27 June 1963 (B. Vogel, AMNH), 1♂ 2♀. Grand County: S Granby, 26 June 1940 (W. Ivie, AMNH), 2♂ 3♀; 5 mi. S Parshall, 20 June 1963 (B. Vogel, AMNH), 1♂. *Idaho*. Bear Lake County: Nounan, 9 August 1931 (W. J. Gertsch, AMNH), 1♀. Payette County: Payette, 1956 (Evadina Ivie, AMNH), 3♂ 1♀. Teton County: Victor, 15 August 1940 (W. Ivie, AMNH), 2♀. Valley County: Cascade, 5 July 1943 (W. Ivie, CNC), 2♂ 2♀; S Donnelly, 5 July 1943 (W. Ivie, AMNH), 1♀. *Montana*. Horse Prairie (not located), 11 July 1935 (W. Ivie, AMNH), 2♀. Jefferson County: S Butte, Toll Mt. Campground, 6 August 1964 (D. C. Lowrie, AMNH), 1♀. *Oregon*. Harney County: Malheur Lake, 18 June 1940 (L. W. Saylor, AMNH), 1♀ (holotype of *P. subra*). *Utah*. Rich County: Bear Lake (S end), 26 June 1962 (W. Ivie, AMNH), 1♀. Salt Lake County: Salt Lake City, September 1930 (W. J. Gertsch, AMNH), 1♀. Sevier County: Fish Lake, 4 September 1929 (Chamberlin & Gertsch, AMNH), 1♀, 22–23 June 1930 (W. J. Gertsch, AMNH), 3♀ (incl. holotype), 13 July 1931 (W. J. Gertsch, AMNH), 1♂, 1 July 1940 (Gertsch & Hook, AMNH), 2♂ 4♀; Seven-mile Creek 8 mi. N Fish Lake, 9400 ft, 14 July 1973 (B. R. Vogel, BRV, NRS), 3♂ 18♀. Summit County: W Wasatch Station, 3 June 1933 (W. Ivie, AMNH), 1♂ 1♀. *Washington*. Douglas County: 5–10 mi. E Bridgeport, prairie community, in wet area, amongst *Artemisia*, 7 July 1964 (D. C. Lowrie, AMNH), 1♀. *Wyoming*. Teton County: Grand Teton National Park, S Jackson, 24 June 1938 (W. Ivie, AMNH), 1♂; Grand Teton National Park, Moran area (Jackson Hole Biological Research Station, Uhl Hill &c.), July–August 1961–69 (D. C. Lowrie, AMNH), 2♂ 17♀; Grand Teton

National Park, Lake Solitude, moist meadow, 3 August 1962 (D. C. Lowrie, NRS), 1♂; Teton National Forest (all near Gros Ventre R.), Bridge Creek, in moist sedge-grass field, 30 August 1964 (D. C. Lowrie, CNC), 3♀; same, Lafferty Creek, in moist willows, 30 August 1964 (D. C. Lowrie, NRS), 1♀; same, nr Soda Lake, 30 August 1964 (D. C. Lowrie, AMNH), 5♀. Uinta County: 10 mi. E Evanston, 18 July 1935 (W. Ivie, AMNH), 1♀; Yellowstone National Park: Bridge Bay, 9 July 1935 (W. Ivie, AMNH), 1♂ 2♀, 20 June 1938 (W. Ivie, AMNH), 21♂ 16♀; Yellowstone Lake, 21 June 1938 (W. Ivie, AMNH), 1♀.

One ♂ from Canada, Ontario, St. Thomas, 1928 (McBride, AMNH) is believed to be incorrectly recorded (cf. Dondale & Redner 1986:818 concerning material of other *Pardosa* species incorrectly recorded from St. Thomas).

**Habitat.**—According to Lowrie (1973:110) “a moist meadow form. . . [but] further characterization of its microhabitat is needed.”

*Pardosa vogelae*, new species

Figs. 2, 4, 7, 8, 11, 13, 16, 18, 20, 21b, 22;  
Table 1

**Type.**—Male holotype from United States: Utah, Daggett County, Leidy Peak, 11,500 ft (Beatrice R. Vogel & C. Durden), deposited in AMNH.

**Etymology.**—Named for Dr. Beatrice R. Vogel, one of the collectors, who has contributed substantially to the exploration of the North American lycosid fauna.



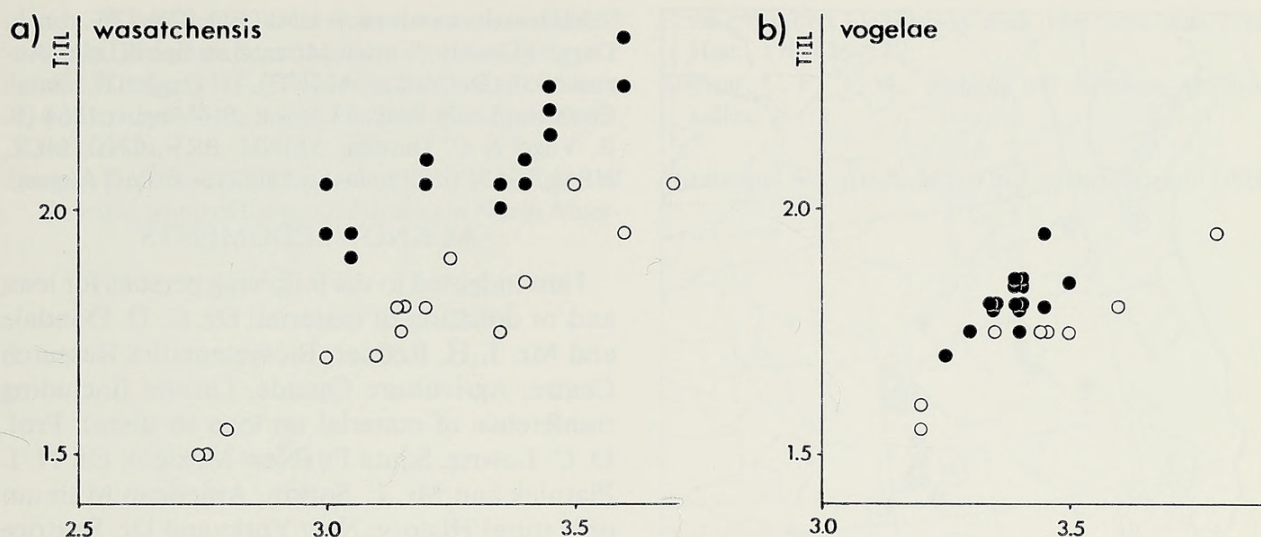


Figure 21.—Tibia I length (TiIL)/carapace length in adult males (closed circles) and females (open circles). a) *Pardosa wasatchensis* Gertsch; b) *P. vogelae* sp. n.

**Diagnosis.**—Males may be distinguished by the very prominent, curved and pointed tooth of the terminal apophysis, and by the configuration of the conductor (Fig. 4); females by the proportions of the flask-shaped epigyne, with a very wide septum and the rims of lateral elevations characteristically curved (Fig. 16).

**Male.**—*Holotype*: Total length 6.6 mm; carapace 3.40 mm long, 2.45 mm wide.

**Carapace:** Dusky brownish; median band in thoracic part yellowish; lateral bands light brownish, uneven in width and with darker breaks, not continuous to clypeus. Postocular spots in cephalic part brownish. Sides of thoracic part with numerous short dark hairs, fewer recumbent grayish ones, and some longer erect, somewhat wavy hairs. Median band with recumbent whitish hairs, around fovea additionally with short and few long erect dark hairs. Clypeus yellowish, in apparently old specimens now available devoid of hairs except long forwardly directed dark ones. Chelicerae brownish with darker streaks, distally yellowish on inner side, furnished with dark hairs. Sternum blackish brown with small light median stripe in front, furnished with recumbent light and more erect dark hairs.

**Eyes:** Width of row I 48 (slightly procurved as seen from front), row II 65, row III 85, row II–III 62. Diameter of AME 10, ALE 10, PME 24, PLE 19. Distance between AME 7, between AME and ALE 2.

**Abdomen:** Dorsally grayish brown; posteriorly on each side of median area a row of darker patches with light dots between patches. Light grayish brown, dark-bordered lanceolate stripe

in front. Dorsum with long erect and short dark hairs as well as light hairs (latter numerous in lanceolate stripe). Sides of abdomen mottled with yellowish brown spots on grayish background. Venter brownish with recumbent white pubescence and scattered erect dark hairs.

**Legs:** (Table 1) Femora yellowish with sooty brown dorsal markings, less sooty ventrally. Outer segments yellowish to light brownish. Hairiness of leg I as in rest of legs. Tibia I with two, only distal or no retrolateral spine(s).

**Palp:** Patella 0.65 mm, tibia 0.65 mm, cymbium 1.35 mm. Femur, patella, tibia and cymbium dusky brownish; femur with darker markings, cymbium lighter distally. Patella with dark hairs, tibia with numerous long and short dark hairs, cymbium with dark hairs except distally. Tegular apophysis in ventral view (Figs. 2, 13) shaped like bird's head, with bulky, rounded basal part (including anteriorly directed branch); lateral process shorter than width of basal part, not considerably narrowing before slightly hook-shaped tip. Terminal apophysis (in ventral view: Figs. 4, 11) with curved, heavily sclerotized tooth-like process protruding forwards, tip acute; sclerotized retrolateral process, end pointed; heavily sclerotized rounded portion protruding posteriad. Conductor (as seen in Figs. 4, 11) distally bifurcate, upper branch longest, evenly tapering to pointed tip; lower branch short, unsclerotized. Embolus as in Figs. 7, 8.

**Female.**—*Allotype*: Total length 6.5 mm (carried egg sac); carapace 3.35 mm long, 2.45 mm wide.

Similar to male in color pattern and hairiness.



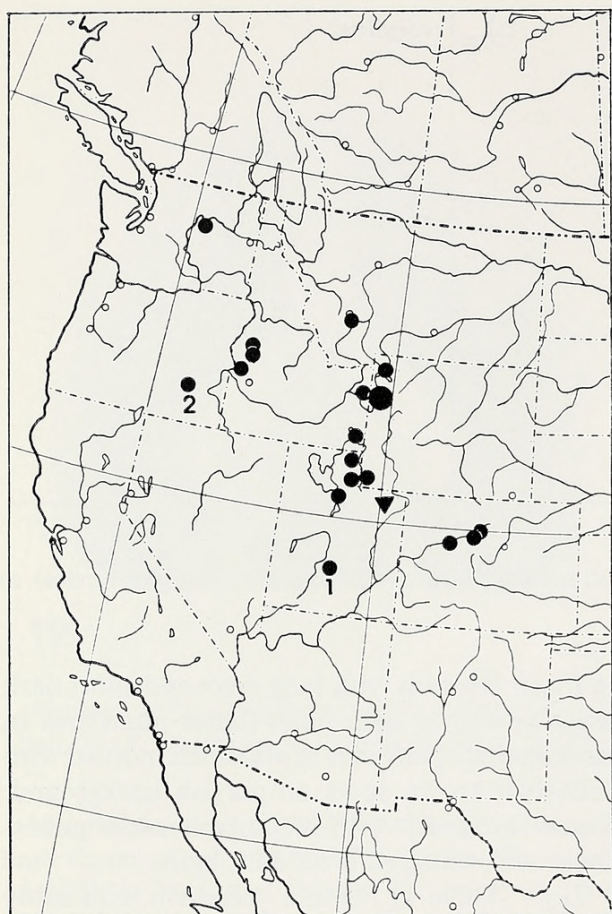


Figure 22.—Collection localities of *Pardosa wasatchensis* Gertsch (circles) and *P. vogelae* sp. n. (triangles). Type localities of *P. wasatchensis* (1) and *P. subra* Chamberlin & Ivie (2). Large circle refers to more than three close localities.

Carapace with more distinct yellowish median and broken lateral bands, latter with whitish hairs. Lanceolate stripe on abdomen more clear yellowish.

**Legs:** (Table 1) Brownish; femora laterally yellowish, at least in distal half, sometimes with traces of darker pseudoannulation; tibia I with no or only distal retrolateral spine.

**Epigyne:** Flask-shaped (Figs. 16, 18; cleared Fig. 20). Narrow indistinct (unsclerotized) septal ridge continuing into very wide septum, evenly rounded posteriorly. Sclerotized rim of lateral elevations characteristically curved (Fig. 18, arrow). Lateral elevations coming close posteriorly, separated by narrow slit. Two deep pockets covered by septum in front of extensive cavity sclerites. Receptacles comparatively narrow (Fig. 20).

**Size variation.**—Carapace lengths of material measured: males 3.25–3.50 mm ( $n = 16$ ), females 3.20–3.80 mm ( $n = 8$ ); tibia I length vs. carapace length in Fig. 21b.

**Material examined.**—UNITED STATES. *Utah*. Daggett County: Uintah Mountains, Spirit Lake, August 1935 (D. Cottam, AMNH), 1♀. Daggett & Uintah Counties: Leidy Peak, 11,500 ft, 5–6 August 1964 (B. R. Vogel & C. Durden, AMNH, BRV, CNC, MCZ, NRS), 16♂ 7♀ (incl. holo- and allotype from 5 August).

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## LITERATURE CITED

- Bonnet, P. 1958. *Bibliographia araneorum*, 2(4). Toulouse.
- Chamberlin, R. V. & W. Ivie. 1942. A hundred new species of American spiders. *Bull. Univ. Utah*, 32(13) (Biol. ser., 7(1)):1–117.
- Dondale, C. D. & J. H. Redner. 1986. The *coloradensis*, *xerampelina*, *lapponica*, and *tesquorum* groups of the genus *Pardosa* (Araneae: Lycosidae) in North America. *Canadian Entomol.*, 118:815–835.
- Dondale, C. D. & J. H. Redner. 1990. The insects and arachnids of Canada. Part 17. The wolf spiders, nurseryweb spiders, and lynx spiders of Canada and Alaska (Araneae: Lycosidae, Pisauridae, and Oxyopidae). *Publ. Dept. Agric. Canada*, 1856:1–383.
- Gertsch, W. J. 1933. New genera and species of North American spiders. *American Mus. Novitates*, 636: 1–28.
- Kronstedt, T. 1975. Studies on species of Holarctic *Pardosa* groups (Araneae, Lycosidae). I. Redescription of *Pardosa albomaculata* Emerton and description of two new species from North America, with comments on some taxonomic characters. *Zool. Scr.*, 4:217–228.
- Kronstedt, T. 1981. Studies on species of Holarctic *Pardosa* groups (Araneae, Lycosidae), II. Redescriptions of *Pardosa modica* (Blackwall), *Pardosa labradorensis* (Thorell), and *Pardosa sinistra* (Thorell). *Bull. American Mus. Nat. Hist.*, 170:111–124.
- Kronstedt, T. 1986. Studies on species of Holarctic *Pardosa* groups (Araneae, Lycosidae). III. Redescriptions of *Pardosa algens* (Kulczyński), *P. septentrionalis* (Westring), and *P. sodalis* Holm. *Entomol. Scandinavica*, 17:215–234.
- Kronstedt, T. 1988. Studies on species of Holarctic *Pardosa* groups (Araneae, Lycosidae). IV. Redescription of *Pardosa tetonensis* Gertsch and descrip-



- tion of two new species from the western United States. Entomol. Scandinavica, 18:409–424.
- Lowrie, D. C. 1973. The microhabitats of western wolf spiders of the genus *Pardosa*. Entomol. News, 84:103–116.
- Lowrie, D. C. & C. D. Dondale. 1981. A revision of the *nigra* group of the genus *Pardosa* in North America (Araneae, Lycosidae). Bull. American Mus. Nat. Hist., 170:125–139.
- Roewer, C. F. 1954. Katalog der Araneae 2a. Bruxelles.

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