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The subterranean asellids of Texas (Crustacea: Isopoda: Asellidae)

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Abstract.—Seven species of subterranean asellids are recognized from Texas. Four are species of *Lirceolus,* including *Caecidotea bisetus* now reassigned to *Lirceolus,* and *Lirceolus hardeni,* n. sp., described from caves and springs in east-central Texas. Previously known only from the type-locality, a new collection site for *Lirceolus pilus* is also reported. Three species of subterranean *Caecidotea* are known from the state. *Caecidotea reddelli* is redescribed and reported from both caves and collection sites that sample phreatic habitats such as wells and seeps. *Caecidotea bilineata,* n. sp., is a phreatobite occurring in non-cave groundwater habitats in northeastern Texas. A troglobitic *Caecidotea* sp. from Border Cave, Culberson County remains undescribed due to insufficient material.

The first subterranean asellid discovered in Texas was obtained from an artesian well drilled at the end of the 19th century for the United States Fish Commission in San Marcos, Texas. Eigenmann (1900) reported this isopod and named it *Caecidotea smithii,* but gave no description, thus creating a nomen nudum. Ulrich (1902) described *Caecidotea smithii* as a new species.

New material of *Caecidotea smithii* became available after the artesian well and fish hatchery at San Marcos was deeded to Southwest Texas State University in 1964, which administered the site as an aquatic station. As the morphology of *C. smithii* was clearly different from other *Caecidotea* species known at the time, the new genus *Lirceolus* was proposed by Bowman & Longley 1976.

Steeves (1968) described three additional new species of asellids collected from Texas caves, *Asellus* (=*Caecidotea*) *bisetus, A. pilus* and *A. reddelli.* Lewis (1983) examined *Caecidotea pilus* and added the species to the genus *Lirceolus* on the basis of its similar male second pleopod, oblique suture of the pleopod 3 exopod, and partial fusion of the rami of pleopods 4 and 5. The morphology of the mouthparts required emendation of the diagnosis of the genus *Lirceolus* to accommodate *C. pilus.*

Two further additions are here made to *Lirceolus, Caecidotea bisetus* (Steeves 1968) and *Lirceolus hardeni,* new species. All *Lirceolus* species are endemic to central Texas, minute in size, and share a certain uniformity of the tip elements of the male second pleopod endopod. We believe *Lirceolus* to have evolved from *Caecidotea,* with *L. bisetus* being the most morphologically similar to *Caecidotea* and *L. smithii* and *L. hardeni* the most divergent. *Caecidotea serrata* (Fleming 1973), a subterranean species known from the Ozark Plateau, shares some morphological characteristics with *Lirceolus.* Specifically, *C. serrata* is minute in size (2 mm), the gnathopod propod lacks palmar processes, the male second pleopod exopod is sparsely setose, and the third pleopod exopod has a rather oblique suture.

Species of *Lirceolus* (and *C. serrata*) are

the smallest asellids known in North America. Their minute size makes them inconspicuous and therefore difficult to collect and dissect. Multiple collections available for study from Barton Springs revealed the syntopy of *L. hardeni* and *L. bisetus*. Considering that ten species of subterranean amphipods have been recovered from the artesian well at San Marcos (Holsinger & Longley 1980), it is not surprising to find syntopy among the isopods, also. Some of these species may be more widespread than is currently realized.

The addition of *Lirceolus hardeni* and *L. bisetus* makes further emendation of the diagnosis of the genus necessary.

Lirceolus Bowman & Longley, 1976

Diagnosis.—Eyeless, unpigmented, length to 4.0 mm. Mandibles with 2–3 or 4–4 cuspate incisors and lacinia mobilis. Maxilla 1, outer lobe with 10 or 13 spines, inner lobe with 4, 5 or 8 plumose setae. Pereopod 1, palmar margin of propodus without processes, dactyl flexer margin without processes. Male pleopod 1 slender, elongate, distal segment oval or subtriangular, with sparse nonplumose setation. Male pleopod 2, exopod with transverse suture, setation sparse or absent, 0–4 setae present along margins; endopod with basal spur and basal apophysis short, blunt, about equal in length. Pleopod 3 exopod with transverse to transverse/oblique suture.

Lirceolus smithii (Ulrich, 1902)
Fig. 11

Caecidotea smithii Eigenmann, 1900:302 (nomen nudem).
Caecidotea smithii Ulrich, 1902:93, plate 16, figs. 10-18.—Banta, 1907:77.—Chappuis, 1927:61.—Van Name, 1936: 472–473.—Jeannel, 1943:261.J—Nicholas, 1960:132.
Caecidotea smithsii Ulrich.—Richardson, 1905:438–439.–Creaser, 1931:6.—Miller, 1933:103.
Conasellus smithii (Ulrich).—Birstein, 1951:53.—Henry & Magniez, 1970.356.—Mitchell & Reddell, 1971.55.
Asellus smithii (Ulrich).—Chase et al. 1959:875.—Reddell, 1965, 158; 1970, 396.—Reddell & Mitchell, 1969.8. Steeves, 1968:183.—Fleming, 1973:294.
Lirceolus smithii (Ulrich).—Bowman & Longley, 1976:489–496.—Lewis, 1983: 145–148.

Description.—*Lirceolus smithii,* the type-species of the genus *Lirceolus,* was redescribed in detail by Bowman & Longley (1976).

Habitat.—This isopod is known only from the groundwaters tapped by the artesian well at San Marcos.

Range.—Known only from the type locality.

Lirceolus hardeni, new species
Figs. 1, 2

Material examined.—Texas: Blanco County: Pedernales Falls Spring, 14 m E. Johnson City, 18 Jun 1976, A. G. Grubbs, 9♂♂, 11♀♀.—Comal County: Knee Deep Cave, Guadalupe River State Park, 19 May 1985, S. J. Harden, C. F. Lindblom, 1♂, 5♀♀; 11 Jul 1986, S. J. Harden, 3♂♂; 9 Aug 1984, S. J. Harden, C. T. McAllister, 1♂, 2♀♀;—Travis County: Barton Springs (Cliff Spring), 14 Jul 1987, A. Spinelli, 4♂♂, 4♀♀; Barton Springs (Concession Spring), 7 Jul 1982, A. Spinelli, 1♂; 8 Jul 1982, A. Spinelli, 1♂; 9 Jul 1982, A. Spinelli, 1♂; 14 Jul 1983, A. Spinelli, 1♂, 12♀♀; 19 Jul 1982, D. Pate, W. Russell, 3♂♂; Barton Springs (Chair Spring), 30 Jun 1982, A. Spinelli, 2♂♂; 8 Jul 1982, A. Spinelli, 1♂, 1♀ (fragment); 14 Jul 1982, A. Spinelli, 1♂; Spicewood Springs, 7 Jun 1986, D. Pate, 2♂♂, 14 Jun 1986, D. Pate, 3♂♂, 4♀♀.

A 2.2 millimeter ♂ from Knee Deep Cave, 9 Aug 1984 is the holotype (USNM 259984), 2 ♀♀ from Knee Deep Cave, 9 Aug 1984 (USNM 259985), 3 ♂♂ from Knee Deep Cave 11 Jul 1986 (USNM 259986), and 2 specimens from Pedernales

Falls Spring (USNM 259987) are designated as paratypes.

Description.—Longest ♂ 2.2mm, longest ♀ 2mm (ovigerous); body slender, linear, about 5× as long as wide, head about 1.5× as wide as long. Antenna 1 extending only to midlength of 4th peduncular segment of antenna 2, flagellum of about 5 segments, aesthete formula 2-0. Antenna 2, flagellum quite short, of about 12-18 segments. Mandible with 4-cuspate incisors and lacinia mobilis, palp with very sparse plumose setae on distal segments. Maxilla 1, inner lobe with 4 plumose setae, outer lobe with 13 stout spines. Maxilliped with 2–13 retinacula.

Coxae visible in dorsal view. Male pereopod 1, palmar margin of propus slightly concave, slender proximal spine present; propus about 2.2× as long as wide in male and female, sexual dimorphism not apparent. Pereopod 4 sexual dimorphism apparent, carpus of male about 2.1× as long as wide, 2.5× in female.

Pleotelson about 1.4× as long as wide, caudomedial lobe not pronounced. Pleopod 1 longer than pleopod 2, protopod with 2 retinacula; exopod oval, about 1.6× length of protopod, distal margin broadly rounded, with sparse non-plumose setae. Pleopod 2, exopod proximal segment with single lateral seta, distal segment with 4 long setae; endopod, basal spur prominent, longer than knob-like basal apophysis, tip with digitiform cannula directed distolaterally, other processes absent. Pleopod 3 exopod with transverse suture, sparse setae on distal margin. Pleopod 4 exopod with weak transverse suture, proximolateral setules present, setae absent. Pleopod 5 apparently lacking sutures. Uropods about 0.5× length of pleotelson in male and female, sexual dimorphism not pronounced.

Etymology.—Named in honor of Mr. Scott Harden, the collector of this unusual species.

Habitat.—*Lirceolus hardeni* has been collected from cave streams and springs. Harden reported (pers. comm.) the stream temperature in Knee Deep Cave to be approximately 20°C. The isopods were taken from the undersides of stones starting about 60 meters from the entrance.

Range.—This species is known only from the karst area associated with the Balcones Fault Zone of central Texas.

Relationships.—*Lirceolus hardeni* is closely related to *L. smithii* and *L. bisetus.* The male second pleopod endopod tip is very similar in these species, consisting of a knob-like distolaterally projecting cannula. The first pleopod exopod is oval in both species and sparsely setose. Similarly, the gnathopods of each are similar in lacking processes along the palmar margin of the propus. Both *Lirceolus smithii* and *L. hardeni* have identical 2-0 aesthete formulas of the first antenna flagellum. In *L. bisetus* the aesthete formula is 3-0. The species of *Lirceolus* may be separated by the characters found in Table 1.

The presence of only four setae on the inner lobe of maxilla 1 was a surprising find, since other *Lirceolus* possess five or eight (*L. smithii*). All populations of *Lirceolus hardeni* examined were found to have only four setae.

Lirceolus bisetus (Steeves, 1968)
Figs. 3, 4

Asellus bisetus Steeves, 1968:183–185.—Reddell & Mitchell, 1969:7, 43.—Fleming, 1973:295, 300.

Conasellus bisetus (Steeves).—Henry & Magniez, 1970:356.—Mitchell & Reddell, 1971:54–55.

Caecidotea bisetus (Steeves).—Lewis, 1983:145.

Material examined.—Texas: San Saba County: Gorman Cave, 6 miles southwest of Bend, 15 Mar 1963, J. R. Reddell, 2♂♂, 6♀♀; 14 Sep 1985, 14♂♀. Travis County: Barton Springs (Concession Spring), 12 Jul 1982, A. Spinelli, 5♂♂, 5♀♀; 14 Jul 1982, A. Spinelli, 1♂; 8 Aug 1984, R. Herschler, 2♂♂, 25♀♀.

Description.—Longest ♂ 3.25mm, ♀

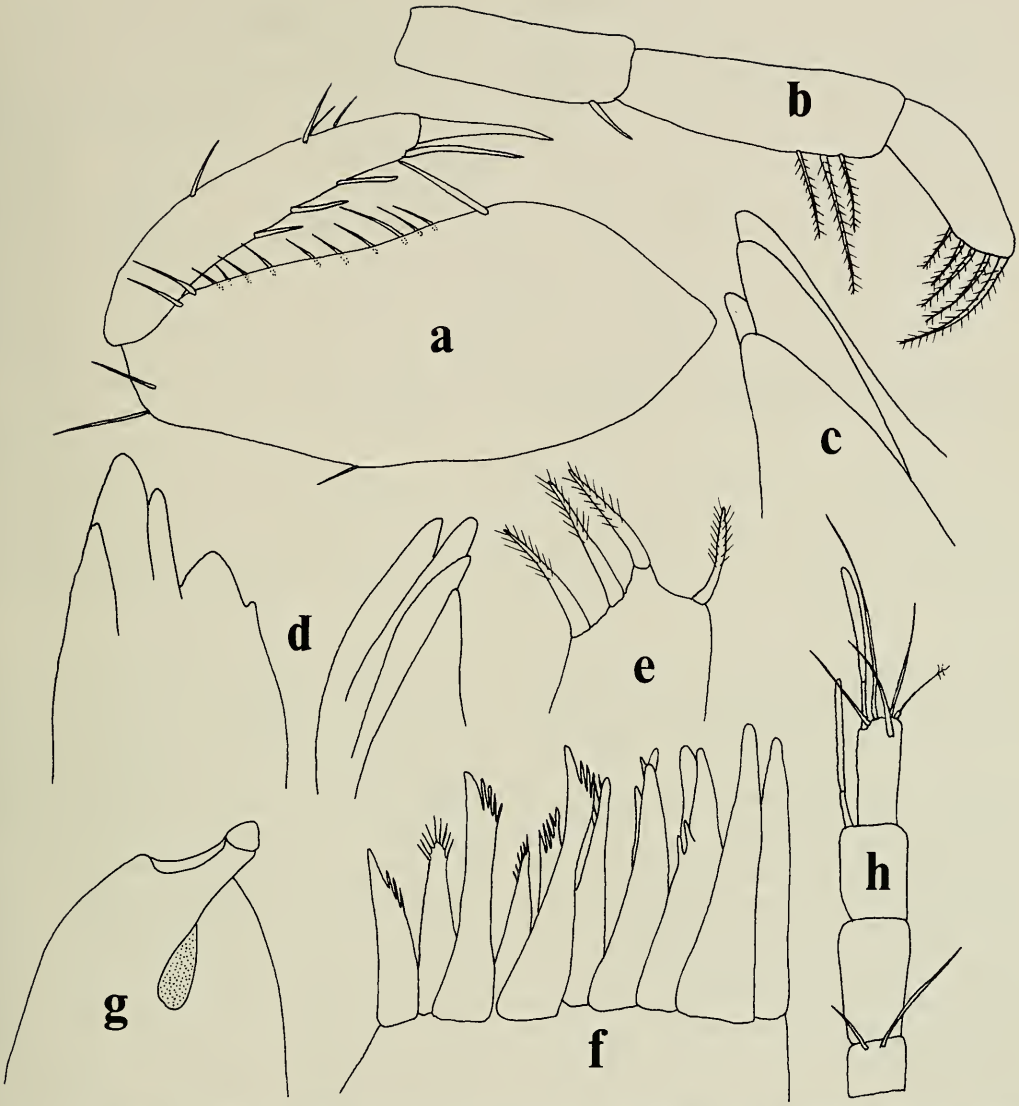

Fig. 1. *Lirceolus hardeni,* Pedernales Falls Spring, Blanco Co.: a, Pereopod 1; b, Mandibular palp; c, Incisor, right mandible; d, Incisor and lacinia mobilis, left mandible; e, Maxilla 1, inner lobe; f, Maxilla 1, outer lobe; g, Pleopod 2, endopod tip; h, Antenna 1, apical segments.

4.0mm, body slender, linear, about 4× as long as wide. Antenna 1, flagellum to about 6 segments, aesthete formula 3-0. Antenna 2 broken in all types. Mandibles with 4 cuspate incisors and lacinia mobilis, palp with plumose setae on distal segments. Maxilla 1, inner lobe with 5 plumose setae, outer lobe with 13 stout spines.

Coxae of pereopods visible in dorsal view. Pereopod 1, female propus about 3.5× as long as wide, lacking processes and proximal spine. Pereopod 4 missing in all types.

Pleotelson about 1.2× as long as wide, sides subparallel, caudomedial lobe not produced. Pleopod 1 longer than pleopod 2, protopod with 2–4 retinacula, exopod ovate, with short non-plumose setae on dis-

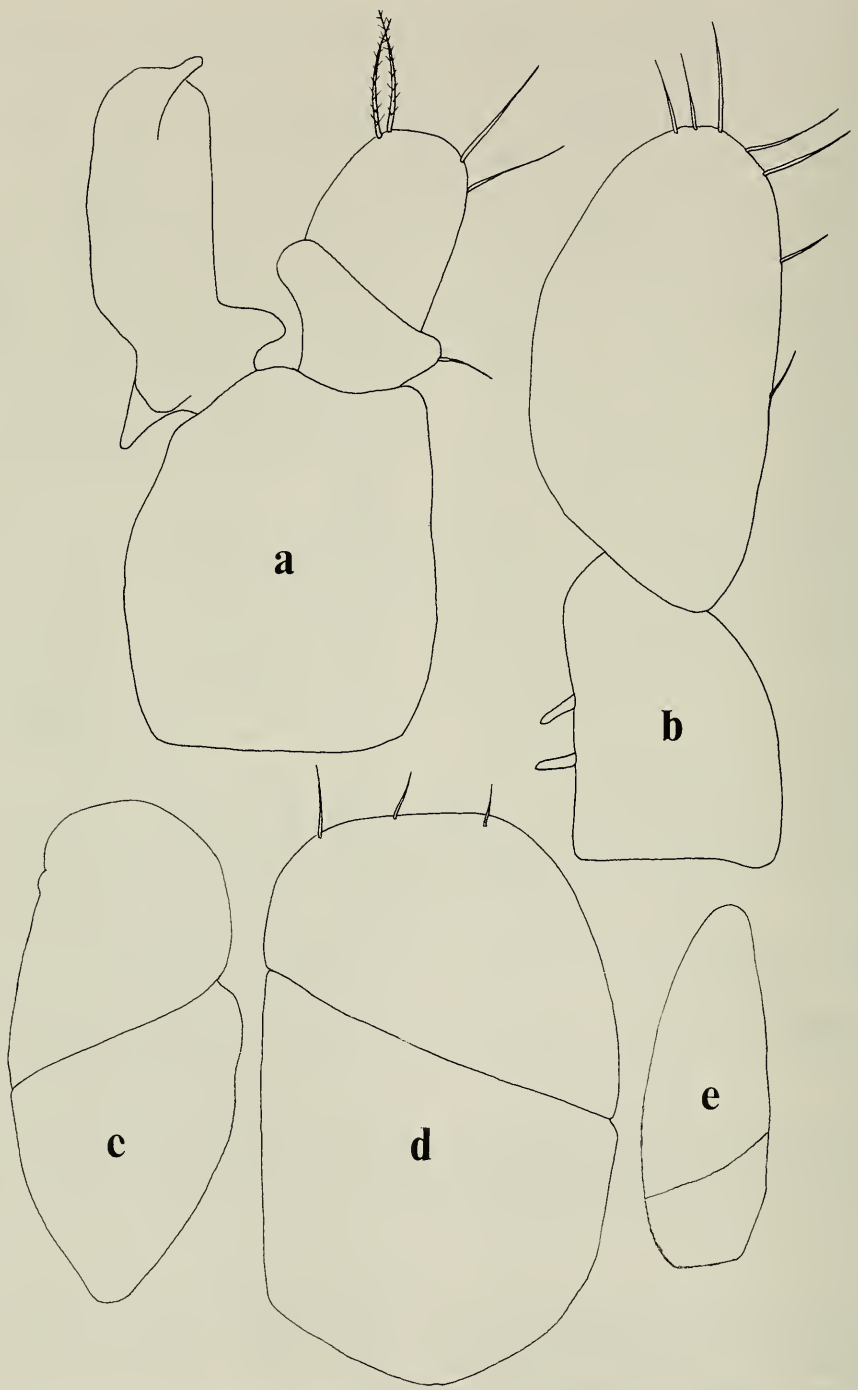

Fig. 2. *Lirceolus hardeni,* Pedernales Falls Spring, Blanco Co.: a, Pleopod 2; b, Pleopod 1; c, Pleopod 4; d, Pleopod 3; e, Pleopod 5.

Table 1.—Comparison of selected male morphology of *Lirceolus* species.

	bisetus	*pilus*	*hardeni*	*smithii*
Habitus, maximum length	4.0 mm	3.0 mm	2.2 mm	3.7 mm
Mandibles, incisors/lacinia cusps	4-4	4-4	4-4	2-3
Maxilla 1				
outer lobe spines	13	13	13	10
inner lobe plumose setae	5	5	4	8
Pleopod 1	oval	oval	oval	oval
Pleopod 2				
exopod setae	2–3	1	4	0
endopod cannula	disto-laterally extended knob	disto-laterally extended knob*	disto-laterally extended knob	disto-laterally extended knob
Pleopod 3				
exopod suture	transverse	oblique	oblique	oblique
Pleopod 4				
exopod sutures	2	1	1	membranous

* without cover slip (see text).

tal and distolateral margins. Pleopod 2, exopod proximal segment with 0-1 lateral setae, distal segment with 2–3 elongate setae. Endopod, basal spur and basal apophysis about equal in length, tip with single digitiform process, the cannula, extending somewhat obliquely across axis of endopod. Pleopod 3 exopod with transverse suture, 3 non-plumose setae on distal margin. Pleopod 4 with 2 sutures. Pleopod 5 with single suture. Uropod elongate, endopod about 1.3× as long as protopod, exopod about 0.67× length of endopod.

Etymology.—Steeves (1968) attributed the name of this species to the presence of 2 setae on the distal segment of the pleopod 2 exopod; *bisetus* is from the Latin bi = 2, and seta = hair. This is in at least some cases a misnomer; the male paratype examined had 3 setae.

Habitat.—Steeves (1968) reported that the type-series was collected from a small pool about 245 meters from the entrance of Gorman Cave.

Range.—Lirceolus bisetus was previously known only from the type-locality, Gorman Cave, in the Ellenburger karst area. A map and description of Gorman Cave was presented by Fieseler et al. (1978). This species is now known to co-occur with *L. hardeni* at Barton Springs, in Travis County.

Relationships.—The specimens available to Steeves for description were depauperate. He apparently misinterpreted the structure of the male second pleopod endopod tip. It was believed that the fingerlike projection of the endopod tip was the mesial process; it is interpreted here as the cannula, homologous to that of *Lirceolus smithii* and *Lirceolus hardeni.* There is an unusual sclerotized, triangular projection on the posterior side of the endopod that is hidden by the cannula except at high (1000×) magnification. This may be the structure that Steeves believed to be the cannula.

Lirceolus bisetus is most closely related to *L. smithii* and *L. hardeni* all of which share the following characteristics: (1) antenna 1 with consecutive aesthetes on the distal 2–3 segments; (2) pleopod 1 exopod oval, with sparse non-plumose setae along the apical margin; (3) pleopod 2 exopod distal segment sparsely setose, with only 0–3 setae present; (4) pleopod 2 endopod tips nearly identical in all three species, with the

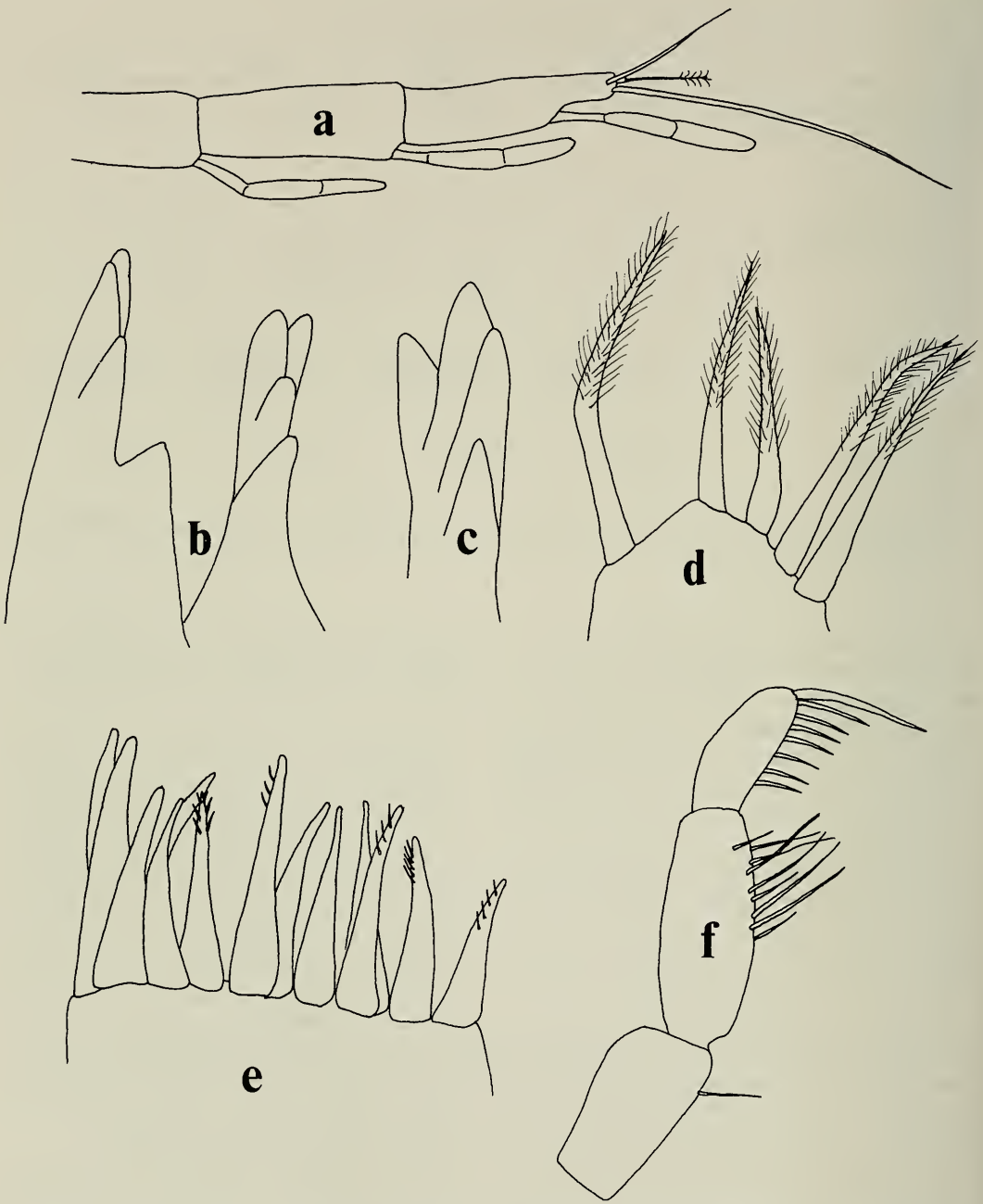

Fig. 3. *Lirceolus bisetus,* Gorman Cave, San Saba Co.: a, Antenna 1, apical segments; b, Incisor and lacinia mobilis, left mandible; c, Incisor, right mandible; d, Maxilla 1, inner lobe; e, Maxilla 1, outer lobe; f, Mandibular palp.

cannula somewhat more elongate in *L. bisetus.*

Lirceolus bisetus can be separated from *L. smithii* or *L. hardeni* by the number of setae on the inner lobe of maxilla 1: four in *Lirceolus hardeni,* five in *Lirceolus bisetus,* and eight in *L. smithii.* The male second pleopod endopod tip of all three species

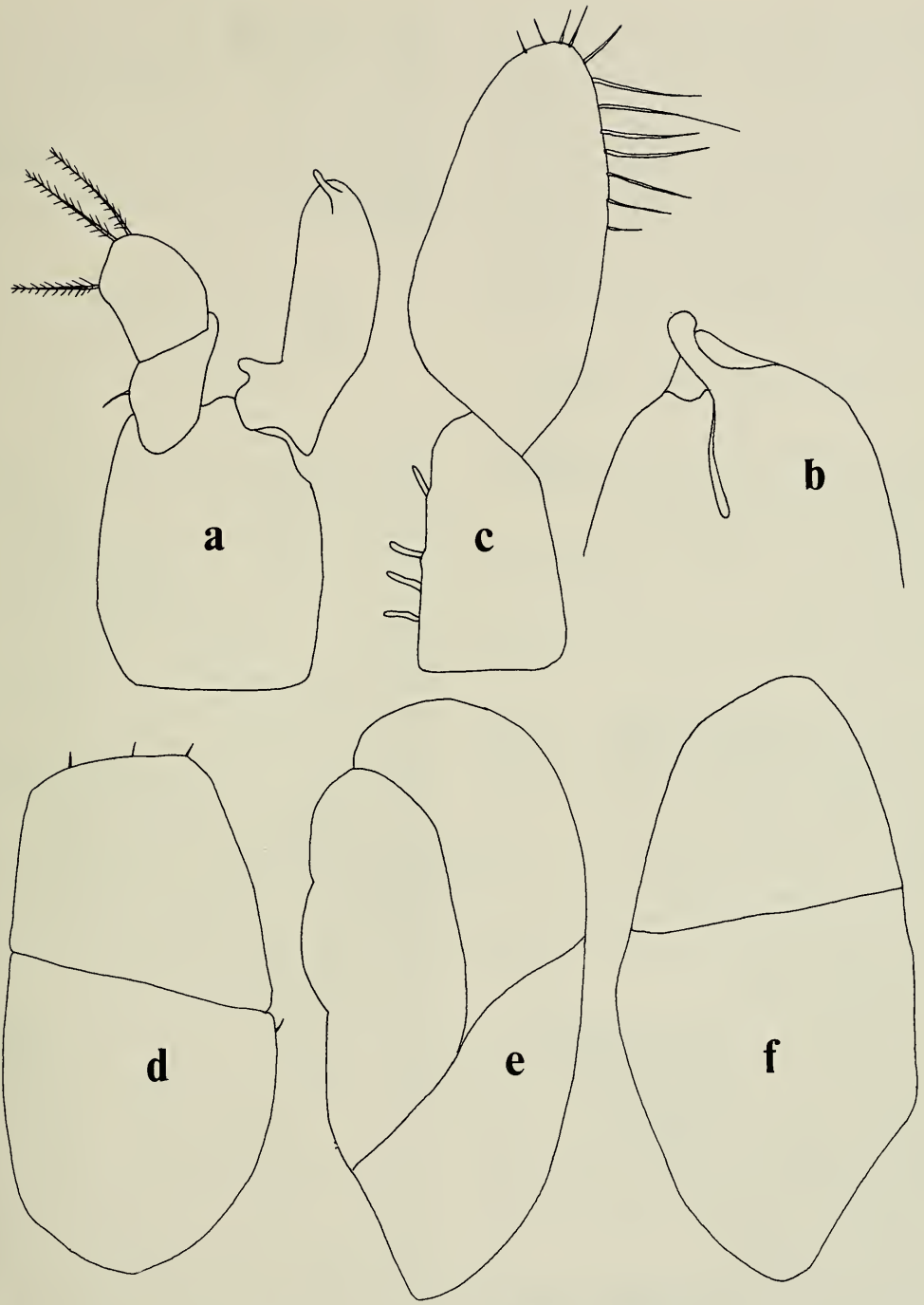

Fig. 4. *Lirceolus bisetus,* Gorman Cave, San Saba Co.: a, Pleopod 2; b, Pleopod 2, endopod tip; c, Pleopod 1; d, Pleopod 3; e, Pleopod 4; f, Pleopod 5.

possesses a cannula consisting of a knob-like process. The caudal process of *L. bisetus* is produced as a subtriangular extension of the endopod, while in *L. hardeni* and *L. smithii* it is more broadly rounded. In *L. bisetus,* pleopod 3 exopod has a transverse suture, while this suture is oblique in *L. smithii* and *L. hardeni.* The fourth pleopod exopod has two sutures in *L. bisetus,* one suture in *L. hardeni,* and is membranous without distinct sutures in *L. smithii.*

Lirceolus pilus (Steeves, 1968)
Figs. 5, 6

Asellus pilus Steeves, 1968:188. Reddell & Mitchell, 1969:8. Reddell, 1970: 396.—Fleming, 1973:295, 297.

Conasellus pilus (Steeves).—Henry & Magniez, 1970:356.—Mitchell & Reddell, 1971:55.

Lirceolus pilus (Steeves).—Lewis, 1983: 145–148.

Material examined.—Texas: Bandera County: Lost Maples State Park, Jun 1986, S. J. Harden, 1♂♂, 2♀♀; Medina County: Valdina Farms Sinkhole, 15 miles north Sabinal, 12 Jan 1963, J. Reddell, D. McKenzie, J. Porter, holotype ♂ (USNM 119593), allotype ♀ (USNM 119594), 1♂, 1♀ paratypes (USNM 119595); same locality, 20 Mar 1971, J. Reddell, S. Wylie, T. Mollhagen, 2♂♂.

Description.—The illustrations of the male pleopod 2 endopod tip by Steeves (1968) and Lewis (1983) show the cannula as a decurved, beak-like process. This is the appearance of the cannula when viewed under the weight of a coverslip. When viewed floating in glycerin the cannula has more of a knob-like appearance, similar to other species of *Lirceolus.*

Distribution.—*Lirceolus pilus* is known from two localities associated with the Balcones Fault Zone. The species was previously known only from the type-locality in Medina County.

Habitat.—Harden (in litt.) reported that the isopods occurred in Valdina Farms Sinkhole at the junction of two streams. They were found in an area of clay substrate on or near rotten wood. The four specimens used by Steeves (1968) for his description were apparently taken from gravel in the same area. A map of Valdina Farms Sinkhole is given by Fieseler et al. (1978).

Caecidotea Packard, 1871
Species Group uncertain
Caecidotea bilineata, new species
Figs. 7, 8, 11

Material examined.—Texas: Bell Co., Tahuaya Springs, Camp Tahuaya, 14 Jun 1985, Mark Mauldin, ♂♂♀♀; same locality/collector 24 Jun 1985, 1♀; 26 Jun 1985, 4♀♀; 3 Jul 1985, 1♂, 5 Jul 1985, 1♀; 8 Jul 1985 2♀♀; 12 Jul 1985, 1♂; 15 Jul 1985, 1♀; 18 Jul 1985, 1♀; 24 Jul 1985, 1♀; Dallas Co., Chinkapin Spring, 15 Aug 1975, A. G. Grubbs, 4♂♂, 14♀♀; same locality/collector, 2 Jun 1976, 1♂, 1♀; Max's Well, 1 m E. Rowlett, 24 May 1975, A. G. Grubbs, 8♂♂, 2♀♀; Salix Spring, Garland, 5 Jun 1976, A. G. Grubbs, 7♂♂, 5♀♀. Type material from Tahuaya Springs consists of the holotype ♂ (USNM 264052), dissected ♂♀ paratypes (USNM 264053), and 4♀ paratypes (USNM 264054), deposited in the National Museum of Natural History, Smithsonian Institution.

Description.—Eyeless, unpigmented, longest ♂ 7.5mm, ♀ 6.5mm; body slender, linear, about 4.5× as long as wide. Head about 1.6× as wide as long. Antenna 1 reaching to midlength of last segment of peduncle of antenna 2, flagellum with up to 6 segments, aesthete formula 3-0. Antenna 2 flagellum to about 44 segments. Mandible with 4-cuspate incisors and lacinia mobilis, palp with dense rows of plumose setae on distal segments. Maxilla 1, inner lobe with 5 plumose setae, outer lobe with 13 stout spines. Maxilliped with 5–6 retinacula.

Coxae visible in dorsal view. Male pereopod 1, palmar margin of propus lacking processes, 2 small proximal spines present;

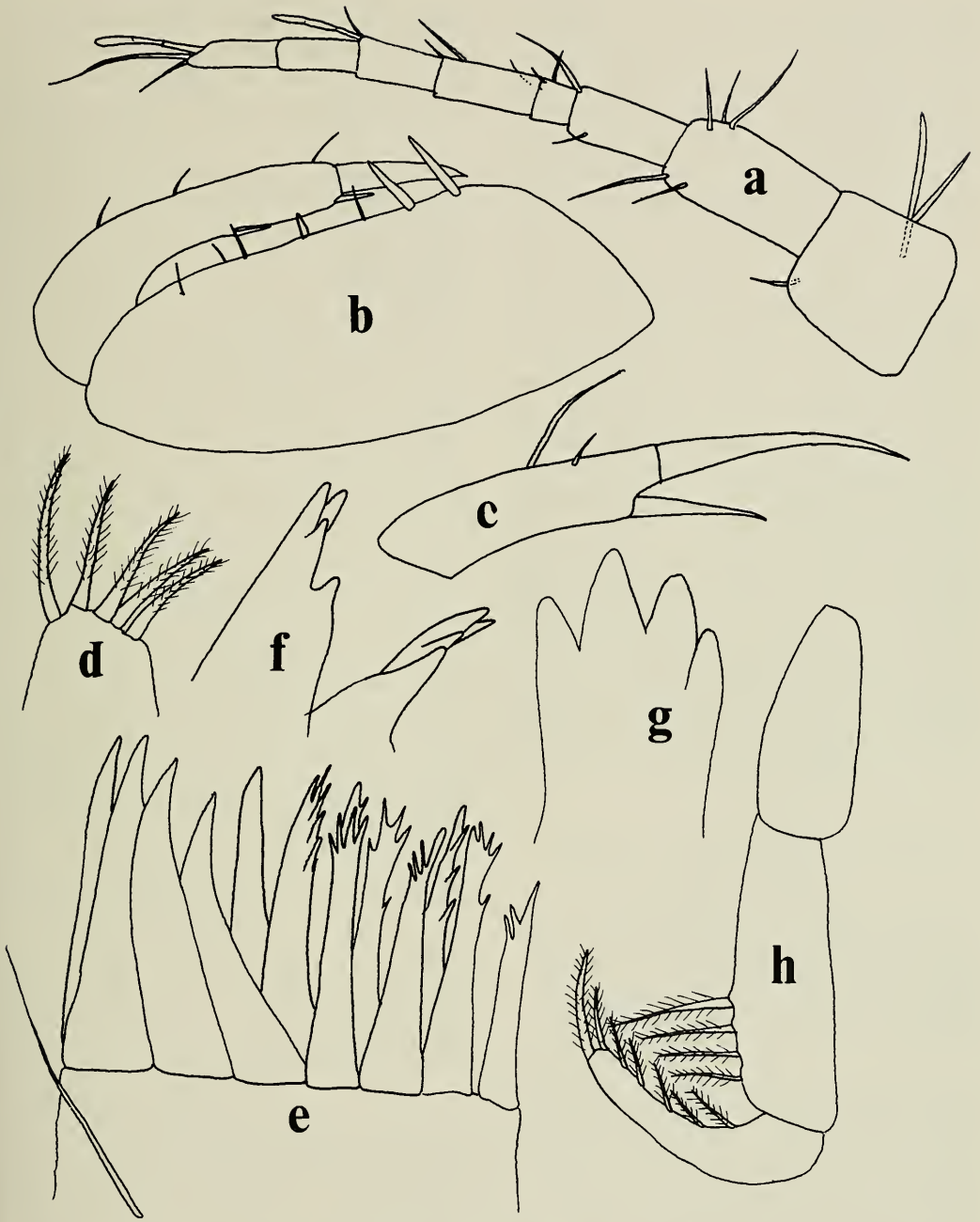

Fig. 5. *Lirceolus pilus,* Valdina Farms Sinkhole, Medina Co.: a, Antenna 1; b, Pereopod 1; c, Pereopod 4, dactyl; d, Maxilla 1, inner lobe; e, Maxilla 1, outer lobe; f, Incisor and lacinia mobilis, left mandible; g, Incisor, right mandible; h, Mandibular palp.

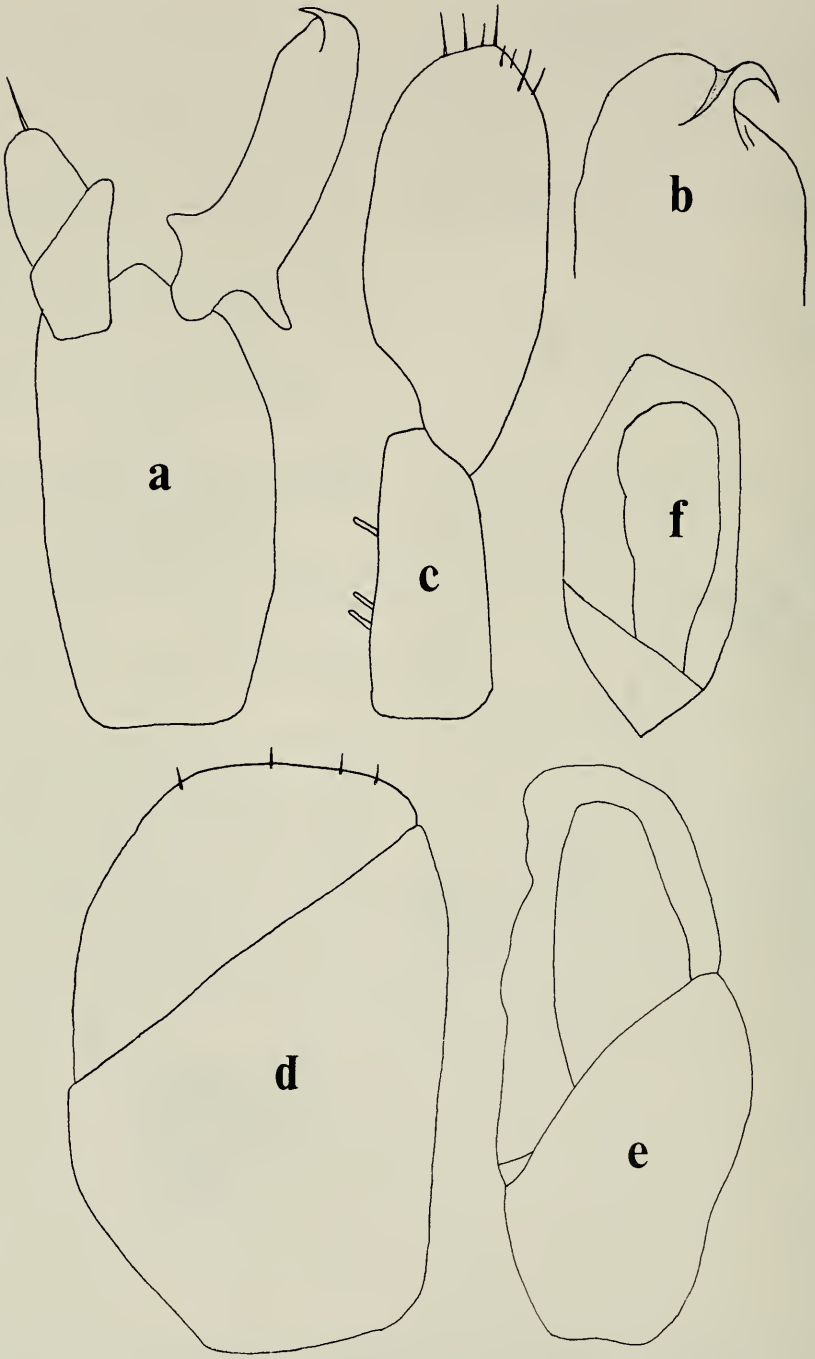

Fig. 6. *Lirceolus pilus,* Valdina Farms Sinkhole, Medina Co.: a, Pleopod 2; b, Pleopod 2, endopod tip; c, Pleopod 1; d, Pleopod 3; e, Pleopod 4; f, Pleopod 5.

propus about 1.9× as long as wide in male and female, sexual dimorphism not apparent. Pereopod 4, carpus of male about 2.7× as long as wide, 3.1× in female, sexual dimorphism slight.

Pleotelson about 1.4× as long as wide, sides subparallel, caudomedial lobe poorly produced. Pleopod 1 longer than pleopod 2, protopod with 7 retinacula, exopod about 1.3× length of protopod, subrectangular, lateral margin slightly concave, about 14 non-plumose setae along distal and distolateral margins. Pleopod 2 exopod, proximal segment with 4 lateral setae (2 of them plumose) and 1 long mesial seta, distal segment with about 17 very long plumose marginal setae. Endopod with pronounced basal apophysis, tip with 4 processes: (1) mesial process subrectangular; (2) lateral process anvil-shaped, produced laterally; (3) cannula conical, base obscured by other processes; and (4) caudal process broadly rounded, extending beyond cannula. Pleopod 3 exopod with transverse suture, distal margin with about 6 long plumose setae. Pleopod 4 exopod with 2 sutures, proximolateral setae present in some specimens. Pleopod 5 exopod with single transverse suture. Uropods quite short, about 0.4× length of pleotelson, endopod and exopod of about equal length.

Etymology.—The name of this species refers to the two suture lines of the fourth pleopod exopod, bi = two, lineata = lines. As first noted by Lewis and Bowman (1981), this morphology is found in many phreatobitic *Caecidotea.*

Habitat.—*Caecidotea bilineata* is known only from non-cave groundwater habitats in deposits of Cretaceous age. It is presumably a phreatobite.

Range.—The range of this species spans about 200 kilometers in northeastern Texas.

Relationships.—The species group assignment of this species is uncertain. *Caecidotea bilineata* shares the following characteristics with the Hobbsi Group: (1) pleopod 1 exopod subrectangular, laterally concave, single seta within proximomesial margin; (2) pleopod 2 exopod distal segment with long plumose setae; (3) pleopod 2 endopod with pronounced basal apophysis; (4) cannula conical, obscured by three other processes; (5) pleopod 3 exopod distal margin with long plumose setae present; (6) pleopod 4 exopod with two sutures, similar to other phreatobitic species of the group.

Caecidotea bilineata is unlike other species of the Hobbsi Group in the lack of both gnathopod processes and long plumose setae on the distal margin of the exopod of the first pleopod. The structure of the gnathopod (the elongate shape and lack of processes along the palmar margin of the propus) is similar to those found in species of the *Lirceolus* or the *Caecidotea* Cannula Group. The very short, cylindrical uropods with equidistant rami are also unusual among subterranean *Caecidotea.* This characteristic is not only interesting, but useful, in that it can be used to quickly separate *Caecidotea bilineata* from *C. reddelli* (which has long, spatulate uropods) in populations where both are present.

Hobbsi Group

Caecidotea reddelli (Steeves, 1968)

Figs. 9, 10, 11

Asellus reddelli Steeves, 1968:185–188.—Reddell & Mitchell, 1969:8.—Reddell, 1970:396.—Elliott & Mitchell, 1973: 171, 178, 181–182, 185, 187.—Fleming, 1973:295, 300.

Conasellus reddelli (Steeves).—Henry & Magniez, 1970:356.—Mitchell & Reddell, 1971:55.

Caecidotea reddelli (Steeves).—Lewis, 1983:145.

Material examined.—Texas: Bell County: Nolan Creek Cave, 4 Oct 1964, D. McKenzie, 4♂♂, 4♀♀; 27 Jan 1990, J. Reddell, M. Reyes, 1♂, 2♀♀; Critchfield Springs, Salada, 8 Jul 1985, M. Maulden, 1♂. Coryell County: Tippitt Cave, 4 Oct 1964, D. McKenzie, 5♂♂, 4♀♀. Dallas County: seeps along Turtle Creek, Dallas,

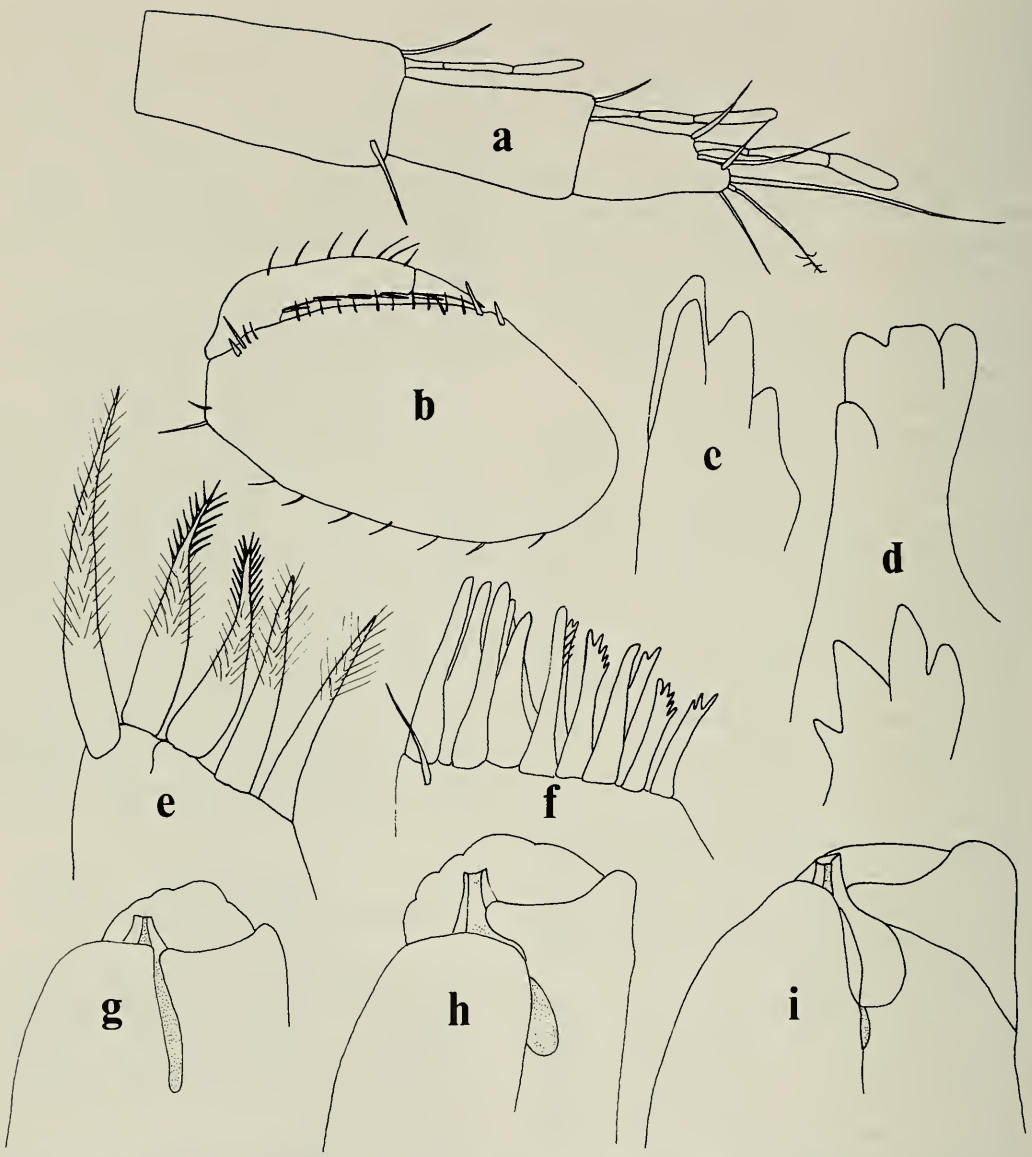

Fig. 7. *Caecidotea bilineata,* a–f, i, Max's Well, Dallas Co.; g, Chinkapin Spring, Dallas Co.; h, Salix Spring, Dallas Co.: a, Antenna 1, apical segments; b, Pereopod 1; c, Incisor, right mandible; d, Incisor and lacinia mobilis, left mandible; e, Maxilla 1, inner lobe; f, Maxilla 1, outer lobe; g, Pleopod 2, endopod tip; h, Pleopod 2, endopod tip; i, Pleopod 2, endopod tip.

15 Feb 1945, Leslie Hubricht, 79♂♀; well water, Dallas, 9 Jun 1920, F. C. Bishop, 1♂, 3♀♀; seeps, 15 miles northwest of Cedar Hill, 29 Feb 1948, Leslie Hubricht, 94♂♀; Salix Spring, Garland, 5 Jun 1976, A. G. Grubbs, 1♂; Henderson County: seep on east bank of Trinity River, above Texas 31 bridge, northeast of Trinidad, 1 Jul 1955, Leslie Hubricht, 51♂♀; Travis County: Armadillo Ranch Sink, 23 Sep 1990, J. Reddell, M. Reyes, C. Sexton, 2♂♂; Kretschnarr Salamander Cave, 6 Apr 1986, J. Reddell, M. Reyes, 2♂♂; 1♀; 21 Apr 1984, J. Reddell, M. Reyes, 8♂♂, 1♀; 4 Jul 1986,

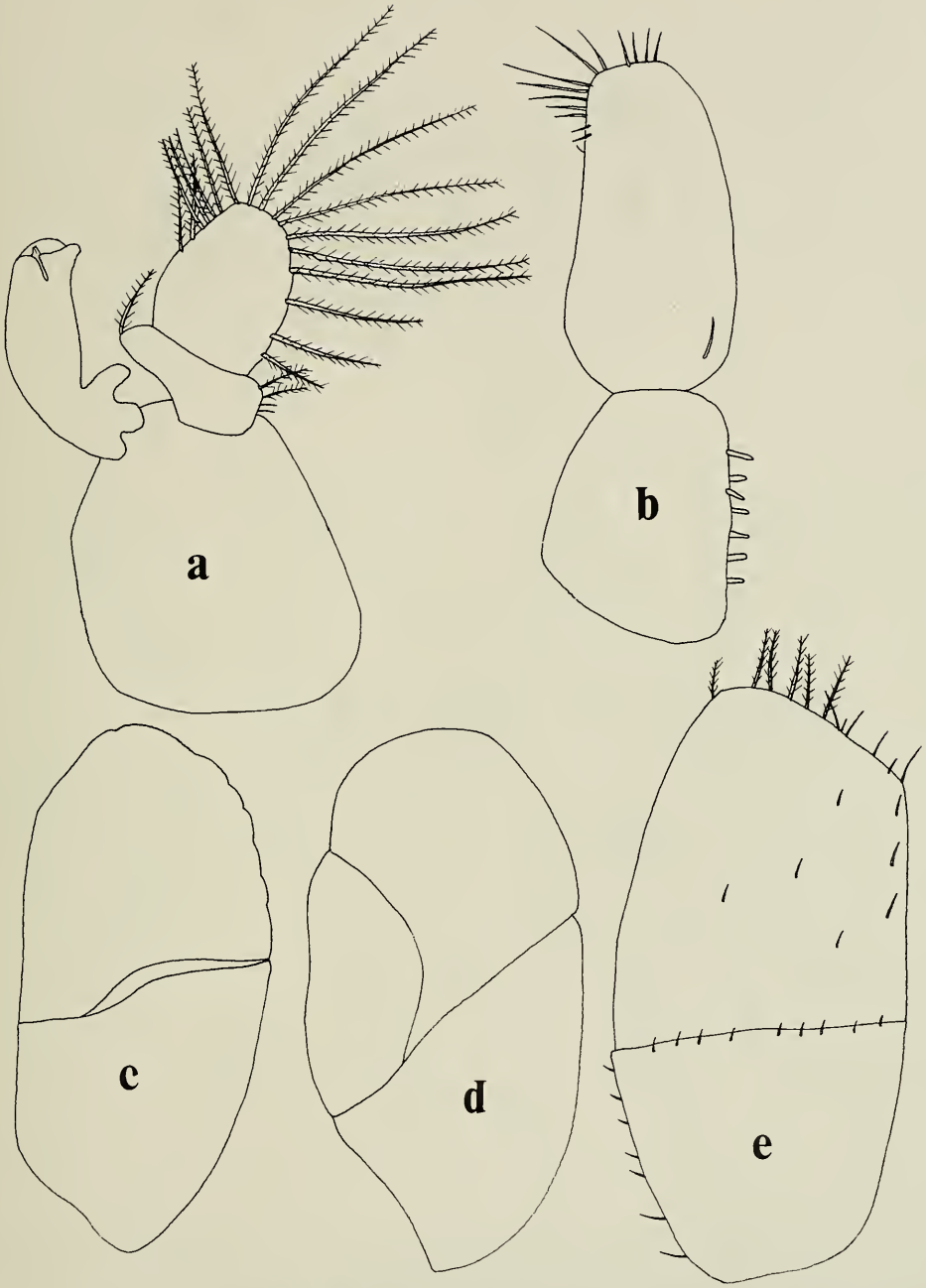

Fig. 8. *Caecidotea bilineata,* Max's Well, Dallas Co.: a, Pleopod 2; b, Pleopod 1; c, Pleopod 5; d, Pleopod 4; e, Pleopod 3.

D. Pate, W. Russell, E. Heinen, M. Standifer 8♂♂, 6♀♀, +juveniles; Buda Boulder Springs, 6 Jun 1975, A. G. Grubbs, 1♂; same locality and collector, 6 Jun 1975, 8♂♂; Spanish Wells Cave, 9 Jun 1967, R. Mitchell, 5♂♂, 5♀♀.

Distribution.—Steeves (1968) gave locations for this species for caves in Wil-

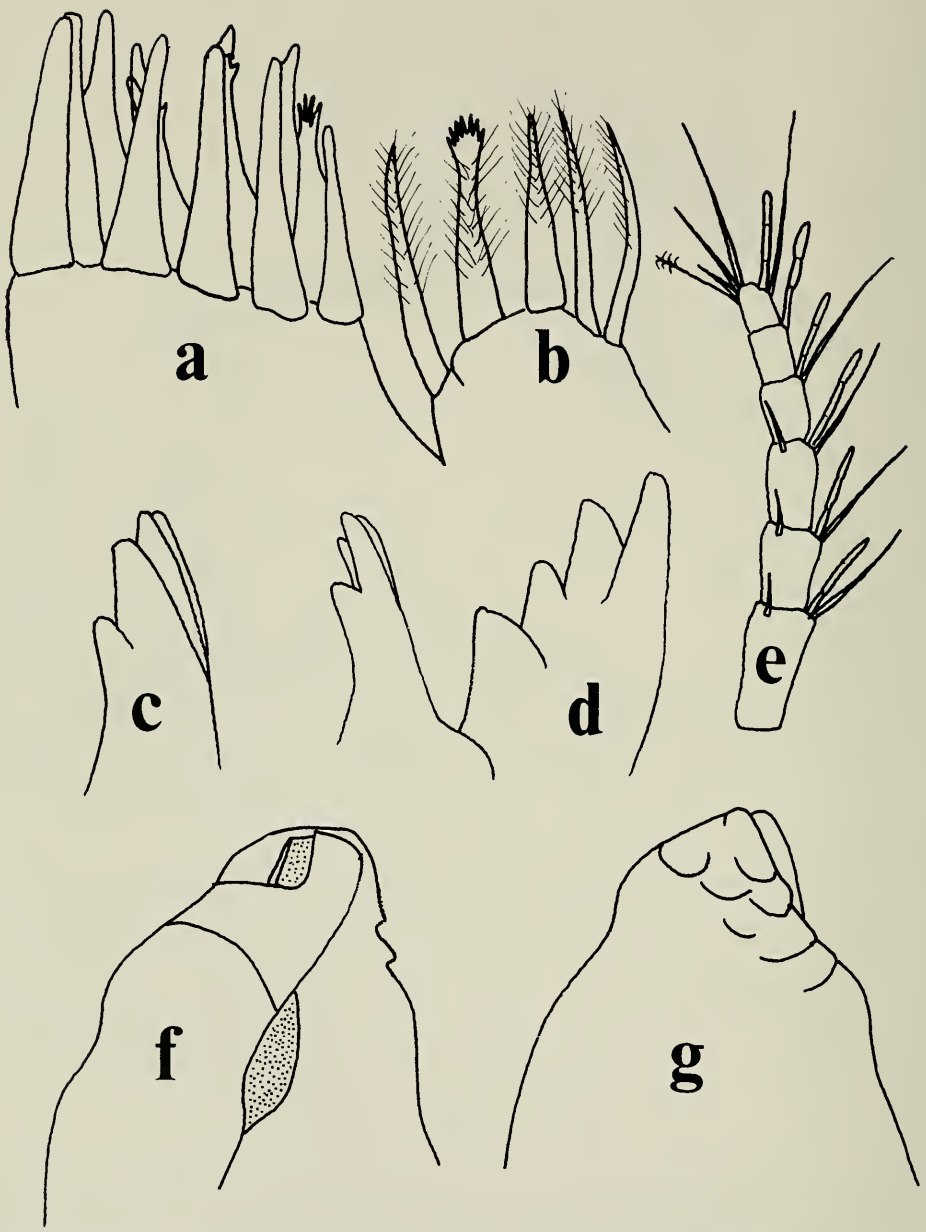

Fig. 9. *Caecidotea reddelli,* Kretschnarr Salamander Cave, Travis Co.: a, Maxilla 1, outer lobe; b, Maxilla 1, inner lobe; c, Incisor, right mandible; d, Incisor and lacinia mobilis, left mandible; e, Antenna 1, apical segments; f, Pleopod 2, endopod tip, anterior; g, Pleopod 2, endopod tip, posterior.

liamson, Travis, Coryell and Bell counties, Texas. Mitchell & Reddell (1971) showed an additional locality in Hays County in the distribution map in their paper. Overall, *C. reddelli* is known from both the North Balcones Fault Zone and the adjacent part of the Gulf Coastal Plain Province directly to the northeast in Dallas and Henderson counties.

Habitat.—Steeves (1968) reported that *Caecidotea reddelli* was taken from small cave streams or pools, typically on gravel

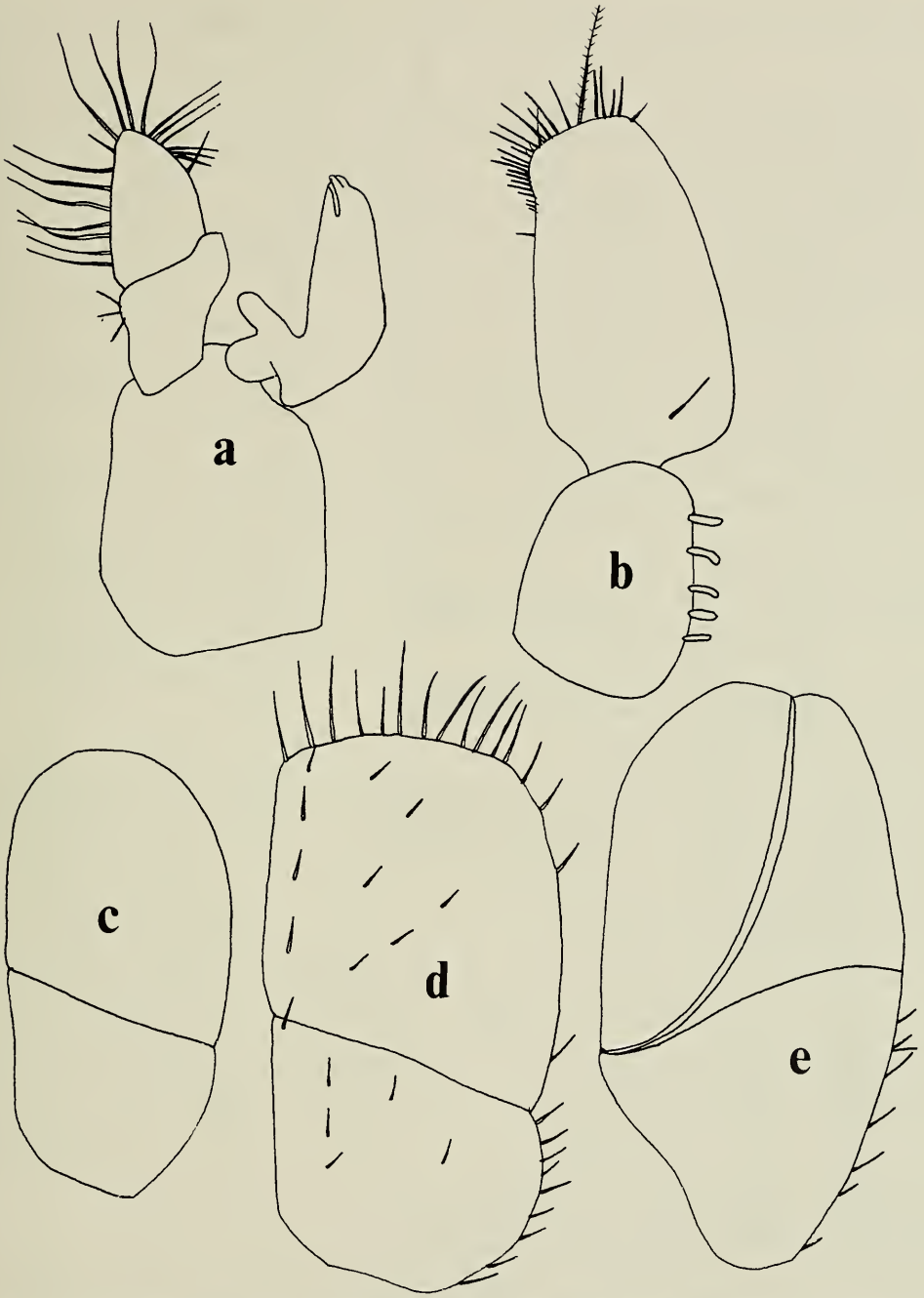

Fig. 10. *Caecidotea reddelli,* Kretschnarr Salamander Cave, Travis Co.: a, Pleopod 2; b, Pleopod 1; c, Pleopod 5; d, Pleopod 3; e, Pleopod 4.

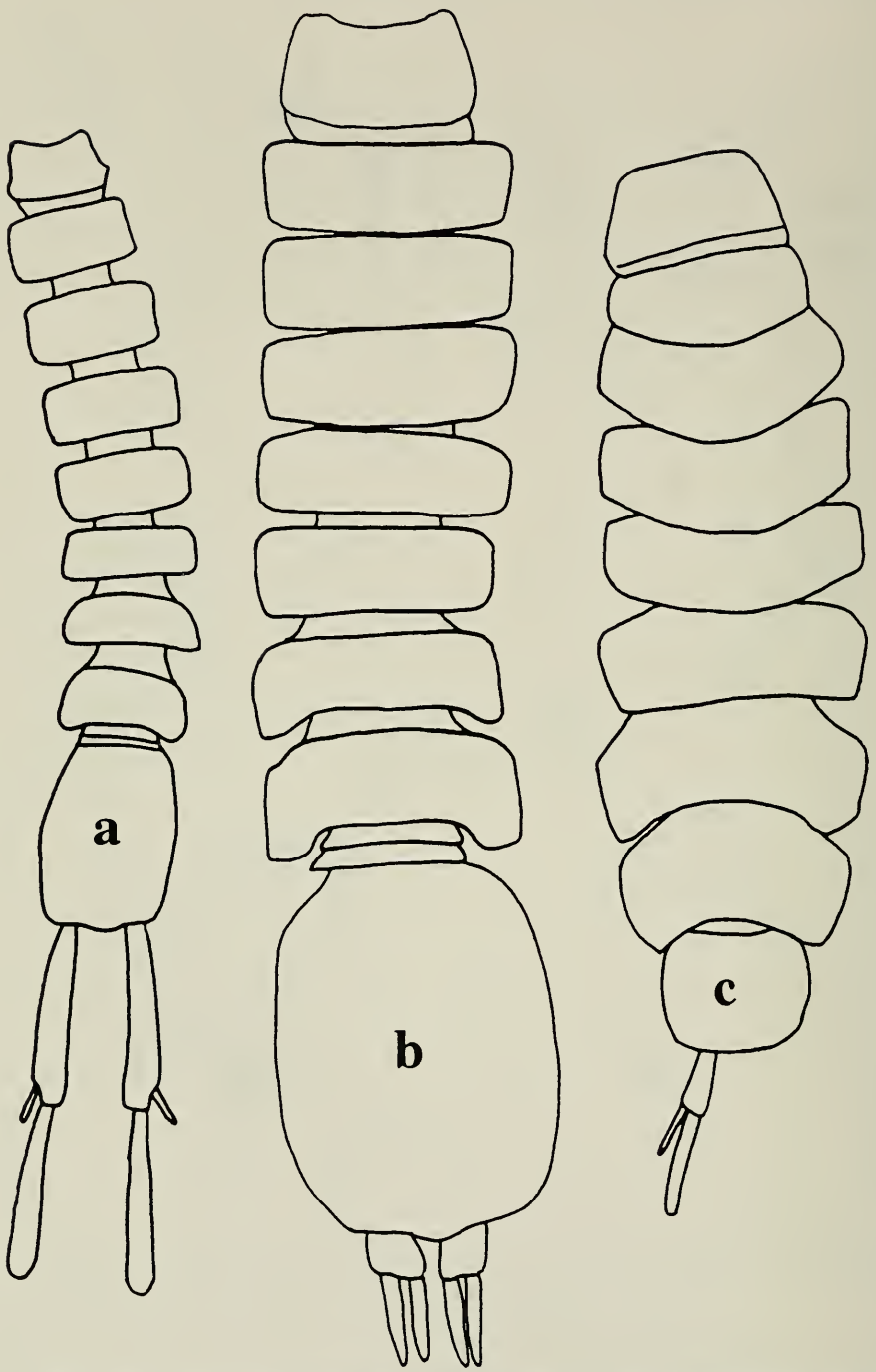

Fig. 11. *Caecidotea reddelli,* Kretschnarr Salamander Cave, Travis Co.: a, habitus and uropods; *Caecidotea bilineata,* Max's Well, Dallas Co.: b, habitus and uropods; *Lirceolus smithii,* artesian well at San Marcos, Hays Co.: c, habitus and uropods (after Bowman & Longley, 1976).

or organic debris. Elliott & Mitchell (1973) conducted a temperature tolerance test on several aquatic troglobites, including *C. reddelli,* and found that this species had no significant temperature preference. They speculated that in some cases troglobites appeared to lose responses to environmental conditions (such as temperature) that remain homogeneous, even though there may be seasonal variation.

Caecidotea reddelli was found to occur syntopically with *C. bilineata* in a collection taken from Salix Spring, in Dallas County. As both Dallas and Henderson counties lie outside of the major cave areas of Texas, *C. reddelli* is presumably phreatobitic, rather than strictly troglobitic. This conclusion is supported by the morphology of the exopod of the fourth pleopod, which has the characteristic 2-suture pattern found almost exclusively in phreatobitic (rather than troglobitic) species of *Caecidotea.*

Caecidotea species

Material examined.—Texas: Culberson County: Border Cave, 4 Jul 1985, Scott J. Harden, C. F. Lindbloom, 2♀♀; same locality, Scott J. Harden, 15 Aug 1986, 1♂, 1♀.

Range.—An undescribed species of the *Hobbsi* Group is known from this cave, but insufficient material was available for description at this time. Its occurrence in Border Cave is the farthest west that any population of subterranean *Caecidotea* has been discovered in North America east of the front range.

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