Myodocopid Ostracoda (Halocypridina, Cladocopina) from Anchialine Caves in the Bahamas, Canary Islands, and Mexico

LOUIS S. KORNICKER
and
THOMAS M. ILIFFE

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 599

SERIES PUBLICATIONS OF THE SMITHSONIAN INSTITUTION

Emphasis upon publication as a means of "diffusing knowledge" was expressed by the first Secretary of the Smithsonian. In his formal plan for the institution, Joseph Henry outlined a program that included the following statement: "It is proposed to publish a series of reports, giving an account of the new discoveries in science, and of the changes made from year to year in all branches of knowledge." This theme of basic research has been adhered to through the years by thousands of titles issued in series publications under the Smithsonian imprint, commencing with *Smithsonian Contributions to Knowledge* in 1848 and continuing with the following active series:

Smithsonian Contributions to Anthropology
Smithsonian Contributions to Botany
Smithsonian Contributions to the Earth Sciences
Smithsonian Contributions to the Marine Sciences
Smithsonian Contributions to Paleobiology
Smithsonian Contributions to Zoology
Smithsonian Folklife Studies
Smithsonian Studies in Air and Space
Smithsonian Studies in History and Technology

In these series, the Institution publishes small papers and full-scale monographs that report the research and collections of its various museums and bureaux or of professional colleagues in the world of science and scholarship. The publications are distributed by mailing lists to libraries, universities, and similar institutions throughout the world.

Papers or monographs submitted for series publication are received by the Smithsonian Institution Press, subject to its own review for format and style, only through departments of the various Smithsonian museums or bureaux, where the manuscripts are given substantive review. Press requirements for manuscript and art preparation are outlined on the inside back cover.

I. Michael Heyman
Secretary
Smithsonian Institution

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 599

Myodocopid Ostracoda (Halocypridina, Cladocopina) from Anchialine Caves in the Bahamas, Canary Islands, and Mexico

Louis S. Kornicker
and Thomas M. Iliffe

SMITHSONIAN INSTITUTION PRESS
Washington, D.C.
1998

ABSTRACT

Kornicker, Louis S., and Thomas M. Iliffe. Myodocopid Ostracoda (Halocypridina, Cladocopina) from Anchialine Caves in the Bahamas, Canary Islands, and Mexico. *Smithsonian Contributions to Zoology,* number 599, 93 pages, 62 figures, 2 maps, 9 tables, 1998.—Halocyprid Ostracoda from the Bahamas (four species (two new) in three genera from anchialine caves) and the Yucatan Peninsula (two species (one new) in two genera) are described and illustrated. The new species are *Spelaeoecia mayan, Deeveya exleyi,* and *Danielopolina exuma.* Supplementary descriptions are presented of *Spelaeoecia styx* Kornicker in Kornicker et al., 1990, and *Danielopolina mexicana* Kornicker and Iliffe, 1989. One species is left in open nomenclature as *Danielopolina* species A. The genus *Spelaeoecia* has not been previously reported from Mexico, and appendages of *Spelaeoecia capax* Kornicker in Kornicker et al., 1990, have not been described previously. The ontogeny of *Spelaeoecia* is discussed, and keys are presented to the species of *Spelaeoecia, Deeveya,* and *Danielopolina.*

Supplementary descriptions are presented of the halocyprid *Danielopolina wilkensi* Hartmann, 1985, and the cladocopid *Eupolycope pnyx* Kornicker and Iliffe, 1995, from a lava tube in Lanzarote, Canary Islands. One specimen of the cladocopid *Polycopiella* from the lava tube is left in open nomenclature as *Polycopiella* species A.

OFFICIAL PUBLICATION DATE is handstamped in a limited number of initial copies and is recorded in the Institution's annual report, *Annals of the Smithsonian Institution.* SERIES COVER DESIGN: The coral *Montastrea cavernosa* (Linnaeus).

Library of Congress Cataloging-in-Publication Data
Kornicker, Louis S., 1919–
Myodocopid Ostracoda (Halocypridina, Cladocopina) from anchialine caves in the Bahamas, Canary Islands, and Mexico / Louis S. Kornicker and Thomas M. Iliffe.
p. cm. – (Smithsonian contributions to zoology ; no. 599)
Includes bibliographical references.
1. Halocyprida–Bahamas. 2. Halocyprida–Canary Islands. 3. Halocyprida–Mexico. I. Iliffe, Thomas M. II. Title. III. Series.
QL1.S54 no. 599 [QL444.085] 590 s–dc21 [595.3'3] 97-35364
CIP

♾ The paper used in this publication meets the minimum requirements of the American National Standard for Permanence of Paper for Printed Library Materials Z39.48—1984.

Contents

Myodocopid Ostracoda (Halocypridina, Cladocopina) from Anchialine Caves in the Bahamas, Canary Islands, and Mexico

Louis S. Kornicker
and Thomas M. Iliffe

Introduction

In a recent publication Aubrecht and Kozur (1995:1) reported abundant specimens of the thaumatocyprid ostracode *Pokornyopsis feifeli* Treible, 1941, in submarine fissure fillings and cavities in the Late Jurassic of the Czorsztyn Unit (Bielie Karpaty Mountains, Western Slovakia) and interpreted them to be "direct forerunners of Recent anchialine and submarine cave ostracod faunas, e.g., *Danielopolina*, doubtlessly a successor (and perhaps a junior synonym of *Pokornyopsis*)."

Another fossil thaumatocyprid, *Thaumatomma piscifrons*, was described by Kornicker and Sohn (1976:107) from Permian limestones on the island of Hydra, Greece. Mainly because of the associated biota, Kornicker and Sohn (1976:17) interpreted the habitat of *T. piscifrons* to be normal marine shelf. Since the publication of that paper, Grant et al. (1991:489) have described in much greater detail the habitat where specimens of *T. piscifrons* were collected. They concluded (p. 489) that "the rich fauna, abundant in taxa and in individuals, points to a favorable environment in shallow, sunny waters at a considerable distance from contaminating sediment or turbulent waves." Furthermore, they concluded (p. 491) that genera of brachiopods collected in the samples suggested that the depositional environment "represented a refugium of sorts, where marine conditions favorable to Paleozoic brachiopods remained longer than in most other places."

Holthuis (1973:3) originally coined the term "anchialine" to refer to "pools with no surface connection with the sea, containing salt or brackish water, which fluctuates with the tides." It was intended to describe land-locked pools on the surface, outside caves. The discovery of similar pools inside caves and extensive networks of submerged cave passages led to the expanded definition proposed by Stock et al. (1986:91): "Anchialine habitats consist of bodies of haline waters, usually with a restricted exposure to open air, always with more or less extensive subterranean connections to the sea, and showing noticeable marine as well as terrestrial influences." Due to reduced numbers of predators and isolation, many crustaceans, algae, etc. are found primarily or exclusively in anchialine habitats. In addition to Indo-Pacific sites mentioned by Holthuis (1973:5-12), open anchialine ponds also occur in the Bahamas (Hobbs, 1978:100-102), Canary Islands (Huys, 1988:140), and Bermuda (Thomas et al., 1992:133-135). Commonly these sites are associated with caves or at least voids between rocks or gravel through which subterranean waters can move. The junior author has done some daytime sampling in open anchialine pools in Bermuda, the Bahamas, and various South Pacific localities, but he never found thaumatocyprids; possibly, night sampling would have been more successful, but this is conjecture. Numerous shrimp otherwise restricted to caves were present in the pools. The close relationship between anchialine pools and anchialine

Louis S. Kornicker, Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560. Thomas M. Iliffe, Department of Marine Biology, Texas A&M University at Galveston, P.O. Box 1675, Galveston, Texas 77553.

Review Chairman: Austin B. Williams, National Marine Fisheries Service Systematics Laboratory, Smithsonian Institution.
Reviewers: Martin V. Angel, Southampton Oceanography Centre, Southampton, United Kingdom; Dan L. Danielopol, Institut für Limnologie, Mondsee, Austria.

TABLE 1.—World distribution of anchialine ostracodes in suborder Halocypridina (Halocyprididae, Thaumatocyprididae). (– = none present.)

Locality	Taxa			
	Spelaeoecia	*Deeveya*	*Danielopolina*	*Euconchoecia*
Palau	–	–	–	*bifurcata pax*
Australia	–	–	*D.* species*	–
Galapagos	–	–	*styx*	–
Canary Islands	–	–	*wilkensi* *phalanx*	–
Bermuda	*bermudensis*	–	–	–
West Indies				
Bahamas	*capax* *styx* *sagax* *barri*	*styrax* *hirpex* *medix* *exleyi* *bransoni* *jillae*	*bahamensis* *exuma* *D.* species A	
Turks and Caicos	–	*spiralis*	–	–
Cuba	*cubensis*	–	*orghidani*	–
Jamaica	*jamaicensis*	–	*elizabethae*	–
Yucatan, Mexico	*mayan*	–	*mexicana*	–

* Baltanás and Danielopol, 1995.

caves may suggest that *Thaumatomma piscifrons* was present in large numbers in open pools, but it also may have occurred, as yet undiscovered, in associated caves in lesser abundance. Thus, it seems possible to the present authors that the "refugium of sorts" identified by Grant et al. (1991:491) may have consisted of anchialine pools.

Maciolek (1983:606) discussed 10 species of anchialine shrimp found in anchialine habitats on 28 islands from Hawaii to the Western Indian Ocean. Nine genera and five families are represented in the 10 species, with only two genera (*Caridena* and *Periclimenes*) having epigeal congeners. Of the remaining seven genera, three are monotypic, whereas four contain two species each. Most of the sites to which Maciolek referred are surface pools, although he noted that some anchialine shrimp were found in "the darkness or near darkness of caves and excavated wells" (Maciolek, 1983:610).

The source of troglobitic ostracodes living in present-day caves has generally been interpreted to be either deep-water (Iliffe, 1990:95, 1991:227–228) or shallow-water crevices (Danielopol, 1990:141; Danielopol et al., 1996:82). A possibility suggested here is that a first step in the evolution of troglobitic cave ostracodes is their presence in anchialine-pool refugia, from which they migrate into cave refugia, which may be more permanent than the pools.

The world distribution of anchialine ostracodes in suborder Halocypridina is shown in Table 1.

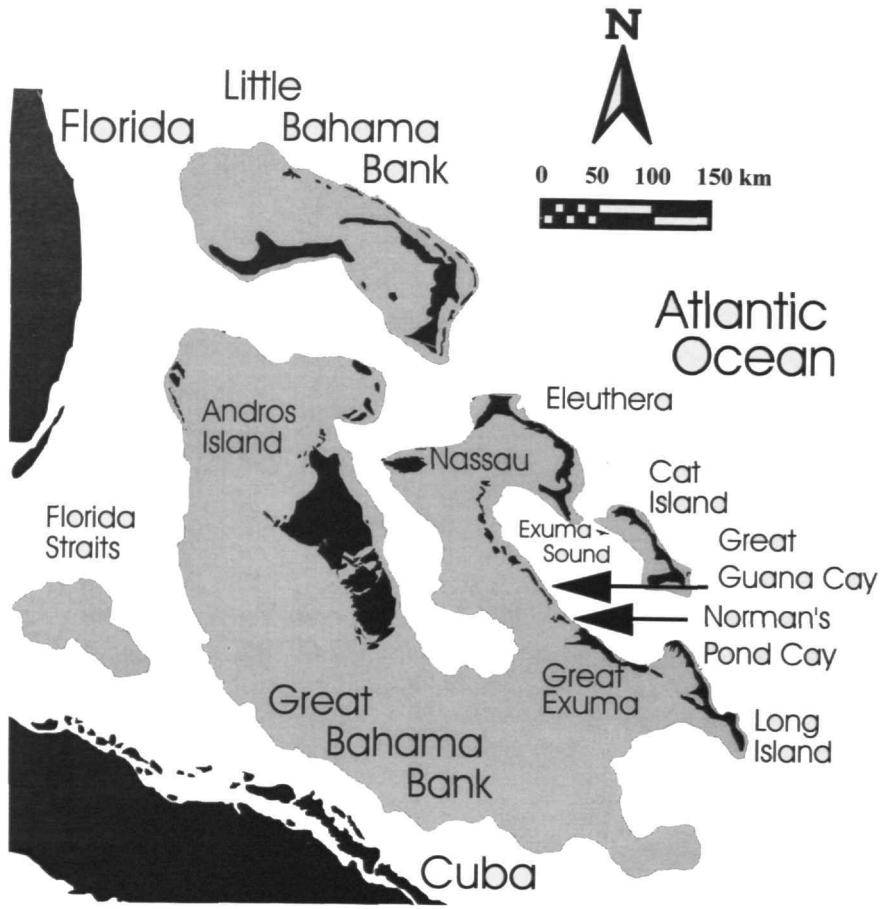
METHODS.—Biological collections were carried out primarily with diver-towed plankton nets (30 cm diameter and 94 um mesh) for each station in the Appendix. Station numbers were assigned by the second author corresponding to the last two digits of the collection year, followed by a number specific to the particular collection at that site. Shortly after collection, the live material was sorted using a binocular dissecting microscope, and specimens were preserved in 70% alcohol. The depths sampled are given for each station in the Appendix.

DISPOSITION OF SPECIMENS.—All specimens have been deposited in the National Museum of Natural History, Smithsonian Institution, and have been assigned USNM (United States National Museum) catalog numbers.

ABBREVIATIONS.—In the figures, Arabic numerals indicate limbs 1–7, as well as individual joints of each limb (the location of the numeral indicating whether a limb or joint is indicated). Roman numerals I–III indicate the endites.

The following abbreviations are used in the illustrations and legends.

am	Central adductor muscle attachments
an	antenna
BO	Bellonci organ
co	copulatory organ
cx	coxale
end	endopodite
ep	epipodite
es	esophagus
ex	exopodite
fu	furca
gl	gland
im	inner margin of infold
l	left
ll	lower lip
lp	lamellar prolongation of selvage
l.v.	left valve
lv	lateral view
md	mandible
mv	medial view
mx	maxilla
nabs	not all bristles shown
precx	precoxale



MAP 1.—Bahama Banks with arrows showing locations of Great Guana Cay and Norman's Pond Cay west of Exuma Sound. (Map based on Caribbean Marine Research Center, Research Opportunities and Proposal Guidelines for 1995, NOAA National Undersea Research Program (fig. 2)).

prot	protopodite
r	right
r.v.	right valve
ul	upper lip

ACKNOWLEDGMENTS.—This research was supported by grants from the Caribbean Marine Research Center (CMRC) of the National Oceanic and Atmospheric Administration (NOAA) National Undersea Research Program. Maps of Norman's Pond and Oven Rock Caves were surveyed and drawn by Brian Kakuk (CMRC). We thank John Pohlman and Brett Dodson (Texas A&M University) and Brian Kakuk for assistance with cave diving collections. Logistical assistance for cave studies in Mexico was provided by Mike Madden, James Coke, Steve Gerrard, and the Center for Investigations of Quintana Roo (CIQRO). Studies in the Canary Islands were supported by grants from the National Geographic Society and the Texas Institute of Oceanography. We thank the Cabildo Insular de Lanzarote, The Casa de Los Volcanes, and the management and staff of the Jameos de Agua for providing logistical assistance during our investigations of the Atlantida Tunnel. Richard Milhollin helped with cave diving collections during the 1994 Atlantida Expedition. We thank Elizabeth Harrison-Nelson, Smithsonian Institution, for preparing the Literature Cited section, lettering many figures, cataloging specimens, and preparing the final draft of the manuscript on a word processor. Penciled camera lucida taxonomic illustrations drawn by Kornicker were inked by Jack Schroeder, Schroeder Associates. Rendered shaded drawings of carapaces and Figure 3 were prepared by Molly Ryan, Smithsonian Institution. We thank reviewers for criticizing the manuscript, and Jack Korytowski, Smithsonian Press/Smithsonian Productions, for final editing and preparation of the manuscript for publication.

Description of Collecting Localities

BAHAMAS.—Bahamian ostracodes reported on in this study were collected from anchialine caves in the Exuma Islands (Map 1; Appendix). The Bahamas consist of a series of broad,

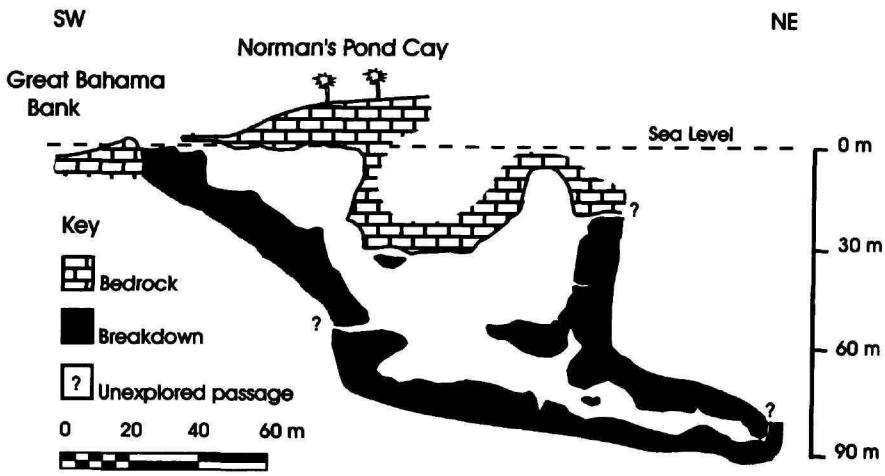


FIGURE 1.—Profile view of Norman's Pond Cave, Norman's Pond Cay, Exuma Cays. Maximum water depth in the cave is 86 m.

shallow-water carbonate platforms rising abruptly from the deep sea. The largest of these platforms is the 100,000 km^2 Great Bahama Bank containing the major islands of Exuma, Andros, New Providence, Eleuthera, Cat, and Long (Map 1). The islands are composed primarily of eolian Pleistocene limestones. The platform is underlain by a continuous thick section of Tertiary and Cretaceous shallow-water limestones and dolomites. Total thickness of these shallow-water deposits exceeds 11,000 m (Meyerhoff and Hatten, 1974). During Pleistocene glacial low sea stands, the Bahama Platform would have consisted of a flat-topped mesa surrounded by near vertical cliffs dropping into the sea.

The Exuma Islands are situated along the eastern rim of the Great Bahama Bank bordering Exuma Sound, a steep-sided submarine valley reaching oceanic depths to over 1800 m. On the west side of the Exuma Islands are the shallow waters of the Great Bahama Bank, whereas to the east is a narrow, terraced shelf. The upper rim of Exuma Sound is a steep drop-off known as the "Wall." The Wall is an abrupt submarine cliff descending from a steep upper edge at about 40 m depth to its base at 150–200 m. Numerous cave entrances and undercuts extend into the Wall, especially between 105 and 140 m depths. The ostracodes in several samples collected from the Wall were examined, but because they appear to be typical open-sea forms, they are not considered further herein but may be described in later papers.

Extensive anchialine and submarine cave systems are present along the margins of the platform. The development of these caves may be related to joint systems in the Pleistocene bedrock. Viewed from the air, the deep blue color of the circular sinkhole cave entrances, in contrast to the lighter bluish green of the shallow banks, has resulted in their being named "blue holes." These blue holes can occur either on islands (referred to as inland blue holes) or in shallow waters of the bank or shelf (referred to as ocean blue holes). Aside from minor currents associated with tidal fluctuations at the open entrance pool, typical inland blue holes contain relatively motionless water bodies. At the opposite extreme, ocean blue holes have extremely strong, reversing currents that correlate with the tides. The currents apparently are due to tidal delays and phase differences between the bank and open ocean, generating hydrostatic gradients at opposite ends of these cave systems. Thus, residence times for water masses from inland blue holes may be quite long, whereas the water in ocean blue holes is exchanged with each tidal cycle. Troglobitic ostracodes have been found exclusively in the inland blue holes.

Many inland and ocean blue holes reach substantial depths. For example, Alfonso Dean's Blue Hole on Long Island has been explored to 201 m depth. Their considerable depth, combined with the presence of underwater stalactites and stalagmites, which must have formed in air, suggests that these caves developed during the Pleistocene glacial period when the sea level was at least 100 m lower than today.

One of the more notable blue holes in the Exumas is Norman's Pond Cave, located near the north end of Norman's Pond Cay (Figure 1).* The entrance to this fracture cave is a 2 m wide by 8 m long sinkhole situated just above the high-tide

*The US Defense Mapping Agency Chart #26300, Andros Island to San Salvador, Scale 1:300,000, 3rd ed. Mar 27 1976, prepared and published by the Defense Mapping Agency Hydrography Center, Washington D.C. 20390 lists "Normans Pond Cay;" however, a note in the legend of this chart states that "names are not necessarily authoritative." The Caribbean Marine Research Center, Research Opportunities, and Proposal Guide Lines for 1995, NOA A National Undersea Research Program, 24 pages, lists "Norman's Pond Cay" and "Norman's Pond Cave." Both Brian Kakuk's draft map of the cave (pers. comm., 1995) and Dill et al. (1990) list it as "Norman's Pond Cave." Therefore, the names Norman's Pond Cay and Norman's Pond Cave are used herein.

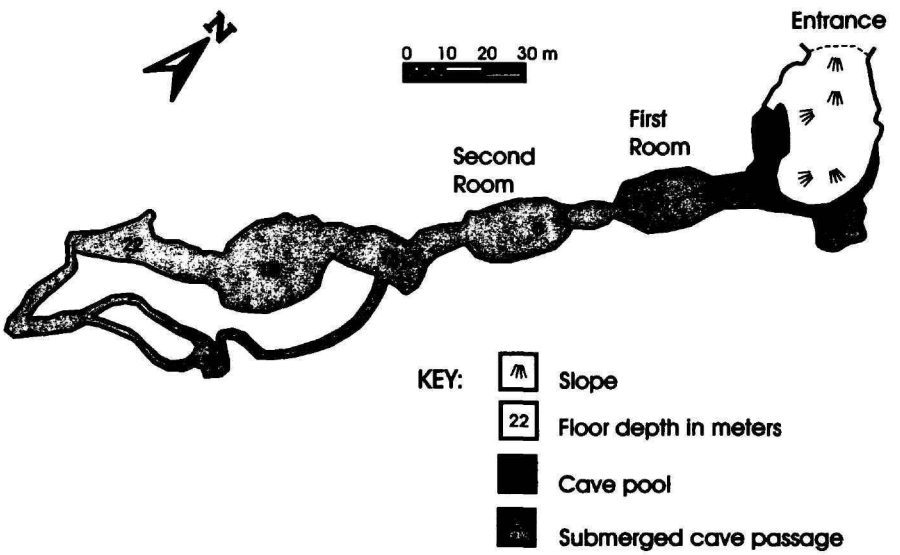


FIGURE 2.—Plan view of Oven Rock Cave, Great Guana Cay, Exuma Cays. Maximum water depth in the cave is 22 m.

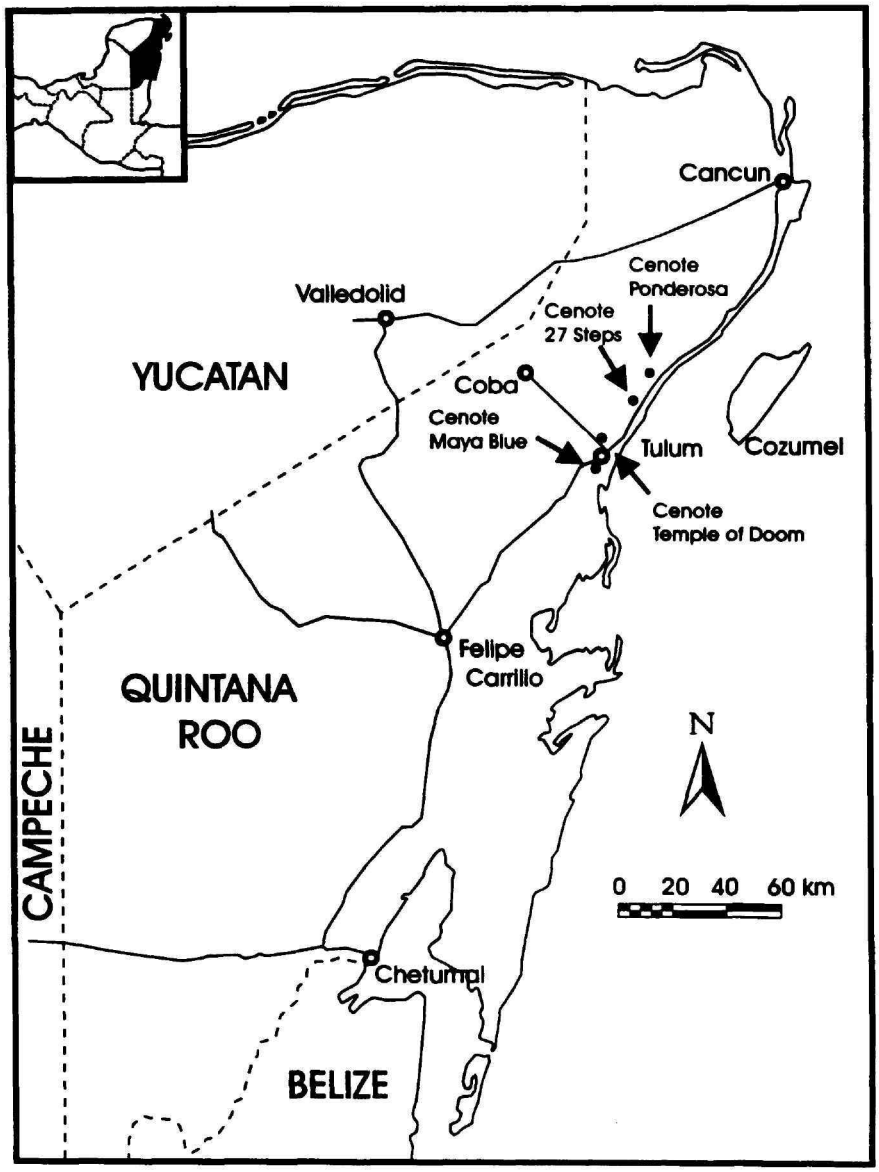
line. An explored horizontal extent of this cave of 175 m, and water depth of 85 m, was reported by Dill et al. (1990). More complete exploration of the cave by Brian Kakuk in 1995 extended the cave horizontally to 210 m, reaching a depth of 86 m (Brian Kakuk, pers. comm., 1995). The cave consists of a collapse-floored fissure up to 8 m wide that extends under the island and trends toward the open waters of the Exuma Sound. Because of its proximity to the coast, waters in the cave are fully marine. Remipedes, amphipods (*Bahadzia* sp.), cyclopoid, harpacticoid, and calanoid copepods, tanaidaceans, cumaceans, and archiannelids, as well as ostracodes (*Spelaeoecia styx* Kornicker, 1990; *Danielopolina exuma,* new species) were collected from the cave.

Oven Rock Cave is located on Great Guana Cay, about 30 km north of Norman's Pond Cay (Figure 2). The cave entrance is situated in a hillside about 1 km from the southern tip of the island. From the 15 m wide, 2.5 m high entrance, a 40 m long dry chamber descends over a breakdown to a tidal anchialine lake. The 1.5 m deep lake extends around the sides and rear of this chamber. The first underwater room of the cave is well decorated with large stalagmites at depths to 9 m. A second room has a small air bell in the ceiling at one end but dips to 17 m depths at the far extreme. From this point, a collapsed floored passage is followed by a low bedding-plane passage reaching depths to 22 m. The length of the cave is over 300 m (Brian Kakuk, pers. comm., 1995). Remipedes, amphipods, cyclopoid, harpacticoid, and calanoid copepods, hippolytid shrimp (*Barbouria cubensis* (von Martens, 1872) and *Somersiella sterreri* Hart and Manning, 1981), and polynoid and archiannelid polychaetes, as well as ostracodes (*Spelaeoecia capax, S. styx, Deeveya exleyi,* new species, and *Danielopolina* sp. A) were collected in the cave.

Collections were made in two additional caves in the Exumas (see Appendix): Angelfish Cave, Stocking Island, and Crab Cay Crevasse, Crab Cay. Both caves are strongly tidal ocean blue holes with submarine entrances at 10 m depth in protected bays. They differ from the inland blue holes in having powerful reversing tidal currents. Typical open-water species can be swept for considerable distances into these caves, and, likewise, troglobitic species, if present, would be washed out. The caves did not contain either troglobitic halocyprids or polycopids.

MEXICO.—Mexican ostracodes were collected from anchialine caves along the eastern coast of the Yucatan Peninsula in the state of Quintana Roo, Mexico (Map 2; Appendix). The Yucatan Peninsula is a flat limestone plain with no surface streams or rivers. All drainage is subterranean through extensive networks of submerged cave systems. In the area near Tulum, where caves in this study are located, the limestone is upper Pleistocene in age and has been dated at 120 thousand years ago (Back et al., 1986).

The 18.5 km long Systema Naranjal Cave System is one of the longest underwater caves in the world. It is located about 5 km inland from the Caribbean coast near Tulum. The two main entrances to the system are the Maya Blue and Naharon cenotes. Primary orientation of the cave is perpendicular to the coast, suggesting that it serves as a major freshwater drainage conduit to the sea. Cave passages are predominantly developed at the halocline in 15 m water depths where mixing corrosion between fresh and salt water occurs. Water above the halocline averages about 2 ppt salinity, whereas below the abrupt halocline, salinity is 35 ppt. A rich and diverse fauna inhabits the cave, including troglobitic shrimp (*Creaseria morleyi* (Creaser, 1936); *Typhlatya mitchelli* Hobbs and Hobbs, 1976;



MAP 2.—Northeastern coast of Yucatan Peninsula with arrows showing locations of Temple of Doom Cenote and Maya Blue Cenote (map derived from Reddell, 1977, fig. 11).

Typhlatya pearsei Creaser, 1936), remipedes (*Speleoectes tulumensis* Yager, 1987), mysids (*Antromysis* (*Antromysis*) *cenotensis* Creaser, 1936), thermosbaenaceans (*Tulumella unidens* Bowman and Iliffe, 1988), amphipods (*Tuluweckelia cernua* Holsinger, 1990), isopods (*Creaseriella anops* (Creaser, 1936)), copepods, fish (*Ogilbia pearsei* Hubbs, 1938), and ostracodes (*Danielopolina mexicana* Kornicker and Iliffe, 1989b, and *Spelaeoecia mayan,* new species).

Temple of Doom Cenote (also known as Cenote Esqueleto), Tulum, is located on the east side of the Tulum-Coba road about 2 km north of main Cancun-Chetumal highway. It is reached by a 150 m long footpath. The entrance consists of a 10 m diameter sinkhole with a vertical drop of 3 m to the water in a 30 m diameter lake chamber, which is inhabited by bats. A central cone of sand and breakdown lies directly beneath this entrance at 3 m depth. Above a sharp halocline at 14 m depth, salinity is 2 ppt. Below the halocline, salinity increases to 35 ppt. From the entrance chamber two submerged cave passages

extend south at 12–20 m depths and head in the general direction of the coast. In the shallow, freshwater layer, a noticeable current flows away from the entrance area and into these passages. Numerous large stalactites and stalagmites are present in the submerged sections of the cave. Its biology is similar to Systema Naranjal (Maya Blue Cenote), but the cave did not contain the ostracode *Spelaeoecia mayan.*

CANARY ISLANDS.—Canary Island ostracodes were collected in the Atlantida Tunnel lava tube (*Eupolycope pnyx* Kornicker and Iliffe, 1995, *Polycopiella* species A, and *Danielopolina wilkensi* Hartmann, 1985). The lava tube and its fauna were described recently by Kornicker and Iliffe (1995:3).

Superorder MYODOCOPA Sars, 1866

Order HALOCYPRIDA Dana, 1853

Suborder HALOCYPRIDINA Dana, 1853

COMPOSITION.—The suborder comprises the superfamilies Halocypridoidea Dana, 1853, and Thaumatocypridoidea Müller, 1906. Both superfamilies are represented in the collections reported upon herein.

REMARKS.—Our studies of anchialine halocyprid ostracodes indicate that the morphology of the male copulatory organ is of considerable importance in the discrimination of species. To encourage collecting of specimens of species whose males are unknown, they are listed here.

Danielopolina mexicana: Maya Blue Cave near Tulum, Quintana Roo, Yucatan Peninsula, Mexico.

Danielopolina orghidani: Grieta Punta de Guana Matanza at Cape Matanzas.

Danielopolina styx: Deep Grieta east of Tortuga Bay, and Grieta de Caleta la Torta, Santa Cruz Island, Galapagos Islands.

Deeveya bransoni: Evelyn Green's Blue Hole and Stargate Blue Hole, South Andros Island, Great Bahama Bank, Bahamas.

Deeveya exleyi: Oven Rock Cave, Great Guana Cay, Exuma Cays, Great Bahama Bank, Bahamas.

Deeveya hirpex: Dan's Cave, Abaco Island, Little Bahama Bank, Bahamas.

Deeveya jillae: Hatchet Bay Cave, Hatchet Bay, Eleuthera, Great Bahama Bank, Bahamas.

Deeveya spiralis: The Hole, Providenciales Island, Caicos Islands, Turks and Caicos Islands.

Spelaeoecia jamaicensis: Air Strip Cave #1, #2, and #5 and South Bull Cave, Discovery Bay, Jamaica.

Superfamily HALOCYPRIDOIDEA Dana, 1853

COMPOSITION.—The superfamily includes the single family Halocyprididae Dana, 1853.

Family HALOCYPRIDIDAE Dana, 1853

COMPOSITION.—The family comprises five subfamilies of which only the Deeveyinae Kornicker and Iliffe, 1985, are represented in the present collections.

Subfamily DEEVEYINAE Kornicker and Iliffe, 1985

COMPOSITION.—The subfamily comprises the genera *Deeveya* Kornicker and Iliffe, 1985, and *Spelaeoecia* Angel and Iliffe, 1987.

Spelaeoecia Angel and Iliffe, 1987

Spelaeoecia Angel and Iliffe, 1987:545, figs. 2–6.

TYPE SPECIES.—*Spelaeoecia bermudensis* Angel and Iliffe, 1987:545.

COMPOSITION AND DISTRIBUTION.—The genus includes eight species from anchialine caves in the following localities: Bermuda: *S. bermudensis* Angel and Iliffe, 1987; Bahamas: *S. capax, S. sagax, S. styx* Kornicker, 1990 (in Kornicker et al., 1990), and *S. barri* Kornicker and Barr, 1997; Jamaica: *S. jamaicensis* Kornicker and Iliffe, 1992; Mexico: *S. mayan,* new species; Cuba: *S. cubensis* Kornicker and Yager, 1996.

EMENDED DIAGNOSIS.—Intended to supplement characteristics mentioned by Angel and Iliffe (1987:543) and Kornicker et al. (1990:4). Posterior branch of male copulatory organ either with long styliform process with hirsute tip or with broad tip with subterminal spine. Species are compared in Table 2.

REMARKS CONCERNING FURCA.—Angel and Iliffe (1987:548) stated the following concerning the furca of *S. bermudensis:* "Each lamella of furca carrying 8 claw setae. Second claw seta inserted on prominent base and in every specimen examined 'snapped' off close to its base." Kornicker (1989:322) and Kornicker and Iliffe (1989c:48) examined additional specimens of *S. bermudensis* and also reported all specimens with 2nd furcal claw broken off near base. A broken 2nd claw was not present on two species (*S. sagax, S. styx*), but the furca of *S. sagax* has "an internal gland proximal to claw 2 leading to a minute pore anterior to base of claw 2" (Kornicker et al., 1990:18). The furcae of *S. mayan, S. barri, S. capax,* and *S. cubensis* also have a stump-like process posterior to claw 1. In *S. cubensis* it is a stout glandular process (Kornicker and Yager, 1996:10). In *S. capax* the process is much narrower than the following claw and may have a gland leading to it (Figure 9*e*). The process is extremely small on *S. styx* and *S. exleyi* (visible under high magnification, ×1500). A glandular peg between the 1st and 2nd furcal claws has been reported in four species of *Deeveya: D. styrax* (Kornicker et al., 1990:32), *D. hirpex* (Kornicker et al., 1990:42), *D. medix* (Kornicker et al., 1990:48), and *D. exleyi,* new species. It is the opinion of the

TABLE 2.—Distribution of some bristles and claws on species of *Spelaeoecia*. (B = boomerang, Br = broad, C = club, D = dorsal, H = hook, L = lines, N = narrow, nd = no data, P = pits, R = reticulate, S = spear, V = ventral.)

Character	*sagax*	*styx*	*bermudensis*	*capax*	*cubensis*	*mayan*	*barri*	*jamaicensis*
Average length (mm)								
Adult female	1.75	1.04	1.58	2.85	2.08	1.35	1.27	1.28
Adult male	1.68	1.06	1.37	2.86	2.17	1.30	1.22	1.16
Surface	L	R	L	L	L?	L?	P	L
1st Antenna								
2nd joint	1D	1D	1D	1D	1D	1D	1D	1D
3rd joint	0	0	1V	1V	0	1V	0	0
4th joint								
Ventral	0	0–1	1	1	1	1–2	0	1
Dorsal	1	1	1	1	1	1	1	1
2nd Antenna								
endopodite, male right clasper	H	H	C	S	B	C	H	nd
Mandible								
Basale, No. twisted	0	0	0	2	2	0	0	0
6th Limb								
Endopodite	5	5	4	5	5	4	5	5
Furca	8	7	7	8	5	6	8	6*
Copulatory organ								
Tip of posterior branch	N	N	N	Br	Br	N	Br	nd

*A–1 or A–2 male and female.

senior author that *S. bermudensis* does not have the 2nd claw broken off, and that what appears to be a stump is not the remnant of a claw but is probably a "glandular process." Therefore, *S. bermudensis* only has 7 pairs of claws on the caudal furca and not 8 as originally described.

POSTERIOR BRANCH OF MALE COPULATORY ORGAN.—Within the Deeveyinae the posterior branch of the male copulatory organ appears to have two end types. Known males of species of *Deeveya* have a broad spinous tip (*D. medix* (Kornicker et al., 1990, fig. 28j), *D. styrax* (Kornicker et al., 1990, fig. 19e). A similar tip is present on the posterior branch of three species of *Spelaeoecia: S. cubensis* (Kornicker and Yager, 1996, fig. 6g,h), *S. capax* (Figure 3*a*), and *S. barri* (Kornicker and Barr, 1997, fig. 8j). Four species of *Spelaeoecia* have a dorsal branch that narrows distally to a styliform tip: *S. styx* (Kornicker et al., 1990, fig. 5h,j; herein, Figures 3*d*, 20*f*), *S. sagax* (Kornicker et al., 1990, fig. 9b), and *S. bermudensis* (Kornicker, 1989, fig. 2i). The posterior branch of *S. mayan* has a somewhat intermediate form (Figure 36*h*).

In the Thaumatocyprididae known males of species of *Thaumatoconcha* have a copulatory organ with a styliform tip on the posterior branch: *T. sandersi* (Kornicker and Sohn, 1976, fig. 18a), *T. radiata* (Kornicker and Sohn, 1976, fig. 18d), *T. caraione* (Kornicker and Sohn, 1976, fig. 18g), *T. tuberculata* (Kornicker and Sohn, 1976, fig. 18j), *T. elongata* (Kornicker and Sohn, 1976, fig. 18n), *T. polythrix* (Kornicker and Sohn, 1976, fig. 18q), and *T. pix* (Kornicker, 1992, fig. 3b). The posterior branch of the male copulatory organ of the monotypic genus *Thaumatocypris*, represented by *T. echinata* Müller, 1906, also has a styliform tip (Rudjakov, 1993, fig. 4e,f). The posterior branch of the four known males of *Danielopolina* also has a styliform tip: *D. wilkensi* (Kornicker and Iliffe, 1995, fig. 10h) and *D. phalanx* (Kornicker and Iliffe, 1995, fig. 7h); *D. elizabethae* (Kornicker and Iliffe, 1992, fig. 8n), and *D. bahamensis*, (Kornicker and Iliffe, 1989b, fig. 5f).

Based on the posterior branch of the male copulatory organ, *Spelaeoecia* may be divided roughly into the *S. bermudensis* Group, in which the branch narrows distally to a styliform tip (Figure 3*d*), and the *S. capax* Group, in which the branch has either a broad tip (Figure 3*a*) or a tip of intermediate width (*S. mayan*, Figure 36*a*). (The adult male of *S. jamaicensis* is unknown.) Each group may be further subdivided on the basis of the shape of the clasper forming the 3rd endopodial joint of the 2nd antenna, which may be split into four types: boomerang (Figure 3*b*), club (Figure 3*e*), spear (Figure 3*c*), and hook (Figure 3*f*). The clasper of the right limb is usually better developed than that of the left limb and may have a more complex structure. The boomerang-type clasper seems morphologically farther from the linear types, which could be interpreted to be variants of a similar structure. The boomerang-type clasper is common on members of the Euconchoecinae (Angel,1993, figs. 29I, 30I, 31f). It is present on both the left and right 2nd antennae of *Bathyconchoecia* and on the right

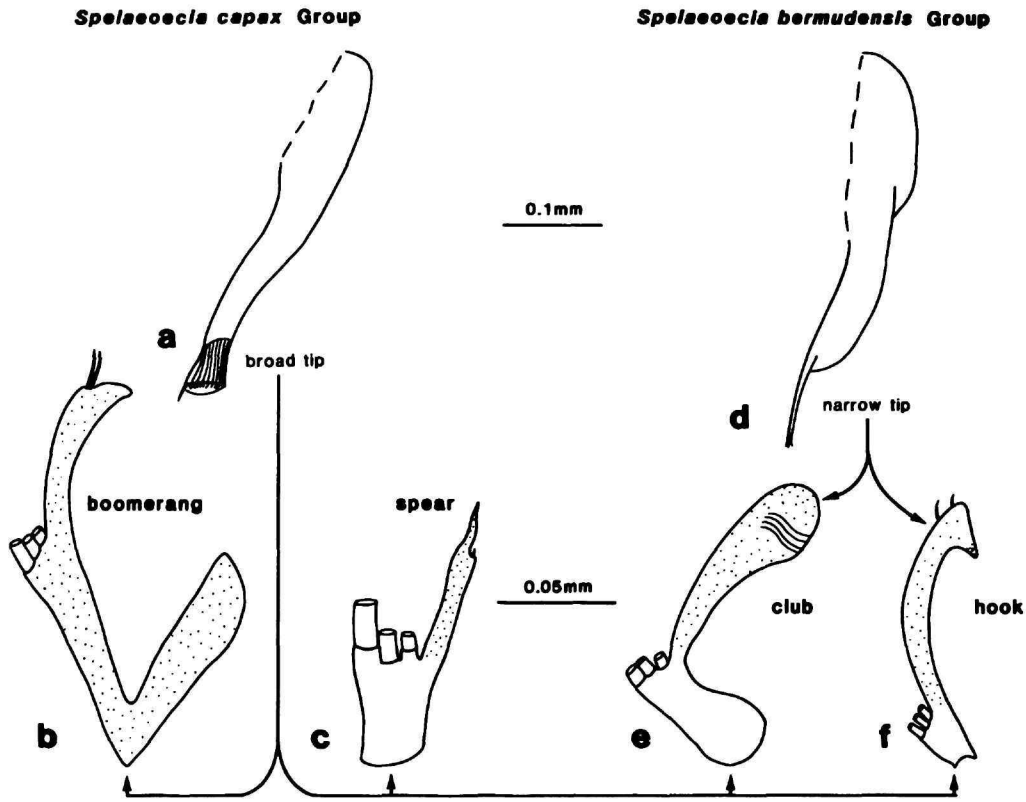


FIGURE 3.—Representative posterior branches of the copulatory organs and claspers of the endopodite of the male 2nd antennae of the *Spelaeoecia capax* and *Spelaeoecia bermudensis* groups: *a*, posterior branch of copulatory organ of *S. capax* (USNM 194289); *b,c*, claspers of endopodites of male right 2nd antennae of *S. cubensis* (USNM 194306) (mv) and *S. capax* (USNM 194289) (lv), respectively; *d*, posterior branch of copulatory organ of *S. styx* (USNM 194300); *e,f*, claspers of endopodites of male right 2nd antennae of *S. mayan* (USNM 194321) (mv) and *S. styx* (USNM 194260 (mv), respectively.

limb only of *Euconchoecia* (Angel, 1993:84).

A. *Spelaeoecia capax* Group (tip of posterior branch of copulatory organ broad (Figure 3*a*) or of intermediate width (Figure 36*a*)).
   1. Boomerang-like clasper (right limb only) (Figure 3*b*): *S. cubensis*.
   2. Spear-like clasper (Figure 3*c*): *S. capax*.
   3. Hook-like clasper (Figure 3*f*): *S. barri*.
   4. Club-like clasper (Figure 3*e*): *S. mayan*.

B. *Spelaeoecia bermudensis* Group (tip of posterior branch of copulatory organ narrow) (Figure 3*d*).
   1. Club-like clasper (Figure 3*e*): *S. bermudensis*.
   2. Hook-like clasper (right limb only) (Figure 3*f*): *S. styx, S. sagax*.

Neither of the two known males of *Deeveya* has a clasper on the endopodite of the 2nd antenna. In the Thaumatocyprididae, *Thaumatoconcha* and *Danielopolina* have a hook-like clasper on the endopodite of the male 2nd antenna, whereas *Thaumatocypris* is without a clasper.

LATERAL BRISTLES OF BASALE OF MANDIBLE.—The basale of the mandible of both *S. capax* and *S. cubensis* have two entwined bristles, a character also present in all known species of *Deeveya*. It is not known whether this is an apomorphic or plesiomorphic character state, but it is probably the former.

BRISTLES OF ENDOPODITE OF 6TH LIMB.—*Spelaeoecia bermudensis* and *S. mayan*, the two species having club-like claspers, also have only 4 endopodial bristles on the 6th limb compared to 5 on the species having different claspers. All known species of *Deeveya* have only 4 endopodial bristles on the 6th limb. Neither of the two known males of *Deeveya* has a clasper on the endopodite of the 2nd antenna.

Key to the Species of *Spelaeoecia*

(adults)

1. Each lamella of furca with 5 claws . . . . . ***S. cubensis***
   Each lamella of furca with more than 5 claws 2
2. Carapace longer than 2.25 mm . . . . . ***S. capax***
   Carapace shorter than 1.95 mm 3
3. Posterodorsal gland of right valve on protuberance, carapace shorter than 1.15 mm . . . . . ***S. styx***
   Posteroventral gland of right valve not on protuberance, carapace longer than 1.25 mm 4
4. First antenna without ventral bristle on 3rd joint 5
   First antenna with ventral bristle on 3rd joint 7
5. First antenna with ventral bristle on 4th joint . . . . . ***S. jamaicensis***
   First antenna without ventral bristle on 4th joint 6
6. Carapace with evenly rounded posterior edge . . . . . ***S. sagax***
   Carapace with projecting posterior edge . . . . . ***S. barri***
7. Furca with 7 claws . . . . . ***S. bermudensis***
   Furca with 6 claws . . . . . ***S. mayan,*** new species

Spelaeoecia capax Kornicker, 1990

FIGURES 3*a*, 4–16

Spelaeoecia capax Kornicker in Kornicker et al., 1990:23, fig. 14.

HOLOTYPE.—USNM 193449, empty carapace in alcohol (sex and age unknown).

TYPE LOCALITY.—Alfonso Dean Blue Hole, Long Island, Great Bahama Bank.

MATERIAL.—Oven Rock Cay, Great Guana Cay, Exuma Cays: Sta 93-006: USNM 194290, undissected adult female in alcohol; USNM 194291, undissected A–1 female in alcohol; USNM 194292, A–1 male on slide and in alcohol. Sta 93-007: USNM 194267, adult female on slide and in alcohol; USNM 194265, empty carapace in alcohol (length 2.11 mm, height 1.00 mm); USNM 194264, undissected adult female in alcohol; USNM 194286, undissected A–1 male in alcohol. Sta 93-008: USNM 194289, adult male on slide and in alcohol; USNM 194294, undissected A–2 instar (sex unknown) in alcohol; USNM 194293, undissected A–3 instar (sex unknown) on slide and in alcohol; USNM 194288, 4 undissected adult females in alcohol. Sta 93-009: USNM 194287, undissected adult female in alcohol. Sta 94-014: USNM 194412, undissected adult male in alcohol; USNM 194413, A–2 instar (sex unknown) with

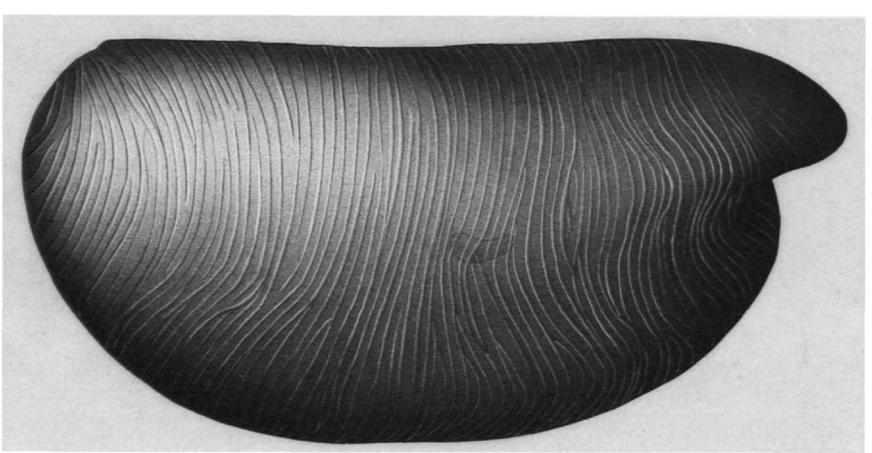


FIGURE 4.—*Spelaeoecia capax* Kornicker, 1990, USNM 194264, adult female, length 2.94 mm, complete specimen from right side.

carapace removed in alcohol. Sta 95-012: USNM 194444A–M, 13 undissected adult males in alcohol; USNM 194444N–X, 11 undissected adult females in alcohol; USNM 194445A–C, 3 undissected A–1 males in alcohol; USNM 194446A,B, 2 undissected A–1 females in alcohol; USNM 194447A–D, 4 undissected A–2 instars (sex unknown) in alcohol; USNM 194448A–F, 6 undissected A–3 instars (sex unknown) in alcohol; USNM 194449A,B, 2 undissected A–4 instars (sex unknown) in alcohol.

DISTRIBUTION.—Great Bahama Bank: Oven Rock Cave, Great Guana Cay, Exuma Cays, at depths of 0–20 m, salinity 35–36 ppt. Alphonso Dean Blue Hole, Long Island (type locality), at depth of 13 m, salinity about 20 ppt.

REMARKS.—The original description of the species was based on the shell of a specimen (sex and age unknown (probably an adult on the basis of data presented herein)) collected on Long Island, Bahamas. The collections from Great Guana Cay, Exuma Cays, Bahamas, provided the opportunity to describe the appendages of the adult male and female as well as three instars.

DESCRIPTION OF ADULT FEMALE (Figures 4–10, 11*a,b*, 16).—Carapace shape similar to specimen (sex unknown) described by Kornicker (in Kornicker et al., 1990:25) (Figures 4, 5).

Ornamentation: Vertical and oblique striations well defined on specimens in alcohol, less well defined but present on those preserved in glycerine (Figures 4, 5*b*). Striations present on outer surface of the part of rostrum facing inward (Figure 5*e*).

Infold (Figure 5*c–g*): List absent along anteroventral and ventral infolds. Kornicker (in Kornicker et al., 1990:25) considered the absence of a list in these regions in the type specimen might have been indicative of its not being adult.)

Glands: Glands similar to specimen described by Kornicker (in Kornicker et al., 1990:25) (Figure 5*g*). In addition to shell glands, that specimen contained many amber-colored cell clusters; cell clusters are less numerous on present specimens and they lack the amber color (Figure 5*c*).

Muscle Attachments: Elongate oval mandibular scar near anterior 1/3 of carapace near midheight (Figures 5*d,h*, 11*a*). Several indistinct oval central adductor muscle attachments posterior to mandibular scar (not all shown in Figures 5*h*, 11*a*).

Carapace Size (length, height in mm) (Figure 16): USNM 194264, 2.94, 1.40. USNM 194267, 2.74, 1.41. USNM 194287, 2.86, 1.32. USNM 194288, 4 specimens: 2.60, 1.24; 2.79, 1.27; 2.89, 1.29; 2.82, 1.31. USNM 194290, 2.87, 1.29. USNM 194444N–X, 11 specimens: 2.84, 1.39; 2.78, 1.36; 3.15, 1.54; 2.91, 1.43; 2.65, 1.29; 2.94, 1.38; 2.91, 1.38; 2.77, 1.31; 2.99, 1.45; 2.78, 1.30; 2.88, 1.44. Length range (N = 19) 2.60–3.15 mm. Average length 2.85 mm.

First Antenna (Figure 6*a–c*): 1st joint with terminal ventral lobe with numerous short spines. 2nd joint with distinct dorsal bristle (with small marginal spines) and typical distal medial spinules. 3rd joint 3 or 4 times length of 4th joint, with suture separating joints more strongly developed on medial side, and ventral bristle with small indistinct marginal spines. 4th joint with terminal dorsal bristle (with small indistinct marginal spines) and spinous ventral bristle at midlength. 5th joint about same length as 4th, with long ventral filament. 6th joint shorter than 5th joint, bare. 7th joint about same length as combined 5th and 6th joints, with short dorsal a-bristle, and ventral b-bristle about 3/4 length of long ventral c-bristle. 8th joint small with 4 terminal bristles (lateral d-bristle about twice length of a-bristle and with minute widely separated marginal spines; long lateral e-bristle about same length as c-bristle, with indistinct rings and minute marginal spines; medial f-bristle about 1/2 length of e-bristle and oriented ventrally; g-bristle lateral to f-bristle and ventral to e-bristle, about 2/3 length of e-bristle, and with minute marginal spines).

Second Antenna (Figure 6*d–g*): Protopodite bare with few distal sclerites (Figure 6*d,e*). Endopodite 3-jointed but 2nd and 3rd joints fused (Figure 6*f–h*): 1st joint with b-bristle about twice length of a-bristle, both with short spines; 2nd joint with small medial c-bristle (with small spines) near base of j-bristle, filament-like f-bristle and longer stout filament-like g-bristle with proximal rings and proximal minute widely separated marginal spines (each bristle with minute terminal papilla), and 1 minute lateral bristle or peg near base of f-bristle; 3rd joint with h-, i-, and j-bristles, each filament-like and with terminal papilla, all shorter than g-bristle. Exopodite with 9 joints: 1st joint divided into long proximal and short distal parts, with separating suture only on medial side, with long ventral distal bristle with ventral spines and dorsal natatory hairs; proximal part of 1st joint with complex sclerites and short internal muscle (Figure 6*d*); bristles of joints 2–7 with natatory hairs; bristle of 8th joint with dorsal spines and natatory hairs; 9th joint with 4 bristles of varying lengths and with short dorsal spines (longest bristle ventral and with ventral natatory hairs); all long bristles of exopodite with few long proximal segments followed by closely spaced rings.

Mandible: Coxale endite with proximal and distal sets of teeth separated by gap (Figure 7*a–d*): proximal set comprising 4 broad cusps plus small distal triangular or bifurcate posterior tooth; surface between cusps and just proximal to cusps with slender spines; 1 minute indistinct bristle on corner just anterior to anterior cusp (this could be cluster of spines rather than a bristle) (Figure 7*a,b*); 1 minute indistinct spinous bristle just posterior to posterior cusp; 2 or 3 (difficult to resolve exact number) spinous and dentate bristles adjacent to posterior triangular tooth (Figure 7*a–c*). Distal set of teeth comprising 2 flat teeth (distal with 7 cusps; proximal with 6 or 7 cusps) (Figure 7*d*); 1 stout curved spinous process and 1 minute bristle proximal to flat teeth (Figure 7*a–c*). Basale (Figure 7*e,f*): distal edge with 6 terminal triangular cusps and 1 sharper triangular anterior tooth; lateral surface near distal edge with sharp tooth near midwidth; lateral surface distal to midlength with 1 minute

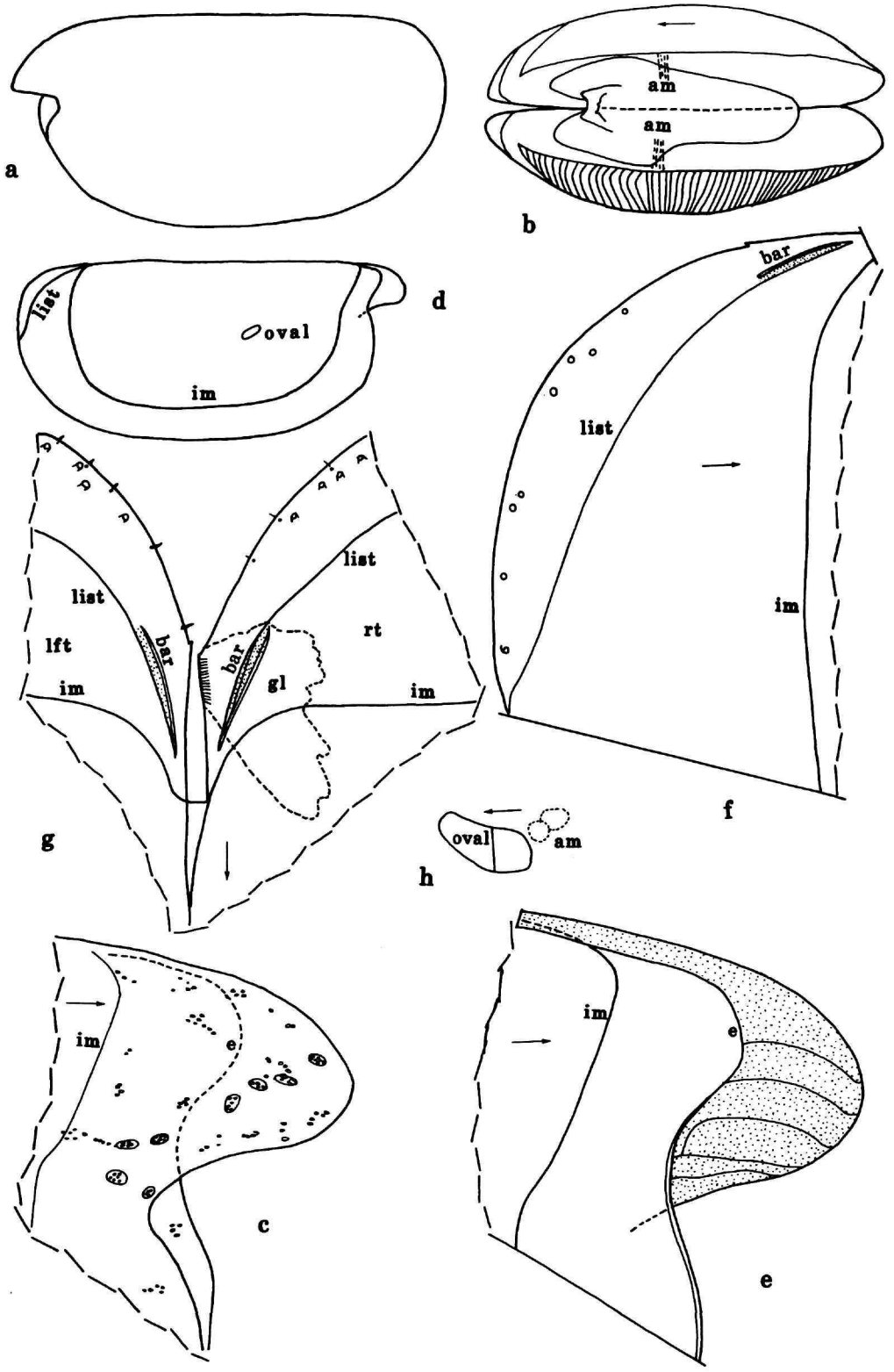


FIGURE 5.—*Spelaeoecia capax* Kornicker, 1990, USNM 194267, adult female: *a*, complete specimen from left side, length 2.74 mm; *b*, anterior right valve, ov; *c*, ventral view of specimen with valves partly open showing outline of body (lineations shown only on right valve); *d*, left valve, iv; *e,f*, details from *d; g*, dorsal end of connected valves, iv; *h*, mandibular oval and 2 central adductor muscle attachments, left valve, ov.

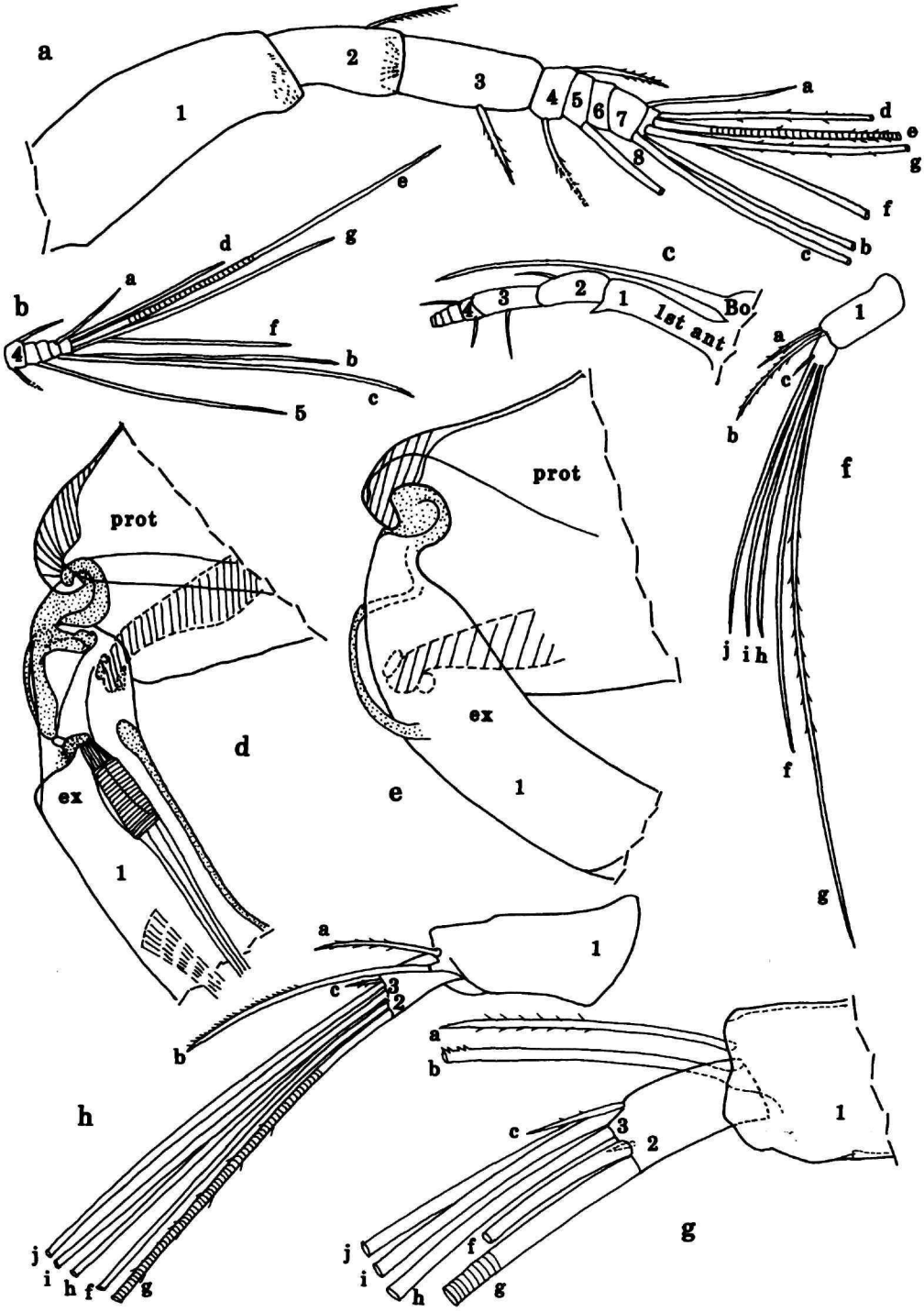


FIGURE 6.—*Spelaeoecia capax* Kornicker, 1990, USNM 194267, adult female: *a,b,* left 1st antenna, lv; *c,* Bellonci organ and left 1st antenna (nabs); *d,* part left 2nd antenna (exopodial muscles striated, sclerotized parts of exopodite stippled, sclerotized parts of protopodite striated), lv; *e,* part right 2nd antenna, mv; *f,g,* endopodite right 2nd antenna, mv; *h,* endopodite left 2nd antenna, lv.

and 5 longer bristles (2 longest twisted around each other); anterior margin with 1 long bristle distal to midlength; posterior margin hirsute, with 2 distal bristles (proximal ringed in proximal 3/4 and with unringed pointed tip, distal tubular). Proximal medial surface of basale with 2 transparent plumose bristles (1 closer to dorsal margin) (an additional plumose bristle may have broken off during dissection), and 1 short bristle near endopodite; lateral surface near insertion of endopodite with 1 long spinous bristle. Endopodite (Figure 7*f*): 1st joint widening distally, with 3 spinous bristles (1 long dorsal, 1 long and 1 short near ventral margin); 2nd joint widening distally, with 3 dorsal bristles (1 stout unringed claw-like with marginal spines, 1 short ringed medial bare, 1 short ringed lateral bare), and 1 long ringed subterminal spinous ventral bristle; 3rd joint with 2 long stout unringed spinous claw-like bristles, 4 short ringed bristles forming medial row along distal edge, and 1 slightly longer ringed spinous bristle on terminal lateral edge; anterior margin and medial surface of 3rd joint hirsute.

Maxilla (Figure 8*a*): Endite I with 2 proximal and 13 terminal bristles (4 tubular) (nabs); endite II with 2 proximal and 7 terminal bristles (5 tubular, 2 claw-like); endite III with 1 proximal and 5 terminal bristles (2 tubular, 3 claw-like). Coxale and basale fused; coxale with long stout plumose dorsal bristle; basale with long spinous ventral bristle. Endopodite: 1st joint with 4 anterior bristles (3 at midlength, 1 distal), 2 terminal posterior bristles, and 2 proximal (these could be on basale) and 3 distal bristles near ventral margin; 2nd joint hirsute, with 2 stout spinous claws and 5 slender ringed bristles.

Fifth Limb (Figure 8*b–d*): Epipodite with plumose bristles forming 3 groups (ventral and middle groups each with 5 long bristles, dorsal group with 5 bristles (4 long and 1 short dorsal). Protopodite with medial spines and hairs, and 2 ventral endites: endite I with 4 bristles (2 with long spines, 1 shorter tubular with slender hairs, 1 short proximal (could be on endite II)). Endite II with 3 ventral bristles (1 with long spines, 2 shorter tubular bare). Basale with medial spines and hairs, 1 long lateral anterior bristle with long spines, and 1 ventral endite with 1 proximal medial bristle with short spines and 6 ventral bristles (2 unringed claw-like, 3 tubular either bare or with short spines, 1 long with long spines). Endopodite with 1 proximal medial bristle with short spines, and 9 additional bristles (1 short tooth-like medial (with small pad of spines proximal to base), 1 short lateral subventral, 2 claw-like unringed ventral, 1 long ventral with pointed tip, 2 tubular ventral either bare or with short spines, and 2 long anterior with long spines). Exopodite: 1st joint: dorsal margin with 1 long subterminal bristle and 2 plumose bristles (the 2nd plumose bristle is broken off on illustrated limb, but socket visible); ventral margin divided into broad proximal and more slender distal parts: proximal part with 3 slender ventral bristles (bare or with short spines), 1 long plumose lateral bristle near ventral margin, and 1 fairly long bare medial bristle near ventral margin; distal part with 3 subterminal ventral bristles (bare or with short spines) and 1 distal lateral plumose bristle near midwidth of joint. 2nd endopodial joint: dorsal margin with 1 distal bristle; ventral margin with 5 slender bristles near midlength. 3rd joint with 2 stout claw-like bristles (dorsal with oblique lines, other without oblique lines), 1 slender ringed bare ventral bristle, and 1 minute medial subterminal bristle near dorsal claw-like bristle (Figure 8*d*).

Sixth Limb (Figures 9*a–d*, 11*b*): Epipodite with plumose bristles in either 3 groups of 5 or 6 bristles (5 long and 1 short (dorsal), 6 (middle), and 5 (ventral) (Figure 9*a*), or 3 groups each with 5 bristles (Figure 9*b*). Prodopodite with 4 plumose ventral bristles on precoxale, and 5 (2 plumose, 2 with long spines, 1 short with short spines) ventral bristles on coxale (Figure 9*b,d*). Basale with 7 bristles (5 plumose and 1 bare near ventral margin, 1 plumose distolateral bristle near midwidth) (Figure 9*b,c*). Endopodite well developed, with 5 long bristles (3 plumose (bases on edge), 2 bare (bases lateral)) (Figure 9*b,c*). Exopodite 3-jointed (Figure 9*b,c*): 1st joint with 4 bare ventral bristles; 2nd joint with 4 bare bristles (3 ventral, 1 dorsal); 3rd joint with minute medial bristle and 3 long bristles (middle bristle claw-like, unringed, with ventral spines; dorsal bristle slender, bare, tending to be claw-like, with distal oblique rings; ventral bristle bare, ringed).

Seventh Limb (Figures 8*e*, 11*b*): Elongate with 3 terminal bristles (1 long, 2 shorter).

Furca (Figures 9*e*, 10*h*, 11*b*): Each lamella with 8 claws with basal sutures (all claws not shown in Figure 11*b*); anterior 3 claws (possibly others) with indistinct minute teeth along posterior edge; anterior 4 claws with weakly developed oblique lines; stout glandular process between claws 1 and 2 but closer to claw 2. Posterior end of furca with bifurcate unpaired ringed bristle. Apron present anterior to furca.

Bellonci Organ (Figures 6*c*, 8*f*): Elongate, bifurcating distal to midlength (only basal suture of bifurcation shown in Figure 6*c*); one branch with tapered tip, other with rounded tip with minute terminal spine (Figure 8*f*).

Lips (Figure 10*a–g*): Anterior face with 2 large widely spaced processes (with rounded tips) near midheight and 2 more closely spaced triangular processes ventral to them. Terminal posterior edge of upper lip with minute spine-like processes and slender spines. Lower lip with triangular process on each side of mouth (Figure 10*d*).

Genitalia (Figure 10*h*): Narrow internal tube on left side of body adjacent to 1 or 2 minute bristles.

Ganglion: Amber-colored oval ganglion proximal to base of 1st antenna.

DESCRIPTION OF ADULT MALE (Figures 11*c–g*, 16).— Shape, ornamentation, infold, and glands similar to those of adult female (surface striations not shown in Figure 11*c*).

Muscle Attachments (Figure 11*e*): Central adductor muscle attachments comprising many indistinct oval attachments. Mandibular scar oval, well defined, anterior to adductor muscle.

Carapace Size (length, height in mm) (Figure 16): USNM

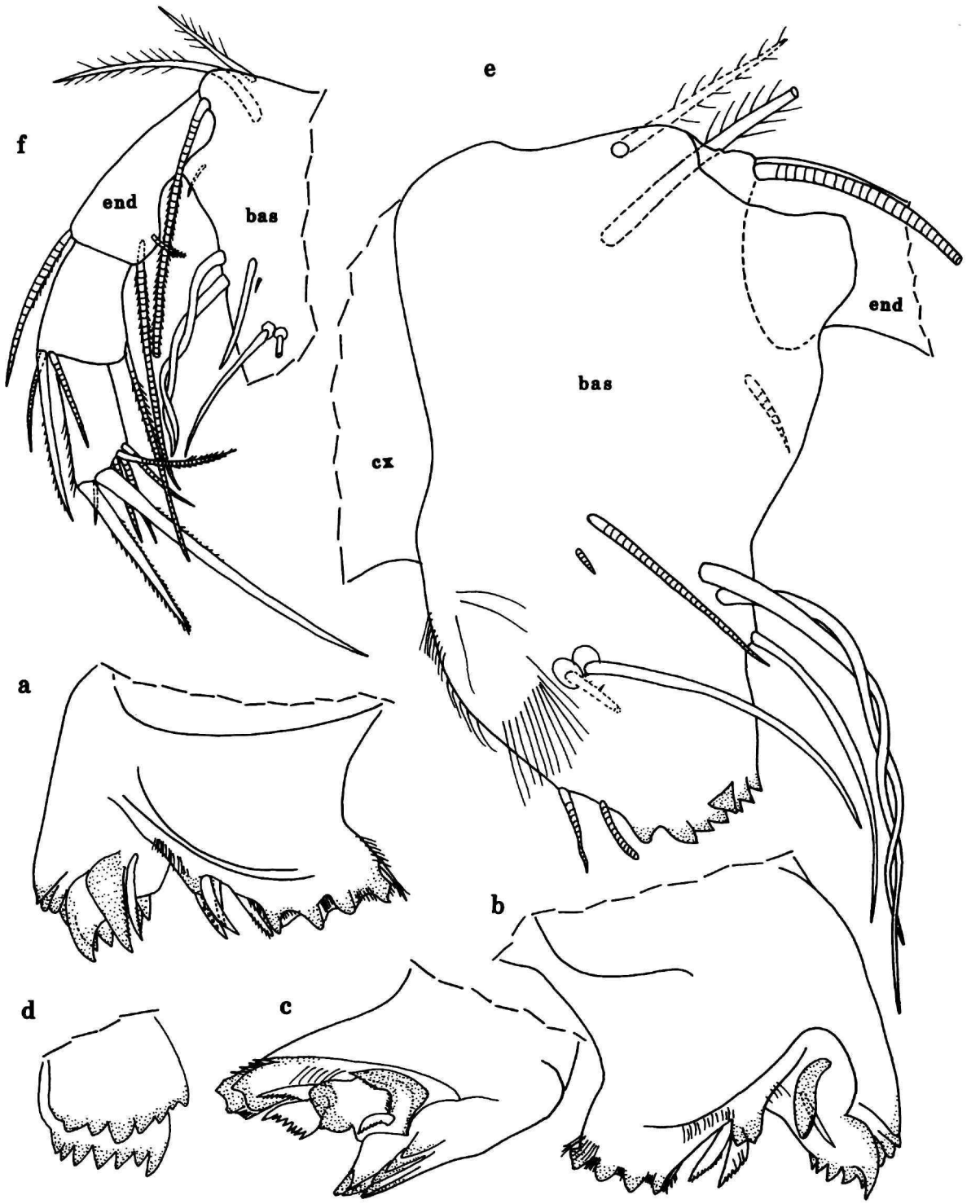


FIGURE 7.—*Spelaeoecia capax* Kornicker, 1990, USNM 194267, adult female: *a*, coxale endite left mandible, *mv*; *b,c*, coxale endite right mandible, *mv*; *d*, proximal (lower) and distal (upper) sets of teeth of coxale endite of right mandible, mv; *e*, part right mandible, lv; *f*, part right mandible, lv.

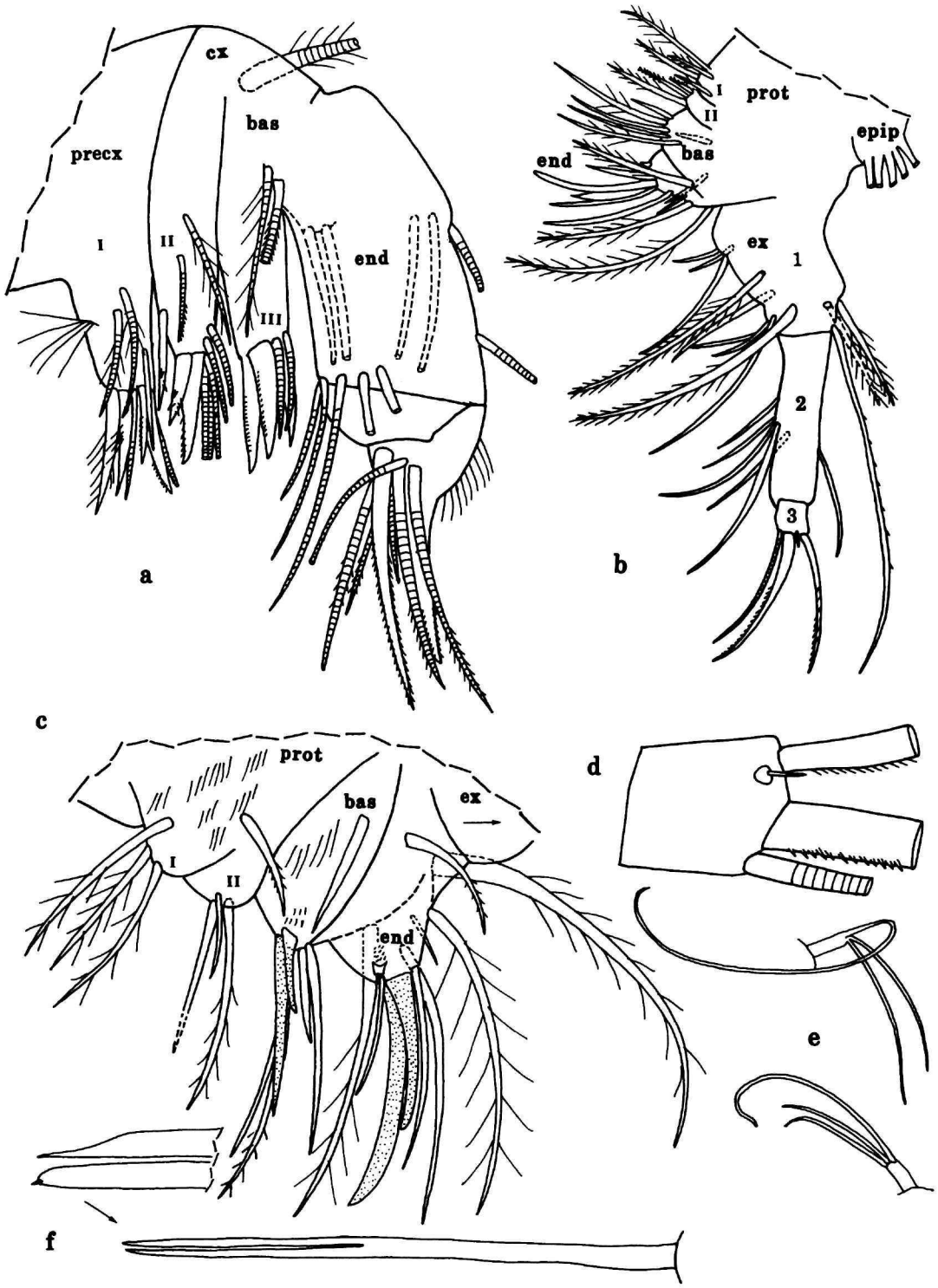


FIGURE 8.—*Spelaeoecia capax* Kornicker, 1990, USNM 194267, adult female: *a*, maxilla; *b*, left 5th limb, lv; *c*, proximal part right 5th limb, mv; *d*, tip right 5th limb, mv; *e*, left (above) and right (below) 7th limbs; *f*, Bellonci organ.

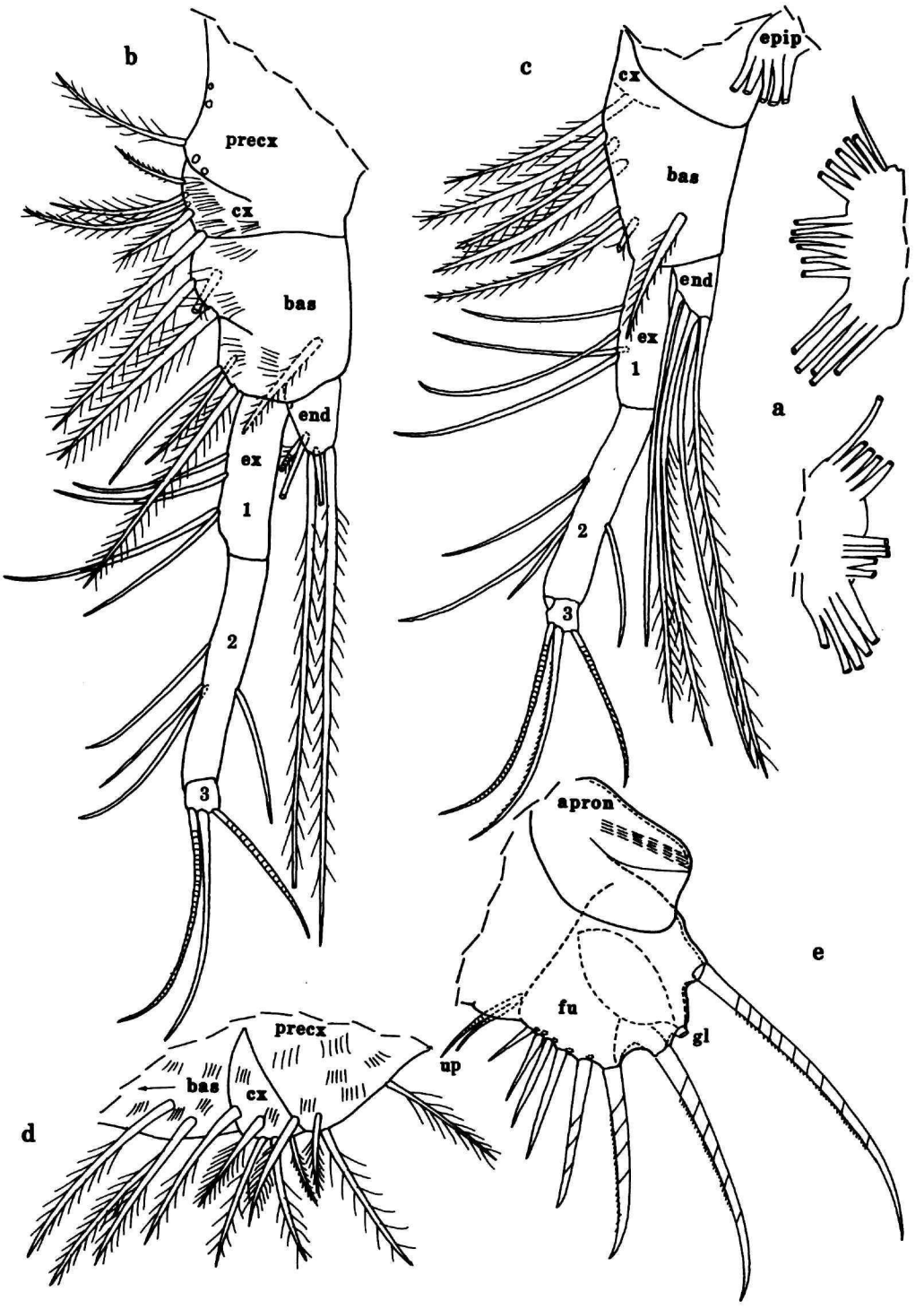


FIGURE 9.—*Spelaeoecia capax* Kornicker, 1990, USNM 194267, adult female: *a*, epipodites of right (above) and left (below) 6th limbs, lv; *b*, right 6th limb (some bristles of precoxale represented by empty sockets), mv; *c*, part left 6th limb, lv; *d*, proximal part left 6th limb, mv; *e*, right furcal lamella, unpaired process, and apron.

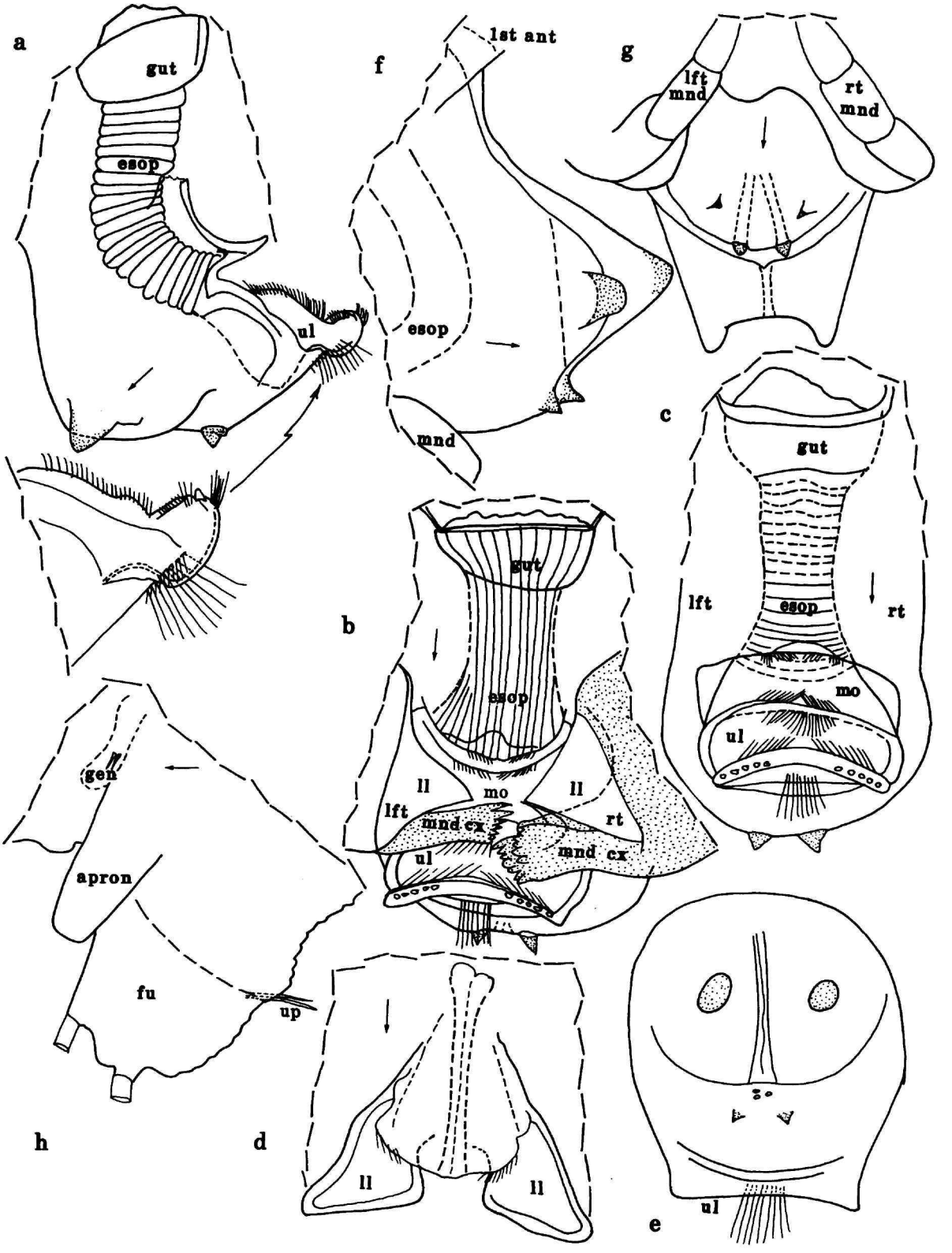

a
gut
esop
ul
f
1st ant
esop
mnd
g
lft mnd
rt mnd
c
gut
lft
esop
rt
mo
ul
b
gut
esop
ll
mo
ll
lft
mnd cx
rt
ul
mnd cx
gen
apron
fu
up
h
d
ll
ll
e
ul

FIGURE 10 (left).—*Spelaeoecia capax* Komicker, 1990, USNM 194267, adult female: *a*, part of anterior of body from left side; *b*, anterior part of body, vw; *c*, anterior of body with mandibles and lower lip removed, vw; *d*, from *c*, lower lip removed, vv; *e*, anterior view of anterior of body, ventral end toward bottom; *f*, anterior of body from right side; *g*, anterior of body, vv; *h*, left lamella of furca (not all claws shown), unpaired process, apron, and left genitalia, from left side.

194289, 2.86, 1.29. USNM 194412, 2.72, 1.25. USNM 194444A–M, 13 specimens: 2.94, 1.40; 2.67, 1.22; 2.69, 1.28; 2.95, 1.37; 2.69, 1.29; 2.70, 1.29; 2.83, 1.37; 2.71, 1.26; 2.73, 1.29; 2.68, 1.31; 2.95, 1.44; 2.97, 1.46; 2.86, 1.39. Length range (N = 15): 2.67–2.97 mm. Average length 2.80 mm.

First Antenna (Figure 11*f,g*): Joints 1–3 similar to those of

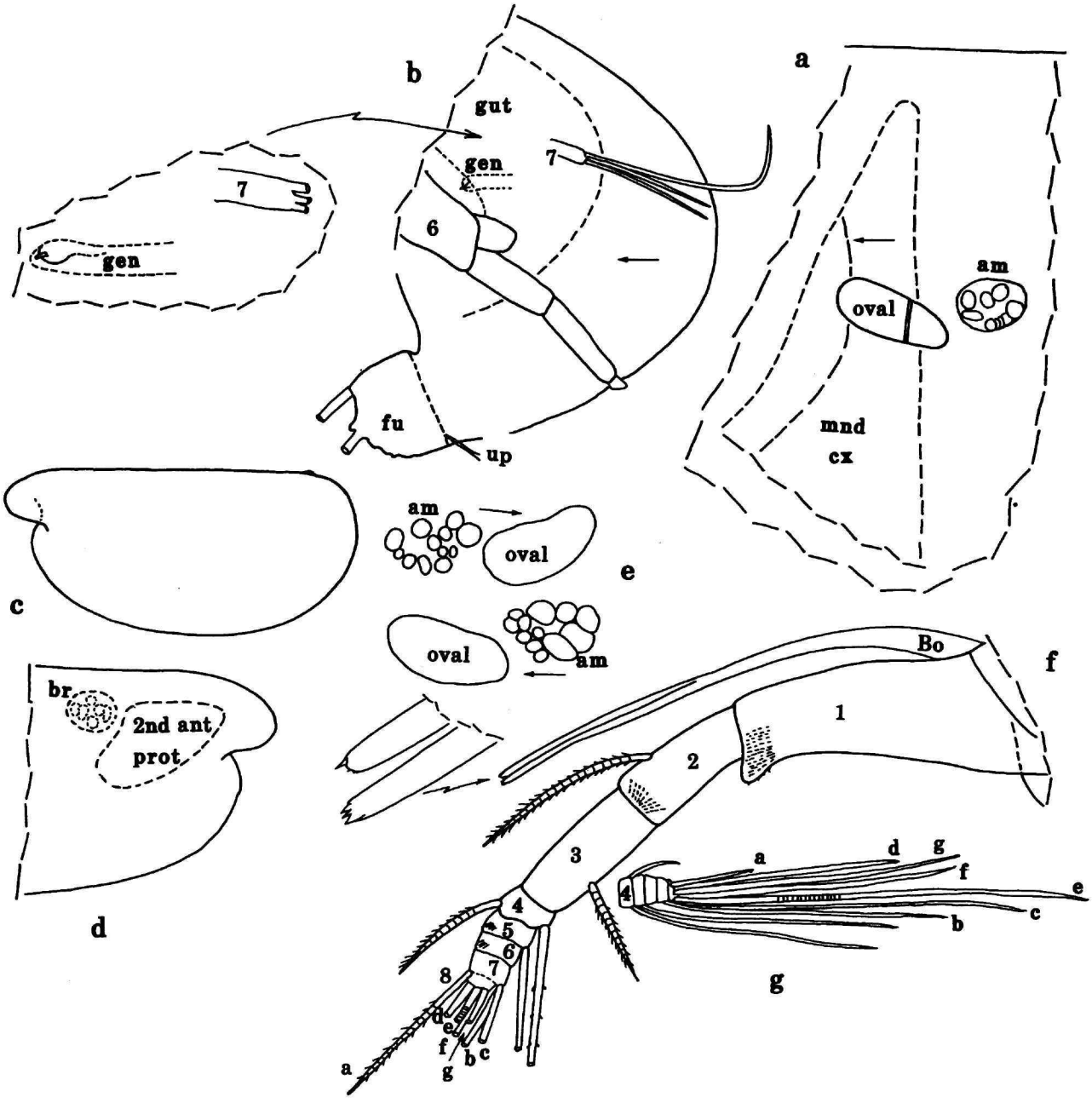


FIGURE 11.—*Spelaeoecia capax* Komicker, 1990, USNM 194287, adult female, length 2.86 mm: *a*, central part of complete specimen from left side (dorsal edge of valve at top); *b*, posterior of body from left side (not all furcal claws nor bristles of 6th limb shown). USNM 194289, adult male: *c*, complete specimen from left side, length 2.86 mm; *d*, anterior one-half of complete specimen from right side; *e*, mandibular oval and central adductor muscle attachments of right (above) and left (below) valves, ov; *f*, Bellonci organ and left 1st antenna, lv; *g*, tip left 1st antenna, mv.

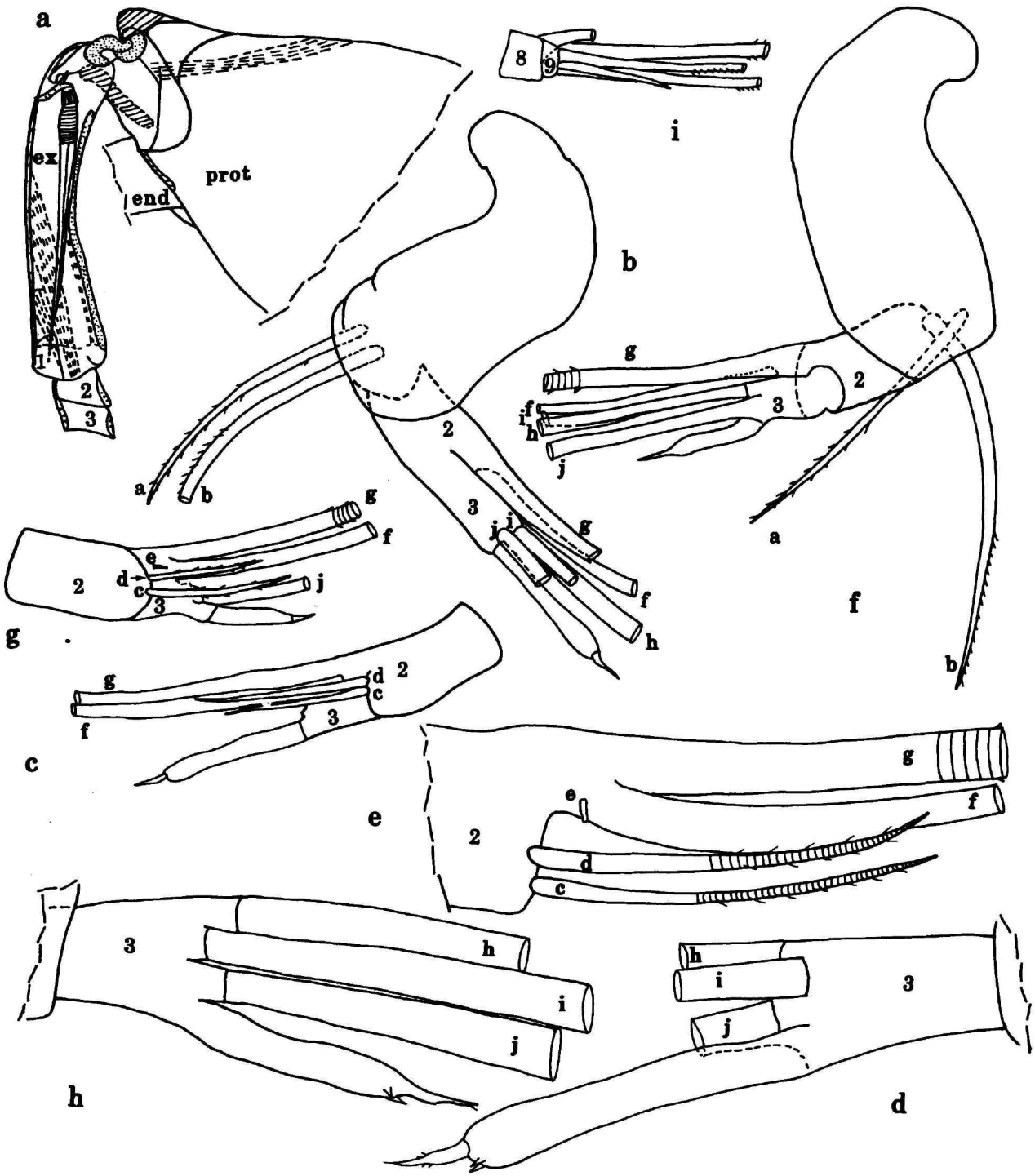


FIGURE 12.—*Spelaeoecia capax* Kornicker, 1990, USNM 194289, adult male: *a*, part left 2nd antenna, lv (muscles in exopodite striated, sclerotized part in exopodite stippled, sclerotized parts in protopodite striated); *b*, endopodite right 2nd antenna, mv; *c*, part endopodite right 2nd antenna, lv (h-, i-, and j-bristles not shown); *d,e*, parts endopodites right and left 2nd antennae, respectively, lv; *f*, endopodite left 2nd antenna, mv; *g*, endopodite left 2nd antenna, lv (nabs); *h*, part endopodite left 2nd antenna, lv (nabs); *i*, tip exopodite left 2nd antenna, lv.

adult female except dorsal bristle of 2nd joint much longer. 4th joint with short spinous ringed dorsal bristle and long filament-like ventral bristle with widely spaced minute marginal spines. 5th joint with long ventral filament and few distal hairs near dorsal edge. 6th joint with few distal hairs near dorsal margin. 7th joint with spinous ringed a-bristle and filament-like b- and c-bristles. 8th joint similar to that of adult female except f-bristle not oriented ventrally.

Second Antenna: Protopodite and exopodite similar to those of adult female (Figures 11*d*, 12*a,i*). Endopodite 3-jointed (Figure 12*b–h*): 1st joint elongate with slender spinous a- and b-bristles; 2nd joint with distal medial spines, 2 terminal f- and g-bristles with parallel sides and minute terminal papilla (g-bristle medial, stouter, and about 1/3 longer than f-bristle, weakly ringed proximally, and with widely spaced minute marginal spines), 2 slender ringed spinous lateral c- and d-bristles, and 1 minute peg-like lateral e-bristle near base of f-bristle; 3rd joint with equilength h-, i-, and j-bristles, all about 1/2 length of g-bristle and with terminal papilla, and slightly narrower in short proximal part; clasper elongate, straight, with long terminal spine and 2 minute subterminal spines; clasper of right limb about 1/4 longer than that of left limb.

Mandible: Coxale endite, basale (Figure 13*a–d*), and endopodite (Figure 13*e*) similar to those of adult female.

Maxilla: Not examined in detail but, in general, similar to that of adult female.

Fifth Limb (Figure 13*g*): Epipodite with plumose bristles forming 3 groups, each with 5 bristles. Protopodite with lateral glandular process absent on female (detail in Figure 13*d*). Exopodite differs from that of adult female in having 2 instead of 3 subterminal bristles on ventral margin of 1st joint (probably just intraspecific variability). Bristles of protopodite and endopodite, in general, similar to those of adult female.

Sixth Limb (Figure 13*h*): Epipodite with plumose bristles forming 3 groups (dorsal group with 7 bristles (6 long, 1 shorter (dorsal), middle group with 6 long bristles, ventral group with 5 long bristles). Limb otherwise similar to that of adult female.

Seventh Limb (Figure 13*f*), *Furca* (Figure 14*a*), *Bellonci Organ* (Figure 11*f*), *and Lips* (Figure 14*b–d*): Similar to those of adult female.

Genitalia (Figure 14*e–i*): Consisting of 2 parts on left side of body Posterior rod-shaped branch with broad terminus striated (could be hairs) except at convex tip, and anterior spine. Anterior branch with flexible transparent tube at tip. Kidney-shaped brown organ containing abundant minute round globules present at base of copulatory organ. The kidney-shaped brown organ resembles the vas deferens of *Conchoecia clausii* illustrated by Müller (1894, pl. 38: fig. 19). In that illustration a sac-like testis is connected to the posterodorsal corner of the vas deferens; a sac-like testis was not observed in *S. capax*, but a tube connected to the posterodorsal corner (exact location difficult to ascertain) of the vas deferens curves ventrally around the vas deferens and enters the anterior branch of the copulatory organ (Figure 14*e,i*). The tube in USNM 194289 contains thread-like sperm (Figure 14*e,i*). The vas deferens are paired in *C. capax*, each located close to the outer right and left sides of the body, respectively. The tube connected to the right vas deferens angles inward toward the copulatory organ on the left side of the body (Figure 14i), but whether it enters the anterior branch could not be determined from examination of the whole mount.

Ganglion (Figures 11*d*, 14*b*): Amber-colored oval ganglion present in head region proximal to 1st antenna.

DESCRIPTION OF A–1 MALE (INSTAR VI?) (Figures 15*a–g*, 16).—Carapace similar in shape and ornamentation to that of adult female (Figure 15*a*).

Carapace Size (length, height in mm) (Figure 16): USNM 194286, 2.10, 0.99. USNM 194292, 2.09, 0.91. USNM 194445A–C, 3 specimens: 1.94, 0.90; 2.20, 0.97; 2.16, 0.89. Length range (N = 5) 1.94–2.20 mm. Average length 2.0 mm.

First Antenna (Figure 15*b*): Similar to that of adult female.

Second Antenna: Protopodite and exopodite similar to those of adult female. Endopodite 3 jointed but 2nd and 3rd joints fused (Figure 15*c,d*): 1st joint similar to that of adult female; 2nd joint with small c-bristle, small lateral bristle near base of f-bristle, and stout filament-like f- and g-bristles (g-bristle stouter, ringed, and about 1/3 longer than f-bristle); 3rd joint with equilength filament-like h-, i-, and j-bristles about 1/2 length of g-bristle, and 2 minute medial bristles near base of j-bristle.

Mandible: Not examined in detail but, in general similar to that of adults (2 long lateral bristles of basale twisted around each other as on adults).

Fifth and Sixth Limbs: Not examined in detail but, in general, similar to those of adult female. 5th limb without protopodial gland present on adult male.

Seventh Limb (Figure 15*e*): Similar to that of adults.

Furca (Figure 15*f*): Each lamella with 7 claws followed by small triangular process (incipient 8th claw). Glandular process between claws 1 and 2 but closer to claw 2. Bifurcate unpaired bristle similar to that of adults.

Bellonci Organ: Similar to that of adults.

Lips: Anterior face with 2 large widely spaced processes as on adults (Figure 15*b*). Lip not examined.

Genitalia (Figure 15*g*): Copulatory organ with 2 branches: anterior branch with rounded tip without structures. Tip of posterior branch with 3 small bristles or processes.

Ganglion: Amber-colored ganglion proximal to 1st antenna similar to that of adult male.

DESCRIPTION OF A–1 FEMALE (INSTAR VI?) (Figures 15*h*, 16).—Carapace similar in shape and ornamentation to that of adult female (Figure 15*h*).

Carapace Size (length, height in mm) (Figure 16): USNM 194291, 2.25, 1.01. USNM 194446A,B, 2 specimens: 2.13, 1.01; 2.17, 0.95. Length range (N = 3) 2.13–2.25 mm. Average length 2.18 mm.

Furca: Similar to that of A–1 male.

Seventh Limb: Similar to that of adult female.

FIGURE 13.—*Spelaeoecia capax* Kornicker, 1990, USNM 194289, adult male: *a*, part left mandible, lv (nabs); *b*, part left mandible, mv; *c*, part basale right mandible, lv; *d*, part basale left mandible, mv, lv; *e*, endopodite right mandible, mv; *f*, right 7th limb, lv; *g*, left 5th limb, lv; *h*, right 6th limb, mv.

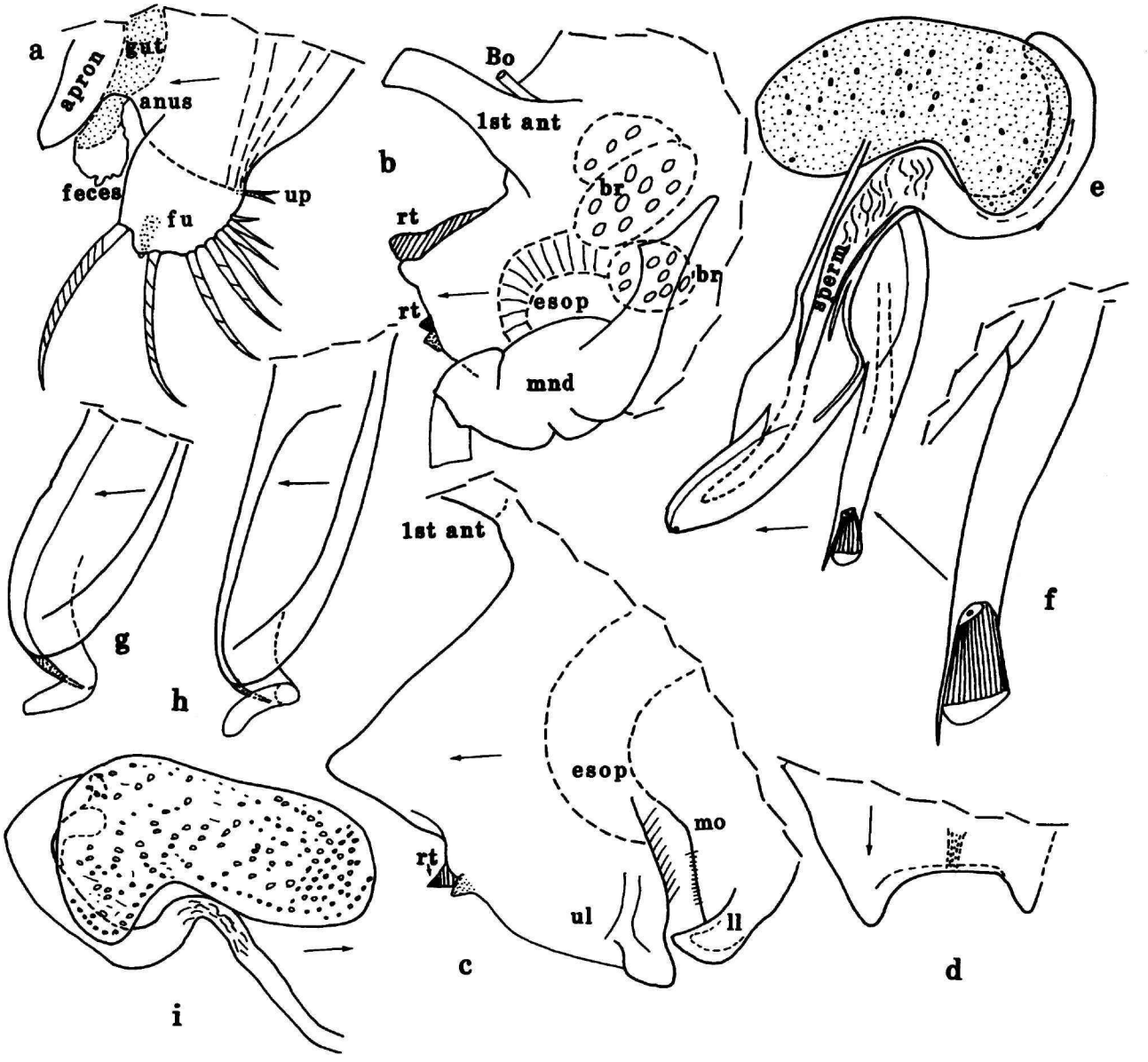


FIGURE 14.—*Spelaeoecia capax* Kornicker, 1990, USNM 194289, adult male: *a*, part posterior of body from left side; *b*, part anterior of body from left side; *c*, anterior of body from left side (mandible not shown); *d*, ventral or dorsal view of anterior edge of body; *e,f*, male genitalia from left side; *g,h*, tip of anterior branch of copulatory organ showing 2 slightly different positions of terminal tube; *i*, testis of genitalia from right side.

Genitalia: Absent (observation made through transparent shell).

DESCRIPTION OF A–2 INSTAR (INSTAR V?) (sex unknown) (Figures 15*i–l*, 16).—Carapace similar in shape and ornamentation to that of adult female (Figure 15*i*).

Carapace Size (length, height in mm) (Figure 16): USNM 194294, 1.59, 0.68. USNM 194413, 1.56, 0.68. USNM 194447A–D (4 specimens): 1.48, 0.62; 1.38, 0.61; 1.50, 0.67; 1.53, 0.70. Length range (N = 6) 1.38–1.59 mm. Average length 1.51 mm.

Mandible: Basale with 2 distal long lateral bristles twisted around each other (Figure 15*j*).

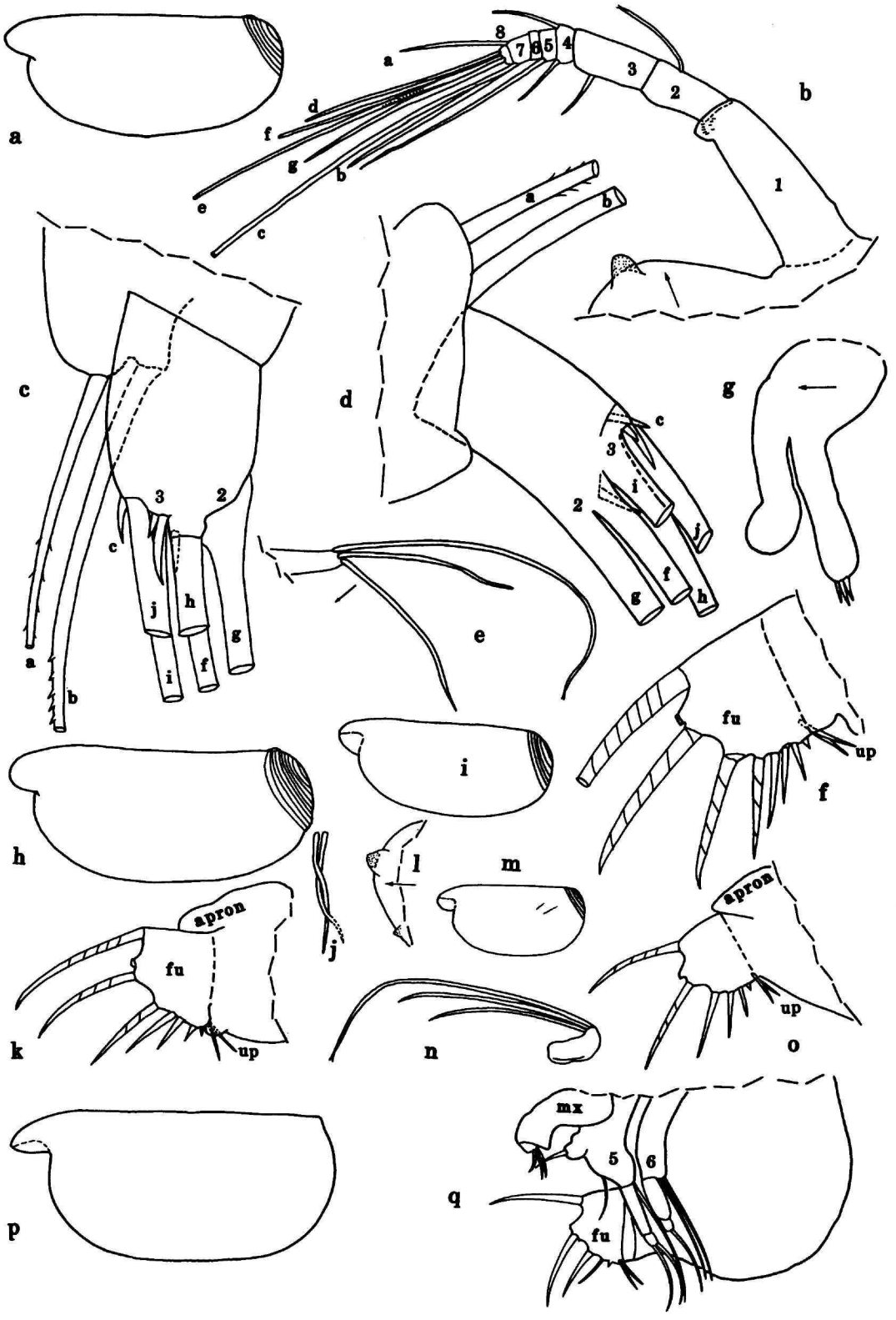

a
b
c
d
e
f
g
h
i
j
k
l
m
n
o
p
q
apron
fu
up
mx
5
6

FIGURE 15 (left).—*Spelaeoecia capax* Kornicker, 1990, USNM 194292, A–1 male (Instar VI?): *a*, complete specimen from left side showing representative lineations, length 2.09 mm; *b*, part of anterior of body showing left 1st antenna, lv; *c,d*, endopodites of right and left 2nd antenna, respectively, mv; *e*, left 7th limb; *f*, left lamella of furca; *g*, copulatory organ from left side. *h*, USNM 194291, A–1 female (Instar VI?), complete specimen from left side showing representative lineations, length 2.25 mm. USNM 194294, A–2 Instar (Instar V?) (sex unknown): *i*, complete specimen from left side showing representative lineations, length 1.59 mm; *j*, entwined bristles of basale of left mandible, lv; *k*, left lamella of furca; *l*, part of anterior of body from left side. USNM 194293, Instar A–3 (Instar IV?) (sex unknown): *m*, complete specimen from left side showing representative lineations, length 1.10 mm; *n*, right 7th limb; *o*, left lamella of furca. USNM 194449A, Instar A–4 (Instar III?) (sex unknown): *p*, outline of complete specimen from left side (surface lineations omitted), length 0.81 mm; *q*, posterior of animal from left side (nabs).

Seventh Limb: Similar to that of adults.

Furca (Figure 15*f*): Each lamella with 6 claws followed by translucent triangular process (incipient 7th claw). Glandular process present between claws 1 and 2 but closer to claw 2. Bifurcate unpaired bristle similar to that of adult female.

Anterior of Body (Figure 15*l*): Similar to that of adults.

DESCRIPTION OF A–3 INSTAR (INSTAR IV?) (sex unknown) (Figures 15*m–o*, 16).—Carapace similar in shape and ornamentation to that of adult female (Figure 5*m*).

Carapace Size (length, height in mm) (Figure 16): USNM 194293, 1.10, 0.52. USNM 194448A–F, 6 specimens: 1.07, 0.52; 1.12, 0.51; 1.09, 0.43; 1.13, 0.50; 1.08, 0.50; 1.05, 0.50. Length range (N = 7) 1.05–1.13 mm. Average length 1.09 mm.

Second Antenna: Endopodite: 1st joint with only 1 dorsal bristle. Exopodite with 9 joints.

Mandible: Basale with 2 distal entwined lateral bristles.

Fifth and Sixth Limbs: Both well developed, 6th limb extending well past 5th limb, similar to those of adults.

Seventh Limb (Figure 15*n*): Similar to that of adults.

Furca (Figure 15*o*): Each lamella with 5 claws followed by transparent triangular process (incipient 6th claw). Glandular process present between claws 1 and 2 but closer to claw 2. Bifurcate unpaired bristle similar to that of adults. Apron present but shorter than that of adults.

DESCRIPTION OF A–4 INSTAR (INSTAR III?) (Sex unknown) (Figures 15*p,q*, 16).—Carapace similar in shape and ornamentation to that of adult female (Figure 15*p*).

Carapace Size (length, height in mm) (Figure 16): USNM 194449A,B, 2 specimens: 0.81, 0.38; 0.82, 0.42. Length range (N = 2) 0.81–0.82 mm. Average length 0.815 mm.

Second Antenna: Endopodite: 1st joint with 1 long dorsal bristle. Exopodite with 9 joints.

Mandible: Lateral side of mandibular basale without 2 entwined bristles (both specimens viewed through shell).

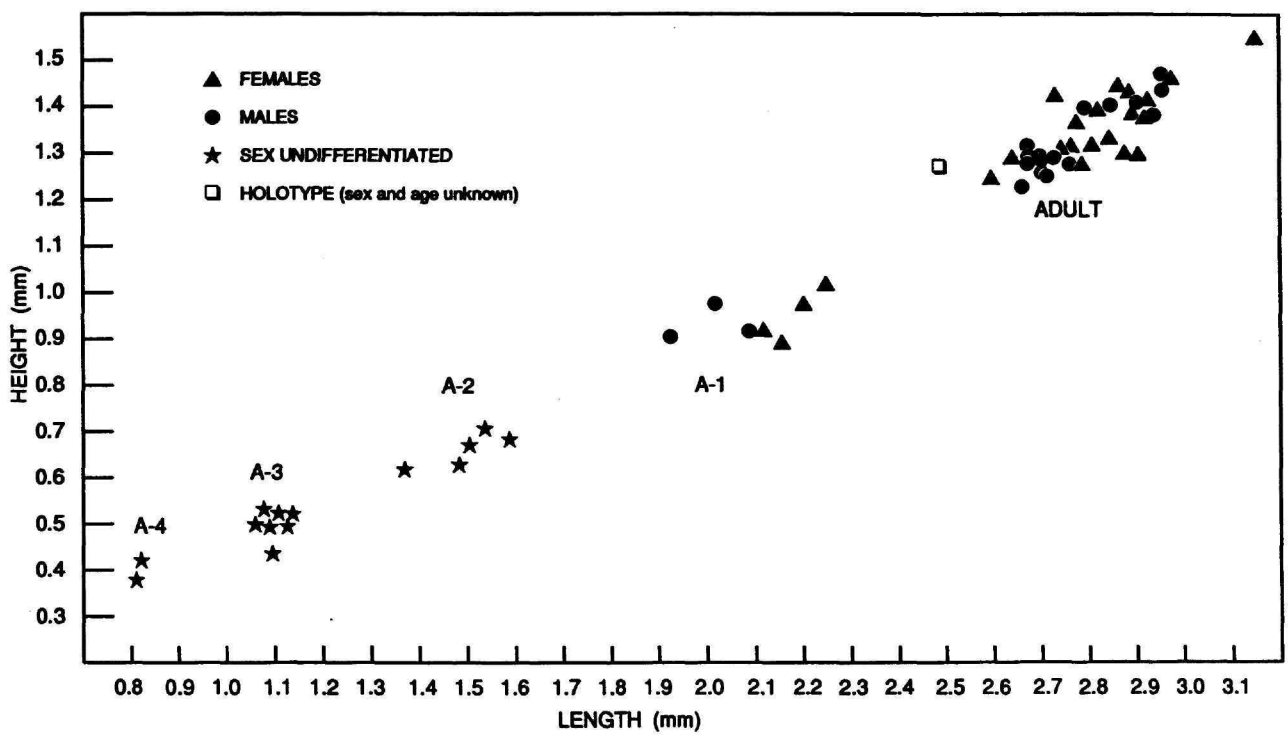


FIGURE 16.—Length-height distribution of growth stages of *Spelaeoecia capax* Kornicker, 1990.

TABLE 3.—Growth factors for shell length between stages of specimens of *Spelaeoecia capax* from Oven Rock Cave, Great Guana Cay, Exuma Cays. Males and females are combined.

Stage	Number of specimens	Average length (mm)	Growth factor
Adults	34	2.83	
			1.33
A–1	8	2.13	
			1.41
A–2	6	1.51	
			1.39
A–3	7	1.09	
			1.33
A–4	2	0.82	
Avg. growth factor			1.37

Maxilla (Figure 15*q*): Well developed but with fewer bristles than on adult (not all bristles shown).

Fifth and Sixth Limbs (Figure 15*q*): Both well developed but with fewer bristles than on adult (not all bristles shown); 6th limb not extending past 5th limb.

Seventh Limb: Absent.

Furca (Figure 15*q*): Each lamella with 4 claws followed by small triangular process (incipient claw). Posterior end of furca with bifurcate unpaired bristle.

COMPARISONS.—In the original description of the species, only the carapace of *S. capax* was compared with previously described species (Kornicker et al., 1990:25); therefore, some appendages are compared herein. The 1st antenna of *S. capax* differs from that of *S. styx* and *S. sagax* in having a longer 3rd joint and a ventral bristle on the 3rd and 4th joints. The basale of the mandible of *S. capax* differs from those of *S. styx, S. sagax,* and *S. bermudensis* in having two long distal lateral bristles twisted around each other. The posterior branch of the copulatory organ of *S. capax* differs from those of *S. styx, S. sagax,* and *S. bermudensis* in having a broad tip. Some morphometric characters of species of *Spelaeoecia* are presented in Table 2.

ONTOGENY.—It is estimated that the present collection of *S. capax* comprises adults and instars A–1 to A–4 (instars III–VI based on the premise that members of the genus have six juvenile stages). The 6th limb with bristles is present in instar III, but it does not extend posteriorly past the 5th limb. The 7th limb with bristles is present in instar IV, and the 6th limb of instar IV extends posteriorly well past the 5th limb. A reduced male copulatory organ is present in instar VI. No instar V males were identified with certainty.

The furca of instar III has four stout claws on each lamella (the missing instars I and II probably have two and three furcal claws, respectively). One claw is added at each stage until eight is reached on the adult. The lamellae of instars III–VI have a small triangular process following the claws, which is interpreted as being an incipient claw that becomes a full claw in the following instar. A triangular process is absent on the adult.

The average growth factors for lengths of shells at each growth stage of specimens from Oven Rock Cave are shown in Table 3, and a carapace length-height graph is presented in Figure 16.

REMARKS.—A mandibular basale with 2 distal entwined lateral bristles present on *S. capax* is unusual in the *Spelaeoecia* but is present on known species of *Deeveya* (Kornicker et al., 1990). The broad tip of the posterior branch of the copulatory organ of the male *S. capax* resembles those of the male *Deeveya styrax* and *D. medix* (Kornicker et al., 1990, figs. 19e, 28j).

Spelaeoecia styx Kornicker, 1990

FIGURES 17–29

Spelaeoecia styx Kornicker in Kornicker et al., 1990:6, figs. 2–8.

HOLOTYPE.—USNM 194270, undissected adult male in alcohol.

TYPE LOCALITY.—El Dorado Cave, South Andros Island, Great Bahama Bank.

MATERIAL.—Norman's Pond Cave, Norman's Pond Cay, Exuma Cays: Sta 93-001: USNM 194266, undissected adult female in alcohol; USNM 194295A,B, 2 undissected A–3 instars in alcohol; USNM 194295C, undissected A–4 instar in alcohol. Sta 93-002: USNM 194270, undissected adult male in alcohol; USNM 194276, undissected adult male (lost); USNM 194273, partly dissected A–1 male in alcohol; USNM 194275, undissected A–2 instar (sex unknown) in alcohol; USNM 194274, partly dissected A–3 instar (sex unknown) in alcohol; USNM 194272, undissected A–4 instar (sex unknown) in alcohol; USNM 194271, partly dissected A–5 instar (sex unknown) in alcohol; USNM 194296A–C, 3 undissected adult females in alcohol; USNM 194296D, undissected adult male in alcohol; USNM 194296E–G, 3 undissected A–1 females in alcohol; USNM 194296H, undissected A–2 instar (sex unknown) in alcohol; USNM 194296J,K, 2 undissected A–3 instars (sex unknown) in alcohol; USNM 194300, partly dissected adult male on slide and in alcohol. Sta 93-003: USNM 194260, adult male on slide and in alcohol; USNM 194261, adult female on slide and in alcohol; USNM 194325A, B, 2 undissected adult males in alcohol; USNM 194325C, undissected adult female in alcohol; USNM 194325D, undissected A–2 instar (sex unknown) in alcohol; USNM 194326, undissected A–1 female in alcohol; USNM 194327, 2 undissected A–4 instars (sex unknown) in alcohol. Sta 93-004: USNM 194285, A–3 instar (sex unknown) on slide and in alcohol. Sta 94-016: USNM 194434A, 2 undissected A–4 instars (sex unknown) and 2 undissected A–5 instars (sex unknown) in alcohol; USNM 194434B, 2 undissected A–3 instars (sex unknown) and 3 undissected A–2 instars (sex

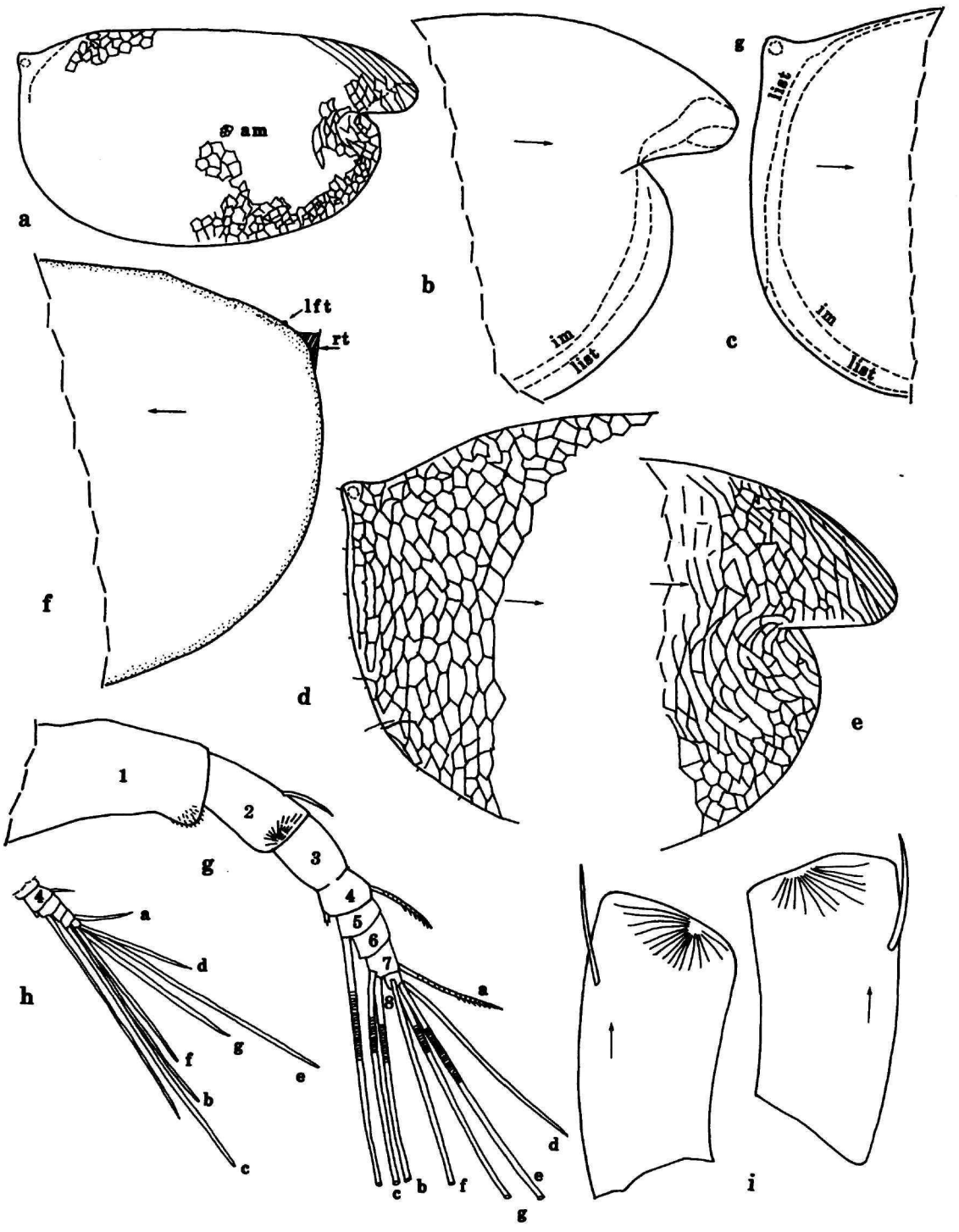


FIGURE 17.—*Spelaeoecia styx* Kornicker, 1990, USNM 194260, adult male: *a*, complete specimen from right side showing representative reticulations, length 1.05 mm; *b–e*, views of parts of right valve, lv; *f*, posterior of complete specimen from left side; *g,h*, left 1st antenna, mv; *i*, 2nd joints of left and right 1st antennae, respectively, mv.

FIGURE 18.—*Spelaeoecia styx* Kornicker, 1990, USNM 194260, adult male: *a,b,* endopodites of right and left 2nd antennae, respectively, mv; *c,* coxale endite right mandible, mv; *d,* part left mandible, lv; *e,* basale left mandible, mv (proximal parts only shown of some bristles; 2 minute lateral bristles near midlength not shown); *f,* tip basale right mandible, mv; *g,* right 7th limb, lv. *h,* paratype, USNM 194300, adult male, length 1.11 mm, left lamella of furca showing small process (stippled) between claws 1 and 2, lv.

unknown) in alcohol; USNM 194434C, 3 undissected A–2 instars (sex unknown) and 1 undissected A–1 female in alcohol; USNM 194434D, 4 undissected A–1 females in alcohol; USNM 194434E, 4 undissected adult males and 4 undissected adult females in alcohol; USNM 194434F, 3 undissected adult males, 3 undissected adult females, and an empty carapace, all in alcohol. Oven Rock Cave, Great Guana Cay, Exuma Cays: Sta 93-006: USNM 194278, undissected A–3 instar (sex unknown) in alcohol; USNM 194297A, adult male on slide and in alcohol; USNM 194297B, undissected A–1 male in alcohol; USNM 194297C,D, 2 undissected A–1 females in alcohol; USNM 194297E, undissected A–2 instar (sex unknown) in alcohol. Sta 93-008: USNM 194298, undissected adult female in alcohol. Sta 93-009: USNM 194277, partly dissected A–5 instar in alcohol; USNM 194299A, undissected adult female in alcohol; USNM 194299B, undissected A–1 female in alcohol. Sta 94-014: USNM 194414, undissected A–1 male in alcohol; USNM 194415, undissected A–5 instar in alcohol. Sta 95-012: USNM 194450A, undissected adult male in alcohol; USNM 194450B,C, 2 undissected adult females in alcohol; USNM 194450D,E, 2 undissected A–1 females in alcohol; USNM 194450F, undissected A–2 instar (sex unknown) in alcohol; USNM 194450G, undissected A–1 male in alcohol. El Dorado Cave, South Andros Island, paratype, USNM 193440, adult male.

DISTRIBUTION.—Exuma Cays, Great Bahama Bank: Norman's Pond Cave, Norman's Pond Cay (Sta 93-001, 93-002, 93-003, 94-016) from water column at depths of 6–35 m and from fine silt on ledge at depth of 6–18 m, salinity 35–36 ppt. Oven Rock Cave, Great Guana Cay (Sta 93-006, 93-008, 93-009, 95-012) from water column at depths of 0–22 m and from dark brown silt on floor at 8 m, salinity 35–36 ppt. South Andros Island, Great Bahama Bank, El Dorado Cave (Kornicker et al., 1990:2).

REMARKS.—The descriptions of adult males and females that follows mainly points out differences between present specimens from Exuma Cays and the type locality, South Andros Island; in the description "types" refers to the specimens described by Kornicker in Kornicker et al. (1990:6).

SUPPLEMENTARY DESCRIPTION OF ADULT MALE (Figures 17–21, 28, 29).—Carapace shape, infold, glands, and hingement similar to those of previously described adult male types (Kornicker et al., 1990:6) (Figures 17*a,c,* 21*a,c,*).

Ornamentation (Figures 17*a,d,e,* 21*b*): Surface reticulate (reticulation not always visible in specimens immersed in glycerine for several weeks).

Glands: Right valve with stout projecting glandular process (Figures 17*a,c,d,f,* 21*a,c*). Left valve with small pointed glandular process (Figure 17*f*).

Carapace Size (length, height in mm) (Figure 28): Norman's Pond Cave: USNM 194260, 1.05, 0.56. USNM 194270, 1.08, 0.61. USNM 194276, 1.05, 0.55. USNM 194296D, 1.07, 0.60. USNM 194300, 1.11, 0.54. USNM 194325A,B, 2 specimens: 1.09, 0.58; 1.10, 0.57. USNM 194434E, 4 specimens: 1.08, 0.54; 1.04, 0.60; 1.12, 0.61; 1.04, 0.53. USNM 194434F, 3 specimens: 1.05, 0.59; 1.06, 0.56; 1.07, 0.52. Oven Rock Cave: USNM 194297A, 0.95, 0.50. USNM 194450A, 0.95, 0.52. Length range (N = 16) 0.95–1.11 mm. Average length 1.06 mm.

First Antenna (Figures 17*g–i,* 20*a,b,e,* 29*a,b*): Except for dorsal bristle of 2nd joint being well defined and longer (extends past suture between 2nd and 3rd joints) (Figure 29*a*), limb essentially similar to that of type (Figure 29*b*). Left limb of USNM 194260 with small terminal ventral process or bristle on 4th joint (Figure 17*g,h*) (process not on right limb nor on either limb of USNM 194300). Both limbs of USNM 194260 and USNM 194297A with 1 ventral filament on 5th joint, unlike types, which have 1 or 2 ventral filaments.

Second Antenna: Except for absence of spines, protopodite similar to that of types. Except for absence of spines on 1st joint, exopodite similar to that of types. Except for tip of straight clasper being more rounded on USNM 194260, endopodite of right limb similar to that of types (Figure 18*a,*); endopodite of right limb of USNM 194300 similar to that of types (Figure 21*d,e*); except for tip of straight clasper not having small sclerotized process on terminal ventral edge and having 3 instead of 2 terminal spines, endopodite of left limb similar to that of types (Figures 18*b,* 21*f,g*).

Mandible: Proximal of distal set of teeth with 6 instead of 7 cusps, otherwise coxale endite similar to that of types (Figure 18*c*). Basale: right limb of USNM 194260 similar to that of types (Figure 18*f*); left limb aberrant in having a total of 6 rather than 7 terminal cusps and in not having a lateral tooth near distal edge (Figure 18*d,e*). Endopodite: 2nd joint of both limbs with 3 ringed dorsal bristles rather than 2 or 3 as on types; and 3rd joint of both limbs with 4 bristles in ventral group; limb otherwise similar to that of types (Figure 18*d*).

Maxilla (Figure 19*a–c*): Endite I with 2 proximal and 11 terminal bristles (3 tubular); endite II with 2 proximal and 9 terminal bristles (4 tubular); endite III with 1 proximal and 5 terminal bristles (1 tubular) (Figure 19*a*). Coxale and basale partly fused (Figure 19*b,c*); coxale with long stout plumose dorsal bristle (Figure 19*b,c*); basale with 3 ventral bristles (1 long plumose, 1 fairly long bare tubular, 1 short pointed) (Figure 19*c*). Endopodite (Figure 19*b*): 1st joint with 5 or 6 anterior bristles (4 or 5 proximal, 1 distal), and 6 posterior bristles (1 proximal, 5 distal); end joint hirsute, with 2 stout claws and 5 slender ringed bristles (rings not shown).

Fifth Limb (Figure 19*d,e*): Epipodite with 3 groups of 5 or 6 plumose bristles (4 long and 1 short (dorsal) in dorsal group, 6 long in middle group; 5 in ventral group). Protopodite with elongate glandular process and 2 ventral endites: endite I with 3 spinous bristles; endite II with 1 proximal medial bristle and 3 ventral bristles. Basale with 1 long lateral anterior bristle with long spines, and 6 ventral bristles (2 tending to be claw-like)

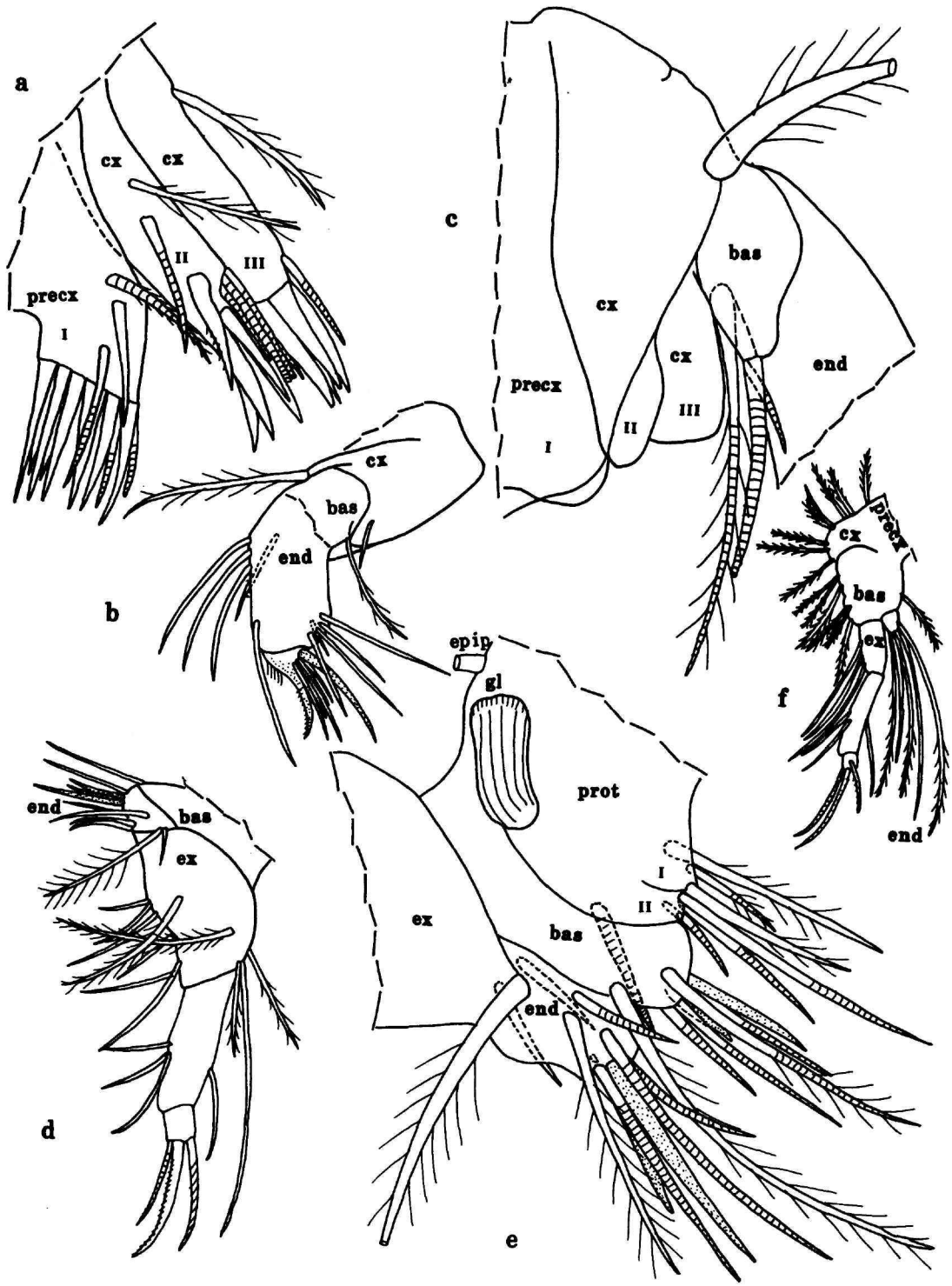


FIGURE 19.—*Spelaeoecia styx* Kornicker, 1990, USNM 194260, adult male: *a*, endites of maxilla (nabs); *b*, left maxilla, lv (endites not shown); *c*, part left maxilla, mv (endite bristles not shown); *d*, left 5th limb (nabs), lv; *e*, part right 5th limb, lv; *f*, left 6th limb, lv.

FIGURE 20.—*Spelaeoecia styx* Kornicker, 1990, USNM 194260, adult male: *a*, Bellonci organ and part of left 1st antenna (nabs), lv; *b*, anterior of body from right side (nabs); *c*, right lamella of furca, lv; *d*, posterior of body from right side (only claw 1 of furca shown); *e*, anterior of body from left side; *f*, copulatory organ from left side; *g*, tip of anterior branch of copulatory organ.

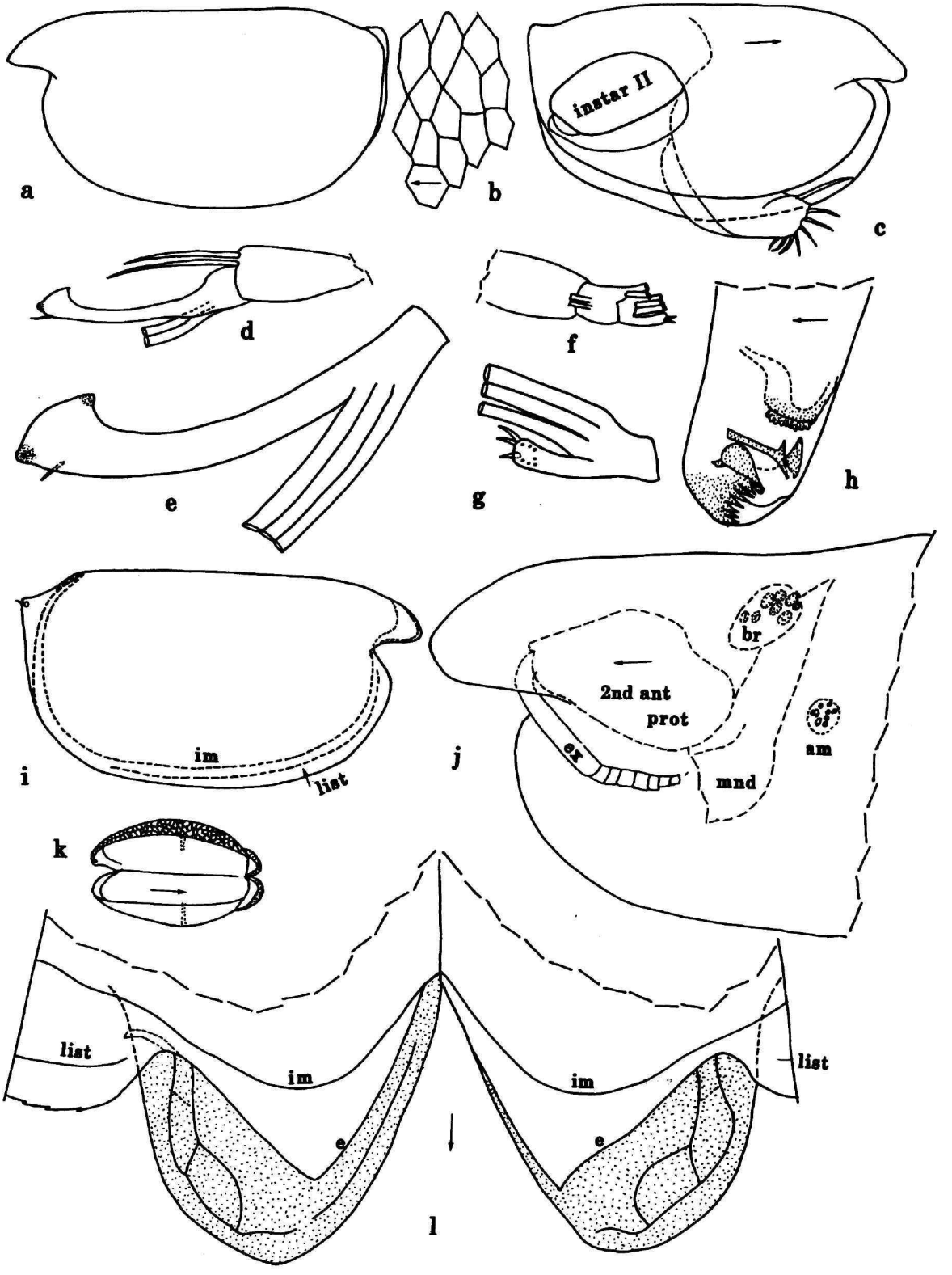

a
b
instar II
c
d
e
f
g
h
i
im
list
j
br
2nd ant
prot
os
mnd
am
k
list
im
e
im
list
e
l

FIGURE 21.—*Spelaeoecia styx* Kornicker, 1990, USNM 194276, adult male: *a*, complete specimen from left side (reticulations not shown), length 1.05 mm; *b*, reticulations from left valve just posterior to midlength. *c*, USNM 194270, adult male containing a juvenile specimen (Instar II) within shell, complete specimen from right side, length 1.08 mm. USNM 194300, adult male, length 1.11 mm: *d,e*, endopodite right 2nd antenna, mv; *f*, endopodite left 2nd antenna, lv; *g*, 3rd joint endopodite left 2nd antenna, mv; *h*, tip anterior branch copulatory organ. USNM 194261, adult female: *i*, complete specimen from right side (reticulations not shown), length 1.02 mm; *j*, anterior part of complete specimen from left side; *k*, ventral view of partly open carapace, reticulations shown only on right valve; *l*, anterior part of carapace (valves not entirely flat), iv.

(Figure 19*e*). Endopodite with 2 short proximal medial bristles and 9 additional bristles (1 short tooth-like medial subventral bristle, 1 long lateral anterior bristle with long spines, 2 claw-like ventral bristles, 3 subventral ringed lateral bristles, and 2 ringed ventral bristles) (Figure 19*e*). Exopodite (Figure 19*d*): dorsal margin with 1 long subterminal bristle, 1 plumose bristle with base on or near dorsal margin and proximal to subterminal bristle; ventral margin dividing joint: broad proximal part with 3 slender ventral bristles, 1 long spinous lateral bristle, and 1 short medial bristle near ventral margin; narrower distal part with 2 slender ventral bristles near midlength, and 2 distal plumose lateral bristles (1 close to dorsal margin). 2nd joint: dorsal margin with 1 distal bristle; ventral margin with 3 slender bristles near midlength. 3rd joint with 2 stout claw-like bristles (long claw with indistinct ventral spines; short claw with oblique lines) and 1 slender ringed ventral bristle. (Left limb of USNM 194260 aberrant in not having 2 claw-like ventral bristles on basale, and in short ventral claw of endopodite being bifurcate.)

Sixth Limb (Figure 19*f*): Epipodite with plumose bristles in 3 groups each with 5 or 6 bristles. Protopodite weakly divided into precoxale with 3 or 4 ventral bristles and coxale with 5 ventral bristles. Basale with 7 plumose bristles (6 ventral, 1 dorsal). Endopodite well developed, with 5 long bristles (3 plumose, 2 bare). Exopodite 3-jointed: 1st joint with 3 bare ventral bristles; 2nd joint with 2 or 3 bare bristles (1 or 2 ventral, 1 dorsal); 3rd joint with 3 bare bristles (middle and dorsal bristles tending to be claw-like, both with oblique rings; ventral bristle slender ringed).

Seventh Limb (Figure 18*g*): Similar to that of types.

Furca (Figures 18*h*, 20*c,d*): Similar to that of male types except unpaired bristle bifurcate, and minute lateral process present between 1st and 2nd claws but closer to claw 2 (visible at high magnification, ×1500) (Figure 18*h*).

Bellonci Organ (Figures 20*a,b*, 29*d*), *Anterior of Body* (Figure 20*b,e*) *and Lips* (Figure 20*e*): Similar to those of types (Figure 20*a,b*), except 1 branch of Bellonci organ of USNM 194297A with pointed drawn-out tip (Figure 29*d*).

Copulatory Organ (Figures 20*f,g*, 21*h*, 29*e*): Small differences in number of teeth on prongs of anterior branch observed between paratype and Exuma specimens, but tip generally somewhat obscured, and differences attributed to either that or intraspecific variability. (Compare with paratype (Figure 29*c*.) The anterior branch of USNM 194300 (Figure 21*h*) differs from others but prongs may have fragmented.

SUPPLEMENTARY DESCRIPTION OF ADULT FEMALE (Figures 21*i–l*, 22-24, 28).—Carapace similar to that of adult male (Figures 21*i–l*, 22, 23*a,b*).

Carapace Size (length, height in mm) (Figure 28): Norman's Pond Cave: USNM 194261, 1.02, 0.54. USNM 194266, 1.11, 0.56. USNM 194296A,B,C, 3 specimens: 1.10, 0.59; 1.02, 0.54; 1.16, 0.64. USNM 194325C, 1.09, 0.58. USNM 194434E, 1.00, 0.58. USNM 194434F, 3 specimens: 1.08, 0.56; 1.08, 0.56; 1.09, 0.60. Oven Rock Cave: USNM 194298, 0.96, 0.46. USNM 194299A, 0.95, 0.49. USNM 194450B,C, 2 specimens: 0.97, 0.51; 0.95, 0.54. Length range (N = 14) 0.95–1.16 mm. Average length 1.04 mm.

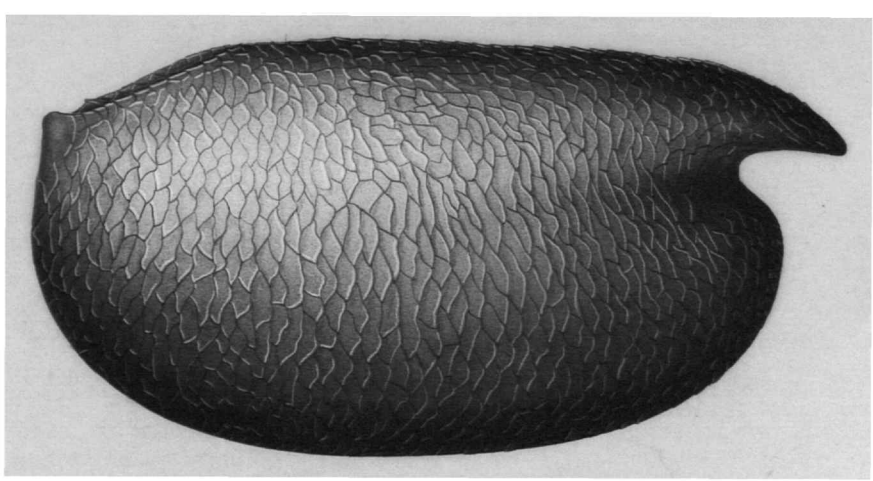


FIGURE 22.—*Spelaeoecia styx* Kornicker, 1990, USNM 194266, adult female, length 1.11 mm, complete specimen from right side.

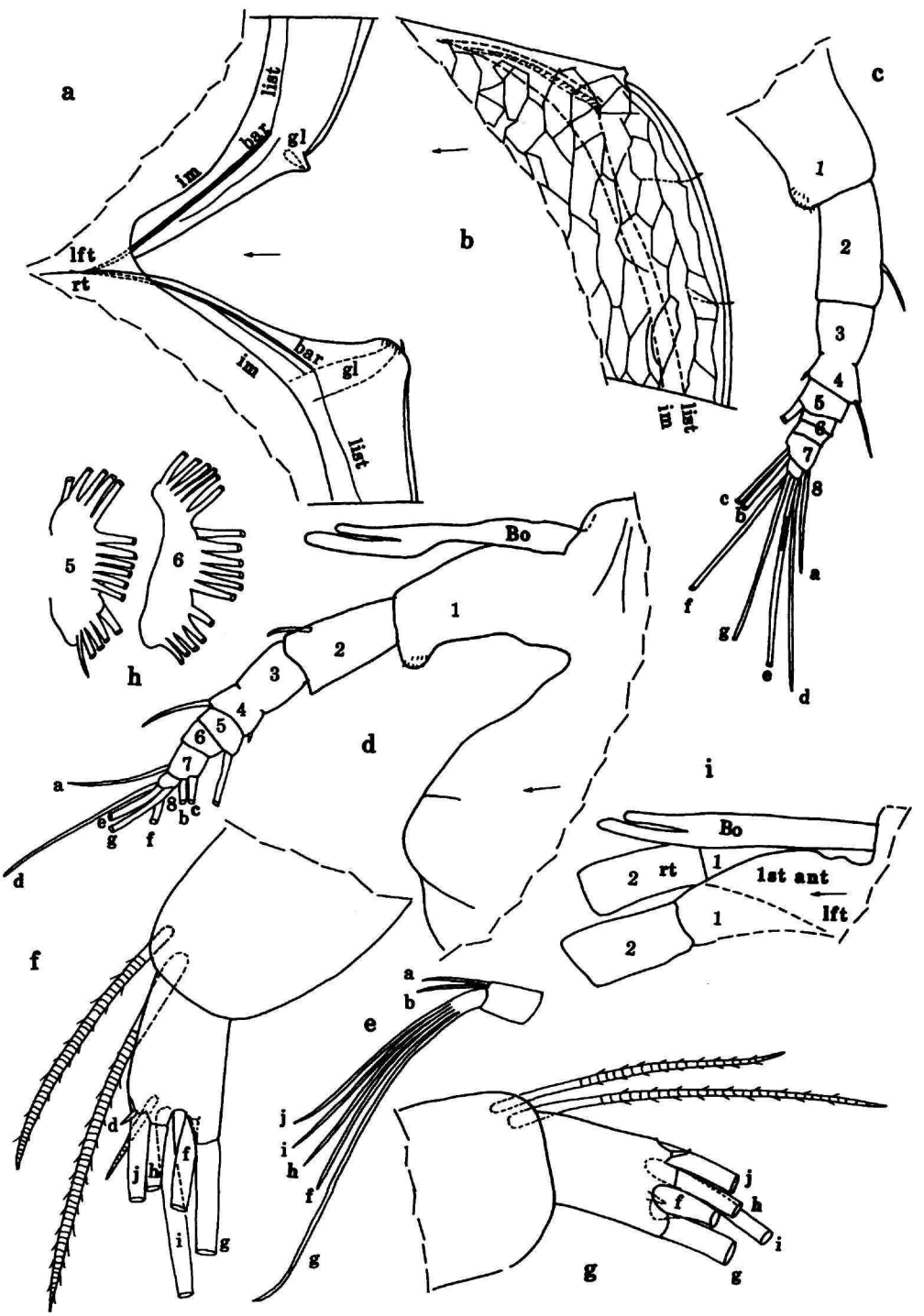


FIGURE 23.—*Spelaeoecia styx* Kornicker, 1990, USNM 194261, adult female, length 1.02 mm: *a*, posterior end opened valve (valves not entirely flat), iv; *b*, posterodorsal corner left valve (bar striated), ov; *c*, right 1st antenna, lv; *d*, Bellonci organ, left 1st antenna (lv), and part anterior of body from left side; *e*, endopodite left 2nd antenna, lv; *f*, endopodite right 2nd antenna, mv; *g*, endopodite left 2nd antenna, mv; *h*, epipodites left 5th and 6th limbs, lv; *i*, Bellonci organ and joints 1 and 2 of 2nd antennae (bristles of 2nd joint not shown).

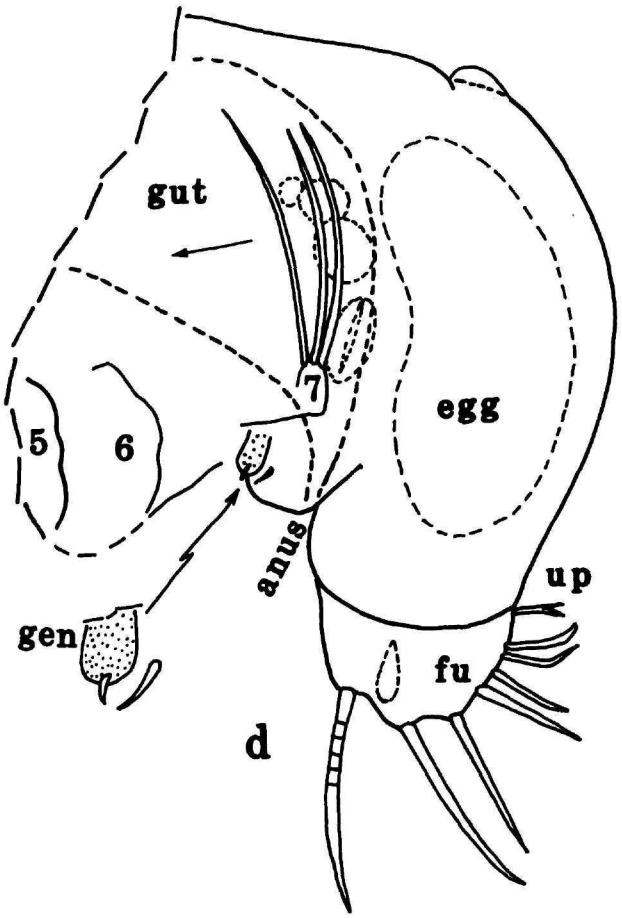


FIGURE 24.—*Spelaeoecia styx* Kornicker, 1990, USNM 194261, adult female, posterior of body from left side.

First Antenna (Figure 23*c,d,i*): Both limbs of 4th joint of USNM 193261 with minute ventral bristle or process. Limb otherwise similar to that of adult male.

Second Antenna: Endopodite (Figures 21*j*, 23*e–g*): differs from that of paratype described by Kornicker in Kornicker et al. (1990:12) in having minute indistinct medial bristle near base of j-bristle. Endopodite of right limb of USNM 194261 aberrant in having short lateral bristle on 2nd joint (Figure 23*f*). Protopodite and exopodite similar to those of adult male (Figure 21*j*).

Mandible and Maxilla: Not examined in detail but, in general, similar to that of adult male.

Fifth Limb (Figures 23*h*, 24): Without glandular process on protopodite, otherwise similar to that of adult male but not studied in detail.

Sixth Limb (Figure 24): Not studied in detail but, in general, similar to that of adult male.

Seventh Limb (Figure 24), *Furca* (Figure 24), *Bellonci Organ* (Figure 23*d,i*), *Anterior of Body, and Lips:* Similar to those of adult male.

Genitalia: Small process bearing terminal spine on left side of body anterior to furca, and additional small spine posterior to it (Figure 24).

DESCRIPTION OF MALE A–1 INSTAR (INSTAR VI?) (Figure 25*a–e*).—Carapace similar in shape and ornamentation (not shown) to that of adult (Figures 25*a,b*, 28).

Carapace Size (length, height in mm) (Figure 28): Norman's Pond Cave: USNM 194273, 0.93, 0.51 mm. Oven Rock Cave: USNM 194297B, 0.82, 0.42. USNM 194414, 0.87, 0.48. USNM 194450G, 0.81, 0.44.

First Antenna (Figure 25*c*): Similar to that of adult, except no minute ventral process or bristle on 4th joint.

Second Antenna: Protopodite and exopodite similar to that of adult (9th joint with 4 bristles). Endopodite not examined in detail but main bristles similar to those of adult female.

Mandible, Maxilla (Figure 25*d*), *Fifth Limb* (Figure 25*d*), *Sixth Limb* (Figure 25*d*), *Seventh Limb* (Figure 25*d*), *and Furca* (Figure 25*e*): Similar to those of adult, except USNM 194450G with 6 claws on left lamella and 7 on right. Unpaired bristle of furca bifurcate.

Bellonci Organ: Broken off on USNM 194273.

Genitalia (Figure 25*d*): Consisting of 2 lobes (labeled CO): anterior lobe broad with rounded tip; posterior lobe narrow, with 3 stout terminal spines or processes (posterior process longer).

DESCRIPTION OF A–1 FEMALE (INSTAR VI?) (Figure 28): Carapace similar to that of A–1 male.

Carapace Size (length, height in mm) (Figure 28): Norman's Pond Cave: USNM 194296E,F,G, 3 specimens: 0.95, 0.52; 0.87, 0.55; 0.93, 0.48. USNM 194326, 0.88, 0.47. USNM 194434C, 0.87, 0.49. USNM 194434D, 4 specimens: 0.95, 0.51; 0.92, 0.52; 0.92, 0.51; 0.92, 0.51. Oven Rock Cave: USNM 194297C,D, 2 specimens: 0.85, 0.45; 0.81, 0.43. USNM 194299B, 0.83, 0.40. USNM 194450D,E, 2 specimens: 0.83, 0.43; 0.81, 0.44. Length range (N = 13) 0.81–0.95 mm. Average length 0.95 mm.

Appendages: Not examined in detail but, in general, similar to those of adult female.

Bellonci Organ: Similar to that of adults.

Furca: Similar to that of A–1 male.

Genitalia: None observed.

REMARKS.—Most specimens were examined through the left valves, and it likely that some vestigial male genitalia may have been obscured resulting in their misidentification as females.

DESCRIPTION OF A–2 INSTAR (INSTAR V?) (sex unknown) (Figures 25*f–h*, 28).—Carapace shape and ornamentation (not shown) similar to that of adults (Figure 25*f,g*).

Carapace Size (length, height in mm) (Figure 28): Norman's Pond Cave: USNM 194275, 0.78, 0.39. USNM 194296H, 0.78, 0.42. USNM 194325D, 0.75, 0.40. USNM 194434B, 3 specimens: 0.76, 0.42; 0.75, 0.39; 0.75, 0.43.

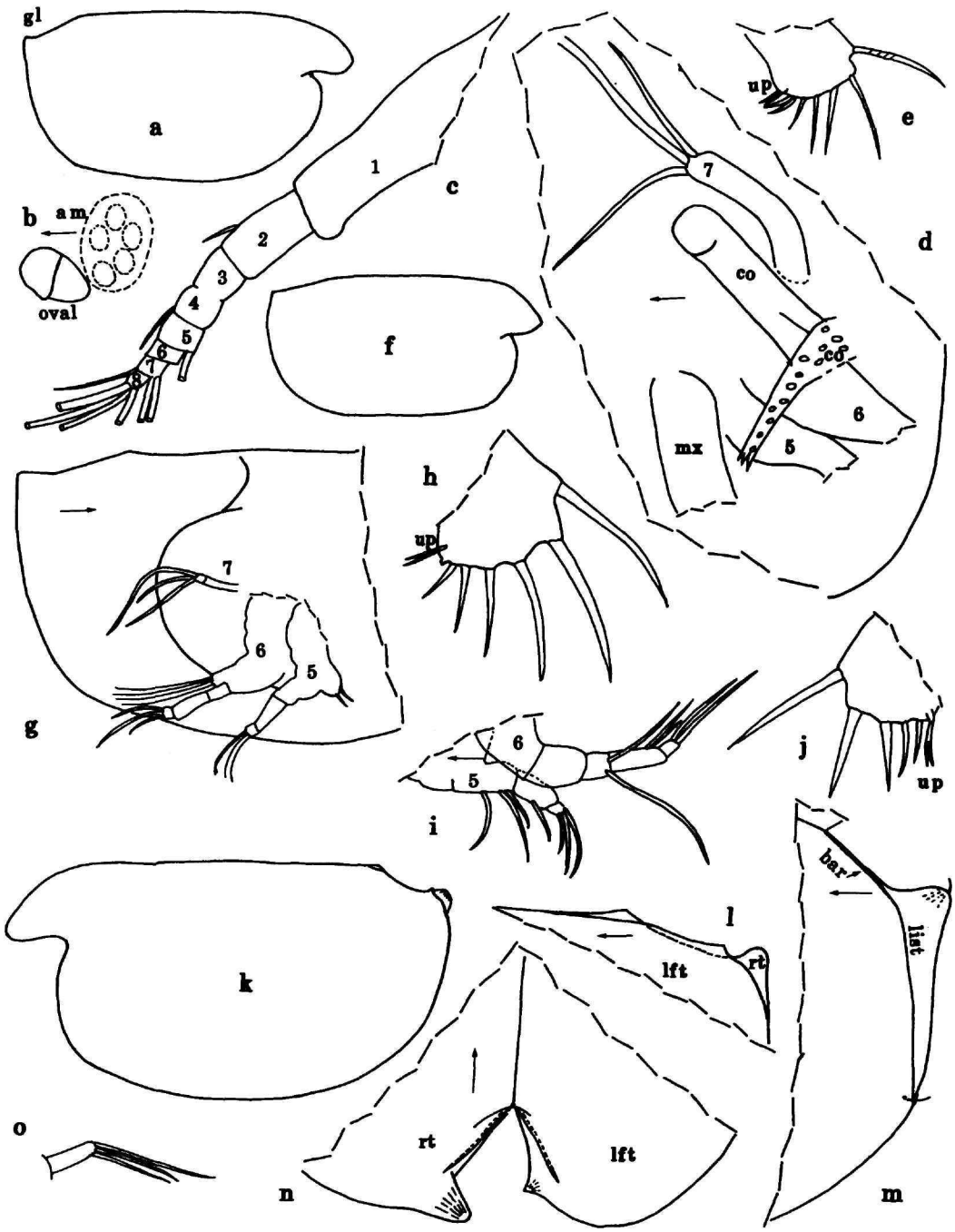


FIGURE 25.—*Spelaeoecia styx* Kornicker, 1990, USNM 194273, Instar A–1 male (Instar VI?): *a*, complete specimen from right side, length 0.93 mm; *b*, mandibular oval and central adductor muscle attachments left valve, ov; *c*, right 1st antenna, mv; *d*, part of posterior of body from left side; *e*, right lamella of furca, lv. USNM 194275, Instar A–2 (Instar V?) (sex unknown): *f*, complete specimen from right side, length 0.78 mm; *g*, right posterior limbs as seen through right valve (nabs); *h*, right lamella of furca. USNM 194274, Instar A–3 (Instar IV?) (sex unknown), length 0.62 mm: *i*, left 5th and 6th limbs as seen through shell (nabs), lv; *j*, left lamella of furca. USNM 194285, Instar A–3 (Instar IV?) (sex unknown): *k*, complete specimen from left side, length 0.56 mm; *l*, detail from *k*; *m*, posterior right valve, iv; *n*, posterior end of valves (valves not entirely flat), iv; *o*, left 7th limb, lv.

USNM 194434C, 3 specimens: 0.78, 0.42; 0.75, 0.42; 0.78, 0.43. Oven Rock Cave: USNM 194297E, 0.65, 0.36. USNM 194450F, 0.69, 0.37. Length range (N = 11) 0.65–0.78 mm. Average length 0.75 mm.

Appendages: Not examined in detail but all well developed (Figure 25*g*).

Furca (Figure 25*h*): Each lamella with 6 claws followed by small triangular process (incipient 7th claw).

Genitalia: None observed on USNM 194275; small lobe on USNM 194325D.

DESCRIPTION OF A–3 INSTAR (INSTAR IV?) (sex unknown) (Figures 25*i–o*, 28).—Carapace shape and ornamentation similar to that of adults (Figures 25*k–n*, 26*a,b*, 27*k,l*).

Carapace Size (length, height in mm) (Figure 28): Norman's Pond Cave: USNM 194274, 0.62, 0.34. USNM 194285, 0.56, 0.3. USNM 194295A,B, 2 specimens: 0.58, 0.32; 0.62, 0.37. USNM 194296J,K, 2 specimens: 0.61, 0.33; 0.62, 0.33. USNM 194434B, 2 specimens: 0.62, 0.35; 0.60, 0.32. Oven Rock Cave: USNM 194278, 0.58, 0.33. Length range (N = 9) 0.56–0.62 mm. Average length 0.60 mm.

First Antenna (Figure 26*c,d*): 2nd and 4th joint each with short weakly developed dorsal bristle. Sensory bristle of 5th joint short, just reaching past 8th joint. b-bristle of 7th joint very short. Limb otherwise similar to that of adult.

Second Antenna: Protopodite similar to that of adult. Exopodite (Figure 26*g*): bristle of 1st joint reaching 6th joint, with ventral spines; 9th joint with 3 bristles (spines not observed on bristles); branch otherwise similar to that of adult. Endopodite (Figure 26*e,f*): 1st joint with only 1 dorsal bristle; 2nd and 3rd joints similar to those of adult female.

Mandible (Figure 26*h*), *Maxilla* (Figure 26*i*), *Fifth Limb* (Figures 25*i*, 26*j*), *Sixth Limb* (Figures 25*i*, 26*k*), *Seventh Limb* (Figures 25*o*, 26*l*), *Bellonci Organ* (Figure 26*c,d*), *and Anterior of Body and Lips* (Figure 26*d*): Not examined in detail but all well developed. Limbs similar to those of adult but many with fewer bristles.

Furca (Figures 25*j*, 26*l,m*): Each lamella with 5 claws followed by indistinct minute triangular process (incipient 6th claw). Unpaired bristle bifurcate.

Genitalia: Absent.

DESCRIPTION OF A–4 INSTAR (INSTAR III?) (sex unknown) (Figures 27*a–d*, 28).—Carapace similar to that of adult (Figure 27*a,d*).

Carapace Size (length, height in mm) (Figure 28): Norman's Pond Cave: USNM 194272, 0.50, 0.28. USNM 194295C, 0.51, 0.29. USNM 194327, 2 specimens: 0.50, 0.29; 0.52, 0.29. USNM 194434A, 2 specimens: 0.50, 0.28; 0.52, 0.31. Length range (N = 6) 0.50–0.52 mm. Average length 0.51 mm.

Fifth and Sixth Limbs: Both well developed, but 6th limb not extending posteriorly past 5th limb (Figure 27*b*).

Seventh Limb: Absent.

Furca (Figure 27*c*): Each lamella with 4 claws followed by small triangular process (incipient 5th claw).

Genitalia: Absent.

DESCRIPTION OF A–5 INSTAR (INSTAR II?) (sex unknown) (Figures 27*e–j*, 28).—Carapace and ornamentation similar to that of adult (Figure 27*f,g*).

Carapace Size (length, height in mm) (Figure 28): Norman's Pond Cave: USNM 194271, 0.42 mm, 0.24 mm. USNM 194434A, 2 specimens: 0.42, 0.24; 0.44, 0.24. Oven Rock Cave: USNM 194277, 0.39, 0.25. USNM 194415, 0.41, 0.23. Length range (N = 5) 0.39–0.44 mm. Average length 0.42 mm.

Appendages (Figure 27*h,i*): 6th and 7th limbs absent, other appendages well developed but with fewer bristles than on adult.

Furca (Figure 27*e,j*): Each lamella with 3 claws followed by indistinct minute triangular process (incipient 4th claw).

Genitalia: Absent.

COMPARISONS.—Except for being reticulate, the carapaces of the Exuma specimens are similar to those from South Andros Island (Kornicker et al., 1990:6). In many specimens of the former, the reticulations are no longer visible after having been preserved in glycerin for several weeks. It is quite possible that when alive, before being kept in glycerine, the carapaces of specimens from South Andros Island, which have remnants of striations (Kornicker et al., 1990:6), were also reticulate, but to be certain fresh collections from South Andros Island should be studied. The appendages of the Exuma specimens mainly differ from those of types as follows: (1) the tip of the male copulatory organs of the Exuma specimens are fairly similar to that of the types but may have fewer teeth on the middle prong of the anterior branches; (2) the dorsal bristle of the 2nd joint of the 1st antenna of the Exuma specimens is well defined and reaches the 3rd joint, whereas that bristle on the types is much smaller and more indistinct. It is possible that further studies will show the specimens from Exuma Cays and South Andros Island not to be conspecific, but at this time the differences seem too few to warrant proposal of a new species for the Exuma specimens.

Specimens from Oven Rock Cave appear to be smaller than those from Norman's Pond Cave (Table 4). The dimensions of those from Oven Rock Cave are closer to the types from South Andros Island (types: adult male length 0.98 mm, ?adult female length 0.82 mm).

ONTOGENY.—It is estimated that the present collection of *S. styx* comprises adults and instars A–1 to A–5 (instars II–VI based on the premise that members of the genus have six juvenile stages). The 5th limb with bristles is present in instar II. The 6th limb with bristles is present in instar III, but it does not extend posteriorly past the 5th limb. The 7th limb with bristles is present in instar IV, and the 6th limb of instar IV extends posteriorly well past the 5th limb. A reduced male copulatory organ is present in instar VI. No instar V males were identified with certainty, but USNM 194326 has a small bare lobe that might represent a copulatory organ.

The furca of instar II has three stout claws on each lamella (the missing instar I probably has two furcal claws). One additional claw is added at each stage until seven is reached on instar VI (A–1 instar), the same number as on the adult. The

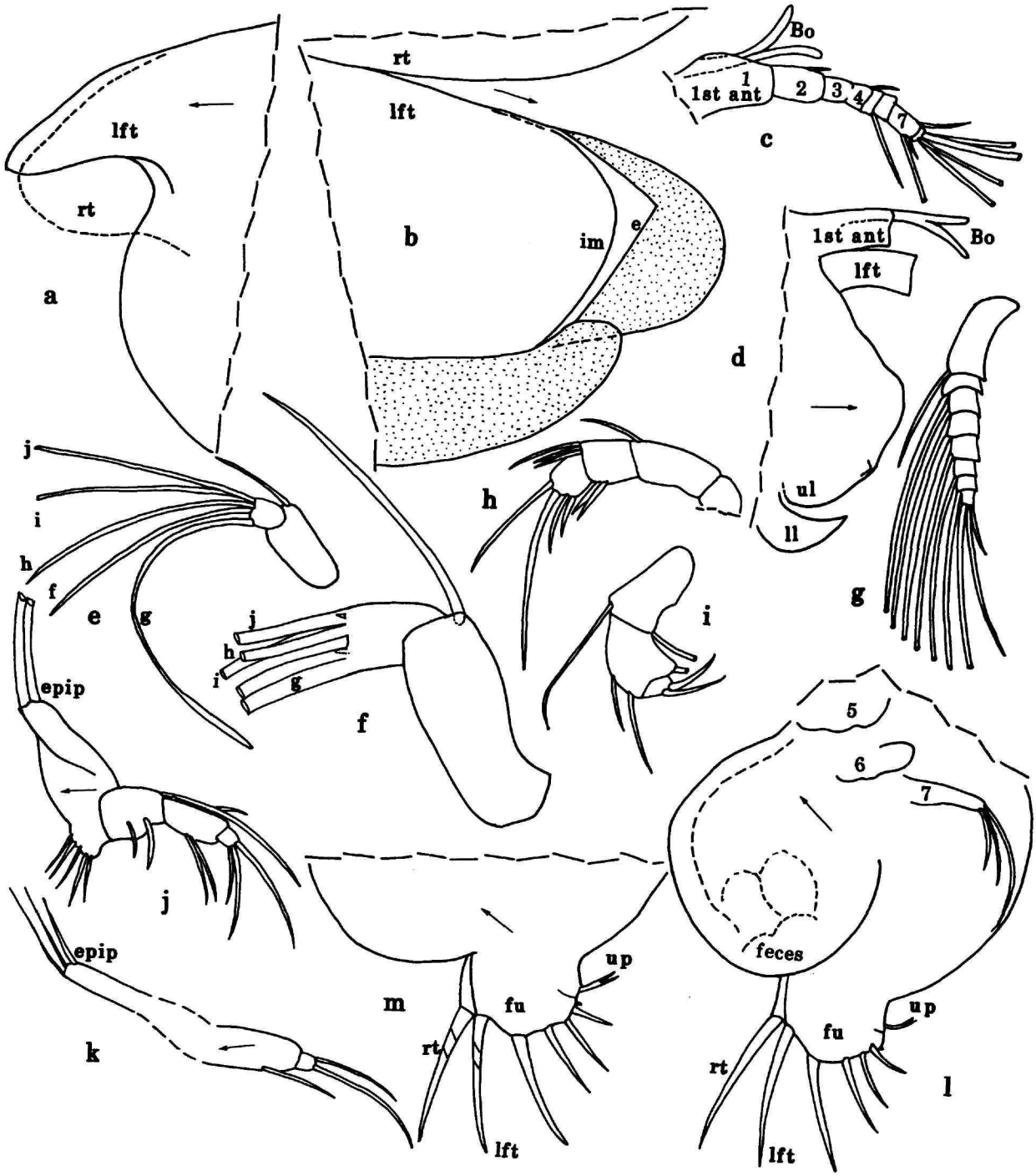


FIGURE 26.— *Spelaeoecia styx* Kornicker, 1990, USNM 194285, Instar A–3 (Instar IV?) (sex unknown), length 0.56 mm: *a*, anterior of both valves from left side; *b*, anterior left valve (not completely flat), iv; *c*, Bellonci organ and right 1st antenna, lv; *d*, anterior of body from right side; *e*, endopodite left 2nd antenna, lv; *f*, endopodite right 2nd antenna, mv; *g*, exopodite left 2nd antenna, lv; *h*, endopodite left mandible, lv; *i*, left maxilla (nabs), lv; *j*, left 6th limb (nabs), lv; *k*, left 6th limb (nabs), lv; *l*, posterior of body from left side (only bases of epipodites of 5th and 6th limbs shown) (feces appears partly squeezed out of anus); *m*, detail from *l*.

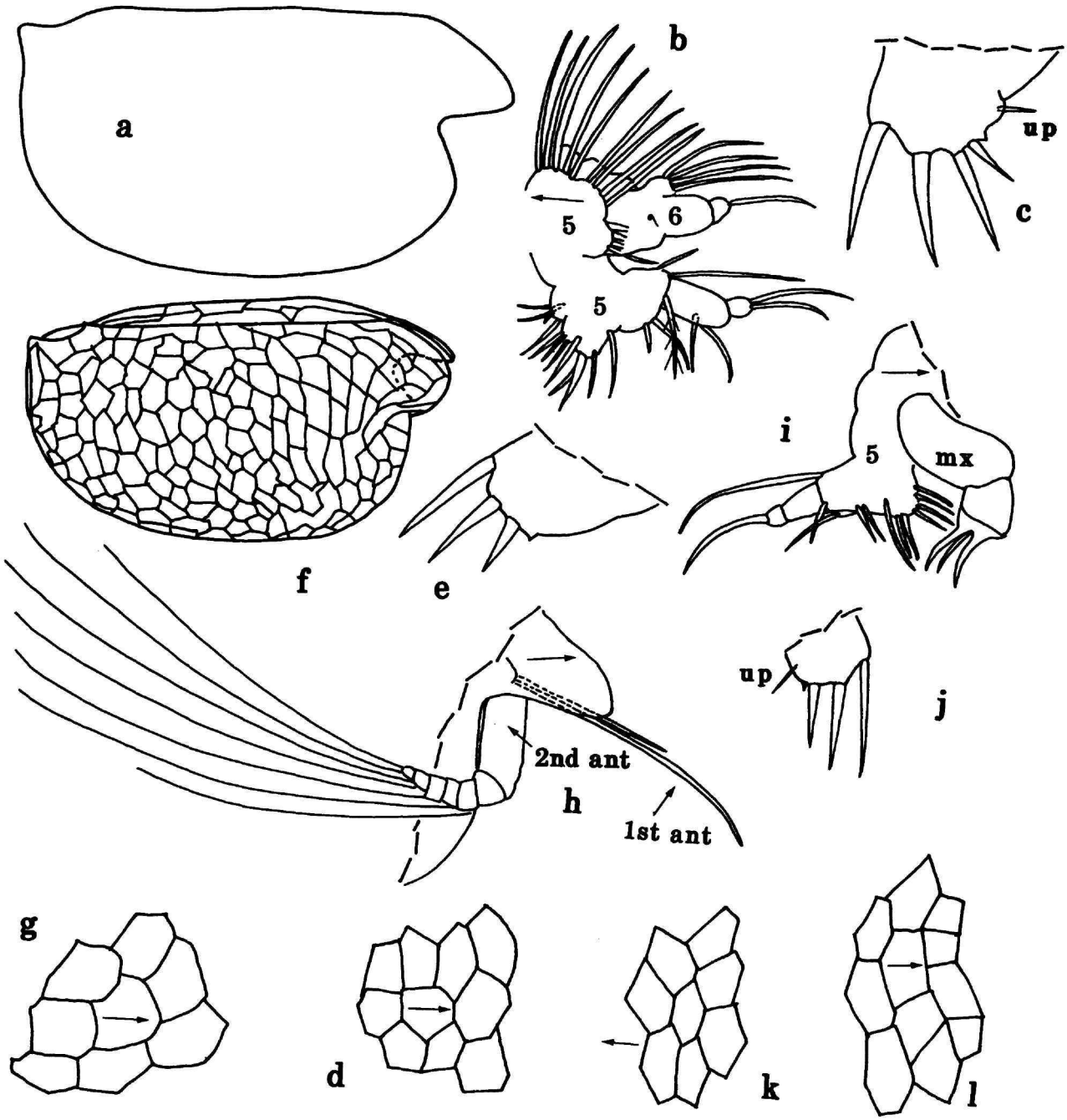


FIGURE 27.—*Spelaeoecia styx* Komicker, 1990, USNM 194272, Instar A–4 (Instar III?) (sex unknown): *a*, complete specimen from right side, length 0.50 mm; *b*, left 5th and 6th limbs as seen through left valve, lv; *c*, left lamella of furca; *d*, detail of reticulations right valve, ov. *e*, USNM 194277, Instar A–5 (Instar II?) (sex unknown), length 0.39 mm, left lamella of furca. USNM 194271, Instar A–5 (Instar II?) (sex unknown): *f*, complete specimen from right side, length 0.42 mm; *g*, detail of reticulations right valve, ov; *h*, anterior of specimen from right side (nabs); *i*, right maxilla and 5th limb (6th limb absent), lv; *j*, right lamella of furca. *k*, USNM 194274, Instar A–3 (Instar IV?), length 0.62 mm, detail of reticulations left valve, ov. *l*, USNM 194275, Instar A–2 (Instar V?), length 0.78 mm, detail of reticulations right valve, ov. (*g,d,k,l* drawn at same magnification.)

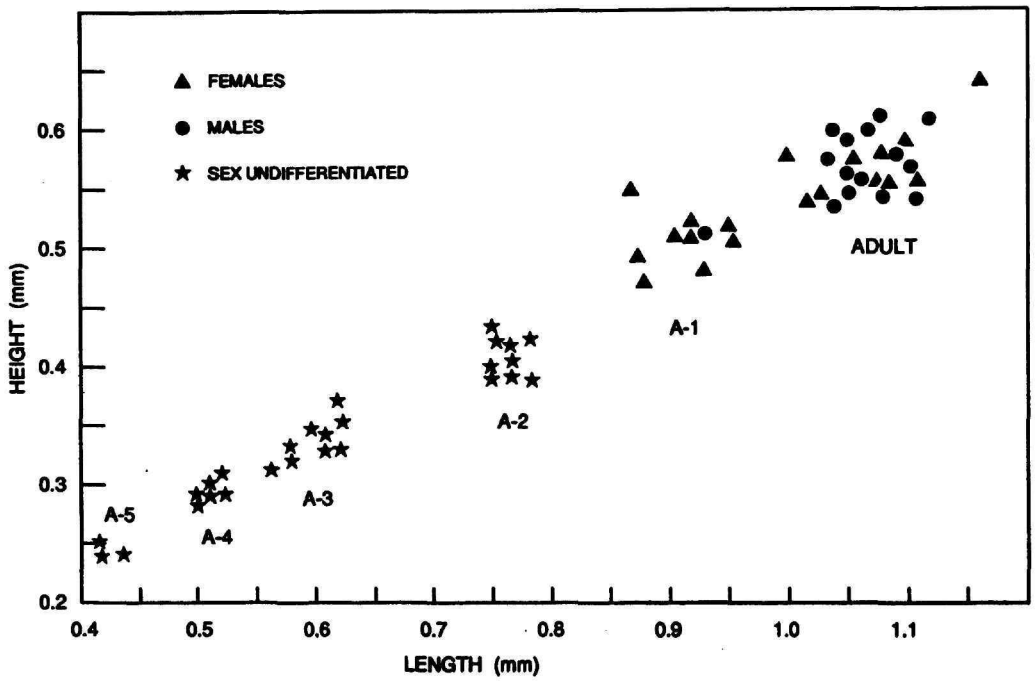


FIGURE 28.—Length-height distribution of growth stages of *Spelaeoecia styx* (only specimens from Norman's Pond Cave included in graph).

lamellae of instars II–V have a small triangular process following the claws, which is tentatively interpreted as being an incipient claw that becomes a full claw in the following instar. A triangular process is absent on instar VI and adults.

The average growth factors for lengths of shells at each growth stage of specimens from Norman's Pond Cave are shown in Table 5. The growth factor between stages of *S. styx* ranges from 1.18 to 1.27 (average 1.20), which are lower than growth factors of shell length of *S. capax* from Oven Rock Cave studied herein, which range from 1.33 to 1.41 (average 1.37) (Table 3). Perhaps the higher growth factors for *S. capax* are a function of its carapace being much longer than those of *S. styx* at the same stage of development, but that hypothesis requires further testing with other species.

The total number of juvenile instars in species of *Spelaeoecia* is not known with certainty because the earliest stages may not have been collected. Angel and Iliffe (1987:549) reported five stages of *S. bermudensis,* which they interpreted to be the adult to A–4 instars. Six stages of *S. styx* are described above (adult to A–5 instar). The A–5 instar has a well-developed 5th limb, which indicates that at least one earlier instar with an undeveloped 5th limb is missing from the collection. Thus, it is hypothesized that *Spelaeoecia* has six juvenile stages. Although data are few, it suggests that the 7th

TABLE 4.—Comparison of carapace lengths of specimens of *Spelaeoecia styx* collected in Norman's Pond Cave and Oven Rock Cave, Exuma Cays.

Stage	Norman's Pond Cave		Oven Rock Cave	
	Length (mm)	No. of specimens	Length (mm)	No. of specimens
Adult male	1.04–1.12	14	0.95	2
Adult female	1.00–1.16	13	0.95–0.97	4
A–1 male	0.93	1	0.81–0.87	3
A–1 female	0.87–0.95	9	0.81–0.85	5
A–2 sex?	0.75–0.78	9	0.65–0.69	2
A–3 sex?	0.56–0.62	8	0.58	1
A–4 sex?	0.50–0.52	6	no data	0
A–5 sex?	0.42–0.44	3	0.39–0.41	2

TABLE 5.—Growth factors for shell length between stages of specimens of *Spelaeoecia styx* from Norman's Pond Cave, Exuma Cays. Males and females are combined.

Stage	Number of specimens	Average length (mm)	Growth factor
Adults	24	1.07	
			1.18
A–1	10	0.91	
			1.20
A–2	9	0.76	
			1.27
A–3	9	0.60	
			1.18
A–4	6	0.51	
			1.19
A–5	3	0.43	
Avg. growth factor			1.20

limb with bristles is first present on the A–3 instar (instar IV based on premise of six juvenile stages for species of genus). Table 6 lists the instar in which bristles first appear on the 7th limbs of selected species of Halocypridina and Myodocopina.

Ikeda (1992:313) raised specimens of *Conchoecia pseudodiscophora* in the laboratory and interpreted the data to imply that the species has seven juvenile stages plus one adult stage (Table 6). Both instar I and instar II of that species have quite similar appendages (e.g., two claws on the furca), so it may be difficult to separate those two stages in a collection from the sea. Kornicker and Iliffe (1989b:42) estimated that a collection of *Euconchoecia bifurcata pax* from a marine cave has six juvenile stages and described them (Table 6). However, one specimen interpreted to be a 1st instar (USNM 193308J), having a length of 0.29 mm, has only one terminal bristle on the 1st antenna, whereas, another 1st instar (USNM 193308L), having a length of 0.34 mm, appears to have several indistinct

TABLE 6.—First appearance of bristles on 7th limbs of selected species of Halocypridina and Myodocopina. (A = no 7th limb or, if present, without bristles; P = 7th limb with bristles; nd = no data; – = stage interpreted to be absent in species.)

Species	Instar A–7	A–6	A–5	A–4	A–3	A–2	A–1
				HALOCYPRIDINA			
Spelaeoecia capax	nd	nd	nd	nd	P	P	P
Spelaeoeca exleyi	nd	nd	A	A	P	P	P
Spelaeoecia cubensis	nd	nd	nd	A	nd	nd	P
Spelaeoecia sagax	nd	nd	nd	nd	nd	P	P
Spelaeoecia barri	nd	nd	nd	A	A–P	P	P
Conchoecia pseudodiscophora	A	A	A	P?*	P	P	P
Euconchoecia bifurcata pax	–	A	A	A	A	P	P
Euconchoecia elongata	–	A	A	A	A	P	P
Thaumatoconcha radiata	–	A	A	A	P	P	P
Danielopolina bahamensis	–	–	–	A	A	A	nd
Danielopolina wilkensi	–	A	A	A	nd	nd	P
				MYODOCOPINA			
Euphilomedes nipponica	–	–	A	A	A	P	P
Philomedes globosus	–	–	A	A	A	P	P
Pseudophilomedes kylix	–	–	–	A	nd	A	nd
Cypridina spina	–	–	nd	A	A	P	P
Cypridina spinula	–	–	nd	A	A	P	P
Skogsbergia lerneri	–	–	A	A	A	P	P
Skogsbergia galapagensis	–	–	A	A	A	P	P
Doloria pectinata	–	–	A	A	A	P	P
Vargula hilgendorfii	–	–	A	A	A	P	P
Eusarsiella misakiensis	–	–	–	A	A	A	P
Eusarsiella disparalis	–	–	–	nd	A	A	P
Eusarsiella zostericola	–	–	–	nd	A	A	P
Spinacopia sandersi	–	–	–	A	A	A	P
Amboleberis americana	–	A	A	A	P	P	P
Cycloleberis christiei	–	A	A	A	P	P	P
Leuroleberis sharpei	–	A	A	A	P	P	P
Asteropteron fuscum	–	–	–	A	A	A	P
Bathyleberis yamadai	–	–	A	A	A	P	P
Azygocypridina imperialis	–	–	A	A	A	P	P

* 7th limb present but whether or not it has bristles is not stated in Ikeda (1992).

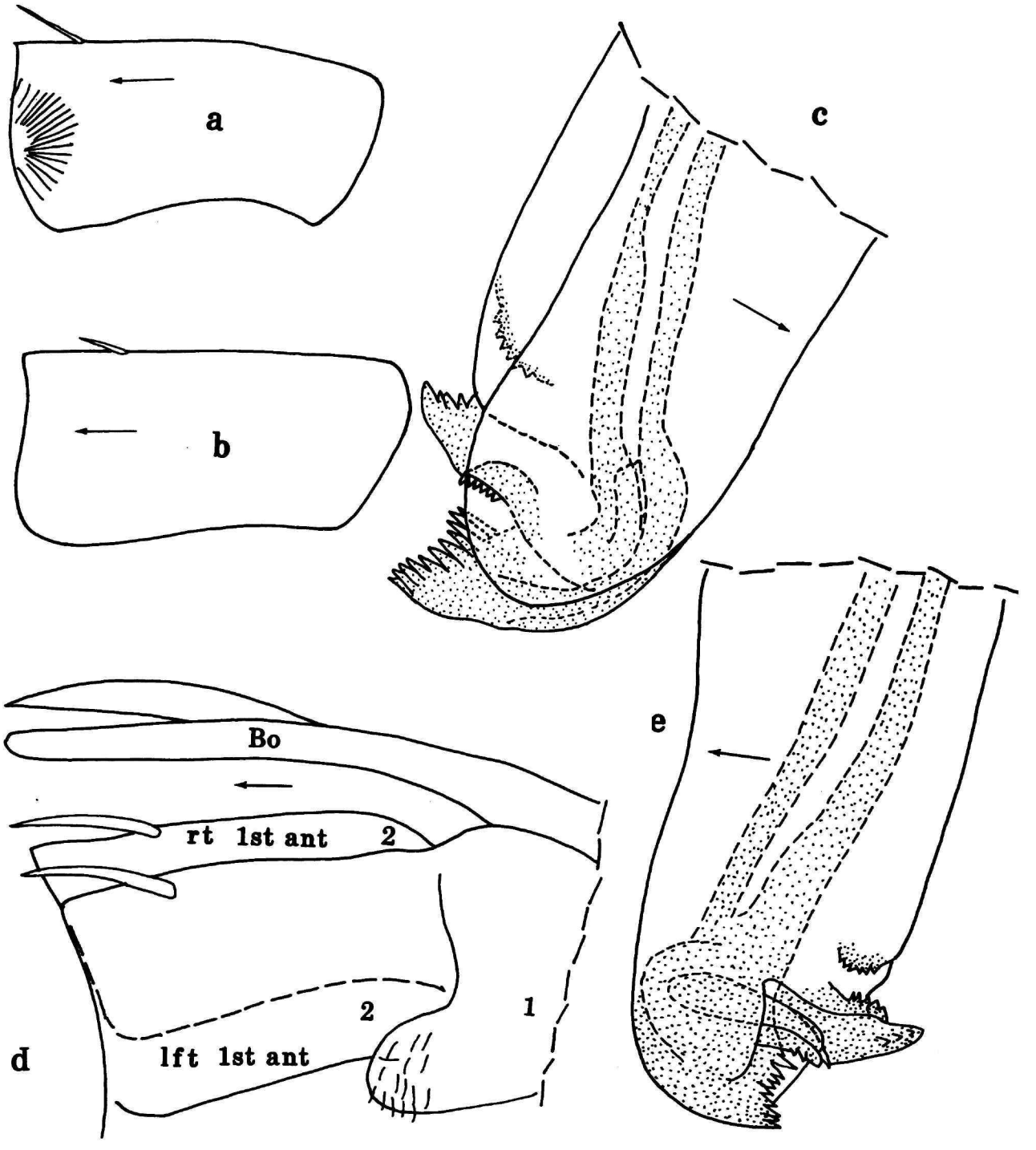


FIGURE 29.—*Spelaeoecia styx* Kornicker, 1990, paratype, USNM 193440, adult male, length 0.98 mm: *a,b,* 2nd joints of right (mv) and left (lv) 1st antennae, respectively; *c,* tip of anterior branch of copulatory organ. USNM 194297A, adult male, length 0.95 mm: *d,* part of anterior of body from left side; *e,* tip of anterior branch of copulatory organ.

TABLE 7.—Distribution of instars and adults of *Spelaeoecia styx* from Norman's Pond and Oven Rock caves, Exuma Cays, and *S. bermudensis* Angel and Iliffe, 1987, from Bermudian caves (Angel and Iliffe, 1987:549). All collections were during the month of May except for collections from Bermuda, which occurred over many months.

Stage	*S. styx*										*S. bermudensis*
	Norman's Pond Cave					Oven Rock Cave					Bermuda
	Sta 93-001 6–10 m	Sta 93-002 10–25 m	Sta 93-003 15–35 m	Sta 93-004 6 m	Sta 94-016 10–18 m	Sta 93-006 0–1 m	Sta 93-008 3–15 m	Sta 93-009 8 m	Sta 94-014 15–20 m	Sta 95-012 1–22 m	Many 0–20 m
Adult female	1	3	2	0	7	0	1	1	0	2	36
Adult male	0	4	3	0	7	1	0	0	0	1	1
A–1 instar	0	4	1	0	5	3	0	1	1	3	27
A–2 instar	0	2	1	0	6	1	0	0	0	1	2
A–3 instar	2	3	0	1	2	1	0	0	0	0	5
A–4 instar	1	1	2	0	2	0	0	0	0	0	1
A–5 instar	0	1	0	0	2	0	0	1	1	0	0

terminal bristles; both specimens have two furcal claws. It is possible that the smaller specimen is the 1st instar and the larger specimen the 2nd instar. With that interpretation the species has seven juvenile instars, the same number found by Ikeda (1992) for *C. pseudodiscophora*. Tseng (1975) raised *Euconchoecia elongata* in the laboratory and interpreted the species to have six juvenile stages and two adult stages, which he termed "Small Adult" and "Large Adult." Kornicker and Iliffe (1989b:44) thought that the "Small Adults" might be comprised partly of A–1 juveniles and partly of adults, and they suggested that the species has six juvenile instars and one adult stage (Table 6), but this is not known with certainty; another possibility is that the "Small Adults" are actually A–1 instars, which would result in seven juvenile instars plus one adult stage.

SAMPLE COMPOSITION.—The distribution of adults and instars of *S. styx* in ten samples from Norman's Pond Cave and Oven Rock Caves combined are compared with that of *S. bermudensis* Angel and Iliffe, 1987, reported from Bermudian Caves (Angel and Iliffe, 1987:549) in Table 7. The striking difference is the nearly equal number of adult males to adult females (16 M : 17 F) for the combined ten samples. The ratio of adult males to adult females in the five combined samples of *S. capax* from Oven Rock Cave is also low (15 M : 19 F). The reason for the samples of the Bermudian species having only one male is puzzling and warrants further investigation.

CORRECTION OF ORIGINAL DESCRIPTION OF *S. styx*.—Reexamination of the right mandible of a male paratype (USNM 193440) revealed that the 3rd endopodial joint has five terminal bristles in the ventral group rather than four as on the left limb, which is probably an aberrancy or could be attributed to intraspecific variability. Not all bristles in the terminal ventral group of the 3rd endopodial joint are medial on either the left or right mandibles of USNM 193440 as described by Kornicker in Kornicker et al. (1990:18), at least one is lateral. Kornicker in Kornicker et al. (1990:8) described the 5th limb of the male *S. styx* as having three bare bristles on the 3rd endopodial joint but illustrated a limb with minute spines on the longest bristle (fig. 5*a*); reexamination of the limb showed the illustration to be correct.

Spelaeoecia mayan, new species

FIGURES 30–36

ETYMOLOGY.—From the name of the cenote (Maya Blue Cenote) containing the species (noun in apposition).

HOLOTYPE.—USNM 194322, undissected adult male in alcohol.

TYPE LOCALITY.—Sta 94-001, Maya Blue Cenote, Tulum, Quintana Roo, Mexico, from water column in 17–21 m depths, salinity 35 ppt.

PARATYPES.—Sta 93-040: USNM 194268, adult female on slide and in alcohol. Sta 94-001: USNM 194321, adult male on slide and in alcohol. Sta 94-024: USNM 194405, 3 undissected adult females in alcohol.

DISTRIBUTION.—Maya Blue Cenote, Tulum, Quintana Roo, Mexico.

DESCRIPTION OF ADULT FEMALE (Figures 30–33).—Carapace uncalcified, flexible, elongate, dorsal margin straight and slightly lower near posterior end, ventral margin convex, anteroventral and posteroventral margins evenly rounded (Figure 30*a*); anterior incisur dorsal to midheight (Figure 30*a*); anterior of valve viewed from inside with edge of valve forming convex, evenly rounded rostrum (Figure 30*f*); anterior outer part of valve overreaching rostrum to form broadly rounded extension of rostrum (Figure 30*e,f*). Posterodorsal corner of right valve with small glandular-bearing protuberance (Figure 30*a,c,g*).

Ornamentation: Surface with few long single bristles. Surface of preserved holotype mostly smooth but remnants of vertical lineations visible in vicinity of central adductor muscle attachments of right valve (Figure 30*d*). Edge of valve with small bristle between each pair of glandular tubes (Figure 30*b*).

Infold: Broad infold except along hinge (Figure 30*a,f,g*). List extending from posterodorsal corner of valve to posterior

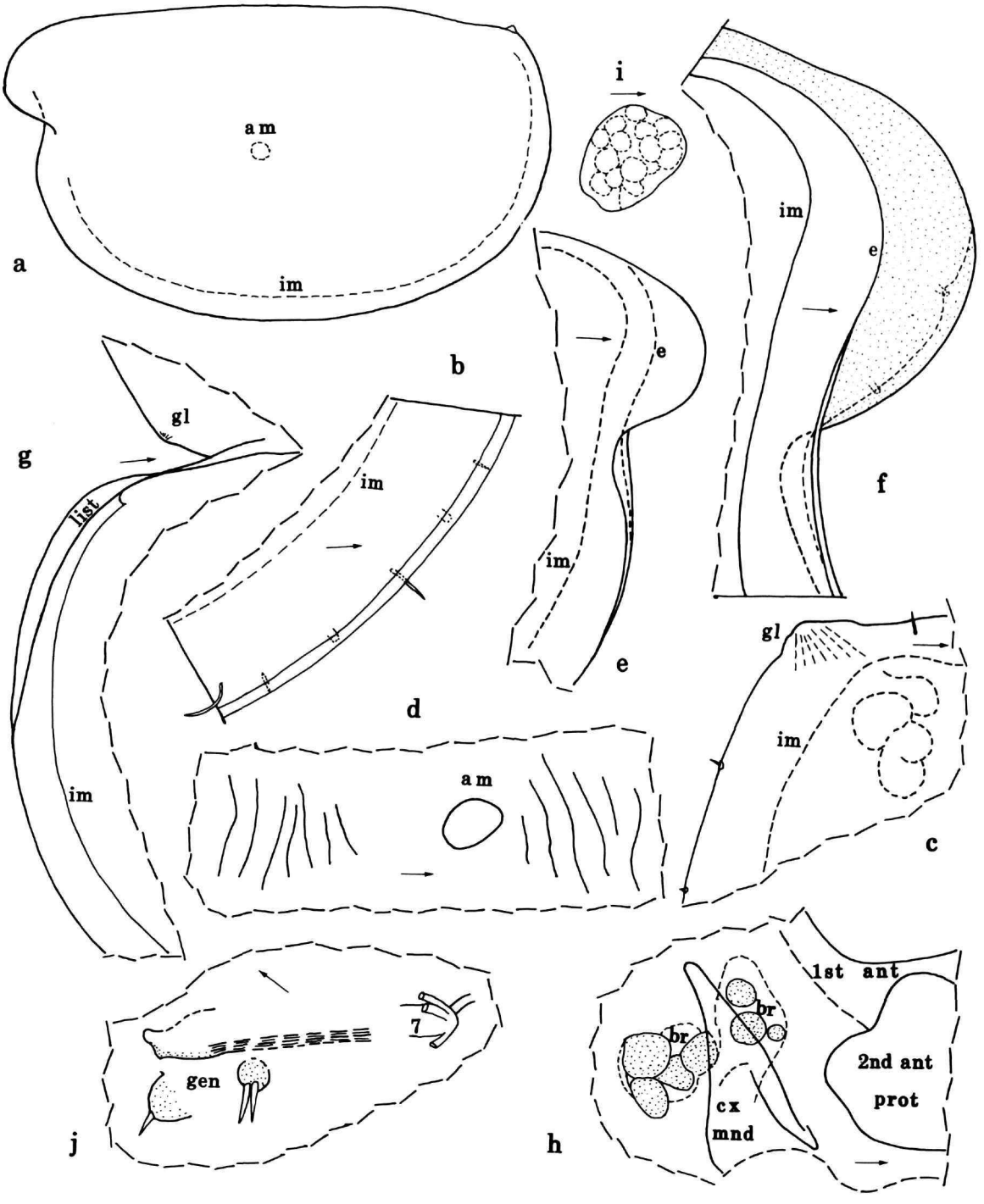


FIGURE 30.—*Spelaeoecia mayan,* new species, paratype, USNM 194268, adult female: *a,* complete specimen from left side, length 1.30 mm; *b,* anteroventral corner right valve, ov; *c,* posterodorsal corner right valve, ov; *d,* area of central adductor muscle attachments (oval) and lineations on right valve, ov; *e,* anterior right valve, ov; *f,* anterior left valve, iv; *g,* posterior of left valve and posterodorsal corner of right valve, iv; *h,* part of body from right side; *i,* central adductor muscle attachments right valve, ov; *j,* genitalia and 7th limb on left side of body, lv.

valve edge at about midheight (Figure 30*g*); ventral list absent.

Glands: Posterodorsal corner of right valve with slight protuberance bearing minute glandular openings (Figure 30*a,c,g*). Outer edge of infold with minute tube-like glandular openings (Figure 30*b*); 2 tube-like glandular openings near anterior edge of rostrum (Figure 30*f*).

Central Adductor Muscle Attachments (Figure 30*a,d*): Indistinct compact group of individual round attachments difficult to resolve.

Carapace Size (length, height in mm): USNM 194268, 1.30, 0.79. USNM 194405, 3 specimens: 1.28, 0.73; 1.46, 0.85; 1.35, 0.87. Length range (N = 4) 1.28–1.46 mm. Average length 1.35 mm.

First Antenna (Figure 31*a–f*): 1st joint with terminal ventral lobe with numerous short spines. 2nd joint with distinct dorsal bristle and typical distal medial spinules. 3rd and 4th joints fused except at ventral and distal corners; 3rd joint about 1/2 length of 2nd joint and about twice length of 4th joint, with 1 ventral bristle. 4th joint with 2 or 3 short terminal bristles (1 or 2 ventral, 1 dorsal). 5th joint with long ventral filament with terminal papilla. 6th joint bare. 7th joint with short dorsal a-bristle, and long ventral b-bristle shorter than c-bristle. 8th joint small with 4 terminal bristles (lateral d-bristle almost twice length of a-bristle; long lateral e-bristle about same length as c-bristle and with indistinct proximal rings; medial f-bristle about 2/3 length of e-bristle and oriented ventrally; lateral g-bristle slightly longer than f-bristle; all bristles filament-like with terminal papilla).

Second Antenna: Protopodite bare with few distal sclerites (Figures 30*h*, 31*f,g*). Endopodite 3-jointed but 2nd and 3rd joints fused (Figure 31*g–j*): 1st joint with b-bristle about twice length of a-bristle, both with short spines; 2nd joint with small medial c-bristle near base of i-bristle, filament-like f-bristle and longer stouter filament-like g-bristle (each with terminal papilla), and 1 minute lateral bristle at base of f-bristle; 3rd joint with h-, i-, and j-bristles, each filament-like with terminal papilla and more than 1/2 length of g-bristle. Exopodite with 9 joints: 1st joint divided into long proximal and short distal parts with separating suture only on medial side; bristles of joints 1 and 2 long, with ventral spines and natatory hairs; bristles of joints 3–7 with natatory hairs, no spines; bristle of joint 8 with long slender dorsal spines and natatory hairs; 9th joint small with 4 bristles with short dorsal spines (longest bristle ventral and with natatory hairs); all long bristles with few long proximal segments followed by closely spaced rings.

Mandible: Coxale endite with proximal and distal sets of teeth separated by gap (Figure 32*a–c*): proximal set comprising 4 broad cusps plus small distal posterior triangular tooth; surface between cusps and just proximal to cusps with slender spines; a minute indistinct spinous bristle on anterior and posterior ends of cusps; 2 spinous and dentate bristles adjacent to posterior triangular tooth. Distal set of teeth comprising 2 flat teeth (distal flat tooth with 6 cusps (Figure 32*c*); proximal with 9 cusps (Figure 32*b*)); 1 stout curved spinous process and 1 small indistinct bristle proximal to flat teeth (Figure 32*b*). Basale (Figure 32*d–g*): distal edge with 6 terminal triangular cusps and 1 sharper triangular anterior tooth; lateral surface near distal edge with sharp tooth near midwidth; lateral surface distal to midlength with 5 bristles on left limb of USNM 194268 (Figure 32*d*) and 7 on right (Figure 32*f*) (difference between left and right limbs unusual); anterior margin with 1 long bristle distal to midlength; posterior margin hirsute, with 2 short ringed distal bristles (proximal with pointed tip, distal tubular). Proximal medial surface of basale with transparent plumose bristle, a transparent plumose bristle closer to dorsal margin, and 1 short bristle near endopodite; lateral surface near insertion of endopodite with 1 long bristle (bristle may have few minute marginal spines). Endopodite (Figure 32*d,g*): 1st joint with 3 distal bristles (1 long dorsal, 1 long medial, 1 short ventral); 2nd joint with 3 dorsal bristles (1 unringed claw-like, 2 shorter ringed), and 1 long ringed subterminal ventral bristle; 3rd joint with 2 long unringed spinous claw-like bristles, 4 short ringed bristles forming medial row along distal edge, and 1 slightly longer ringed spinous bristle on terminal lateral edge; anterior margin and medial surface of 3rd joint hirsute. (Rings not shown on all bristles.)

Maxilla (Figure 32*h–j*): Endite I with 2 proximal and 13 terminal bristles (4 tubular); endite II with 2 proximal and 8 terminal bristles (4 tubular); endite III with 1 proximal and 6 terminal bristles (2 tubular, 3 claw-like) (Figure 32*h*). Coxale and basale fused; coxale with stout plumose dorsal bristle (Figure 32*i*); basale with long spinous ventral bristle (Figure 32*j*). Endopodite: 1st joint with 7 proximal bristles, 1 or no distal anterior bristle, and 5 distal bristles closer to posterior margin (Figure 32*i,j*); 2nd joint hirsute with 2 stout claws and 4 slender ringed bristles.

Fifth Limb: Epipodite with plumose bristles forming 3 groups (ventral group with 5 long bristles, middle group with 6 long bristles, dorsal group with 4 long and 1 short bristle) (Figure 33*c*). Protopodite with medial spines and hairs and 2 ventral endites (Figure 33*a*): endite I with 3 ventral bristles (1 with long spines, 1 with short spines, 1 shorter tubular with long hairs); endite II with 4 bristles (1 long ventral with long spines, 3 medial (2 tubular) bare or with short spines). Basale with medial spines and hairs, 1 long anterior bristle with long spines, 1 short proximal medial bristle, and 5 ventral bristles (2 unringed claw-like (1 very small), 2 tubular with short spines, 1 long with long spines). Endopodite with 10 bristles (1 short ringed medial proximal, 2 claw-like unringed ventral, 2 long ringed anterolateral with long spines, 3 (2 short) ringed tubular either bare or with short spines, 1 long ringed with short spines, 1 minute tooth-like medial near base of stout claw). Exopodite: 1st joint: dorsal margin with 1 long bare subterminal bristle (broken on illustrated limb) and 2 plumose bristles; ventral margin divided into broad proximal and more slender distal parts: proximal part with 3 slender ventral bristles bare or with short spines (2 shorter bristles may be tubular), 1 plumose lateral bristle near midwidth); distal part with 3 bristles near

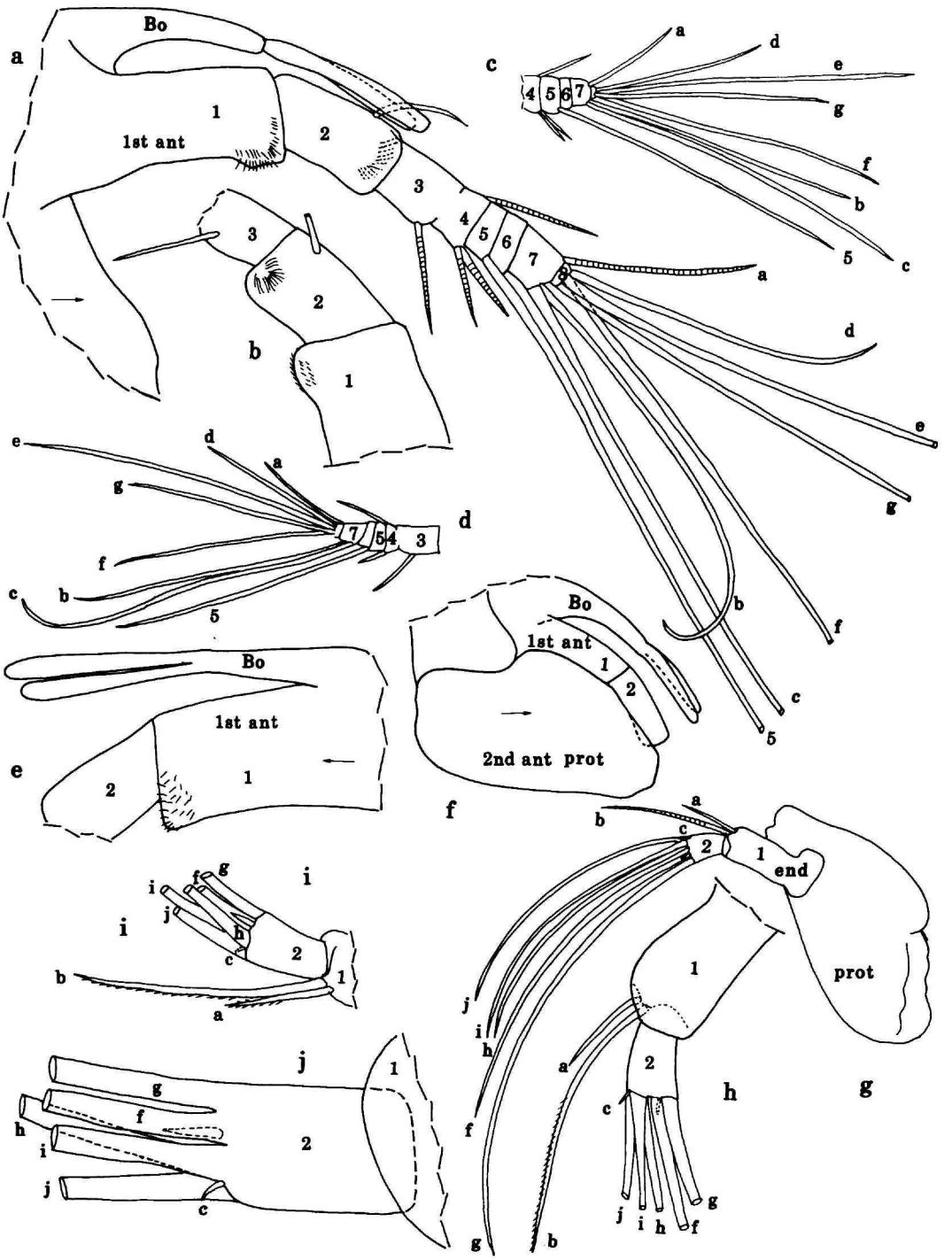


FIGURE 31.—*Spelaeoecia mayan,* new species, paratype, USNM 194268, adult female: *a,* Bellonci organ and right 1st antenna, lv; *b,* part right 1st antenna, mv; *c,d,* distal right and left 1st antennae, respectively, lv; *e,* Bellonci organ and proximal part left 1st antenna (nabs), lv; *f,* anterodorsal part of body from right side (nabs); *g,* part right 2nd antenna, mv; *h,* detail of endopodite in *g; i,* distal endopodite right 2nd antenna, lv; *j,* distal endopodite left 2nd antenna, mv.

FIGURE 32.—*Spelaeoecia mayan*, new species, paratype, USNM 194268, adult female: *a*, anterior view coxale of each mandible; *b*, proximal set of teeth of coxale endite of left mandible, pv; *c*, distal set of teeth of coxale endite (proximal set shown in *c*) and distal part of basale of left mandible, pv; *d*, basale and part of endopodite left mandible, lv; *e*, basale and part of endopodite right mandible (nabs), mv; *f*, basale right mandible, lv; *g*, endopodite right mandible, lv; *h*, endites of maxilla; *i,j*, maxillae (nabs).

FIGURE 33.—*Spelaeoecia mayan*, new species, paratype, USNM 194268, adult female: *a*, right 5th limb, lv; *b*, tip left 5th limb, mv; *c*, epipodites right 5th and 6th limbs, lv; *d*, left 6th limb, mv; *e*, right 7th limb, lv; *f*, posterior of body from left side (not all bristles or furcal claws shown); *g*, posterior of body from right side; *h*, anteroventral part of body from left side.

ventral margin and 1 lateral plumose bristle near midwidth of joint. 2nd endopodial joint: dorsal margin with 1 distal bristle; ventral margin with 4 slender bristles near midlength. 3rd joint with 1 stout claw-like bristle at midwidth, 1 long dorsal bristle with many closely spaced oblique rings (bristle somewhat claw-like), 1 long slender ringed bare bristle, and 1 minute subterminal medial bristle near dorsal claw-like bristle (Figure 33*a,b*). (Rings shown on only tubular bristles of protopodite, basale, and endopodite.)

Sixth Limb: Epipodite with plumose bristles in 3 groups (5 long bristles in ventral group, 6 in middle group, and 6 long and 1 short (dorsal) in dorsal group (Figure 33*c*). Prodopodite with 5 ventral bristles on precoxale (2 plumose, 2 with long spines, 1 shorter bare), and 5 ventral bristles on coxale (2 plumose, 2 with long spines, 1 bare) (Figure 33*d*). Basale with 7 bristles near ventral margin (3 plumose, 2 medial with long spines, 2 bare), and 1 plumose distolateral bristle near dorsal margin. Endopodite well developed, with 4 bristles (3 plumose with bases along edge, and 1 bare with base lateral). Exopodite 3-jointed: 1st joint with 3 or 4 bare ventral bristles; 2nd joint with 3 bare bristles (2 ventral, 1 dorsal); 3rd joint with 3 bristles (middle bristle claw-like with distal oblique lines; dorsal bristle about 1/2 length of ventral bristle, both slender ringed bare) and 1 minute medial spine-like bristle (not shown). Protopodite and proximal part of basale with hairs near ventral margin. (Rings not shown on all bristles.)

Seventh Limb (Figures 30*j*, 33*e,f*): USNM 194268 with 3 bristles on right limb and 4 (aberrant) on left limb.

Furca (Figure 33*f,g*): Each lamella with 6 claws with basal sutures; claws 1 and 2 with few indistinct oblique lines; stout "glandular" process between claws 1 and 2 but closer to claw 2. Posterior end of furca with divided unpaired bristle. Apron present anterior to furca.

Bellonci Organ (Figure 31*e,f*): Elongate, bifurcating near midlength; each branch with broadly rounded bare tip.

Lips (Figure 33*h*): Anterior face without processes at midheight but with small triangular process on each side ventral to midheight. Terminal posterior edge of upper lip with minute spine-like processes and slender spines. Anterior face with small glandular processes (not shown). Lower lip with triangular process on each side of mouth.

Genitalia (Figures 30*j*, 33*f*): Small spined process anterior to 2nd process with 2 terminal bristles, both on left side only.

DESCRIPTION OF ADULT MALE (Figures 34–36).—Shape similar to that of adult female (Figure 34*a*).

Ornamentation: None observed.

Infold (Figure 34*b,c*) *and Glands* (Figure 34*a,b*): Similar to those of adult female.

Central Adductor Muscle Attachments (Figure 34*d,e*): Indistinct group of about 6 ovoid attachments.

Carapace Size (length, height in mm): USNM 194321, 1.31, 0.79. USNM 194322, holotype, 1.28, 0.72. Average length 1.30 mm.

First Antenna (Figure 34*f,g*): Joints 1–3 and 5–7 similar to those of adult female. 4th joint differs from that of adult female in having long terminal ventral filament instead of 1 or 2 short bristles. 8th joint: d-bristle more than twice length of a-bristle, f-bristle not oriented ventrally, joint otherwise similar to that of adult female.

Second Antenna: Protopodite similar to that of adult female. Endopodite 3-jointed (Figure 34*h–j*): 1st joint elongate with spinous a- and b-bristles (a-bristle about 1/2 length of b-bristle); 2nd joint with small ringed spinous c- and d-bristles, smaller lateral unringed bare e-bristle near base of f-bristle, and long terminal filament-like f- and g-bristles each with terminal papilla (g-bristle slightly medial to f-bristle and longer); 3rd joint with filament-like h-, i-, and j-bristles about 3/4 length of g-bristle (all with terminal papilla), and terminal club-like process (process of right limb longer and stouter than that of left limb). Exopodite (Figure 34*k*): bristle of 1st joint with ventral spines and natatory hairs; joints 2–8 with natatory hairs, no spines; 9th joint with 4 bristles, some with short ventral spines; all long bristles with few long proximal segments followed by closely spaced rings.

Mandible: Coxale similar to that of adult female. Basale (Figure 35*a–c*): USNM 194321 with 5 distal lateral bristles on both limbs, otherwise similar to that of adult female. Endopodite similar to that of adult female (Figure 35*c*).

Maxilla: Endite bristles not counted but, in general, similar to those of adult female. Coxale with stout plumose dorsal bristle. Basale obscured, possibly with 3 terminal bristles (2 ventral, 1 dorsal). 1st endopodial joint with 5 posterior bristles (4 proximal, 1 distal); ventral margin with 4 distal bristles. 2nd endopodial joint similar to that of adult female.

Fifth Limb (Figure 35*d,e*): Epipodite similar to that of adult female (Figure 35*d*). Protopodite with long sensory organ (Figure 35*d*) and 2 endites (Figure 35*e*): endite I with 3 bristles (1 tubular with long hairs, 2 with short spines); endite II with 5 bristles (2 long ventral with long spines, 2 short medial bare tubular, 1 short medial proximal with short spines). Basale with medial spines and hairs, 1 long anterior bristle with long spines, 1 short proximal medial bristle with short spines, and 5 ventral bristles (2 weakly ringed, somewhat claw-like, 2 tubular with short spines, 1 longer with short spines). Endopodite and exopodite similar to those of adult female.

Sixth Limb (Figure 35*f*): Epipodite with 4 bristles in ventral group, 5 in middle group, and 6 long and 1 short in dorsal group. Prodopodite with 6 ventral bristles on precoxale and 4 ventral bristles on coxale, all plumose or with long spines. Basale with 7 bristles near ventral margin and 1 plumose distolateral bristle near dorsal margin. Endopodite similar to that of adult female. Exopodite: 1st joint with 3 bare ventral bristles; 2nd joint with 2 or 3 bare bristles (1 or 2 ventral, 1 dorsal); 3rd joint similar to that of adult female (detail in Figure 35*f*).

Seventh Limb (Figure 36*a*): With 3 bristles.

Furca (Figure 36*b*): Furca, apron, and unpaired bristle similar to those of adult female.

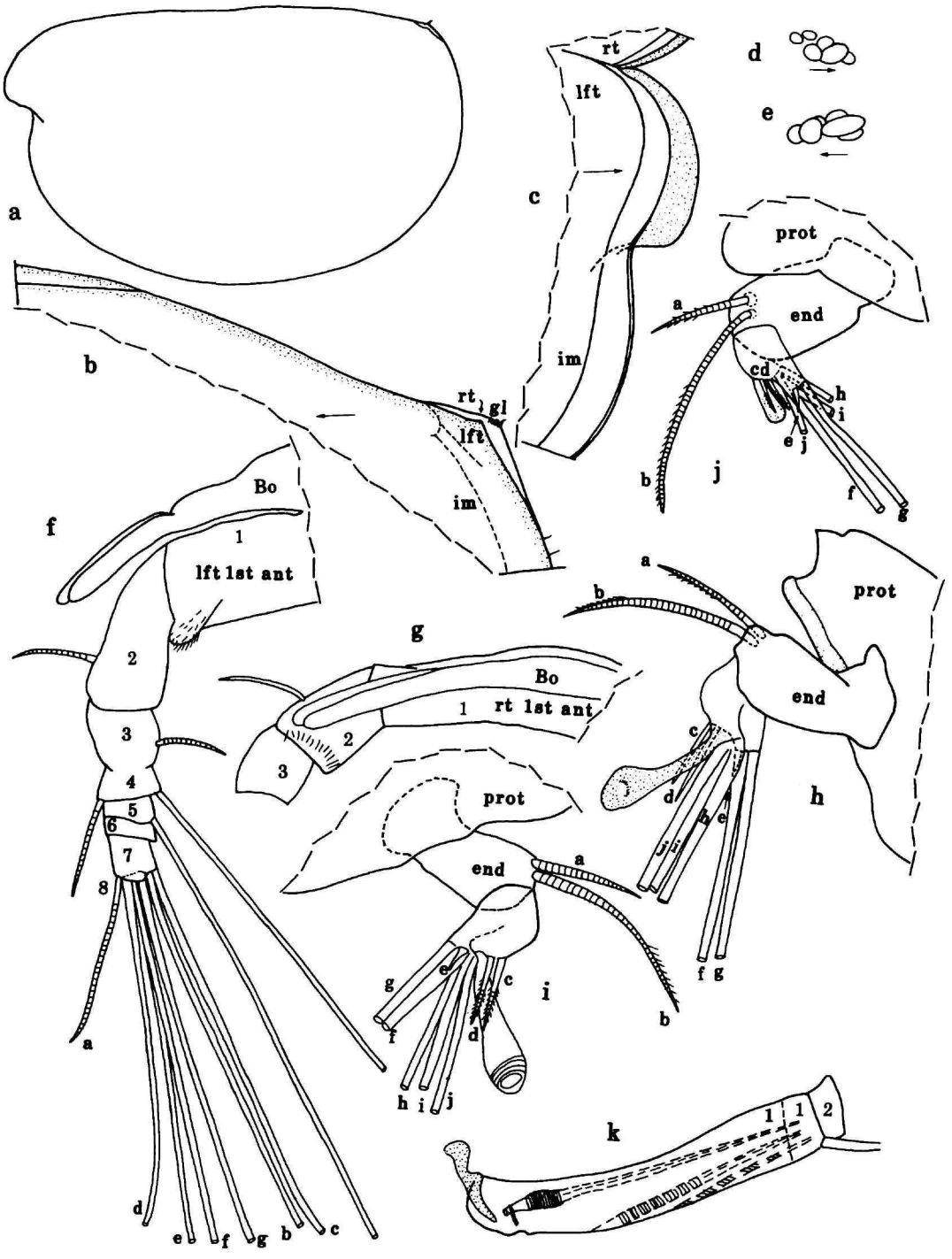


FIGURE 34.—*Spelaeoecia mayan,* new species, paratype, USNM 194321, adult male: *a,* complete specimen from left side, length 1.31 mm; *b,* detail of posteroventral corner of *a; c,* anterior left valve, iv; *d,e,* central adductor muscle attachments of right and left valves, respectively, ov; *f,* Bellonci organ and left 1st antenna, lv; *g,* Bellonci organ and proximal right 1st antenna (nabs), mv; *h,i,* part right 2nd antenna, medial and lateral views, respectively; *j,* part left 2nd antenna, lv; *k,* proximal part exopodite left 2nd antenna, lv.

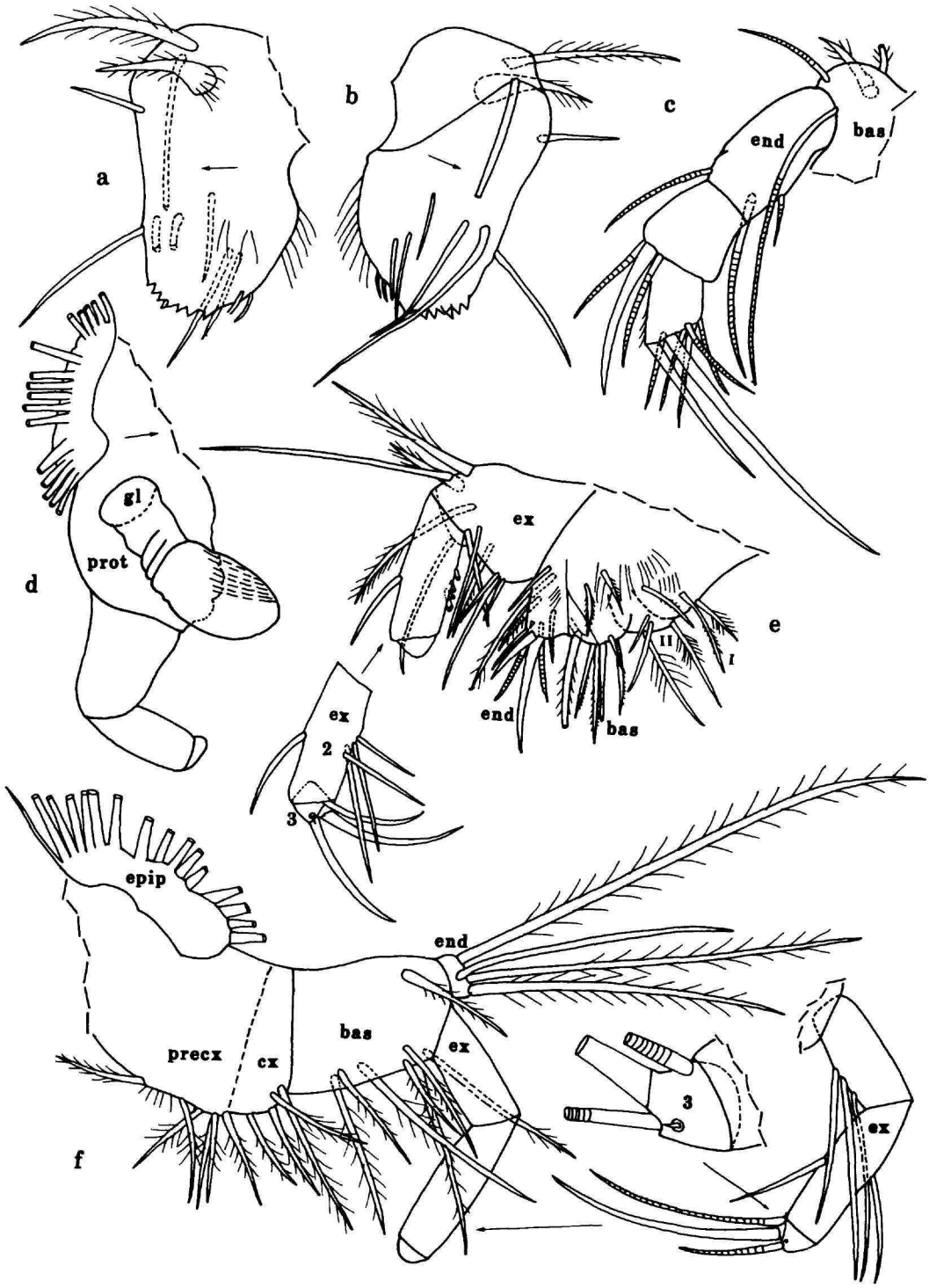


FIGURE 35.—*Spelaeoecia mayan,* new species, paratype, USNM 194321, adult male: *a,b,* medial and lateral views, respectively, of basale of right mandible; *c,* endopodite and part of basale left mandible, lv; *d,* part right 5th limb (nabs), lv; *e,* left 5th limb, mv; *f,* right 6th limb, mv.

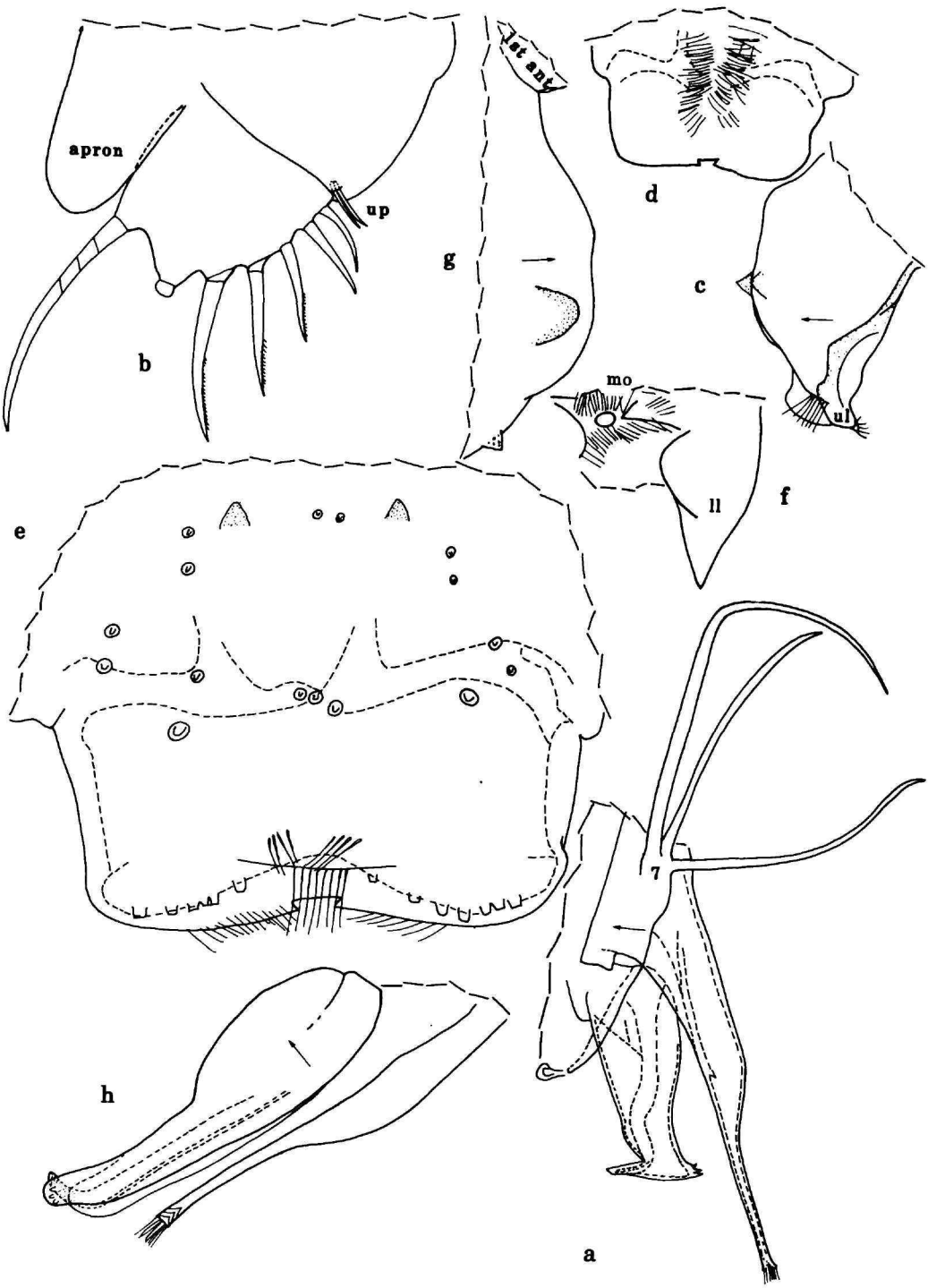


FIGURE 36.—*Spelaeoecia mayan*, new species, paratype, USNM 194321, adult male: *a*, left 7th limb and copulatory organ from left side; *b*, left lamella of furca; *c*, anterior of body from left side; *d*, inner side of upper lip; *e*, anterior view of ventral part of anterior of body; *f*, ventral view mouth area and triangular left lower lip; *g*, anterior of body from right side. *h*, holotype, USNM 194322, adult male, length 1.28 mm, copulatory organ from left side.

Bellonci Organ (Figure 34*f,g*): Similar to that of adult female.

Lips (Figure 36*c–f*): Anterior face with low lateral bulge just ventral to midheight and small triangular process on each side closer to ventral edge (Figure 36*g*). Terminal posterior edge and lower lip similar to those of adult female (Figure 36*c,e,f*). Anterior face and posterior edge of upper lip with many small glandular processes (Figure 36*e*).

Genitalia (Figure 36*a,h*): Copulatory organ on left side of body. Tip of anterior part with projecting anterior process and 3 minute posterior teeth. Posterior part lateral to anterior part, broad in proximal 2/3, slender in distal 1/3; tip broadening slightly and hirsute. Copulatory organ lies medial to the endopodite of the left 6th limb.

COMPARISONS.—The appendages of *S. mayan* differ from those of *S. sagax* and *S. styx* as follows: the endopodite of the 6th limb of *S. mayan* bears four rather than five bristles, the 3rd and 4th joints of the 1st antenna of *S. mayan* have ventral bristles absent on *S. sagax* and *S. styx*, and the caudal lamella of *S. mayan* bears a large "glandular" process between the 1st and 2nd claws that is absent or reduced on *S. sajax* and *S. styx*. *Spelaeoecia jamaicensis* is without the large process between furcal claws 1 and 2 and, also, has five bristles on the endopodite of the 6th limb. *Spelaeoecia maya* differs from *S. capax* in not having twisted lateral bristles on the basale of the mandible, in having the 3rd joint of the 1st antenna shorter rather than longer than the 2nd joint, four rather than five bristles on the endopodite of the 6th limb, six rather than eight claws on each lamella of the furca, a narrower infold along the posterior margin, as well as the carapace being much smaller. *Spelaeoecia mayan* is close to *S. bermudensis;* they differ in that the furca of the adult *S. bermudensis* bears seven claws on each lamella compared to only six on *S. mayan*, and the tip of the anterior part of the male copulatory limb is more complex on *S. mayan*.

Deeveya Kornicker and Iliffe, 1985

Deeveya Kornicker and Iliffe, 1985:476.

TYPE SPECIES.—*Deeveya spiralis* Kornicker and Iliffe, 1985:476, figs. 1–12.

COMPOSITION AND DISTRIBUTION.—The genus includes seven species from anchialine caves: *D. spiralis* Kornicker and Iliffe, 1985, Turks and Caicos Islands; *D. bransoni* Kornicker and Palmer, 1987, Bahamas; *D. jillae* Kornicker and Iliffe, 1987, Bahamas; *D. styrax, D. hirpex,* and *D. medix* Kornicker in Kornicker et al., 1990, Bahamas; and *D. exleyi,* new species, Bahamas.

Key to the Species of *Deeveya*

1. Adult carapace longer than 2.5 mm 2
   Adult carapace shorter than 2.5 mm 3
2. Anterior margin of carapace with unbranched bristles; width of distal end of 3rd joint of 1st antenna about 1/4 length of dorsal margin of joint; terminal joint of 5th limb with 4 bristles . . . . . ***D. styrax***
   Anterior margin of carapace with bifurcate bristles; width of distal end of 3rd joint of 1st antenna more than 1/3 length of dorsal margin of joint; terminal joint of 5th limb with 5 bristles . . . . . ***D. spiralis***
3. Adult carapace longer than 2.2 mm . . . . . ***D. hirpex***
   Adult carapace shorter than 2.2 mm 4
4. Carapace when viewed with transmitted light with disks at intersections of reticule not wider than walls of reticulations . . . . . ***D. bransoni***
   Carapaces when viewed with transmitted light with disks at intersections of reticule much wider than walls of reticulations 5
5. Estimated length of adult carapace less than 1.75 mm . . . . . ***D. jillae***
   Length of adult carapace more than 1.75 mm 6
6. Width of distal end of 3rd joint of 1st antenna 38% length of dorsal margin of joint; 1st endopodial joint of mandible with 4 medial bristles . . . . . ***D. medix***
   Width of distal end of 3rd joint of 1st antenna 26% length of dorsal margin of joint; 1st endopodial joint of mandible with 6 medial bristles . . . . . ***D. exleyi,*** new species

Deeveya exleyi, new species

FIGURES 37–42

ETYMOLOGY.—Named in honor of Sheck Exley, the world's most experienced cave diver and author of 10 books on cave diving safety. He had accompanied the junior author while collecting ostracodes in lava tubes in the Canary Islands as recently as 1992. He died while diving in a Mexican cave in

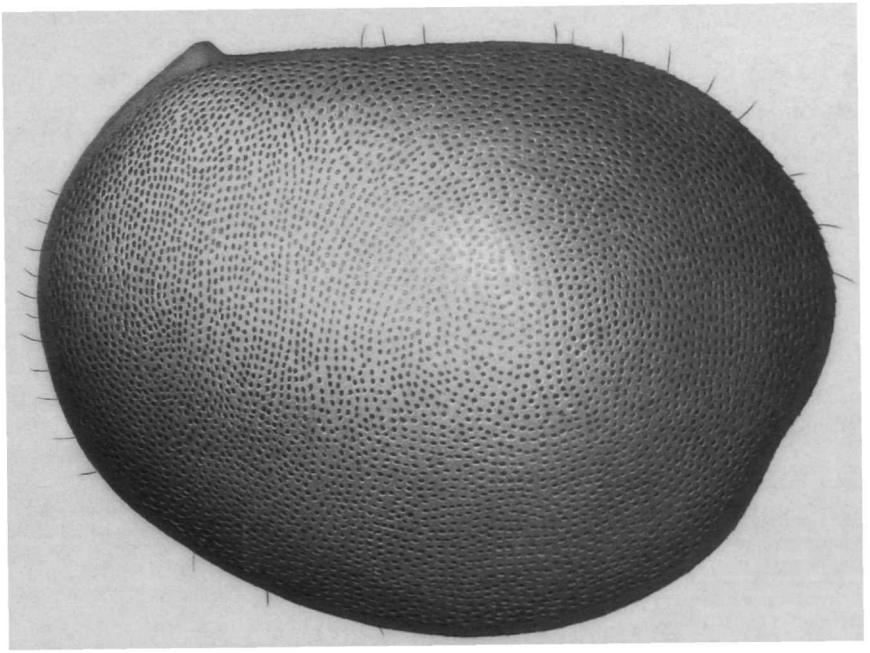


FIGURE 37.—*Deeveya exleyi*, new species, holotype, USNM 194269, right valve, ov, anterior to right, length 1.83 mm.

April, 1994, while attempting to set a world's depth record.

HOLOTYPE.—USNM 194269, adult female on slide and in alcohol.

TYPE LOCALITY.—Sta 93-006, Oven Rock Cave, Great Guana Cay, Exuma Cays, Great Bahama Bank.

PARATYPES.—None.

DISTRIBUTION.—Collected only at type locality.

DESCRIPTION OF ADULT FEMALE (Figures 37–42).—Carapace oval in lateral view except for straight dorsal margin and slightly concave anterior margin (Figures 37, 38*a,b*). Right valve with small tubercle on dorsal margin near posterior end (Figures 37, 38*a*). Shell strongly calcified.

Ornamentation (Figures 37, 38*a,d,e*): Carapace when viewed in transmitted light with large disks appearing bright (Figures 37, 38*a,d,e*, and dark polygons with straight-to-curved outer edges (Figure 38*d,e*); polygons separated by clear reticulations with edges formed by outer edges of polygons (Figure 38*d,e*). Anterior, anteroventral, and dorsal margins with minute bosses appearing as projections (Figure 38*h*).

Bristles: Valve margins with undivided bristles (Figure 38*f*). Setal bristle at tip of dorsal tubercle of right valve (Figure 38*g*).

Infold (Figure 38*e,h*): Broad infold along anterior, ventral, and posterior margins, narrowest opposite anterior concavity, widest at anteroventral corner. Narrow uneven list present on infold along anterior, ventral, and posterior valve margins. Selvage along outer margin of infold with narrow lamellar prolongation with smooth outer edge.

Glands: Glandular opening on tip of dorsal tubercle of right valve (Figure 38*a,g*).

Central Adductor Muscle Attachments (Figure 38*b,c*): About 13 individual attachments arranged in ellipse with long axis oblique to dorsal margin. Three indistinct scars forming crescent just anterior and ventral to central adductor muscle attachments.

Carapace Size (mm): USNM 194269, length 1.83, height 1.37.

First Antenna (Figures 38*i–k,q*, 41*a*): 1st joint with terminal ventral spinulose lobe overlapping proximal ventral corner of 2nd joint. 2nd joint with dorsal midbristle bearing short marginal spines, and distal ventral spines. 3rd joint elongate (width of distal margin 26% length of dorsal margin), with distal ventral bristle with few spines, and spines along ventral margin, on medial surface near ventral margin, and proximally along dorsal margin (Figure 38*i–k*). 4th joint short with short slender dorsal bristle. 5th joint short with long ventral terminal filament with minute widely separated minute marginal spines with terminal papilla. 6th joint short bare. 7th joint with short distal lateral a-bristle (with short spines) near dorsal margin, long medial ventral filament-like b-bristle and longer lateral ventral c-bristle (both b- and c-bristles with widely spaced minute marginal spines and with terminal papilla), both longer than bristle of 5th joint; c-bristle almost twice length of b-bristle, ringed proximally, filament-like

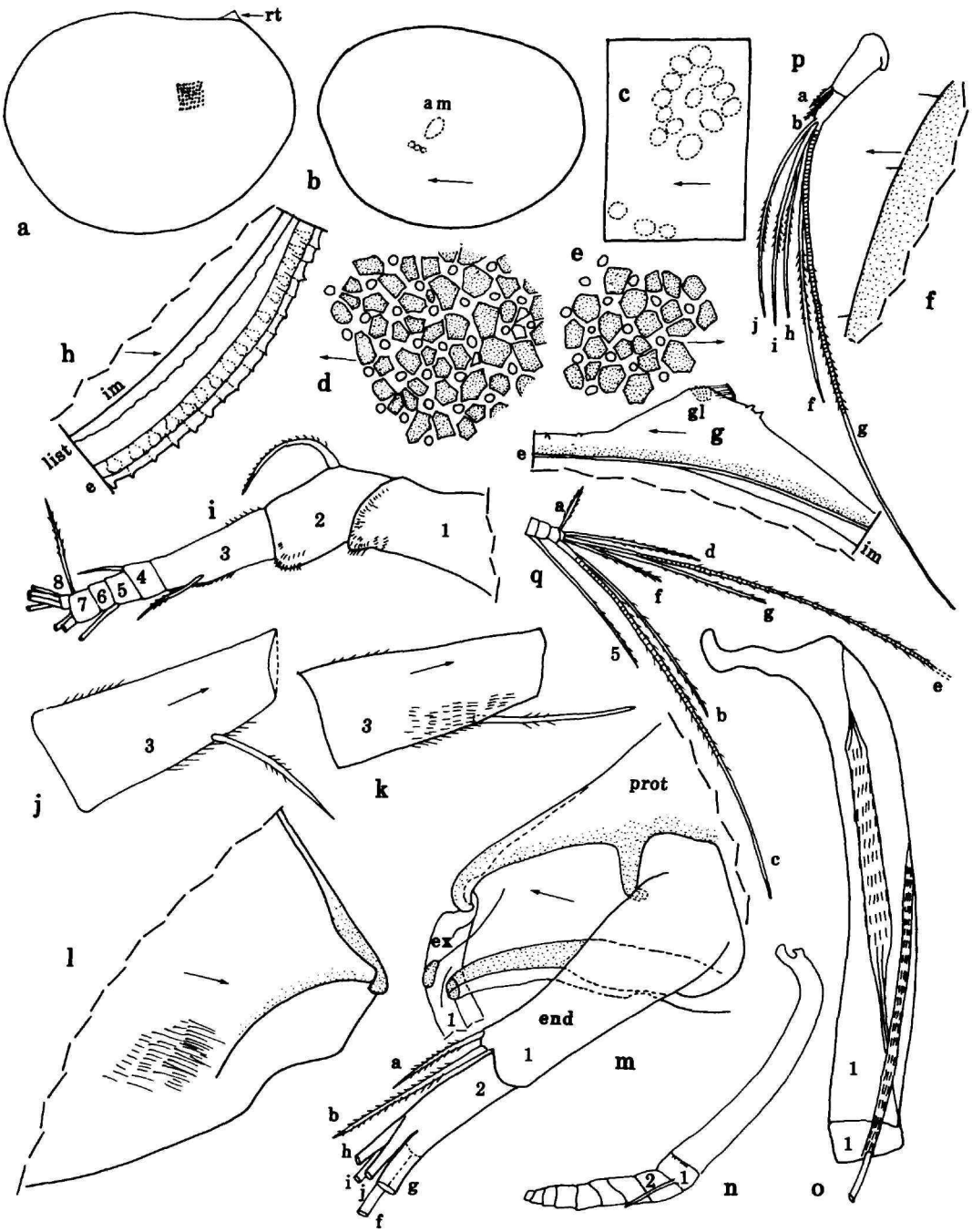


FIGURE 38.—*Deeveya exleyi*, new species, holotype, USNM 194269, adult female: *a*, complete specimen from left side showing representative disks, length 1.83 mm; *b*, left valve showing location of central adductor muscle attachments, ov; *c*, central adductor muscle attachments of left valve (body removed), ov; *d,e*, ornamentation on left and right valves, respectively, ov; *f*, hairs along anterodorsal margin left valve, ov; *g*, posterodorsal corner right valve, iv; *h*, anteroventral corner left valve, iv; *i*, left 1st antenna, lv; *j,k*, 3rd joints of right (lv) and left (mv) 1st antennae, respectively; *l*, distal part protopodite right 2nd antenna, lv; *m*, part right 2nd antenna, mv; *n*, exopodite left 2nd antenna (nabs), mv; *o*, 1st joint of exopodite left 2nd antenna, mv; *p*, endopodite right 2nd antenna, mv; *q*, tip right 1st antenna, lv.

FIGURE 39.—*Deeveya exleyi*, new species, holotype, USNM 194269, adult female: *a*, coxale endite right mandible, mv; *b*, coxale endite left mandible, lv; *c*, detail from *b*; *d*, part of right mandible in place on body, lv; *e*, part left mandible, lv; *f*, endopodite right mandible, mv; *g*, right 5th limb, mv; *h*, proximal left 5th limb, lv.

distally (Figure 38*q*). 8th joint with terminal d-, e-, f-, and g-bristles (d-bristle reaching tip of bristle of 5th joint, filament-like, with widely spaced minute marginal spines and terminal papilla; e-bristle same length as c-bristle, ringed proximally, filament-like distally, with fairly stout marginal spines and terminal papilla; f-bristle at slight ventral angle, shorter than d-bristle, filament-like, with widely spaced minute marginal spines and terminal papilla; g-bristle about 1/2 length of e-bristle, filament-like, with widely spaced marginal spines and terminal papilla (Figure 38*q*).

Second Antenna: Protopodite with distal lateral spines (Figure 38*l*). Endopodite (Figure 38*m,p*): 1st joint with a-bristle about 1/2 length of b-bristle, both with short marginal spines. 2nd and 3rd joints fused; 2nd joint with long f- and g-bristles with marginal spines and terminal papilla (f-bristle filament-like and about 1/2 length of g-bristle; g-bristle ringed proximally and filament-like distally). 3rd joint small with filament-like h-, i-, and j-bristles (with minute widely spaced marginal spines and terminal papilla) shorter than f-bristle. Exopodite 9-jointed (Figure 38*n*): 1st joint divided into long proximal and short distal parts (Figure 38*n,o*); distal part with slender bare medial bristle just reaching 4th joint; 2nd joint with long bristle with ventral spines along distal 2/3 and natatory hairs; bristles of joints 3–8 long with natatory hairs; bristles of 9th joint obscured, some with spines. (Note: proximal internal muscle of 1st exopodial joint (Figure 38*o*) much longer than that of known species of *Spelaeoecia,* for example *S. capax* (Figure 6*d*).)

Mandible: Coxale endite with proximal and distal sets of teeth separated by space (Figure 39*a–c*); proximal set comprising 4 stout cusps; a short spinous bristle on both anterior and posterior edges of proximal set; surface between cusps and anterior and posterior to cusps with abundant slender spines; 2 spinous bristles medial to stout rounded tooth between proximal and distal sets of teeth; 2 spinous bristles medial to distal set of teeth; distal set comprising 2 flat teeth: proximal tooth with 5 cusps (posterior cusp longer); distal tooth with 7 cusps (middle tooth stouter). Basale with 4 long proximal bristles (3 stout plumose, 1 long slender with short marginal spines) (Figure 39*d*). Basale endite (Figure 39*e*): distal edge with 6 terminal triangular cusps; lateral surface near distal edge with sharp tooth near midwidth; lateral surface distal to midlength with 4 slender spinous bristles and 2 long stout entwined spinous bristles crossing each other in 5 places (Figure 39*d,e*); anterior margin with 1 slender spinous bristle; posterior margin with proximal spines and 2 short bare distal bristles (distal of these tubular); medial and lateral surfaces with few rows of long hairs. Endopodite (Figure 39*f*): 1st joint with 8 spinous bristles (1 anterior, 2 posterior, 6 medial); 2nd joint with indistinct medial spines, 1 spinous posterior bristle with base on medial side, and 3 spinous terminal dorsal bristles (1 claw-like on edge of joint and with distal rings, 1 medial ringed, 1 lateral ringed); 3rd joint hirsute medially and along anterior margin, with 4 medial spinous bristles forming row, and 3 stout terminal bristles, all with short marginal spines (middle bristle tending to be claw-like and with weakly developed rings; ventral bristle with spines slenderer and more closely spaced along dorsal 1/2 to 2/3 (spines about same width as bristle)).

Maxilla: Coxale with stout plumose terminal dorsal bristle (Figure 40*a*) (short on right limb (aberrant) (Figure 40*b*)). Endite I with 2 proximal anterior bristles with long proximal hairs and 11 terminal bristles (1 short tubular, 4 long tubular, 6 stout with pointed tips, either bare or with long hairs and indistinct minute teeth) (Figure 40*c*); endite II with 2 proximal bristles with long hairs and about 9 terminal and subterminal bristles (4 tubular, 5 pointed claw-like with distal marginal teeth) (Figure 40*d*); endite III with 1 proximal bristle (with long hairs) with base near basale, and about 6 terminal bristles (2 tubular, about 4 claw-like) (Figure 40*e*). Basale with long tubular spinous ventral bristle and 1 long pointed spinous bristle either near dorsal margin (Figure 40*b*) or medial at midwidth (Figure 40*a*). Endopodite (Figure 40*a,b*): 1st joint with hairs along anterior surface and 9 or 10 spinous bristles (4 proximal, 5 or 6 distal lateral); 2nd joint with 2 stout pectinate claws, 5 or 6 slender tubular bristles (3 or 4 medial, 2 lateral, all bare or with short spines), and hairs along anterior surface. (Terminology: The endopodite in natural position on the animal may have the 2 terminal claws convex either anteriorly or posteriorly, and when mounted on a slide a similar orientation is maintained. The terminology used herein for the endopodite is that the concave curvature of the claws is anterior (inward) and the convex curvature is posterior (outward), regardless of orientation of the endopodite relative to other joints of limb. A similar orientation was used by Iles (1961:313) for the maxilla of the Halocyprididae).

Fifth Limb (Figure 39*g,h*): Epipodite with 15 hirsute bristles forming 3 groups: ventral group with 5 (ventral bristle almost 2/3 length of others); middle group with 6 long; dorsal group with 4 long. Protopodite without glandular field, and with 2 ventral endites: endite I with 4 bristles (3 ventral (longest with long spines, shortest tubular, other with short marginal spines); 1 proximal medial with short spines); endite II with 6 bristles (1 proximal medial with short spines, 3 tubular on ventral edge, and 2 lateral near ventral edge (anterior of these with long proximal spines)). Basale with 1 proximal medial bristle with short spines, 2 long lateral subventral bristles with long proximal spines (posterior of these bifurcate on right limb (aberrancy)), and 7 ventral bristles (1 pectinate somewhat claw-like medial, 1 short spinous pointed medial, 5 tubular slightly medial or on edge). Endopodite with 12 or 13 bristles (2 proximal medial with short spines, 1 lateral subventral with long proximal spines, 1 or 2 long anterior with long proximal spines, 2 claw-like ventral pectinate, 2 medium-length tubular, 2 long lateral subventral with short spines, 1 small pointed lateral subventral, 1 minute triangular medial subventral with pad of minute spines proximal to base). 1st exopodial joint with 14 bristles (ventral margin with 4 proximal and 5 distal bristles;

FIGURE 40.—*Deeveya exley*, new species, holotype, USNM 194269, adult female: *a*, left maxilla (nabs), mv; *b*, right maxilla (nabs), lv; *c–e*, endites of maxilla; *f*, right 6th limb, mv; *g*, right 7th limb, lv.

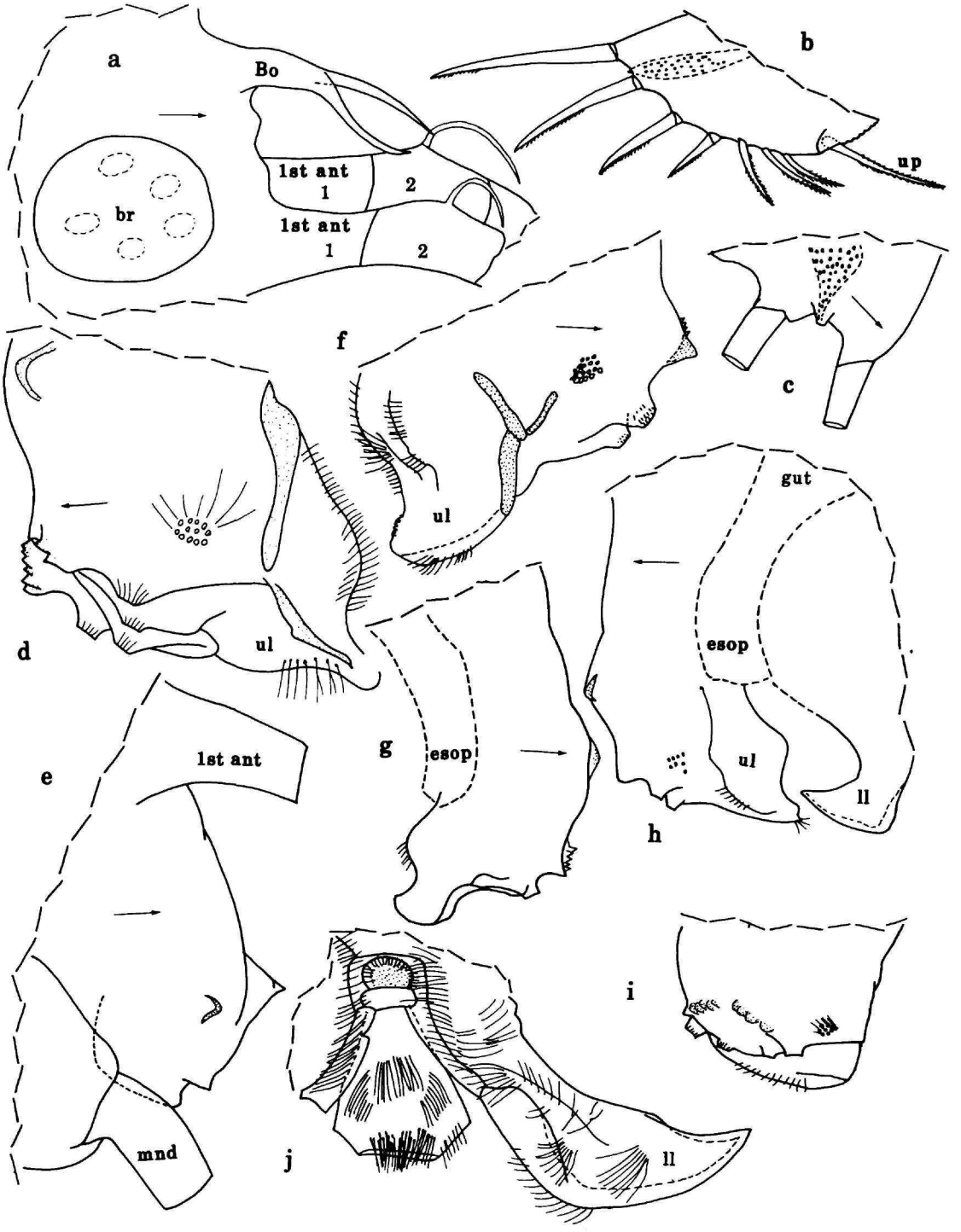


FIGURE 41.—*Deeveya exleyi*, new species, holotype, USNM 194269, adult female: *a*, anterodorsal part of body from right side; *b*, left lamella of furca, lv; *c*, claws 1 and 2 and glandular process right lamella of furca, lv; *d*, part of anterior of body from left side; *e–g*, part of anterior of body from right side; *h*, part of anterior of body from left side; *i*, slightly oblique anterior view of ventral part of anterior of body, anterior toward left; *j*, inside view lower lip.

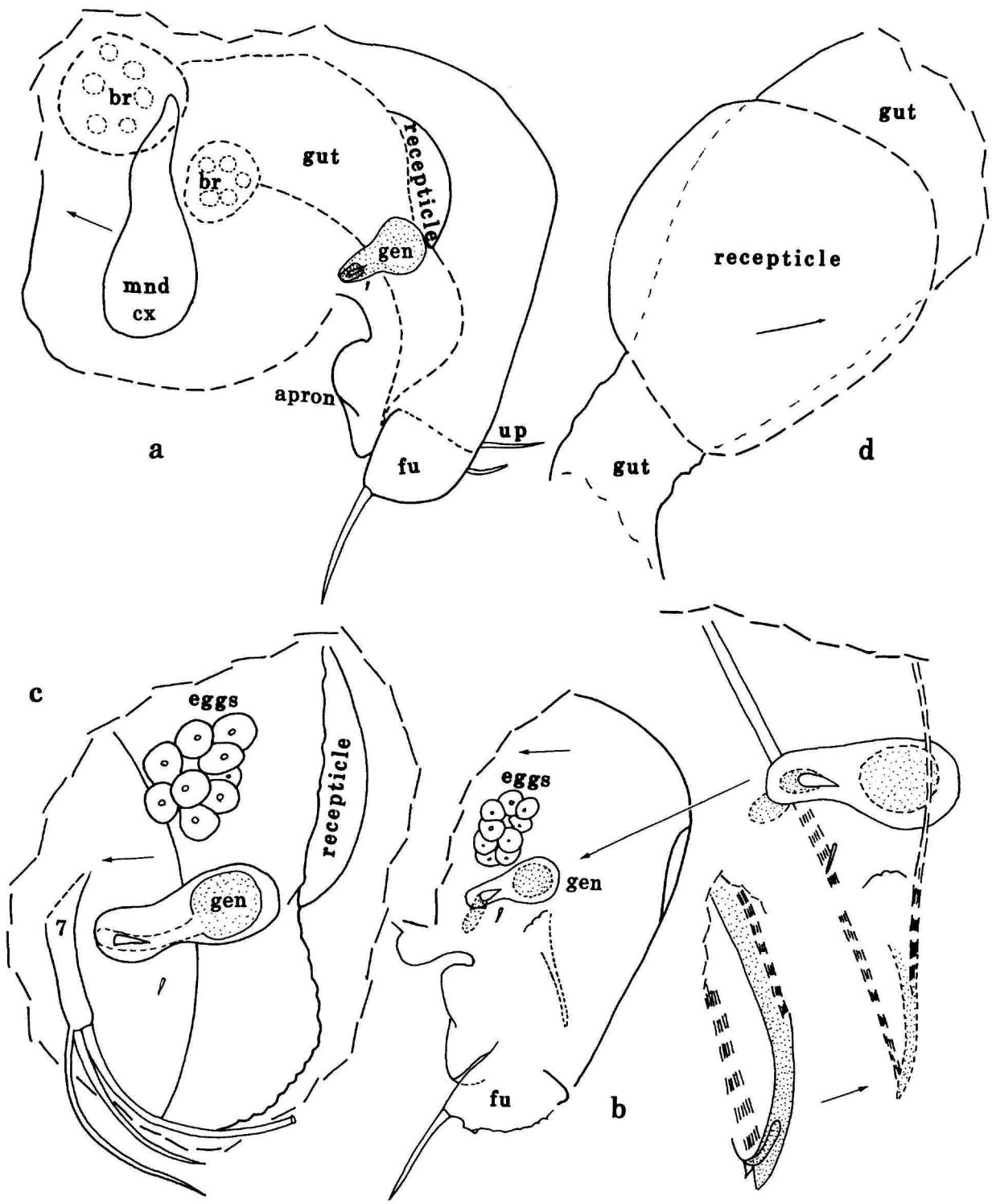


FIGURE 42.—*Deeveya exleyi*, new species, holotype, USNM 194269, adult female: *a–c*, posterior of body from left side (not all furcal claws shown); *d*, disk-like vesicle on right side of gut.

medial side with 1 long bristle near midlength; lateral side with 2 bristles at midwidth (distal of these with long hairs), dorsal margin with long bare subterminal bristle and 1 short plumose bristle just proximal to long bristle). 2nd exopodial joint with 1 distal dorsal bristle and 4 slender bristles near midlength. 3rd exopodial joint with 2 stout pectinate claw-like bristles and 2 slender ringed bristles.

Sixth Limb (Figure 40*f*): Epipodite with 16 or 17 plumose bristles forming 3 groups: ventral group with 5 long bristles; middle group with 5 or 6 long bristles; dorsal group with either 6 long or 5 long and 1 short (dorsal) bristle. Precoxale separated from coxale by distinct suture, both joints with long medial hairs. Precoxale and coxale each with 4 bristles (2 medial subventral with long spines and 2 ventral with short spines). Basale with medial hairs and 7 plumose bristles (1 lateral, 6 medial or ventral). Endopodite forming thumb-like process with 4 long bristles (lateral bristle longest bare, others plumose). Exopodite: 1st joint with 6 ventral bristles (bare or with short marginal spines); 2nd joint with 3 bristles (2 ventral, 1 dorsal); 3rd joint with 4 bristles (2 stout claw-like, both with minute distal ventral teeth, 1 long slender ringed ventral with indistinct spines, and 1 short medial, either bare or with indistinct short spines).

Seventh Limb (Figure 40*g*): Elongate with 3 terminal bristles.

Furca (Figure 41*b,c*): Each lamella with 7 claws; lamellae followed by unpaired spinous dorsal bristle about same length as claw 2; claws 1–4 with teeth along posterior edge, claws 5–7 with teeth along both edges; teeth of claw 7 only very slightly smaller than those of claws 5 and 6; small glandular peg between claws 1 and 2. Well-developed apron anterior to furca.

Bellonci Organ (Figure 41a): Well developed, bifurcate at midlength, with each branch tapering to point.

Lips: Upper lip (Figure 41*d–i*) and lower lip (Figure 41*h,j*) typical for genus.

Genitalia: Single bristle on left side of body near genital area (Figure 42*a–c*). In addition, small triangular process anterior to bristle (Figure 42*a–c*).

Posterior of Body (Figure 42*a,b*): Rounded unsegmented.

Receptacle: Oval near right side of gut (Figure 42*a,c,d*).

Number of Eggs: USNM 194269 with about 9 small unextruded eggs on left side of body (Figure 42*b,c*).

COMPARISONS.—*Deeveya exleyi* differs from previously described species in having six rather than five or fewer medial bristles on the 1st endopodial joint of the mandible. The carapace of *D. exleyi* is larger than that of *D. jillae* and smaller than those of *D. spiralis* and *D. styrax* (Kornicker et al., 1990, fig. 30). Round disks on carapace of *D. exleyi* (Figure 38*a,d,e*) are much greater in diameter than those of *D. bransoni* (Kornicker et al., 1990, fig. 2b). *Deeveya exleyi* is quite similar to the slightly smaller *D. medix*, but the mandible of *D. medix* has four rather than six medial bristles on the 1st endopodial joint. If future collections yield an adult male of *D. exleyi*, study of the copulatory organ may more firmly establish the relationship between *D. medix* and *D. exleyi*.

Superfamily THAUMATOCYPRIDOIDEA Müller, 1906

COMPOSITION.—The superfamily includes the single family Thaumatocyprididae Müller, 1906.

Family THAUMATOCYPRIDIDAE Müller, 1906

COMPOSITION.—The family includes two fossil genera and three from the Holocene (Kornicker and Iliffe, 1989a:24).

Danielopolina Kornicker and Sohn, 1976

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

COMPOSITION AND DISTRIBUTION.—Includes nine species: *D. carolynae* Kornicker and Sohn, 1976, from the mid-Atlantic (depth 3459 m); *D. orghidani* (Danielopol, 1972) from a saline grotto in Cuba; *D. wilkensi* Hartmann, 1985, and *D. phalanx* Kornicker and Iliffe, 1995, from a lava-tunnel in the Canary Islands; *D. bahamensis* Kornicker and Iliffe, 1989b, from an anchialine cave in Eluthera, Bahamas; *D. mexicana* Kornicker and Iliffe, 1989b, from an anchialine cave, Yucatan, Mexico; *D. styx* Kornicker and Iliffe, 1989a, from anchialine pools, Santa Cruz Island, Galapagos Islands; *D. elizabethae* Kornicker and Iliffe, 1992, from an anchialine cave in Jamaica; and *D. exuma*, new species, from an anchialine cave in Exuma Cays, Bahamas. In addition, a species of *Danielopolina* (left in open nomenclature) has been reported from a cave in Cape Range, Western Australia, by Baltanás and Danielopol (1995; Table 1), and a species left in open nomenclature as *Danielopolina* species A, from a cave in Great Iguana Cay, Exumas, Bahamas, is described herein.

Key to the Species of *Danielopolina*

1. Carapace smooth . . . . . ***D. phalanx***
   Carapace with surface spines . . . . . ***D. mexicana***
   Carapace with surface reticulations 2
2. Carapace longer than 1.5 mm . . . . . ***D. carolynae***
   Carapace shorter than 1.0 mm 3

3. Each lamella of furca with 1 articulated anterior claw 4
   Each lamella of furca with 2 articulated anterior claws 5
4. Each valve with posterodorsal process . . . . . ***D. elizabethae***
   Each valve without posterodorsal process . . . . . ***D. styx***
5. Each lamella of furca with 6 short nonarticulated ventral claws . . . . ***D. wilkensi***
   Each lamella of furca with 3 short nonarticulated ventral claws 6
6. Each valve without posterodorsal process . . . . . ***D. bahamensis***
   Each valve with posterodorsal process 7
7. First antenna with 1 bristle on 2nd joint . . . . . ***D. exuma,*** new species
   First antenna with 2 bristles on 2nd joint . . . . . ***D. orghidani***

Danielopolina mexicana Kornicker and Iliffe, 1989

FIGURES 43–48

Danielopolina mexicana Kornicker and Iliffe, 1989b:15, figs. 1, 7, 8.

HOLOTYPE.—USNM 193312, female on slide and in alcohol.

TYPE LOCALITY.—Maya Blue Cave near Tulum, Quintana Roo, Yucatan Peninsula, Mexico, 7 Nov 1986.

MATERIAL.—Maya Blue Cenote, Tulum, Quintana Roo, Mexico: Sta 93-039: USNM 194303, undissected adult female in alcohol; USNM 194330, partly dissected adult female in alcohol. Sta 93-040: USNM 194302 #1, dissected instar II in alcohol; USNM 194302 #2, dissected instar I in alcohol; USNM 194302 #3, partly dissected instar II in alcohol. Sta 93-041: USNM 194301, partly dissected ?A–1 female in alcohol. All from water column in 12–21 m depth, salinity 35 ppt.

REMARKS.—One adult female (USNM 194303) from Sta 93-039, which was placed in glycerin for only a few hours and then kept in alcohol, retained visible surface papillae on its carapace. For remaining specimens, which were left in glycerin for several months prior to final placement in alcohol, most papillae were no longer visible, although reticulations on most juveniles remained.

DISCUSSION.—The original description of this species (Kornicker and Iliffe, 1989b:15) was based on two specimens; the holotype (USNM 193312) was questionably interpreted to be an A–1 female. A female in the present collection, about the same size as the holotype and with the same number of furcal claws, has a large unextruded egg; therefore, the holotype is reinterpreted to be an adult female. The second specimen in the original collection (USNM 194313), which has a furca with only one small nonarticulated ventral claw in addition to the two articulated anterior claws, was questionably interpreted to be an instar II based on an assumption that the species has six juvenile instars. The present collection suggests that the species has only four or five juvenile instars; therefore, that specimen is reinterpreted to be an instar I. The present collection has one specimen interpreted to be an instar I, two specimens interpreted to be instars II, one specimen questionably interpreted to be an A–1 female (could be an adult female), and two specimens interpreted to be adult females (Table 6). The identifications of instars I and II, which lack 6th limbs, are based on the assumption that the species develops in a manner similar to that of *Thaumatoconcha radiata* Kornicker and Sohn, 1976, in which the 6th limb with bristles first appears on instar III (Kornicker and Sohn, 1976:8).

The average growth factors between instars I and II and the A–1 and adult female are 1.11 and 1.23, respectively. The two specimens interpreted to be instars II have lengths (excluding anterior processes) of 0.41 and 0.43 mm, and the A–1 female has a length of 0.66 mm. Thus, the growth factor between instars II and the A–1 female is 1.57, which suggests that two growth stages are missing between instar II and the A–1 female. The specimens interpreted to be instars II have two ventral claws on each furcal lamella, whereas the A–1 female has five (Table 8). This suggests that two instars having three and four ventral claws on the furcal lamella, respectively, are missing from the collection. In *T. radiata* (Kornicker and Sohn, 1976:8) and *Danielopolina exuma,* new species, herein, instar III bears a 6th limb with bristles and is without a 7th limb. That stage is unknown for *D. mexicana;* all specimens are either with or without both 6th and 7th limbs. If instars III and IV are indeed missing the species has either five or six growth stages, depending on whether USNM 194301 is an A–1 or an adult female, which is presently in question. It will be necessary to study a complete series of growth stages of the species to document this hypothesis.

SUPPLEMENTARY DESCRIPTION OF INSTAR I (A–5) (sex unknown) (Figures 43, 44*a,b,* 45).—Carapace similar to that described by Kornicker and Iliffe (1989b:18) (Figure 44*a*).

Carapace Size (mm) (Figure 43): USNM 194302 #2, length with anterior process 0.40, length excluding anterior process 0.36, height with or without processes 0.31.

First Antenna (Figure 45*a*): Joints 1–4 and 6 without bristles. 3rd and 4th joint fused; 3rd joint with ventral spines. 5th joint with small ventral bristle. 7th joint with a- and c-bristles. 8th joint with slender d-bristle and long stout e-bristle.

Second Antenna: Protopodite bare. Endopodite 3-jointed but 2nd and 3rd joints fused (Figure 45*b*): 1st joint without

bristles; fused 2nd and 3rd joints with 3 short and 1 long bristle. Exopodite: 1st joint undivided and without bristle; joints 2–7 each with long bristle; 8th joint with 2 bristles; natatory hairs not visible on bristles.

Mandible: Coxale endite not examined in detail but same type as on adult (Figure 45*c–e*). Basale (Figure 45*e*): with 4 triangular terminal teeth, 1 long distal lateral bristle, 1 long anterior bristle near midlength; 2 short distal posterior bristles; 2 long medial bristles near dorsal margin. Endopodite (Figure 45*e*): 1st joint without bristles; 2nd joint with 1 dorsal bristle and ventral spines; 3rd joint with 1 very long bristle and 3 shorter bristles.

Maxilla (Figure 45*f*): Endite bristles not counted. Coxale with long spinous dorsal bristle. Basale with 1 long ventral bristle. Endopodite: 1st joint with dorsal hairs and 2 long bristle; 2nd joint with 4 bristles.

Fifth Limb (Figure 45*g*): Well developed. Epipodite with about 11 bristles in 3 groups; Exopodite: 1st joint with long dorsal bristle and 2 shorter ventral bristles; 2nd joint without bristles; 3rd joint with 1 long bristle.

Sixth and Seventh Limbs: Absent.

Furca (Figures 44*b*, 45*h*): Each lamella with 1 long anterior articulated claw, 1 smaller unarticulated claw on anteroventral corner, and 1 small unarticulated ventral claw (tip appears broken off on both lamellae of USNM 194302 #2. Unpaired process on posterior of body just proximal to lamellae.

Bellonci Organ: Similar to that of adult.

Upper Lip (Figure 45*i*) *and Posterior of Body* (Figure 45*h*): Similar to those of adult.

TABLE 8.—Some meristic characters of *Danielopolina mexicana*. (A = absent, L = long, P = present, S = short.)

Stage	Average carapace length (mm)	6th limb	7th limb	Furcal claws	1st antenna bristles of 5th joint	2nd antenna bristles of 1st endopodial joint	5th limb stout bristles of 3rd exopodial joint	Mandibular dorsal bristles of 2nd endopodial joint
Instar I	0.38	A	A	3	1S	0	1	1
Instar II	0.42	A	A	4	1S	1	2	2
?A–1 female	0.66	P	P	7	1L	2	3	2
Adult female	0.81	P	P	7	1L	2	3	2

DESCRIPTION OF INSTAR II (A–4) (sex unknown) (Figures 43, 44*c–f*, 46, 47).—Each valve with anterior, anteroventral, and anterodorsal processes (Figure 44*c,e*).

Ornamentation (Figure 44*c,e*): Surface reticulate and with few papillae.

Carapace Size (mm) (Figure 43): USNM 194302 #3, length with anterior process 0.48, length excluding anterior process 0.43, height with processes 0.40, height excluding processes 0.37. USNM 194302 #1, right valve, length with anterior process 0.46, length excluding anterior process 0.41, height with posterodorsal process 0.38, height excluding posterodorsal process 0.36.

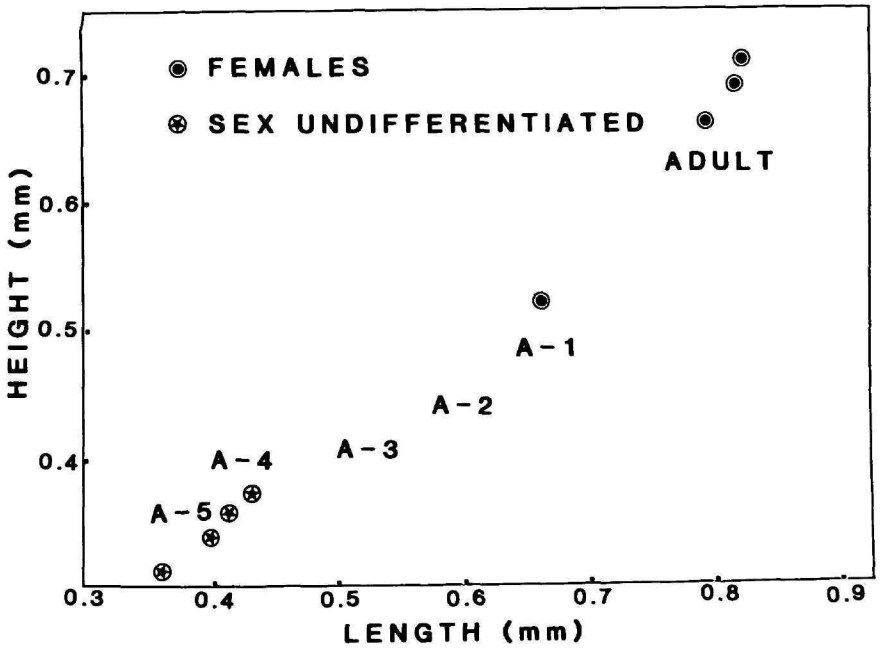


FIGURE 43.—Length-height distribution of growth stages of *Danielopolina mexicana* Kornicker and Iliffe, 1989.

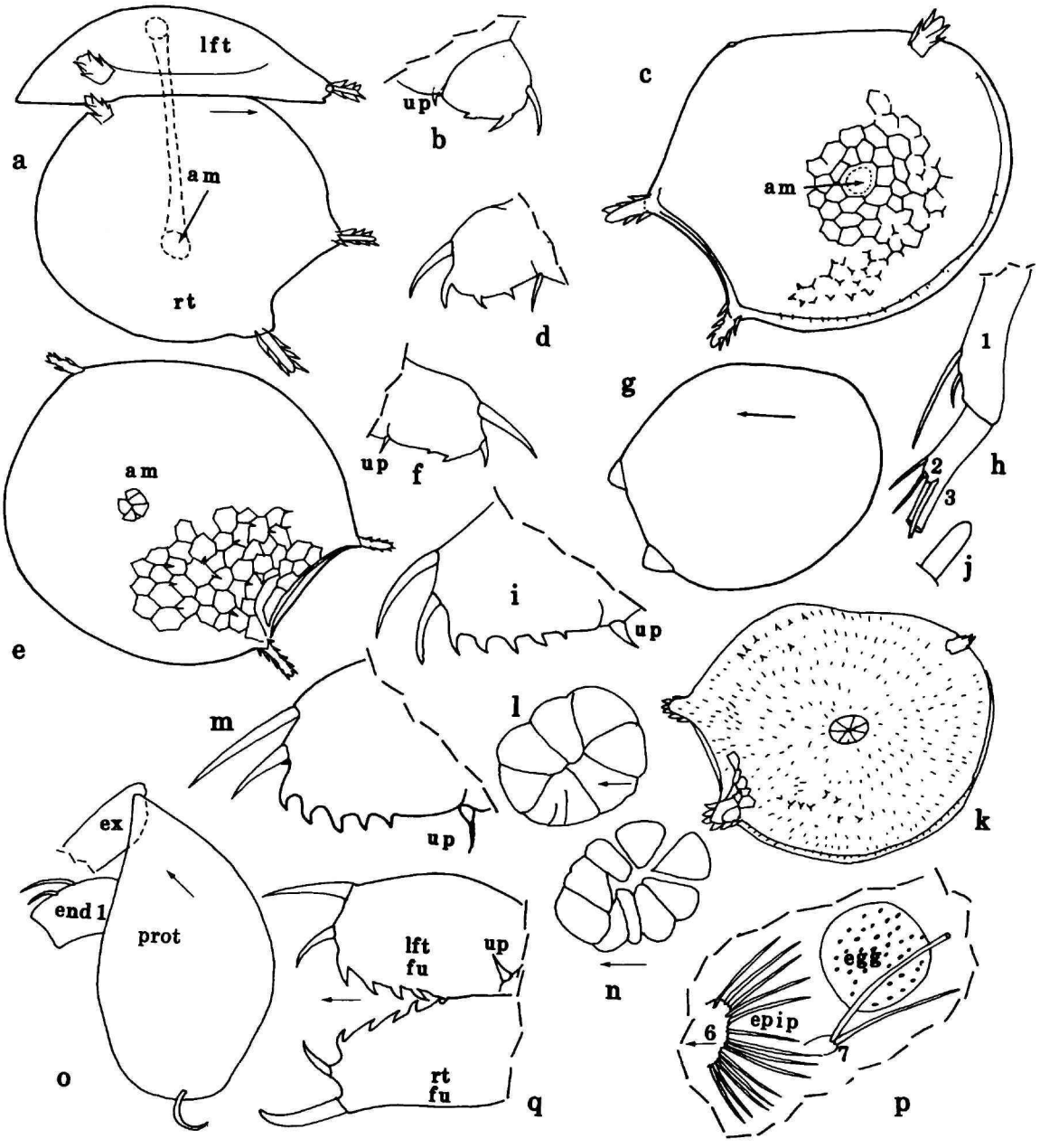


FIGURE 44.—*Danielopolina mexicana* Kornicker and Iliffe, 1989, USNM 194302 #2, Instar I (A–5) (sex unknown): *a*, right valve from right side and dorsal view of left valve (outline of central adductor muscle dashed), length excluding anterior process 0.36 mm; *b*, right lamella of furca. USNM 194302 #3, Instar II (A–4) (sex unknown): *c*, complete specimen from left side showing representative surface reticulations and spines, length excluding anterior process 0.43 mm; *d*, left lamella of furca. USNM 194302 #1, Instar II (A–4) (sex unknown): *e*, complete specimen from right side showing representative reticulations and spines, length excluding anterior process 0.41 mm; *f*, right lamella of furca. USNM 194301, Instar IV? (?A–1 female): *g*, outline of left valve, length without anterior process 0.66 mm, ov; *h*, endopodite left 2nd antenna, lv; *i*, left lamella of furca; *j*, Bellonci organ. USNM 194303 #1, adult female: *k*, complete specimen from left side, length excluding anterior process 0.79 mm; *l*, central adductor muscle attachments left valve, ov; *m*, left lamella of furca. USNM 194330, adult female, length excluding anterior process 0.81 mm: *n*, central adductor muscle attachments left valve, ov; *o*, part of left 2nd antenna, lv; *p*, part of posterior of body from left side; *q*, dorsal view of flattened furca.

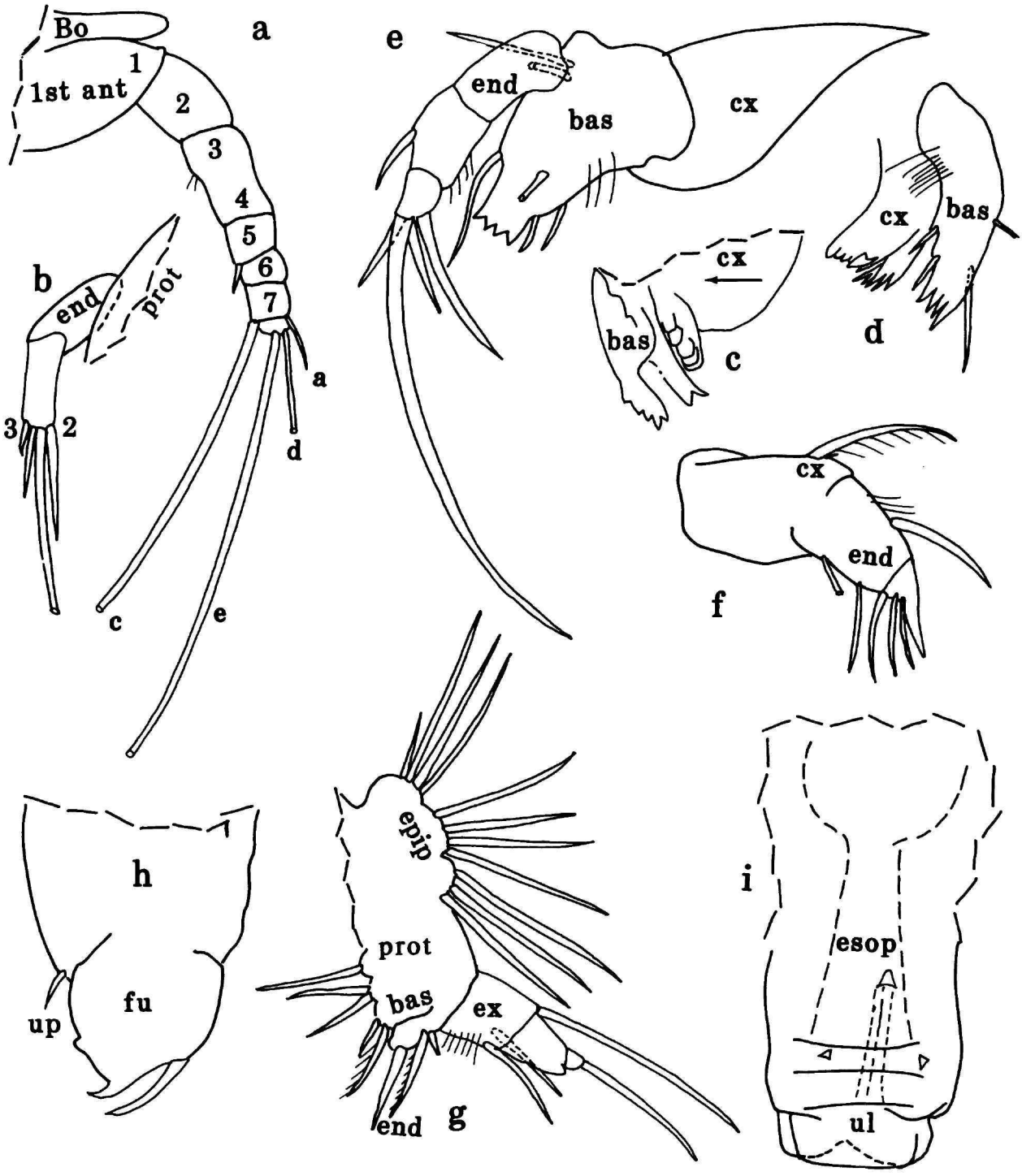


FIGURE 45.—*Danielopolina mexicana* Kornicker and Iliffe, 1989, USNM 194302 #2, Instar I (A–5) (sex unknown): *a*, left 1st antenna (mv) and Bellonci organ; *b*, part left 2nd antenna, lv; *c*, distal end of coxale endite of left mandible, lv; *d*, part right mandible, lv; *e*, part left mandible, lv; *f*, right maxilla (endite bristles not shown), mv; *g*, right 5th limb, mv; *h*, left lamella of furca (mv) and unpaired process; *i*, anterior of body showing upper lip and esophagus.

FIGURE 46.—*Danielopolina mexicana* Kornicker and Iliffe, 1989, USNM 194302 #3, Instar II (A–4) (sex unknown): *a*, endopodite right 2nd antenna, lv; *b*, endopodite left 2nd antenna, mv; *c*, basale right mandible, lv; *d*, endopodite left mandible, lv; *e*, right maxilla (nabs), lv; *f*, right lamella of furca, lv; *g*, left lamella of furca (mv) and unpaired process.

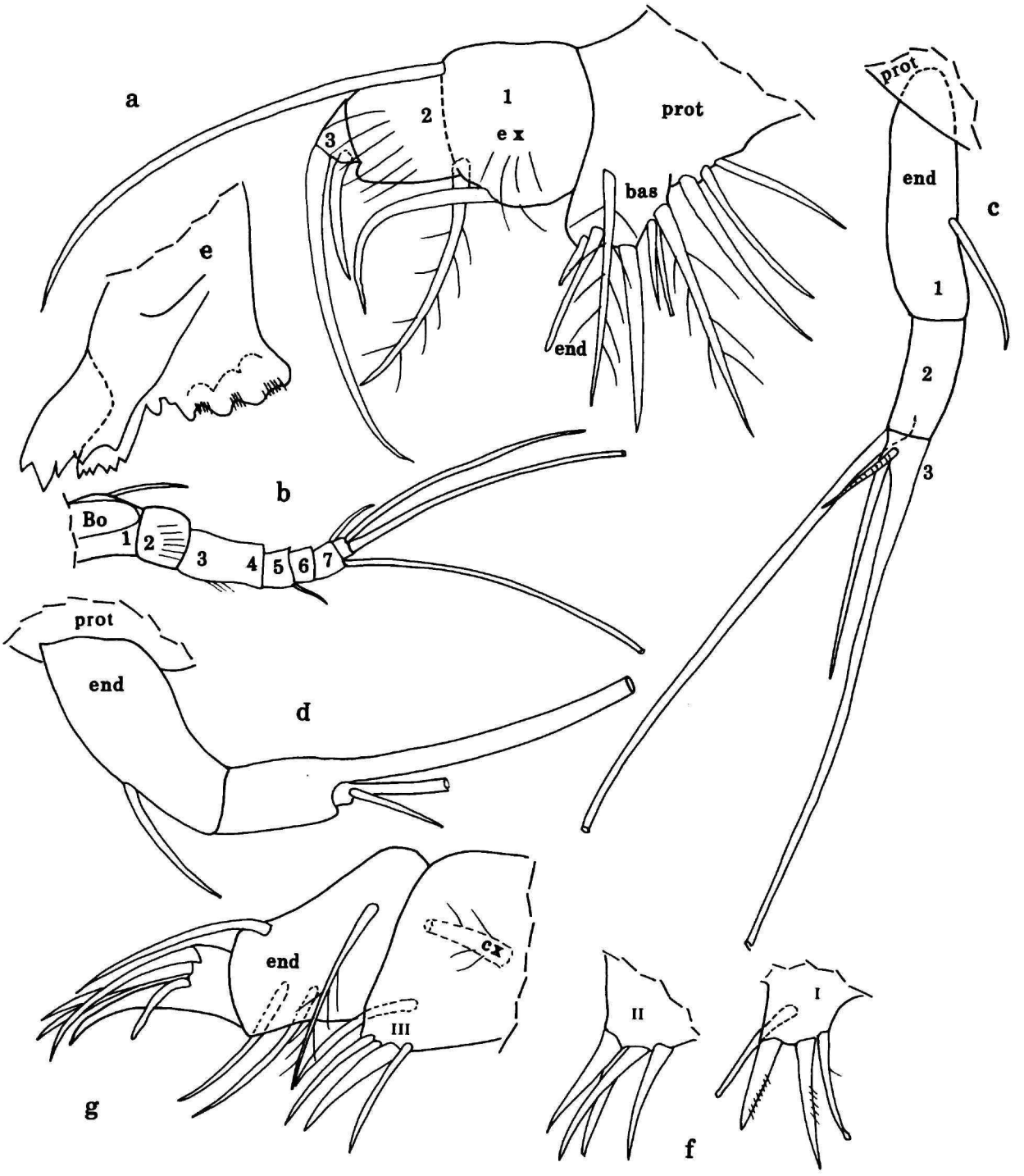


FIGURE 47.—*Danielopolina mexicana* Kornicker and Iliffe, 1989, USNM 194302 #3, Instar II (A–4) (sex unknown): *a*, right 5th limb (epipodite not shown), lv. USNM 194302 #1, Instar II (A–4) (sex unknown): *b*, left 1st antenna (mv) and Bellonci organ; *c*, endopodite left 2nd antenna (endopodite twisted) (mv); *d*, endopodite right 2nd antenna, mv; *e*, tip coxale endite right mandible (lv); *f*, endites left maxilla, mv; *g*, left maxilla (endites I and II not shown), mv.

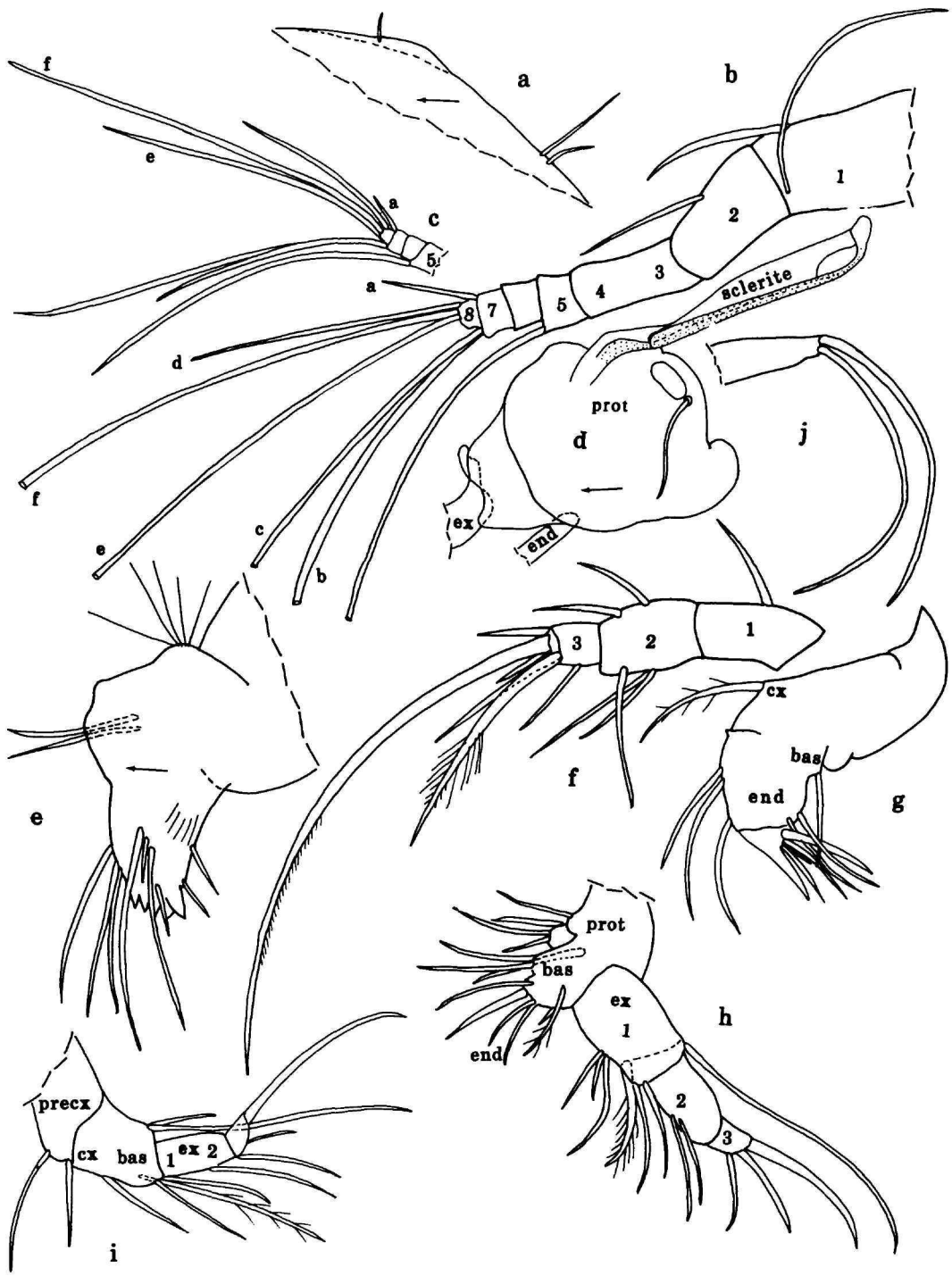


FIGURE 48.—*Danielopolina mexicana* Kornicker and Iliffe, 1989, USNM 194301, Instar IV? (?A–1), female: *a*, posterodorsal corner left valve (length of valve including anterior process 0.70 mm), ov: *b,c*, left 1st antenna, lv; *d*, part left 2nd antenna, lv; *e,f*, basale and endopodite, respectively, left mandible, lv; *g*, left maxilla (nabs), lv; *h*, left 5th limb, lv; *i*, left 6th limb (nabs), lv; *j*, left 7th limb, lv.

First Antenna (Figure 47*b*): 1st joint with dorsal bristle. 2nd joint with spines. 3rd and 4th joints fused; 3rd joint with spines. 5th joint with short ventral bristle. 6th joint bare. 7th joint with short a-bristle and long c-bristle. 8th joint with slender d-bristle and long stout e-bristle.

Second Antenna: Protopodite bare. Endopodite 3-jointed but with 2nd and 3rd joints fused (Figures 46*a,b,* 47*c,d*): 1st joint with dorsal bristle; fused 2nd and 3rd joints with 2 long, 1 medium, and 1 short bristle (medium bristle not observed on right limb of USNM 194302 #1 (Figure 47*d*)). Exopodite: 1st joint undivided, without bristle; joints 2–7 each with long bristle with distal natatory hairs; 8th joint with 2 bristles.

Mandible: Coxale endite of similar type as adult (Figure 46*c,d*). Basale (Figure 46*c*): with 5 triangular terminal teeth, 1 long anterior bristle at 2/3 length, 2 short distal posterior bristles, 2 long lateral bristles near midlength, and 2 medial bristles at 1/4 length. Endopodite (Figure 46*d*): 1st joint with dorsal bristle (appears medial on illustrated limb under coverslip); 2nd joint with 2 dorsal bristles; 3rd joint with 4 terminal bristles.

Maxilla (Figures 46*e,* 47*f,g*): With 3 endites each with 3 or 4 bristles (Figure 47*f,g*). Coxale with spinous dorsal bristle. Basale with long distal ventral bristle (appears medial on illustrated limb under cover slip). Endopodite: 1st joint with 4 long bristles; 2nd joint with 5 bristles.

Fifth Limb (Figure 47*a*): Well developed. Exopodite: 1st joint with long dorsal bristle and 2 shorter ventral bristles; 2nd joint with spines; 3rd joint with 2 bristles.

Sixth and Seventh Limbs: Absent.

Furca (Figures 44*d,f,* 46*f,g*): With 2 articulated anterior claws and 2 unarticulated ventral claws.

Bellonci Organ: Similar to that of adult.

Upper Lip and Posterior of Body: Similar to those of adult.

Genitalia: Absent.

DESCRIPTION OF A–1 FEMALE (INSTAR IV?) (Figures 43, 44*g–j,* 48): USNM 194301 without posterodorsal processes and surface reticulations and spines (probably broken off) (Figure 44*g*).

Carapace Size (mm) (Figures 43, 48*a*): USNM 194301, length with triangular anterior process 0.70, length excluding anterior process 0.66, height 0.52.

First Antenna (Figure 48*b,c*): As illustrated.

Second Antenna: Protopodite with proximal lateral bristle (Figure 48*d*). Endopodite (Figure 44*h*): 1st joint with 2 dorsal bristles (distal about 1/2 length of proximal); 2nd joint with 1 short dorsal bristle and 3 long terminal bristles; 3rd joint small dorsal, fused to 2nd, with small terminal bristle. Exopodite: 1st joint divided into long proximal and short distal parts and without bristle. Joints 2–7 each with bristle with natatory hairs; 8th joint with 2 bristles.

Mandible: Coxale endite not examined. Basale (Figure 48*e*) and endopodite (Figure 48*f*) similar to those of adult female.

Maxilla (Figure 48*g*), *Fifth Limb* (Figure 48*h*), *Sixth Limb* (Figure 48*i*), *Seventh Limb* (Figure 48*j*), *Bellonci Organ* (Figure 44*j*), *and Posterior of Body:* Similar to those of adult female.

Furca (Figure 44*i*): With 2 articulated anterior claws and 5 unarticulated shorter ventral claws (last claw smaller than others; anlage?).

REMARKS.—USNM 194301 is questionably interpreted to be an A–1 instar solely on the size of the carapace. The size and morphology of appendages of the specimen and those of adult females are similar. The specimen is interpreted to be a female because of the lack of a male copulatory organ. It is quite possible, perhaps likely, that the specimen is an unusually small adult female.

SUPPLEMENTARY DESCRIPTION OF ADULT FEMALE (Figures 43, 44*k–q*).—Carapace with abundant spine-like papillae (Figure 44*k*).

Central Adductor Muscle Attachments (Figure 44*k,l,n*): With 8 or 9 wedge-shaped more or less radially arranged attachments.

Carapace Size (mm) (Figure 43): USNM 194303, length with anterior process 0.84, length excluding anterior process 0.79, height 0.66. USNM 194330, length with anterior process 0.87, length excluding anterior process 0.81, height 0.69.

Second Antenna: Protopodite with bristle near posterior edge (Figure 44*o*).

Fifth Limb: Well developed, with 3 bristles on terminal joint.

Sixth Limb: Epipodite with bristles forming 3 groups with 5 bristles each in posterior and ventral groups and 4 bristles in middle group (Figure 44*p*). Remaining parts of appendage well developed.

Seventh Limb (Figure 44*p*): Well developed.

Furca (Figure 44*m,q*): With 2 articulated anterior claws and 5 shorter well-developed unarticulated ventral claws. Unpaired bristle on body proximal to lamellae.

Bellonci Organ: Not observed on USNM 194330 (probably broken off).

Eggs: USNM 194330 with large unextruded egg (Figure 44*p*), diameter of egg 0.036 mm.

Danielopolina wilkensi Hartmann, 1985

FIGURE 49

Danielopolina wilkensi Hartmann, 1985:255, figs. 1–8.—Kornicker and Iliffe, 1995:16, figs. 8–13.

HOLOTYPE.—K 32644, female, Zoological Museum Hamburg.

MATERIAL.—Sta 94-034, USNM 194433, undissected Instar I in alcohol.

DISTRIBUTION.—Atlantida Tunnel, Jameos del Aqua lava tube (type locality) (Jameo de Los Lagos and Cueva de Los

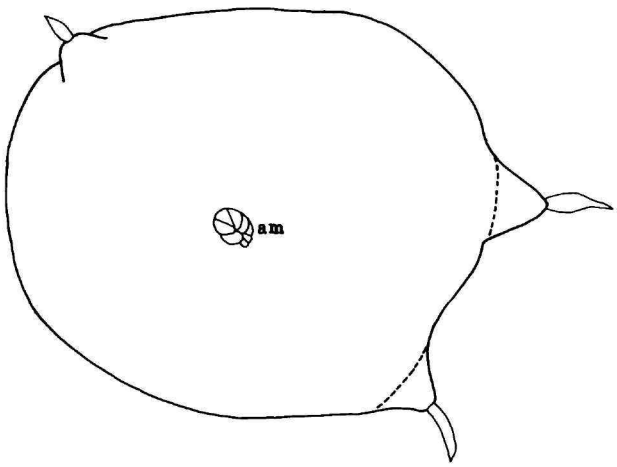


FIGURE 49.—*Danielopolina wilkensi* Hartmann, 1985, USNM 194433, complete specimen from right side, length without diaphanous anterior extension 0.30 mm.

Lagos are the same locality), Lanzarote, Canary Islands.

REMARKS.—Wilkens et al. (1986:225) reported *D. wilkensi* in wells at Punta Mujeres and Los Marmoles on Lanzarote. An attempt was made by the junior author to resample ostracodes from those wells. The Punta Mujeres well had collapsed and had trash dumped into it so that it is no longer possible to reach water level. A plankton net dropped into the older disused well of the desalination plant at Los Marmoles yielded 17 copepods and one juvenile polychaete, but no ostracodes. It was difficult to effectively sample the well, located only about 20 m inland from the coast, because permission to enter the water was not granted. Wells at Los Cocoteros and Los Charcos, which had been reported by Wilkens et al. (1986, fig. 1) to not have ostracodes, also were resampled and they yielded copepods and one amphipod, but no ostracodes.

SUPPLEMENTARY DESCRIPTION OF INSTAR I (Figure 49).—Carapace with anterior, anteroventral, and posterodorsal triangular processes each with diaphanous extension (Figure 49).

Ornamentation: Reticulations missing on preserved specimen.

Carapace Size (mm): USNM 194433, length with diaphanous extension on triangular anterior process 0.35, length without extension 0.30, height without processes 0.24.

Appendages: Terminal joint of 5th limb with 1 bristle. 6th and 7th limbs absent. Each lamella of furca with 3 claws.

REMARKS.—The lack of reticulations on the carapace is not unusual in preserved specimens and presumably has been dissolved. The specimen is identified as Instar I by the presence of only one bristle on the end joint of the 5th limb, the absence of 6th and 7th limbs, and the presence of only three furcal claws (see Kornicker and Iliffe, 1995:25).

Danielopolina exuma, new species

FIGURES 50–60

ETYMOLOGY.—The specific name is from the island group where the species was collected (noun in apposition).

HOLOTYPE.—USNM 194305, undissected adult female in alcohol.

TYPE LOCALITY.—Sta 93-002: Norman's Pond Cave, Norman's Pond Cay, Exuma Cays, Great Bahama Bank, from water column in 10–25 m depth, salinity 36 ppt.

PARATYPES.—Norman's Pond Cave: Sta 93-003: USNM 194262, A–1 female on slide and in alcohol; USNM 194263, adult female on slide and in alcohol. Sta 93-004: USNM 194304A, 194304C, 2 undissected A–1 females in alcohol; USNM 194304B, undissected A–1 instar in alcohol. Sta 94-010: USNM 194421, dissected A–3 instar on slide and in alcohol. Sta 94-012: USNM 194420, undissected adult female in alcohol; USNM 194432A, undissected A–3 instar in alcohol; USNM 194432B, undissected A–2 instar in alcohol. Sta 94-013: USNM 194417, adult male on slide and in alcohol; USNM 194418, 2 undissected adult females in alcohol; USNM 194422, partly dissected A–1 female in alcohol; USNM 194424, partly dissected A–4 instar in alcohol; USNM 194425, partly dissected A–3 instar in alcohol; USNM 194431A–F, 6 undissected A–3 instars in alcohol; USNM 194431G, 1 undissected A–4 instar in alcohol. Sta 94-016: USNM 194419, undissected adult female in alcohol; USNM 194428, partly dissected A–4 instar in alcohol; USNM 194429, partly dissected A–3 instar in alcohol; USNM 194423B, dissected A–2 instar on slide and in alcohol; USNM 194426, partly dissected A–2 instar in alcohol; USNM 194423A, 194423C, 2 undissected juveniles in alcohol; USNM 194427, dissected A–4 instar on slide; USNM 194430A–C, 3 undissected A–4 instars in alcohol. Sta 95-003: adult female in alcohol.

DISTRIBUTION.—Great Bahama Bank: Norman's Pond Cave, Norman's Pond Cay, Lee Stocking Island, Exuma Cays, (Sta 93-002, 93-003, 93-004, 94-010, 94-012, 94-013, 94-016, 95-003), from water column in 10–35 m depth, and from fine silt on ledges at 6 m depth, salinity 36 ppt.

DESCRIPTION OF ADULT FEMALE (Figures 50–52).—Carapace subround in lateral view with fairly straight margin between anterior and anteroventral processes (Figure 51*b*); hinge line appearing straight in medial view, but margin in vicinity of hinge convex in lateral view; ventral, dorsal, and posterior margins as well as anterior margin dorsal to anterior process evenly rounded. Short anterior and anteroventral processes with bases just lateral to valve edge; each process bearing small cylindrical terminal process and fragile spine-bearing frill that easily breaks off at slight touch with dissecting needle leaving small firm triangular protuberance; a similar posterodorsal process in same place on each valve (Figure 51*a,b*). Outer surface of valve with few scattered bristles more numerous along edges, mostly undivided but a few along

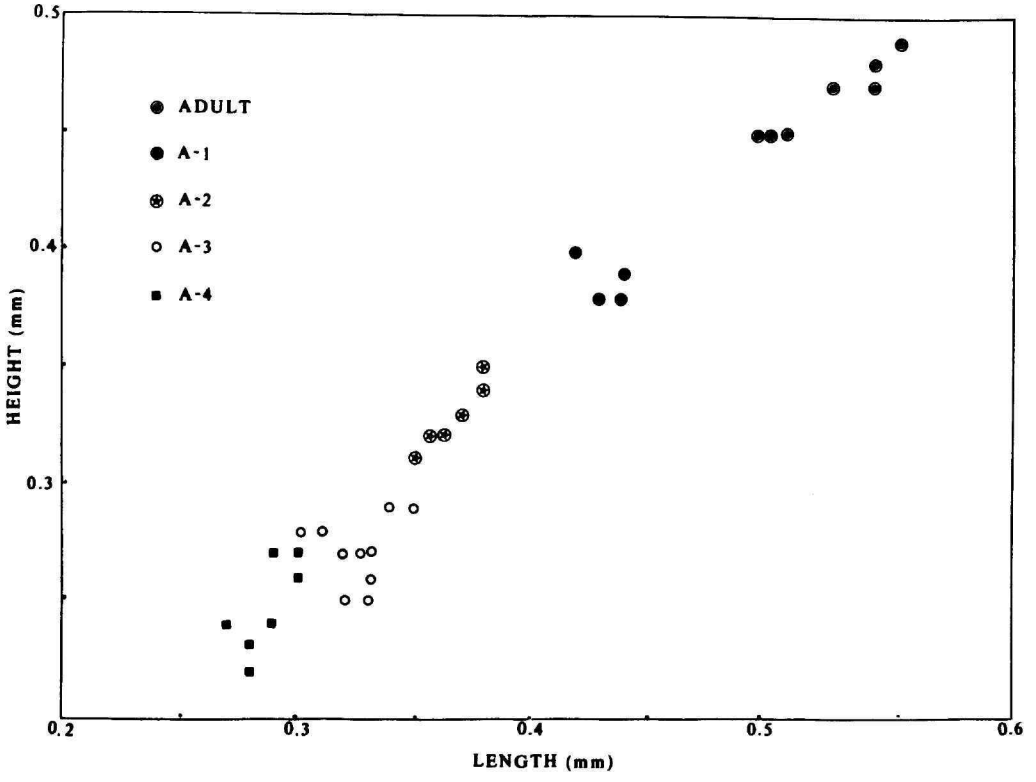


FIGURE 50.—Length-height distribution of growth stages of *Danelopolina exuma*, new species.

anteroventral edge with divided tip (Figure 51*c*).

Ornamentation (Figure 51*a,b*): Surface finely reticulate with reticulation walls formed of minute subelliptical closely spaced papillae; most papillae with rounded tips (Figure 51*a*) but some pointed (2 pointed papillae shown near ventral margin of valve in Figure 51*b*).

Central Adductor Muscle Attachments: Comprising 6 more or less radially arranged attachments (Figure 51*b*). Crescent-shaped scar anteroventral to muscle attachments (Figure 51*b*).

Carapace Size (mm) (Figure 50): USNM 194263, length without processes 0.54, height without processes 0.47. USNM 194305, holotype, length without processes 0.50, length with anterior process 0.62, height without processes 0.45. USNM 194418, 2 specimens: length without processes 0.53, length with anterior process 0.59, height without processes 0.47; length without processes 0.53, length with anterior process 0.58, height without processes 0.48. USNM 194419, length without processes 0.50, length with anterior process, 0.58, height without processes 0.45. USNM 194420, length without processes 0.55, length with anterior process 0.60, height without processes 0.51. USNM 194454, length without processes 0.53, length with anterior process 0.62, height without processes 0.47.

First Antenna (Figure 51*d–f*): 1st joint with 2 bristles (1 very long ventral with base lateral and oriented posteriorly; 1 fairly long dorsal (dorsal bristle missing on illustrated left limb of USNM 194263)). 2nd joint at right angle to 1st joint, with distal medial spines and fairly long dorsal bristle (tip missing on illustrated left limb of USNM 194263). 3rd and 4th joints fused but place of boundary indicated by slight indentation on ventral margin; neither joint with bristles. 5th joint with long ventral filament with indistinct minute widely separated marginal spines. 6th joint bare. 7th joint with 2 ventral bristles (medial b-bristle shorter and slenderer than lateral c-bristle). 8th joint with 3 bristles (dorsal d-bristle shorter, ringed in proximal half, and with closely spaced short marginal spines; long stout lateral filament-like e-bristle with minute widely spaced marginal spines and proximal rings; and medial filament-like f-bristle shorter and narrower than e-bristle and with indistinct widely spaced minute marginal spines).

Second Antenna: Protopodite bare. Endopodite 3-jointed but with 2nd and 3rd joints fused (Figure 51*g,h*): 1st joint with dorsal a- and b-bristles; 2nd joint with minute lateral spine-like bristle near dorsal margin and 2 long terminal bristles; 3rd joint narrow with short terminal bristle. Exopodite

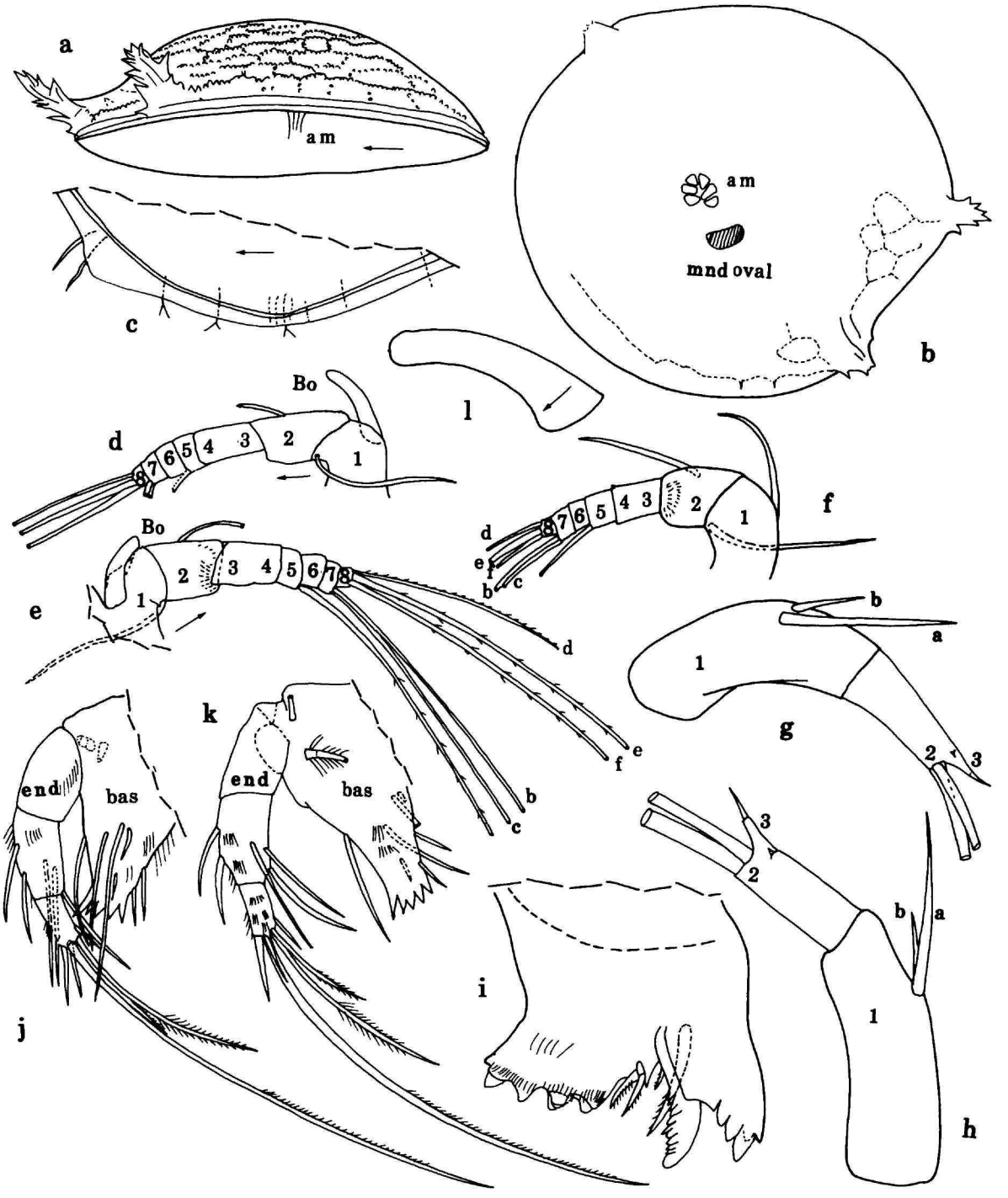


FIGURE 51.—*Danielopolina exuma,* new species, holotype, USNM 194305, adult female: *a,* ventral view (slightly oblique) left valve. Paratype, USNM 194263, adult female: *b,* complete specimen from right side (only few reticulations shown), length without processes 0.54 mm; *c,* anteroventral edge right valve, iv; *d,e,* lateral and medial views, respectively, of Bellonci organ and left 1st antenna; *f,* right 1st antenna, mv; *g,h,* endopodites of right and left 2nd antennae, respectively, lv; *i,* coxale endite left mandible, lv; *j,* basale and endopodite left mandible, lv; *k,* basale and endopodite right mandible, mv; *l,* Bellonci organ from left side.

8 jointed: 1st joint divided weakly into long proximal and short distal parts; bristle of joints 2–7 long with indistinct natatory hairs; 8th joint with 2 bristles (shorter bristle about 1/3 length of longer and with short ventral hairs, other with long natatory hairs).

Mandible: Coxale endite with proximal and distal sets of teeth separated by space; proximal set comprising 4 broad cusps plus triangular tooth close to distal set of teeth (Figure 51*i*); surface between cusps and surfaces just proximal to cusps with slender spines; 2 spinous bristles with bases just proximal and another with base just distal to triangular tooth; distal set of teeth consisting of 2 flat teeth (distal with 7 cusps, proximal with about 10 smaller cusps); 1 slender spinous bristle with base proximal to distal set of teeth. Basale (Figure 51*j,k*): tooth of endite with 5 triangular cusps (anterior 4 with marginal teeth); posterior edge of endite spinous, with 2 short ringed distal bristles (distal of these tubular with flaring tip; proximal tending to be tubular but with pointed tip); anterior margin of endite with long ringed bristle near midlength; lateral side of endite with spines near posterior edge and 3 ringed bristles (2 long, 1 short) near midlength and 1 short distal bristle with spine at tip; medial side near midlength with long spines; medial side near dorsal margin with 2 long ringed bristles (ventral of these with long spines). Endopodite 3-jointed (Figure 51*j,k*): 1st joint with lateral spines; 2nd joint spinous, with 1 ringed terminal ventral bristle, 2 ringed medial bristles near ventral margin, and 2 ringed dorsal bristles; 3rd joint with dorsal and medial spines, 2 terminal lateral bristles (1 at midwidth about twice length of endopodite, with distal spines; 1 at ventral edge about 1/2 length of bristle at midwidth, with distal spines (longest spines at midlength)), 3 shorter ringed terminal medial bristles, and 1 ringed subterminal bristle on ventral margin.

Maxilla: Endite I with about 9 bristles (3 tubular); endite II with about 5 bristles (2 tubular) (Figure 52*a*); endite III with about 4 bristles (1 tubular). Coxale with long spinous dorsal bristle (broken off on illustrated limbs). Basale with 2 long bristles (1 proximal ventral (with long hairs) near base of endite III, 1 medial on terminal edge, tubular) (Figure 52*b,c*). Endopodite (Figure 52*b,c*): 1st joint: hirsute, with 3 dorsal bristles and 3 distal bristles on or near ventral margin; 2nd joint with stout, straight, unringed, nonarticulated, terminal claw and 3 or 4 ringed articulated bristles (1 medial tubular, 2 or 3 lateral (longest somewhat claw-like spinous).

Fifth Limb (Figure 52*d–f*): Epipodite with plumose bristles forming 3 groups, each with 4 or 5 bristles. Protopodite with 3 or 4 bristles. Basale with 5 bristles (1 short stout medial, 1 short slender medial proximal, 1 tubular, 2 long lateral with long spines)). Endopodite with 6 bristles (1 short medial tubular, 2 stout ventral claw-like, 1 long ventral tubular, 2 long plumose anterior). Exopodite 3-jointed: 1st joint separated by suture in ventral half into proximal part with 3 bristles on or near ventral margin and 1 long dorsal bristle, and distal part with 2 ventral bristles; 2nd joint with 2 ventral bristles at midlength; 3rd joint with 3 bristles (middle bristle 46%–54% and smallest bristle 26%–28% of longest bristle).

Sixth Limb (Figure 52*g,h*): Epipodite with plumose bristles forming 3 groups, each with 4 or 5 bristles. Precoxale with 3 plumose bristles. Coxale with 2 plumose bristles. Basale with 1 plumose bristles. Small endopodite with 2 unequal plumose bristles. Exopodite: 1st and 2nd joints fused, with 2 bristles at midlength; 3rd joint with 2 bristles (long terminal bristle broken off in Figure 52*h*).

Seventh Limb (Figure 52*i*): Elongate with 2 long terminal bristles.

Furca (Figure 52*k,l*): Each lamella with 2 long articulated anterior claws and 3 short nonarticulated ventral claws; all claws with spines along posterior margin; claw 1 indistinctly ringed; each lamella with minute medial spines along ventral margin. Stout unpaired process on posterior of body just proximal to furca.

Bellonci Organ (Figure 51*d,e,l*): Small but well defined, with rounded tip.

Lips: Each side of tip of upper lip with small process oriented posteriorly (Figure 52*m*); anterior face of lip with minute broad spine pointing anteriorly. Lower lip a triangular process at each side of mouth (Figure 52*n*).

Genitalia: None observed.

Eggs: USNM 194263 with several unextruded eggs (Figure 52*l*).

Gut Content: Brown unidentified particles.

DESCRIPTION OF ADULT MALE (Figures 50, 53–55).—Carapace similar to that of adult female (Figure 53*a*).

Carapace Size (mm) (Figure 50): USNM 194417, length without processes 0.51, length with anterior process 0.58, height without processes 0.45.

First Antenna (Figure 53*b*): Joints 1, 2, 6–8 similar to those of adult female. 3rd and 4th joints separated by very weak suture on lateral side only; 4th joint with 2 long ventral bristles. 5th joint with 3 long ventral bristles.

Second Antenna: Protopodite and endopodite similar to those of adult female. Endopodite 3-jointed (Figure 53*c,d*): 1st joint with dorsal a- and b-bristles similar to those of adult female; 2nd joint with short terminal lateral bristle near dorsal margin and row of 4 longer bristles closer to ventral margin; 3rd joint with long slender proximal process on dorsal margin; bent knob-like tip with 2 spines and minute teeth; endopodites of left and right limbs similar.

Mandible (Figure 54*a–e*): Except for basale having additional long lateral bristle near midlength (Figure 54*d*), mandible similar to that of adult female.

Maxilla (Figure 54*f*): Similar to that of adult female (endite bristles not counted). Bristle observed on dorsal margin of coxale prior to dissection but broken off on illustrated limb.

Fifth Limb (Figure 55*a*), *Sixth Limb* (Figure 55*b*), *Seventh Limb* (Figure 53*e*), *Furca* (Figure 53*f*), *Bellonci Organ* (Figure 53*b*), *and Lips:* Similar to those of adult female.

Genitalia (Figure 55*c*): Single copulatory organ on left

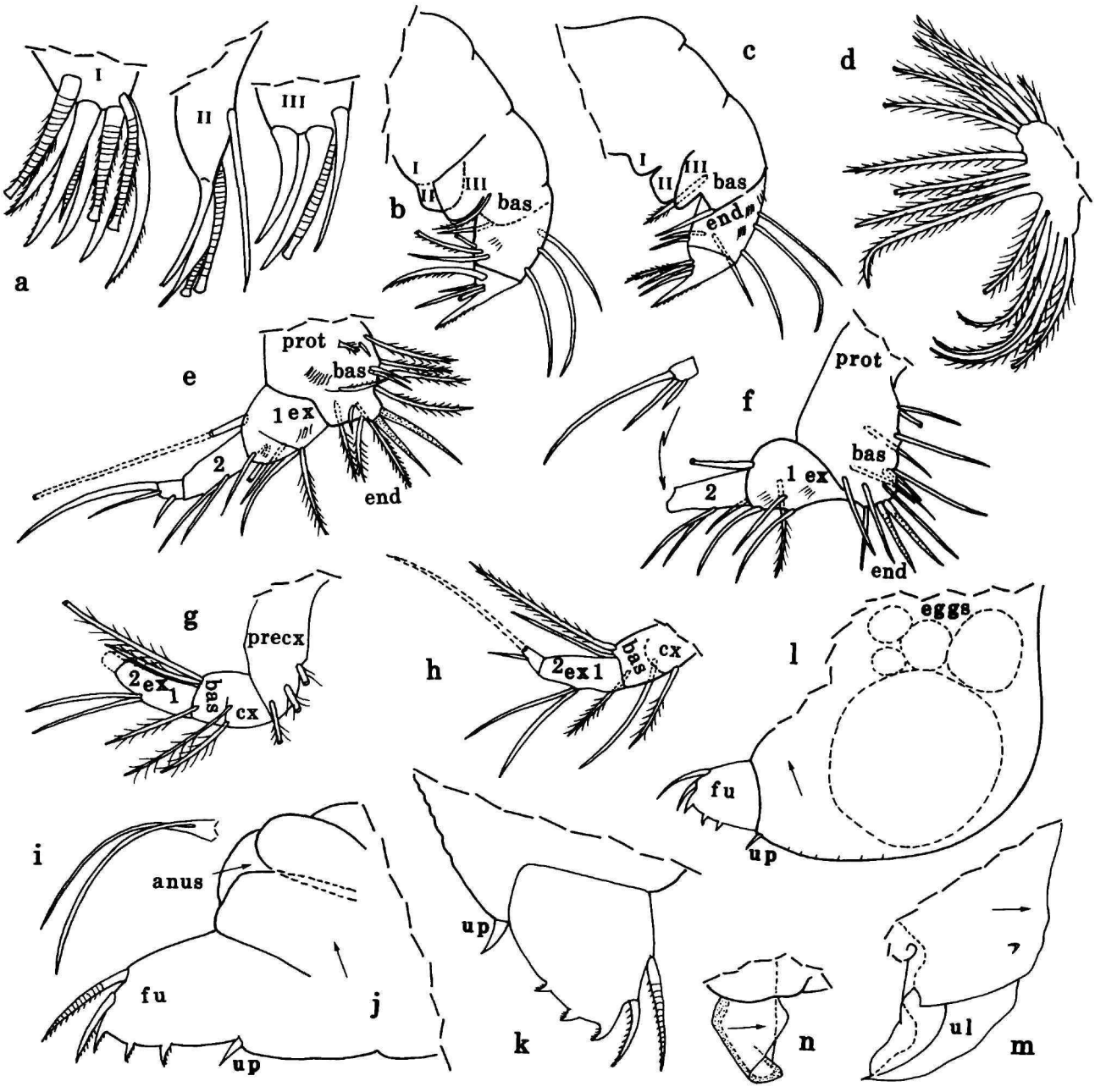


FIGURE 52.—*Danielopolina exuma*, new species, paratype, USNM 194263, adult female: *a*, endites left maxilla, mv; *b*, left maxilla (nabs), mv; *c*, right maxilla, lv; *d*, epipodial appendage of either 5th or 6th limb; *e*, left 5th limb, mv; *f*, right 5th limb, lv; *g,h*, 6th limbs (nabs); *i*, right 7th limb, lv; *j,k*, left and right lamellae, respectively, of furca, lv; *l*, posterior of body from left side; *m,n*, upper and lower lips, respectively, from right side.

side of body. Anterior part with long recurved process tapering to pointed tip. Posterior process short; tip of process obscured but may penetrate anterior part.

DESCRIPTION OF A–1 FEMALE (INSTAR IV) (Figures 50, 56, 57).—Carapace similar to that of adult female (Figures 56, 57*a–d,g*).

Carapace Size (mm) (Figure 50): USNM 194262, length without processes 0.44, length with anterior process 0.50,

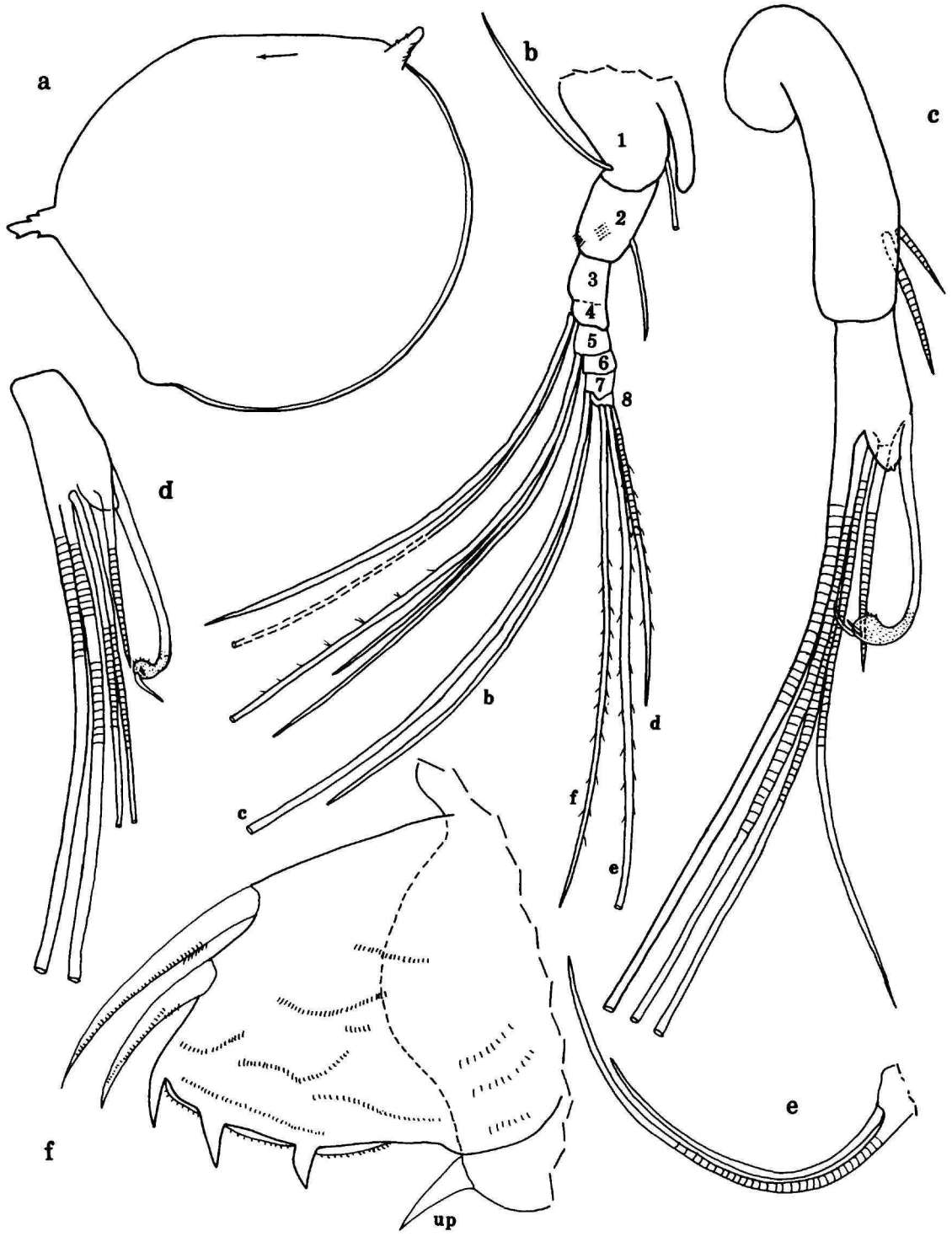


FIGURE 53.—*Danielopolina exuma*, new species, paratype, USNM 194417, adult male: *a*, complete specimen from left side, length including anterodorsal process 0.58 mm; *b*, right 1st antenna (lv) and Bellonci organ; *c,d*, endopodites of left (mv) and right (lv) 2nd antennae, respectively; *e*, left 7th limb, lv; *f*, left lamella of furca (lv) and unpaired process.

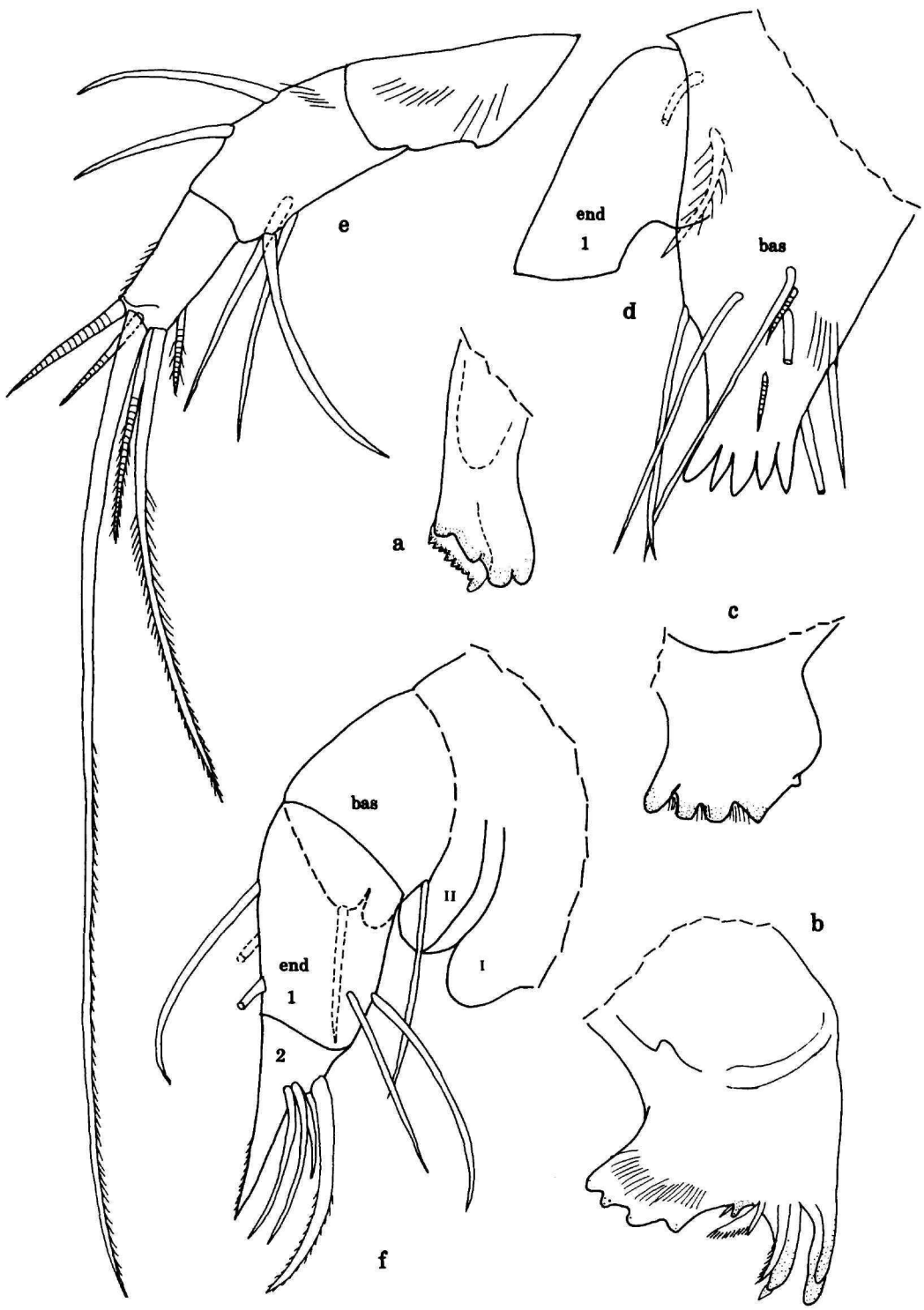


FIGURE 54.—*Danielopolina exuma,* new species, paratype, USNM 194417, adult male: *a,b,* tips coxale endite of left (lv) and right (mv) mandibles, respectively; *c,* part tip coxale endite left mandible (mv); *d,e,* basale and endopodite, respectively, of left mandible, lv; *f,* left maxilla (nabs), lv.

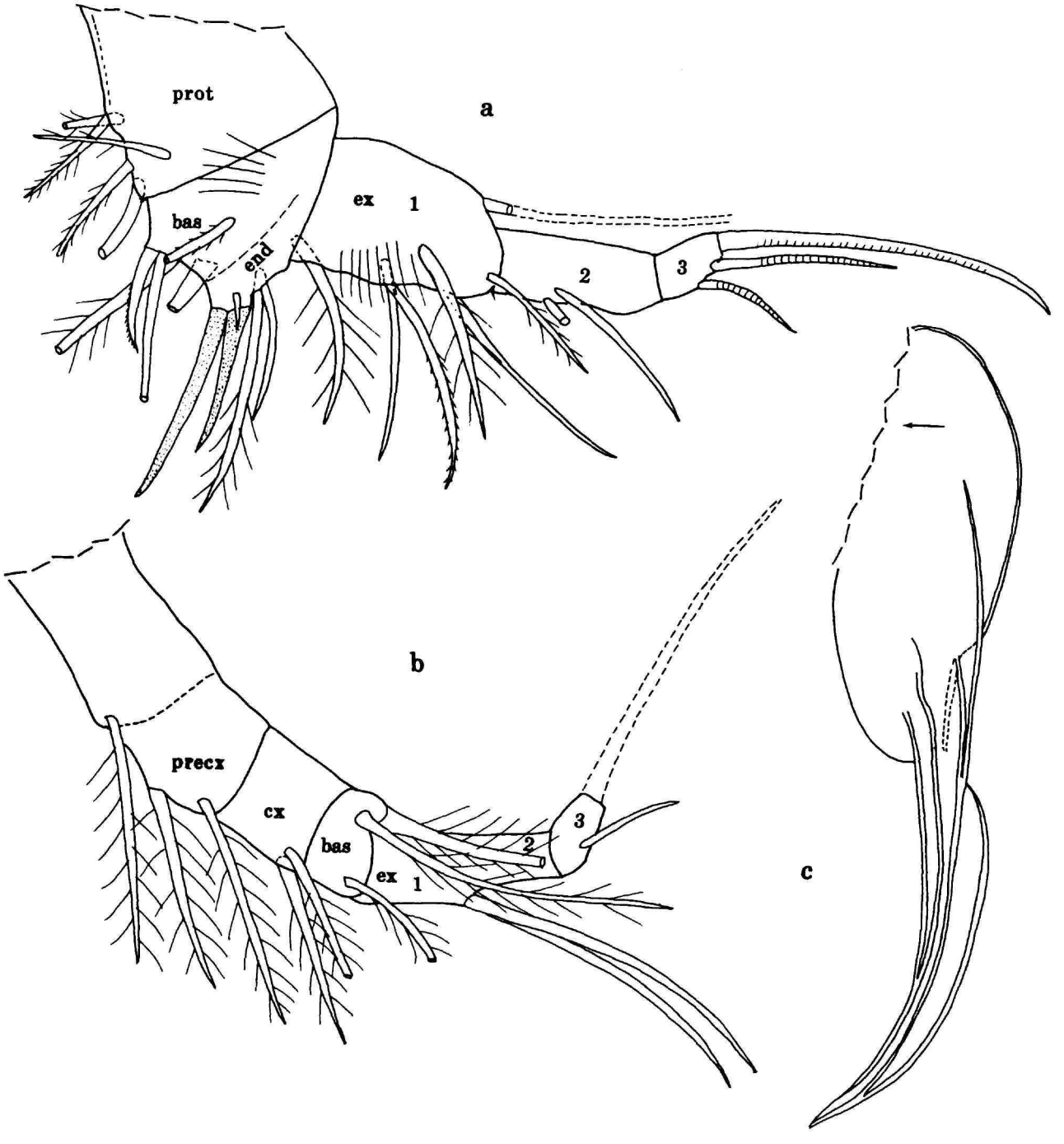


FIGURE 55.—*Danielopolina exuma*, new species, paratype, USNM 194417, adult male: *a*, 5th limb; *b*, 6th limb; *c*, copulatory organ, lv.

height without processes 0.39. USNM 194422, length without processes 0.42, length with anterior process 0.46, height without processes 0.40. USNM 194304A, length without processes 0.44, length with anterior process 0.49, height without processes 0.38. USNM 194304C, length without processes 0.43, length with anterior process 0.48, height

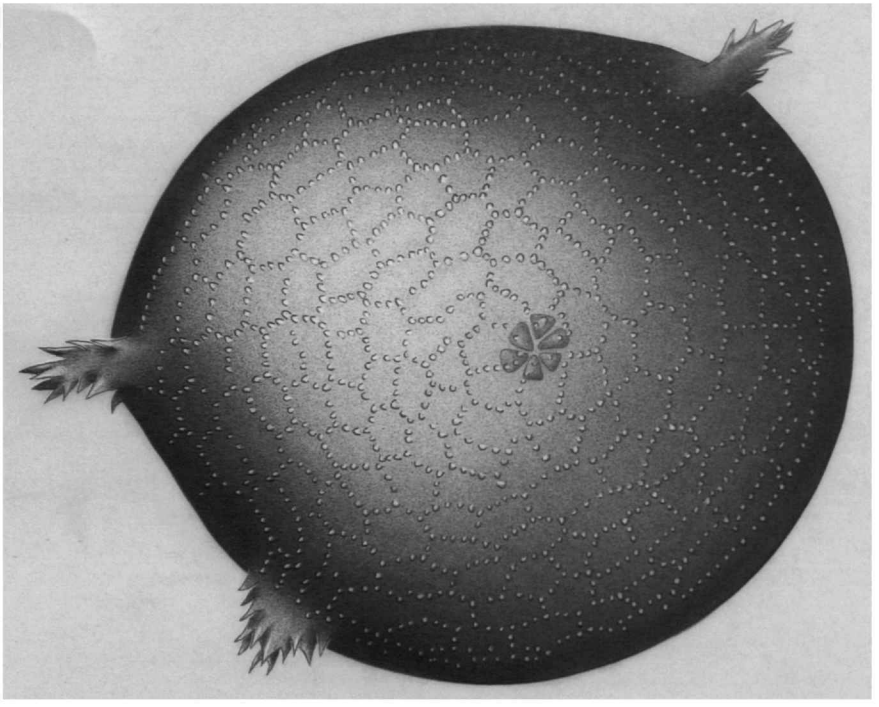


FIGURE 56.—*Danielopolina exuma*, new species, paratype, USNM 194262, A–1 female, complete specimen from left side, length 0.44 mm.

without processes 0.38.

First Antenna: Similar to that of adult female, but lateral bristle not observed on 1st joint.

Second Antenna (left limb): Protopodite and exopodite similar to that of adult female. Endopodite differs from that of adult female in having only 1 dorsal bristle on 1st joint, a longer lateral bristle on 2nd joint, and 2 bristles on elongate 3rd joint (Figure 57*e,h*).

Mandible: Not examined in detail but, in general, similar to that of adult female.

Maxilla: Dorsal margin of coxale with long bristle bearing long hairs. Remaining part of limb similar to that of adult female. Endite bristles not counted.

Fifth Limb: Not examined in detail but, in general, similar to that of adult female. 3rd exopodial joint with 3 bristles.

Sixth Limb: Not examined in detail but, in general, similar to that of adult female. Limb with about same posterior projection as 5th limb, and 3rd exopodial joint with 1 or 2 bristles.

Seventh Limb, Furca (Figure 57*h*), *Bellonci Organ, and Lips:* Similar to those of adult female.

Genitalia: None observed.

Sex and Age of Specimen: Specimen judged an A–1 instar because of its size, and probably a female because of the absence of a vestigial copulatory limb usually present on A–1 males.

DESCRIPTION OF INSTAR III (A–2) (sex unknown) (Figures 50, 58).—Carapace similar to that of adult female.

Carapace Size (mm) (Figure 50): USNM 194423A, length without processes 0.37, length with anterior process 0.42, height without processes 0.33. USNM 194423B, length without processes 0.36, height without processes 0.32. USNM 194423C, length without processes 0.34, length with anterior process 0.39, height without processes 0.31. USNM 194426, length without processes 0.38, length with anterior process, 0.44, height without processes 0.34. USNM 194432B, length without processes 0.38, height without processes 0.35. USNM 194432B, length without processes 0.36, length with processes 0.40, height without processes 0.32.

First Antenna (Figure 58*a*): Joint 1 with 1 dorsal bristle. Joints 2–6 similar to those of adult female. 7th joint with small transparent b-bristle and long c-bristle. 8th joint with long d- and e-bristles and short transparent f-bristle.

Second Antenna: Protopodite similar to that of adult female (Figure 58*g,e*). Exopodite differs from that of adult female in the 1st joint not being divided into 2 parts (Figure 58*c*). Endopodite 3-jointed (Figure 58*b,d*): 1st joint with dorsal bristle; 2nd joint with 2 bristles (1 long, 1 short); 3rd joint elongate with 3 terminal bristles (1 long, 2 short).

Mandible and Maxilla: Not examined in detail but same type as on adult female.

Fifth Limb: Well developed, with 3 bristles on 3rd exopodial joint (Figure 58*f,h*).

Sixth Limb: Well developed but slightly shorter or about

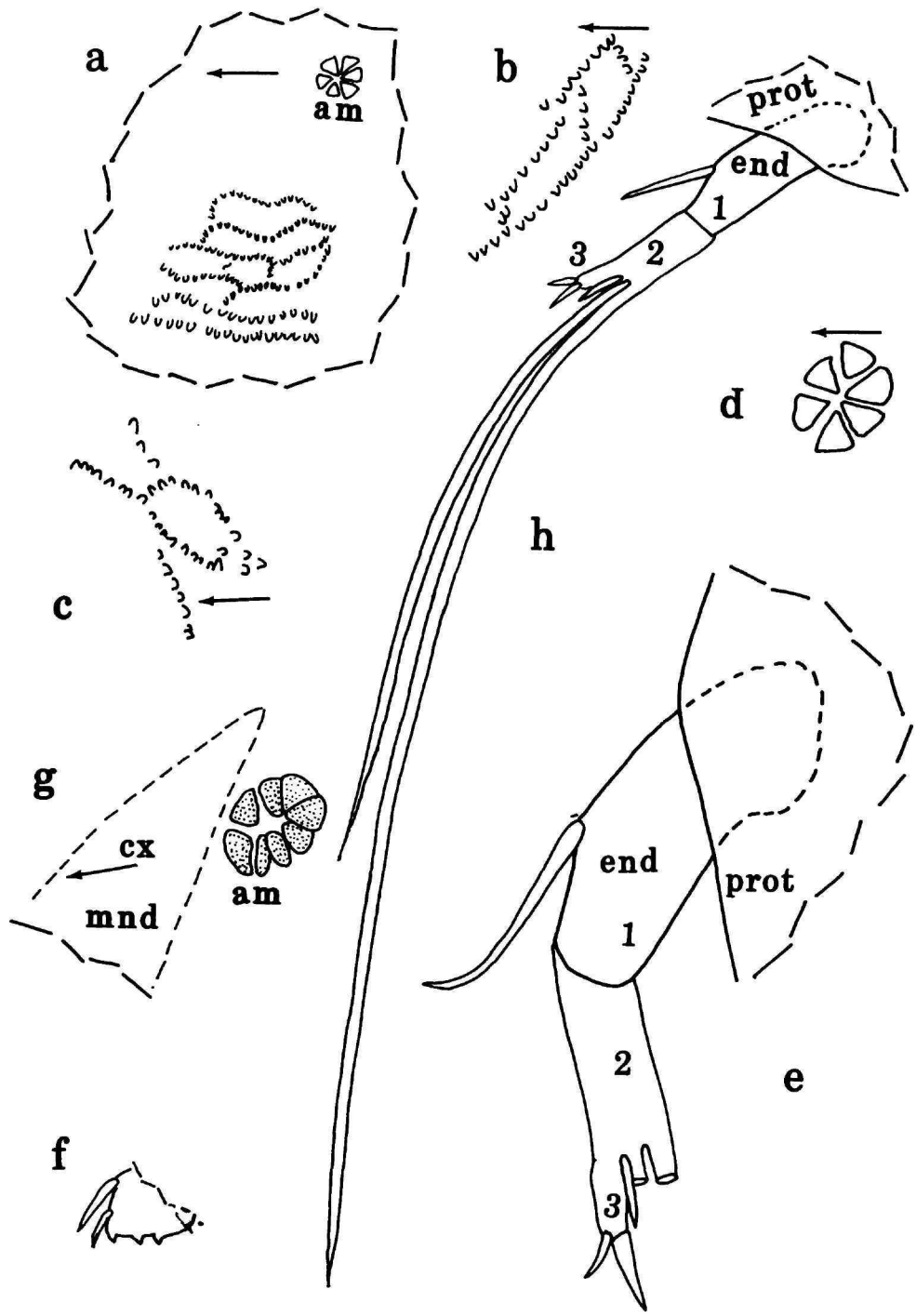


FIGURE 57.—*Danielopolina exuma*, new species, paratype, USNM 194262, A–1 female: *a*, central adductor muscle attachments and ornamentation near ventral margin of left valve, ov; *b*, ornamentation along posteroventral margin left valve, ov; *c*, ornamentation along posterior margin left valve; *d*, detail of central adductor muscle attachments shown in *a*; *e*, part left 2nd antenna, lv; *f*, left lamella of furca. *g*, paratype, USNM 194304C, A–1 female, central adductor muscle attachments of left valve (ov) and proximal part left coxale endite in natural position (dashed). *h*, paratype, USNM 194422, A–1 female, endopodite left 2nd antenna, lv.

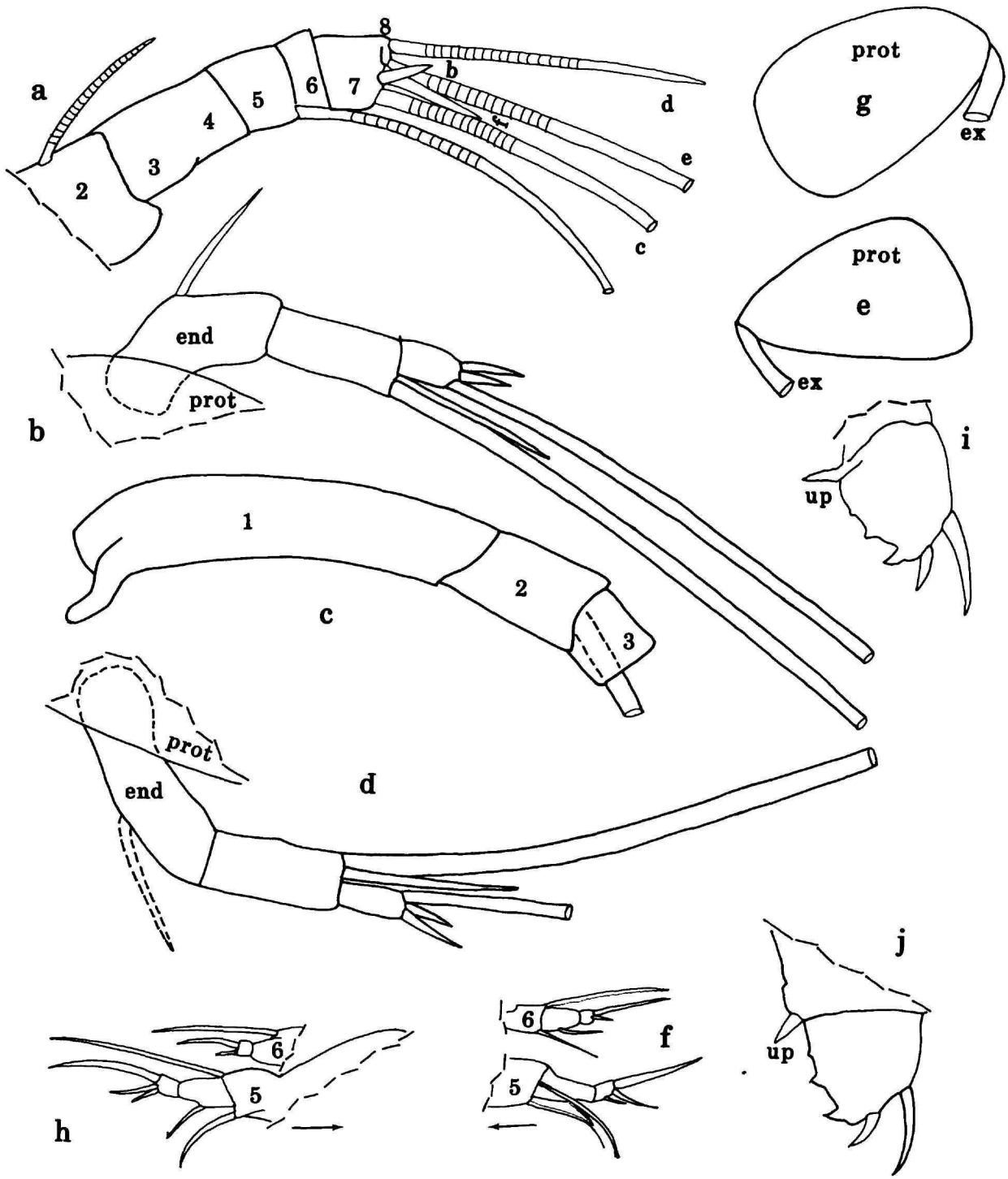


FIGURE 58.—*Danielopolina exuma*, new species, paratype, USNM 194423B, Instar III (A–2) (sex unknown): *a*, part left 1st antenna, mv; *b,c*, endopodite and part exopodite, respectively, right 2nd antenna, lv; *d*, endopodite left 2nd antenna, lv; *e*, protopodite left 2nd antenna, lv; *f*, tips of left 5th and 6th limbs, lv. Paratype, USNM 194426, Instar III (A–2) (sex unknown): *g*, protopodite right 2nd antenna, lv; *h*, tips of right 5th and 6th limbs, lv; *i*, right lamella of furca, lv; *j*, paratype, USNM 194423A, Instar III (A–2) (sex unknown), right lamella of furca, lv.

same extension as 5th limb, with 2 bristles on 3rd exopodial joint (Figure 58*f,g*).

Seventh Limb: Absent.

Furca (Figure 58*i,j*): With 2 articulated anterior claws and 2 nonarticulated shorter ventral claws; small triangular projection posterior to ventral claws. Single posterior process proximal to lamellae.

Bellonci Organ, Lips, and Posterior of Body: Similar to those of adult female.

Genitalia: None observed.

DESCRIPTION OF INSTAR II (A–3) (sex unknown) (Figures 50, 59): Carapace similar to that of adult female (Figure 59*a* (3 representative reticulations shown as dotted polygons)).

Carapace Size (mm) (Figure 50): USNM 194425, length without processes 0.33, length with anterior process 0.36, height without processes 0.27. USNM 194421, length without processes 0.32, length with anterior process 0.37, height without processes 0.27. USNM 194429, length without processes 0.34, length with anterior process 0.39, height without processes 0.29. USNM 194432A, length without processes 0.35, height without processes 0.29. USNM 194431A, length without processes 0.32, height without processes 0.25. USNM 194431B, length without processes 0.33, height without processes 0.27. USNM 194431C, length without processes 0.30, height without processes 0.28. USNM 194431D, length without processes 0.33, length with anterior process 0.37, height without processes 0.25. USNM 194431E, length without processes 0.33, length with anterior process 0.36, height without processes 0.26. USNM 194431F, length without processes 0.31, length with anterior process 0.36, height without processes 0.28.

First Antenna: 1st joint with 1 dorsal bristle. Joints 2–4 and 6 without bristles; 3rd and 4th joints not separated by suture. 5th joint with short ventral unringed bristle. 7th joint with long ventral filament-like c-bristle. 8th joint with ringed medium-length d-bristle and long filament-like e-bristle.

Second Antenna: Protopodite similar to that of adult female. Exopodite: 1st joint undivided; 8th joint with 2 bristles (Figure 59*b,c*). Endopodite 3-jointed (Figure 59*d*): 1st joint with 1 dorsal bristle; 2nd joint with long filament-like terminal bristle; 3rd joint with long filament-like bristle and 1 medium and 1 short bristle.

Mandible (Figure 59*e*): Distal basale endite similar to that of adult female except with only 2 lateral bristles. Endopodite: 2nd joint with 2 dorsal bristles; 3rd joint with 4 bristles.

Maxilla (Figure 59*f*): 1st endopodial joint with 3 bristles; 2nd endopodial joint with 5 bristles.

Fifth Limb: Well developed. 3rd exopodial joint with 1 long terminal bristle and 1 short bristle (Figure 59*g,h*).

Sixth and Seventh Limbs: Absent.

Furca (Figure 59*i*): With 1 long articulated anterior claw, 1 nonarticulated claw on anteroventral corner, 1 shorter nonarticulated ventral claw, followed by small nonarticulated triangular process (incipient claw?). Unpaired process following lamellae.

Bellonci Organ, Lips, and Posterior of Body: Similar to those of adult female.

Genitalia: Absent.

DESCRIPTION OF INSTAR I (A–4) (sex unknown) (Figures 50, 60).—Carapace similar to that of adult female (Figure 60*g*).

Carapace Size (mm) (Figure 50): USNM 194424, length without processes 0.28, height without processes 0.22. USNM 194427, length without processes 0.29, length with processes 0.34, height without processes 0.27. USNM 194428, length without processes 0.29, length with anterior process 0.35, height without processes 0.24. USNM 194431G, length without processes 0.28, height without processes 0.23. USNM 194430A, length without processes 0.30, length with anterior process 0.35, height without processes 0.26. USNM 194430B, length without processes 0.27, length with anterior process 0.33, height without processes 0.24. USNM 194430C, length without processes 0.30, length with anterior process 0.34, height without processes 0.27.

First Antenna (Figure 60*a*): 5th joint with small unringed ventral bristle. Bristles of 7th and 8th joints similar to those of A–3 instar.

Second Antenna: Protopodite similar to that of adult female. Exopodite: 1st joint undivided; 8th joint with 2 bristles. Endopodite 3-jointed (Figure 60*b,c*): 1st joint bare; 2nd joint with long terminal filament-like bristle; 3rd joint with 3 bristles (1 long, 1 medium, 1 short) (Figure 60*c*); left limb of USNM 194427 differs in having a medium bristle in place of long bristle (aberrancy?) (Figure 60*b*).

Mandible (Figure 60*d*): Basale endite with only 4 triangular terminal teeth, and only 1 lateral bristle, otherwise similar to A–3 instar. Endopodite: except for 2nd joint having only 1 dorsal bristle, endopodite similar to that of A–3 instar.

Maxilla (Figure 60*e*): 2nd endopodial joint with 4 bristles.

Fifth Limb (Figure 60*f*): Well developed. 3rd exopodial joint with 1 bristle.

Sixth and Seventh Limbs: Absent.

Furca (Figure 60*h*): With long articulated anterior claw, 1 shorter nonarticulated claw on anteroventral corner, and a small triangular nonarticulated ventral process (incipient claw?). Unpaired process following lamellae.

Bellonci Organ, Lips, and Posterior of Body: Similar to those of adult female, but upper lip not examined in detail.

Genitalia: Absent.

COMPARISONS.—The carapace of *D. exuma* resembles those of *D. orghidani.* The 1st antenna of *D. exuma* differs from that of *D. orghidani* in having one instead of two bristles on the 2nd joint. Except for the absence of a posterodorsal process on each valve, the carapace of *D. styx* resembles that of *D. exuma.* The furca of *D. styx* differs from that of *D. exuma* in having one instead of two articulated anterior claws and more than three short nonarticulated ventral claws. The carapace of *D. bahamensis* differs from that of *D. exuma* in having reticulate walls formed of continuous and discontinuous segments rather than papillae, and in not having a cylindrical posterodorsal process on all valves. The 1st antenna of *D. bahamensis* differs

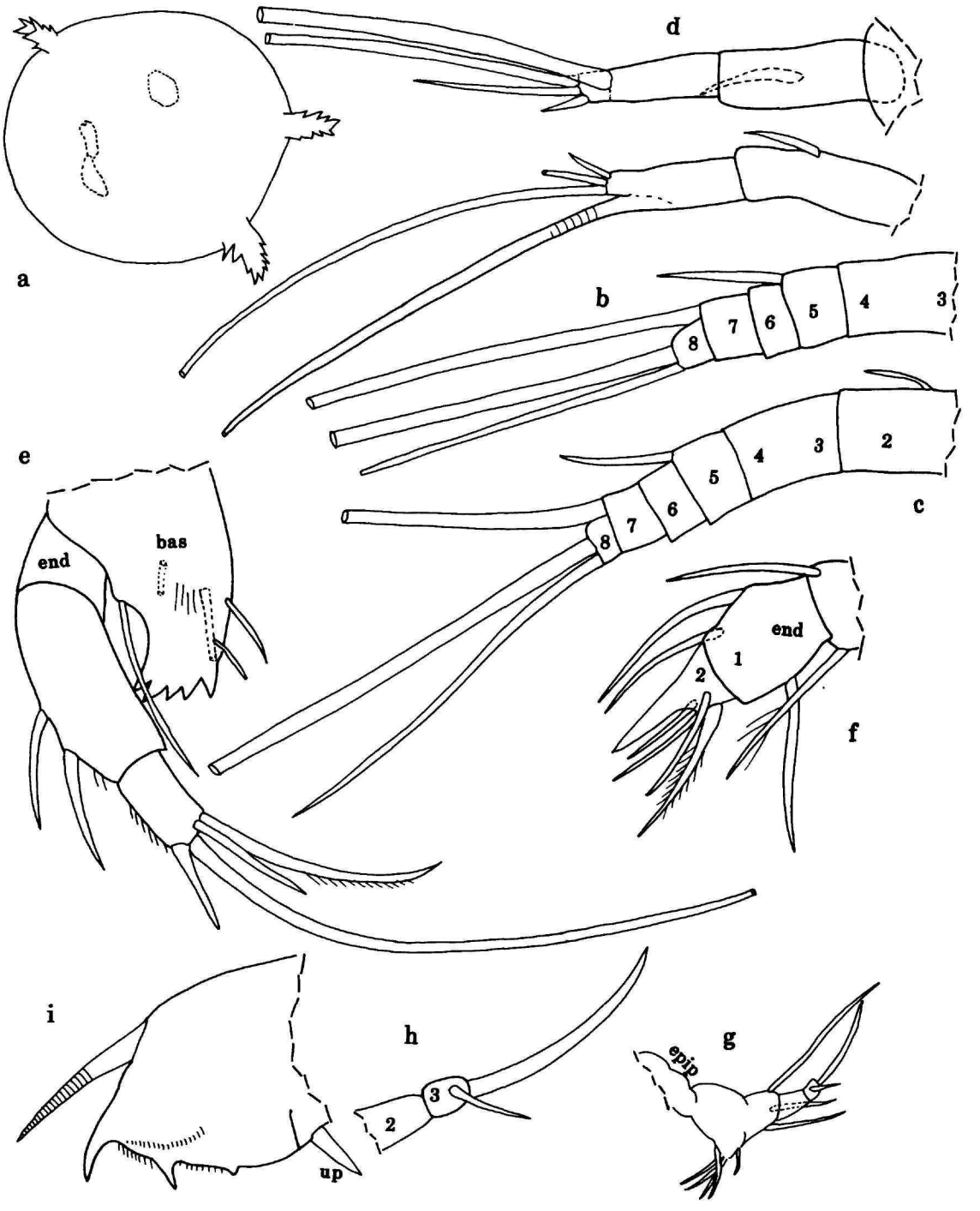


FIGURE 59.—*Danielopolina exuma*, new species, paratype, USNM 194421, Instar II (A–3) (sex unknown): *a*, complete specimen from right side showing 3 of the many surface reticulations, length with anterior process 0.37 mm, ov; *b,c*, right (mv) and left (lv) of 2nd antennae, respectively; *d*, endopodites of left (lv) (upper illustration) and right (mv) 2nd antennae, respectively; *e*, part right mandible, mv; *f*, part right maxilla (nabs), mv; *g*, right 5th limb (nabs), lv; *h*, tip left 5th limb, lv; *i*, left lamella of furca (lv) and unpaired process.

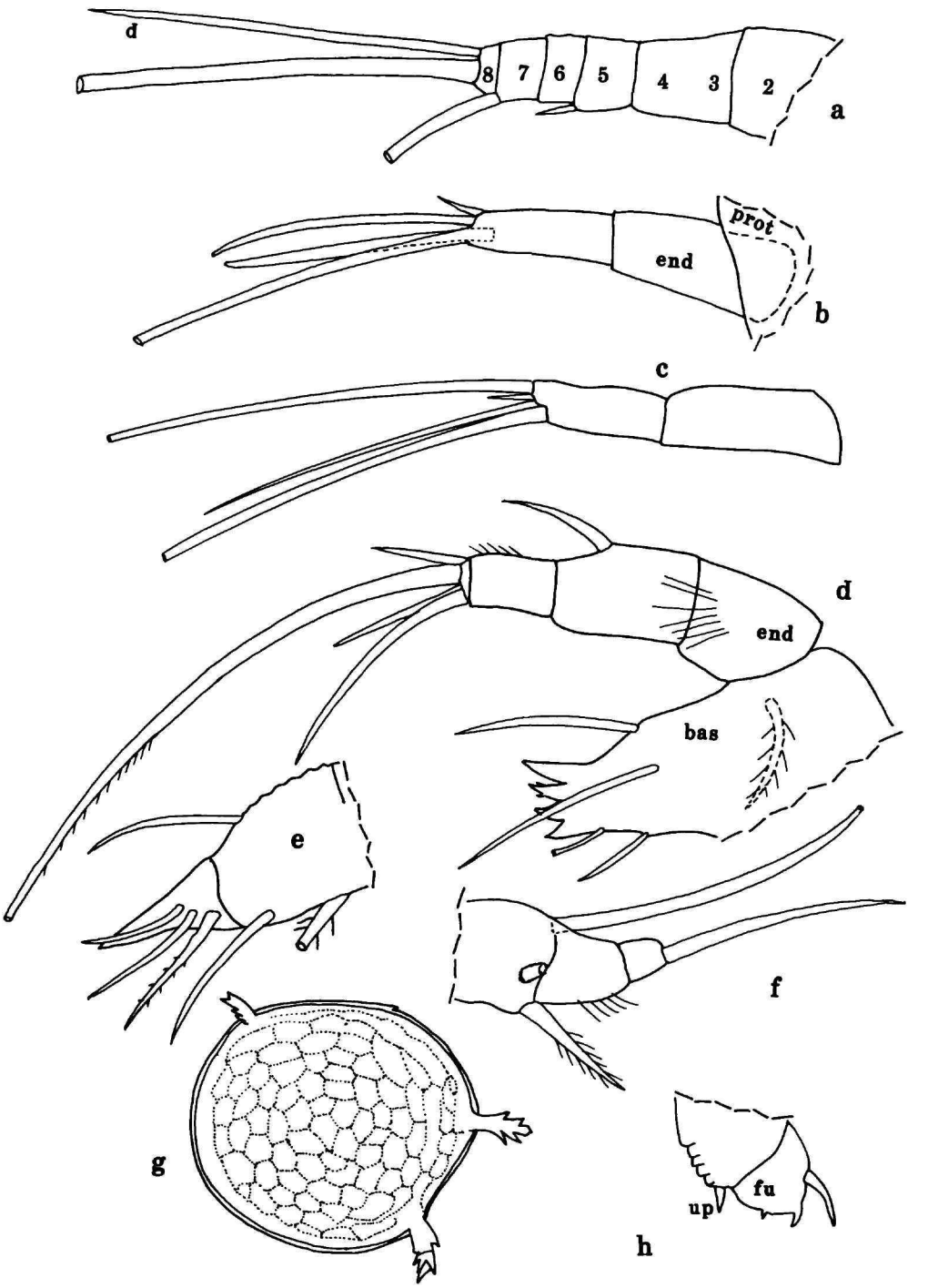


FIGURE 60.—*Danielopolina exuma*, new species, paratype, USNM 194427, Instar I (A–4) (sex unknown): *a*, part left 1st antenna, lv; *b,c*, endopodites of left (lv) and right (mv) 2nd antennae, respectively; *d*, part left mandible, lv; *e*, left maxilla (nabs), lv; *f*, tip 5th limb. *g*, paratype, USNM 194428, Instar I (A–4) (sex unknown), complete carapace from right side, length with processes 0.35 mm. *h*, paratype, USNM 194424, Instar I (A–4) (sex unknown), right lamella of furca, unpaired processes, and "segmented" posterior margin of body.

TABLE 9.—Some meristic characters of *Danielopolina exuma*. (A = absent, L = long, P = present, S = short.)

Stage	Average carapace length (mm)	6th limb	7th limb	Furcal claws	1st antenna bristles of 5th joint	2nd antenna bristles of 1st endopodial joint	5th limb stout bristles of 3rd exopodial joint	Mandibular dorsal bristles of 2nd endopodial joint
A–4(I)	0.29	A	A	2*	1S	0	1	1
A–3(II)	0.33	A	A	3*	1S	1	2	2
A–2(III)	0.37	P	A	4*	1L	1	3	2
A–1(IV)	0.43	P	P	5	1L	1	3	2
Adult female	0.53	P	P	5	1L	2	3	2
Adult male	0.51	P	P	5	3L	2	3	2

* Small nonarticulated triangular process following claws.

from that of *D. exuma* in lacking a bristle on the 2nd joint and in having a dorsal a-bristle on the 7th joint. The mandible of *D. bahamensis* differs from that of *D. exuma* in having a bristle on the 1st endopodial joint. The carapace of *D. elizabethae* differs from that of *D. exuma* in having reticulations formed of discontinuous ridges rather than papillae, and the furca differs in having one instead of two articulated anterior claws on each lamella. The carapace of *D. mexicana* differs from that of *D. exuma* in having surface spines, and the furca differs in having more than three nonarticulated ventral claws on each lamella.

ONTOGENY AND SEXUAL DIMORPHISM (Table 9).—The carapaces of all stages are similar in distribution of processes and ornamentation. Instar I lacks 6th and 7th limbs. The 6th limb with bristles first appears on instar III; an anlage of the 6th limb was not observed on instar II. The 7th limb with bristles first appears on instar IV, the A–1 instar. The Bellonci Organ, lips, and posterior of body are similar in instars and adults. The species is interpreted to have 5 growth stages.

Carapace: Average lengths of carapaces excluding processes for each stage is shown in Table 9. Average growth factors between each succeeding stage (excluding adult male): 1.14; 1.12; 1.16, and 1.23. The growth factor between the two A–1 ?females and the single adult male in the collection is 1.19.

First Antenna: Lateral bristle of 1st joint observed only on adult but could have been obscured on late instars; dorsal bristle of the 1st joint appears first on instar II. Dorsal bristle of 2nd joint appears first in instar III. 4th joint of adult male with 2 long ventral bristles; none present on adult female or instars. Ventral bristle of the 5th joint appears first as a small unringed bristle on instar I; bristle only slightly longer on instar II, and very long on later stages, whereas adult female bears 1 long ventral filament-like bristle, the adult male bears 3. 7th joint: a-bristle absent; b-bristle appears first on instar III as small transparent bristle, and longer on later instars and adults; the c-bristle already present as long transparent filament on instar I. 8th joint: d- and e-bristles well developed in instar I; f-bristle appears first on instar III as short transparent bristle, and longer on later instars and adults.

Second Antenna: Protopodite and exopodite similar in all stages. Endopodite: 1st joint without dorsal bristle on instar I, with 1 dorsal bristle on instars II, III, and IV, and 2 dorsal bristles on adults. 2nd joint with 1 long filament-like bristle on instars I and II, 1 long and 1 short bristle on instar III, 2 long and 1 short bristle on instar III ?female, 2 long and 1 minute bristle on adult female, and 4 long and 1 short bristle on adult male. 3rd joint with 3 bristles of varying lengths on instars I, II, and III, 2 short bristles on instar IV ?female, 1 short bristle on adult female, and long slender clasper on adult male.

Mandible: Coxale endite not examined in detail on instars, but of same type, in general, as that of adults. Basale: endite with 4 terminal triangular teeth on instar I, and 5 on later instars and adults. Endopodite: 1st joint with 1 dorsal bristle on endite I and 2 on later instars and adults.

Fifth Limb: 3rd exopodial joint with 1 long bristle on instar I, 1 long and 1 short bristle on instar II, and 1 long and 2 short bristles on later instars and adults.

Furca: Each lamella of instar I with 1 articulated anterior claw, 1 nonarticulated claw on anteroventral corner, and 1 small nonarticulated triangular process (incipient claw?); furca of instar II similar to that of instar I except ventral claw stouter and followed by small nonarticulated triangular process (anlage of claw); furca of instar III with 2 articulated anterior claws and 2 nonarticulated ventral claws followed by small nonarticulated triangular process (anlage of claw); furcae of instar IV and adults with 2 articulated anterior claws and 3 nonarticulated ventral claws.

Danielopolina species A

FIGURE 61

MATERIAL.—USNM 194416, Instar II on slide and in alcohol.

DISTRIBUTION.—Sta 94-014, Open Rock Cave, Great Guana Cay, Exuma Cays, Bahamas.

DESCRIPTION OF INSTAR II (Figure 61).—Carapace subround in lateral view with straight dorsal margin in vicinity of hinge and also straight margin between anterior and anteroventral processes (Figure 61*a*); ventral and posterior margins as well as anterior margin dorsal to anterior process evenly rounded. Short anterior and anteroventral processes with bases just lateral to valve edge; each process bearing fragile spine-bearing frill. Posterodorsal margin without process.

Ornamentation (Figure 61*a–c*): Surface finely reticulate with walls formed of both continuous and discontinuous segments (most segments appear continuous on undissected specimen, but on separate valves under coverslip most are discontinuous (Figure 61*c*), possibly caused by fracturing resulting from pressure of coverslip).

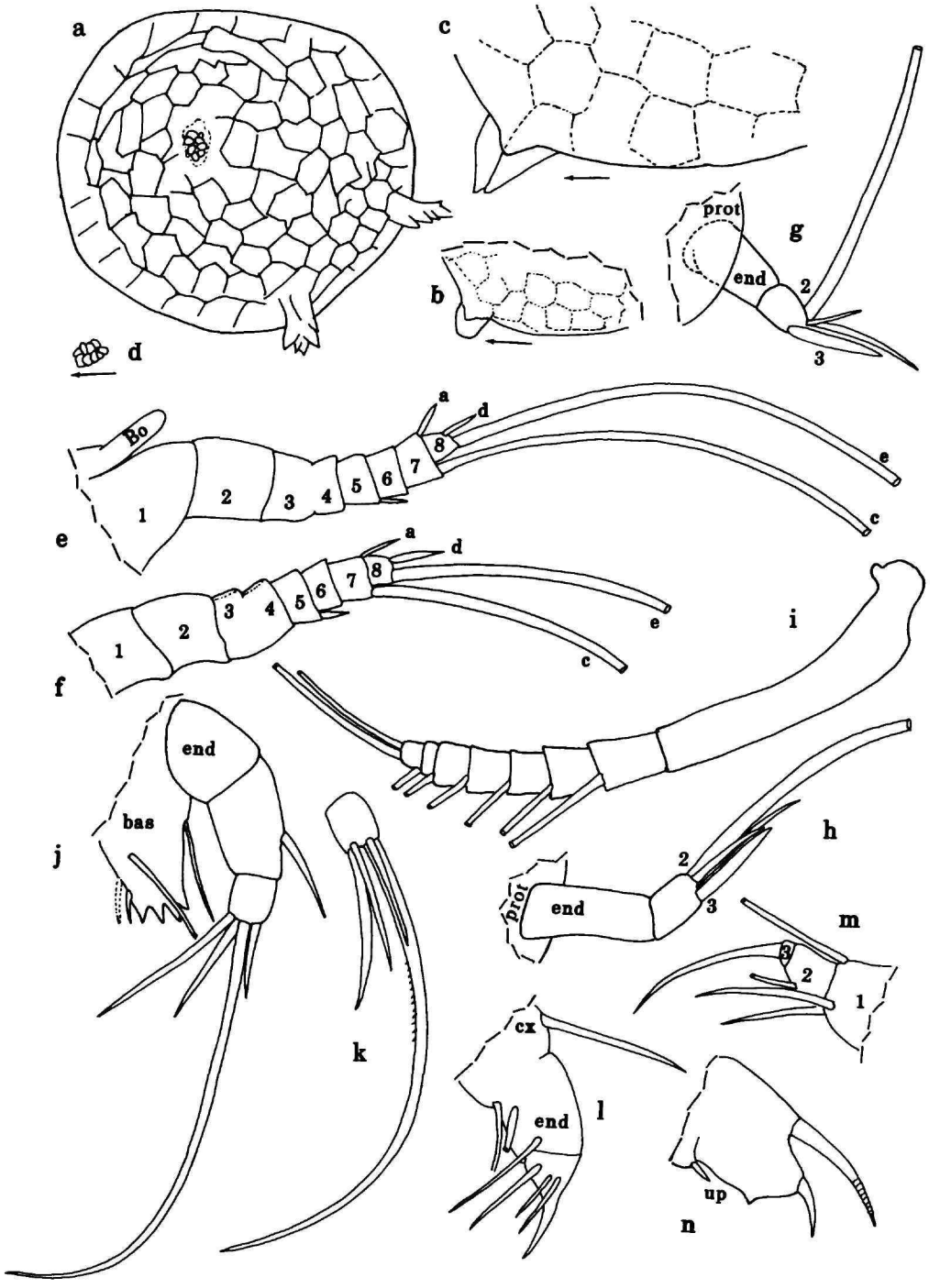


FIGURE 61.—*Danielopolina* species A, USNM 194416, Instar II (sex unknown): *a*, complete specimen from right side, length with triangular anterior process 0.25 mm; *b,c*, reticulations anteroventral part right valve, iv; *d*, central adductor attachments left valve, ov; *e*, right 1st antenna (lv) and Bellonci organ; *f*, left 1st antenna, mv; *g,h*, lateral and medial views, respectively, of endopodite left 2nd antenna; *i*, exopodite left 2nd antenna, mv; *j*, part right mandible, lv; *k*, tip endopodite left mandible, mv; *l*, right maxilla (nabs), lv; *m*, tip 5th limb; *n*, right lamella of furca, lv.

Central Adductor Muscle Attachments (Figure 61*a,d*): About 8 small scars in 2 rows more-or-less radially arranged.

Carapace Size (mm): USNM 194416, length without processes 0.22, length including anterior process 0.25, height without processes 0.18.

First Antenna (Figure 61*e,f*): Joints 1–4 and 6 without bristles. Joint 5 with short ventral bristle. 7th joint with short dorsal a-bristle and long ventral c-bristle. 8th joint with short d-bristle and very long e-bristle. Joints 3 and 4 fused but separation indicated by division in sclerotization along dorsal margins.

Second Antenna: Protopodite bare. Endopodite 3-jointed but 2nd and 3rd joints fused (Figure 61*g,h*): 1st joint bare; 2nd joint with 3 bristles (1 long, 2 short indistinct); 3rd joint with broad short diaphanous bristle. Exopodite (Figure 61*i*): 1st joint undivided and without bristle; joints 2–7 each with long bristle (natatory hairs not observed); 8th joint with 2 bristles (1 long and 1 short).

Mandible (Figure 61*j,k*): Coxale endite not examined in detail but of similar type for genus. Basale: tooth of endite with only 4 triangular cusps; lateral side with 1 long bristle near midlength; medial side with 1 bristle near dorsal margin; anterior margin with long bristle near midlength; posterior margin with 2 short distal bristles. Endopodite: 1st joint without bristles; 2nd joint with 1 dorsal bristle; 3rd joint with 4 bristles (1 very long, 3 short).

Maxilla (Figure 61*l*): Endite bristles not counted. Coxale with stout dorsal bristle. Basale with ventral bristle. Endopodite: 1st joint with 2 bristles; 2nd joint with 4 bristles.

Fifth Limb: Exopodite (Figure 61*m*): 1st joint with long dorsal bristle and 2 shorter ventral bristles; 2nd joint with short ventral bristle. 3rd joint with long terminal bristle.

Sixth and Seventh Limbs: Absent.

Furca (Figure 61*n*): Each lamella with 2 long articulated anterior claws followed by small triangular protuberance. Well-developed unpaired process following lamellae.

Bellonci Organ (Figure 61*e*): Thumb-like (appearing brown, not diaphanous).

COMPARISONS.—The carapace and appendages of *Danielopolina* species A resemble those of Instar II of *D. bahamensis* (Kornicker and Iliffe, 1989b:10, fig. 5m–v). The present specimen is not referred to that species because of the presence of a Bellonci organ, which was reported to be absent on *D. bahamensis* (Kornicker and Iliffe, 1989b:10). Also, the segments forming reticulations on the carapace of *Danielopolina* species A appear to be more continuous than those of *D. bahamensis,* but the variability of that character is unknown. The 1st antenna of *Danielopolina* species A differs from that of *D. exuma,* new species, herein, in having an a-bristle on the 7th joint, and the carapace differs in not having a posterodorsal process.

Suborder CLADOCOPINA Sars, 1866

Superfamily POLYCOPOIDEA Sars, 1866

Family POLYCOPIDAE Sars, 1866

Subfamily POLYCOPINAE Sars, 1866

COMPOSITION AND DISTRIBUTION.—The Polycopinae include 14 genera of which *Micropolycope* Chavtur, 1981, and *Polycopissa* Chavtur, 1981, were reported in Bermudian Caves (Kornicker and Iliffe, 1989c), *Pontopolycope* Chavtur, 1981, was reported in a Jamaican Cave (Kornicker and Iliffe, 1992), and *Eupolycope* Chavtur, 1981, was reported in a lava tube in Lanzarote, Canary Islands (Kornicker and Iliffe, 1995). *Polycopiella* species A is reported from the Lanzarote lava tube herein. Another species in the lava tube in Lanzarote was left in open nomenclature as "Genus and Species indeterminate" (Kornicker and Iliffe, 1995). One species of *Metapolycope* Kornicker and Morkhoven, 1976, which is in the subfamily Polycopissinae Chavtur, 1983, is known from Bermudian Caves (Kornicker and Iliffe, 1989c:50).

Eupolycope Chavtur, 1981

TYPE SPECIES.—*Polycope putjatini* Chavtur, 1977.

COMPOSITION.—The genus includes many species of which only *E. pnyx* has been reported from an anchialine environment (Chavtur, 1981, 1983; Kornicker and Iliffe, 1995:25).

Eupolycope pnyx Kornicker and Iliffe, 1995

FIGURE 62

Eupolycope pnyx Kornicker and Iliffe, 1995:25, figs. 14, 15.

HOLOTYPE.—USNM 194149, undissected adult female in alcohol.

TYPE LOCALITY.—Atlantida Tunnel lava tube, Lanzarote, Canary Islands.

MATERIAL.—Sta 94-030, USNM 194406, undissected adult female on slide.

DISTRIBUTION.—Atlantida Tunnel lava tube, Lanzarote, Canary Islands.

SUPPLEMENTAL DESCRIPTION OF ADULT FEMALE (Figure 62).—Carapace with lineations in anterior and anteroventral one-half (Figure 62*a,b*); right valve with 2 minute triangular processes on posteroventral corner (Figure 62*a*).

Central Adductor Muscle Attachments (Figure 62*a,b*): USNM 194406 with 3 ovoid attachments; radiating lines surround attachments.

Carapace Size (mm): USNM 194406, length 0.22, height 0.18.

REMARKS.—In the description of the carapace by Kornicker and Iliffe (1995:25) the presence of two minute triangular

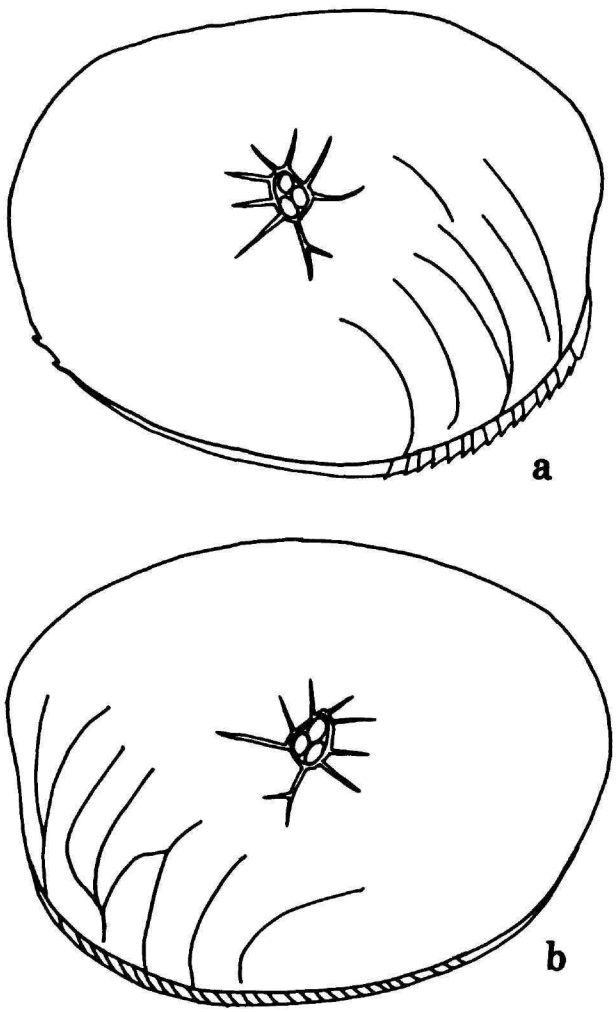


FIGURE 62.—*Eupolycope pnyx* Kornicker and Iliffe, 1995: *a,b,* USNM 194406, adult female, length 0.22 mm, right and left views, respectively, of carapace of complete specimen.

processes on the posteroventral corner was not mentioned, but one process was illustrated (fig. 14a). Reexamination of the type specimens revealed two minute processes. The central adductor muscle attachments illustrated by Kornicker and Iliffe (1995, fig. 14f) appear as six peripheral triangular attachments. Reexamination of the type specimens revealed considerable variation in the attachments; three ovoid attachments appear in some specimens, whereas in others the attachments have additional sutures permitting interpreting the attachments to be more numerous.

Polycopiella Chavtur, 1981

TYPE SPECIES.—*Polycopiella microdentata* Chavtur, 1979.

COMPOSITION.—The genus has not previously been recorded from an anchialine environment (Chavtur, 1981).

Polycopiella species A

FIGURE 63

MATERIAL.—Sta 94-030, USNM 194407, 1 mounted partly dissected adult male.

DISTRIBUTION.—Atlantida Tunnel lava tube, Lanzarote, Canary Islands.

REMARKS.—Unfortunately, the only specimen in the collection is mounted in a position that obscures most appendages, and for that reason it has been left in open nomenclature. The specimen is referred to *Polycopiella* mainly because of the morphology of the carapace, the elongate 5th limb, and the structure of the male copulatory organ, all of which are fairly similar to those of the type species, *P. microdentata,* illustrated by Chavtur (1979, fig. 2). It is possible that the referral may have to be changed when the morphology of the mandible becomes known.

DESCRIPTION OF ADULT MALE (Figure 63).—Carapace elongate with evenly rounded and serrate anterior margin (Figure 63*a*); periphery with radiating structures that may be pore canals.

Carapace Size (mm): USNM 194407, length 0.32, height 0.26.

Central Adductor Muscle Attachments: Not visible on specimen.

First Antenna (Figure 63*b*): Illustration drawn prior to mounting, and is obscured on mounted specimen; all bristles may not be shown.

Second Antenna (Figure 63*c*): Protopodite narrow and with row of spines. Endopodite and exopodite as shown.

Mandible and Maxilla: Obscured or incomplete.

Fifth Limb (Figure 63*d*), *Furca* (Figure 63*e*), *and Copulatory Organ* (Figure 63*d,e*): As shown.

Bellonci Organ (Figure 63*b*): Single tapered (illustration drawn prior to mounting, and is obscured on mounted specimen).

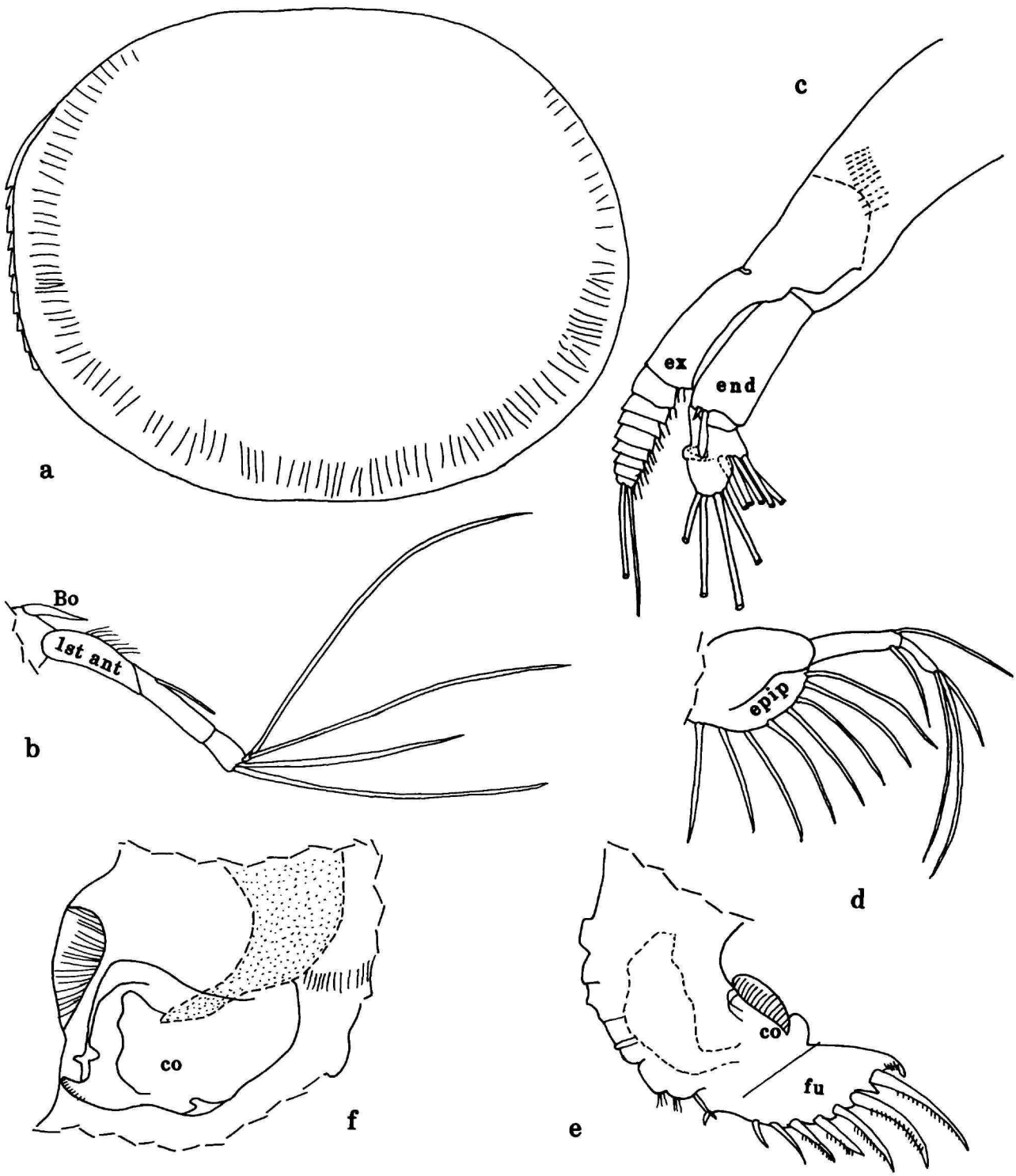


FIGURE 63.—*Polycopiella* species A, USNM 194407: *a*, complete specimen from left side, length 0.32 mm; *b*, Bellonci organ and 1st antenna; *c*, 2nd antenna; *d*, 5th limb; *e*, posterior of body from right side showing copulatory organ and left furcal lamella; *f*, detail of part of right side of body showing copulatory organ.

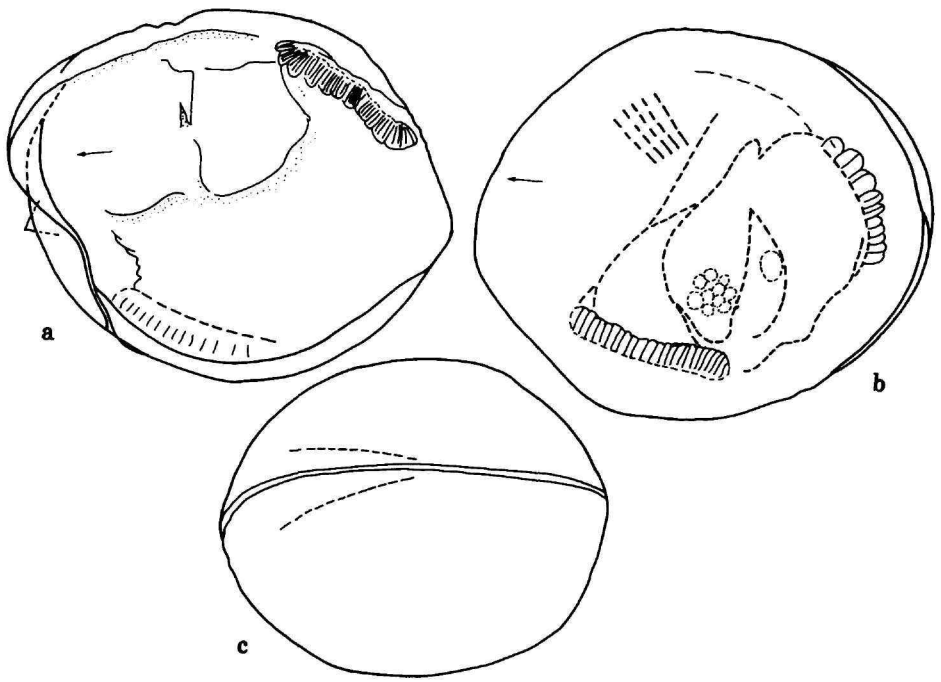


FIGURE 64.—Incertae sedis: *a*, inside view of specimen #1 with left valve removed, length 0.28 mm; *b,c*, lateral and dorsal views, respectively, of specimen #2, length 0.32 mm. (Orientation uncertain.)

Incertae Sedis

FIGURE 64

MATERIAL.—Two specimens from Sta 93-003, Norman's Pond Cave, Lee Stocking Island, Exuma Cays, Great Bahama Bank.

DESCRIPTION (Figure 64).—Bivalve with no apparent calcification and unidentified internal parts.

Carapace Size (length, height in mm, orientation uncertain): Specimen #1, 0.28, 0.24; specimen #2, 0.32, 0.26.

DISCUSSION.—The specimens were shown to two mollusk specialists, Thomas Waller (S.I.) and Robert Hershler (S.I.), neither believed them to be clams. They also were shown to Mark Grygier (Lake Biwa Museum, Kusatsu, Shiga Prefecture, Japan), who did not believe them to be crustacean larvae. The affinity of the specimens is unknown to the authors. They are presented here as Incertae Sedis to promote their further study.

Appendix

Station Data for Collected Specimens

(in chronological order)

Sta 93-001, 4 May 1993, Norman's Pond Cave, Norman's Pond Cay, Exuma Cays, Bahamas; salinity 36 ppt; collected with plankton net from water column between 6–10 m depths.
Spelaeoecia styx: 4 specimens.

Sta 93-002, 4 May 1993, Norman's Pond Cave, Norman's Pond Cay, Exuma Cays, Bahamas; salinity 36 ppt; collected with plankton net from water column between 10–25 m depths.
Spelaeoecia styx: 18 specimens.
Danielopolina exuma: 1 specimen.

Sta 93-003, 6 May 1993, Norman's Pond Cave, Norman's Pond Cay, Exuma Cays, Bahamas; salinity 36 ppt; collected with plankton net between 15–35 m depths.
Spelaeoecia styx: 9 specimens.
Danielopolina exuma: 3 specimens.
Incertae sedis: 2 specimens.

Sta 93-004, 6 May 1993, Norman's Pond Cave, Norman's Pond Cay, Exuma Cays, Bahamas; salinity 36 ppt; collected with plankton net from fine silt on ledges in 6 m depth.
Spelaeoecia styx: 1 specimen.
Danielopolina exuma: 3 specimens.

Sta 93-006, 8 May 1993, Oven Rock Cave, Great Guana Cay, Exuma Cays, Bahamas; salinity 35 ppt; collected with plankton net from water column between 0–1 m depths.
Spelaeoecia capax: 3 specimens.
Spelaeoecia styx: 6 specimens.
Deeveya exleyi: 1 specimen.

Sta 93-007, 8 May 1993, Oven Rock Cave, Great Guana Cay, Exuma Cays, Bahamas; salinity 36 ppt; collected with plankton net from water column between 3–6 m depth.
Spelaeoecia capax: 4 specimens.

Sta 93-008, 8 May 1993, Oven Rock Cave, Great Guana Cay, Exuma Cays, Bahamas; salinity 36 ppt; collected with plankton net from water column between 3–15 m depths.
Spelaeoecia capax: 7 specimens.
Spelaeoecia styx: 1 specimen.

Sta 93-009, 8 May 1993, Oven Rock Cave, Great Guana Cay, Exuma Cays, Bahamas; salinity 36 ppt; collected with plankton net from fine, dark brown silt on floor in 8 m depth.
Spelaeoecia capax: 1 specimen.
Spelaeoecia styx: 3 specimens.

Sta 93-039, 1 Jul 1993, Temple of Doom Cenote, Tulum, Quintana Roo, Mexico; salinity 35 ppt; plankton net from water column between 12–18 m depths.
Danielopolina mexicana: 2 specimens.

Sta 93-040, 3 Jul 1993, Maya Blue Cenote, Tulum, Quintana Roo, Mexico; salinity 35 ppt; collected with plankton net from water column between 17–21 m depth.
Spelaeoecia mayan: 1 specimen.
Danielopolina mexicana: 3 specimens.

Sta 93-041, 4 Jul 1993, Maya Blue Cenote, Tulum, Quintana Roo, Mexico; salinity 35 ppt; collected with plankton net from water column between 12–21 m depth.
Danielopolina mexicana: 1 specimen.

Sta 94-001, 17 Aug 1994, Maya Blue Cenote, Tulum, Quintana Roo, Mexico; salinity 35 ppt; collected 0.5–1 m below halocline in 18–20 m water depth in individual vials (visually observed swimming).
Spelaeoecia mayan: 2 specimens.

Sta 94-010, 12 May 1994, Norman's Pond Cave, Norman's Pond Cay, Exuma Cays, Bahamas; salinity 35 ppt; collected with plankton net from water column in 9–18 m depth in first room.
Danielopolina exuma: 1 specimen.

Sta 94-012, 15 May 1994, Norman's Pond Cave, Norman's Pond Cay, Exuma Cays, Bahamas; salinity 35 ppt; collected with plankton net from water column in 30–43 m depth in second room.
Danielopolina exuma: 3 specimens.

Sta 94-013, 14 May 1994, Norman's Pond Cave, Norman's Pond Cay, Exuma Cays, Bahamas; salinity 35 ppt; collected with plankton net from water column in 12–15 m depths in first room.
Danielopolina exuma: 13 specimens.

Sta 94-014, 16 May 1994, Oven Rock Cave, Great Guana Cay, Exumas Cays, Bahamas; salinity 35 ppt; collected with

plankton net from water column in 15–20 m depth in horizontal passage off second room.
Spelaeoecia capax: 2 specimens.
Spelaeoecia styx: 2 specimen.
Danielopolina species A: 1 specimen.

Sta 94-016, 18 May 1994, Norman's Pond Cave, Norman's Pond Cay, Exuma Cays, Bahamas; salinity 35 ppt; collected with plankton net from water column and silt ledges in 10–18 m depths in first room.
Spelaeoecia styx: 32 specimens.
Danielopolina exuma: 11 specimens.

Sta 94-024, 16 Aug 1994, Maya Blue Cenote, Tulum, Quintana Roo, Mexico; salinity 35 ppt; collected with plankton net from water column at the halocline in 18 m depth from the Dead Zone Rooms 1 and 2.

Sta 94-030, 6 Jun 1994, upper and lower levels, Atlantida Tunnel lava tube, Lanzarote, Canary Islands; salinity 35 ppt; collected with plankton net from water column in 0–21 m depths.
Eupolycope pnyx: 1 specimen.
Polycopiella species A: 1 specimen.

Sta 94-034, 9 Jun 1994, Cueva de Los Lagos volcanic cave, Atlantida Tunnel lava tube, Lanzarote, Canary Islands; salinity 35 ppt; collected with plankton net from water column in 0–1 m depths.
Danielopolina wilkensi: 1 specimen.
Spelaeoecia mayan: 3 specimens.

Sta 95-003, 14 May 1995, Norman's Pond Cave, Norman's Pond Cay, Exuma Cays, Bahamas; salinity 36 ppt; collected by hand with a vial from water column in 15–21 m depths.
Danielopolina exuma: 1 specimen.

Sta 95-008, 18 May 1995, Angelfish Cave, Stocking Island, Exuma Cays, Bahamas; salinity 35 ppt; collected with suction bottle from sandy ledge near cave entrance in 9 m water depth.
Bairdia sp.: 1 specimen.
Cylindroleberidinae: 1 specimen with large lateral eyes.
Halocyprid cave species: None.

Sta 95-010, 18 May 1995, Crab Cay Crevasse, Crab Cay, Exuma Cays, Bahamas; salinity 35 ppt; collected with 93 um mesh plankton net from coarse sediment at 35 m depth about 100 m inside cave.
Podocopa and Myodocopina: 89 specimens.
Halocyprid cave species: None.

Sta 95-011, 16 May 1995, Norman's Pond Cave, Norman's Pond Cay, Exuma Cays, Bahamas; salinity 36 ppt; collected with suction bottle from rocks just inside cave entrance at 4 m depth.
Bairdia sp.: 1 specimen.
Halocyprid cave species: None.

Sta 95-012, 22 May 1995, Oven Rock Cave, Great Guana Cay, Exuma Cays, Bahamas; salinity 35 ppt; collected with 93 um mesh plankton net and suction bottle from water column at 1–22 m water depth.
Spelaeoecia capax: 41 specimens.
Spelaeoecia styx: 7 specimens.
Podocopa: 2 specimens (2 species).
Pelecypod: 1 larva.

Literature Cited

Angel, Martin V.

1993. Marine Planktonic Ostracods. *Synopses of the British Fauna* (new series), 48: viii + 240 pages, 86 figures.

Angel, M.V., and T.M. Iliffe

1987. *Spelaeocia bermudensis* New Genus, New Species, a Halocyprid Ostracod from Marine Caves in Bermuda. *Journal of Crustacean Biology*, 7:541–553, figures 1–7, tables 1–3.

Aubrecht, Roman, and Heinz Kozur

1995. *Pokornyopsis* (Ostracoda) from Submarine Fissure Fillings and Cavities in the Late Jurassic of Czorsztyn Unit and the Possible Origin of the Recent Anchialine Faunas. *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen*, 196(1):1–17, figures 1–8.

Back, W., B.B. Hanshaw, J.S. Herman, and J.N. Van Driel

1986. Differential Dissolution of a Pleistocene Reef in the Ground-Water Mixing Zone of Coastal Yucatan, Mexico. *Geology*, 14: 137–140.

Baltanás, Angel, and D.L. Danielopol

1995. Cladistic Analysis of *Danielopolina* Species (Ostracoda, Thaumatocyprididae) and the Origin of Anchialine Fauna. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, 92:315–324, figures 1, 2, tables 1, 2.

Bowman, Thomas E., and Thomas M. Iliffe

1988. *Tulumella unidens*, a New Genus and Species of Thermosbaenacean Crustacean from the Yucatan Peninsula, Mexico. *Proceedings of the Biological Society of Washington*, 10(1):221–226, figures 1, 2.

Chavtur, V.G.

1977. [Ostracods of the Family Polycopidae (Cladocopa) of the Kurile Islands.] In *Fauna of the Coastal Zone of the Kurile Islands*, pages 144–171, figures 1–14. Moscow: Science Publishing House. [Translated from Russian for the Smithsonian Institution and the National Science Foundation, Washington, D.C., by ESDUCK Cairo, 1981.]

1979. [New Data on Ostracodes of the Polycopidae Family (Ostracoda-Cladocopa) for Eastern Seas.] *In* Investigations of Pelagic and Bottom Organisms from the Far-Eastern Seas. *Transactions of the Institute of Marine Biology, Far East Science Center, Academy of Sciences of the U.S.S.R.* (Vladivostok), 15:91–105, figures 1–8. [In Russian; translated by Dr. Ervin G. Otvos.]

1981. [On the Systematic Position of the Modern Ostracoda in the Family Polycopidae (Ostracoda, Cladocopinae).] *Trudy Institut Okeanologiia*, 115:53–60. [In Russian; translated by Dr. Ervin G. Otvos.]

Creaser, Edwin P.

1936. Crustaceans from Yucatan. *Carnegie Institution of Washington Publications*, 457:117–132, figures 1–43, tables 1–3.

Dana, J.D.

1853. Tribe III: Cyproidea = Ostracoda. In *Crustacea of United States Exploring Expedition during the Years 1838, 1839, 1840, 1841, 1842, under the Command of Charles Wilkes, U.S.N., with Atlas of 96 plates*, 13(2):1277–1304, plates 90, 91. Philadelphia: C. Sherman.

Danielopol, Dan L.

1972. Sur la presence de *Thaumatocypris orghidani* n. sp. (Ostracoda, Myodocopida) dans une grotte de Cuba. *Compte Rendu Hebdomadaire des Séances de l'Académie des Sciences* (Paris), 274:1390–1393.

1990. The Origin of the Anchialine Cave Fauna—the "Deep Sea" Versus the "Shallow Water" Hypothesis Tested against the Empirical Evidence of the Thaumatocyprididae (Ostracoda). *Bijdragen tot de Dierkunde*, 60(3/4):137–143, figure 1.

Danielopol, Dan L., A. Baltanas, and G. Bonaduce

1996. The Darkness Syndrome in Subsurface-Shallow and Deep-Sea Dwelling Ostracoda (Crustacea). *In* F. Uiblein, J. Ott, and M. Stachowitsch, editors, Deep-Sea and Extreme Shallow-Water Habitats: Affinities and Adaptations. *Biosystematics and Ecology Series*, 11:123–144. Vienna: Austrian Academy of Sciences.

Dill, R.F., R. Wilkens, and H.A. Curran

1990. Caves and Blue Holes. *In* Christopher G. St.C. Kendall, Robert F. Dill, and Eugene A. Shinn, editors, *Guidebook to the Marine Geology and Tropical Environments of Lee Stocking Island, the Southern Exumas, Bahamas*, pages 59–60. San Diego, California: KenDill Publishers.

Grant, R.E., M.K. Nestell, A. Baud, and C. Jenny

1991. Permian Stratigraphy of Hydra Island, Greece. *Palaios*, 5:479–497.

Hart, C.W., Jr., and Raymond B. Manning

1981. The Cavernicolous Caridean Shrimps of Bermuda (Alpheidae, Hippolytidae, and Atyidae). *Journal of Crustacean Biology*, 1(3):441–456, figures 1–77.

Hartmann, Gerd

1985. *Danielopolina wilkensi* n. sp. (Halocyprida, Thaumatocyprididae), ein neuer Ostracode aus einem marinen Lava-Tunnel auf Lanzarote (Kanarische Inseln). *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, 82:255–261, figures 1–7.

Hobbs, H.H., III

1978. The Female of *Barbouria cubensis* (von Martens) (Decapoda, Hippolytidae) with Notes on a Population in the Bahamas. *Crustaceana*, 35:99–102.

Hobbs, H.H., III, and Horton H. Hobbs, Jr.

1976. On the Troglobitic Shrimps of the Yucatan Peninsula, Mexico (Decapoda: Atyidae and Palaemonidae). *Smithsonian Contributions to Zoology*, 240: 23 pages, 8 figures, 2 maps.

Holsinger, John R.

1990. *Tuluweckelia cernua*, a New Genus and Species of Stygobiont Amphipod Crustacean (Hadziidae) from Anchialine Caves on the Yucatan Peninsula in Mexico. *Beaufortia*, 41(14):97–107, figures 1–5.

Holthuis, L.B.

1973. Caridean Shrimps Found in Land-Locked Saltwater Pools at Four Indo-West Pacific Localities (Sinai Peninsula, Funafuti Atoll, Maui and Hawaii Islands), with the Description of One New Genus and Four New Species. *Zoologische Verhandlingen* (Leiden), 128: 47 pages, 13 figures, 7 plates.

Hubbs, C.L.

1938. Fishes from the Caves of Yucatan. *Carnegie Institution of Washington Publications*, 491:261–295.

Huys, R.

1988. *Boxhallia bulbantennulata* gen. et spec. nov. (Copepoda: Misophrioida) from an Anchihaline Lava Pool on Lanzarote, Canary Islands. *Stygologia*, 4(2):138–154.

Ikeda, T.

1992. Laboratory Observations on Spawning, Fecundity and Early Development of a Mesopelagic Ostracod, *Conchoecia pseudodiscophora*, from the Japan Sea. *Marine Biology*, 112(2):313–318.

Iles, E.J.

1961. The Appendages of the Halocyprididae. *Discovery Reports*, 31: 299–326, figures 1–14.

Iliffe, Thomas M.
1990. Crevicular Dispersal of Marine Cave Faunas. *Mémoires de Biospéologie,* 17:93–96.
1991. Anchialine Fauna of the Galapagos Islands. *In* M.J. James, editor, *Galapagos Marine Invertebrates,* pages 209–231. New York: Plenum Press.

Kornicker, Louis S.
1989. The Adult Male of the Troglobitic Ostracode *Spelaeocia bermudensis* Angel and Iliffe, 1989, from an Anchialine Cave in Bermuda (Crustacea: Ostracoda: Halocypridoidea). *Proceedings of the Biological Society of Washington,* 102(2):313–323, figures 1–5.
1992. *Thaumatoconcha pix,* a New Bathyal and Abyssal Species from off SE Australia and NE Tasmania (Crustacea: Ostracoda: Thaumatocyprididae). *Proceedings of the Biological Society of Washington,* 105(2):233–239, figures 1–3.

Kornicker, Louis S., and Douglas J. Barr
1997. Anchialine Ostracoda (Halocyprididae) from San Salvador, Bahamas. *Smithsonian Contributions to Zoology,* 588: 20 pages, 11 figures, 2 tables.

Kornicker, Louis S., and Thomas M. Iliffe
1985. Deeveyinae, a New Subfamily of Ostracoda (Halocyprididae) from a Marine Cave on the Turks and Caicos Islands. *Proceedings of the Biological Society of Washington,* 98(2):476–493, figures 1–13.
1989a. Troglobitic Ostracoda (Myodocopa: Cypridinididae, Thaumatocyprididae) from Anchialine Pools on Santa Cruz Island, Galapagos Islands. *Smithsonian Contributions to Zoology,* 483: 38 pages, 17 figures, 15 tables.
1989b. New Ostracoda (Halocyprida: Thaumatocyprididae and Halocyprididae) from Anchialine Caves in the Bahamas, Palau, and Mexico. *Smithsonian Contributions to Zoology,* 470: 47 pages, 22 figures, 8 tables.
1989c. Ostracoda (Myodocopina, Cladocopina, Halocypridina) Mainly from Anchialine Caves in Bermuda. *Smithsonian Contributions to Zoology,* 475: 88 pages, 49 figures, 22 tables.
1992. Ostracoda (Halocypridina, Cladocopina) from Anchialine Caves in Jamaica, West Indies. *Smithsonian Contributions to Zoology,* 530: 22 pages, 11 figures, 1 table.
1995. Ostracoda (Halocypridina, Cladocopina) from an Anchialine Lava Tube in Lanzarote, Canary Islands. *Smithsonian Contributions to Zoology,* 568: 32 pages, 16 figures, 1 table.

Kornicker, Louis S., and R.J. Palmer
1987. *Deeveya bransoni,* a New Species of Troglobitic Halocyprid Ostracode from Anchialine Caves on South Andros Island, Bahamas (Crustacea: Ostracoda). *Proceedings of the Biological Society of Washington,* 100(3):610–623, figures 1–6.

Kornicker, Louis S., and I.G. Sohn
1976. Phylogeny, Ontogeny, and Morphology of Living and Fossil Thaumatocypridacea (Myodocopa: Ostracoda). *Smithsonian Contributions to Zoology,* 219: 124 pages, 93 figures.

Kornicker, L.S., and F.P.C.M. Van Morkhoven
1976. *Metapolycope,* a New Genus of Bathyal Ostracoda from the Atlantic (Suborder Cladocopina). *Smithsonian Contributions to Zoology,* 225: 29 pages, 24 figures.

Kornicker, Louis S., and Jill Yager
1996. The Troglobitic Halocyprid Ostracoda of Anchialine Caves in Cuba. *Smithsonian Contributions to Zoology,* 580: 16 pages, 9 figures, 1 table.

Kornicker, Louis S., Jill Yager, and Dennis Williams
1990. Ostracoda (Halocyprididae) from Anchialine Caves in the Bahamas. *Smithsonian Contributions to Zoology,* 495: 51 pages, 30 figures, 4 tables.

Maciolek, J.A.
1983. Distribution and Biology of Indo-Pacific Insular Hypogeal Shrimps. *Bulletin of Marine Science,* 33:606–618.

Meyerhoff, A.A., and C.W. Hatten
1974. Bahamas Salient of North America: Tectonic Framework, Stratigraphy, and Petroleum Potential. *American Association of Petroleum Geologists Bulletin,* 58:1201–1239.

Müller, G.W.
1894. Die Ostracoden des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. *Fauna und Flora des Golfes von Neapel,* 21: 404 pages, 40 plates.
1906. Ostracoda. *Wissenschaftliche Ergnebnisse der Deutsche Tiefsee-Expedition ... 1898–1899,* 8(2): 154 pages, 31 plates.

Reddell, James R.
1977. A Preliminary Survey of the Caves of the Yucatan Peninsula. *In* James R. Reddell, editor, Studies of the Caves and Cave Fauna of the Yucatan Peninsula. *Association for Mexican Cave Studies Bulletin,* 6:215–296, figures 1–15, table 1. Austin, Texas: The Speleo Press.

Rudjakov, J.A.
1993. The First Finding of the Male of *Thaumatocypris echinata* Müller, 1906 (Crustacea, Ostracoda). *Proceedings of the Biological Society of Washington,* 106(2):305–314, figures 1–5, table 1.

Sars, G.O.
1866 ("1865"). Oversigt af Norges marine Ostracoder. *Forhandlinger i Videnskabs-Selskabet I Christiania,* 8:1–130. [Preprint, 1865.]

Stock, J.H., Thomas M. Iliffe, and Dennis Williams
1986. The Concept "Anchialine" Reconsidered. *Stygologia,* 2(1/2):90–92.

Thomas, M.L.H., A. Logan, K.E. Eakins, and S.M. Mathers
1992. Biotic Characteristics of the Anchialine Ponds of Bermuda. *Bulletin of Marine Science,* 50(1):133–157.

Triebel, Erich
1941. Zur Morphologie und Okologie der fossilen Ostracoden, mit Beschreibung eineger neuer Gattungen und Arten. *Senckenbergiana,* 23(4–6):294–400, 15 plates.

Tseng, Wen-Young
1975. Biology of the Pelagic Ostracod *Euconchoecia elongata* Müller. *Laboratory of Fishery Biology Report* (Taiwan), 27:1–183, figures I–VII, tables I–VII.

Von Martens, E.
1872. Ueber Cubanische Crustaceen nach den Sammlungen Dr. J. Gundlach's [sic]. *Archiv für Naturgeschichte,* 38(1):77–147, 257, 258, plates 4, 5.

Wilkens, Horst, Jakob Parzefall, and Thomas M. Iliffe
1986. Origin and Age of the Marine Stygofauna of Lanzarote, Canary Islands. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut,* 83:223–230, figures 1–3.

Yager, Jill
1987. *Speleonectes tulumensis* n. sp. (Crustacea: Remipedia) from Two Anchialine Cenotes of the Yucatan Peninsula, Mexico. *Stygologia,* 3(2):160–166, figures 1, 2.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1998 417-844 / 20038

REQUIREMENTS FOR SMITHSONIAN SERIES PUBLICATION

Manuscripts intended for series publication receive substantive review (conducted by their originating Smithsonian museums or offices) and are submitted to the Smithsonian Institution Press with Form SI-36, which must show the approval of the appropriate authority designated by the sponsoring organizational unit. Requests for special treatment—use of color, foldouts, case-bound covers, etc.—require, on the same form, the added approval of the sponsoring authority.

Review of manuscripts and art by the Press for requirements of series format and style, completeness and clarity of copy, and arrangement of all material, as outlined below, will govern, within the judgment of the Press, acceptance or rejection of manuscripts and art.

Copy must be prepared on typewriter or word processor, double-spaced, on one side of standard white bond paper (not erasable), with 1¼″ margins, submitted as ribbon copy (not carbon or xerox), in loose sheets (not stapled or bound), and accompanied by original art. Minimum acceptable length is 30 pages.

Front matter (preceding the text) should include: **title** page with only title and author and no other information; **abstract** page with author, title, series, etc., following the established format; table of **contents** with indents reflecting the hierarchy of heads in the paper; also, **foreword** and/or **preface**, if appropriate.

First page of text should carry the title and author at the top of the page; **second page** should have only the author's name and professional mailing address, to be used as an unnumbered footnote on the first page of printed text.

Center heads of whatever level should be typed with initial caps of major words, with extra space above and below the head, but no other preparation (such as all caps or underline, except for the underline necessary for generic and specific epithets). Run-in paragraph heads should use period/dashes or colons as necessary.

Tabulations within text (lists of data, often in parallel columns) can be typed on the text page where they occur, but they should not contain rules or numbered table captions.

Formal tables (numbered, with captions, boxheads, stubs, rules) should be submitted as carefully typed, double-spaced copy separate from the text; they will be typeset unless otherwise requested. If camera-copy use is anticipated, do not draw rules on manuscript copy.

Taxonomic keys in natural history papers should use the aligned-couplet form for zoology and may use the multi-level indent form for botany. If cross referencing is required between key and text, do not include page references within the key, but number the keyed-out taxa, using the same numbers with their corresponding heads in the text.

Synonymy in zoology must use the short form (taxon, author, year:page), with full reference at the end of the paper under "Literature Cited." For botany, the long form (taxon, author, abbreviated journal or book title, volume, page, year, with no reference in "Literature Cited") is optional.

Text-reference system (author, year:page used within the text, with full citation in "Literature Cited" at the end of the text) must be used in place of bibliographic footnotes in all Contributions Series and is strongly recommended in the Studies Series: "(Jones, 1910:122)" or "...Jones (1910:122)." If bibliographic footnotes are required, use the short form (author, brief title, page) with the full citation in the bibliography.

Footnotes, when few in number, whether annotative or bibliographic, should be typed on separate sheets and inserted immediately after the text pages on which the references occur. Extensive notes must be gathered together and placed at the end of the text in a notes section.

Bibliography, depending upon use, is termed "Literature Cited," "References," or "Bibliography." Spell out titles of books, articles, journals, and monographic series. For book and article titles use sentence-style capitalization according to the rules of the language employed (exception: capitalize all major words in English). For journal and series titles, capitalize the initial word and all subsequent words except articles, conjunctions, and prepositions. Transliterate languages that use a non-Roman alphabet according to the Library of Congress system. Underline (for italics) titles of journals and series and titles of books that are not part of a series. Use the parentheses/colon system for volume (number):pagination: "10(2):5–9." For alignment and arrangement of elements, follow the format of recent publications in the series for which the manuscript is intended. Guidelines for preparing bibliography may be secured from Series Section, SI Press.

Legends for illustrations must be submitted at the end of the manuscript, with as many legends typed, double-spaced, to a page as convenient.

Illustrations must be submitted as original art (not copies) accompanying, but separate from, the manuscript. Guidelines for preparing art may be secured from the Series Section, SI Press. All types of illustrations (photographs, line drawings, maps, etc.) may be intermixed throughout the printed text. They should be termed **Figures** and should be numbered consecutively as they will appear in the monograph. If several illustrations are treated as components of a single composite figure, they should be designated by lowercase italic letters on the illustration; also, in the legend and in text references the italic letters (underlined in copy) should be used: "Figure 9b." Illustrations that are intended to follow the printed text may be termed **Plates**, and any components should be similarly lettered and referenced: "Plate 9b." Keys to any symbols within an illustation should appear on the art rather than in the legend.

Some points of style: Do not use periods after such abbreviations as "mm, ft, USNM, NNE." Spell out numbers "one" through "nine" in expository text, but use digits in all other cases if possible. Use of the metric system of measurement is preferable; where use of the English system is unavoidable, supply metric equivalents in parentheses. Use the decimal system for precise measurements and relationships, common fractions for approximations. Use day/month/year sequence for dates: "9 April 1976." For months in tabular listings or data sections, use three-letter abbreviations with no periods: "Jan, Mar, Jun," etc. Omit space between initials of a personal name: "J.B. Jones."

Arrange and paginate sequentially every sheet of manuscript in the following order: (1) title page, (2) abstract, (3) contents, (4) foreword and/or preface, (5) text, (6) appendices, (7) notes section, (8) glossary, (9) bibliography, (10) legends, (11) tables. Index copy may be submitted at page proof stage, but plans for an index should be indicated when the manuscript is submitted.