

Troglobitic Ostracoda
(Myodocopa: Cypridinidae,
Thaumatocyprididae) from
Anchialine Pools on Santa
Cruz Island, Galapagos Islands

LOUIS S. KORNICKER

and

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Santa Cruz Island, Galapagos Islands

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ABSTRACT

Kornicker, Louis S., and Thomas M. Iliffe. Troglobitic Ostracoda (Myodocopa: Cypridinidae, Thaumatoocyprididae) from Anchialine Pools on Santa Cruz Island, Galapagos Islands. *Smithsonian Contributions to Zoology*, number 483, 38 pages, 17 figures, 15 tables, 1989.—Two new species, *Skogsbergia galapagensis* and *Danielopolina styx*, are described from 3 anchialine pools (grietas) in fissures on the south coast of Santa Cruz Island, Galapagos Islands. *Skogsbergia galapagensis* is the first known troglobitic Cypridinidae. *Danielopolina styx* is the first troglobitic *Danielopolina* from the Pacific, and the fifth troglobite in the genus to be described. The ontogeny of both species is described, and the ontogeny of *S. galapagensis* is compared to that of *S. leneri*, an open sea, shallow water Atlantic form, and found to be similar.

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Troglobitic Ostracoda (Myodocopa: Cypridinidae, Thaumatocyprididae) from Anchialine Pools on Santa Cruz Island, Galapagos Islands

Louis S. Kornicker and Thomas M. Iliffe

Introduction

Extensive recent faulting has occurred in the Galapagos Islands. Among the most notable locations is the south coast of Santa Cruz Island, where faults may be up to 20 km long and generally trend in an east-west direction, parallel to the coast. Some of these faults may have been formed within the last few thousand years (McBirney and Williams, 1969). Apparently all the faulting is normal faulting, in which one crustal block has moved up or down with respect to its neighbor along a nearly vertical fracture or fault plane (Simkin, 1984). Such faulting has produced an impressive series of high cliffs and deep fissures. Some of these fissures nearer to the coast extend down to anchialine pools, locally referred to as "grietas." Typically, fissures and grieta pools consist of opposite-facing sheer rock walls 1–10 m apart and up to 30 m high. Large collapse breakdown blocks, which were probably generated by the earthquakes forming the fissure, make up the floor. Occasionally, talus caves occur, both above and below water, where it is possible to enter totally dark areas under the breakdown and between fissure walls.

Deep Grieta (Sta 87-005) is located about 250 m east of the beach at Tortuga Bay and 80 m inland, behind a conspicuous round lava mound. This large grieta pool runs parallel to the coast. It is situated between 10 m high cliffs and is about 8 m wide by 40 m long. Maximum depth in the pool is 12 m. The rear part of the pool is roofed over with well-wedged collapse blocks and is thus in darkness. Some root masses extend down into the water in this section of the pool. Water temperature measured on 3 May 1987 decreased slightly with depth in the

pool, while salinity increased from 8 ‰ to 22 ‰ at 12 m (Table 1). Collections had been made previously from this grieta by Peck and Peck (1986) and Peck and Kulalova-Peck (1986). In addition to ostracodes, large numbers of the blind shrimp *Typhlatya galapagensis* Monod and Cals, 1970, are present in the pool, especially at the greater depths.

Grieta de Caleta la Torta (Sta 87-018) is located 7 km west of Puerta Ayora on the south coast of Santa Cruz Island. It is situated about 100 m inland from a small but well-protected bay. The grieta is at the western end of a prominent 15 to 20 m high cliff and consists of 3 long pools separated by collapse barriers. All collections were made in the first (eastern-most) pool, 3–5 m wide by 100 m long. By passing through a narrow hole between breakdown blocks at 12 m depth, a large chamber was reached, which extended to 29 m depths. This chamber contained clear water in total darkness. Water temperatures in the pool were nearly constant throughout, while salinity increased with depth from 9 ‰ at the surface to 29 ‰ at 17 m (Table 1). In addition to ostracodes, copepods, amphipods, several *T. galapagensis*, and a red hippolytid shrimp (being studied by Dr. A.J. Bruce, Darwin, Australia) were collected in the pool.

The grieta north of the trail to Tortuga Bay (Sta 87-021B) is probably the same one visited by Peck and Peck (1986:43). This grieta is located about 100 m past the last house in Puerta Ayora on the trail to Tortuga Bay. Immediately on the north side of this trail is a sheer-walled fissure 1 to 2 m wide by 10 m deep. About 30 m along this fissure is a 30 m long pool divided by breakdown into 2 sections. A small electric pump is used to take water from the pool, probably for domestic purposes. In the second part of the pool, a deep crack extends down underwater past a marked halocline at 9 m before ending in collapse at 10 m depth. Moderate tidal currents are present

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TABLE 1.—Temperature and salinity depth profiles for grietas on Santa Cruz Island, Galapagos Islands, from which myodocopid ostracodes were collected.

Locality	Temperature (°C)	Salinity (‰)
Deep Grieta east of Tortuga Bay, 3 May 1987, sta 87-005		
Surface	24.8	8
1 m	24.2	9
3 m	24.0	10
12 m	23.1	22
Grieta de Caleta la Torta, 30 April 1987, sta 87-018		
Surface	22.8	9
1 m	22.8	9
3 m	22.8	11
17 m	22.3	29
Grieta north of trail to Tortuga Bay, 18 June 1987, sta 87-021B		
Surface	22.7	1.5
3 m	22.7	1.5
9 m	22.7	12.5
10 m	22.7	13.0

at the surface of the pool. The deepest part of the pool is in nearly total darkness as are narrow sections of the fissure extending through the breakdown at either end of the pools. Water temperatures were uniform, and the salinity changed sharply at the 9 m deep halocline from 1.5 ‰ to 12.5 ‰ (Table 1).

COLLECTING METHODS.—Sta 87-005: Ostracodes (*Danielopolina styx* and *Skogsbergia galapagensis*) were observed to be swimming in the water column at 6–12 m depths and were collected on 3 May 1987 by Thomas M. Iliffe and Jacqueline Tracey with a suction bottle and a 93 µm mesh plankton net. Sta 87-018: Specimens of *D. styx* were collected with a plankton net towed by a diver at 17 to 29 m depths; specimens of *S. galapagensis* were collected 8–12 June 1987 by Thomas M. Iliffe with plastic bottle traps (Manning, 1986) baited with a crushed crab and left overnight at 10–18 m water depth (most specimens came from traps at 17–18 m depths). Sta 87-021B: Specimens of *S. galapagensis* were collected 18–19 June 1987 by Thomas M. Iliffe in a plastic bottle trap baited with a crushed crab and left overnight at 9–10 m water depth. All specimens have been deposited at the National Museum of Natural History and have been given USNM numbers.

ABBREVIATIONS.—The following abbreviations are used in the illustrations: ant., antenna; B.O., Bellonci organ; endop., endopodite; exop., exopodite; u.p., unpaired process.

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commenting on the manuscript, Jack R. Schroeder, Schroeder Prints, Inc., Crisfield, Maryland, for inking illustrations of appendages, Molly Ryan, Smithsonian Institution, for rendering the carapace of *D. styx*, Elizabeth Harrison-Nelson, Smithsonian Institution, for general technical assistance, and Don Fisher, Smithsonian Institution Press, for final editing and preparation of the manuscript for publication. This paper is contribution No. 1140 of the Bermuda Biological Station for Research.

Zoogeography

Danielopolina styx is the second example of a troglobitic species from the Galapagos Islands whose congeners are otherwise restricted to the Atlantic Ocean. Atlantic species of *Danielopolina* are found in caves in the Bahamas, Canary Islands, Cuba, and Mexico (Yucatan Peninsula) as well as from a depth of 3459 m in the South Atlantic (Kornicker and Iliffe, in press a). The other troglobite example from the Galapagos is *Typhlatya galapagensis*, a caridean shrimp. The genus *Typhlatya* is represented by 8 other species inhabiting caves and anchialine pools in Ascension Island, Barbuda, Bermuda, Caicos Islands, Cuba, Dominican Republic, Mexico (Campeche and Yucatan Peninsula), and Puerto Rico (Mona Island). It seems likely that the ancestors of both *Danielopolina* and *Typhlatya* in the Galapagos reached the Pacific prior to the closing of the Panama land bridge in the Pliocene. Indeed, *Danielopolina* and 6 other troglobitic invertebrate genera having an ampho-Atlantic distribution may have colonized caves at an early stage in the formation of the Atlantic, perhaps during the Mesozoic, and were subsequently dispersed on plates through sea floor spreading (Iliffe et al., 1984; Hart et al., 1985; Wagele, 1985; Wilkens et al., 1986). The ancestors of *Danielopolina* have been reported from the Permian of Idhra Island, Greece, and the Lower and Upper Jurassic of Germany (Kornicker and Sohn, 1976). Thus, *Danielopolina* is an apparently ancient form having its origins in the Tethys Sea, and dispersal of its ancestors was greatly influenced by plate movement. The present distribution of the genus in marine caves and in the deep sea suggests that the descendants of an initially shelf form in the Mesozoic later found refuge in caves and the deep sea; possibly shelf forms could not survive increased competition from abundant new post-tethyan shelf taxa. However, other scenarios that cannot be excluded have been suggested for cave and deep sea invertebrates by others (Iliffe et al., 1983; Stock, 1986).

Superorder MYODOCOPA Sars, 1866

COMPOSITION.—The Myodocopa comprise 2 orders: Myodocopida Sars, 1866, and Halocyprida Dana, 1853, both with representatives in the anchialine caves of the Galapagos Islands.

Order MYODOCOPIDA Sars, 1866

COMPOSITION.—This order contains only the suborder Myodocopina Sars, 1866.

Suborder MYODOCOPINA Sars, 1866

COMPOSITION.—This suborder comprises 5 families of which 4, Philomedidae, Sarsiellidae, Rutidermatidae, and Cylindroleberididae, have been reported from anchialine caves in Bermuda (Kornicker and Iliffe, in press b). All of the Bermudan cave myodocopine ostracodes have eyes similar to the same species, or to closely related species, collected in shallow waters of the open sea, and it was concluded by Kornicker and Iliffe (in press b) that none were troglobites. The troglobitic myodocopine described herein is a member of the Cypridinidae, a family not collected in Bermudan caves, nor in open water outside the caves (the latter is possibly because of insufficient collecting).

CYPRIDINIDAE Baird, 1850

COMPOSITION.—The Cypridinidae comprise 2 subfamilies of which none has been reported previously from anchialine caves, but only in the open sea, at shallow to abyssal depths. Only the Cypridininae is represented in the present collection.

CYPRIDININAE Baird, 1850

COMPOSITION.—The Cypridininae comprise 21 genera in 2 tribes, Cypridinini and Gigantocypridinini, some widespread, others with limited distribution.

CYPRIDININI Baird, 1850

COMPOSITION.—The Cypridinini comprise 20 genera, of which only *Skogsbergia* is represented in the anchialine caves of the Galapagos Islands.

Skogsbergia Kornicker, 1974

Skogsbergia Poulsen, 1962:162 [nomen nudum].—Kornicker, 1974:3 [selected type species].

TYPE SPECIES.—*Skogsbergia minuta* Poulsen, 1962, by Kornicker (1974:3).

COMPOSITION AND DISTRIBUTION.—Ten species are referred to *Skogsbergia*, including the new species described herein (Table 2). Species of the genus are widespread between latitudes of 60°N and 34°S, and except for *S. galapagensis*, live in the open sea, most at shelf depths.

Skogsbergia galapagensis, new species

FIGURES 1-10

ETYMOLOGY.—From the collecting area.

MATERIAL.—*Holotype*: Sta 87-018: USNM 193420, 1

adult female in alcohol and on slide.

Allotype: Sta 87-005: USNM 193423, 1 adult male in alcohol and on slide.

Paratypes: Sta 87-005: USNM 193434, 8 specimens in alcohol. Sta 87-018: USNM 193422, 4 adult females in alcohol; USNM 193424, 1 instar I in alcohol and on slide; USNM 193425, 1 instar II in alcohol and on slide; USNM 193426, 1 instar III in alcohol and on slide; USNM 193427, 1 male instar IV in alcohol and on slide; USNM 193428, 1 female instar IV in alcohol; USNM 193429, 1 male instar V in alcohol and on slide; USNM 193430, 1 female instar V in alcohol; USNM 193431 1 adult female in alcohol; USNM 193432, 18 specimens in alcohol. Sta 87-021B: USNM 193433, 6 specimens in alcohol.

DISTRIBUTION.—Santa Cruz Island, Galapagos Islands: Deep Grieta east of Tortuga Bay at 6–12 m water depth; Grieta de Caleta la Torta at 10–18 m water depth (type locality); grieta north of trail to Tortuga Bay at 9–10 m water depth.

DESCRIPTION OF ADULT FEMALE (Figures 1–4c).—Carapace oval in lateral view with small incisor at midheight and narrow but distinct caudal process (Figure 1a); ventral and dorsal margins convex; tip of rostrum with minute denticulations (Figure 1c). Outer surface of valves smooth.

Infold (Figure 1b–e): Rostral infold with 1 short and 4 long divided hirsute bristles in addition to 2 divided bristles (1 long, 1 short) near inner edge of incisor (Figure 1b,c); 1 small slender divided bristle just ventral to inner end of incisor; anteroventral infold with 28–34 spinous divided hirsute bristles forming row just distal to narrow list (Figure 1b); ventral infold with 3–6 widely separated short bristles along narrow list; left valve only with bristle at midwidth of ventral infold just anterior to caudal process; list broadening anterior to caudal process and forming inner margin of infold, with 3 or 4 small bristles and numerous pores perpendicular to list and leading to its posterior edge (Figure 1d,e). 7–10 minute pores forming row along outer edge of infold of caudal process; 2 or 3 minute pores near outer edge of caudal process visible through infold and leading to slender bristle on outer surface of valve (Figure 1d,e). Right valve with sclerotized bar along inner edge of posterior infold dorsal to caudal process (Figure 1e).

Selvage (Figure 1b): Selvage without fringe. Anterodorsal selvage along rostrum narrow, broadening and becoming narrowly striate along dorsal and ventral edges of incisor, dividing at inner end of incisor, narrow along anteroventral and ventral margins of valve, and absent along outer edge of caudal process and posterior edge of valve.

Size: USNM 193420, length 2.09 mm, height 1.36 mm; USNM 193431, length 2.02 mm, height 1.35 mm. USNM 193422, 4 specimens: length 2.07 mm, height 1.38 mm; length 2.10 mm, height 1.35 mm; length 2.14 mm, height 1.40 mm; length 2.04 mm, height 1.41 mm.

First Antenna (Figures 1f,g, 3g): 1st joint bare. 2nd joint spinous. 3rd joint short with medial spines forming rows and 2 short spinous bristles (1 ventral, 1 dorsal). 4th joint with 2

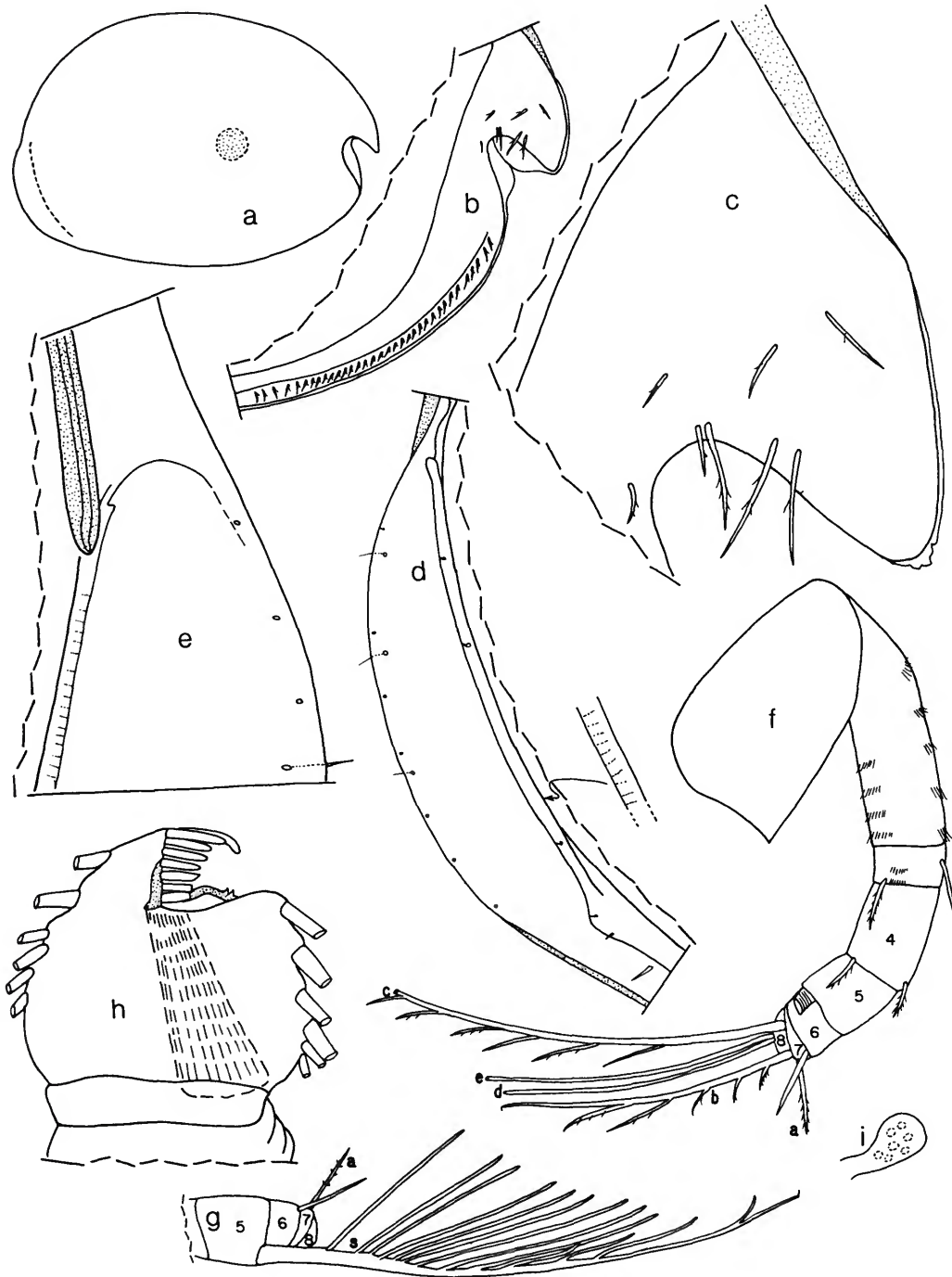


FIGURE 1.—*Skogsbergia galapagensis*, new species, USNM 193420, holotype, adult female: *a*, complete specimen from right side, length 2.09 mm, area of central adductor muscle attachments stippled, inner margin of infold of caudal process as viewed through shell dashed; *b*, inside view of anterior of left valve; *c*, detail from *b*; *d*, inside view of caudal process of left valve; *e*, dorsal end of caudal process of right valve; *f*, left 1st antenna, medial view, only base of sensory bristle of 5th joint shown; *g*, tip of left 1st antenna showing filaments of sensory bristle of 5th joint; *h*, tip of 7th limb; *i*, lateral eye.

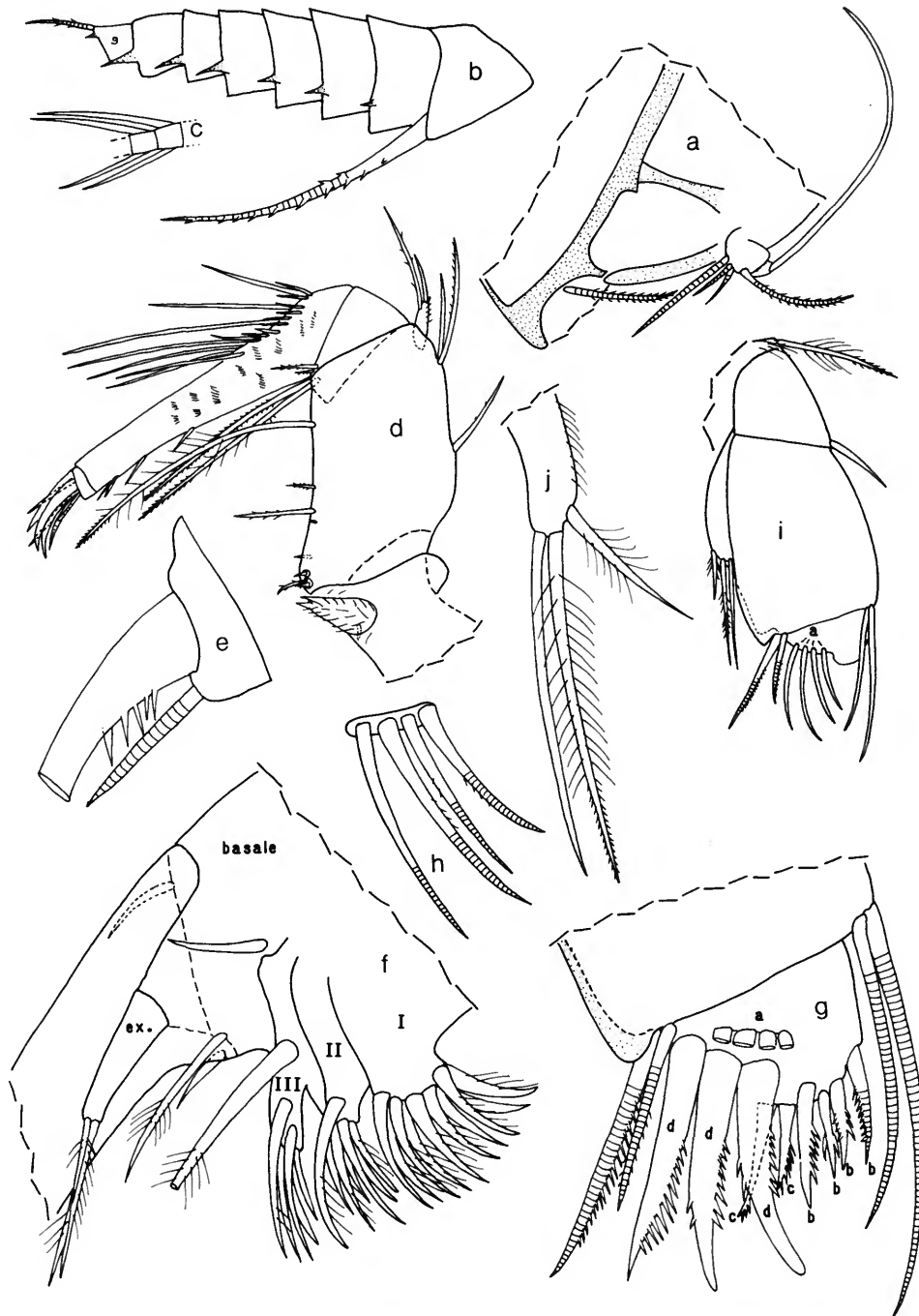


FIGURE 2.—*Skogsbergia galapagensis*, new species, USNM 193420, holotype, adult female: a, distal part of protopodite and endopodite of right 2nd antenna, medial view; b, joints 2-9 of exopodite of right 2nd antenna, lateral view, all bristles not shown; c, marginal hairs near midlength of bristle of 3rd exopodial joint of right 2nd antenna, ventral edge on top; d, right mandible, medial view; e, base of medial claw and short ventral bristle on 3rd joint of mandible shown in d; f, left maxilla, lateral view, bristles of endopodial joints not shown. g-j, right maxilla: g, bristles of 1st and 2nd endopodial joints, lateral view, only bases of a-bristles shown; h, a-bristles of 2nd endopodial joint; i, lateral view, neither endites nor all bristles shown; j, medial view of exopodite.

short spinous bristles (1 ventral, 1 dorsal). Stout sensory bristle of 5th joint with 9 long filaments followed by 3 short filaments and 1 smaller filament (long filaments with minute terminal papillae; short filaments and tip of bristle with minute terminal spine) (Figure 1g). 6th joint with short medial bristle near dorsal margin. 7th joint: a-bristle about same length as bristle of 6th joint, with few marginal spines; b-bristle about 4 times length of a-bristle, with 3 short filaments followed by 2 longer filaments (filaments with few marginal spines; bristle and filaments with terminal spine); c-bristle about $\frac{1}{3}$ longer than sensory bristle of 5th joint, with 8 short filaments followed by 1 longer filament and 1 very small subterminal filament (some filaments with short marginal spines; filaments and bristle with terminal spine). 8th joint: d- and e-bristles about same length as b-bristle, with blunt tips; f-bristle long (tip broken off on holotype), with 7 marginal filaments, some with marginal spines; g-bristle long (tip broken off on holotype) with 10 marginal filaments, some with marginal spines.

Second Antenna (Figure 2a-c): Protopodite with short spinous distal medial bristle. Endopodite 2-jointed: 1st joint with 3 bare proximal bristles (1 long, 2 short) and 1 spinous distal bristle (about same length as long proximal bristle); 2nd joint short, with long terminal filament with blunt tip (Figure 2a). Exopodite (Figure 2b,c): bristle of 2nd joint reaching 9th joint, ventral margin of bristle with about 6 stout spines (3rd or 4th spine from proximal end stouter) followed by 2 slender spines and stout subterminal spine; dorsal margin of bristle with few slender proximal spines; tip of bristle with narrowly ringed segment; bristles of joints 3 and 4 with slender proximal ventral spines and broad spine-like ventral hairs at midlength followed by slender natatory hairs (Figure 2c); bristles of joints 5-8 with natatory hairs; 9th joint with 4 bristles (3 long with natatory hairs, 1 small with few short hairs); joints 3-8 with slender sharply pointed basal spines increasing in length on distal joints (spine of 8th joint reaching past distal margin of 9th joint) (Figure 2b); 9th joint with small lateral spine near dorsal margin.

Mandible (Figure 2d,e): Coxale endite spinous with 2 stout terminal prongs with small process between them; minute bristle near base of endite. Basale: ventral margin with 3 small a-bristles (distal unringed), 1 small lateral b-bristle, 2 spinous c-bristles, 1 long spinous d-bristle, and 1 minute medial bristle just proximal to c-bristles; dorsal margin with 1 bristle (with few spines) at midlength and 2 subterminal (bare or with few spines). Exopodite about $\frac{3}{4}$ length dorsal margin of 1st endopodial joint, hirsute distally, with 2 subterminal bristles (proximal bristle spinous, about twice length distal bristle). 1st endopodial joint with 4 ventral bristles (2 long, 1 short, 1 minute). 2nd endopodial joint: ventral margin with bristles forming 3 groups comprising 1, 1, and 2 short slender bristles (lateral bristle of distal pair shorter than medial bristle); dorsal margin and medial surface near dorsal margin with about 14 short bristles (not all shown on illustrated limb), 1 or 2 slightly longer bristles, and 6 long bristles (some with bases on lateral

side); medial surface with spines forming rows. 3rd endopodial joint with 3 short claws (medial and lateral claws with stout proximal spines (Figure 2e); shorter dorsal claw bare) and 4 bristles (ventral bristle short; no bristles swollen near base).

Maxilla (Figure 2f-j): Endites I-III with about 10, 7, and 6 bristles, respectively; 1 short bristle near base of endite III (on basale?) (Figure 2f). Precoxale and coxale with dorsal fringe of long hairs; coxale with hirsute dorsal bristle with long proximal and short distal hairs (Figure 2i). Basale with 3 distal bristles: 1 short dorsal, 2 ventral (1 medial short, 1 long lateral). Exopodite with short proximal bristle with base close to 2 terminal bristles (proximal bristle with long proximal hairs; outer terminal bristle with long hairs followed by shorter hairs) (Figure 2j). 1st endopodial joint with 2 bare alpha-bristles, 2 beta-bristles (outer pectinate, inner with few hairs), and smoothly rounded terminal tooth on inner margin (Figure 2g). 2nd endopodial joint with 4 a-bristles with few proximal spines (Figure 2h), 3 or 4 pectinate b-bristles (presence of 4th b-bristle on right limb probably aberrancy), 2 pectinate c-bristles, and 3 stout pectinate d-bristles (Figure 2g).

Fifth Limb (Figure 3a-c,f): Sclerotized anterior process of protopodite elongate, undulate, with smoothly rounded tip (Figure 3b). Endites I and II each with 5 or 6 bristles; endite III with 6 or 7 bristles. 1st exopodial joint: anterior side with 1 proximal bristle (with long proximal and short distal spines) near process of protopodite and 3 distal bristles forming row (outer bristle stout with long proximal spines and pectinate distally; inner bristles with long proximal and short distal spines); main tooth comprising triangular peg followed by 6 pectinate teeth; bristle with long proximal hairs and short distal spines present proximal to peg of main tooth. 2nd exopodial joint with 4 stout pectinate unringed a-bristles, 6 pectinate b-bristles (ringed distally), c-bristle with long proximal and short distal spines, and long anterior d-bristle with long proximal and short distal spines. 3rd exopodial joint with 3 bristles on inner lobe and 2 on outer lobe (on left limb of USNM 193420, both bristles of outer lobe with long proximal hairs, on right limb only outer bristle with long hairs); fused 4th and 5th joints with 4 or 5 bristles.

Sixth Limb (Figure 3d,e): Endites with total of 16-19 bristles: endite I with 3 or 4 bristles (1 or 2 short proximal, 2 longer terminal); endite II with 3 or 4 bristles (1 or 2 short medial proximal, 2 terminal); endite III with 4 or 5 bristles (0 or 1 medial proximal, 4 terminal); endite IV with 5-7 bristles (1 medial proximal, 4-6 terminal). End joint with 13-15 bristles (posterior 2 plumose, others with long proximal hairs and short distal spines, or only short spines). Stem with 3 or 4 bare epipodial bristles.

Seventh Limb (Figure 1h): Each limb with 18 or 19 bristles (12 in terminal group, 6 on each side, and 6 or 7 in proximal group, 3 or 4 on each side), each with up to 7 bells (most with 4 bells, 2 with only 1 bell). Terminal comb with 11 teeth (3 long teeth in middle, and on each side 4 shorter teeth with rounded tips and 2 short teeth with square tips). Surface

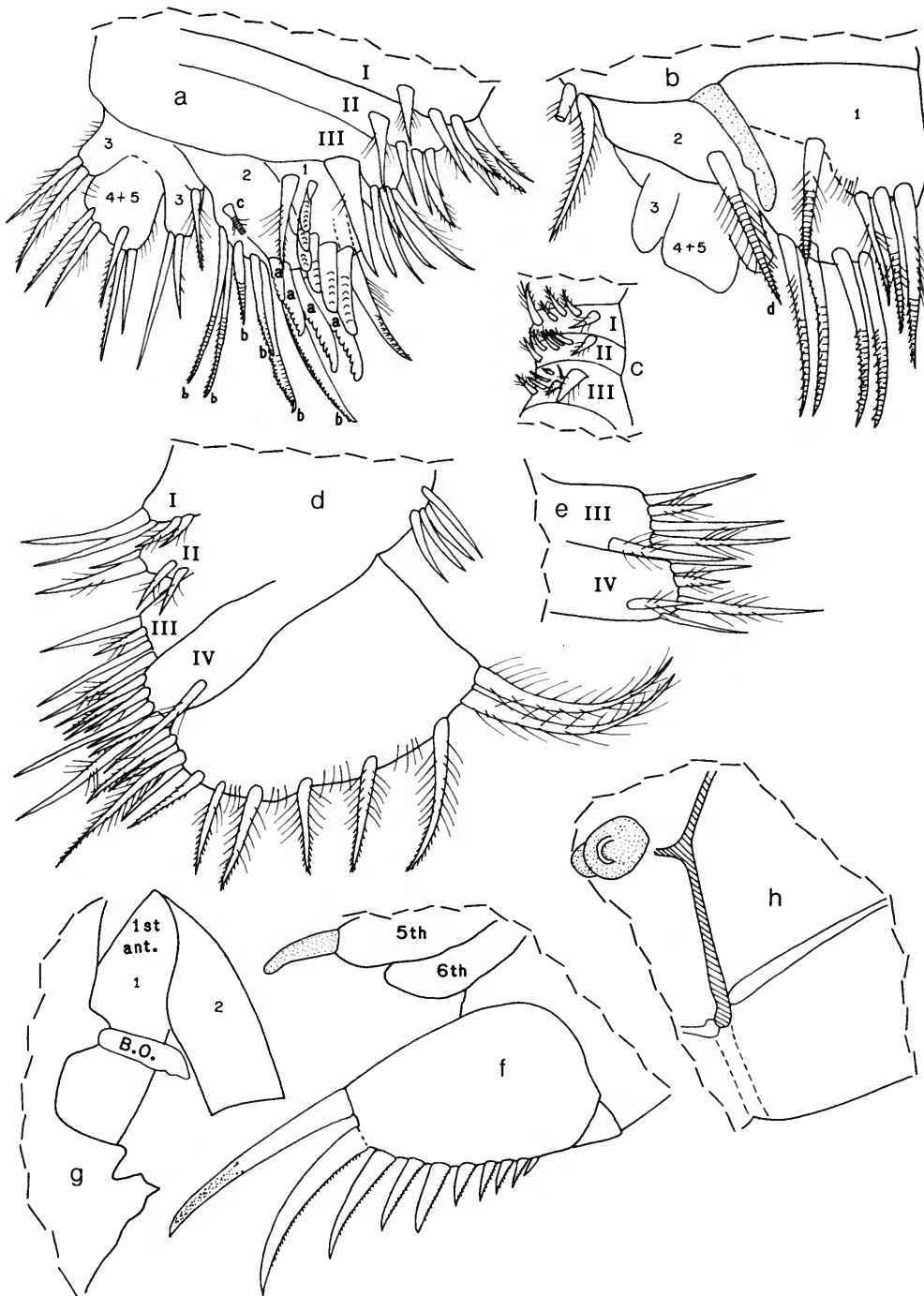


FIGURE 3.—*Skogsbergia galapagensis*, new species, USNM 193420, holotype, adult female: *a*, left 5th limb, posterior view; *b*, right 5th limb, anterior view, not all bristles shown; *c*, endites of right 5th limb, medial view (limb not under cover slip); *d*, right 6th limb, medial view; *e*, endites III and IV of left 6th limb, medial view; *f*, left lamella of furca, anterior process of protopodite of 5th limb, and location of 6th limb; *g*, anterior of body showing 1st and 2nd joints of left 1st antenna, Bellonci organ attached to medial eye, and anterior process; *h*, posterior of body from left side showing genitalia (stippled) and Y-sclerite (lined).

opposite comb with 4 minute teeth (2 on each side; only closer 2 shown on Figure 1h).

Furca (Figure 3f): Each lamella with 10 claws; claw 2 broader distally than claw 1 but about same width at base; claw 5 slightly broader than claw 4 but about same length, and narrower as well as shorter than claw 3; claw 2 with weak basal suture defined best at anterior and posterior ends; claw 1 with slender teeth along posterior edge and stouter medial teeth forming row with stouter teeth at claw midlength; remaining claws with slender teeth along posterior margin forming lateral and medial row; right lamella slightly anterior to left and with few indistinct spines along anterior margin.

Bellonci Organ (Figure 3g): Elongate with tapering tip.

Eyes: Medial eye small, unpigmented (Figure 3g). Lateral eye indistinct, unpigmented, minute, with globular cells but no ommatidia (Figure 1i).

Upper Lip (Figure 4a,b): Anterior part undivided and with glandular openings along both anterior and ventral margins; posterior part paired and with ventral glandular openings; 2 small lobes with few glandular openings present lateral to posterior end of each paired part; posterior of lip rounded hirsute.

Genitalia (Figure 3h): Comprising ring on each side of body.

Anterior of Body (Figures 3g, 4a): Single sclerotized process with pointed tip present between upper lip and medial eye.

Posterior of Body (Figure 4c): Bare and without dorsal process. Posterodorsal margin dorsal to sclerotized internal girdle slightly scalloped in lateral view with indentations caused by banded muscles (not segmented).

Y-Sclerite (Figure 3h): Typical for subfamily.

Eggs: No ovigerous females in collection.

Gut Content: 5 specimens (USNM 193420, 193422) with gut gorged with fine grained unidentified substance appearing white in reflected light and light amber in transmitted light.

DESCRIPTION OF ADULT MALE (Figure 4d-k).—Carapace similar to that of adult female but smaller, and rostrum more rounded (Figure 4d,e).

Infold (Figure 4f,g): Bristles of rostrum and caudal process similar to those of adult female. Anteroventral infold with 24 bristles forming row.

Size: USNM 193423, length 1.76 mm, height 1.10 mm.

First Antenna (Figure 4h,i): Joints 1–6 similar to joints of adult female except for smaller ventral bristle on 4th joint. 7th joint: a-bristle small, similar to that of adult female; b-bristle about 7 times length of a-bristle, not as long as sensory bristle of 5th joint, with bulbous base bearing both short filament (with large transparent sucker at midlength and small subterminal node) and stem with 2 slender marginal filaments (proximal with 6, distal with 8 minute suckers), followed by 2 slender marginal filaments (each with about 4 minute marginal spines), and minute terminal papilla; c-bristle almost twice length of b-bristle, with bulbous base bearing both short

filament (with large transparent sucker at midlength and small subterminal node) and stem with 2 slender marginal filaments (each with 8 minute suckers), followed by 6 long slender marginal filaments (some with few marginal spines) and short subterminal filament; tip of stem blunt. 8th joint: d- and e-bristles slightly shorter than b-bristle, bare with blunt tips; f- and g-bristles about same length as c-bristle, both with many long proximal hair-like filaments followed by about 7 stouter filaments and terminal papilla.

Second Antenna: Protodipite with short spinous distal medial bristle. Endopodite 2-jointed (similar to that of adult female): 1st joint with 3 proximal bristles (1 long, 2 short) and 1 spinous distal bristle (slightly shorter than long proximal bristle); 2nd joint small, with long terminal filament. Exopodite without medial terminal bristle on 1st joint (also absent on adult female); bristle of 2nd joint reaching just past 9th joint, ventral margin with few long proximal hairs followed by 4 stout spines, 2 slender spines, 1 stout subterminal spine, and terminal papilla; bristles of 3rd and 4th joints with broad flat spear-like ventral hairs proximal to midlength (similar to those of same bristles of female); remaining characters similar to those of adult female.

Mandible: b-bristle of basale absent on left limb of USNM 193423, but present on right limb (possibly, absence of b-bristle on left limb aberrant); dorsal margin of 2nd endopodial joint with 21 bristles (14 spinous bristles forming medial row along edge of joint, 2 longer spinous bristles (about twice length short bristles) lateral to short bristles, and 6 long bristles (some with few spines) along edge of joint or on lateral side near dorsal margin; limb otherwise similar to that of adult female.

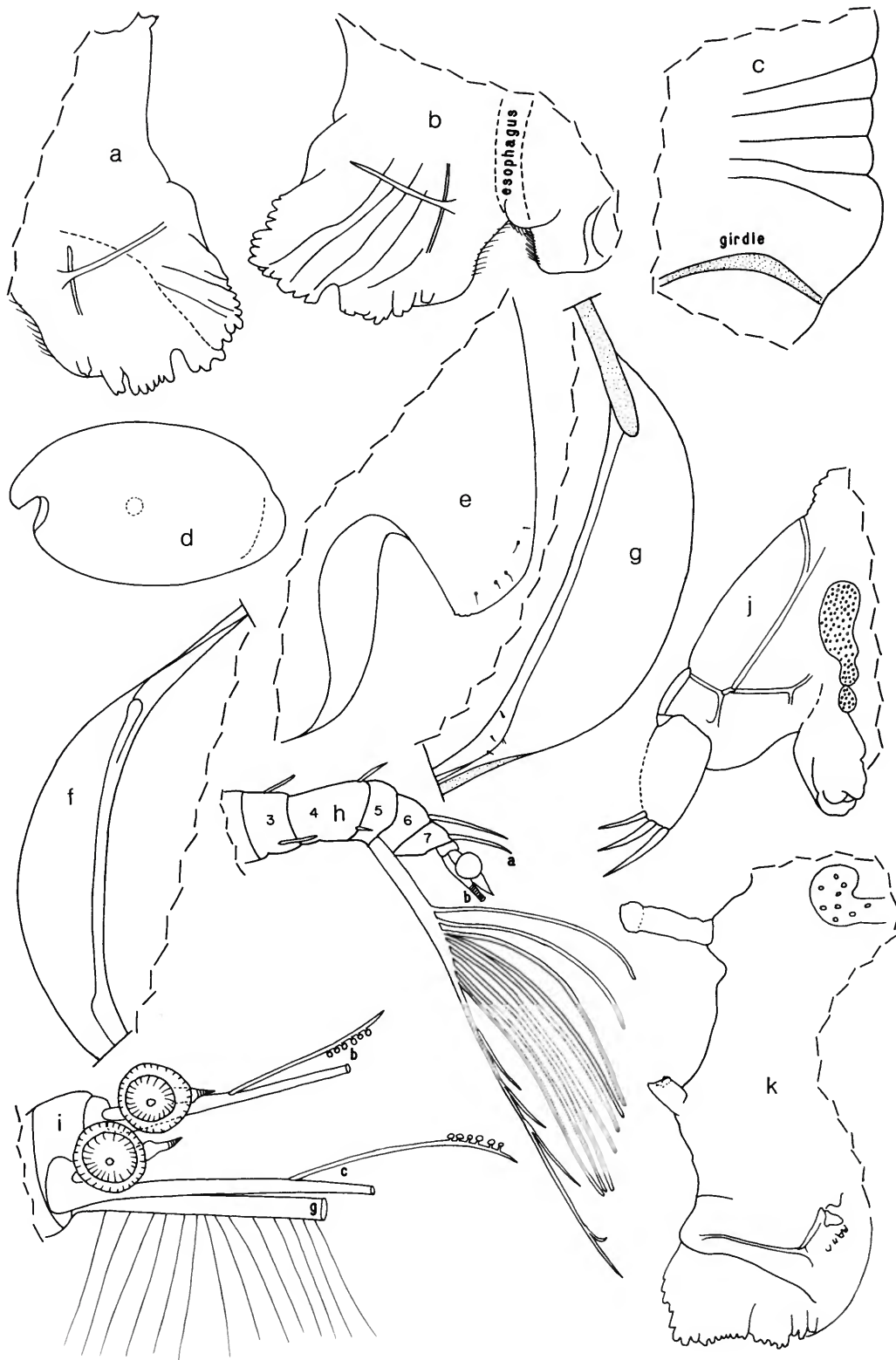
Maxilla: Similar to that of adult female. 2nd endopodial joint with 4 a-bristles, 3 b-bristles, 2 c-bristles, and 3 d-bristles.

Fifth Limb: Epipodite with 53 plumose bristles. Endite I with 6 bristles, endite II with 5 bristles, endite III with 7 bristles. Exopodite similar to that of adult female.

Sixth Limb: Epipodite with 4 bristles. End joint with 12 bristles. Endite bristles not counted.

Seventh Limb: Left limb of USNM 193423 with 23 bristles

FIGURE 4.—*Skogsbergia galapagensis*, new species, USNM 193420, holotype, adult female: a, anterior of body from right side showing anterior process at top and upper lip at bottom; b, upper and lower lips from left side and esophagus (dashed); c, posterior of body showing scalloped posterodorsal margin dorsal to stippled girdle. USNM 193423, allotype, adult male: d, complete specimen from left side, length 1.76 mm, central adductor muscle attachments indicated by dashed oval, inner margin of infold of caudal process as viewed through shell dashed; e, outside view of anterior of right valve; f,g, inside view of caudal process of left and right valves, respectively, not all bristles of list shown; h, left 1st antenna, medial view, all bristles of 7th and 8th joints not shown; i, proximal suckers of b- and c-bristles and proximal part of g-bristle of left 1st antenna, medial view; j, posterior of body showing claws 1–3 of right lamella of furca, right copulatory structures, and internal sclerites; k, anterior of body from left side showing left lateral eye, medial eye and Bellonci organ, anterior process at midheight, and upper lip (note 4 lateral glandular processes).



(15 in terminal group, 7 or 8 on each side, and 8 in proximal group, 3 on comb side, 5 on opposite side); bells on bristles similar to those of adult female. Comb and surface opposite comb similar to adult female.

Furca (Figure 4j): Similar to that of adult female except claws appearing slightly more slender.

Bellonci Organ (Figure 4k), *Posterior of Body*, *Y-Sclerite*: Similar to those of adult female.

Eyes: Medial eye small unpigmented (Figure 4k). Lateral eye indistinct, transparent, with small amber-colored cells (Figure 4k).

Upper Lip (Figure 4k): Four small glandular openings forming row proximal to small posterior lateral lobe; lip otherwise similar to that of adult female.

Genitalia (Figure 4j): Copulatory organ well developed, lobate.

Anterior of Body (Figure 4k): Single process with 2 small triangular processes on tip.

Gut Content: Gut with unrecognizable minute light amber-colored particles.

DESCRIPTION OF INSTAR I (Sex unknown) (Figures 5–6c).—Carapace similar to that of adult female except being more elongate and with relatively broader caudal process (Figure 5a). Tip of rostrum digitate as on adult female. Narrow curved line (ridge?) extending from upper edge of inner end of incisur and intersecting anteroventral valve edge as on adult female.

Infold: Infold of rostrum similar to that of adult female, with 4 long bristles, 1 short bristle near inner end of incisur, and paired bristles near valve edge at inner end of incisur. Inner edge of infold and list well defined, similar to those of adult female. Anteroventral infold with 1 bristle near inner end of incisur and 11 bristles forming row just distal to list. Broad list of caudal process similar to that of adult female. Ventral infold with 2 bristles (1 near middle, 1 near caudal process). Right valve with bar dorsal to list of caudal process similar to that of adult female.

Selvage: With lamellar prolongation similar to that of adult female.

Size: USNM 193424, length 0.78 mm, height 0.53 mm.

First Antenna (Figure 5b,c): 1st joint bare. 2nd joint with distal medial and lateral spines. 3rd joint with 2 short bristles (1 ventral, 1 dorsal). 4th joint bare. Sensory bristle of 5th joint without marginal filaments and with minute terminal papilla. 6th joint with short medial bristle with few marginal spines. 7th joint: a-bristle about same length as bristle of 6th joint, with few marginal spines; b-bristle bare, about 4 times length of a-bristle; c-bristle long, bare. 8th joint: d- and e-bristles longer than b-bristle, bare with blunt tips; f-bristle long, bare, bent dorsally; g-bristle long bare.

Second Antenna (Figure 5c,d): Protopodite with well-developed distal medial bristle. Endopodite 2-jointed (Figure 5d): 1st joint bare; 2nd joint about same length as 1st joint, with long terminal filament. Exopodite: joints 3–8 with minute spines forming row along distal margins; bristle of 2nd joint

reaching midlength of 8th joint, with few ventral spines; 9th joint with 2 bristles, limb otherwise similar to that of adult female.

Mandible: Coxale endite spinous similar to that of adult, with small bristle near base. Ventral margin of basale with 2 a-bristles (proximal about half length distal), no b-bristle, 2 c-bristles, and no d-bristle; dorsal margin with 1 midbristle and 2 subterminal bristles. Exopodite almost reaching distal margin of 1st endopodial joint, with 2 bristles (proximal about 4 times length of distal). 1st endopodial joint with 2 long ventral bristles. Ventral margin of 2nd endopodial joint with distal spines and only 1 bristle (distance of base of bristle from distal margin of joint equal to width of joint); dorsal margin with 5 bristles (3 long, 2 short). End joint with 3 claws (lateral and medial stout and with proximal spines, dorsal more slender and bare, all about same length) and 1 ventral bristle about same length as claws.

Maxilla (Figure 5e,f): Endites I–III each with 5 spinous bristles (Figure 5e). Coxale with long slender dorsal bristle (relatively longer than coxale bristle of adult). Basale with long terminal ventral bristle. 1st endopodial joint with 1 slender alpha-bristle and 1 pectinate beta-bristle. 2nd endopodial joint with 2 a-bristles (with few proximal spines), 1 pectinate b-bristle, and 2 pectinate claw-like d-bristles; cutting tooth with 2 prongs (Figure 5f). Exopodite similar to that of adult.

Fifth Limb (Figure 5g,h): Sclerotized anterior process of protopodite very small or absent. Endites I–III with 2, 3, and 4 bristles, respectively; posterior bristle of each endite minute, bare, others spinous. 1st exopodial joint: anterior side with stout proximal bristle with long proximal spines and pectinate distally; main tooth with triangular peg followed by 1 complex pectinate tooth; spinous posterior bristle proximal to teeth. 2nd exopodial joint with 1 stout pectinate a-bristle (ringed distally), 1 long b-, or d-bristle (with long proximal spines and pectinate distally; distal teeth stronger than on d-bristle of later instars) on proximal outer edge of joint, and c-bristle with long proximal spines. 3rd exopodial joint: inner lobe not well defined, without bristles, outer lobe hirsute, with 2 bristles with long proximal hairs; fused 4th and 5th exopodial joints hirsute, with 2 terminal bristles (posterior with short marginal spines, anterior with long proximal and short distal spines). Epipodite with about 30 plumose bristles.

Sixth Limb (Figure 5i): Flap-like, hirsute, without bristles.

Seventh Limb: Absent.

Furca (Figure 6a–c): Each lamella with 5 claws; claws 2–5 without basal suture, but narrow ledge along inner edge of lamellar medial to claws 3–5 appears to be basal suture when viewed in transmitted light; claws 3 and 4 small, straight, with broad spinous base; claw 5 small blunt with terminal spines (Figure 6c); claws 1 and 2 with spines forming medial and lateral rows along posterior margins (distal medial spines of claw 1 larger); minute spines forming row along lamella posterior to claw 5; right lamella slightly anterior to left.

Bellonci Organ: Elongate, similar to that of adult female

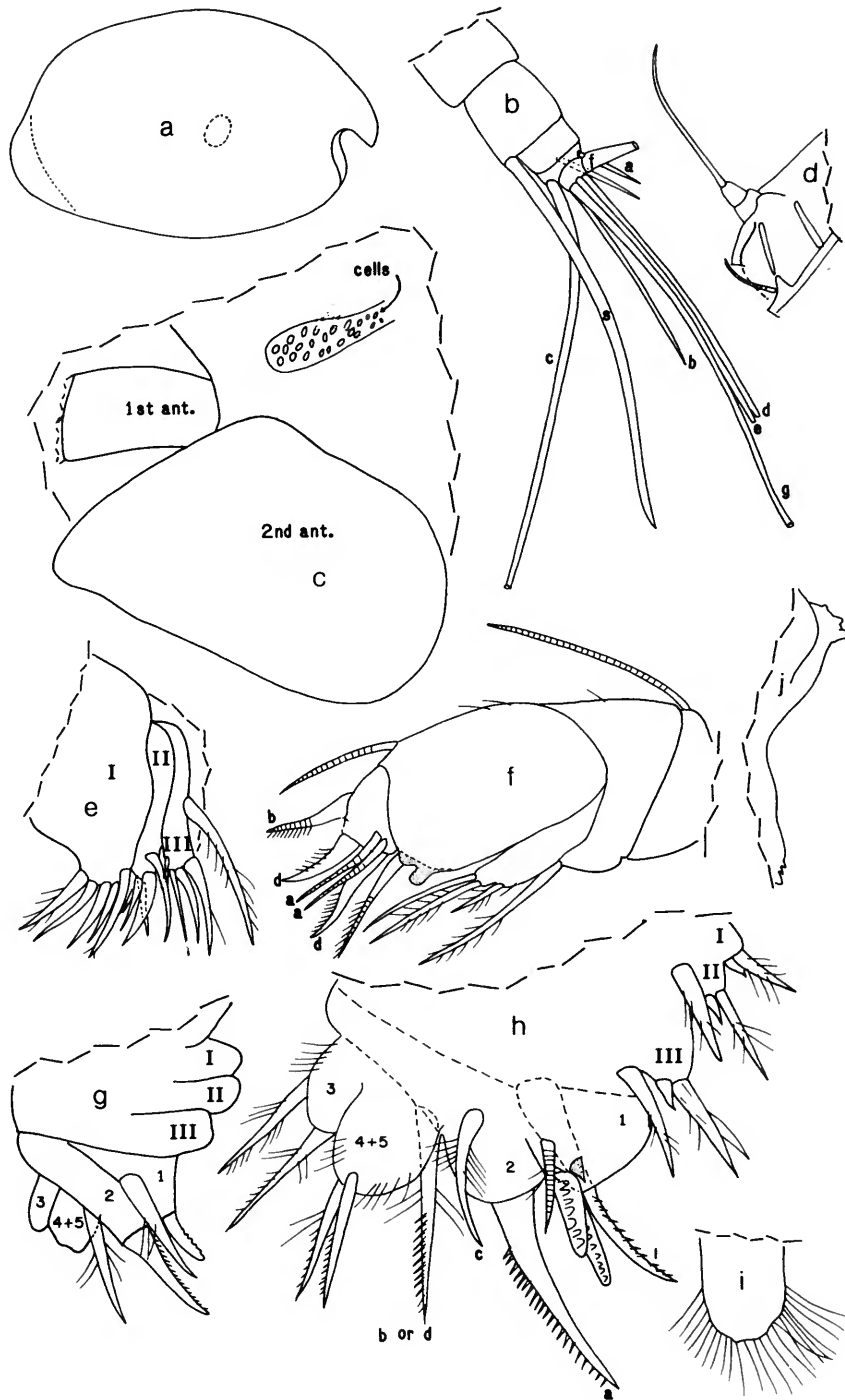


FIGURE 5.—*Skogsbergia galapagensis*, new species, USNM 193424, paratype, instar I (sex unknown): a, complete specimen from right side, length 0.78 mm, central adductor muscle attachments indicated by dashed oval, inner margin of infold of caudal process as viewed through shell dashed; b, tip of right 1st antenna, lateral view, only proximal part of f-, c-, and g-bristles shown; c, anterior part of body from left side showing location of lateral eye,

1st antenna, and protopodite of 2nd antenna; d, distal part of protopodite and endopodite of left 2nd antenna, medial view; e, endites of right maxilla, medial view; f, left maxilla, lateral view, endites not shown; g, right 5th limb, anterior view, not all bristles shown; h, left 5th limb, posterior view; i, right 6th limb, anterior view; j, anterior of body from right side showing anterior process at upper right and part of upper lip at bottom.



FIGURE 6.—*Skogsbergia galapagensis*, new species, USNM 193424, paratype, instar I (sex unknown): *a*, posterior of body from left side showing hirsute dorsal process, left lamella of furca, and fused Y-sclerite and girdle; *b*, right lamella of furca; *c*, detail from *b*. USNM 193425, paratype, instar II (sex unknown): *d*, complete specimen from right side, length 0.92 mm, central adductor muscle attachments indicated by dashed circle, inner margin of infold of caudal process as viewed through shell dashed, *e*, anterior of body from left side showing location of lateral eye, 1st antenna, and anterior process; *f*, distal part of protopodite and endopodite of right 2nd antenna, medial view; *g*, tip of left maxilla, medial view, α -bristles not shown; *h*, left 5th limb, posterior view, endites I and II not shown; *i*, right 6th limb, anterior to right; *j*, right 7th limb; *k*, posterior of body from right side showing posterodorsal hairs, right lamella of furca, and internal sclerites; *l*, right lateral eye.

but filled with cells or globules.

Eyes: Medial eye small unpigmented. Lateral eye elongate, indistinct, filled with cells or globules (Figure 5c).

Upper Lip: Similar to that of adult female.

Anterior of Body (Figure 5j): Anterior process between medial eye and upper lip with 3 small processes.

Posterior of Body (Figure 6a): Posterodorsal corner with small process with few long hairs.

Y-Sclerite (Figure 6a): Posterior end fused to other sclerites; anterior end without ventral branch.

Gut Content: USNM 193424 with mostly unidentifiable particles but also with few fragments bearing claws suggesting arthropod origin.

DESCRIPTION OF INSTAR II (Sex unknown) (Figure 6d–l).—Carapace similar to that of adult female except caudal process relatively broader (Figure 6d). Tip of rostrum with minute single process (not digitate as on adult and instar I).

Infold: Anteroventral infold with 13 bristles. Bristles of infold of rostrum, ventral margin, and caudal process similar in number to those of adult female.

Selvae: Lamellar prolongation similar to that of adult female.

Size: USNM 193425, length 0.92 mm, height 0.58 mm.

First Antenna (Figure 6e): 1st joint bare. 2nd joint with distal medial spines. 3rd joint with medial spines and 2 bristles (1 ventral, 1 dorsal). 4th joint with 1 dorsal bristle; sensory bristle of 5th joint with 3 long stout proximal filaments followed by 1 short slender filament and 1 smaller subterminal filament. 6th joint with short medial bristle. 7th joint: a-bristle slightly shorter than bristle of 6th joint; b-bristle about 3 times length of a-bristle, with 1 proximal filament; c-bristle long, with 4 long filaments followed by 1 short subterminal filament. 8th joint: d- and e-bristles about $\frac{1}{3}$ longer than b-bristle, bare with blunt tips; f-bristle long, with 3 long filaments followed by 1 short subterminal bristle; g-bristle long, with 4 long filaments followed by 1 short subterminal filament.

Second Antenna (Figure 6f): Protopodite with medial distal bristle with short marginal spines. Endopodite 2-jointed: 1st joint with fairly long distal bristle; short 2nd joint with long terminal filament. Exopodite: bristle of 2nd joint reaching 8th joint, with about 7 ventral spines (proximal 3 stouter than others; subterminal spine long slender); 9th joint with 3 bristles (1 long with natatory hairs, 1 short and 1 minute, both with short marginal hairs); bristles of other joints and basal spines similar to those of adult female.

Mandible: Coxale endite similar to that of adult. Basale with 3 a-bristles, 1 b-bristle, 2 c-bristles, 1 minute medial bristle just proximal to c-bristles, and no d-bristle; dorsal margin of basale with 3 bristles (1 near midlength, 2 subterminal). 1st endopodial joint with 3 ventral bristles. 2nd endopodial joint: ventral margin with spines, and bristles forming 2 groups (1 in proximal group, 2 in distal group); dorsal margin with 7 bristles (3 long, 4 medium or short). End joint with 3 claws (2 stouter claws with ventral spines) and 3

bristles.

Maxilla (Figure 6g): Coxale with long slender dorsal bristle. Endite I with 7 bristles, endites II and III each with about 6 bristles; 1 short bristle on basale some distance from proximal end of endite III (an equivalent bristle on adult female is close to endite III). Basale with additional long ventral bristle near ventral margin and no dorsal bristle (proximal ventral corner obscured on both limbs of USNM 193424, and long ventral bristle could be on endite III). 1st endopodial joint with 1 slender alpha-bristle and 1 pectinate beta-bristle; cutting tooth with 2 prongs. 2nd endopodial joint with 3 a-bristles (not shown), 2 b-bristles, 1 c-bristle, and 3 d-bristles; exopodite similar to that of adult female.

Fifth Limb (Figure 6h): Sclerotized anterior process of protopodite elongate with smoothly rounded tip. Endites I and II each with 5 bristles; endite III with 6 bristles. 1st exopodial joint: anterior side with 2 distal bristles forming row (outer bristle stouter, with long proximal hairs and pectinate distally; inner bristle with long proximal and short distal hairs); main tooth of 1st exopodial joint with 1 triangular peg and 2 pectinate teeth; spinous bristle proximal to peg. 2nd exopodial joint with 3 pectinate a-bristles (proximal ringed distally), 4 pectinate b-bristles (ringed distally), c-bristle with long proximal and short distal spines, and anterior d-bristle with long proximal and short distal spines. Inner and outer lobes of 3rd exopodial joint each with 2 bristles; fused 4th and 5th joints with 2 bristles; outer lobe of 3rd joint and fused 4th and 5th joints hirsute.

Sixth Limb (Figure 6i): Single endite with 1 long bristle.

Seventh Limb (Figure 6j): Short bare thumb-like.

Furca (Figure 6k): With 5 claws; claw 2 without basal suture; claw 3 narrower and longer than claw 4.

Bellonci Organ: Similar to that of adult female.

Eyes: Medial eye small unpigmented. Lateral eye small with few light amber-colored cells, no ommatidia (Figure 6e, l).

Upper Lip: Similar to that of adult female.

Anterior of Body (Figure 6e): With anterior process similar to that of adult female.

Posterior of Body (Figure 6k): With small dorsal process with few long hairs similar to that on instar I.

Y-Sclerite (Figure 6k): Posterior end not fused to other sclerites as on instar I; anterior end without ventral branch.

Gut Content: Unidentifiable minute particles amber in transmitted light.

DESCRIPTION OF INSTAR III (Sex unknown) (Figure 7a–g).—Carapace similar to that of adult female (Figure 7a). Tip of rostrum minutely digitate.

Infold: Anteroventral infold with 15 bristles just distal to list; infold otherwise similar to that of adult female.

Selvae: Lamellar prolongation similar to that of adult female.

Size: USNM 193426, length 1.19 mm, height 0.70 mm.

First Antenna (Figure 7b,g): Joints 1–3 similar to those of instar II. 4th joint with 2 bristles (1 ventral, 1 dorsal).

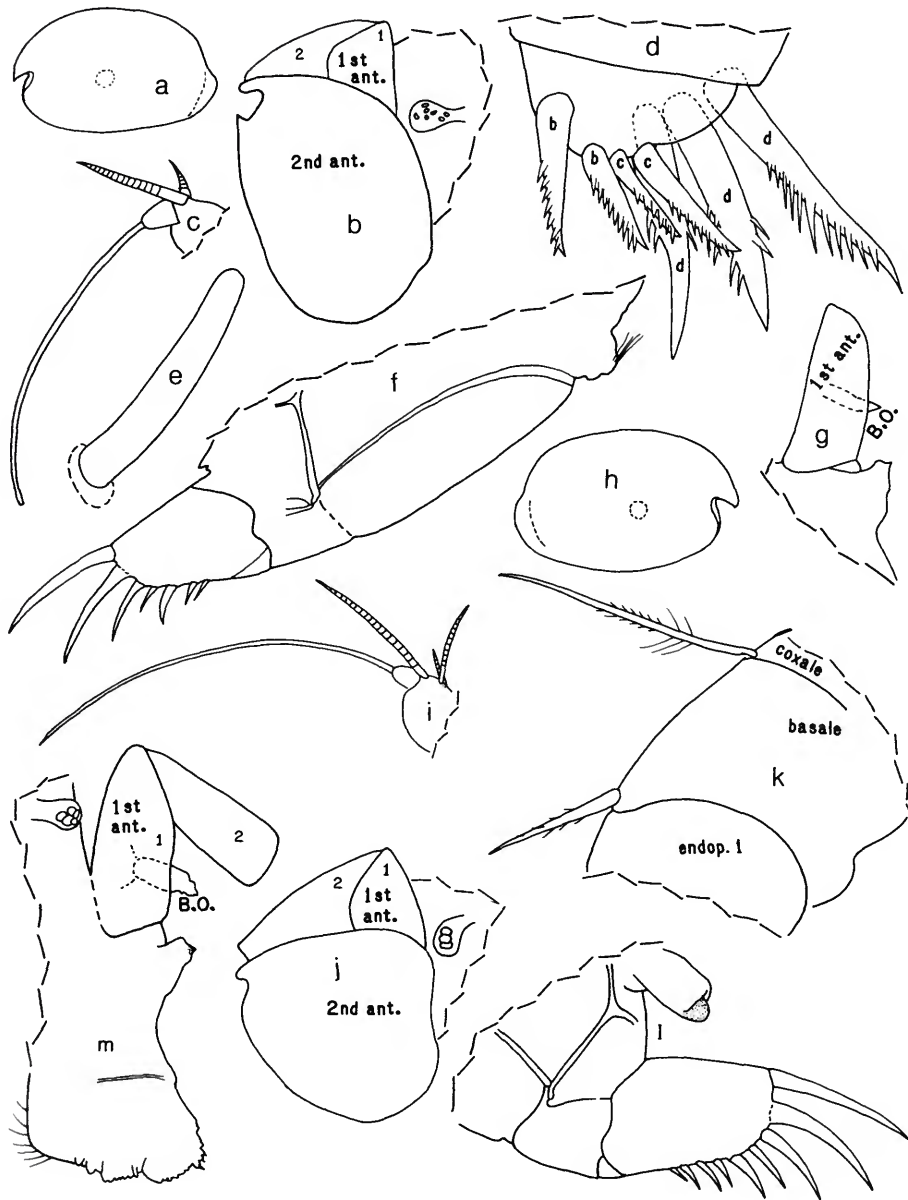


FIGURE 7.—*Skogsbergia galapagensis*, new species, USNM 193426, paratype, instar III (sex unknown): *a*, complete specimen from left side, length 1.19 mm, central adductor muscle attachments indicated by dashed oval, inner margin of infold of caudal process as viewed through shell dashed; *b*, anterior of body from left side showing location of 1st antenna, protopodite of 2nd antenna, and lateral eye; *c*, endopodite of left 2nd antenna, lateral view; *d*, end joint of endopodite of right maxilla, a-bristles not shown, medial view; *e*, left 7th limb, anterior to left; *f*, posterior of body from left side showing hairs, posterodorsal process, left lamella of furca, and internal sclerites (Y-sclerite, girdle); *g*, anterior of body from right side showing 1st joint of 1st antenna, Bellonci organ, and anterior process. USNM 193427, paratype, male instar IV: *h*, complete specimen from right side, length 1.30 mm, central adductor muscle attachments indicated by dashed oval, inner margin of infold of caudal process as viewed through shell dashed; *i*, endopodite of right 2nd antenna, medial view; *j*, anterior of body from left side showing joints 1 and 2 of left 1st antenna, protopodite of 2nd antenna, and lateral eye; *k*, part of left maxilla showing dorsal bristles of coxale and basale; *l*, posterior of body showing right lamella of furca, right copulatory organ, and internal sclerites; *m*, anterior of body from right side showing joints 1 and 2 of right 1st antenna, Bellonci organ, lateral eye, and upper lip.

Sensory bristle of 5th joint with 4 long stout filaments followed by 2 short slender filaments and smaller subterminal filament. 6th joint with short medial bristle. 7th joint: a-bristle spinous, about same length as bristle of 6th joint; b-bristle 4 or 5 times length of a-bristle, with 2 short marginal filaments (1 proximal, 1 near midlength); c-bristle long, with 4 marginal filaments followed by 1 long filament and 1 short subterminal filament. 8th joint: d- and e-bristles bare with blunt tips; f-bristle long, tip broken off on specimen examined, with 5 filaments on remaining part, some with marginal spines; g-bristle long, with 5 marginal filaments followed by 1 longer filament and short subterminal filament.

Second Antenna (Figure 7b,c): Protopodite with distal medial bristle. Endopodite 2-jointed (Figure 7c): 1st joint with 2 bristles; 2nd joint with long terminal filament. Exopodite: bristle of 2nd joint reaching 7th joint; ventral margin of bristle of 2nd joint with few slender marginal spines followed by 4 stout spines followed by 4 or 5 slender spines (distal spine longer); 9th joint with 3 bristles (1 long with natatory hairs, 1 about $1/2$ length of long bristle, also with natatory hairs, 1 short bare, or with few short hairs); other bristles and joints similar to those of adult female.

Mandible: Coxale endite, basale, exopodite, similar to those of adult female. 1st endopodial joint with 3 bristles (2 long, 1 short). 2nd endopodial joint: ventral margin spinous, with bristles forming 2 groups (1 in proximal group, 2 in distal group); dorsal margin with 7 bristles (4 long, 1 medium, 2 short). End joint with 3 claws and 3 bristles.

Maxilla: Endite I with 9 bristles; endite II with 6 bristles, endite III with 4 terminal bristles; 1 short bristle near base of endite III. Coxale with fringe of dorsal hairs; dorsal bristle not observed. Basale with 1 long bristle near ventral margin and 1 short dorsal bristle. Exopodite similar to that of adult female. 1st endopodial joint with 2 slender alpha-bristles and 2 beta-bristles (inner short, outer long pectinate), and poorly defined cutting tooth. 2nd endopodial joint with 3 slender a-bristles, 2 pectinate b-bristles (proximal ringed), 2 pectinate c-bristles, and 3 pectinate d-bristles (Figure 7d).

Fifth Limb: Sclerotized anterior process of protopodite elongate with smoothly rounded tip. Endite I with 6 bristles; endite II with 5 bristles; endite III with 7 bristles. 1st exopodial joint: anterior side with 1 proximal bristle near process of protopodite and 3 distal bristles forming row (outer bristle stout with long proximal spines and pectinate distally); main tooth comprising triangular peg and 3 pectinate teeth; bristle present proximal to peg. 2nd exopodial joint with 3 stout pectinate unringed a-bristles, 6 pectinate b-bristles (ringed distally), c-bristle with long proximal and short distal spines, and anterior d-bristle (with long proximal and short distal spines) proximal to 3rd joint. 3rd exopodial joint with 3 bristles on inner lobe and 2 on outer lobe. Fused 4th and 5th joints with 3 bristles.

Sixth Limb: Endite I with 1 long spinous bristle; endite II with 4 spinous bristles; endites III and IV each with 3 spinous

bristles. End joint spinous, with 2 anterior bristles with long proximal and short distal spines, and 2 stouter posterior plumose bristles; 1 epipodial bristle present.

Seventh Limb (Figure 7e): Elongate, bare.

Furca (Figure 7f): Each lamella with 7 claws; claw 2 with weak basal suture; claw 5 stouter and longer than claw 4.

Bellonci Organ (Figure 7g): Similar to that of adult female.

Eyes: Medial eye small, unpigmented. Lateral eye small with several minute amber-colored cells (Figure 7b).

Upper Lip, Y-Sclerite (Figure 7f): Similar to those of adult female.

Anterior of Body (Figure 7g): Anterior process similar to that of adult female.

Posterior of Body (Figure 7f): With dorsal process bearing long hairs.

Gut Content: Gut gorged with unidentifiable particles amber-colored in transmitted light.

DESCRIPTION OF MALE INSTAR IV (Figure 7h-m).—Carapace similar in shape to that of adult female (Figure 7h).

Infold: Bristles of rostrum and caudal process similar to those of adult female. 1 small bristle just ventral to inner end of incisur. Anteroventral infold with 18–21 bristles forming row.

Size: USNM 193427, length 1.30 mm, height 0.81 mm.

First Antenna (Figure 7j,m): Joints 1–4 similar to those of instar III. Sensory bristle of 5th joint with 5 long stout filaments followed by 3 short slender filaments and smaller subterminal filament. Sixth joint with short medial bristle. 7th joint: a-bristle about same length as bristle of 6th joint; b-bristle about 5 times length of a-bristle, with 3 marginal filaments; c-bristle long, with 6 short filaments followed by 1 long filament and short subterminal filament. 8th joint: d- and e-bristles bare with blunt tips; f- and g-bristles long, with about 5 short filaments followed by 1 long filament and 1 short subterminal filament.

Second Antenna (Figure 7i,j): Protopodite with distal medial bristle. Endopodite 2-jointed: 1st joint with 3 bristles; 2nd joint with long terminal filament. Exopodite: bristle of 2nd joint reaching 8th joint, with 8 ventral spines (proximal 4 stout, distal slender spine longer than other slender spines); 9th joint with 3 bristles (middle bristle about twice length of dorsal bristle; ventral bristle almost twice length middle bristle, all bristles with natatory hairs); remaining bristles and joints similar to those of adult female.

Mandible: Coxale, endite, basale, and exopodite similar to those of adult female. 1st endopodial joint with 3 or 4 bristles (2 long, 1 or 2 small). 2nd endopodial joint: ventral margin with bristles forming 3 groups comprising 1, 1, and 2 short slender bristles; dorsal margin with 9 bristles (4 long, 2 medium, 3 short). End joint with 3 claws and 4 bristles (ventral bristle minute).

Maxilla (Figure 7k): Coxale and precoxale with dorsal fringe; coxale with very long slender dorsal bristle. Endite I with 10 bristles, endites II and III each with 6 bristles; 1 short

bristle near base of endite III (on basale?). Basale with 3 distal bristles (1 short dorsal, 1 long ventral, 1 short medial near ventral margin). Exopodite similar to that of adult female. 1st endopodial joint with 2 slender alpha-bristles and 2 beta-bristles (outer longer and pectinate), and evenly rounded cutting tooth. 2nd endopodial joint with 4 bare a-bristles, 3 pectinate b-bristles, 2 pectinate c-bristles, and 3 pectinate d-bristles.

Fifth Limb: Sclerotized anterior process of protopodite similar to that of adult female. Endites I and II each with 5 bristles; endite III with 7 bristles. 1st exopodial joint: anterior side with 1 proximal bristle near process of protopodite and 3 distal bristles forming row (outer bristle stout and with long proximal and short distal hairs); main tooth with smooth triangular peg and 4 pectinate teeth; spinous bristle present proximal to peg. 2nd exopodial joint with 3 pectinate a-bristles, 6 pectinate b-bristles, 1 posterior c-bristle, and 1 anterior d-bristle (proximal to 3rd exopodial joint). 3rd exopodial joint with 3 bristles on inner lobe and 2 on hirsute outer lobe. Fused 4th and 5th joints hirsute, with 4 bristles.

Sixth Limb: Endite I with 2 bristles; endite II with 3 bristles; endite III with 4 bristles; endite IV with 6 bristles. End joint with 5 anterior bristles followed by space and 3 or 4 bristles along edge of posterior half of joint (1 or 2 posterior bristles plumose, 2 anterior bristles short and with short marginal spines, others with long proximal and short distal spines). 2 epipodial bristles present.

Seventh Limb: Bristles strongly tapered. Each limb with 5 or 6 bristles (4 in terminal group, 2 on each side, and 1 or 2 in proximal group, 1 on comb side, 0 or 1 on process side); each bristle with 1 bell. Terminal comb with 7 teeth (3 long teeth in middle, and 2 short teeth on each side). Surface opposite comb with small triangular process.

Furca (Figure 7l): Each lamella with 9 claws; claw 2 with weak basal suture; claw 5 broader than claw 4.

Bellonci Organ (Figure 7m): Similar to that of adult female.

Eyes: Medial eye small unpigmented. Lateral eye small with 3–5 cells (Figure 7j,m).

Upper Lip (Figure 7m), *Y-Sclerite* (Figure 7l): Similar to adult female.

Genitalia (Figure 7l): Well-defined copulatory organ on each side of body anterior to furca.

Anterior of Body (Figure 7m): With anterior process similar to that of adult female.

Posterior of Body: Small dorsal process, but without hairs that were present in younger instars.

Gut Content: Gut gorged with unidentifiable particulate matter amber-colored in transmitted light.

DESCRIPTION OF FEMALE INSTAR IV (Figure 8a,b).—Carapace similar in shape to that of male instar IV (Figure 8a).

Infold: Bristles similar to those of adult female; anteroventral infold with 18 bristles forming row.

Selvage: Similar to that of adult female.

Central Adductor Muscle Attachments: Comprising both elongate and oval individual scars (not all muscles shown in Figure 8b.)

Size: USNM 193428, length 1.39 mm, height 0.88 mm.

First Antenna (Figure 8b): Joints 1–4, and 6 similar to those of male instar IV. Sensory bristle of 5th joint with 5 long stout filaments followed by 3 short slender filaments and smaller subterminal filament. 7th joint: a-bristle about same length as bristle of 6th joint; b-bristle with 3 marginal filaments; c-bristle long, with 5 short filaments followed by 1 long filament and short subterminal filament. 8th joint: d- and e-bristles bare with blunt tips; f-bristle long, with about 5 marginal filaments and shorter subterminal filament; g-bristle long, with about 8 marginal filaments and short subterminal filament.

Second Antenna (Figure 8b), *Mandible:* Similar to those of male instar IV.

Maxilla, Fifth and Sixth Limbs: Not examined in detail but seemingly similar to those of instar IV male.

Seventh Limb: Proximal group with 2 bristles, 1 on each side; terminal group with 4 bristles, 2 on each side. Terminal comb with 2 short teeth on each side of 3 longer teeth; side opposite comb with small triangular process.

Furca: Each lamella with 8 claws; claw 2 with weak basal suture; claw 5 broader than claw 4 but about same length.

Bellonci Organ, Upper Lip, Y-Sclerite: Similar to those of adult female.

Eyes: Lateral eye small, unpigmented, with few minute amber-colored cells (Figure 8b). Medial eye small, unpigmented.

Genitalia: None observed.

Anterior of Body: Anterior process similar to that of adult female.

Posterior of Body: Posterodorsal corner without tuft of hairs.

Gut Content: Gut gorged with unidentifiable fine-grained particles, amber-colored in transmitted light.

DESCRIPTION OF INSTAR V MALE (Figure 8d–g).—Carapace similar in shape to that of adult female (Figure 8d).

Infold: Bristles of rostrum and caudal process similar to those of adult female. Anteroventral infold with 23–27 bristles.

Selvage: Similar to that of adult female.

Size: USNM 193429, length 1.83 mm, height 1.16 mm.

First Antenna (Figure 8f): Joints 1–4 and 6 similar to those of adult female. Sensory bristle of 5th joint with 7 long stout filaments followed by 3 short slender filaments and 1 smaller subterminal filament. 7th joint: a-bristle about same length as bristle of 6th joint; b-bristle short, with 3 marginal filaments; c-bristle long, with 5 short slender filaments followed by 1 long slender filament and 1 short subterminal filament. 8th joint: d- and e-bristles bare with blunt tips; f-bristle long, with 6 marginal filaments followed by 1 shorter subterminal filament; g-bristle long, with about 6 short

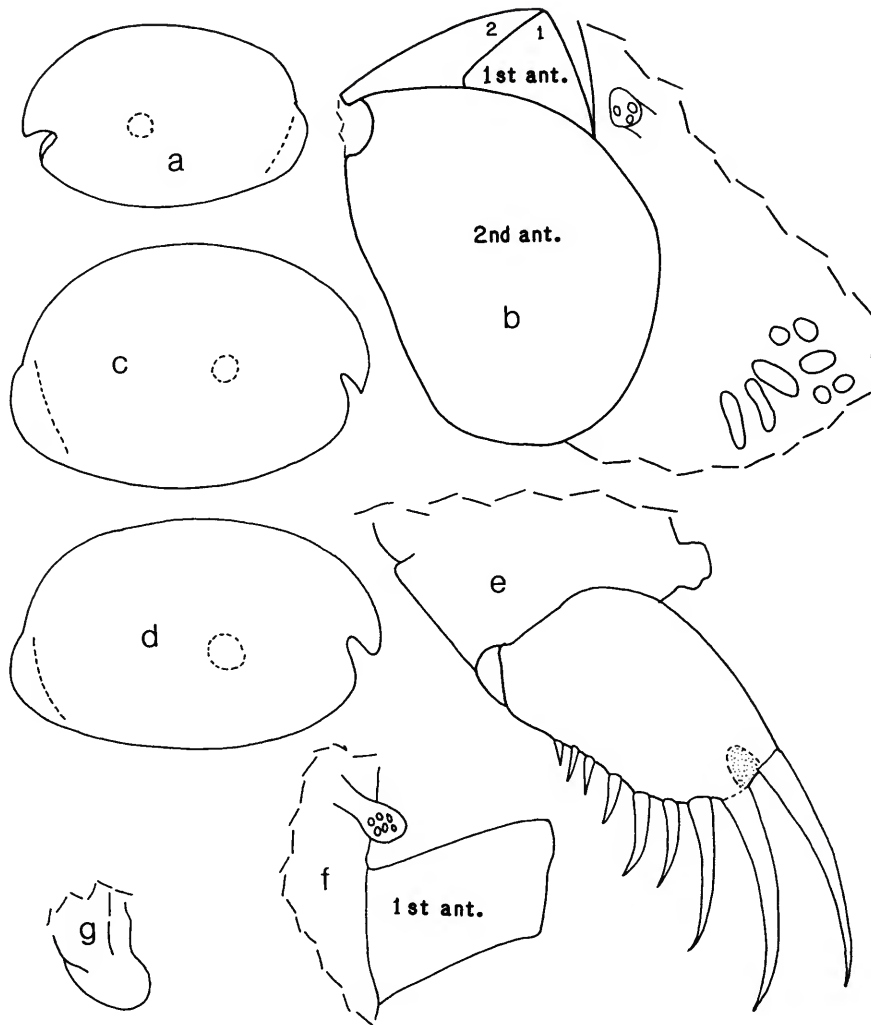


FIGURE 8.—*Skogsbergia galapagensis*, new species, USNM 193428, paratype, female instar IV: *a*, complete specimen from left side, length 1.39 mm, central adductor muscle attachments indicated by dashed oval, inner margin of infold of caudal process as viewed through shell dashed; *b*, anterior of body from left side showing joints 1 and 2 of left 1st antenna, protopodite of 2nd antenna, lateral eye, and some central adductor muscle attachments. USNM 193430, paratype, female instar V: *c*, complete specimen from right side, length 1.75 mm, central adductor muscle attachments indicated by dashed oval, inner margin of infold of caudal process as viewed through shell dashed. USNM 193429, paratype, male instar V: *d*, complete specimen from right side, length 1.83 mm, central adductor muscle attachments indicated by dashed oval, inner margin of infold of caudal process as viewed through shell dashed; *e*, posterior of body showing right lamella of furca; *f*, anterior of body showing 1st joint of left 1st antenna and lateral eye; *g*, right copulatory organ.

filaments followed by 1 shorter subterminal filament.

Second Antenna: Same number of bristles as that of adult female.

Mandible: Coxale, basale, 1st endopodial joints similar to those of adult female. 2nd endopodial joint: bristles of ventral margin similar to those of adult female; dorsal margin with 10 bristles (5 long, 2 medium, 3 short). End joint similar to that of adult female.

Maxilla: Coxale with dorsal bristle. Endite I with about 10 bristles, endite II with about 7 bristles, endite III with 6 bristles; 1 short bristle near base of endite III. Basale with 3 distal bristles: 1 short dorsal, 2 ventral (1 medial short, 1 lateral, long). Bristles of exopodite and 1st endopodial joint similar to those of adult female; cutting tooth of 1st endopodial joint evenly rounded; 2nd exopodial joint with 4 a-bristles, 3 b-bristles, 2 c-bristles, and 3 d-bristles.

TABLE 2.—Comparison of carapace, furca, and lateral eyes of species of *Skogsbergia* (nd = no data).

Species	Carapace length (mm)		Caudal process	Furcal claws		Lateral eyes
	female	male		total	fused*	
<i>S. costai</i> Kornicker, 1974	3.14–3.9	2.7	narrow	10–11	2	large
<i>S. curvata</i> Poulsen, 1962	1.70–1.80	1.50–1.70	narrow	8	2	large
<i>S. galapagensis</i> , new species	2.04–2.14	1.76	narrow	10	2†	vestigial
<i>S. hesperida</i> (Müller, 1906)	2.00–2.12	nd	long	9–10	0	large
<i>S. lernerii</i> (Kornicker, 1958)	1.40–2.11	1.50–1.76	narrow	7–9	2	large
<i>S?</i> <i>megalops</i> (Sars, 1872)	3	nd	narrow	11	nd	large
<i>S. menezii</i> Kornicker, 1970	1.61	1.49	narrow	8	2	large
<i>S. minuta</i> Poulsen, 1962	0.93–1.20	1.13	narrow	8	2	large
<i>S?</i> <i>sarsi</i> (Müller, 1912)	2.62	nd	pointed	9–10	0?	large
<i>S. squamosa</i> (Müller, 1894)	3.3	2.6	narrow	7	2,3	large

*The number of the claw or claws fused to lamella.

†Claw with weak suture at base.

Note: Data for *S. hesperida* from Müller, 1906, and Poulsen, 1962; *S. lernerii* from Cohen, 1983, and Kornicker, 1984; *S?* *sarsi* from Sars, 1888, and Müller, 1912; *S. squamosa* from Müller, 1894, and Kornicker, 1974; remaining species from original descriptions.

Fifth Limb: Sclerotized anterior process of protopodite similar to that of adult female. Endite I with 5 bristles; endite II with 6 bristles; endite III with 7 bristles. 1st exopodial joint: anterior side with 4 anterior bristles similar to those of adult female; main tooth comprising triangular peg followed by 5 pectinate teeth; bristle with long proximal and short distal spines present proximal to peg of main tooth. 2nd exopodial joint with 4 stout pectinate a-bristles, 5 pectinate b-bristles, c-bristle with long proximal and short distal spines, and anterior d-bristle with long proximal and short distal spines. 3rd exopodial joint with 3 bristles on inner lobe and 1–2 on outer lobe; fused 4th and 5th joints hirsute, with 5 bristles.

Sixth Limb: Endites with total of 18–20 bristles: endite I with 3–4 bristles (2 short proximal, 1 or 2 long terminal); endite II with 4 bristles (2 short, medial, proximal, 1 long and 1 short, terminal); endite III with 5 bristles (1 medial, proximal, 4 terminal); endite IV with 6 or 7 bristles (1 short, proximal, 5 or 6 terminal). End joint with 10 bristles (posterior 2 plumose, others with long proximal hairs and short distal spines, or only short spines. Stem with 2 or 3 epipodial bristles.

Seventh Limb: Limb with 18 tapered bristles (terminal group with 7 on comb side and 5 on opposite side; proximal group with 3 on comb side, 4 on opposite side); 4 or 5 proximal bristles with only 1 bell, others with 3; several terminal bristles with 1 bell, others with 3 or 4 bells. Surface opposite comb not examined in detail, but of similar type to that of adult female.

Furca (Figure 8e): Each limb with 9 claws; claw 2 with weak basal suture; claw 5 stouter than claw 4 but about same length.

Bellonci Organ, Upper Lip, Anterior and Posterior of Body, Y-Sclerite: Similar to those of adult female.

Eyes: Lateral eye (Figure 8f) and medial eye similar to that of adult female.

Genitalia (Figure 8g): Small copulatory organ on each

side (not identified with certainty).

Gut Content: Gut gorged with unidentifiable particles amber-colored in transmitted light.

DESCRIPTION OF FEMALE INSTAR V (Figure 8c).—Carapace similar in shape to that of adult female (Figure 8c).

Size: USNM 193430, length 1.75 mm, height 1.18 mm.

Seventh Limb: Bristles tapered, many with only 1 bell.

Furca: Each lamella with 9 claws; claw 2 of left lamella with weak basal suture, of right lamella with strong suture (aberration?). Claw 5 stouter than claw 4 but about same length.

Gut Content: Gut gorged with unidentifiable particles amber-colored in transmitted light.

COMPARISONS.—*Skogsbergia galapagensis* differs from previously described species referred to *Skogsbergia* in lacking well-developed lateral eyes. Some important morphological characters of the species of *Skogsbergia* are compared in Table 2. Two species that according to Poulsen (1962:162) probably should be referred to *Skogsbergia* are included in the table with a question, because they are insufficiently known.

REMARKS CONCERNING SEVENTH LIMB.—The 7th limbs of the preserved specimens vary in length and degree of curl. Some adult females and juveniles have fairly short 7th limbs having either curled (Figure 9c,d) or fairly straight tips. At least 1 adult female and 1 juvenile were observed to have 7th limbs about 1.5 times the length of the short type, and their tips were uncurled (Figure 9b). The single adult male in the collection has a 7th limb about 1.6 times the length of the limb of adult females having short 7th limbs, and the tip of the male limb is straight (Figure 9a). The different types of 7th limbs are shown in Figure 9 (limbs drawn at same magnification; only proximal bristles indicated on limbs). The coils are on the posterior side of the limb (clockwise when viewed from left side and counterclockwise when viewed from right side).

NUMBER OF GROWTH STAGES.—*Skogsbergia galapagensis* has 5 juvenile instars, the same number reported for *S. lernerii*

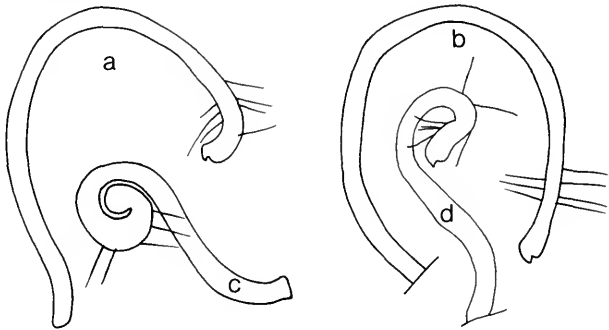


FIGURE 9.—Relative total length and degree of curling of 7th limbs of *Skogsbergia galapagensis*, new species: a, long limb of adult male, USNM 193423 (allotype); b, long limb of adult female, USNM 193431 (paratype); c,d, short curled limbs of adult females, USNM 193432 (paratype) and 193420 (holotype), respectively.

by Cohen (1983:250); all growth stages of *S. galapagensis* are present in the collection. Five juvenile instars have been reported for 3 additional species in 3 other genera of Cypridinini: *Doloria pectinata* Skogsberg, 1920, by Kornicker (1969, table 1), *Macrocypridina castanea* Skogsberg, 1920, by Poulsen (1962:126), and *Vargula hilgendorffii* (Müller, 1908), by Hiruta (1980:145). No members of the Cypridinini have been reported with other than 5 juvenile growth stages. This suggests that the number of juvenile instars is constant in the Cypridinini, and that the troglobitic habit of *S. galapagensis* has not affected the number of growth stages.

ONTOGENY AND SEXUAL DIMORPHISM.—Except for the caudal process being slightly broader, the shape of the juvenile carapace is similar to that of the adult. The adult carapace bears an unusually low number of bristles on the rostral infold, only 7, and that number is present on all instars including the 1st. The number of bristles on the anteroventral infold increases from 11 on instar I to 24–34 on the adult (Table 9). The shape of the adult male carapace is similar to that of the adult female but is smaller (Table 10).

The order of appearance of appendages is similar to that reported for many myodocopids (Table 3): the anterior 5 limbs are already well developed in the 1st instar; in instar I the 6th limb appears as an anlage without bristles and the 7th limb is

TABLE 3.—Order of appearance of appendages of *Skogsbergia galapagensis* (x = present; 0 = absent; anlage = appendage present but without bristles).

Growth stage	1st and 2nd antennae, mandible, maxilla, 5th limb, furca, Bellonci organ	6th limb	7th limb
I	x	anlage	0
II	x	x	anlage
III	x	x	anlage
IV	x	x	x
V	x	x	x
Adult	x	x	x

absent; the latter appears as a small bare bud in instar II and is longer but remains bare in instar III; bristles appear on the 6th limb in instar II and on the 7th limb in instar IV. The copulatory limb of the male was observed to appear in instar IV, but the female genitalia was observed only in the adult.

First Antenna (Table 4): All instars have no bristles on joints 1 and 2, 2 bristles (1 ventral, 1 dorsal) on joint 3, 1 sensory bristle on joint 5, 1 bristle (medial) on joint 6, 3 bristles on joint 7, and 4 bristles on joint 8. The 4th joint bears no bristles in instar I, 1 dorsal bristle in instar II, and 2 bristles (1 ventral, 1 dorsal) in later instars. The sensory bristle of the 5th joint is without sensory filaments in instar I, and the number of filaments gradually increase to 13 in the adult (Table 5). The b- and c-bristles of the 7th joint, and the f- and g-bristles of the 8th joint are without filaments on instar I, and have filaments in later instars. The adult male has suckers on the b- and c-bristles of the 7th joint, and abundant hair-like proximal filaments on the f- and g-bristles of the 8th joint.

Second Antenna (Table 5): In all instars the protopodite bears a single medial bristle, and exopodial joints 2–8 each bear a single bristle, of which those on joints 3–8 are natatory. The endopodite is 2-jointed on all instars, but the 2nd joint is longer on younger instars, and bears a terminal filament in all instars; the 1st joint is without bristles in instar I, and the number of bristles increases gradually to 4 in instar V. The number of bristles on the 9th exopodial joint is 2 in instar I, and the number increases gradually to 4 in instar V. The appendage is similar in males and females.

Mandible (Table 6): The coxale endite is similar and the dorsal margin of the basale bears 3 bristles in all instars. The ventral margin of the basale bears 2 a-bristles in instar I and 3 in later instars, and 2 c-bristles in all instars; the lateral b-bristle and a small medial bristle proximal to the c-bristles is absent in instar I but present in other instars; the d-bristle appears first in instar III. The 1st endopodial joint bears 2 ventral bristles in instar I, and the number increases gradually to 4 in instar IV or V. The ventral margin of the 2nd endopodial joint bears 1 bristle in instar I, and this increases to 3 in instars II and III, and to 4 in later instars. The dorsal margin has 5 bristles in instar I, and this number increases gradually to 10 in instar V, then jumps to about 22 in the adult. The end joint bears 3 claws in all instars but the number of bristles increases from 1 in instar I to 4 in instar IV. The appendage is similar in males and females.

Maxilla (Table 7): Endite I bears 5 bristles in instar I, and the number increases gradually to 10 in instar IV; endite II bears 5 bristles in instar I, 6 in instars II–IV, and 7 in later instars; instar III bears 5 bristles in instar I and 6 in later instars. The exopodites are similar in all instars. The basale bears 1 bristle in instar I, and the number increases gradually to 4 in instar IV. The 1st endopodial joint bears 1 alpha-bristle and 1 beta-bristle in instar I, and increases to 2 in instar III and later instars; the cutting tooth bears 2 prongs in instars I and II and is evenly rounded in instars III or IV and later instars. The 2nd

TABLE 4.—Number of bristles on joints of 1st antenna of *Skogsbergia galapagensis*.

Growth stage	1st joint	2nd joint	3rd joint		4th joint		5th joint	6th joint	7th joint	8th joint
			ventral	dorsal	ventral	dorsal				
I	0	0	1	1	0	0	1*	1	3*	4*
II	0	0	1	1	0	1	1	1	3	4
III	0	0	1	1	1	1	1	1	3	4
IV	0	0	1	1	1	1	1	1	3	4
V	0	0	1	1	1	1	1	1	3	4
Adult										
Female	0	0	1	1	1	1	1	1	3	4
Male	0	0	1	1	1	1	1	1	3†	4‡

*Bristles without marginal filaments.

†b- and c-bristles with suckers.

‡f- and g-bristles with abundant long hair-like proximal filaments.

TABLE 5.—Distribution of filaments on the sensory bristle of the 5th joint of the 1st antenna, and number of bristles on the endopodite and 9th joint of the exopodite of the 2nd antenna of *Skogsbergia galapagensis*.

Growth stage	Filaments of sensory bristle of 1st antenna		2nd antenna	
	long proximal	short distal	Endopodite	Exopodite
			1st joint	9th joint
I	0	0	0	2
II	3	2	1	3
III	4	3	2	3
IV female	5	4	3	3
IV male	5	4	3	3
V male	7	4	4	4
Adult				
female	9	4	4	4
male	9	4	4	4

TABLE 6.—Distribution of bristles and claws on joints of mandible of *Skogsbergia galapagensis*.

Growth stage	Basale (ventral)*				Endopodite			
	a	b	c	d	1st joint	2nd joint		3rd joint
						ventral	dorsal	
I	2	0	2	0	2	1	5	4
II	3	1	2	0	3	3	7	6
III	3	1	2	1	3	3	7	6
IV male	3	1	2	1	3-4	4	9	7
V male	3	1	2	1	4	4	10	7
Adult								
female	3	1	2	1	4	4	22	7
male	3	0-1	2	1	4	4	22	7

*Letters a-d represent a-, b-, c-, d-bristles.

TABLE 7.—Distribution of bristles on maxilla of *Skogsbergia galapagensis*.

Growth stage	Endites			Coxale	Basale	Exopodite	Endopodite					
	I	II	III				1st joint		2nd joint			
							alpha	beta	a	b	c	d
I	5	5	5	1	1	3	1	1	2	1	0	2
II	7	6	6	1	2*	3	1	1	3	2	1	3
III	9	6	6	0	3*	3	2	2	3	2	2	3
IV male	10	6	6	1	4*	3	2	2	4	3	2	3
V male	10	7	6	1	4*	3	2	2	4	3	2	3
Adult												
female	10	7	6	1	4*	3	2	2	4	3	2	3
male	10	7	6	1	4*	3	2	2	4	3	2	3

*Includes 1 short bristle close to base of endite III.

TABLE 8.—Distribution of bristles on the 5th limb of *Skogsbergia galapagensis* (ant. = anterior).

Growth stage	Endites			Exopodial joints								
	I	II	III	1st		2nd*				3rd†		4th+5th
				ant.	main tooth	a	b	c	d	inner	outer	
I	2	3	4	1	peg + 1 tooth	1	0	1	1	0	2	2
II	5	5	6	2	peg + 2 teeth	3	4	1	1	2	2	2
III	6	5	7	4	peg + 3 teeth	3	6	1	1	3	2	3
IV male	5	5	7	4	peg + 4 teeth	3	6	1	1	3	2	4
V male	5	6	7	4	peg + 5 teeth	4	5	1	1	3	1-2	5
Adult												
female	6	6	7	4	peg + 6 teeth	4	6	1	1	3	2	4-5
male	6	5	7	4	peg + 6 teeth	4	6	1	1	3	2	4

*Letters a-d represent a-, b-, c-, and d-bristles.

†Bristles on inner and outer lobes.

TABLE 9.—Distribution of bristles on 6th and 7th limbs of *Skogsbergia galapagensis*, and number of bristles forming row along anteroventral infold of carapace (nd = no data).

Growth stage	6th limb			7th limb	Carapace
	Endites	End joint	Epipodite		
I	0	0	0	absent	11
II	1	0	0	0	13
III	11	4	1	0	15
IV male	15	8-9	2	5-6*	18-21
V male	18-20	10	2-3	18*	23-27
Adult					
female	16-19	13-15	3-4	18-19	28-34
male	nd	12	4	24	24

*Bristles tapering distally.

endopodial joint bears 5 bristles in instar I, and the number increases gradually to 12 in instar V. The appendage is similar on males and females.

Fifth Limb (Table 8): Endites I–III bear a total of 9 bristles in instar I, 16 bristles in instar II, and 17 to 19 in later instars. The number of anterior bristles on the 1st exopodial joint increases from 1 in instar I to 4 in instar III and later instars; the main tooth bears a proximal smooth triangular peg in all instars, 1 pectinate tooth in instar I, then the number of pectinate teeth increases by 1 tooth in each later instar (adult with 6 pectinate teeth); a spinous bristle is present on all instars proximal to the triangular peg. The 2nd exopodial joint bears 3 bristles in instar I, and the number increases gradually to 12 in the adult. The outer lobe of the 3rd exopodial joint bears 2 bristles in all instars, whereas the inner lobe bears no bristles in instar I, 2 in instar II and 3 in later instars. The fused 4th and 5th exopodial joints bear 2 bristles in instars I and II, 3 in instar III, and 4 or 5 in later instars. The appendage is similar in males and females.

Sixth Limb (Table 9): The limb in instar I is flap-like with marginal hairs but no bristles. In instar II it bears a single bristle on an endite. The number of endite bristles increases to 11 in instar III and 18–20 in instar V. The number of bristles on the end joint increases from 4 in instar III to 12–15 in the adult. The number of epipodial bristles increases from 1 in instar III to 3 or 4 in the adult. The appendage is similar in males and females.

Seventh Limb (Table 9): The limb is absent in instar I, minute in instar II, elongate but bare in instar III, elongate with tapering bristles in instars IV (5 or 6 bristles) and V (18 bristles). The adult bears 18–24 cylindrical bristles. The distal part of the limb is straight in the adult male, a small number of adult females, and a small number of instars IV and V, and is curled as well as being shorter in others. The adult male may have more bristles than the adult female (24 compared to 18 or 19, but more specimens would have to be examined to rule out variability).

Furca (Table 10): Claw 1 has a distinct basal suture in all instars. Claw 2 is either without a basal suture (instar I) or has a weakly developed suture (instar II to adult). Except in instar I remaining claws have a distinct basal suture; in instar I claws 3–5 are without a basal suture. The number of claws increases from 5 in instar I to 10 in the adult (instars I and II have 5 claws, instar III 7 claws, instar IV 8 or 9 claws, instar V 9 claws, and the adult 10 claws). The furca is similar in males and females.

Bellonci Organ: Similar in all instars and in males and females.

Eyes: The medial eye is similar in all instars and in males and females. The lateral eye is vestigial in all instars, but is relatively slightly larger in instar I.

Upper Lip: Similar in all instars and in the adult male and female, except 4 posterior, lateral, glandular processes observed on adult male, but not on others.

Genitalia: A reduced male copulatory organ is present in instars IV and V, but female genitalia were observed only in the adult.

Anterior of Body: The anterior process has a pointed tip in juvenile instars and in the adult female but the tip bears 2 triangular processes in the male; however, as only 1 male was examined, the difference could be due to intraspecific variability.

Posterior of Body: The posterodorsal corner bears a tuft of long hairs in instars I–III, absent in later instars.

Y-Sclerite: The posterior end of the sclerite is fused to other sclerites in instar I but is separated from them in later instars. The distal ventral branch is absent in instars I and II and present in later instars.

Gut Content: The gut of the only 1st instar examined ($\times 1500$ magnification) contained small fragments bearing claws suggesting arthropod origin; no recognizable fragments were observed in later instars, but as these were examined at lower magnification ($\times 300$) it is possible that minute fragments were not resolved.

COMPARATIVE ONTOGENY.—A reason for the detailed study of the ontogeny of *S. galapagensis* herein is to compare the ontogeny of a troglobitic species with that of an open water species of *Skogsbergia*. *Skogsbergia leneri* (Kornicker, 1958) was recently redescribed by Kornicker (1984:14), and its ontogeny studied by Cohen (1983). It is a species that has been collected in the Gulf of Mexico and Caribbean Sea (Kornicker, 1984:5), and has been shown by Cohen (1983:242) to be a scavenger of dead animals. Unlike *S. galapagensis*, which have vestigial lateral eyes, all instars of *S. leneri* have well-developed lateral eyes. Both species have 5 juvenile and 1 adult instars.

Carapace: The carapace of *S. galapagensis* is larger than that of *S. leneri* but the growth curves of both species are parallel (Figure 10). The rostral infold of the adult *S. leneri* bears 32–42 bristles compared to only 7 for *S. galapagensis*. The anteroventral infold of *S. leneri* bears 15–20 bristles inside the list compared to none on *S. galapagensis*. For both species, the infolds of the caudal process are similar and the carapaces of adult males are smaller than those of adult females.

First Antenna: The distribution of bristles during ontogeny is similar in both species with 1 exception: the 4th joint of the adult male *S. galapagensis* bears 2 bristles (1 ventral, 1 dorsal) whereas none were reported on *S. leneri* by Cohen (1983, table 1). The distribution of filaments on adult females are, in general, similar for both species. The adult male of *S. leneri* has 1 or 2 small suckers on each distal filament of the b- and c-bristles (Cohen, in litt., 1988) compared to 6–8 for *S. galapagensis*.

Second Antenna: The addition of bristles on the 9th exopodial joint is similar for both species up to the adult stage, where *S. galapagensis* has 4 bristles and *S. leneri* 5. The addition of endopodial bristles is similar for both species.

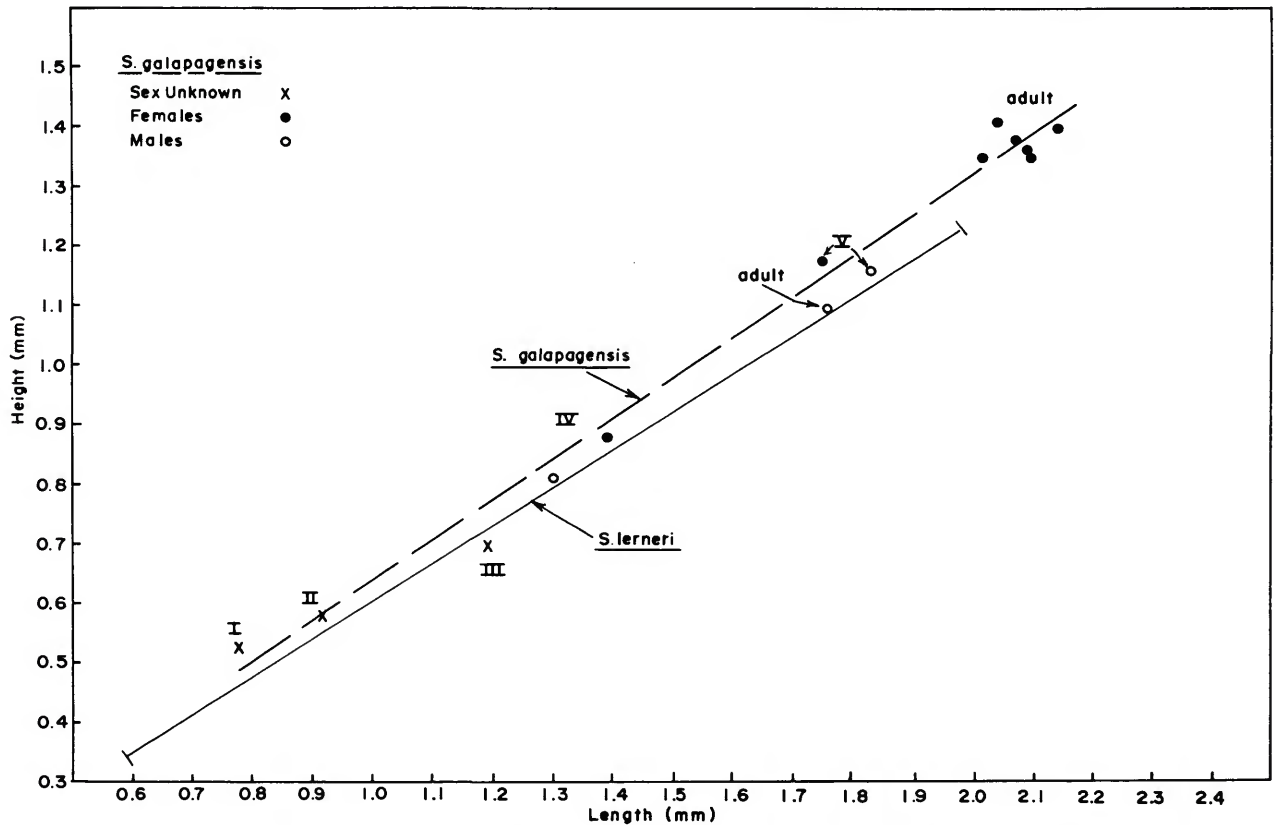


FIGURE 10.—Length-height curve of ontogenetic series of carapaces of *Skogsbergia galapagensis*, new species, compared to that of *S. lernerii* (Kornicker, 1958). Latter curve from Cohen (1983, fig. 3).

TABLE 10.—Carapace lengths and distribution of claws on each lamella of furca of *Skogsbergia galapagensis* (X = claw with basal suture; A = claw with basal suture and stouter than previous claw; x = claw with either weak basal suture or no basal suture).

Growth stage	Sex	Carapace length (mm)	Distribution of claws*											
			1	2	3	4	5	6	7	8	9	10		
I	unknown	0.78	X	x	x	x	x							
II	unknown	0.92	X	x	X	A	X							
III	unknown	1.19	X	x	X	X	A	X	X					
IV	female	1.39	X	x	X	X	A	X	X	X				
IV	male	1.30	X	x	X	X	A	X	X	X	X			
V	female	1.75	X	x	X	X	A	X	X	X	X			
V	male	1.83	X	x	X	X	A	X	X	X	X			
Adult	female	2.02-2.14	X	x	X	X	A	X	X	X	X	X		X
Adult	male	1.76	X	x	X	X	A	X	X	X	X	X		X

*Each number represents the position of a claw counting from distal end of lamella.

Mandible: The development of bristles of the coxale, basale, exopodite, ventral margin of the 1st endopodial joint, and the number of claws and bristles on the 2nd endopodial joint are similar for both species. The 1st endopodial joint of instar III of *S. galapagensis* has 3 bristles compared to 4 for *S.*

lernerii (Cohen, in litt., 1988). The number of dorsal bristles on the 2nd endopodial joint of the adult, is 22 on *S. galapagensis* and about 17 on *S. lernerii*.

Maxilla: The increase in numbers of alpha- and beta-bristles on the 1st endopodial joints during ontogeny is similar

for both species. The number of bristles on the 2nd endopodial joint of instar II *S. lernerii* is 9 not 6 as was listed in Cohen (1983, table 1) (Cohen, in litt., 1988).

Fifth Limb: Only small differences occur between the 2 species in the number of bristles on the fused 4th and 5th exopodial joints. Additional differences may occur in the number of bristles on the 1st and 2nd exopodial joints, but the data presented herein and that by Cohen (1983, tables 1, 2) are not directly comparable.

Sixth Limb: The increase in the number of bristles in instars I and II are similar for both species, and differs only slightly in later instars.

Seventh Limb: Bristles appear first in instar IV for both species, and the rate of increase of bristles in later instars differs only slightly.

Furca: For both species each lamella of the furca in instar I has 5 claws, with only claw 1 having a basal suture, and in instar II each lamella bears 5 claws with all except claw 2 having a distinct basal suture. In later instars *S. galapagensis* bears 1 or 2 more claws than *S. lernerii* (the adult *S. galapagensis* has 10 claws, whereas *S. lernerii* has only 8).

Lateral Eye: The lateral eye of *S. galapagensis* is vestigial on all instars, but it is relatively larger in instar I (compared to size of protopodite of 2nd antenna (Figure 5c)). The lateral eye of the embryo as well as juveniles and adults of *S. lernerii* are well developed (Cohen, in litt., 1988).

Upper Lip: The upper lip was fully developed in instar I for both species.

Posterior of Body: For both species a tuft of hairs is present on the posterodorsal margin of instars I-III, and absent in later instars.

CONCLUSION.—Except for the vestigial lateral eye on the troglobite *S. galapagensis*, its morphology and ontogeny are quite similar to that of the open water species *S. lernerii*.

Order HALOCYPRIDA Dana, 1853

COMPOSITION.—The Halocyprida comprise the suborders Halocypridina Dana, 1853, and Cladocopina Sars, 1866. Only the former is present in the anchialine caves of the Galapagos Islands.

Suborder HALOCYPRIDINA Dana, 1853

COMPOSITION.—The Halocypridina comprise the superfamilies Thaumatoocypridoidea Müller, 1906, and Halocypridoidea Dana, 1853 (Kornicker and Sohn, 1976, fig. 2). Only the former is represented in the collection from the Galapagos Islands.

Superfamily THAUMATOOCYPRIDOIDEA Müller, 1906

COMPOSITION.—The superfamily comprises the family Thaumatoocyprididae Müller, 1906.

THAUMATOOCYPRIDIDAE Müller, 1906

COMPOSITION.—This long-ranging family (Permian to Holocene) comprises 5 genera: 2 known only as fossils (*Thaumatomma* Kornicker and Sohn, 1976, from the Permian of Idhra Island, Greece, and *Pokornyopsis* Kozur, 1974, from the Upper and Lower Jurassic of southwestern and western Germany), and 3 known only from the Holocene (*Thaumatoocypris* Müller, 1906, from off Sumatra (1100 m) and Indonesia (2000 m), *Thaumatoconcha* Kornicker and Sohn, 1976, widely distributed in the Atlantic, Pacific, and Indian Oceans at depths ranging from 150 to 4758 m, and *Danielopolina* Kornicker and Sohn, 1976, from marine caves (Cuba, Canary Islands, Bahamas, Yucatan peninsula, Mexico, Galapagos Islands) and also from the deep sea (South Atlantic, 3459 m) (Kornicker and Iliffe, in press a)).

Key to Living Genera of Thaumatoocyprididae

1. Each valve of carapace with long spine-like process (about $\frac{1}{2}$ length of carapace) at anteroventral margin *Thaumatoocypris*
Each valve of carapace with only short process (less than $\frac{1}{4}$ length of carapace) at anteroventral margin 2
2. Carapace surface smooth or punctate *Thaumatoconcha*
Carapace surface reticulate or spinous *Danielopolina*

Danielopolina Kornicker and Sohn, 1976

TYPE SPECIES.—*Danielopolina carolynae* Kornicker and Sohn, 1976.

COMPOSITION AND DISTRIBUTION.—The genus comprises 6 species: *D. carolynae* Kornicker and Sohn, 1976, from the South Atlantic near the equator at a depth of 3459 m, *D.*

orghidani (Danielopol, 1972), from a saline grotto in Cuba, *D. wilkensi* Hartmann, 1985, from a marine lava-tunnel in the Canary Islands, *D. bahamensis* Kornicker and Iliffe, in press a, from a marine cave in Eleuthera, Bahamas, *D. mexicana* Kornicker and Iliffe, in press a, from a marine cave on the Yucatan Peninsula, Mexico, and *D. styx*, new species, from a marine pool in the Galapagos Islands.

Key to the Species of *Danielopolina*

1. Carapace with surface spines *D. mexicana*
 Carapace with surface reticulations 2
2. Carapace with walls of reticulations formed of minute papillae 3
 Carapace with walls of reticulations formed by continuous or discontinuous ridges
 5
3. Carapace longer than 1.5 mm *D. carolynae*
 Carapace shorter than 1.0 mm 4
4. Each valve with single posterodorsal process; each lamella of adult furca with 3
 short nonarticulated claws *D. orghidani*
 Each valve without posterodorsal process; each lamella of adult furca with more
 than 3 short nonarticulated claws *D. styx*, new species
5. Adult furca with 3 short nonarticulated claws on each lamella *D. bahamensis*
 Adult furca with 6 short nonarticulated claws on each lamella *D. wilkensi*

***Danielopolina styx*, new species**

FIGURES 11-17

ETYMOLOGY.—From the Latin and Greek *Styx* (river in the nether world).

MATERIAL.—*Holotype*: Sta 87-005: USNM 193439, 1 instar IV, appendages on 1 slide, carapace in alcohol.

Paratypes: Sta 87-005: USNM 193421, 1 instar III, appendages on 1 slide, carapace in alcohol. Sta 87-018: USNM 193436A,B, 2 instar III, undissected, in alcohol; USNM 193437, 1 instar II, appendages on slide, carapace in alcohol; USNM 193438, 1 instar I, appendages and 1 furcal lamella on slide, carapace and 1 furcal lamella in alcohol.

DISTRIBUTION.—Santa Cruz Island, Galapagos Islands: Deep Grieta east of Tortuga Bay, at 6-12 m water depth (type locality); Grieta de Caleta la Torta at 17-29 m water depth.

MATURITY OF SPECIMENS.—Previously described species of Thaumatoocyprididae have on each lamella of the furca of the adult 2 articulated claws on the anterior margin followed by 3-6 nonarticulated ventral claws. The furcae of the 4 stages of *D. styx* in the present collection have only 1 articulated anterior claw. Therefore, the furca is a different type than previously described. Because of this, the number of nonarticulated claws cannot be used with certainty to estimate the age of the specimens. However, because the number of nonarticulated ventral claws increases by 1 in each of the 4 stages, it is reasonable to believe that the stages are in sequence. In 2

previously described species of Thaumatoocyprididae, *D. bahamensis* and *Thaumatoconcha radiata*, the 6th limb (bearing bristles) appeared first in instar III, and for the latter species the 7th limb appeared first in instar IV. Instar IV is not known for *D. bahamensis*, but since the 7th limb is absent in instar III and present in instar V, it may also be present in instar IV (Kornicker and Iliffe, in press a, table 2). By using the first appearance of the 6th and 7th limbs on the 4 stages of *D. styx*, the stages are interpreted to be instars I to IV (Table 11).

The total number of growth stages in the ontogeny of *D. styx* is unknown. Within the Thaumatoocyprididae, species with 5 and 7 growth stages have been described (Kornicker and Iliffe, in press a). If *D. styx* is assumed to have either 5 or 7 growth stages, its instar IV would be either the A-1 or A-3 stage, but it is not known which. The ventral edge of each lamella of the furca of instars I-III, but not instar IV, bears a small triangular process that could be the site of a claw present on the following stage. Its absence on instar IV may indicate that instar IV is an adult, but because no genitalia were observed that conclusion cannot be made at this time; however, the possibility cannot be eliminated, because female genitalia are small and could be overlooked.

DESCRIPTION OF INSTAR IV (Figures 11, 12).—Carapace similar in shape, ornamentation, selvage, and central adductor muscle attachments to those of instar III described herein.

Size: USNM 193439, length with anterior process 0.68 mm, length without anterior process 0.59 mm, height 0.51 mm.

First Antenna (Figure 11a,b): Limb with 8 joints. 1st joint with 1 bare dorsal bristle and 1 longer, bare, backward pointing, lateral bristle near ventral margin. 2nd joint with 1 bare dorsal bristle and distal medial spines. 3rd joint defined from 4th by slight indentation in ventral margin but without medial or lateral sutures, and without separation of sclerotized frame at ventral and dorsal margins, with spines forming 2 rows on ventral margin. 4th joint with none or 1 short ventral bristle; ventral edge of 3rd joint longer than ventral edge of 4th joint, but dorsal margins of 3rd and 4th joints without discernible

TABLE 11.—Order of appearance of appendages of *Danielopolina styx* (x = present; 0 = absent).

Growth stage	1st and 2nd antennae, mandible, maxilla, 5th limb, furca	6th limb	7th limb
I	x	0	0
II	x	0	0
III	x	x	0
IV	x	x	x

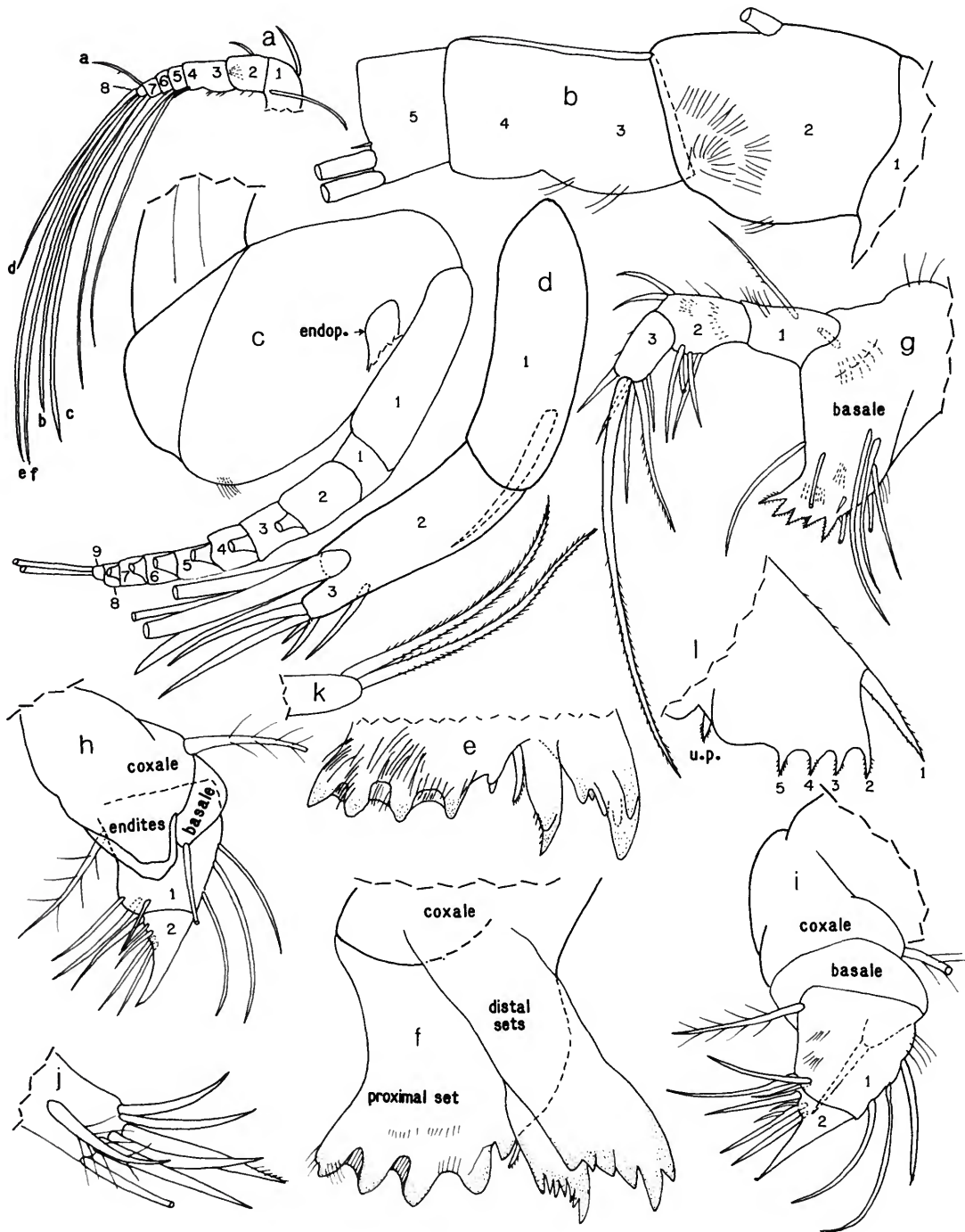


FIGURE 11.—*Danielopolina styx*, new species, USNM 193439, holotype, instar IV, length 0.68 mm: *a*, left 1st antenna, lateral view; *b*, joints 2-5 of right 1st antenna, medial view; *c*, left 2nd antenna, medial view, only base of endopodite shown; *d*, endopodite of left 2nd antenna, medial view; *e*, coxale endite of left mandible, medial view; *f*, coxale endite of right mandible, lateral view; *g*, basale and endopodite of left mandible, lateral view; *h*, left maxilla, medial view, bristles of endites not shown; *i*, right maxilla, lateral view, bristles of endites not shown; *j*, an endite of maxilla; *k*, left 7th limb; *l*, right lamella of furca and unpaired process (u.p.).

boundary separating them. 5th joint about same length as ventral margin of 4th joint, with 3 ventral bristles (2 long, 1 minute, medial) (Figure 11b). 6th joint bare, slightly shorter than 5th joint. 7th joint slightly longer than 6th, with 2 long ventral b-, and c-bristles, and 1 short, dorsal a-bristle with small marginal spines. 8th joint about half length of 7th, with 3 bristles (2 long ventral e-, and f-bristles, 1 shorter dorsal d-bristle).

Second Antenna: Protopodite with long spines at posteroventral corner (Figure 11c). Endopodite (Figure 11d): 1st joint elongate with 1 distal bristle; 2nd joint slightly shorter than 1st, with 1 short, dorsal, lateral bristle and 4 terminal ventral bristles (3 long, 1 short); 3rd joint short, with 4 terminal bristles (2 short, 2 minute). Exopodite with 9 joints (Figure 11c): 1st joint divided by medial suture into long proximal and short distal parts; joints 2–8 each with long bristle with distal natatory hairs; 9th joint small, with 2 bristles (1 long, 1 medium), both with distal natatory hairs; some long bristles with few widely separated marginal spines.

Mandible: Coxale endite similar to that of instar III (Figure 11e,f). Basale (Figure 11g): tooth of endite with 5 triangular cusps with small marginal teeth; posterior edge of endite with 2 distal tubular bristles; anterior margin with 1 distal bristle; lateral side of endite with 3 long bristles near posterior margin, 1 long bristle near anterior margin, and 1 short distal knife-like bristle; medial side with 1 proximal bristle near dorsal margin (only proximal part shown in illustrated limb) and proximal and distal hairs. Endopodite (Figure 11g): 1st joint spinous, with 1 dorsal bristle at midlength; 2nd joint spinous, with 2 distal dorsal bristles, and 3 or 4 distal ventral bristles; 3rd joint spinous, with 6 bristles.

Maxilla (Figure 11h–j): Coxale with stout plumose dorsal bristle. Basale with slender medial tubeformed bristle. Endopodite: 1st joint with proximal ventral bristle with long spines, 3 dorsal bristles, and 3 distal bristles on or near ventral margin; end joint with 1 stout, unringed, nonarticulated, terminal claw and 5 articulated ringed bristles. Endites obscure but each with about 6 or 7 bristles, some tubular.

Fifth Limb (Figure 12a–c): Epipodite with bristles forming 3 groups, each with 4 or 5 hirsute bristles (Figure 12c). Protopodite and endopodite with 16 or 17 bristles (Figure 12a); distal endopodial joint with additional short tooth-like medial bristle. Exopodite 3-jointed: 1st joint divided into proximal and distal parts by weak medial suture; proximal part with 3 ventral bristles at joint midlength, 1 medial bristle at joint midwidth, and 1 long terminal dorsal bristle; distal part with 2 terminal ventral bristles and 1 medial bristle at joint midwidth; 2nd joint with 1 ventral bristle at joint midlength, and 1 medial bristle at joint midwidth; end joint with 3 bristles (midbristle 50–59 percent and smallest bristle 35–42 percent length of longest bristle) (Figure 12b).

Sixth Limb (Figure 12d,e): Epipodite with 14 bristles forming 3 groups (proximal dorsal group and distal ventral group, each with 5 bristles, middle group with 4 bristles).

Protopodite with 3 distal, spinous, ventral bristles. Basale with 2 spinous ventral bristles. Small endopodite with 2 long spinous bristles. Exopodite: 1st and 2nd joints fused (bare on right limb (Figure 12d)), left limb with 2 distal bristles (1 ventral, 1 at midwidth (Figure 12e)); end joint with 2 bristles (smaller bristle 71–72 percent of longer bristle).

Seventh Limb (Figure 11k): Elongate with 2 long spinous terminal bristles.

Furca (Figure 11l): Each lamella with 1 long anterior articulated claw and 4 short ventral nonarticulated claws; all claws with minute, anterior and posterior spines; each lamella with medial and lateral spines (not shown in illustration; similar to those on furca of instar III); stout unpaired process (with minute marginal spines) on posterior of body just proximal to lamellae.

Bellonci Organ: Absent.

Lip: Upper lip hirsute, in lateral view projecting posteriorly (Figure 12f–h); posterior edge with 2 tubular bristles and 2 stout spines (Figure 12h). Esophagus narrow then broadens at anterior gut (Figure 12f). Lower lip comprising lateral flap on each side of mouth (Figure 12i).

Gut Content: Unrecognized granular particles.

DESCRIPTION OF INSTAR I (Figure 13).—Carapace similar in shape (illustrated carapace somewhat distorted (Figure 13a)), ornamentation, and central adductor muscle attachment scar to that of instar III.

Size: USNM 193438 (shell distorted), length with anterior process 0.29 mm, length without anterior process 0.27 mm, height 0.27 mm.

First Antenna (Figure 13b): Limb with 8 joints similar in proportions to those of instar II. 1st joint bare. 2nd joint with distal medial spines. 3rd and 4th joints similar to those of instars II and III. 5th joint with small ventral bristle not reaching distal end of 7th joint. 6th joint bare. 7th joint with 2 bristles (1 long ventral, 1 short dorsal); 8th joint with 2 bristles.

Second Antenna (Figure 13c): Protopodite bare. Endopodite 3-jointed but with 2nd and 3rd joints fused: 1st joint elongate, bare; fused 2nd and 3rd joints with 1 filamentous short unringed ventral bristle and 4 ringed bristles (2 long, 2 short). Exopodite similar to that of instar III, 8th joint with 2 bristles.

Mandible: Coxale endite similar to that of instar III (Figure 13d). Basale (Figure 13e): 4 terminal teeth and 2 posterior tubular bristles similar to those of instar III; anterior margin with 1 long distal bristle; lateral side with 1 long bristle distal to midlength; indistinct short proximal medial bristle near dorsal margin. Endopodite (Figure 13e): 1st joint bare; 2nd joint with 1 dorsal bristle; 3rd joint with 4 bristles.

Maxilla (Figure 13f,g): Endite I with about 6 bristles; endite II with 1 proximal and 4 terminal bristles; endite III with 1 proximal and 3 terminal bristles; at least 1 tubular bristle on each endite. Coxale with spinous dorsal bristle. Basale with 1 or 2 bristles near ventral margin (1 medial, 1 lateral).

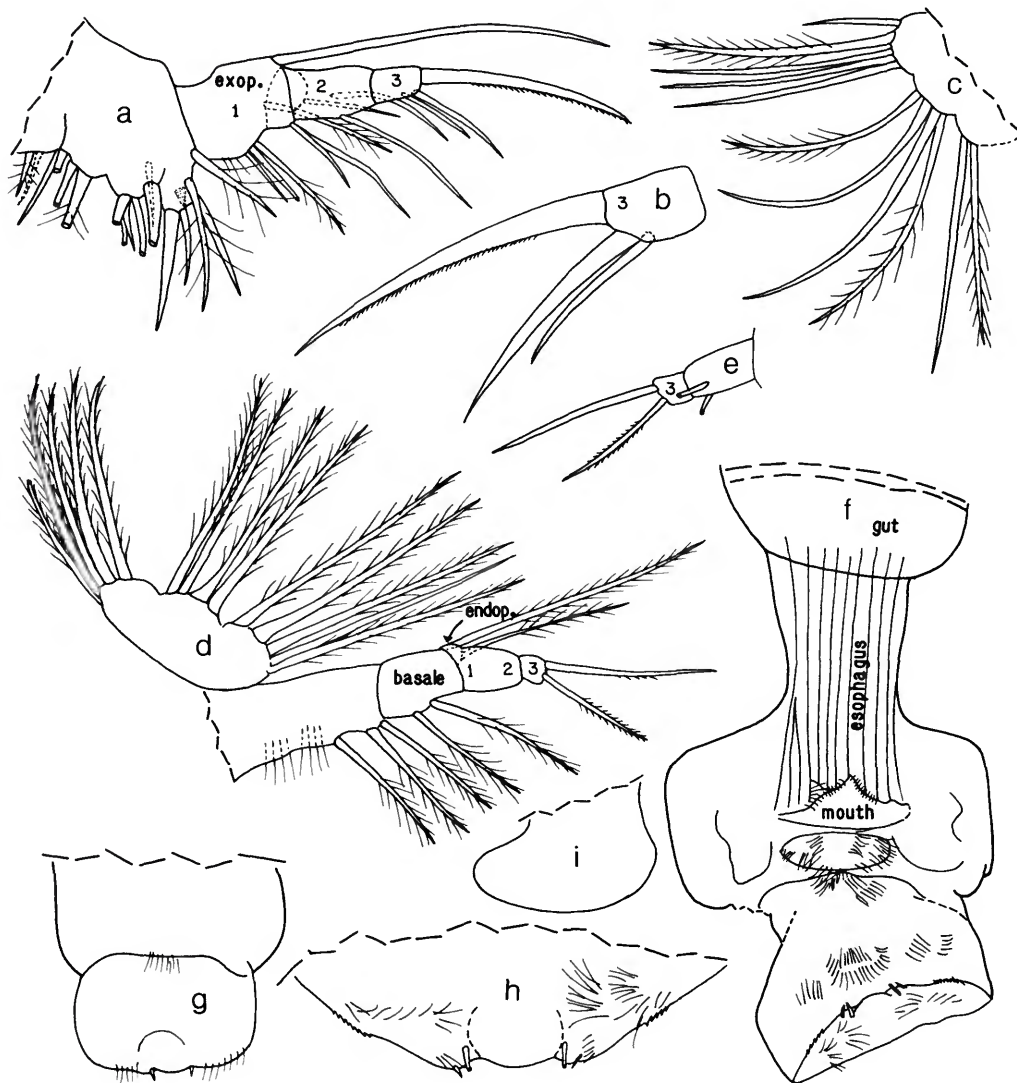


FIGURE 12.—*Danielopolina styx*, new species, USNM 193439, holotype, instar IV, length 0.68 mm: a, left 5th limb, lateral view, epipodite not shown; b, tip of right 5th limb, lateral view; c, epipodite of 5th limb, dorsal lobe at top, not all bristles shown on ventral lobe; d, left 6th limb, lateral view; e, tip of right 6th limb, lateral view; f, posterior view of esophagus, mouth, and upper lip, compressed under cover slip; g, posterior view of upper lip, not under cover slip; h, detail of edge of upper lip from f; i, lower lip, anterior to left.

Endopodite: 1st joint with no or 1 proximal ventral bristle and 2 distal bristles (1 ventral, 1 dorsal); 2nd joint with 1 stout nonarticulated claw-like bristle, and 2 or 3 slender bristles. (Sutures between joints indistinct so that exact location of some bristles uncertain.)

Fifth Limb (Figure 13*h,i*): Epipodite with bristles forming 3 groups (not all bristles shown on Figure 13*i*). Protopodite and endopodite with 7 or 8 bristles including short tooth-like bristle on distal endopodial joint. Exopodite 3-jointed but with 1st and 2nd joints fused: 1st joint with 1 long terminal dorsal

bristle, and 2 bristles (1 ventral, 1 medial near ventral margin); 2nd joint bare; 3rd joint small with 1 terminal bristle.

Sixth and Seventh Limbs: Absent.

Furca (Figure 13*j*): Each lamella with 1 long anterior articulated claw followed by 1 short nonarticulated claw on anteroventral corner of lamella; a small triangular process at midlength of ventral margin of each lamella; lateral and medial surfaces of each lamella with spines forming rows; stout unpaired process on posterior of body just proximal to lamellae.

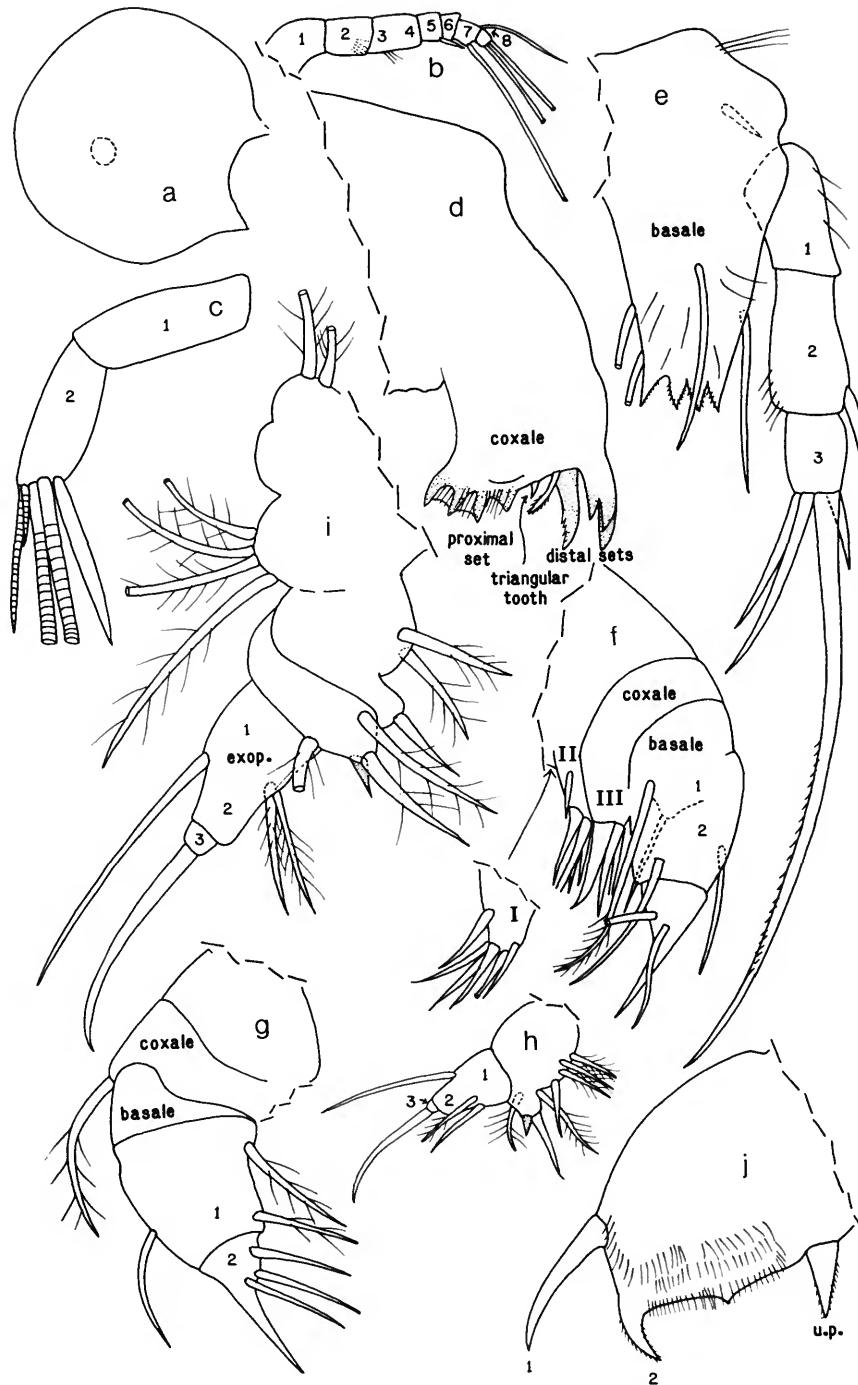


FIGURE 13.—*Danielopolina styx*, new species, USNM 193438, paratype, instar I: *a*, complete specimen from right side (shell distorted), length including anterior process 0.29 mm, central adductor muscle attachments indicated by dashed oval; *b*, right 1st antenna, lateral view; *c*, endopodite of right 2nd antenna, medial view; *d*, coxale endite of right mandible, lateral view; *e*, basale and endopodite of right mandible, lateral view; *f, g*, maxillae; *h*, left 5th limb, medial view; *i*, right 5th limb, lateral view, not all epipodial bristles shown; *j*, left lamella of furca and stout unpaired process (u.p.).

Bellonci Organ: Absent.

DESCRIPTION OF INSTAR II (Figure 14).—Carapace similar in shape, ornamentation and central adductor muscle attachment scar to that of instar III (Figure 14a,b).

Size: USNM 193437: left valve, length with anterior process 0.50 mm, length without anterior process 0.46 mm, height 0.40 mm; right valve, length with anterior process 0.48 mm, length without anterior process 0.46 mm, height 0.40 mm.

First Antenna (Figure 14c,d): Limb with 8 joints. 1st joint with 1 bare dorsal bristle. 2nd joint with distal medial spines and distal low bulbous process (with small spines) extending past ventral margin of joint (Figure 14d). 3rd joint defined from 4th by slight step in ventral margin but without medial or lateral sutures and without separation of sclerotized frame at ventral and dorsal margins (slight sinuate curvature in dorsal margin probably indicates location of division between 3rd and 4th joints), with spines forming 2 rows on ventral margin, and spines forming distal row on dorsal margin. 4th joint bare. Ventral edge of 3rd joint longer than ventral edge of 4th joint but reverse on dorsal margin. 5th joint smaller than 4th, with short ventral bristle with minute terminal papilla. 6th joint smaller than 5th and without bristles. 7th joint longer than 6th, with 2 bristles (1 long ventral with few widely separated minute spines, 1 short dorsal with small marginal spines). 8th joint smaller than 7th, with 3 bristles (1 long lateral, 1 medium dorsal medial, 1 short ventral medial, all with widely separated minute marginal spines and terminal papilla).

Second Antenna: Protopodite bare. Endopodite 3-jointed but with 2nd and 3rd joints fused (Figure 14e): 1st joint elongate with 1 short distal bristle; fused 2nd and 3rd joints with 5 bristles (3 long, 1 short, 1 minute). Exopodite similar to that of instar III.

Mandible: Coxale endite folded on illustrated limb (Figure 14f), but similar to that of instar III. Basale similar to that of instar III except for absence of short distal lateral bristle, and for 1 of paired anterior bristles being short (Figure 14g). Endopodite with 1 dorsal bristle on 1st joint, 2 dorsal bristles on 2nd joint, and 4 bristles on end joint (Figure 14h).

Maxilla (Figure 14i,j): Similar to that of instar III but with fewer terminal bristles. Endites not examined in detail.

Fifth Limb (Figure 14k): Epipodite present but exact number of bristles not determined because bristles obscured. Protopodite obscured on specimen examined. Distal endopodial joint with short tooth-like bristle, 4 ventral bristles (1 stout pectinate, 3 slender). Exopodite 3-jointed: 1st joint with 1 very long terminal dorsal bristle, 1 ventral bristle, and 1 medial bristle at joint midwidth; 2nd joint elongate, without bristles; end joint small with 2 or 3 bristles (1 long, 1 or 2 short, all with marginal spines).

Sixth Limb: Not observed.

Seventh Limb: Absent.

Furca (Figure 14l): Each lamella with 1 long anterior articulated claw followed by 2 short nonarticulated ventral claws and small triangular process; all claws with anterior and

posterior spines; lateral and medial surfaces of lamella with spines forming rows; stout unpaired process on posterior of body just proximal to lamellae.

Bellonci Organ: Absent.

Lip: Similar to that of instar III.

Gut Content: Unrecognized amber-colored particles.

DESCRIPTION OF INSTAR III (Figures 15–17).—Carapace subround in lateral view with straight dorsal margin in vicinity of hinge and also straight margin between anterior and anteroventral processes (Figures 15, 16a,b); ventral and posterior margins as well as anterior margin dorsal to anterior process evenly rounded; valves broadest at about midlength and midheight, in vicinity of central adductor muscle attachments. Short anterior and anteroventral processes with bases just lateral to valve edge; each process bearing fragile spine-bearing frill that easily breaks off at slight touch with dissecting needle leaving smaller firm triangular protuberance.

Ornamentation (Figures 15, 16a,b): Surface finely reticulate with reticulation walls formed of minute pustules, most with blunt tips, but few with pointed tips; on anterior part of shell pustules form rows (about 8) paralleling straight edge of shell between anterior and anteroventral processes. (Pustules break off easily, and on most specimens in collection pustules missing on parts of shell, especially near center.)

Adductor Muscle Attachment Scar (Figures 15, 16a): Scar central in location; subround with greatest diameter trending towards posterodorsal margin of shell; scar consisting of 7 or 8 wedge-shaped scars more or less radially arranged. Crescent-shaped mandibular scar located anteroventral to adductor muscle scar (Figure 16a).

Size: USNM 193421, length with anterior process 0.57 mm, length without anterior process 0.52 mm, height 0.41 mm; USNM 193436A, length with anterior process 0.59 mm, length without anterior process, 0.55 mm, height 0.46 mm; USNM 193436B, length with anterior process 0.56 mm, length without anterior process 0.53 mm, height 0.44 mm.

First Antenna (Figure 16c): Limb with 8 joints. 1st joint with 1 bare dorsal bristle. 2nd joint with 1 bare dorsal bristle and distal medial spines. 3rd joint defined from 4th by slight step in ventral margin but without medial or lateral sutures, and without separation of sclerotized frame at ventral or dorsal margins (slight sinuate curvature in dorsal margin probably indicates location of division between 3rd and 4th joints), with spines forming 1 or 2 ventral rows, and spines forming distal row near dorsal margin. 4th joint bare; ventral edge of 3rd joint longer than dorsal edge of ventral 4th joint, but relationship reversed on dorsal margin. 5th joint smaller than 4th, with 1 long ventral bristle with few minute widely separated spines. 6th joint slightly smaller than 5th and without bristles. 7th joint about same length as 6th, with 2 bristles (1 long ventral and with few small widely separated marginal spines, 1 short dorsal with small marginal spines), 8th joint smaller than 7th, with 2 long ventral bristles and 1 shorter, dorsal bristle.

Second Antenna (Figure 16d): Protopodite with long

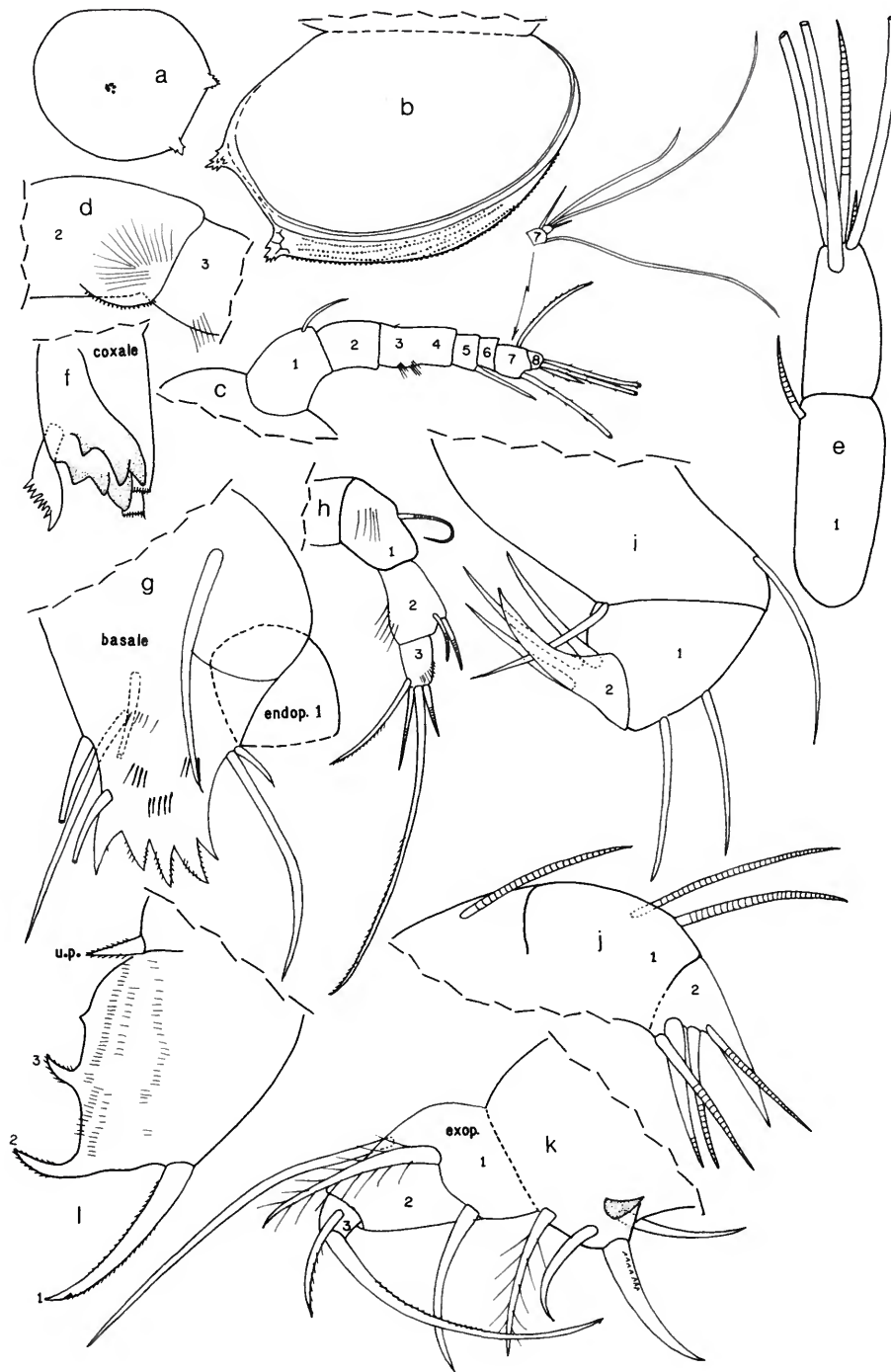


FIGURE 14.—*Danielopolina styx*, new species, USNM 193437, paratype, instar II: *a*, complete specimen from right side, length including anterior process 0.50 mm; *b*, oblique view of right valve from inside, note list along ventral and posterior infold; *c*, right 1st antenna, lateral view; *d*, parts of joints 2 and 3 of left 1st antenna showing spines, medial view; *e*, endopodite of right 2nd antenna, lateral view; *f*, coxale endite of left mandible (endite folded); *g*, basale and 1st endopodial joint of left mandible, medial view, dorsal bristle of 1st endopodial joint not shown; *h*, endopodite of right mandible, lateral view; *i*, left maxilla, medial view, endite bristles not shown; *j*, right maxilla, lateral view, endite bristles not shown; *k*, left 5th limb, medial view; *l*, right lamella of furca and unpaired process (u.p.).

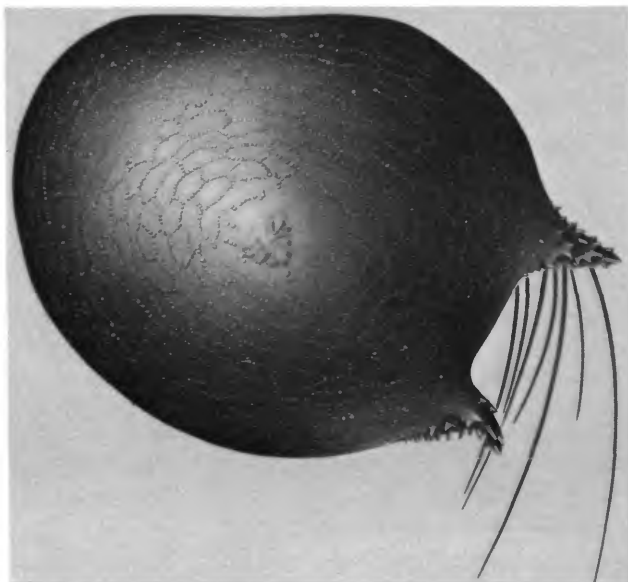


FIGURE 15.—*Danielopolina styx*, new species, USNM 193421, paratype, instar III, complete specimen from right side, length including anterior process, 0.57 mm.

spines at posteroventral corner (Figure 16d). Endopodite 3-jointed, but with 2nd and 3rd joints fused: 1st joint elongate, with 1 bristle; 2nd joint about $\frac{3}{4}$ length of 1st, with 2 terminal bristles (1 lateral, short, filamentous, 1 medial, long, ringed, bare); 3rd joint short, with 4 bristles (2 long, 1 short, 1 minute). Exopodite with 8 joints: 1st joint undivided; bristles of joints 2–7 long, ringed, with few widely separated minute marginal spines, and distal natatory hairs; 8th joint with 2 bristles (1 long, 1 medium), both with few minute widely separated marginal spines.

Mandible (Figure 16e–g): Coxale endite with proximal and distal sets of teeth separated by space (Figure 16e); proximal set comprising 4 broad cusps plus triangular tooth close to distal set of teeth; surface between cusps and medial and lateral surfaces just proximal to cusps with slender spines; 1 spinous bristle with base just distal to triangular tooth; distal set of teeth consisting of 2 flat teeth, each having 4 or 5 pointed cusps; cusps of proximal flat tooth pectinate; distal flat tooth with small proximal medial tooth on medial cusp. Basale (Figure 16f): tooth of endite with 5 triangular cusps with small marginal teeth; posterior edge of endite with 2 tubular bristles (1 proximal, 1 distal, each with terminal papilla); anterior margin of endite with 2 ringed bristles (1 with medial base, 1 with lateral base); lateral side of endite with 2 slender proximal ringed bristles and 1 shorter distal ringed bristle; medial side with 1 proximal ringed bristle near dorsal margin. Endopodite 3-jointed with 1st and 2nd joints about same length and 3rd joint shorter (Figure 16f,g): 1st joint with 1 dorsal bristle at midlength; 2nd joint spinous, with 2

dorsal bristles (dorsal margin of joint narrower distal to bristles); 3rd joint spinous, with 4 bristles.

Maxilla (Figure 17a–c): Endite I with 6 bristles; endite II with 7 bristles; endite III with about 4 bristles; 1 or 2 tubular bristles on each endite. Coxale with long stout plumose dorsal bristle. Basale with slender medial tubular bristle. Endopodite: 1st joint with 2 distal bristles on or near dorsal margin and distal bristle at joint midwidth or near ventral margin. End joint with 1 anterior, stout, linear, sclerotized nonarticulated claw, and 4 articulated slender bristles.

Fifth Limb (Figure 17d,e): Epipodite with bristles forming 3 groups (Figure 17d). Protopodite and endopodite with about 11 bristles; distal endopodial joint with additional short tooth-like bristle. Exopodite 3 jointed: 1st joint with 1 very long terminal dorsal bristle, 1 ventral bristle, and 1 medial bristle at joint midwidth; 2nd joint elongate with 1 bristle on ventral margin; end joint small with 3 bristles (middle bristle 45 percent and smallest bristle 32 percent length of longest bristle).

Sixth Limb (Figure 17f,g): Epipodite with bristles forming 3 groups (Figure 17f). Protopodite obscured on limb examined. Basale with 1 ventral bristle (this bristle could be on protopodite). Small endopodite with 2 long bristles. Exopodite: 1st and 2nd joints fused, bare; end joint short, with 2 weakly developed bristles.

Seventh Limb: Not observed.

Furca (Figure 17h): Each lamella with 1 long anterior articulated claw followed by 3 short nonarticulated ventral claws; claws with minute spines along anterior and posterior edges; 1 or both lamellae with small triangular process posterior to posterior ventral claw; anterior margin of lamella with few short spines; lateral surface of lamella with minute spines forming rows, more and longer spines on medial surface (some medial spines extending past ventral edge of lamella); stout unpaired process (with minute marginal spines) on posterior of body just proximal to lamellae.

Bellonci Organ: None observed.

Lip: Upper lip with distal spines and a short tubular bristle on posterior edge on each side of midwidth (Figure 16h). Esophagus narrow; broad anterior part of gut separated from smaller and narrower posterior part by slight restriction; anus small (Figure 16i).

Gut Content (Figure 16i): Unrecognized brown particles.

COMPARISONS.—The carapace of *D. styx* resembles those of *D. orghidani* and *D. carolynae* in having reticulations with walls formed by papillae. It differs from both species in not having a small posterodorsal process on each valve. The carapace of *D. styx* is much smaller than that of *D. carolynae*. *Danielopolina styx* bears more than the 3 short nonarticulated claws present on each lamella of the furca of *D. orghidani*. *Danielopolina styx* differs from previously described species of the Thaumatoocyprididae in having only 1 instead of 2 articulated anterior claws on each lamella of the furca.

ONTOGENY.—As in *Thaumatoconcha radiata* and *D.*

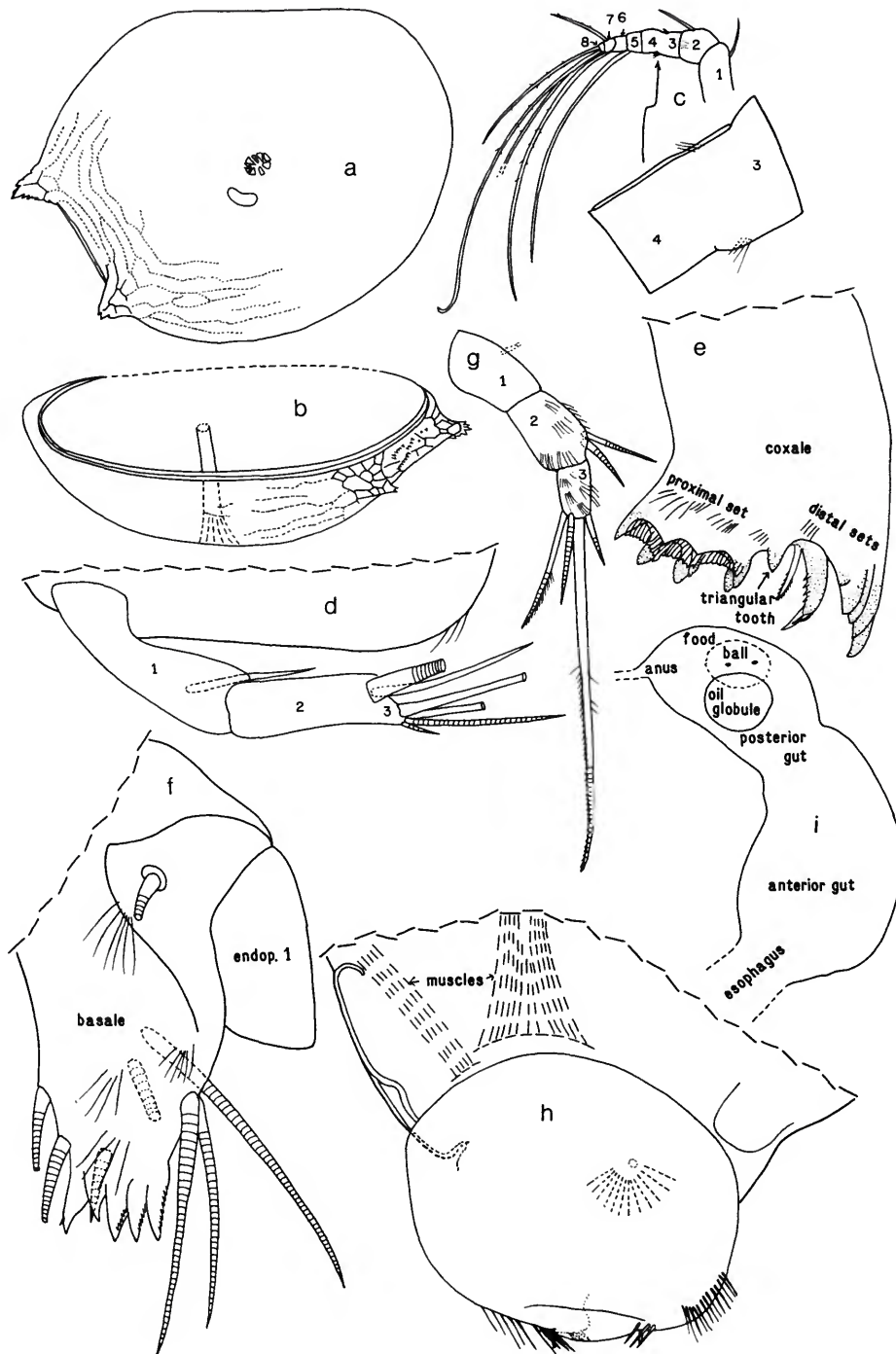


FIGURE 16.—*Danielopolina styx*, new species, USNM 193421, paratype, instar III: *a*, complete specimen from left side, length including anterior process 0.57 mm; *b*, oblique view of left valve from inside, note central adductor muscle bundle; *c*, left 1st antenna, lateral view; *d*, endopodite and distal part of protopodite of right 2nd antenna, medial view; *e*, coxale endite of left mandible, medial view; *f*, basale and 1st endopodial joint of left mandible, medial view, dorsal bristle of 1st endopodial joint not shown; *g*, endopodite of left mandible, medial view; *h*, upper lip compressed under cover slip; *i*, gut viewed from right side, ventral side to left.

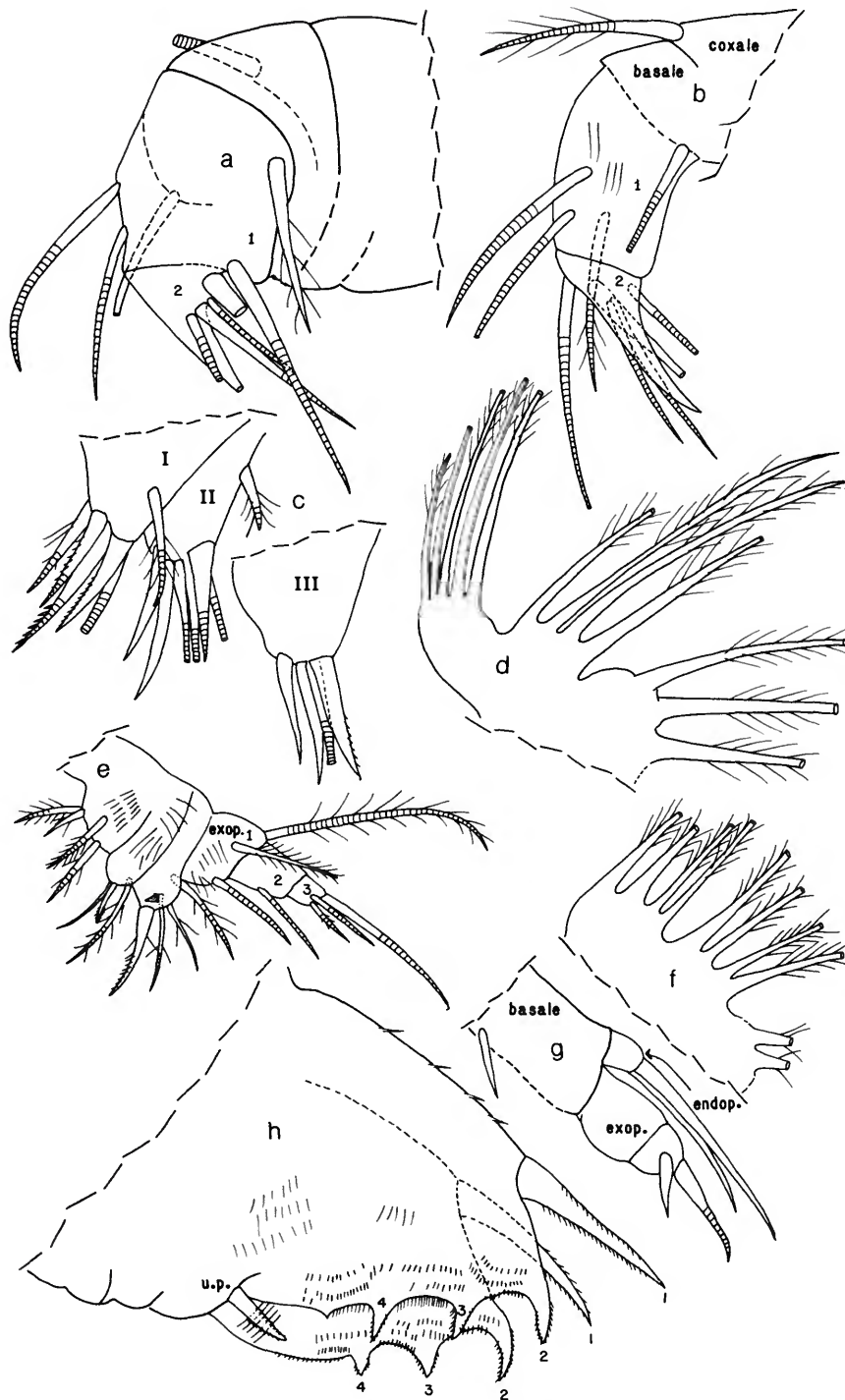


FIGURE 17.—*Danielopolina styx*, new species, USNM 193421, paratype, instar III: *a, b*, maxillae, bristles of endites not shown; *c*, endites of maxilla shown in *b*; *d*, epipodite of 5th limb, dorsal lobe at top, not all bristles shown on ventral lobe; *e*, right 5th limb, medial view, epipodite not shown; *f*, epipodite of 6th limb, dorsal lobe at top, not all bristles shown on ventral lobe; *g*, 6th limb, epipodite not shown; *h*, furcal lamellae and unpaired process (u.p.).

bahamensis the 1st and 2nd antennae, mandible, maxilla, 5th limb, and furca are already present in the 1st instar (Table 11); the 6th and 7th limbs are not present; the Bellonci organ is absent on all instars. The 6th limb appears, but with just a few bristles, in the 3rd instar, and the 7th limb in the 4th instar. The carapace of the single instar I in the collection is distorted, but all instars appear similar except for size.

First Antenna: The number of bristles on the 1st antenna increases from 5 on instar I to 12 or 13 on instar IV (Table 12). The ventral bristle of the 5th joint of does not reach past the 8th joint on instars I and II but is extremely long on instar III.

Second Antenna: The protopodite of the 2nd antenna is bare on instars I and II but bears long spines on the posterior ventral corner on instars III and IV. The exopodite has 8 joints on instars I to III and 9 joints on instar IV. The exopodial bristles bear distal natatory hairs on all instars. The 1st endopodial joint is bare on the 1st instar but bears 1 bristle on later instars (Table 13). The 2nd and 3rd endopodial joints are fused on all instars, but can be differentiated by the location of bristles on instars III and IV. The total number of bristles on the 2nd and 3rd joints increases from 5 on instar I to 9 on instar IV (Table 13). All 4 terminal bristles of the 3rd

endopodial joint of instar IV are short, whereas 2 of 4 terminal bristles of instar III are very long, possibly the difference is sexual, but sex of the instars was not determined.

Mandible: The terminal teeth of the coxale and basale are similar on all 4 instars. The number of lateral bristles of the basale as well as the number of bristles of 1st and 2nd endopodial joints are higher on later instars, but the number of bristles of the 3rd endopodial joint remains at 4 (Table 13).

Fifth Limb: The number of exopodial bristles increases from 4 on instar I to 13 on instar IV (Table 14).

Sixth Limb: The 6th limb appears first on instar III, and bears rather short and weakly developed bristles, but the number of bristles is only slightly less than on the limb of instar IV (Table 14).

Seventh Limb: The limb appears first on instar IV and bears 2 terminal bristles, the same number observed on adults of other species of the genus.

Furca: All 4 instars have only 1 articulated claw on the anterior margin of each lamella. The number of nonarticulated claws increases from 1 on instar I to 4 on instar IV (Table 15). The distribution of furcal claws on other Thaumatoctyrididae are presented for comparison in Table 15.

TABLE 12.—Number of bristles on joints of 1st antenna of *Danielopolina styx*.

Growth stage	1st joint		2nd joint	3rd joint	4th joint	5th joint	6th joint	7th joint		8th joint
	lateral	dorsal	dorsal		ventral	ventral		ventral	dorsal	
I	0	0	0	0	0	1	0	1	1	2
II	0	1	0	0	0	1	0	1	1	3
III	0	1	1	0	0	1	0	1	1	3
IV	1	1	1	0	0-1	3	0	1-2	1	3

TABLE 13.—Number of bristles on 2nd antenna and mandible of *Danielopolina styx*.

Growth stage	Second antenna		Mandible			
	Endopodite		Basale lateral bristles	Endopodite		
	1st joint	2nd + 3rd joints		1st joint	2nd joint	3rd joint
I	0	5	1	0	1	4
II	1	5	2	1	2	4
III	1	6	3	1	2	4
IV	1	9	5	1	5-6	4

TABLE 14.—Number of bristles on exopodites of 5th and 6th limbs of *Danielopolina styx*.

Growth stage	Fifth limb			Sixth limb		
	1st joint	2nd joint	3rd joint	1st joint	1st-2nd joints (fused)	3rd joint
I	3	0	1		limb absent	
II	3	0	2-3		limb absent	
III	3	1	3	3	0	2
IV	8	2	3	4	0-2	2

TABLE 15.—Number of claws on each lamella of furca of *Danielopolina styx*, *D. bahamensis*, and *Thaumatoconcha radiata* (long articulated anterior claws: short nonarticulated ventral claws; nd = no data; ns = species without this stage).

Growth stage	<i>D. styx</i>	<i>D. bahamensis</i> *	<i>T. radiata</i> †
I	1:1	2‡:0	2‡:0
II	1:2	2:1 (anlage)	2:1
III	1:3	2:1	2:2
IV	1:4	nd	2:3
V	nd	ns	2:4
VI	nd	ns	2:5
Adult	nd	2:3	2:6

*Data from Kornicker and Iliffe (in press a).

†Data from Kornicker and Sohn (1976, table 7).

‡Second long anterior claw not articulated.

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