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**Ontogeny of *Deeveya spiralis* Kornicker & Iliffe, 1985, collected in anchialine caves in the Caicos Islands (Crustacea, Ostracoda, Halocyprida, Deeveyidae)**

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*Abstract.*—Three juvenile instars (A-3, A-2, A-1) of *Deeveya spiralis* from caves in Cottage Pond, North Caicos Island, and Conch Bar Cave, Conch Bar, Middle Caicos Island, are described and illustrated. The ontogeny of the species is compared with that of *Deeveya bransoni* Kornicker & Palmer, 1987. The changes that take place during the ontogeny of members of the genus are described.

Kornicker & Iliffe (1985:476) described *Deeveya spiralis* from an anchialine cave “The Hole,” Providenciales Island, Turks and Caicos Islands, Bahamas. That collection contained two adult females. The present collection from Cottage Pond, North Caicos Island, and Conch Bar Cave, Middle Caicos Island, contained one adult female and four juvenile instars. The latter included an A-1, A-2, and A-3 instar, which are described herein. *Deeveya spiralis* is the type species for the genus *Deeveya*, which is the type for the subfamily Deeveyinae. That subfamily also contains the genus *Spelaeoecia* Angel & Iliffe, 1987, which has been collected elsewhere in the Bahamas, as well as in Bermuda, Cuba, and Yucatan, Mexico. Species of *Deeveya* are known only from anchialine caves and a few ocean blue holes in the Bahamas.

Biological collections from anchialine caves in the Caicos Islands have yielded especially interesting discoveries, including a number of new higher taxa. In

addition to description of the new ostracode subfamily Deeveyinae by Kornicker & Iliffe (1985), a new copepod superfamily Fosshagenioidea (Suárez-Morales & Iliffe 1996), a new remipede family Micropacteridae (Koenemann et al. 2007); three new remipede genera *Lasionectes* (Yager & Schram, 1986), *Godzillius* (Schram et al., 1986), and *Kaloketos* (Koenemann et al., 2004); two new copepod genera *Erebonecoides* (Fosshagen & Iliffe, 1994) and *Caiconectes* (Fosshagen & Iliffe, 2007); a new shrimp genus *Agostocaris* (Hart & Manning, 1986); a new genus of nebaliacean *Speonebalia* (Bowman et al., 1995); and a new polychaete genus *Pelagomacellicephala* (Pettibone, 1985) have been described from this locality.

*Disposition of specimens.*—Specimens are deposited in the National Museum of Natural History, Smithsonian Institution, and have been assigned USNM catalog numbers.

*Description of collecting localities.*—The Caicos Islands consist of a group of small islands comprising South Caicos, East Caicos, Middle Caicos, North Caicos, Providenciales, West Caicos, and

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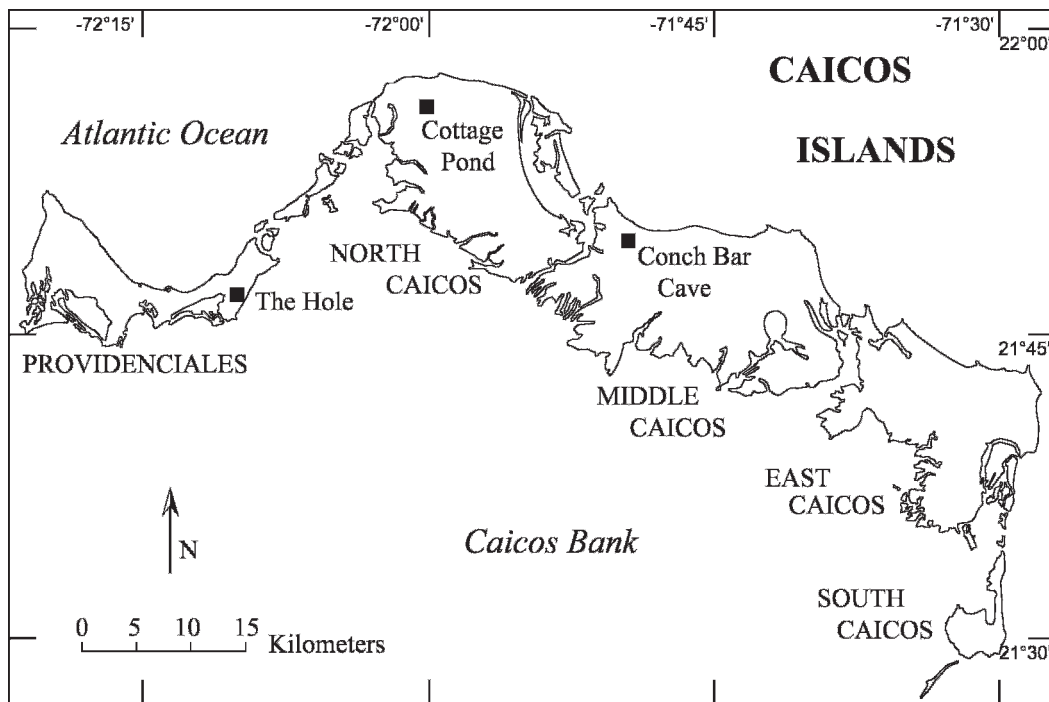


Fig. 1. Location of The Hole, Cottage Pond, and Conch Bar Cave in the Caicos Islands.

numerous small cays along the northern edge of Caicos Bank (Fig. 1). They are a geographical and geological southward extension of the Bahamas archipelago.

Cottage Pond is a submerged sinkhole located 4 km inland from the coast on North Caicos Island (Fig. 1). The pond consists of a 50 m diameter, nearly circular, pool in a shallow, rock-rimmed depression. Tidal amplitude in the pond is approximately 50 cm. The pond water is somewhat murky, seasonally limiting underwater visibility at the surface to about 1–3 m. Near the center of the pond at about 20 m depth, a 12 m long vertical crack opens into a 70 m diameter collapse chamber reaching water depths of 80 m (Fig. 2). At 15–20 m depth, several tree stumps in growth position with roots intact indicate periods of lower sea level. Directly below the crack is a conical debris mound beginning at 40 m depth and extending to the bottom of the chamber. Several large logs and boulders are located on the lower slope of the

debris mound. Submerged stalactites and flowstone, evidence of prior subaerial exposure, are present to at least 45 m depth. A Hydrolab Datasonde 3 was used to obtain a water-quality profile from the cave (Fig. 3). Surface water in the pond in June 2003 was slightly brackish (2.9‰), relatively warm (30.7°C), saturated with dissolved oxygen (7.5 mg/l) and slightly basic (pH 7.77). A halocline began at 8 m depth and stabilized at 30‰ salinity by 24 m depth. At this point, the temperature had decreased substantially to 24.13°C, DO to 0.42 mg/l and pH to 6.59. In the deeper waters below the halocline, the salinity remained nearly constant while DO and temperature continued to decline and pH increased slightly. At the deepest depth monitored with the Hydrolab (64.4 m), salinity was 30.6‰, temperature 22.35°C, DO 0.18 mg/l and pH 6.63. In addition to *Deeveya spiralis*, other stygobitic animals collected from salt water below the halocline in Cottage Pond consist of the

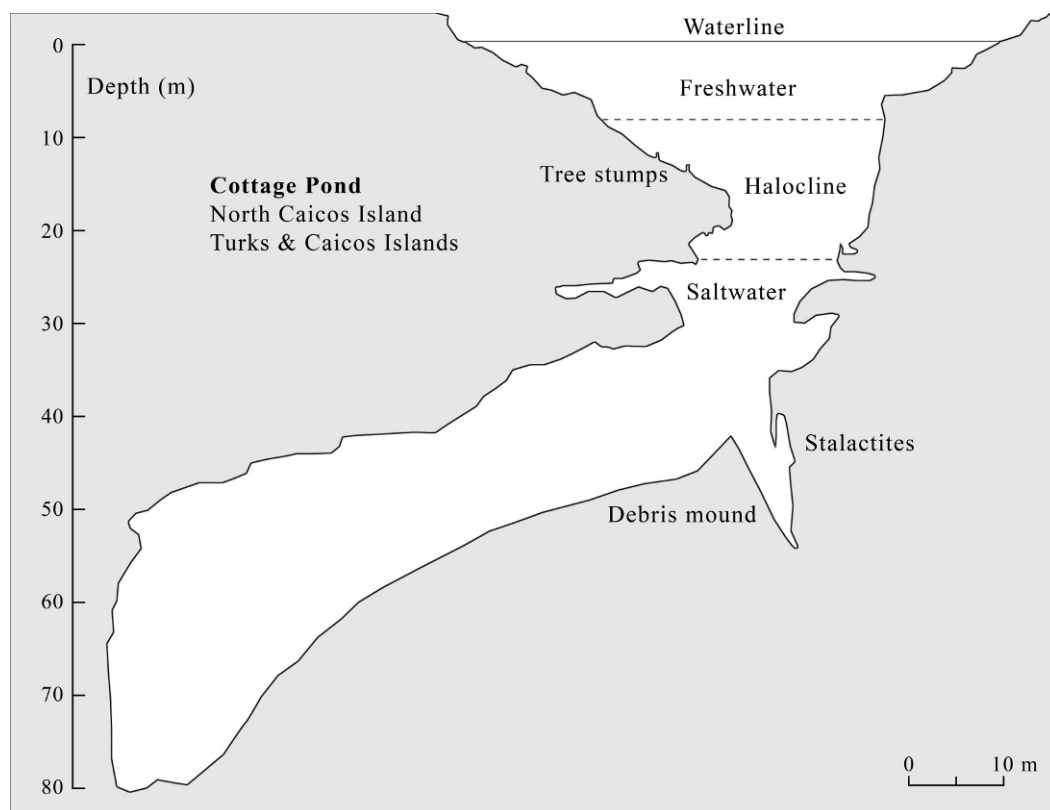


Fig. 2. Profile of Cottage Pond, North Caicos Island.

remipedes *Godzillius robustus*, *Lasionectes entrichoma* and *Kaloketos pilosus* (Koene-mann et al., 2004); a leptostracan, probably *Speonebalia cannoni*; a new species of cirrolanid isopod, *Bahalana caicosana* (Botosaneanu & Iliffe, 2003); the agostocarid shrimp *Agostocaris williamsi*; and copepods including the epactericiscids *Caiconectes antiquus* and *Azygonectes plumosus*, a diaptomid, probably a *Mastigodiptomus* species, and a tiny ridgewayiid (Fosshagen & Iliffe 2007).

Conch Bar Cave on Middle Caicos Island is one of the larger caves in the Bahamian archipelago, with more than 2 miles (3.3 km) of surveyed passage (Gregor 1981, Richards 2000) (Fig. 1). The cave consists of interconnected passages and domes developed on four horizontal levels. The uppermost level is made up of discontinuous relict cave

passages at 12–16 m above present sea level. The main level is the most extensive part of the cave with rock floor at 2–6 m above sea level. The next level consists of partially flooded rooms with rock bottom down to 2 m below sea level, while the lowest section of the cave is completely submerged with water depths to 15 m. Although there is no direct connection with the sea, water levels in the cave vary tidally by about 80 cm. Water in the cave is brackish at the surface and fully marine at depth. Animals collected from the cave include the hippolytid shrimp *Barbouria cubensis*, the polynoid polychaete *Pelagomacellicephala iliffei*, the mysid *Stygiomysis clarkei*, cirrolanid isopods, and the calanoid copepods *Fosshagenia ferrarii*, *Erebonectoides macrochaetus*, *Caiconectes antiquus* and *Bofuriella spinosa*. The cave is also inhabited by four species of bats

## Water Quality Profile: Cottage Pond, North Caicos Island, 9 June 2003

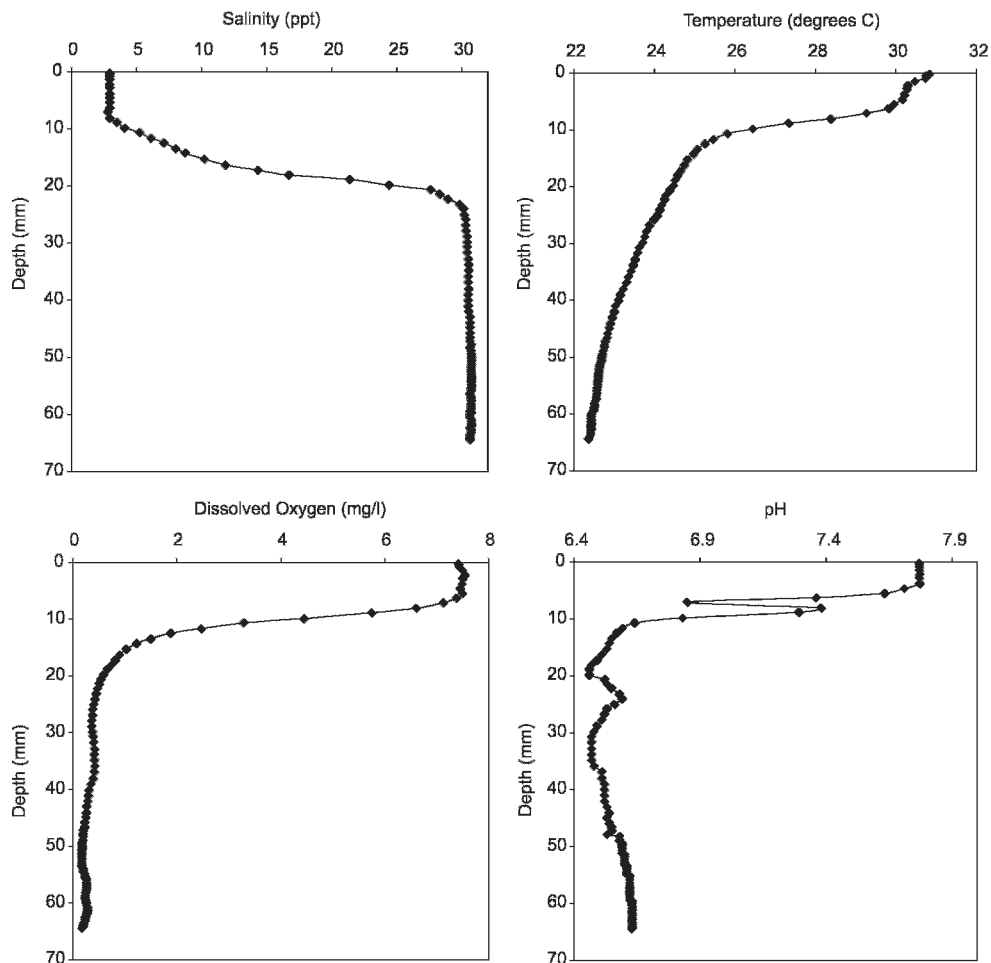


Fig. 3. Water quality profile of Cottage Pond, North Caicos Island.

from the family Phyllostomidae, including the big-eared bat *Macrotus waterhousii*, Cuban fruit-eating bat *Brachyphylla nana*, buffy flower bat *Erophylla sezekorni*, and Leach's long-tongued bat *Monophyllus redmani* (Darwin Initiative 2002). The bat population in Conch Bar Cave numbers approximately 1000–1500 individuals, with many bats roosting directly over pools in the cave, such that their guano likely provides an important food resource for aquatic fauna.

The Hole on Providenciales Island (Fig. 1) was described in Kornicker &

Iliffe (1985:477–478). Animals collected in the cave included a nebeliacean *Speonebalia cannoni*, and a crab *Sesarma miersii*.

Order Halocyprida Dana, 1853

Suborder Halocypridina Dana, 1853

Superfamily Halocypridoidea Dana, 1853

Family Deeveyidae Kornicker & Iliffe, 1985

Subfamily Deeveyinae Kornicker & Iliffe, 1985

*Deeveya* Kornicker & Iliffe, 1985

*Type species.*—*Deeveya spiralis* Kornicker & Iliffe, 1985.

*Deeveya spiralis* Kornicker & Iliffe, 1985  
Figs. 4–14

*Deeveya spiralis* Kornicker & Iliffe, 1985:477, figs. 1–12.—Kornicker & Palmer, 1987:619, fig. 6.—Kornicker et al., 1990:37, figs. 22a, 23a, 30.—Kornicker et al., 2007:56, tab. 10, 11.

*Holotype*.—USNM 193117, adult female on slides and in alcohol.

*Type locality*.—The Hole, Providenciales Island, Caicos Islands, Turks and Caicos Islands.

*Material examined*.—Sta 03-016, 9 Jun 2003, Cottage Pond, North Caicos Island, 25–46 m depth: USNM 1111743, complete specimen in alcohol, length 2.62 mm, height 1.84 mm (probably A-1 instar but could be adult; specimen not opened in order to have whole specimen in museum collection); USNM 1111773, A-2 instar on slides and in alcohol. Sta 03-019, 9 Jun 2003, Cottage Pond, North Caicos Island, 25–30 m depth: USNM 1111777, adult female with body removed from carapace, in alcohol; USNM 1111779, A-1 male on slide and in alcohol. Sta 03-022, 9 Jun 2003, Conch Bar Cave, Conch Bar, Middle Caicos Island, 0.5–15 m depth: USNM 1111780, A-3 instar on slide and in alcohol. Specimens collected from water column with vials and plankton net.

*Distribution*.—Caicos Islands (Fig. 1): The Hole (21°47'N, 72°1'W), Providenciales Island, 7 m depth; Cottage Pond (21°56'N, 72°00'W), North Caicos Island, 25–46 m depth; Conch Bar Cave (21°49'N, 71°49'W), Conch Bar, Middle Caicos Island, 0–15 m depth. Known depth range 7–46 m.

*Description of A-3 instar* (sex unknown) (Figs. 4–7A–C).—Carapace oval in lateral view with slightly concave anterior margin and projecting glandular process on posterior corner of dorsal margin of right valve (Fig. 4C, D).

Ornamentation (Fig. 4B): In outside view with transmitted light, clear ovals

visible lateral to reticulations; ovals located at intersections of underlying reticulations. Similar to ornamentation of adult female valves illustrated in Kornicker & Iliffe (1985:figs. 3–6).

Central adductor muscle attachments: Similar to those of adult female.

Carapace size (length, height in mm): USNM 1111780, 1.42, 1.10.

First antenna (Figs. 4E, F, 6G): Elongate with 8 articles. Article 1 with distal lateral spines. Article 2 with spines and spinous dorsal bristle near midlength. Article 3 with spines and ventral bristle. Article 4 short, with terminal dorsal bristle. Article 5 short, with short terminal ventral bristle. Article 6 short, bare. Article 7 with short dorsal a-bristle and 2 ventral bristles (short b-bristle, long c-bristle with widely separated short marginal spines). Article 8 with long e-bristle with widely separated short marginal spines and shorter filament-like d-, f-, and g-bristles. Article 2 may be aberrant in having indistinct broad bristle-like terminal branch. Left limb of USNM 1111780 without bristle on fourth article.

Second antenna (Fig. 4G–I): Protopod with distal medial spines near endopod. Endopod with 3 articles: article 1 with dorsal bristle; article 2 with long filament-like f-bristle and much longer g-bristle with distal widely separated minute marginal spines; minute lateral triangular process on margin just dorsal to f-bristle; article 3 with long filamentous h-, i-, and j-bristles (j-bristle missing on right limb of USNM 1111780, possibly broken off). Exopod with 9 articles: article 1 divided subterminally by weak medial suture, with 1 short terminal bristle; articles 2 to 8 with long bristle with natatory hairs; article 9 with 3 bristles (1 short, 1 medium, 1 long).

Mandible (Fig. 5A–C): Coxa endite with proximal and distal sets of teeth separated by space; proximal set with 4 stout cusps; numerous spines anterior and posterior to cusps and between cusps, and

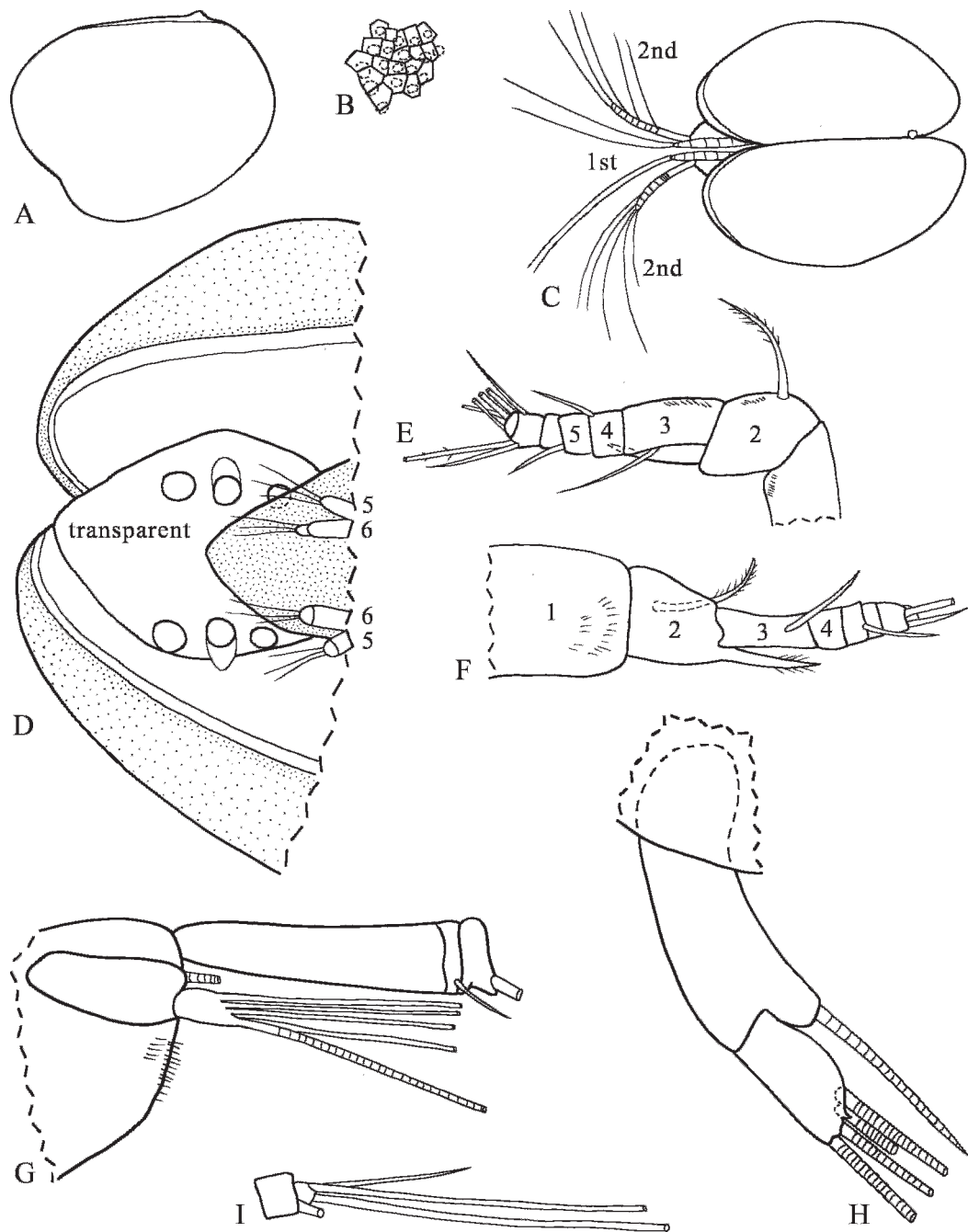


Fig. 4. *Deeveya spiralis*, A-3 instar, sex unknown, USNM 1111780. A, Outline of complete carapace from left side, length 1.42 mm; B, Detail of inside of shell; C, Dorsal view of complete specimen with valves partly open; D, Ventral view of posterior end of complete specimen (transparent film with 6 round unidentified ovals; posterior of body stippled); E, Left first antenna drawn while attached to body, lateral view; F, Right first antenna, lateral view; G, Left second antenna, medial view; H, Endpod of right second antenna, lateral view; I, Tip of exopod of left second antenna, medial view.



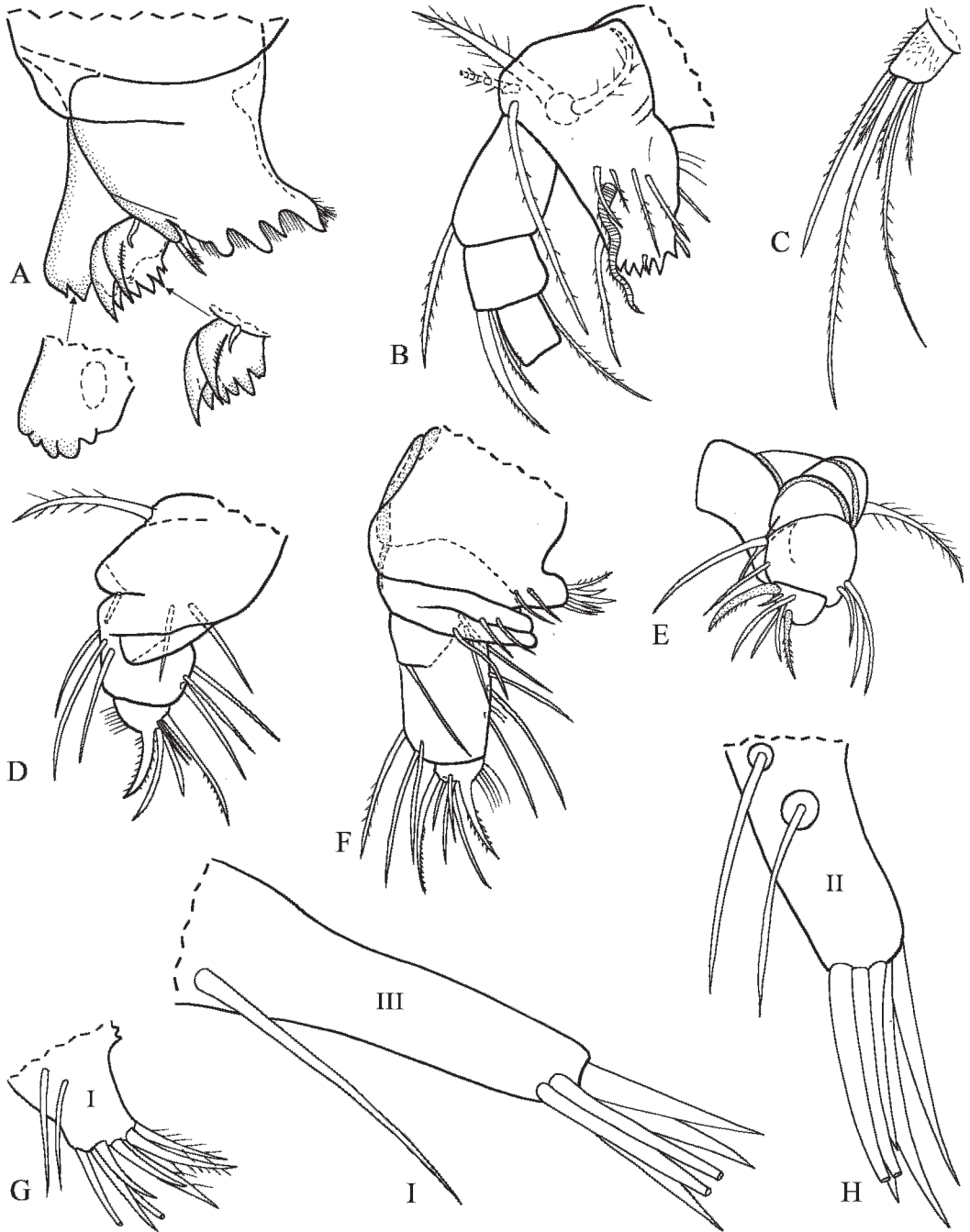


Fig. 5. *Deeveya spiralis*, A-3 instar, sex unknown, USNM 1111780. A, Distal coxa of left mandible, lateral view; B, Basis and part of endopod of left mandible, lateral view; C, Tip of endopod of left mandible, lateral view; D, Part of left maxilla, lateral view; E, Right maxilla drawn on body, ventral view; F, Right maxilla (under glass cover slip), medial view of endites, lateral view of endopod; G, H, I, Endopods I, II, and III, respectively, of right maxilla shown in F.



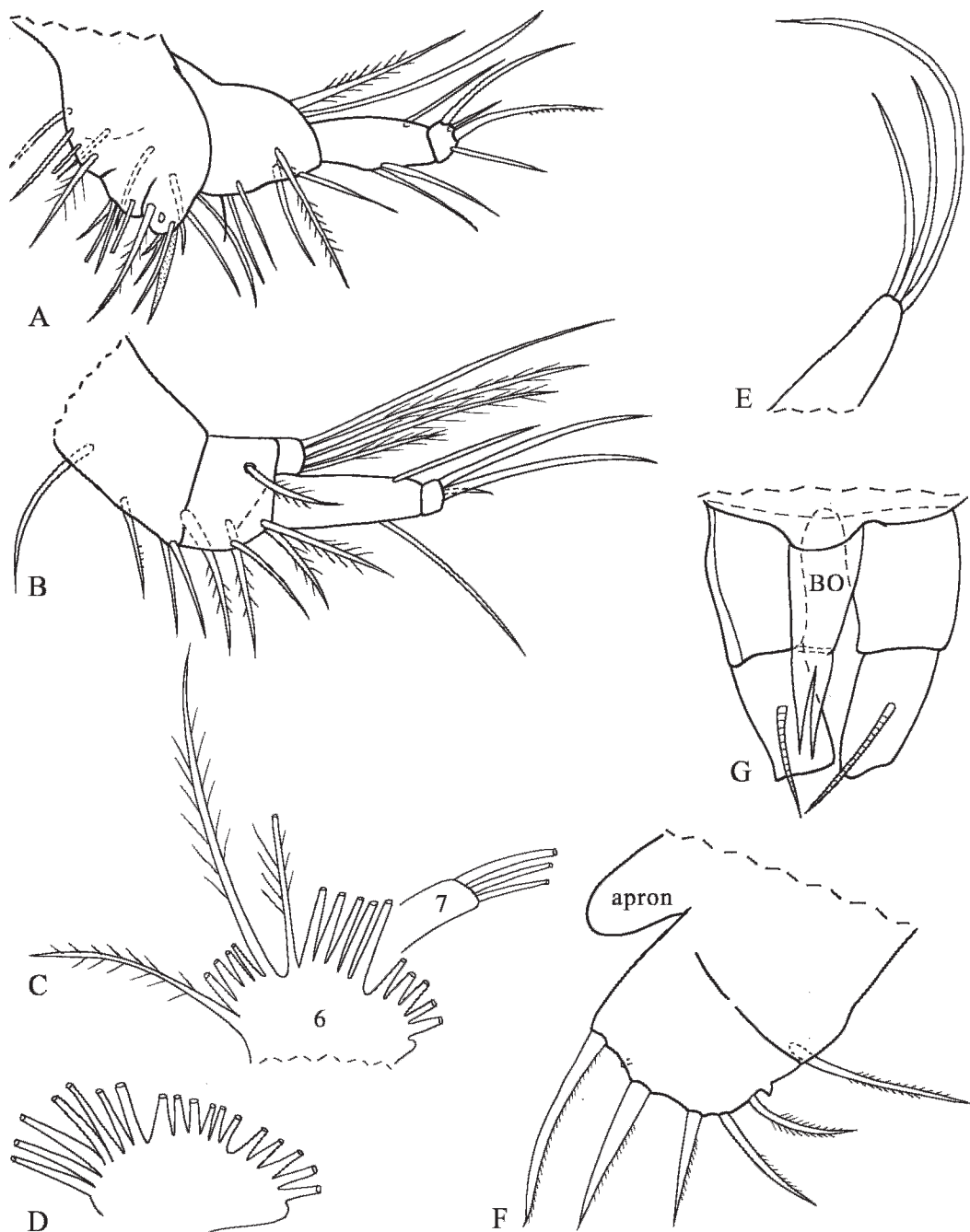


Fig. 6. *Deeveya spiralis*, A-3 instar, sex unknown, USNM 1111780. A, Left fifth limb, lateral view; B, Left sixth limb, lateral view; C, Epipod of left sixth limb and left seventh limb, lateral view; D, Epipod of right sixth limb, lateral view; E, Right seventh limb, lateral view (ventral edge to left); F, Left lamella of furca drawn on body; G, Dorsal view of Bellonci Organ and proximal parts of first antennae, drawn on body.

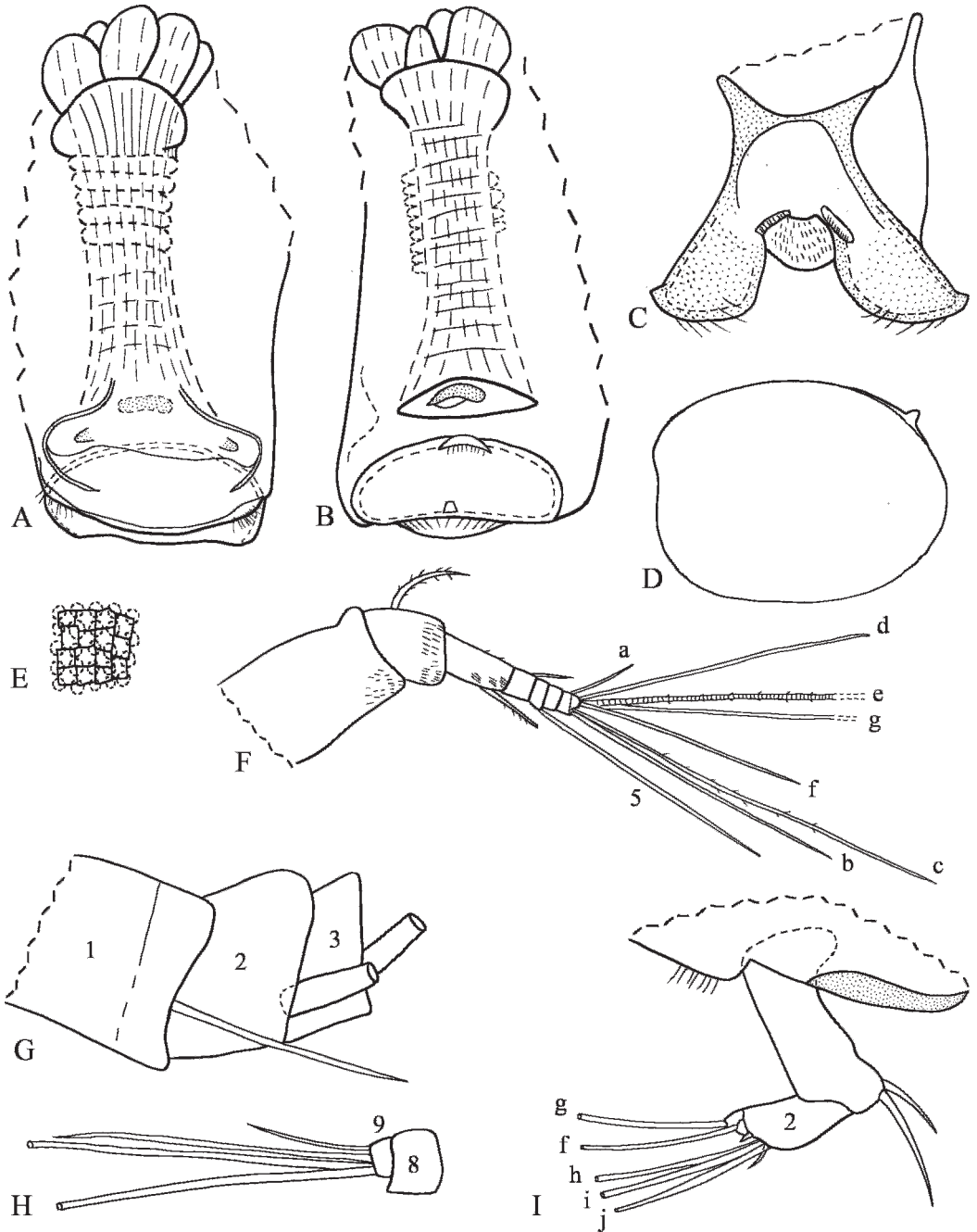


Fig. 7. *Deeveya spiralis*, A-3 instar, sex unknown, USNM 1111780. A-C: A, B, Anterior and posterior views of upper lip and esophagus (not under cover slip); C, Posterior view of lower lip (not under cover slip). *D. spiralis*, A-2 instar, sex unknown, USNM 1111773. D-I: D, Outline of complete carapace from left side, length 2.12 mm; E, Inside view of shell fragment from right valve; F, Left first antenna, medial view; G, Proximal part of exopod of right second antenna, medial view; H, Tip of exopod of right second antenna, medial view; I, Endopod of right second antenna, lateral view.

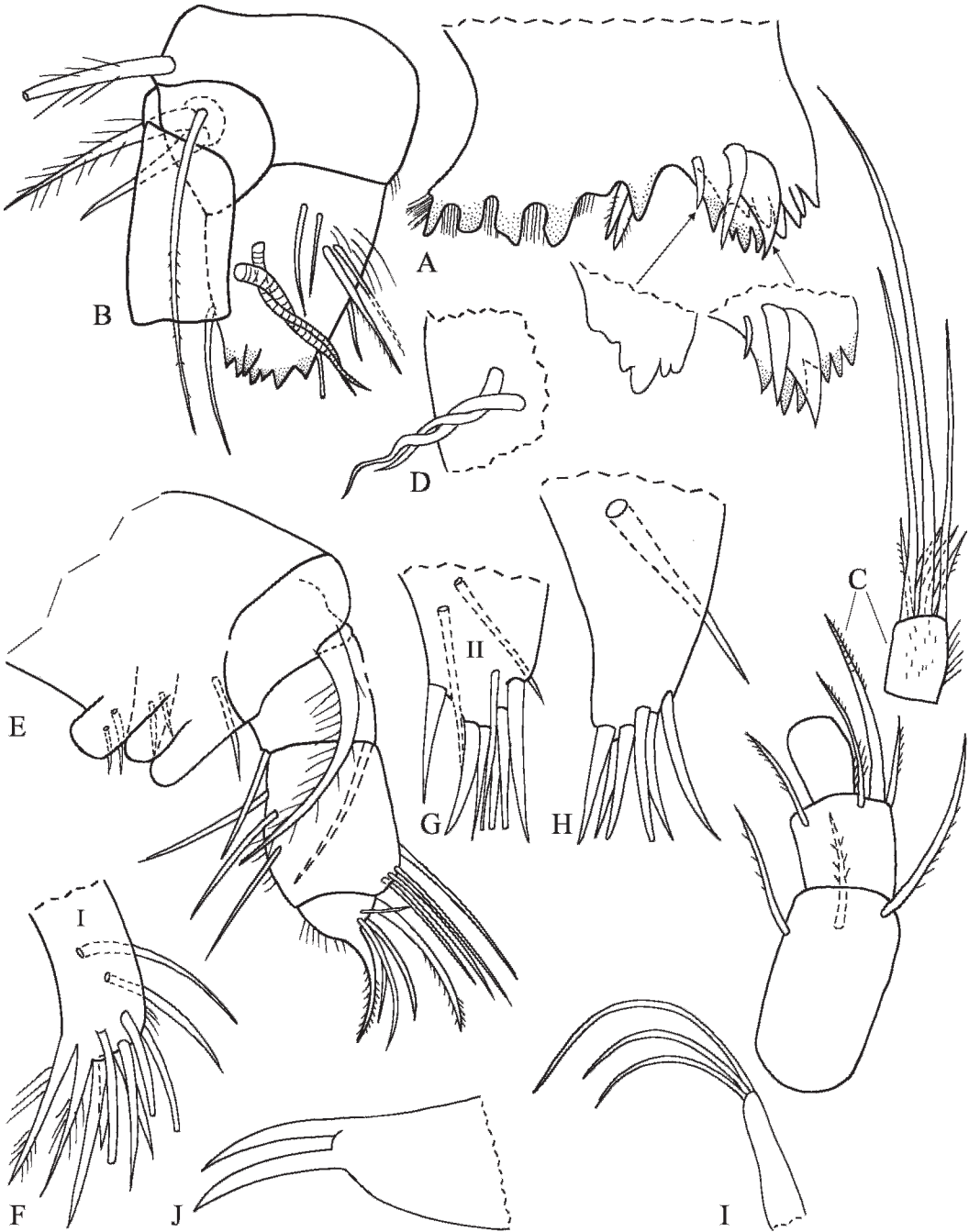


Fig. 8. *Deeveya spiralis*, A-2 instar, sex unknown, USNM 1111773. A, Distal coxa of left mandible, medial view; B, Basis and proximal part of endopod of left mandible, lateral view; C, Endopod of left mandible, lateral view; D, Entwined bristles on basis of right mandible, lateral view; E, Left maxilla, medial view; F-H, Endites I-III, respectively, of left maxilla, medial view; I, seventh limb; J, Bellonci Organ.

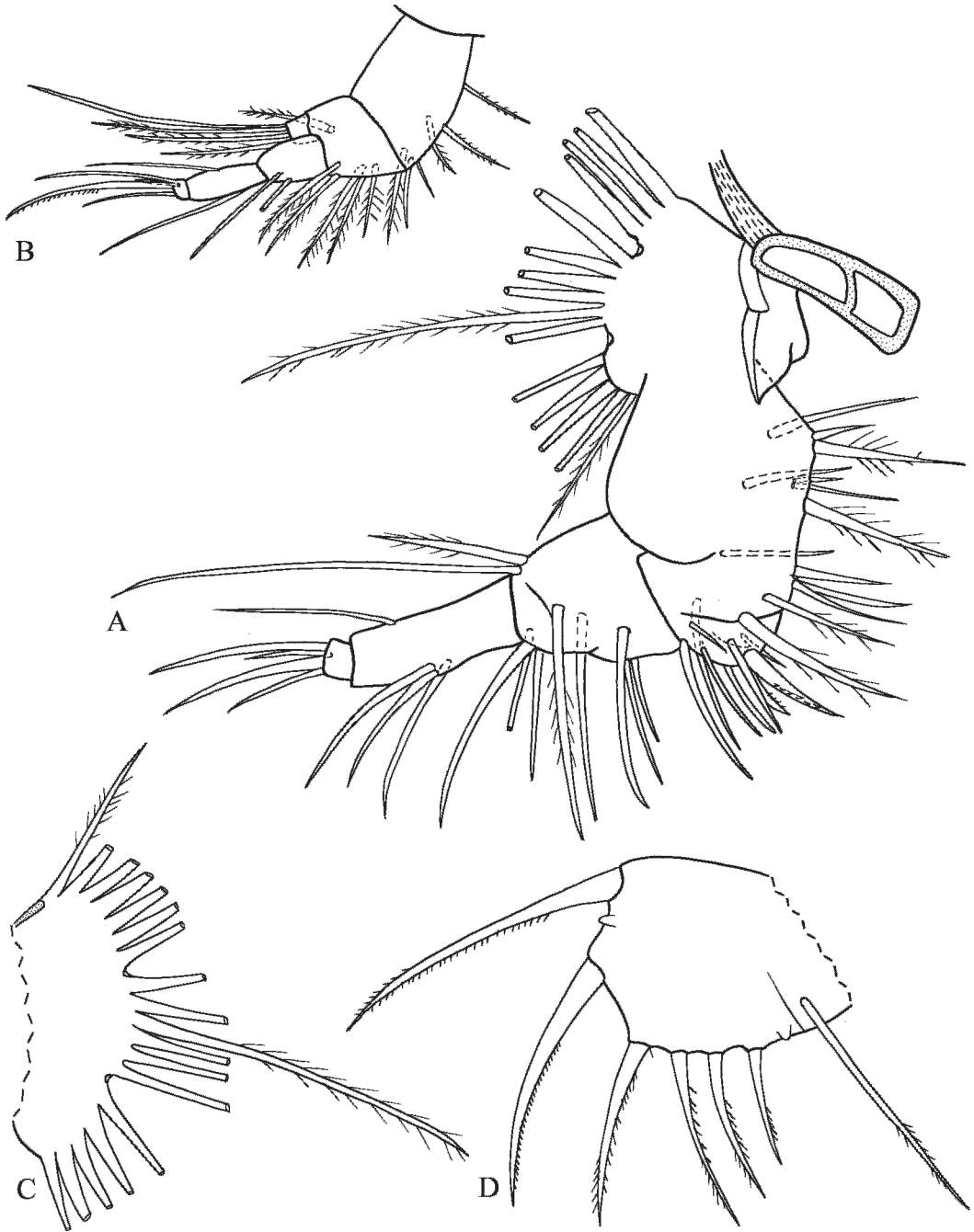


Fig. 9. *Deeveya spiralis*, A-2 instar, sex unknown, USNM 1111773. A, Right fifth limb, lateral view; B, Left sixth limb, medial view; C, Epipod of left sixth limb; D, Right furcal lamella, medial view.

1 indistinct small spinous bristle posterior to cusps. Stout rounded tooth between proximal and distal sets of teeth, with 2 spinous bristles adjacent to tooth.

set of teeth comprising 2 flat teeth, each with 4 or 5 cusps; 2 broad sclerotized flat bristles lateral to distal set of teeth; 1 small lateral bristle adjacent to bases of

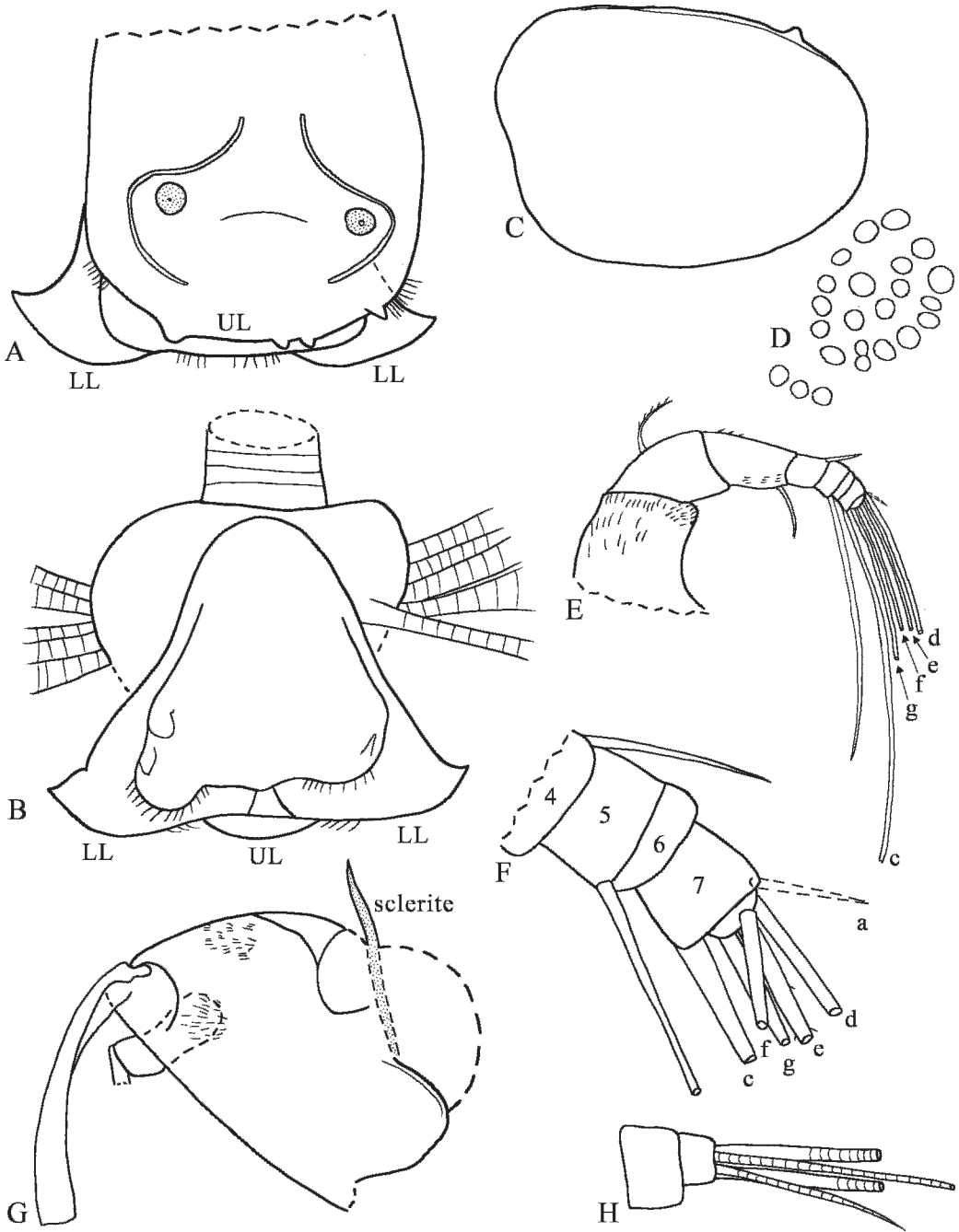


Fig. 10. *Deeveya spiralis*, A-2 instar, sex unknown, USNM 1111773. A, B, Anterior and posterior views of lips (not under cover slip). A-1 male, USNM 1111779. C-H: C, Outline of complete carapace from left side, length 2.5 mm; D, Lateral view of central adductor muscle attachments of left valve; E, Right first antenna, lateral view; F, Distal part of left first antenna, medial view; G, Part of left second antenna, lateral view; H, Tip of exopod of left second antenna, lateral view.

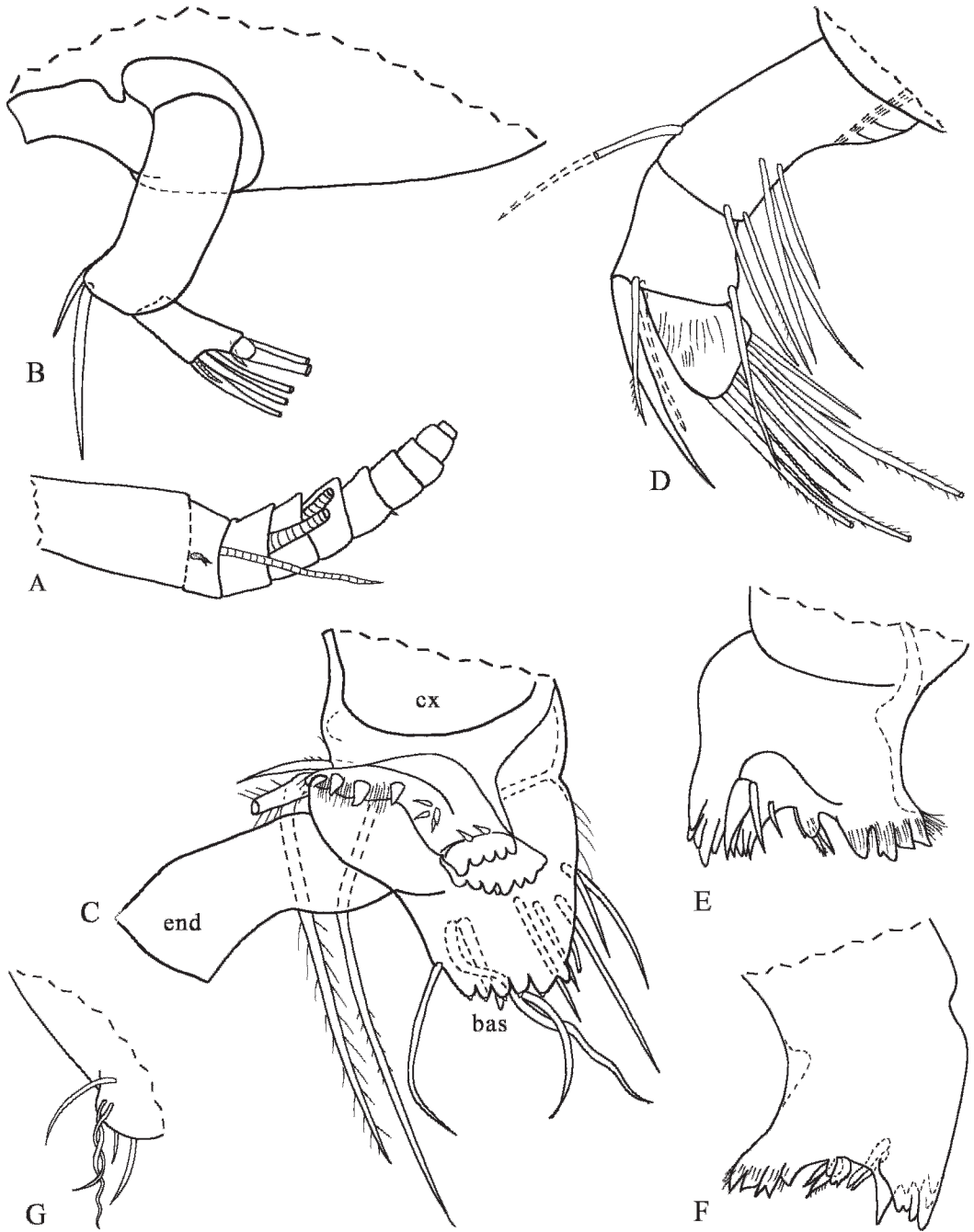


Fig. 11. *Deeveya spiralis*, A-1 male, USNM 1111779. A, Part of exopod of right second antenna, medial view (nabs); B, Endopod right second antenna, medial view; C, Coxa, basis and part of endopod of right mandible, medial view (not under cover slip; nabs); D, Endopod of right mandible, medial view (not under cover slip); E, F, Medial and lateral views of tip of coxa of left mandible (not under cover slip); G, Lateral view of anterior part of tip of basis of left mandible (drawn on body). Abbreviation: nabs = not all bristles shown.

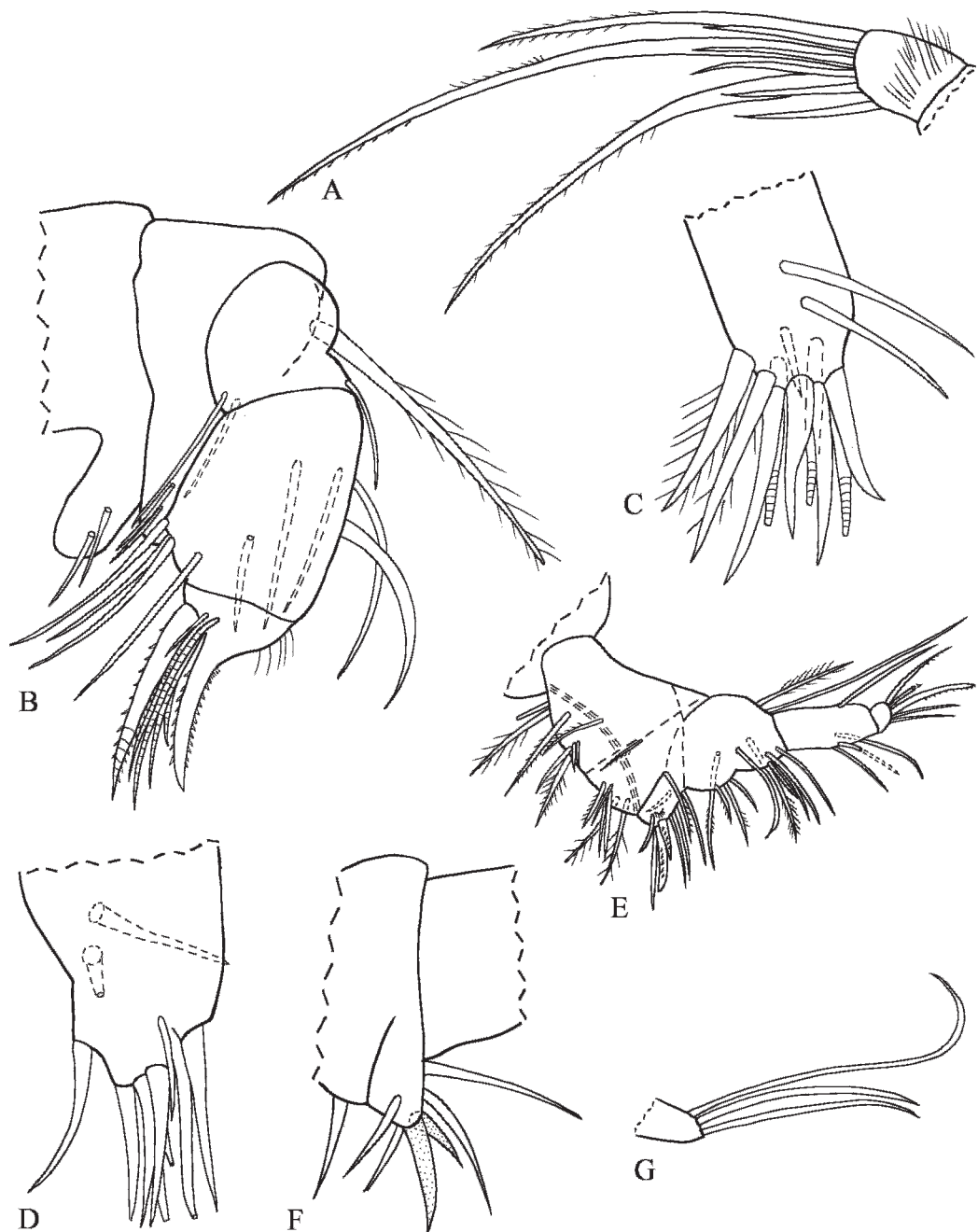


Fig. 12. *Deeveya spiralis*, A-1 male, USNM 1111779. A, Medial view of tip of endopod of right mandible; B, Right maxilla, lateral view (nabs); C, Endite I of right maxilla, lateral view; D, Endite II of left maxilla, medial view; E, Right fifth limb, medial view; F, Part of ventral edge of precoxa and coxa of left fifth limb (drawn on body; nabs); G, Left seventh limb (drawn on body). Abbreviation: nabs = not all bristles shown.



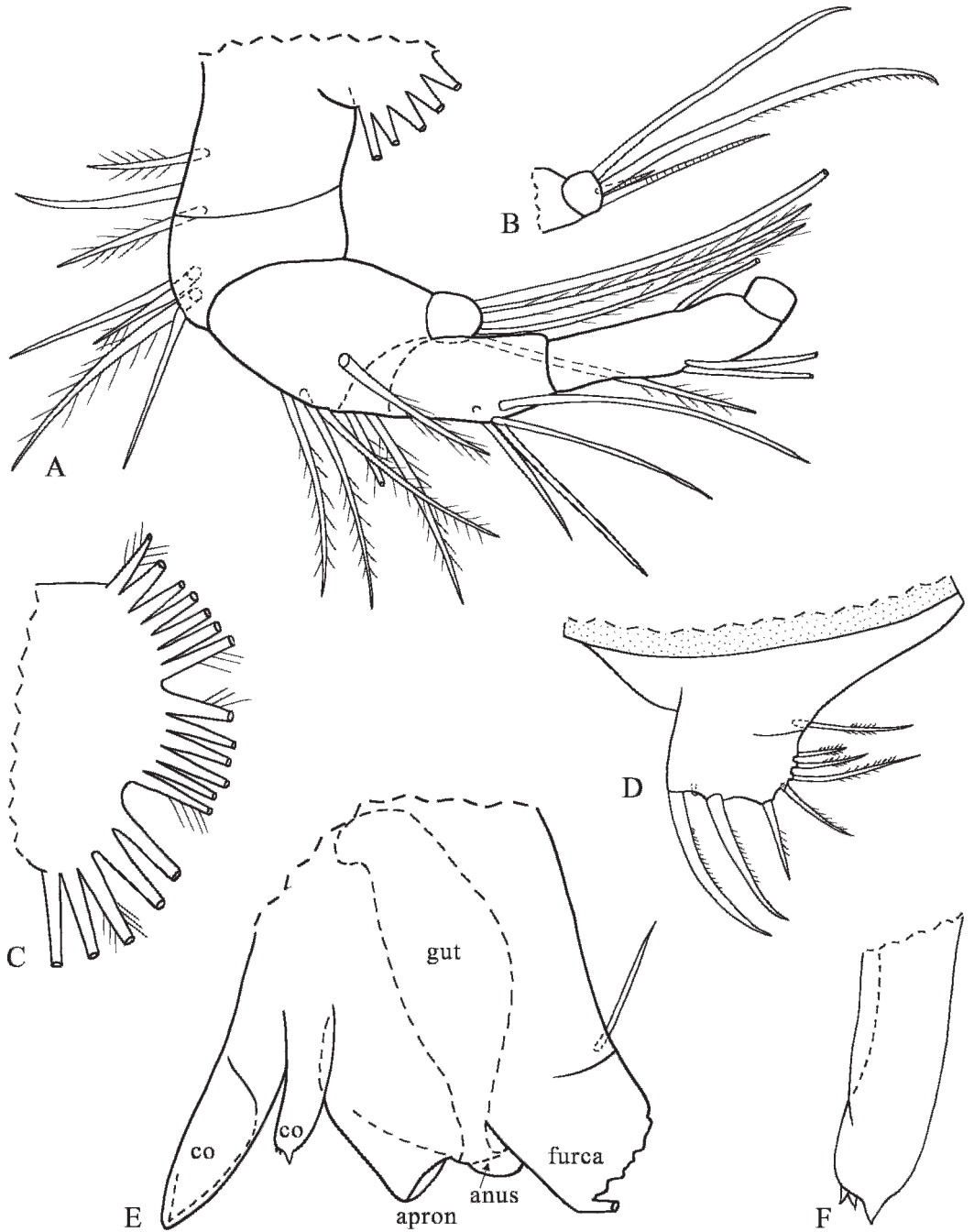


Fig. 13. *Deeveya spiralis*, A-1 male, USNM 1111779. A, Lateral view of left sixth limb (not under cover slip; nabs); B, Tip of sixth limb shown in A; C, Epipod of left sixth limb shown in A; D, Lateral view of left lamella of furca projecting from carapace; E, Posterior of body from left side (not all claws shown on furca). F, Detail from E showing posterior branch of copulatory organ (branch is medial to epipod of sixth limb and lateral to apron). Abbreviation: nabs = not all bristles shown.

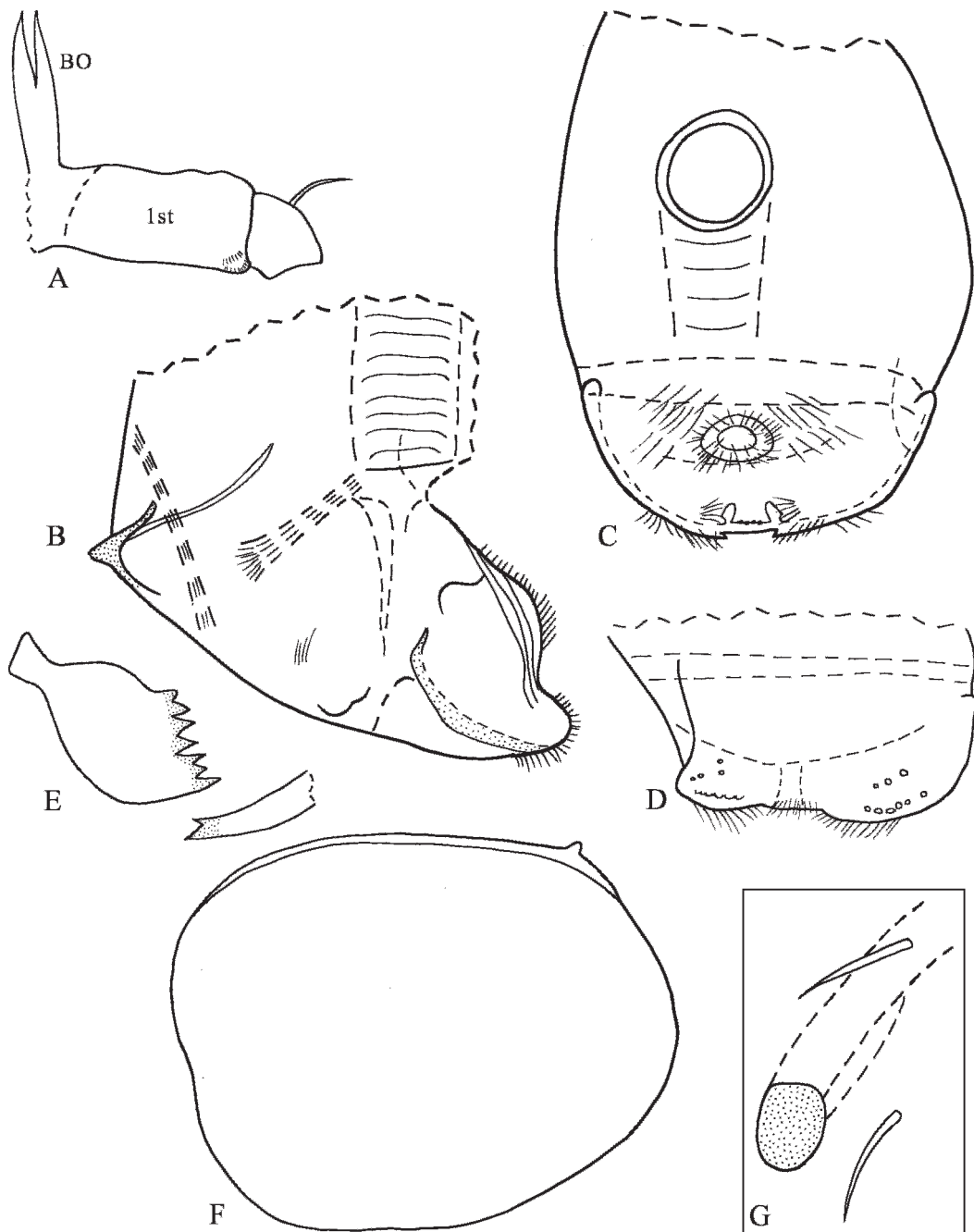


Fig. 14. *Deeveya spiralis*, A-1 male, USNM 1111779. A-E: A, Bellonci Organ and proximal part of right first antenna; B-D, Upper lip from left side, posterior, and anterior (not under cover slip); E, Fragments of food removed from gut. Adult female, USNM 1111777. F, G: F, Outline of complete carapace from left side, length 3.00 mm; G, Genitalia on left side of body (anterior to left).

the sclerotized flat bristles. Basis with 4 proximal bristles (1 plumose dorsal, 1 long slender lateral near endopod and with minute marginal spines, and 2 plumose medial bristles (1 long, 1 shorter) on small node). Basis endite: anterior margin with single distal bristle; posterior margin with proximal hairs, 1 short bristle proximal to 1 short tubular bristle; lateral side with 4 slender bristles forming row, 1 stouter and longer bristle distal bristle forming spiral, and 1 short stout tooth just proximal to distal end of endite; ventral edge of endite with 6 terminal cusps (posterior cusp smaller than others). Endopod with 3 articles. Article 1 with 1 spinous distal dorsal bristle. Article 2 with 2 spinous dorsal terminal bristles (1 claw-like with distal rings), and 1 spinous terminal ventral bristle. Article 3 with dorsal (anterior) and medial hairs, 3 medial terminal spinous bristles forming row, and 3 stout spinous terminal bristles [dorsal (anterior) of these with base slightly medial; middle bristle longest and with slightly recurved tip].

Maxilla (fourth limb) (Fig. 5D–I): Endite I with 2 proximal and 8 terminal bristles (2 tubular); endite II with 2 proximal and about 6 terminal (1 or 2 tubular) bristles; endite III with 1 proximal and about 5 terminal (about 2 tubular) bristles. Coxa with stout spinous dorsal bristle. Basis with 2 terminal bristles (1 dorsal, 1 ventral). Endopod: first article with 3 anterior and 3 distal posterior bristles; second article with long hairs along anterior margin, 2 stout pectinate terminal claws, and 4 terminal bristles.

Fifth limb (Fig. 6A): Epipod: dorsal group with 4 long bristles; middle group with 6 long bristles; ventral group with 5 bristles (4 long, 1 short). Precoxa and coxa with 18 bristles and 1 small spinous medial ventral process. Basis with 6 bristles. Exopod represented by 2 bristles (1 long bare, 1 shorter plumose). Endopod: first article with 3 bristles (2 ventral,

1 dorsal); second article with 2 long and 2 short bristles.

Sixth limb (Fig. 6B–D): Tip of limb extends well past tip of fifth limb. Epipod (Fig. 6C, D): dorsal group with 6 or 7 bristles; middle group with 6 bristles; ventral group with 5 bristles. Precoxa and coxa with 5 ventral bristles. Basis with 5 bristles. Exopod with 4 long bristles (Fig. 6B). Endopod: first and second articles fused, with 2 bristles (1 dorsal, 1 ventral) on second article; third article with 2 long claw-like bristles and 1 short slender bristle.

Seventh limb (Fig. 6C, E): With 3 terminal bristles (1 long, 2 shorter).

Furca (Fig. 6F): Each lamella with 5 claws followed by small node. Lamellae followed by unpaired bristle. Small glandular process between claws 1 and 2. Apron anterior to furca.

Bellonci Organ (Fig. 6G): Bifurcate distally, branches tapering to pointed tip.

Lips: Upper lip (Fig. 7A, B) and lower lip (Fig. 7C) similar to those of adult.

Gut content: Unidentified particulate matter.

*Description of A-2 instar* (sex unknown) (Fig. 7D–I).—Carapace oval in lateral view with slightly concave anterior margin and projecting glandular process on posterior corner of dorsal margin of right valve (Fig. 7D). Bifurcate bristles along anterior and ventral margins.

Ornamentation (Fig. 7E): In outside view with transmitted light, clear ovals visible lateral to reticulations; ovals located at intersections of underlying reticulations. Similar to ornamentation of adult female valves illustrated in Kornicker & Iliffe (1985:figs. 3–6).

Central adductor muscle attachments: Similar to those of adult female.

Carapace size (length, height in mm): USNM 1111773, 2.12, 1.21.

First antenna (Fig. 7F): Elongate, with 8 articles. Article 1 with distal lateral spines. Article 2 with spines and spinous dorsal bristle near midlength. Article 3

with spines and ventral bristle. Article 4 short with terminal dorsal bristle. Article 5 short with long terminal ventral bristle. Article 6 short, bare. Article 7 with short dorsal a-bristle and 2 long b- and c-bristles (latter with short widely separated marginal spines). Article 8 with long e-bristle with widely separated short marginal spines and shorter filament-like d-, f-, and g-bristles with few minute spines.

Second antenna (Fig. 7G–I): Protopod with distal spines near endopod. Endopod with 3 articles: article 1 with 2 dorsal bristles; article 2 with long filament-like f-bristle and much longer g-bristle with distal widely separated minute marginal spines; minute lateral triangular process on margin just dorsal to f-bristle; article 3 with long filamentous h-, i-, and j-bristles. Exopod with 9 articles: article 1 divided subterminally by weak medial suture, with 1 short terminal bristle; articles 2 to 8 with long bristle with natatory hairs; article 9 with 4 bristles (1 short, 1 medium, 2 long).

Mandible (Fig. 8A–D): Coxa endite with proximal and distal sets of teeth separated by space; proximal set with 4 stout cusps; numerous spines anterior and posterior to cusps and between cusps, and 1 indistinct small spinous bristle posterior to cusps. Stout rounded tooth between proximal and distal sets of teeth, with 2 spinous bristles adjacent to tooth. Distal set of teeth comprising 2 flat teeth; each with 5 or 6 cusps; 2 broad sclerotized flat bristles lateral to distal set of teeth; 1 small lateral bristle adjacent to bases of the sclerotized flat bristles. Basis with 4 proximal bristles (1 plumose dorsal, 1 long slender lateral near endopod and with minute marginal spines, and 2 plumose bristles on small medial node). Basis endite: anterior margin with single distal bristle; posterior margin with proximal hairs, 1 short bristle proximal to 1 short tubular bristle; lateral side with 4 proximal slender bristles, 2 stouter and longer entwined, spiral, distal bristles

(bristles cross each other 3 times; anterior bristle longer and stouter), and 1 short stout tooth just proximal to distal end of endite; ventral edge of endite with 6 terminal cusps (posterior cusp smaller than others). Endopod with 3 articles. Article 1 with 3 distal bristles (1 ventral, 1 dorsal, 1 medial). Article 2 with 4 spinous distal bristles (1 ventral, 3 dorsal, including 1 claw-like bristle with distal rings). Article 3 with dorsal (anterior) and medial hairs, 4 medial terminal spinous bristles forming row, and 3 stout spinous terminal bristles (dorsal (anterior) of these with base slightly medial; middle bristle longest and with slightly recurved tip).

Maxilla (fourth limb) (Fig. 8E–G): Endite I with 2 proximal and 9 terminal bristles (3 tubular); endite II with 2 proximal and 8 terminal (3 tubular) bristles; endite III with 1 proximal and 6 terminal (about 2 tubular) bristles. Coxa with stout spinous dorsal bristle. Basis with 2 terminal bristles (1 dorsal, 1 ventral). Endopod: first article with 3 anterior bristles and 4 distal posterior bristles; second article with long hairs along anterior margin, 2 stout pectinate terminal claws, and 4 terminal bristles.

Fifth limb (Fig. 9A): Epipod: dorsal group with 4 long bristles; middle group with 6 long bristles; ventral group with 5 bristles (4 long, 1 short). Precoxa and coxa with 22 bristles and 1 small spinous medial ventral process. Basis with 8 bristles. Exopod represented by 2 bristles (1 long bare, 1 shorter plumose). Endopod: first article with 4 bristles (3 ventral, 1 dorsal); second article with 2 long and 2 shorter bristles.

Sixth limb (Fig. 9B, C): Tip of limb extends well past tip of fifth limb. Epipod (Fig. 9C): dorsal group with 7 bristles; middle group with 6 bristles; ventral group with 5 bristles. Precoxa and coxa with 6 ventral bristles. Basis with 6 bristles. Exopod with 4 long bristles.

Endopod: first article with 2 ventral bristles; second article with 2 bristles (1 ventral, 1 dorsal); 3rd article with 2 long claw-like bristles and 2 slender bristles.

Seventh limb (Fig. 8H): With 3 terminal bristles (1 long, 2 shorter).

Furca (Fig. 9D): Each lamella with 6 claws followed by small node. Lamellae followed by unpaired bristle. Small glandular process between claws 1 and 2. Apron anterior to furca.

Bellonci Organ (Fig. 8I): Bifurcate distally, branches tapering to pointed tip.

Lips (Fig. 10A, B): Upper and lower lips similar to those of adult.

Gut content: Unidentified particulate matter.

*Description of A-1 male* (Figs. 10C–H, 14A–E).—Carapace oval in lateral view with slightly concave anterior margin and projecting glandular process on posterior corner of dorsal margin of right valve (Fig. 10C). Few bifurcate bristles along anterior and ventral margins.

Ornamentation: In outside view with transmitted light clear ovals visible lateral to reticulations; ovals located at intersections of underlying reticulations. Similar to ornamentation of adult female valves illustrated in Kornicker & Iliffe (1985:figs. 3–6).

Central adductor muscle attachments (Fig. 10D): Similar to those of adult female.

Carapace size (length, height in mm): USNM 1111779, 2.5, 2.0.

First antenna (Fig. 10E, F): Elongate with 8 articles. Article 1 with distal lateral spines. Article 2 with spines and spinous dorsal bristle near midlength. Article 3 with spines and ventral bristle. Article 4 short with terminal dorsal bristle. Article 5 short with long terminal ventral bristle. Article 6 short, bare, separated from fifth article by indistinct suture. Article 7 with short dorsal a-bristle and long b- and c-bristles with short widely separated marginal spines (b-bristle missing on both limbs of USNM 1111779, but loose bristle

present on slide). Article 8 with long e-bristle with widely separated short marginal spines and shorter filament-like d-, f-, and g-bristles with few minute spines.

Second antenna (Figs. 10G, H, 11A, B): Protopod with distal lateral spines near endopod and dorsal margin. Endopod with 3 articles: article 1 with 2 dorsal bristles; article 2 with long filament-like f-bristle and much longer g-bristle with widely separated minute marginal distal spines; minute lateral triangular process near f-bristle (triangular process with base on suture proximal to bases of f- and g-bristles); article 3 with long filamentous h-, i-, and j-bristles and small medial bristle near dorsal margin. Exopod with 9 articles: article 1 divided subterminally by weak medial suture, with 1 short medial terminal bristle and 2 or 3 medial bristles with bases proximal to terminal bristle; articles 2 with long bristle with proximal ventral spines and distal natatory hairs; articles 3 to 8 with long bristle with natatory hairs; article 9 with 4 bristles (1 short bare, 1 medium with ventral spines, 2 long bare). [Suture proximal to bases of f- and g-bristles of endopod suggests that bristles may be on third rather than second article. See Skogsberg (1920:580, 581) for discussion of numbering articles of endopod.]

Mandible (Figs. 11C–G, 12A): Coxa endite with proximal and distal sets of teeth separated by space; proximal set with 4 stout cusps; numerous spines anterior and posterior to cusps and between cusps, and 1 indistinct small spinous bristle posterior to cusps. Two teeth between proximal and distal sets of teeth, with 2 spinous bristles adjacent to teeth. Distal set of teeth comprising 2 flat teeth; each with 5 or 6 cusps; 2 broad sclerotized flat bristles lateral to distal set of teeth; 1 small lateral bristle adjacent to bases of the sclerotized flat bristles. Basis with 4 proximal bristles [1 long plumose dorsal, 1 long slender lateral near endopod and with minute marginal spines, and

2 bristles (1 long plumose, 1 short with indistinct short spines)]. Basis endite: anterior margin with single distal bristle; posterior margin with proximal hairs, 1 short bristle proximal to 1 short tubular bristle; lateral side with 4 proximal slender bristles, 2 stouter and longer entwined, spiral, distal bristles (bristles cross each other 3 times; anterior bristle longer and stouter), and 1 short stout lateral tooth just proximal to distal end of endite; ventral edge of endite with 6 terminal cusps (posterior cusp smaller than others). Endopod with 3 articles. Article 1 with 6 distal bristles (1 ventral, 1 dorsal, 4 medial). Article 2 with 4 spinous distal bristles [1 ventral, 3 dorsal (1 claw-like with distal rings)]. Article 3 with dorsal (anterior) and medial hairs, 5 medial terminal spinous bristles forming row, and 3 stout spinous terminal bristles [dorsal (anterior) of these with base slightly medial; middle bristle longest; both bristles with slightly recurved tip].

Maxilla (fourth limb) (Fig. 12B–D): Endite I with 2 proximal and about 10 terminal bristles (3 tubular); endite II with 2 proximal and about 9 terminal (3 tubular) bristles; endite III with 1 proximal bristle (terminal bristles obscured). Coxa with stout spinous dorsal bristle. Basis with 2 terminal bristles (1 dorsal, 1 ventral). Endopod: first article with 3 anterior bristles, 4 distal posterior bristles, and 3 medial bristles; second article with long hairs along anterior margin, 2 stout pectinate terminal claws, and 5 terminal bristles.

Fifth limb (Fig. 12E, F): Epipod fragmented, with bristles forming 3 groups. Precoxa and coxa with 24 bristles and 1 small spinous medial ventral process. Basis with 10 bristles. Exopod represented by 2 bristles (1 long bare, 1 shorter plumose). Endopod: first article with 4 bristles (3 ventral, 1 dorsal); second article with 2 long and 3 shorter bristles.

Sixth limb (Fig. 13A–C): Tip of limb extends well past tip of fifth limb. Epipod

(Fig. 13C): dorsal group with 7 bristles (dorsal bristle shorter); middle group with 6 bristles; ventral group with 5 bristles. Precoxa and coxa with 7 ventral bristles. Basis with 6 bristles. Exopod with 4 long bristles. Endopod: first article with 4 ventral bristles; second article with 3 bristles (2 ventral, 1 dorsal) (Fig. 13A); third article with 2 long claw-like bristles and 2 slender bristles (Fig. 13B).

Seventh limb (Fig. 12F): With 3 terminal bristles (1 long, 2 shorter).

Furca (Fig. 13D, E): Each lamella with 7 claws. Lamellae followed by unpaired bristle. Small glandular process between claws 1 and 2. Apron anterior to furca (Fig. 13E).

Bellonci Organ (Fig. 14A): Bifurcate distally, branches tapering to pointed tip.

Lips (Fig. 14B–D): Upper and lower lips similar to those of adult.

Copulatory organ (Fig. 13E, F): Comprising 2 elongate processes; posterior smaller process with 3 terminal teeth.

Gut content: Anterior end of gut near esophagus with animal fragments, some with sclerotized teeth (Fig. 14E).

*Supplementary description of adult female* (Fig. 14F, G).—Carapace Size: USNM 1111777, length 3.0 mm, height 2.3 mm (Fig. 14F).

Sixth limb: First endopod article with 6 bristles.

Genitalia (Fig. 14G): Left side of body posterior to sixth limb with 2 bristles adjacent to brown oval.

Eggs: USNM 1111777 with 4 small round unextruded eggs.

*Ontogenetic development.*—*Deeveya spiralis* was known previously from only the adult female (Kornicker & Iliffe 1985). The present collection contained in addition to an adult female, an A-1 male and 3 instars (A-3, A-2, and an A-1 male). The sexes of the A-2 and A-3 instars are not known. Kornicker et al. (2007:58) described the A-5 to A-1 instars and adults of *D. bransoni*. The total numbers of bristles on appendages of *D.*



Table 1.—Comparison of carapace lengths and number of bristles and claws on limbs of *Deeveya spiralis* Kornicker & Iliffe, 1985, and *D. bransoni* Kornicker & Palmer, 1987. Sex not determined for some instars; morphometrics of both sexes (if known) of instars combined. (ab = absent, B = bristles, F = female, M = male, P = present, — = specimens at particular stage unknown, ? = number of bristles uncertain.) Data on *D. bransoni* from Kornicker et al. (2007: Table 9).

Character	Stage					Adult	
	A-5	A-4	A-3	A-2	A-1	F	M
Carapace length (mm)							
<i>D. spiralis</i>	—	—	1.42	2.12	2.50	2.94	—
<i>D. bransoni</i>	0.58	0.73	0.92	1.20	1.60	2.03	2.02
Appendages (No. bristles and claws)							
First antenna							
<i>D. spiralis</i>	—	—	11	11	11	11	—
<i>D. bransoni</i>	4	9	11	11	11	11	11
Second Antenna							
Exopod							
<i>D. spiralis</i>	—	—	11	12	12	12	—
<i>D. bransoni</i>	9	10	11	12	12	12	12
Endopod (long B)							
<i>D. spiralis</i>	—	—	6	7	7	7	—
<i>D. bransoni</i>	5	6	6	7	7	7	7
Mandible							
Basis (No. entwined)							
<i>D. spiralis</i>	—	—	10(1)	11(2)	11(2)	11(2)	—
<i>D. bransoni</i>	7(0)	8(1)	10(1)	11(2)	11(2)	11(2)	11(2)
Endopod							
<i>D. spiralis</i>	—	—	10	14	18	19	—
<i>D. bransoni</i>	7	7	10	15	17	17–18	19
Maxilla							
Coxa/Basis							
<i>D. spiralis</i>	—	—	1/2	1/2	1/2	1/2	—
<i>D. bransoni</i>	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Endopod							
<i>D. spiralis</i>	—	—	12	13	17	17	—
<i>D. bransoni</i>	7	8	12	12	17	19	19
Fifth limb							
Precoxa + Coxa							
<i>D. spiralis</i>	—	—	18	22	24	28	—
<i>D. bransoni</i>	9	11	15	20	24	26	29
Basis							
<i>D. spiralis</i>	—	—	6	8	10	11	—
<i>D. bransoni</i>	3	4	5	8	10	12	10
Exopod							
<i>D. spiralis</i>	—	—	2	2	2	2	—
<i>D. bransoni</i>	2	2	2	2	2	2	2
Endopod							
<i>D. spiralis</i>	—	—	7	8	9	10	—
<i>D. bransoni</i>	2	5	7	7	8	9	9
Sixth limb							
Precoxa + Coxa							
<i>D. spiralis</i>	—	—	5	6	7	8	—
<i>D. bransoni</i>	ab	0?	5	5	8	8	8
Basis							
<i>D. spiralis</i>	—	—	5	6	6	7	—
<i>D. bransoni</i>	ab	0	4	6	6	7	7



Table 1.—Continued.

Character	Stage					Adult	
	A-5	A-4	A-3	A-2	A-1	F	M
Exopod							
<i>D. spiralis</i>	—	—	4	4	4	4	—
<i>D. bransoni</i>	ab	3	4	4	4	4	4
Endopod							
<i>D. spiralis</i>	—	—	5	8	11	12	—
<i>D. bransoni</i>	ab	2	5	8	11	13	13
Seventh limb							
<i>D. spiralis</i>	—	—	3	3	3	3	—
<i>D. bransoni</i>	ab	ab	3	3	3	3	3
Furca							
Number of claws							
<i>D. spiralis</i>	—	—	5	6	7	7	—
<i>D. bransoni</i>	3	4	5	6	7	7	7
Triangular process after claws							
<i>D. spiralis</i>	—	—	P	P	ab	ab	—
<i>D. bransoni</i>	P	P	P	P	ab	ab	ab
Unpaired bristle							
<i>D. spiralis</i>	—	—	1	1	1	1	—
<i>D. bransoni</i>	1	1	1	1	1	1	1

*bransoni* and *D. spiralis* are compared in Table 1. Although the numbers of bristles on like appendages differ slightly for the two species, the addition of bristles and claws on appendages is tentatively interpreted to be sufficiently similar to collectively use the data to briefly describe some changes that take place during the ontogeny of the genus.

Carapace: Similar in shape in all stages.

First antenna: The third and fourth segments are fused, and the fifth article is without a bristle on the A-5 and A-4 instars. The seventh article of the A-5 instar is without a b- and c-bristle, and the seventh article of the A-4 instar is without a b-bristle. The bristle on the fifth article of the A-3 instar is short and does not reach past the eighth article.

Second antenna: Endopod: Instars A-5 to A-3 with only 1 bristle on the first article. Exopod: Instars A-5 to A-3 with fewer than 4 bristles on the ninth article.

Mandible: The basis of later stages (A-2 to adult) bears 2 long entwined lateral bristles. Both bristles are absent on the A-5 instar, and only 1 bristle is present on the A-4 and A-3 instars.

Sixth limb: Absent on the A-5 instar, and does not extend past the posterior end of the fifth limb on the A-4 instar.

Seventh limb: Limb with bristles absent on instars A-5 and A-4.

Furca: Number of claws at each stage is A-5 = 3, A-4 = 4, A-3 = 5, A-2 = 6, A-1 and adult = 7. Instars A-5 to A-2 have a small triangular process following the claws.

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### Literature Cited

- Botosaneanu, L., & T. M. Iliffe. 2003. A new species of stygobitic cirolanid genus *Bahalana* from the Caicos Islands in the Caribbean (Isopoda: Cirolanidae).—*Travaux du Musée National d'Histoire Naturelle "Grigore Antipa"* 45: 83–93.
- Bowman, T. E., J. Yager, & T. M. Iliffe. 1985. *Speonebalia cannoni*, n. gen., n. sp., from the Caicos Islands, the first hypogean leptostracan (Nebaliacea: Nebaliidae).—*Proceedings of the Biological Society of Washington* 98:439–446.
- Dana, J. D. 1853. Tribe III: Cyproidea = Ostracoda. Crustacea. In *United States Exploring Expedition During the Years 1838, 1839, 1840, 1841, 1842, Under the Command of Charles Wilkes, U.S.N., with Atlas of 96 plates 13(2):1277–1304, plates 90, 91*. C. Sherman, Philadelphia.
- Darwin Initiative. 2002. Plan for Biodiversity Management and Sustainable Development around Turks & Caicos Ramsar Site, Version 1.0. 225 pages (reprinted at: [http://www.ukotcf.org/pubs/tci\\_ramsar.htm](http://www.ukotcf.org/pubs/tci_ramsar.htm)).
- Fosshagen, A., & T. M. Iliffe. 1994. A new species of *Erebonectes* (Copepoda, Calanoida) from marine caves on Caicos Islands, West Indies.—*Hydrobiologia* 292/293:17–22.
- , & ———. 2007. New species of epactericiscids (Copepoda, Calanoida) from anchialine caves in the Caicos Islands and the Bahamas.—*Marine Biology Research* 3:73–92.
- Gregor, V. A. 1981. Karst and caves in the Turks and Caicos Islands, B.W.I.—*Proceeding of the 8th International Congress of Speleology*, Bowling Green, pp. 805–807.
- Hart, C. W., Jr., & R. B. Manning. 1986. Two new shrimps (Procaridae and Agostocarididae, new family) from marine caves of the western North Atlantic.—*Journal of Crustacean Biology* 6:408–416.
- Koenemann, S., T. M. Iliffe, & J. Yager. 2004. *Kaloketos pilosus*, a new genus and species of Remipedia (Crustacea) from the Turks and Caicos Islands.—*Zootaxa* 618:1–12.
- , ———, & J. van der Ham. 2007. Micropacteridae, a new family of Remipedia (Crustacea) from the Turks and Caicos Islands.—*Organisms, Diversity & Evolution* 7:52e1–52e14.
- Kornicker, L. S., & T. M. Iliffe. 1985. Deeveyinae, a new subfamily of Ostracoda (Halocyprididae) from a marine cave on the Turks and Caicos Islands.—*Proceedings of the Biological Society of Washington* 98:476–493.
- , & R. J. Palmer. 1987. *Deeveya bransoni*, a new species of troglobitic halocyprid ostracode from anchialine caves on South Andros Island, Bahamas (Crustacea: Ostracoda).—*Proceedings of the Biological Society of Washington* 100:610–623.
- , T. M. Iliffe, & E. Harrison-Nelson. 2007. Ostracoda (Myodocopa) from anchialine caves and ocean blue holes.—*Zootaxa* 1565:1–151.
- , J. Yager, & D. Williams. 1990. Ostracoda (Halocyprididae) from anchialine caves in the Bahamas.—*Smithsonian Contributions to Zoology* 495:1–51.
- Pettibone, M. 1985. Worms from a cave in the Bahamas and from experimental wood panels in deep water off the North Atlantic (Polinoidea: Macelliephalinae, Harmothoinae).—*Proceedings of the Biological Society of Washington* 98:127–149.
- Richards, D. A. 2000. Counting drips in Conch Bar Cave.—*Astrolab*. Spring 2000 (reprinted at: <http://www.timespub.tc/Astrolabe/Archive/Spring2000/cave.htm>).
- Schram, F., J. Yager, & M. Emerson. 1986. Remipedia. Part I. Systematics.—*Memoirs of the San Diego Society of Natural History* 15:1–60.
- Skogsberg, T. 1920. Studies on Marine Ostracods, I: Cypridinodes, Halocyprids, and Polyco-pids.—*Zoologiska Bidrag från Uppsala*, supplement 1:1–784.
- Suárez-Morales, E., & T. M. Iliffe. 1996. New superfamily of Calanoida (Copepoda) from an anchialine cave in the Bahamas.—*Journal of Crustacean Biology* 16:754–762.
- Yager, J., & F. Schram. 1986. *Lasionectes entrichoma*, new genus, new species, (Crustacea: Remipedia) from anchialine caves in the Turks and Caicos, British West Indies.—*Proceedings of the Biological Society of Washington* 99:65–70.

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