

University of Missouri-Columbia

Interlibrary Loan

ILLiad TN: 50236

Borrower: AFU

Lending String: UUS,*MUU,OKU,KKU,OKS

Patron: Slay, Michael

Journal Title: Proceedings of the Biological Society of Washington.

Volume: 119 **Issue:** 1

Month/Year: 2006 **Pages:** 15-24

Article Author: Biological Society of Washington.

Article Title: Holsinger, JR; Sawicki, TR; Graening, GO; Bactrurus speleopolis, a new species of subterranean amphipod crustacean (Crangonyctidae) from caves in nort

Imprint: [Washington, Biological Society of Washi

ILL Number: 21269473



CPRR

Call #: X

Location:

ARIEL

Charge

Maxcost: 25.00IFM

Shipping Address:

University of Arkansas-Fayetteville
University Libraries - Interlibrary Loan
365 N McIlroy Ave
Fayetteville AR 72701-4002

Fax: 479-575-5558

Ariel: 130.184.236.32

***Batrurus speleopolis*, a new species of subterranean amphipod crustacean
(Crangonyctidae) from caves in northern Arkansas**

John R. Holsinger, Thomas R. Sawicki, and G. O. Graening

(JRH) Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529,
U.S.A., e-mail: jholsing@odu.edu;

(TRS) Department of Sciences, Spartanburg Technical College, Spartanburg, South Carolina
29303, U.S.A.;

(GOG) Arkansas Field Office, The Nature Conservancy, 601 North University Avenue,
Little Rock, Arkansas 72205, U.S.A.

Abstract.—*Batrurus speleopolis*, a large stygobitic amphipod crustacean in the family Crangonyctidae is described from specimens collected from a lake in Cave City Cave, Sharp County, Arkansas, and is the second species of *Batrurus* Hay, 1902 recorded to date from the state. This species may also occur in Marble Falls Cave in Marion County, but sexually mature specimens are needed to verify that occurrence. The description of *B. speleopolis* raises the total number of species in *Batrurus* to eight. The genus is widespread in subterranean groundwaters of the east-central United States and is also recorded from a few localities farther east in the southern Appalachians.

Recent biological inventory of caves in the Ozark region of northern Arkansas has resulted in the discovery of numerous new populations of subterranean amphipod crustaceans as well as those of many other subterranean organisms. A majority of these collections has resulted in significant range extensions of species from the northern neighboring state of Missouri. In conjunction with an ongoing regional biodiversity study sponsored by The Nature Conservancy, Cave City Cave, located beneath a part of Cave City in Sharp County, was investigated for aquatic biota. Upon careful examination, amphipods sampled from the cave lake in December 2001 proved to represent a large new species of the exclusively subterranean genus *Batrurus* Hay, 1902, described below. Another probable specimen of this new species was collected from Marble Falls Cave in Marion County. Prior to these collections, *B. pseudomucronatus* Koenemann & Hol-

singer, 2001 was the only known species of the genus from Arkansas and was recorded from single caves in Lawrence and Randolph counties.

In a recent taxonomic revision of *Batrurus* by Koenemann & Holsinger (2001), four new species were described and three previously known species were redescribed. The geographic distribution of the genus covers a large part of the east-central United States, extending from eastern Kansas to western Ohio, where five species have been described from the subterranean groundwaters of caves, wells, springs and drain tile outlets. Two other species, both rare and locally endemic, were described from three caves in northeastern Tennessee and southwestern Virginia and one well in northern Alabama (Koenemann & Holsinger 2001). The description of *B. speleopolis* raises the total number of species in the genus to eight. It is also the second largest species in the genus and one of the largest

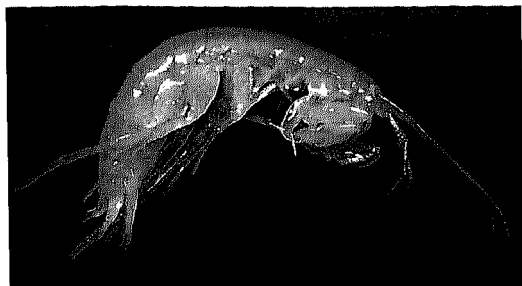


Fig. 1. *Bactrurus speleopolis*, paratype female (27.0 mm) from Cave City Cave, Sharp County, Arkansas. Photograph by Danté B. Fenolio.

cave amphipods recorded from North America. In the description that follows, nomenclature for setal patterns on segment 3 of the mandibular palp follows that used by Koenemann & Holsinger (2001).

Systematics

Bactrurus Hay, 1902

Bactrurus speleopolis, new species

Material examined.—ARKANSAS. Marion Co.: Marble Falls Cave, 1 immature male, G. O. Graening and M. Slay, 7 Sept 2001; Sharp Co.: Cave City Cave, female holotype (26.5 mm) and 3 male paratypes (22.0, 25.0, 27.0 mm), G. O. Graening and D. Fenolio, 13 Dec 2001, and 1 female (13.5 mm) and 2 male (16.5, 20.0 mm) paratypes, G. O. Graening and D. Fenolio, 23 Nov 2002.

The holotype is deposited in the National Museum of Natural History, Smithsonian Institution (USNM 10765188); paratypes are in the collection of J. R. Holsinger (H-4049, H-4134). The specimen from Marble Falls Cave (H-4082) is not designated a paratype (see below).

Diagnosis.—A large cavernicolous species of stygomorphic facies (Fig. 1) distinguished from all other species in the genus *Bactrurus* by vestigial inner lobes of lower lip, proportionately longer, more spinose outer ramus of uropod 3, and telson with U-shaped incision up to 35% of distance to base. Further distinguished from other species

in *Bactrurus*, except *B. brachycaudus* Hubricht & Mackin, 1940 by larger size. Largest female, 27.0 mm; largest male, 20.0 mm.

Female (27.0 mm paratype).—Lateral lobe of head rather prominent and narrowly rounded anteriorly. Antenna 1 (Fig. 2A), 60–65% length of body, 50–55% longer than antenna 2; first peduncular segment as long as combined lengths of peduncular segments 2 and 3; primary flagellum with approximately 47 segments, lacking esthetascs. Antenna 2 (Fig. 2B), peduncular segments 4 and 5 relatively heavily spinose; flagellum with approximately 16 segments. Mandibles (Fig. 4D–E) subequal; spine row of left with 9 spines that of right with 8 spines; segment 2 of palp with row of setae of unequal length on inner margin; segment 3 falcate, approximately as long as combined lengths of segments 1 and 2, bearing long row of approximately 19 short, plumose D setae on inner margin, 8 mostly long E setae apically, 3 or 4 A setae on upper outer margin distal to row of 4 B setae on upper inner margin. Lower lip (Fig. 4C): inner lobes vestigial or absent; upper surface covered with numerous short, fine setae. Maxilla 1 (Fig. 2D): inner plate with 4 apical, plumose setae; outer plate with 7 apical, serrated spines; palp with 4 apical and 6 subapical setae and row of very short setae on outer margin. Maxilla 2 (Fig. 2E): inner plate with oblique row of 6 plumose setae on inner margin toward distal end; outer plate with numerous simple apical setae; both plates with row of short, fine setae on outer margins toward distal ends. Maxilliped (Fig. 2F): inner plate with 5 bladespines and few short, simple setae apically; outer plate with row of simple setae on inner margin, short row of small bladespines subapically, and row of very small spines on inner face near outer margin; palp segments 5 and 6 bearing many simple setae on inner margins and faces.

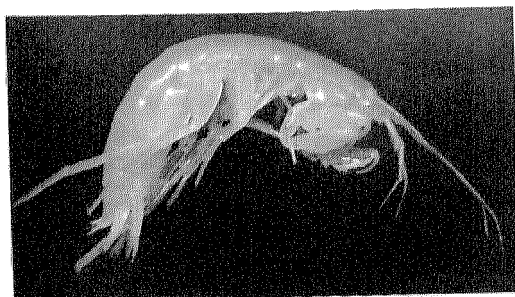


Fig. 1. *Bactrurus speleopolis*, paratype female (27.0 mm) from Cave City Cave, Sharp County, Arkansas. Photograph by Danté B. Fenolio.

cave amphipods recorded from North America. In the description that follows, nomenclature for setal patterns on segment 3 of the mandibular palp follows that used by Koenemann & Holsinger (2001).

Systematics

Bactrurus Hay, 1902

Bactrurus speleopolis, new species

Material examined.—ARKANSAS. Marion Co.: Marble Falls Cave, 1 immature male, G. O. Graening and M. Slay, 7 Sept 2001; Sharp Co.: Cave City Cave, female holotype (26.5 mm) and 3 male paratypes (22.0, 25.0, 27.0 mm), G. O. Graening and D. Fenolio, 13 Dec 2001, and 1 female (13.5 mm) and 2 male (16.5, 20.0 mm) paratypes, G. O. Graening and D. Fenolio, 23 Nov 2002.

The holotype is deposited in the National Museum of Natural History, Smithsonian Institution (USNM 10765188); paratypes are in the collection of J. R. Holsinger (H-4049, H-4134). The specimen from Marble Falls Cave (H-4082) is not designated a paratype (see below).

Diagnosis.—A large cavernicolous species of stygomorphic facies (Fig. 1) distinguished from all other species in the genus *Bactrurus* by vestigial inner lobes of lower lip, proportionately longer, more spinose outer ramus of uropod 3, and telson with U-shaped incision up to 35% of distance to base. Further distinguished from other species

in *Bactrurus*, except *B. brachycaudus* Hubricht & Mackin, 1940 by larger size. Largest female, 27.0 mm; largest male, 20.0 mm.

Female (27.0 mm paratype).—Lateral lobe of head rather prominent and narrowly rounded anteriorly. Antenna 1 (Fig. 2A), 60–65% length of body, 50–55% longer than antenna 2; first peduncular segment as long as combined lengths of peduncular segments 2 and 3; primary flagellum with approximately 47 segments, lacking esthetascs. Antenna 2 (Fig. 2B), peduncular segments 4 and 5 relatively heavily spinose; flagellum with approximately 16 segments. Mandibles (Fig. 4D–E) subequal; spine row of left with 9 spines that of right with 8 spines; segment 2 of palp with row of setae of unequal length on inner margin; segment 3 falcate, approximately as long as combined lengths of segments 1 and 2, bearing long row of approximately 19 short, plumose D setae on inner margin, 8 mostly long E setae apically, 3 or 4 A setae on upper outer margin distal to row of 4 B setae on upper inner margin. Lower lip (Fig. 4C): inner lobes vestigial or absent; upper surface covered with numerous short, fine setae. Maxilla 1 (Fig. 2D): inner plate with 4 apical, plumose setae; outer plate with 7 apical, serrated spines; palp with 4 apical and 6 subapical setae and row of very short setae on outer margin. Maxilla 2 (Fig. 2E): inner plate with oblique row of 6 plumose setae on inner margin toward distal end; outer plate with numerous simple apical setae; both plates with row of short, fine setae on outer margins toward distal ends. Maxilliped (Fig. 2F): inner plate with 5 bladespines and few short, simple setae apically; outer plate with row of simple setae on inner margin, short row of small bladespines subapically, and row of very small spines on inner face near outer margin; palp segments 5 and 6 bearing many simple setae on inner margins and faces.

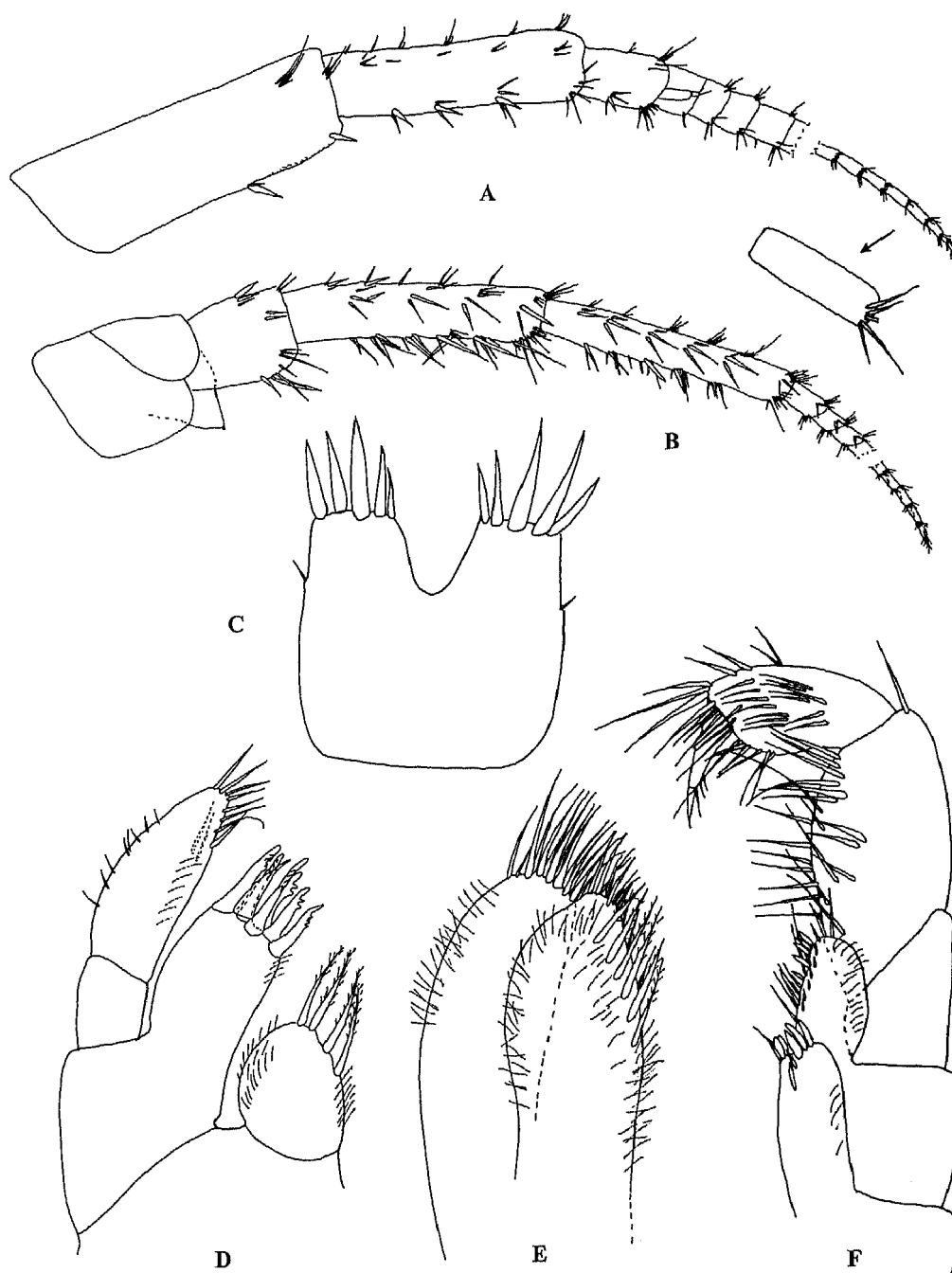


Fig. 2. *Bactrurus speleopolis*, paratype female (27.0 mm) from Cave City Cave, Sharp County, Arkansas: A, antenna 1 (flagellar article enlarged); B, antenna 2; C, telson; D, maxilla 1; E, maxilla 2; F, maxilliped.

Gnathopod 1 (Fig. 3A): propodus little larger than propodus of gnathopod 2; palm slightly convex, bearing complex double row of approximately 60 unequal-size spine teeth (some much longer than others); posterior margin short, only about 20 percent length of palm, bearing 3 sets of simple setae; medial setae in rows and in sets of 2, 3, and 4; dactyl bearing few very short setae, nail very short; posterior margin of carpus with cluster of small rastellate setae; coxa broader than deep, margin with approximately 7 short setae. Gnathopod 2 (Fig. 3B): propodus palm weakly convex, bearing complex double row of approximately 60 unequal-sized spine teeth; posterior margin convex, about 50% length of palm, bearing row of numerous, naked setae; medial setae in two rows and in sets of 2, 3 and 4; dactyl similar to that of gnathopod 1; carpus with rounded posterior lobe bearing numerous setae, some of which are rastellate (Fig. 3C); coxa little broader than deep, margin with 9 or 10 short setae. Pereopods 3 and 4 (Fig. 4A, B) subequal; coxal plate of 3 little deeper than broad, margin with 11 short setae; coxal plate of 4 broader than deep, ventral margin with approximately 14 short setae, posterior margin weakly excavate. Pereopods 5, 6 (Fig. 5A, B) and 7 (Fig. 6A): 7, 60–65% length of body, little longer than 6, approximately 35% longer than 5; bases subequal in shape, wider proximally than distally, posterior margins weakly convex, distoposterior lobes distinct but not enlarged; dactyls approximately 33% length of corresponding propods. Coxal gills on gnathopod 2 and pereopods 2–6, and small, coxal-like gill on pereopod 7. Two pairs simple, flat, apically-pointed lateral sternal gills (Fig. 6F) on pereonites 6 and 7. Brood plates not fully mature, lacking setae.

Pleonal plates 1–3 (Fig. 6G–I): posterior margins slightly convex, each with 2 or 3 setules on lower half; distoposterior corners tiny and rounded (subacute?);

ventral margin of plate 1 nearly straight and unarmed, those of plates 2 and 3 weakly convex and bearing 4 or 5 small, submarginal spines. Pleopods (Fig. 6B) normal, peduncles each bearing 1 pair of coupling spines distally. Uronites free (not fused), lacking dorsal spines. Uropod 1 (Fig. 6C): inner ramus subequal in length to outer ramus, approximately 50% length of peduncle, armed with 4 spines on apex, 6 on dorsal margin, and 4 smaller spines on lower medial margin; outer ramus bearing 5 apical spines and double row of 11 or 12 dorsal spines; peduncle with approximately 11 spines. Uropod 2 (Fig. 6D): inner ramus broader and longer than outer ramus, approximately 80% length of peduncle, armed with 6 spines on apex (2 much larger than others), 4 spines on dorsal margin and 3 much smaller spines on lower medial margin; outer ramus with approximately 5 apical spines and double row of 7 or 8 dorsal spines; peduncle with approximately 8 spines. Uropod 3 (Fig. 6E): outer ramus equal to or little longer than peduncle, apex with 8 spines, lateral margin with 2 sets of 3 or 4 spines, medial margin with row of 6 spines; inner ramus greatly reduced, unarmed and scale-like. Telson (Fig. 2C) about as wide as long, dorsal margin with rather prominent U-shaped notch extending approximately 30–35% of length to base, each lobe bearing 5 apical spines.

Male (20.0 mm paratype).—Closely similar to the female but presumably reaching sexual maturity at smaller size and having a few less spines on uropod 3. Also lacking a distal peduncular process that is present in three other species of the genus (see Koenemann & Holsinger 2001:4).

Type-locality.—Cave City Cave (also known as Crystal River Cave), located beneath the Cave Courts Motel and North Main Street in the town of Cave City in Sharp County, Arkansas. The accessible part of the cave is a single large



Fig. 3. *Bactrurus speleopolis*, paratype female (27.0 mm) from Cave City Cave, Sharp County, Arkansas: A, gnathopod 1 (palmar margin enlarged) B, gnathopod 2 (palmar margin enlarged); C, enlarged rastellate setae.

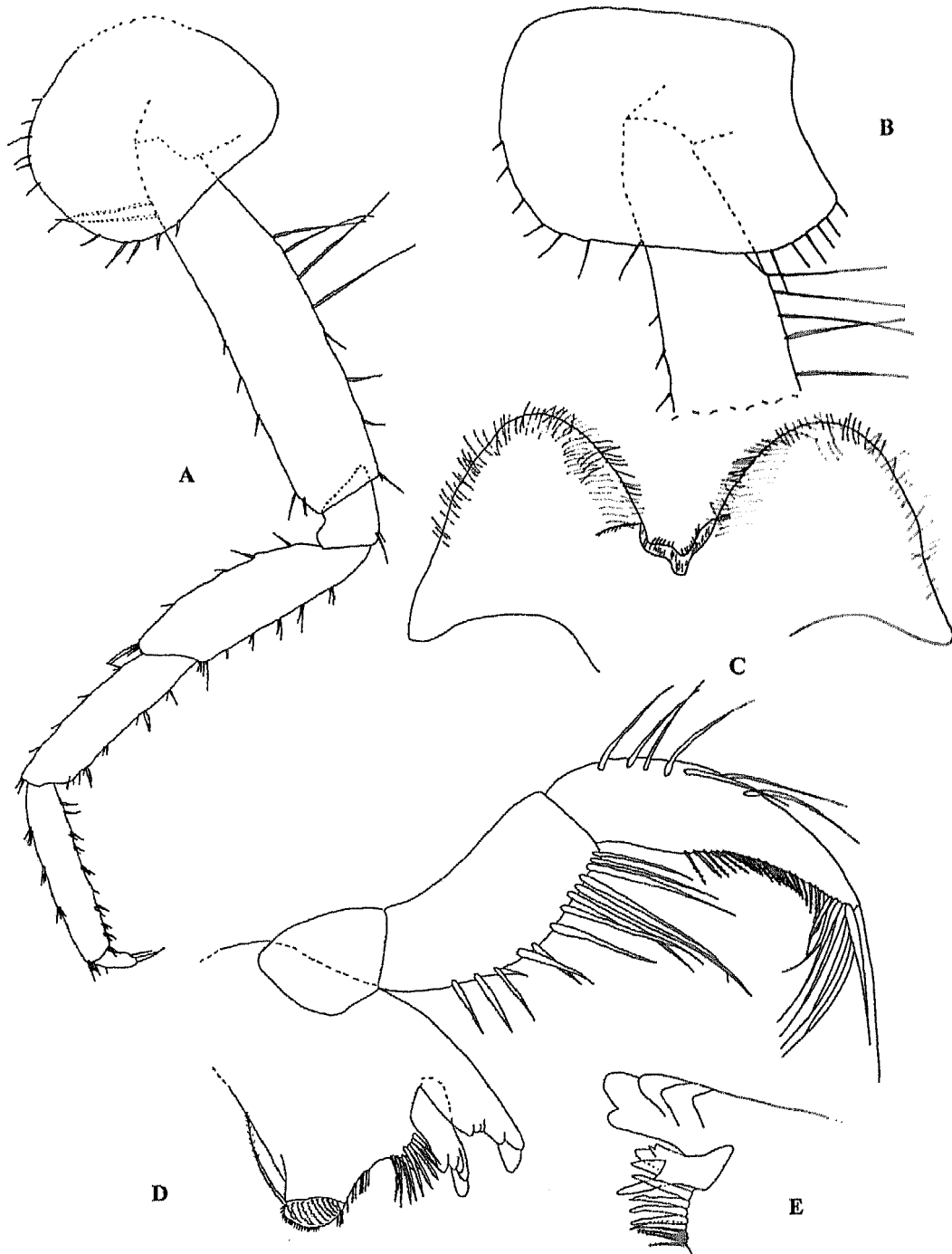


Fig. 4. *Bactrurus speleopolis*, paratype female (27.0 mm) from Cave City Cave, Sharp County, Arkansas: A, pereopod 3; B, pereopod 4 (in part); C, lower lip; D, left mandible; E, incisor and lacinia mobilis of right mandible.

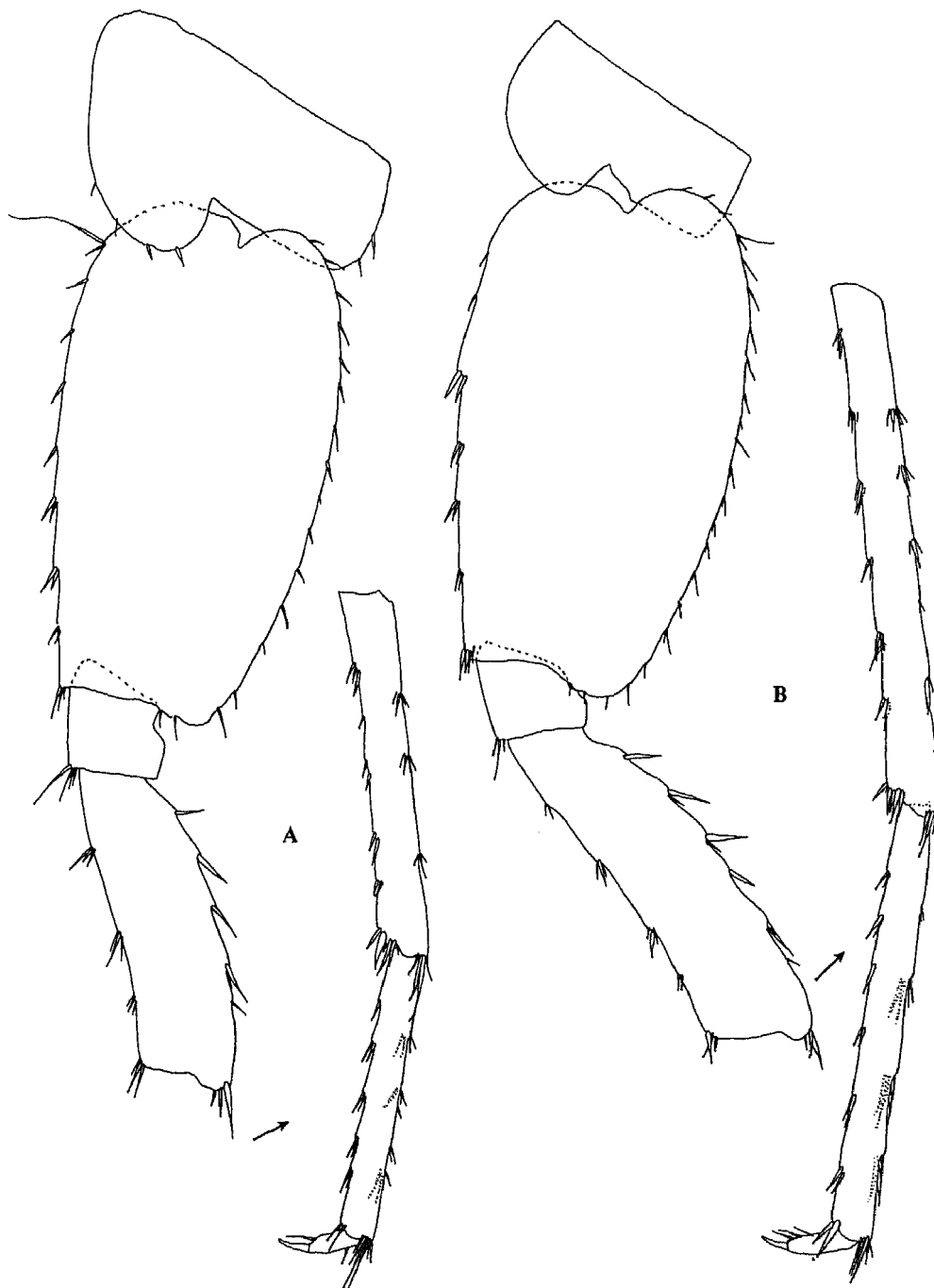


Fig. 5. *Bactrurus speleopolis*, paratype female (27.0 mm) from Cave City Cave, Sharp County, Arkansas: A, pereopod 5; B, pereopod 6.

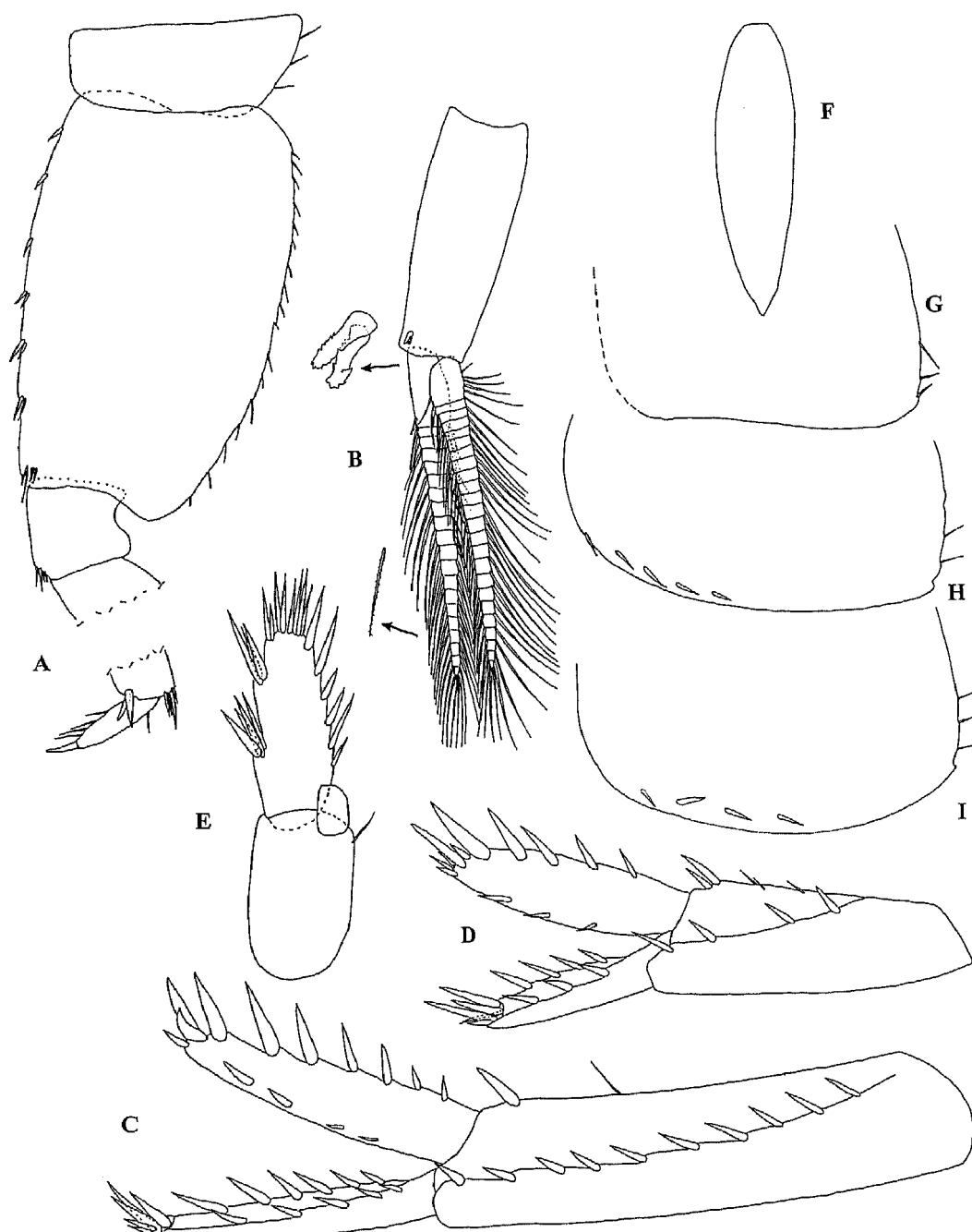


Fig. 6. *Batrurus speleopolis*, paratype female (27.0 mm) from Cave City Cave, Sharp County Arkansas: A, pereopod 7 (in part); B, pleopod 1 (rami with plumose seta) (coupling spines enlarged); C, uropod 1; D, uropod 2; E, uropod 3; F, sternal gill; G, pleonal plate 1; H, pleonal plate 2; I, pleonal plate 3.

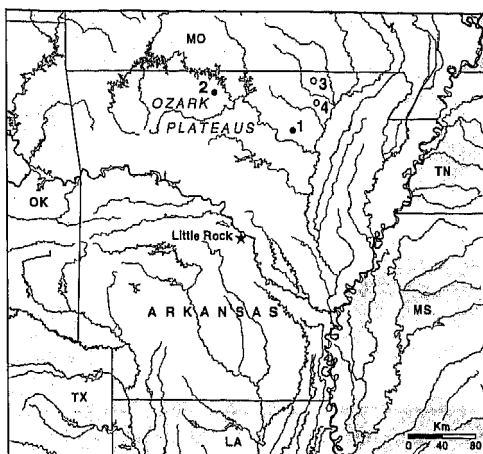


Fig. 7. Distribution of *Bactrurus* in Arkansas. *Bactrurus speleopolis* (closed circles): 1, Cave City Cave (type-locality), Sharp County; 2, Marble Falls Cave, Marion County. *Bactrurus pseudomucronatus* (open circles): 3, Mansell Cave, Randolph County; 4, deep cistern S. of Imboden, Lawrence County.

room, averaging 50 m wide by 300 m long, most of which contains a groundwater lake presumably of phreatic origin, ranging from 1 to 4 m in depth. The submerged part of this room intersects a passage that cave divers have been unable to penetrate because of ceiling collapse (J. Disler, pers. comm.). The lake had a temperature of approximately 14EC in early winter, no observable current, and a substrate composed of fine silt. The bottom was littered with large wooden and metal debris from abandoned docks and rafts.

Distribution and ecology.—To date this species is recorded from its type-locality, Cave City Cave, but probably also occurs in Marble Falls Cave in Marion County (Fig. 7). The latter is located approximately 120 km west-northwest of Cave City Cave. The record for this cave is based on a single submature male specimen with comparatively fewer spines on the telson and uropod 3. Because of the apparent immaturity of the single specimen from Marble Falls Cave and the distance of this locality from Cave City Cave, we have tentatively assigned the

specimen to *B. speleopolis* but elected not to designate it a paratype.

Bactrurus speleopolis was relatively abundant in Cave City Cave. On 13 December 2001, 20 individuals were seen foraging on silt and wood debris in the cave lake. Numerous specimens of the stygobitic isopod *Caecidotea antricola* Creaser, 1931, and several larvae of the salamander *Eurycea* sp. were also observed at this time. On a second visit to the cave on 23 November 2002, 25 specimens of *B. speleopolis* and one specimen of another stygobitic amphipod *Stygobromus* n. sp. (description in ms. by J. R. Holsinger) were seen foraging on fine silt near the edge of the lake.

Etymology.—The epithet *speleopolis* is a toponym derived from a combination of the Greek words *spelaiōn* (= cave) and *polis* (= city). The suggested vernacular name is Cave City Cave Amphipod.

Discussion.—The discovery of this large new species in northern Arkansas is surprising as it occurs only approximately 40 km southwest of the range of *B. pseudomucronatus* (Fig. 7), which was described by Koenemann and Holsinger (2001) from a deep cistern in Lawrence County, Mansell Cave in Randolph County, and also from caves to the north in adjacent southern Missouri. However, *B. pseudomucronatus*, *B. hubrichti* Shoemaker, 1945, to the west in eastern Kansas and northeastern Oklahoma, and *B. brachycaudus* to the north in central Missouri are not closely related morphologically to *B. speleopolis*. *Bactrurus pseudomucronatus* is not only much smaller at sexual maturity (only approximately one-half as long) than *B. speleopolis*, but it is readily distinguished from the latter species by the elongate telson, which is even proportionately longer in the adult male and may reach a length of up to 22% the length of the body. Based on the grouping of species in the recent monographic revision of the genus, *B. speleopolis* represents a new species group

within the genus and is easily distinguished from all other species in the genus by the characters given in the species diagnosis above. The overall body length of *B. speleopolis* is spectacular and rivaled in North American freshwaters only by *B. brachycaudus*, which reaches 31 mm in length (Koenemann & Holsinger 2001) and *Stygobromus clantoni* (Creaser 1934), which reaches 29 mm (J. R. Holsinger, in ms.).

Acknowledgments

We thank John Stark of The Nature Conservancy for coordination of the biological inventory, and Dan and Irma Carrigan for granting access to Cave City Cave and for assisting us in the study of this subterranean habitat. We also thank Don Emminger in the Graphics Office at Old Dominion University for assistance with preparation of the distribution map. The taxonomic description was funded by the Arkansas Field Office of The Nature Conservancy and the U.S. Fish and Wildlife Service.

Literature Cited

- Creaser, E. P. 1931. A new blind isopod of the genus *Caecidotea* from a Missouri cave.—Occasional Papers, University of Michigan Museum of Zoology 222:1–7.
- . 1934. A new genus and species of blind amphipod with notes on parallel evolution in certain amphipod genera.—Occasional Papers, University of Michigan Museum of Zoology 282:1–5.
- Hay, W. P. 1902. Observations on the crustacean fauna of Nickajack Cave, Tennessee and vicinity.—Proceedings of the United States National Museum 25:417–439.
- Hubricht, L., & J. G. Mackin. 1940. Description of nine new species of fresh-water amphipod crustaceans with notes and new localities for other species.—American Midland Naturalist 23:187–218.
- Koenemann, S., & J. R. Holsinger. 2001. Systematics of the North American subterranean amphipod genus *Bactrurus* (Crangonyctidae).—Beaufortia Bulletin Zoological Museum University of Amsterdam 51(1):1–56.
- Shoemaker, C. R. 1945. Notes on the amphipod genus *Bactrurus* Hay, with description of a new species.—Journal of the Washington Academy of Science 35(1):24–27.

Associate Editor: Christopher B. Boyko