

Mud Shrimps, Upogebiidae,
from the Western Atlantic
(Crustacea: Decapoda: Thalassinidea)

AUSTIN B. WILLIAMS

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 544

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ABSTRACT

Williams, Austin B. Mud Shrimps, Upogebiidae, from the Western Atlantic (Crustacea: Decapoda: Thalassinidea). *Smithsonian Contributions to Zoology*, number 544, 77 pages, 31 figures, 1993.—Mud shrimps, Upogebiidae, found in the western Atlantic between Massachusetts, U.S.A., and southern Brazil are reviewed. Twelve species described previously from this region are recognized: *Pomatogebia operculata* (Schmitt), Florida through Caribbean region, and off Espírito Santo, Brazil, in stony corals; *Upogebia acanthura* (Coelho), ranging from Florida, U.S.A., through Caribbean region, and from mouth of Amazon River to Cabo Frio, Brazil, living in sponges; *U. annae* Thistle, Bahamas, Turks and Caicos Islands; *U. brasiliensis* Holthuis, Belize, Surinam, Brazil from Bahia to Santa Catarina; *U. affinis* (Say), Massachusetts to Texas, U.S.A.; *U. corallifora* Williams and Scott, eastern Yucatan Peninsula, Jamaica, Puerto Rico, Virgin Islands, in dead coral; *U. jamaicensis* Thistle, Jamaica, Panama, Colombia; *U. marina* Coelho, Venezuela, Alagoas, Brazil; *U. noronhensis* Fausto-Filho, endemic to Fernando de Noronha, Brazil; *U. omissa* Gomes Corrêa, Greater Antilles, Panama to Santa Catarina, Brazil; *U. spinistipula* Williams and Heard, eastern Gulf of Mexico; *U. vasquezi* Ngoc-Ho, southern Florida, U.S.A., Bahamas, Caribbean region to Bahia, Brazil.

Eleven species new to science are described and one new genus is recognized: *Aethogebia gorei*, new genus and species, Florida Keys, U.S.A.; *U. bermudensis*, Bermuda; *U. casis*, Caribbean region, Surinam; *U. molipollex*, Puerto Rico; *U. aestuari*, Belize; *U. aquilina*, southern Florida, U.S.A.; *U. careospina*, Ceará, Brazil; *U. felderi*, western Gulf of Mexico; *U. inomissa*, eastern Gulf of Mexico and southern Florida, U.S.A.; *U. omissago*, Piauí, Brazil; *U. paraffinis*, Ceará to São Paulo, Brazil; *U. pillsbury*, Panama.

Generic relationships are discussed. Species accounts include synonymy, diagnosis, description, distribution, comparisons, and summary of biological data available. Keys are given for identification of genera and species.

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Contents

	<i>Page</i>
Introduction	1
Acknowledgments	6
Family UPOGEBIIDAE Borradaile, 1903	6
Key to Genera of UPOGEBIIDAE in the Western Atlantic	7
<i>Aethogebia</i> , new genus	7
<i>Aethogebia gorei</i> , new species	7
Genus <i>Pomatogebia</i> Williams and Ngoc-Ho, 1990	9
<i>Pomatogebia operculata</i> (Schmitt, 1924)	10
Genus <i>Upogebia</i> (Leach, 1814)	13
Key to Known Western Atlantic Species of <i>Upogebia</i>	14
<i>Upogebia acanthura</i> (Coêlho, 1973)	16
<i>Upogebia annae</i> Thistle, 1973	20
<i>Upogebia bermudensis</i> , new species	22
<i>Upogebia brasiliensis</i> Holthuis, 1956	24
<i>Upogebia casis</i> , new species	27
<i>Upogebia molipollex</i> , new species	29
<i>Upogebia aestuari</i> , new species	31
<i>Upogebia affinis</i> (Say, 1818)	33
<i>Upogebia aquilina</i> , new species	37
<i>Upogebia careospina</i> , new species	39
<i>Upogebia corallifora</i> Williams and Scott, 1989	41
<i>Upogebia felderi</i> , new species	44
<i>Upogebia inomissa</i> , new species	46
<i>Upogebia jamaicensis</i> Thistle, 1973	48
<i>Upogebia marina</i> Coêlho, 1973	51
<i>Upogebia noronhensis</i> Fausto-Filho, 1969	51
<i>Upogebia omissa</i> Gomes Corrêa, 1968	54
<i>Upogebia omissago</i> , new species	57
<i>Upogebia paraffinis</i> , new species	60
<i>Upogebia pillsbury</i> , new species	62
<i>Upogebia spinistipula</i> Williams and Heard, 1991	64
<i>Upogebia vasquezi</i> Ngoc-Ho, 1989	67
<i>Upogebia incertae sedis</i>	72
Phylogenetic Considerations	72
Literature Cited	74

Mud Shrimps, Upogebiidae, from the Western Atlantic (Crustacea: Decapoda: Thalassinidea)

Austin B. Williams

Introduction

Until now, 12 species of Upogebiidae have been recognized from the continental shelf region of the western Atlantic Ocean from Cape Cod, Massachusetts, U.S.A., to southern Brazil. Eleven additional species have been found in the region, either by new discovery or by partitioning of previously known but ill-defined forms. This latitudinal distance of over 21,000 kilometers (13,000 miles), which includes the continental coast of the Gulf of Mexico and Caribbean Sea in the base measurement, extends through six zoogeographic provinces that have been delimited from north to south as: Western Atlantic Boreal Region (cool temperate in the southern part, Cape Cod to Cape Hatteras, U.S.A.), Carolina Region (warm temperate, Cape Hatteras, U.S.A., to northeastern Mexico, with exception of southern peninsular Florida), West Indian Region (southern Florida, Bahamas, Greater and Lesser Antilles), Caribbean Region (northeastern Mexico to mouth of Orinoco River), Brazilian Region (mouth of Orinoco River to west of Cabo Frio, Brazil), and Eastern South American Region (west of Cabo Frio, Brazil, to Rio de la Plata) (Briggs, 1974:60-76) (Figures 1, 2). No single upogebiid species has a distributional range throughout this geographic array, although *Upogebia affinis* (Say) traditionally and mistakenly has been assigned the full range (see species account). Individual species tend to be confined to a single province or to neighboring provinces; hence, they occur within reasonably uniform environmental regimes. Because the species live in more or less permanent burrow systems after they pass through their larval stages (R.K. Thompson and Pritchard, 1969; Swinbanks and Murray, 1981; Kleemann, 1984; Scott et al., 1988), they would then seem to be shielded to some extent from environmental extremes, especially from low temperatures in northern and southern

parts of this range. As infauna, the species seem intimately associated with substrate types, some species are even highly specialized for commensal existence in sponges or corals.

Over 125 species of Upogebiidae have been described. De Saint Laurent and Le Loeuff (1979:90) pointed out the remarkable uniformity in morphology of the family as a whole and regarded it as monogeneric, within which the subgenera recognized by de Man (1928:35-39) and others have no systematic value because their defining characters have become compromised as the number of recognized species has increased. However, de Saint Laurent and Le Loeuff (1979:92-94) continued to recognize certain clusters of taxa in their attempt to evaluate relationships within the family. At that time about 50 species were known from the Indo-West Pacific, 13 from the eastern Atlantic, and 12 from the western hemisphere. Poore and Griffin (1979:295, 297) added two new species to the fauna of Australia.

In the few years since those papers appeared, several changes in the listing have been published, mainly with reference to Indo-Pacific species. Sakai (1982:2, 3, list) recognized 45 species from the Indo-Pacific region and re-emphasized the remarkable morphologic uniformity in the group. Nevertheless, he placed 40 of the species in the genus *Upogebia*, split into three subgenera (*Upogebia*, *Acutigebia*, new, and *Neogebicula*, new), and erected two new genera, *Wolffogebia* containing four subspecies and the monotypic *Tuerkayogebia*. In making these decisions he renewed attempts to subdivide the unwieldy family into subsets of coherent units, but the task remained refractive because putative group differences are subtle and tend to merge. Lately, Ngoc-Ho (1989a) erected *Gebiacantha* to receive five newly described and six revised species from the Indo-Pacific region, and in a subsequent paper (1989b) she described two additional Indo-Pacific and one Caribbean species. Most recently, Sakai and Mukai (1991) described another new *Upogebia* from Japan, and Ngoc-Ho (1991) described three additional from New Caledonia.

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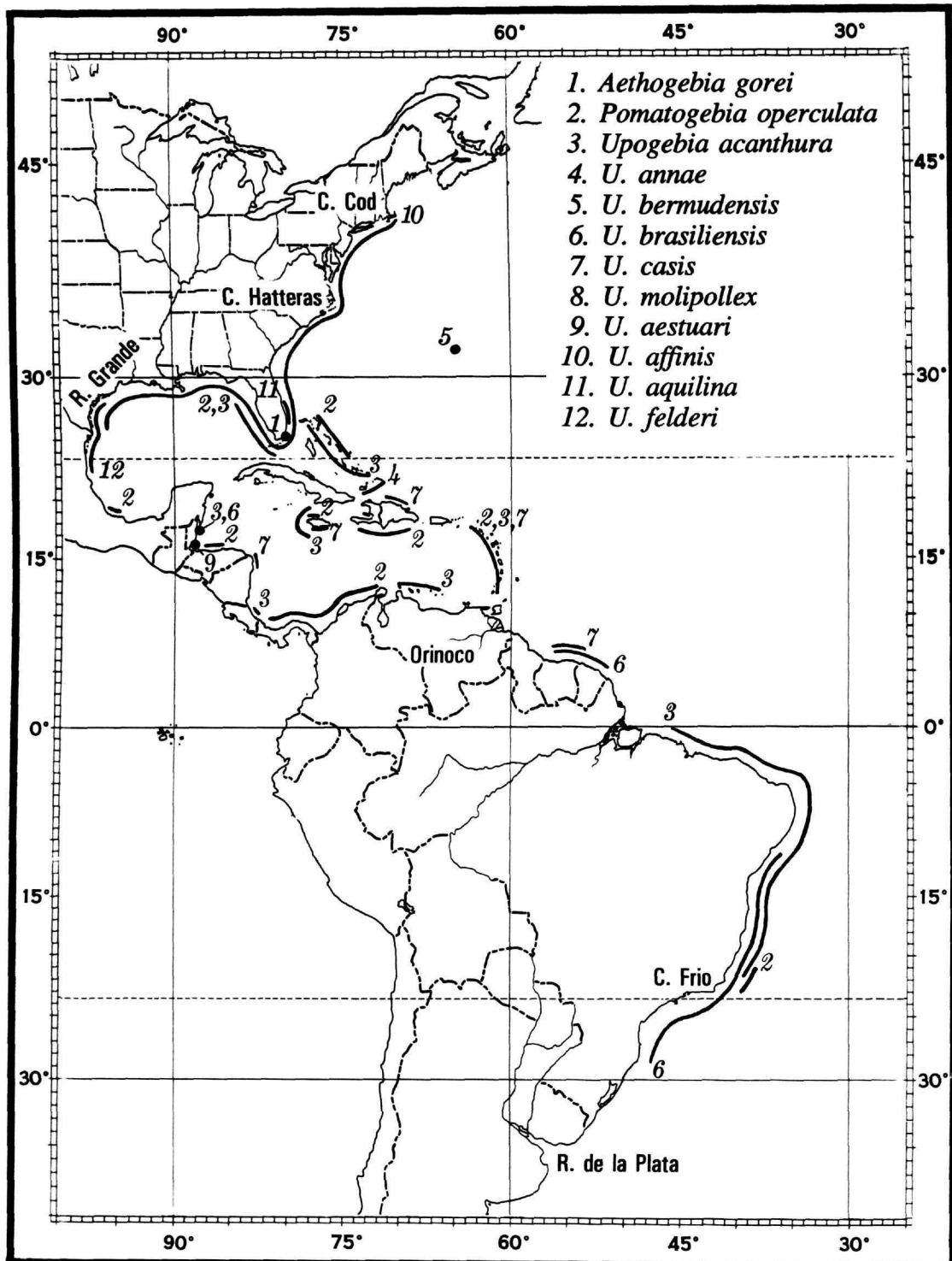


FIGURE 1.—Distributional ranges from Massachusetts, U.S.A., to southern Brazil of 12 western Atlantic species of Upogebiidae. Numbers for listed species are associated with appropriate range lines or restricted localities.

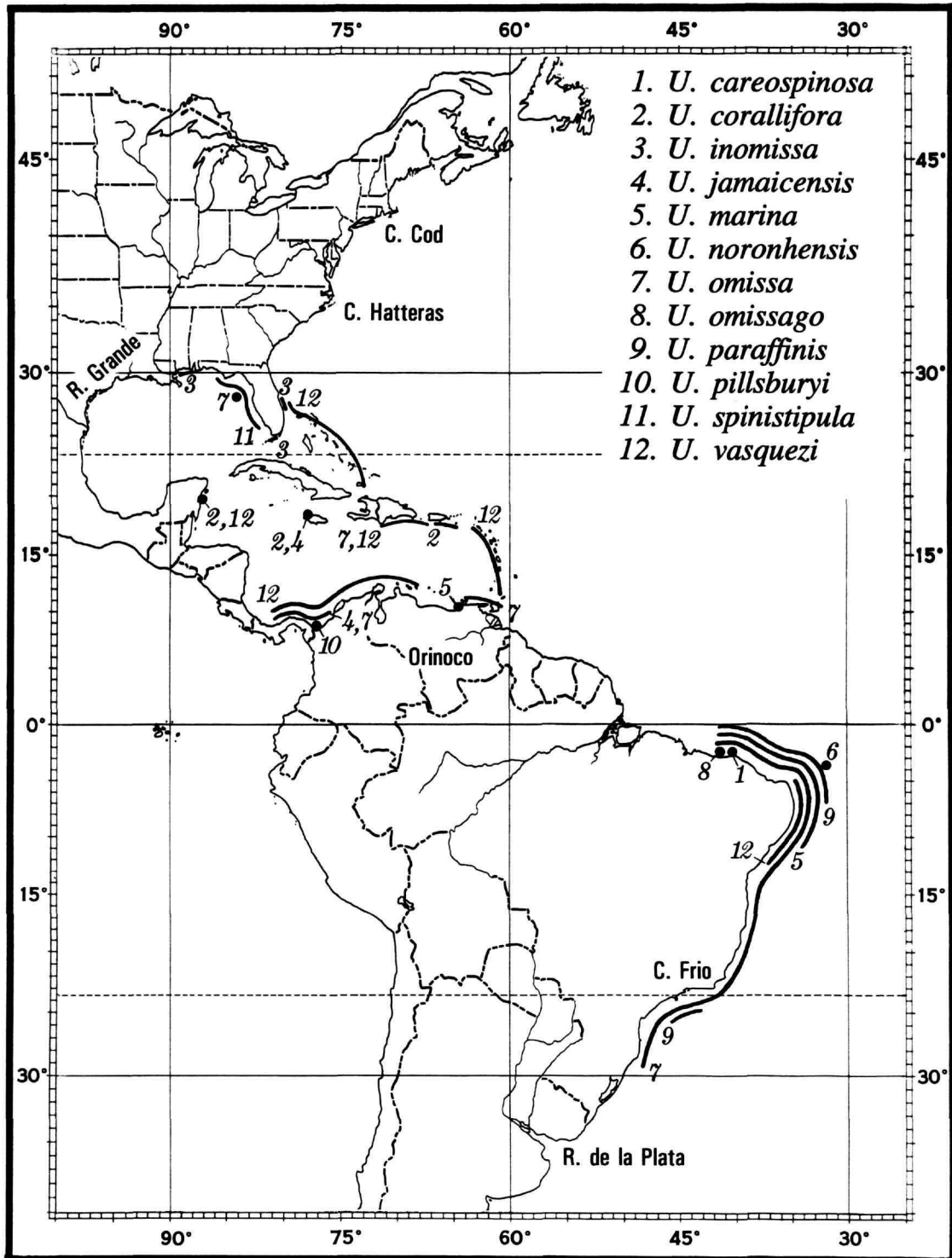


FIGURE 2.—Distributional ranges from Florida, U.S.A., to southern Brazil of 12 western Atlantic species of Upogebiidae. Numbers for listed species are associated with appropriate range lines or restricted localities.

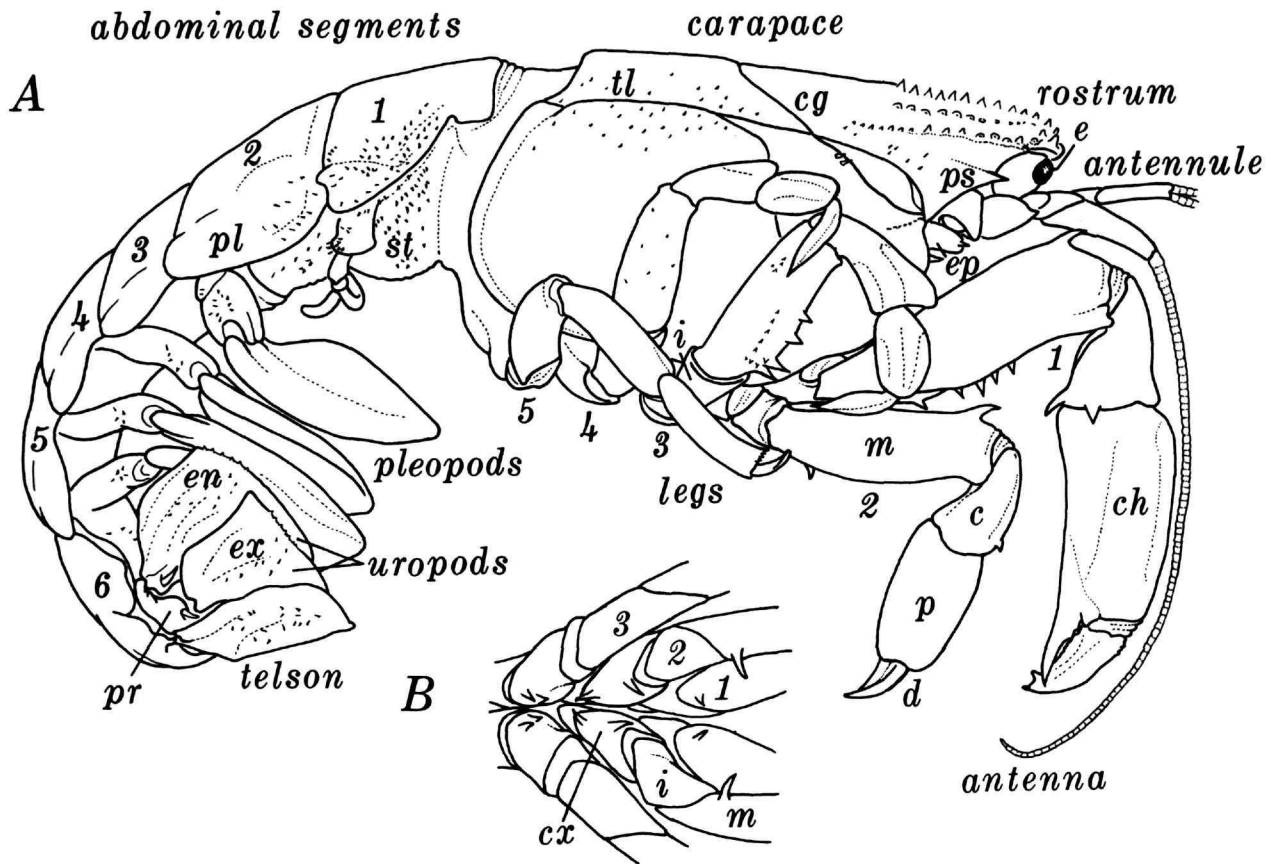


FIGURE 3.—Schematic drawing of upogebiids: A, animal in lateral view; B, coxa and associated articles of legs 1-3 in ventral view; c, carpus; cg, cervical groove; ch, cheliped; cx, coxa (sometimes spined); d, dactyl; e, eye; en, endopodite; ex, exopodite; i, ischium; m, merus (sometimes spined proximally); p, propodus; pl, pleuron (sometimes bearing spinules); pr, protopodite; ps, postorbital spine; st, sternite (sometimes bearing spinules); tl, thalassinidean line (from Williams, 1986).

Less extensive systematic work has been done on Upogebiidae in the western hemisphere where there are fewer species than in the rest of the world. Thistle (1973) recognized six species from the western Atlantic, two described as new, and three from the eastern Pacific. Williams (1986:4, list) described 15 new species from the eastern Pacific. Williams and Scott (1989) and Williams and Heard (1991) each described a new species from the Gulf of Mexico and Caribbean region, Williams and Ngoc-Ho (1990) erected a new genus, *Pomatogebia*, to receive three highly specialized species that are commensal in stony coral, and Williams (1987) described a commensal species from sponges of the Caribbean that turned out to be one of two new species already briefly described in abstracts by Coêlho (1973a, 1973b).

Ngoc-Ho (1981), in a paper directed primarily to the study of

morphology and relationships among some thalassinidean larvae, looked again at possible subdivisions in the genus *Upogebia* on the basis of adult morphology, with particular attention to the form of the gill lamellae. She ended by conservatively stating that although there appear to be clusters of species within the genus, the limits of these groups were not then known, and that potential subdivision into formal units would have to await more study. She (Ngoc-Ho, 1981:245, 246) recognized three types of gills in the genus: type A having arthrobranchs "with a fairly large and flattened structure on either side of the rachis," type B "with a slightly flattened structure on either side of the rachis," and type C having arthrobranchs "with 2 small tubular structures on either side the rachis." Branchial lamellae of types A and C are distinctive, but type B seems a modification of type A. Type A is by far the

predominant type in the western hemisphere, and type C is found in commensal forms. For descriptive impact, I have given the lamellar shape rather than letter designation in accounts that follow.

From this brief review, it is evident that museum research collections of upogebioid study material have reached fairly comprehensive levels. Some species are widely distributed, but others, perhaps because of poor sampling, have distributions that are very restricted or confined to type localities. Sampling for the cryptic animals is difficult, and it is only as diverse collections have accumulated, some from commensal associations, that new rounds of systematic assessment have been attempted. Cryptic habitats evidently impose adaptations within narrow confines, thus divergence has been subtle or hard to define, and the jury is still out on the validity of proposed new genera and subgenera until comprehensive study of the whole group can be done.

This paper treats one aspect of this problem. Its purpose is to provide, for species of Upogebiidae known from the western Atlantic Ocean, keys for identification, synonymies, lists of materials studied, illustrated descriptive accounts, geographic ranges, comparative discussion, and selected notes on biology. Elucidation of relationships within the family as a whole is beyond the scope of this paper, but the suggestions of de Saint Laurent and Le Loeuff (1979:92-94), Ngoc-Ho (1981, 1989a), Williams (1986:3, 4), and Williams and Ngoc-Ho (1990) are reinforced by review of the New World species.

There are four unequal clusters of species in this region (Table 1). Species in the first and by far the largest of these clusters have a reduced epipod associated with the third maxilliped, two arthrobranches arranged in biserial rows of undivided (entire) lamellae on the third maxilliped and legs 1-4, a normal sixth abdominal segment and tail fan, and a dorsally armed triangular rostrum and anterior gastric region, the latter usually is flanked on each side by a well-developed furrow and spined lateral ridge that projects into an anterior process flanking the rostrum. There are 17 of these species in the western Atlantic and 15 in the eastern Pacific. Eleven of the species lack a strong proximal spine on the merus of the second leg (3 Atlantic, 8 Pacific). Nineteen species have a strong proximal spine on the merus of the second leg (12 Atlantic, 7 Pacific). However, two species (both Atlantic) clearly allied to the spineless group are intermediate in respect to this character, the proximal spine on the merus of the second leg usually being absent but occasionally represented by a tubercle. This is but one example of how species groups and higher groups in the family merge.

Species in the remaining three much smaller clusters lack an epipod associated with the third maxilliped and have two arthrobranches arranged in two biserial rows of divided (rod-like) lamellae on the third maxilliped and legs 1-4.

The second cluster is represented by only one species. It has a normal abdominal segment VI and tail fan; strap-shape

TABLE 1.—Groupings of genera and species within the family Upogebiidae in the Western Hemisphere (A = western Atlantic distribution, P = eastern Pacific).

1. Normal abdominal segment VI and tail fan; triangular rostrum and anterior gastric region dorsally armed, latter usually flanked on each side by well-developed furrow and spined lateral ridge projecting into anterior process flanking rostrum.	<p>Lacking strong proximal spine on merus of second leg.</p> <p><i>Upogebia bermudensis</i>, new species, A <i>Upogebia brasiliensis</i> Holthuis, A <i>Upogebia burkenroadi</i> Williams, P <i>Upogebia lepta</i> Williams, P <i>Upogebia maccraryae</i> Williams, P <i>Upogebia macginitieorum</i> Williams, P <i>Upogebia molipollex</i>, new species, A <i>Upogebia onychion</i> Williams, P <i>Upogebia pugettensis</i> (Dana), P <i>Upogebia tenuipollex</i> Williams, P <i>Upogebia veleronis</i> Williams, P</p> <p>Spine on merus of second leg absent or reduced to tubercle.</p> <p><i>Upogebia annae</i> Thistle, A <i>Upogebia casis</i>, new species, A</p> <p>Strong proximal spine on merus of second leg.</p> <p><i>Upogebia acanthops</i> Williams, P <i>Upogebia aestuari</i>, new species, P <i>Upogebia affinis</i> (Say), A (P, one introducton) <i>Upogebia aquilina</i>, new species, A <i>Upogebia careospina</i>, new species, A <i>Upogebia corallifora</i> Williams and Scott, A <i>Upogebia dawsoni</i> Williams, P <i>Upogebia felderi</i>, new species, A <i>Upogebia galapagensis</i> Williams, P <i>Upogebia inomissa</i>, new species, A <i>Upogebia jamaicensis</i> Thistle, A <i>Upogebia jonesi</i> Williams, P <i>Upogebia longipollex</i> (Streets), P <i>Upogebia marina</i> Coelho, A <i>Upogebia noronhensis</i> Fausto-Filho, A <i>Upogebia omissa</i> Gomes Corrêa, A <i>Upogebia omissago</i>, new species, A <i>Upogebia paraffinis</i>, new species, A <i>Upogebia pillsbury</i>, new species, A <i>Upogebia schmitti</i> Williams, P</p>
2. Normal abdominal segment VI and tail fan; strap-shape rostrum with subterminal dorsal spines, other dorsal armature greatly reduced, anterior gastric region not flanked on each side by furrow or lateral ridge.	<p><i>Aethogebia gorei</i>, new genus and species, A</p>
3. Distinctive abdominal segment VI; triangular rostrum and anterior gastric region dorsally armed, latter flanked on each side by well-developed furrow and spined lateral ridge projecting into anterior spines flanking base of rostrum.	<p><i>Upogebia acanthura</i> (Coelho), A <i>Upogebia ramphula</i> Williams, P</p>
4. Distinctive abdominal segment VI, telson and uropods forming operculum; rostrum and anterior gastric region dorsally armed but latter flanked on each side by barely evident furrow and reduced lateral spined ridge.	<p><i>Pomatogebia cocosia</i> Williams, P <i>Pomatogebia operculata</i> (Schmitt), A <i>Pomatogebia rugosa</i> (Lockington), P</p>

rostrum with subterminal dorsal spines, other dorsal armature greatly reduced, and an anterior gastric region not flanked on each side by furrow or lateral ridge. The species was found in coral rubble.

The third cluster, represented by two species, has a distinctive abdominal segment VI; triangular rostrum and anterior gastric region dorsally armed, the latter flanked on each side by a well-developed furrow and spined lateral ridge that projects into anterior spines flanking the base of the rostrum; and fairly large eggs. One species of this group lives in sponges, and the other probably does.

The fourth cluster, composed of three species, has a distinctive abdominal segment VI, with telson and uropods forming an operculum for closure of the burrow opening; rostrum and anterior gastric region dorsally armed but the latter flanked on each side by a barely evident furrow and reduced lateral spined ridge. The group burrows in stony corals.

The arrangement of genera and species in the text is alphabetical within clusters as indicated in Table 1.

Appendages and segments frequently referred to in descriptive accounts are usually abbreviated as follows:

A1	antennule or first antenna
A2	antenna or second antenna
AI-VI	abdominal segments or somites
acl	anterior carapace length or tip of rostrum to mid-dorsal crossing of cervical groove
cl	carapace length
chl	length of chela including fixed finger
chh	midlength height of chela
Mxp1-3	maxillipeds
P1-5	pereopods or legs
P11-5	pleopods
T	telson
U	uropods

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Cambridge, Massachusetts, A.B. Johnston; MESC—Marine Environmental Sciences Consortium, Dauphin Island Sea Lab, Alabama, M. Dardeau (collections now at the Museum of Natural History, University of Alabama, Tuscaloosa); MNHNP—Muséum National d'Histoire Naturelle, Paris, N. Ngoc-Ho; MZUSP—Museu de Zoologia, Universidade de São Paulo, Brazil, G.A.S. de Melo and S. de Almeida Rodrigues; RMNH—Nationaal Natuurhistorisch Museum, Leiden, C.H.J.M. Franzen and L.B. Holthuis; SIO—Scripps Institution of Oceanography, La Jolla, California, S. Luke; USLZ—University of Southwestern Louisiana Museum of Zoology, Lafayette, D.L. Felder; USNM—National Museum of Natural History, Smithsonian Institution, Washington, D.C. (collections of the former United States National Museum); WAM—Western Australian Museum, Perth, G. Morgan; ZMK—Zoologisk Museum, Copenhagen, T. Wolff.

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Family UPOGEBIIDAE Borradaile, 1903

DIAGNOSIS (adapted from de Saint Laurent and Le Loeuff, 1979:35).—Carapace compressed laterally, deeper than broad, poorly calcified on posterolateral parts; cervical groove well marked, crossing near midlength of dorsal line and running obliquely to anterior margin behind base of antennae; thalassinidean line always present in anterior region, sometimes absent or discontinuous in posterior region; gastric region continuous with extensive, flattened rostrum that projects over base of eyestalks, ornamented on about anterior $\frac{2}{3}$ with usually spiniform tubercles and thick pile; anterolateral margin either spineless, armed with single postocular spine, or series of spinules.

Cristiform projection on lateral plate of epistome visible in lateral view below base of antenna.

Abdomen elongate, depressed, pleura little developed, AII longest.

Maxillule with coxal endite triangular, exite broad. Mxp1 with epipod reduced or absent; exopod with flagellum; endopod with 2 articles. Mxp2 bearing short epipod usually pressed against coxa and fringed with setae; exopod with

flagellum. Mxp3 with or without rudiment of epipod; always with exopod; mesial border of endopod with thick fringe of setae; ischium with crista dentata absent or reduced to row of fine spinules nearly invisible at base of setae, 1 hooked proximal spine on inner surface, occasionally a secondary smaller spine.

Chelipeds essentially equal, sub- to fully chelate, rarely simple; fixed finger nearly always more slender than dactyl; merus with 2 fringes of long plumose setae ventrally. P2 with

merus as conspicuously setose as that on cheliped; propodus slightly broadened, dactyl short, both densely setose on margin; P3 and P4 not so conspicuously setose, dactyls more or less spatulate and bearing comb of stiff setae on prehensile surface; P5 subchelate.

P11 absent in male, biarticulate and simple in female; P12-5 foliaceous, endopod about 1/2 as long as exopod, without appendix interna; P12 without appendix masculina in male. U with no division on lateral ramus.

Key to Genera of UPOGEBIIDAE in the Western Atlantic

1. Telson with posterior margin convex and broader than proximal width; tail fan and AV-VI operculiform, upper surface ornamented with rugose pattern *Pomatogebia*
Telson subrectangular, posterior margin straight, slightly concave or convex, but no broader than proximal width and often narrower 2
2. Flattened rostrum broadly triangular, both rostrum and flattened anterior gastric region bearing dorsal spines and pilose tufts; AVI with lateral margin more or less sinuous, but not drawn into flange-like process adapted for interlock with base of uropodal fan *Upogebia*
Rostrum narrow, nearly parallel sided, somewhat flattened surface anterior to cervical groove bearing few setae but no pilose tufts; AVI with flattened lateral margin bearing flange-like process adapted for interlock with base of uropodal fan *Aethogebia*

Aethogebia, new genus

DIAGNOSIS.—Somewhat flattened gastric region projects into narrow, nearly parallel-sided rostrum bearing few dorsal spines, surface anterior to cervical groove bearing few setae, but no pilose tufts; posterior gastric surface smooth. Orbital margin well defined, postorbital and anterolateral margins spineless. Cervical groove well marked and continuous; thalassinidean line present and continuing to posterior margin of carapace.

Abdomen broadly and smoothly arched dorsally; segments gradually broadening from AI to AV; AVI narrower, subrectangular, wider than long; pleura of AI narrowly rounded posterolaterally, those of AII-V broadly rounded; AVI with lateral margin thin and sinuous.

T subrectangular, slightly wider than long; posterior margin broadly convex and densely fringed with setae.

Eyes prominent, cornea almost hemispherical, stalk extending to tip of rostrum.

A1 flagella unequal, lower thinner ramus somewhat longer than thicker upper one.

A2 with long peduncles, sparse long setae ventrally and on proximal 1/2 of flagella.

Two arthrobranchs arranged in 2 biserial rows of divided (rod-like) lamellae on Mxp3 and P1-4.

U with both rami having convex distal margin bearing dense

fringe of setae; mesial ramus with low median longitudinal rib and lateral rib with rounded proximal shoulder; lateral ramus with intermediate rib, and lateral rib paralleling margin slightly curved outward.

TYPE SPECIES.—*Aethogebia gorei*, new species.

REMARKS.—See "Remarks" under *Aethogebia gorei*.

ETYMOLOGY.—From the Greek *aethes* (unusual, strange) plus *gebia*, from *Upogebia*, underground digger. The gender is feminine.

Aethogebia gorei, new species

FIGURE 4

MATERIAL EXAMINED.—U.S.A.: *Florida*: USNM 251425, ♂ (holotype), Pickles Reef, [~9 km, 5 mi] off Key Largo, inside coral rubble, 3 m (10 ft), snorkel, M.E. Rice, D.S. Putnam, and R.H. Gore, 4 May 1972.

DIAGNOSIS.—Rostrum narrow and strap-like, sides parallel, pair of subdistal dorsal spines. Postocular spine absent. Abdominal sternites unarmed; AVI with lateral margin thin, indented posterolaterally to receive uopodal protopod. T distal margin broadly convex. Carpus of cheliped with no spines on anteromesial margin. Merus of P2-4 spineless.

DESCRIPTION.—Rostrum narrow and strap-like, sides parallel in dorsal view, slightly broadened at base curving toward

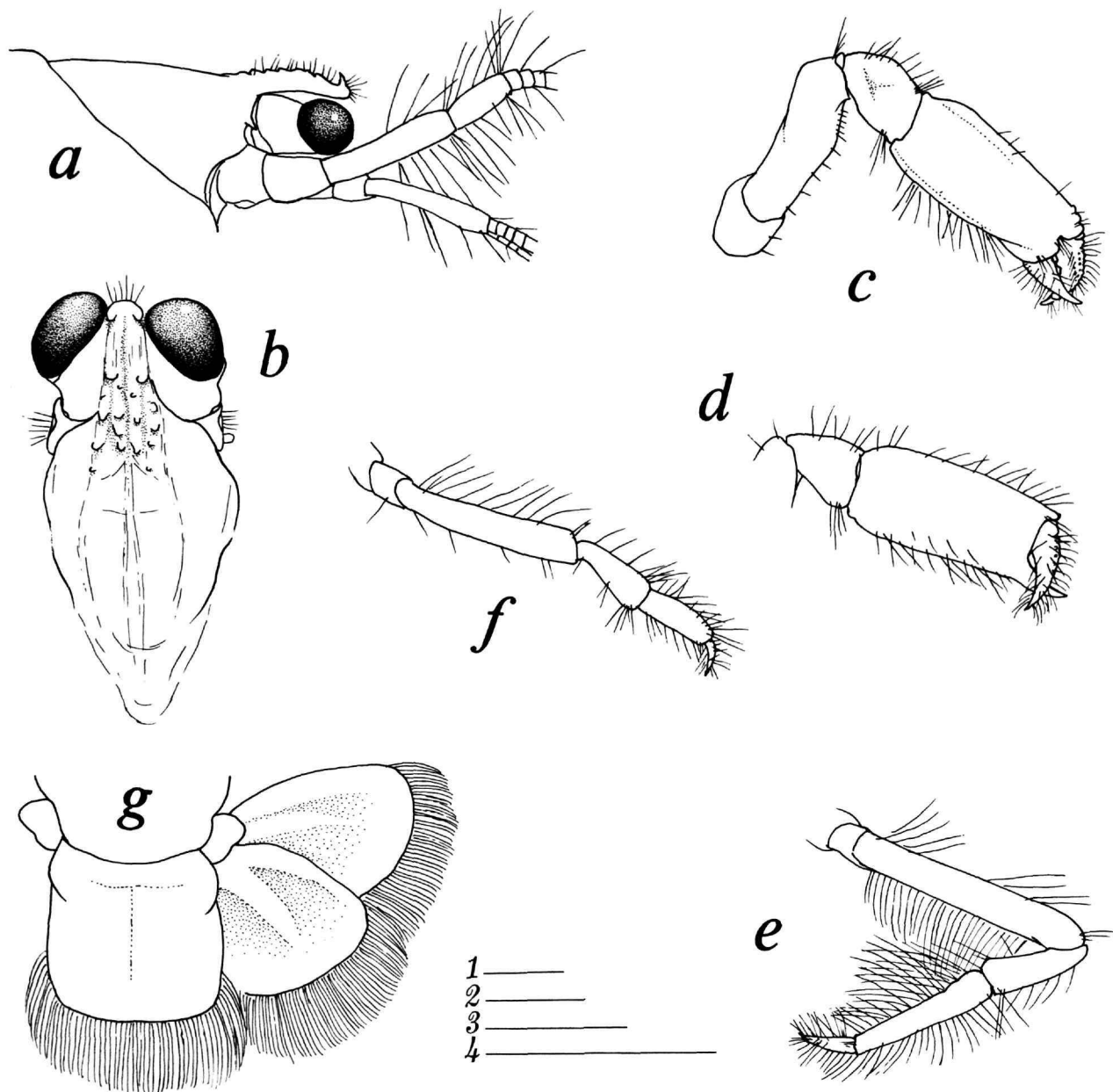


FIGURE 4.—*Aethogetia gorei*, new species, USNM 251425, ♂ holotype: *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e, f*, legs 2, 3; *g*, part of abdominal segment 6, telson, and uropods, dorsal. (Scales = 1 mm: 1 = *c-f*; 2 = *g*; 3 = *a*; 4 = *b*.)

orbital margins at either side, slightly arched at midlength and downcurved distally in lateral view; tip and distal margin of eyestalks reaching common level; dorsal pair of erect, stout apical spines slightly hooked backward, followed on each side by obsolescent, uneven dorsal tubercles arranged along margin;

posteriorly divergent lateral ridge obsolescent, unarmed, and intersecting margin of rostrum at orbital angle. Cervical groove well marked, shoulder lateral to it unarmed. Postocular spine absent.

Abdominal sternites unarmed; pleura of AI very poorly

developed, of AII–V rather well developed and bearing sparse fine setae on margin of AIV–V and posterolateral corner of AV; AVI with lateral margin thin and sinuous, indented posterolaterally to receive uropodal protopod.

T as long as U, slightly wider than long, distal margin broadly convex.

Eyestalk stout, cornea large, ovate, as wide as eyestalk at midlength in lateral view, and directed anterolaterally.

A1 peduncle unarmed, reaching beyond tip of rostrum by about $\frac{1}{2}$ length of short terminal article; flagella considerably longer than peduncle.

A2 peduncle reaching well beyond eyestalks by interval as long as basal $\frac{1}{4}$ of penultimate article, distal $\frac{3}{4}$ of this article gradually broadened in lateral view; sparse, long ventral setae on 2 distal peduncular articles and basal $\frac{1}{2}$ of flagellum, latter extending to tip of chelipeds.

Mxp3 lacking epipod.

Epistomial projection small and triangular in lateral view.

Legs long. P1 moderately robust, articles spineless, chelae strong. Merus reaching to tip of eyestalk and rostrum, or slightly beyond. Carpus rather short, apparently with slight lateral groove (distorted in preservation). Palm with upper and lower margin nearly parallel, slight notch on proximal $\frac{1}{2}$ of dorsal margin near midlength. Fingers elongate, tapering to acute tips, slight gap at base when closed; fixed finger slightly deflexed from line of lower palmar margin, but distally curving slightly toward dactyl, 1 or 2 obsolescent teeth near base; dactyl about $\frac{1}{3}$ longer than fixed finger, scissoring along it mesially when closed, 2 or 3 obsolescent tubercles near base. P2–5 with smooth, spineless articles; dactyls of all acutely falciform, comb of closely spaced corneous spinules on prehensile surface closing against distal end of propodus ornamented with distal tuft of setae on P2–4; P5 subchelate, propodus and dactyl densely setose.

Two arthrobranches arranged in 2 biserial rows of divided (rod-like) lamellae on Mxp3 and P1–4.

P11–5 densely setose on margin of rami, subovate-triangular exopod broader, and far longer than oval endopod.

U lateral ramus with convex distal margin bearing few minute spinules, that of mesial ramus less convex and bearing more prominent spinules, distal spine on protopod lateral to articulation of outer ramus.

MEASUREMENTS (in mm).—Holotype ♂, acl 2.3, cl 4.2, chl 3.3, chh 1.4.

KNOWN RANGE.—Confined to the type locality.

REMARKS.—The western Atlantic harbors small species of upogebiids specialized for existence within or on coral, coral rubble, and sponges (Kleemann, 1984; Scott et al., 1988; Williams, 1987; Williams and Scott, 1989), commensal relationships that probably have been undersampled. *Aethogebia gorei*, one of these commensal species, merits placement in a distinctive new genus.

The upogebiid closest to *Aethogebia gorei* in the region seems to be *Upogebia acanthura*, based on the distinctive AVI

with sinuous flange-like lateral margin that is adapted for interlocking with the extended uropodal tail fan, the lack of an epipod on Mxp3, and the structure of the arthrobranchiae arranged in biserial rows of divided, rod-like lamellae. The lateral flange on AVI in *U. acanthura* is an anterolateral process that is usually hooked, whereas the process in *A. gorei* is a lateral unhooked vane. In other respects of general morphology, the latter species departs far from "typical" upogebiid morphology in the western hemisphere, clearly set apart by the distinctive narrow rostrum, the almost spineless and glabrous postrostral gastric region, lack of a postorbital spine, large distinctive eyes, A1 and A2 with long peduncles, the latter with ventral setae on the distal $\frac{1}{2}$ of the peduncle and proximal $\frac{1}{2}$ of the flagellum, long spineless legs bearing long silky flagella only on the merus and propodus of P2, which also has a distinctive falciform dactyl rather than a stout subtriangular dactyl, to mention the most salient distinctive features.

ETYMOLOGY.—The species is named in honor of R.H. Gore who collected many upogebiids in southeastern Florida.

Genus *Pomatogebia* Williams and Ngoc-Ho, 1990

Pomatogebia Williams and Ngoc-Ho, 1990:614.

DIAGNOSIS.—Carapace anterior to cervical groove more or less flattened dorsally and armed on its gastric $\frac{2}{3}$ with field of spines grading from strong anteriorly to weak or obsolescent posteriorly; spines irregularly distributed but tending to arrangement in rows that diverge posteriorly, many with tufts of setae emerging anterior to base. Gastric region projecting into broadly subtriangular rostrum barely exceeding short eyestalks and bearing pair of subterminal spines, similar spine at each posterolateral corner where rostrum merges with gastric field. Lateral margin of spine field flanked on each side by poorly developed furrow, which in turn flanked by imperfectly developed lateral ridge bearing crest of about 8–11 spines grading from strong anteriorly to obsolescent posteriorly. Incomplete orbital margin concave in dorsal portion; postorbital margin spineless.

Abdomen broadly and smoothly arched dorsally on AI–IV, AIV with dense fringe of setae on posterior margin and transverse band across anterior $\frac{1}{2}$; pleura of AI narrowly rounded posterolaterally, those of AII–V broadly rounded, margins unspined; dense fine setae in tracts on pleura of AIII–IV, tuft on posterolateral corner of AII and anterolateral corner of AV; AVI irregularly rectangular, broader than long, its lateral margin scalloped anteriorly and adapted posteriorly for articulation with base of uropod; dorsal surface of AV and AVI ornamented with symmetrical pattern of meandering rugae.

Tail fan with exposed aspect generally concave. T with sides diverging posteriorly and posterior margin convex, stiffened with radiating longitudinal ribs; lateral and mesial rami of uropods bearing similar radiating ribs. Entire tail fan with dense

fringe of setae on distal margin, forming together with AV and AVI an almost circular operculum when fully extended.

Mxp1 with an epipod, Mxp3 lacking even rudimentary epipod.

Chelipeds equal, rather slender, more slender in females than in males; articles spineless; fixed finger nearly as long as dactyl, toothed proximally, rather stout and gently curved; dactyl curved, setose, stouter than fixed finger, abruptly tapered to tip and hooking beyond tip of opposed finger. P2-5 spineless.

Pomatogobia operculata (Schmitt, 1924)

FIGURE 5

Upogobia (Gebiopsis) operculata Schmitt, 1924:91, pl. V: figs. 1-4.

Gebiopsis hartmeyeri Balss, 1924:178, figs. 1, 2.

Upogobia operculata.—Thistle, 1973:1, 2, 14, 23 [key].—Adkison et al., 1979:83 [occurrence].—Kleemann, 1984:35-57, figs. 1-6, pls. 1-5 [boring in stony coral].—Coelho and Ramos-Porto, 1987:35, 36 [key, distrib.].—Scott et al., 1988:483-495, figs. 1a, 2b, 3a,b, 4a, 5a, 7, 8 [boring in stony coral].

Upogobia (Calliadne) operculata.—De Man, 1928:24 [list], 37, 50 [distrib., key].—Schmitt, 1935:197, fig. 59.—Coelho, 1971, table 1, fig. 1.—Coelho and Ramos, 1972:163 [distrib.].—Coelho and Rattacaso, 1988:387 [summary account].

Pomatogobia operculata.—Williams and Ngoc Ho, 1990:614, fig. 1.

MATERIAL EXAMINED.—U.S.A.: *Florida*: Florida Middle Ground: MESC (unnumbered) 2 ♂, 4 ♀ (2 ovig.), Loran 3Ho-2686-3H1-3821, R/V *Bellows* sta 4, 28 Jun 1977; 2 ♀ ovig., 28°36'N, 84°15'W, 25.8 m (85 ft), R/V *Bellows* sta 12, dredge, 29 Jul 1977; 3 ♂, 2 ♀, trip 3, diver coll., sta 151, decalcified *Madracis*, 18 Jan 1979. CAS 002089, 1 ♂, 1 ♀ ovig., near Pigeon Key, Sombrero Reef, cavity at 4.6 m (15 ft), J.H. Schroeder, Feb 1970. USNM 89227, 1 ♂, Elliott Key, Univ. Miami marine zool. class, sta 120, 5 Apr 1947; USNM 171554, 1 ♂, 1 ♀, Dry Tortugas off Loggerhead Key, from matrix of large brain coral, 3 m, R.F. Cressey, 19 Aug 1966.

BAHAMAS: USNM 251414, 1 ♂, Green Cay, oyster dredge, B.A. Bean, Geogr. Soc. Baltimore, 30 Jun 1903.

JAMAICA: USNM 213283, 1 ♂, 1 ♀, Discovery Bay, boring in coral *Porites astreoides*, P.J.B. Scott, 1983.

DOMINICAN REPUBLIC: USNM 251415, 1 ♂, 1/4 mi off Enriquillo, 17°53'N, 71°13'W, 18-37 m, R/V *Pillsbury* sta P-1286, 10-ft otter trawl, rough bottom, 19 Jul 1970.

LESSER ANTILLES: *Virgin Islands*: ZMK Danish West Indies, 1 ♀, T. Mortensen, 5 Dec 1911; 1 ♂, 2 ♀ (1 ovig.), T. Mortensen, 15 Dec 1911; 1 juv., St. John, Rams Head, 45.7 m (25 fm), T. Mortensen, 10 Mar 1906; 2 ♂, St. Croix, Buck Is., 7.3 m (4 fm), T. Mortensen, 19 Feb 1908. *Virgin Islands of the United States*: St. Croix (all collected by M.L. Reaka project; in following list, excr. = experimental coral rubble sun dried and placed on reef): Teague Bay: USNM 251351, 1 ♀, 1 juv., natural dead coral rubble at base of live fore reef, 12 m, FR-8, 11 Aug 1980; 1 ♂, 4 ♀ (2 ovig.), same habitat, FR-10, 19 Aug 1980; USNM 251352, 2 ♂, 2 ♀, natural dead coral rubble

at base of live fore reef, 12 m, FR-6, 26 Feb 1981; 1 ♂, same habitat, FR-9, 8 Mar 1981; USNM 251353, 1 ♂, 1 ♀, natural dead coral rubble on live patch reef, midlagoon between bank barrier reef and shore, 3 m, PR-1, 4 Mar 1981; 1 ♂, 1 juv., same habitat, PR-3, 4 Mar 1981; 1 ♂, same habitat, PR-6, 4 Mar 1981; USNM 251354, 1 ♀, frags., natural dead coral rubble on live patch reef, midlagoon behind bank barrier reef, 3 m, PR-1, 17 Jun 1981; 1 ♂ frag., same habitat, PR-8, 17 Jun 1981; USNM 251355, 2 ♂, excr. on sand/sea grass floor of lagoon, 3-4 m, DR-4b, 17 Jan 1982. Salt River Canyon: USNM 251356, 4 juvs., excr. on sandy canyon floor, 20 m, MAV3, 12 Jan 1981; 3+ juvs., same habitat, MCIII-3, 12 Jan 1981; USNM 251357, 1 ♂, 1 ♀, natural dead coral rubble on live coral reef slope, 20 m, MCon-1, 26 Jun 1981; USNM 251358, 2 frags. and juvs., natural coral rubble on back side of barrier reef, 3 m, SCon-4, 30 Jun 1981; 1 ♂ juv., same habitat, SCon-10, 30 Jun 1981; USNM 251359, 2 ♂, 1 juv., excr. on sand/sea grass floor of canyon, 20 m, DR-2c, 16 Jan 1982; 2 juvs., same habitat, DR3d, 17 Jan 1982; USNM 251360, 1 ♂, excr. around artificial cinder block reef on sand/sea grass floor, 3-4 m, SAV-3, 17 May 1982; USNM 251361, 1 ♂, excr. around artificial cinder block reef on sandy canyon floor, 20 m, MA III-6, 20 May 1982; 1 ♂, frags., same habitat, same, 20 May 1982; USNM 351362, 2 ♂, excr. around artificial cinder block reef on sandy canyon floor, 20 m, MAI-6, 21 May 1982; 1 ♂, similar experimental array, 30-35 m, DAI-3, 22 May 1982; 2 juvs., same habitat, DAII-1, 22 May 1982; 1 chela, same habitat, DAII-6, 20 Aug 1982; USNM 251363, 1 juv., excr. on sandy canyon floor, 20 m, MCII-3, 23 May 1982; USNM 251364, 1 ♂, natural dead coral rubble on live reef slope, 20 m, MCon-6, 25 May 1982; 1 ♂, same habitat, MCon-9, 25 May 1982; USNM 251365, 2 ♂, excr. on sandy canyon floor, 20 m, MCV-2, 28 Jun 1982. USNM 251416, 1 ♂, 1 frag., St. Barthelemy, 18°01.5'N, 62°55'W, 22 m, R/V *Pillsbury* sta 981, 10-ft otter trawl, 22 Jul 1969; USNM 251417, 3 ♂, 3 ♀ (2 ovig.), NW of Antigua on shelf, 17°15.5'N, 62°02.2'W, 22 m, R/V *Pillsbury* sta 967, 10-ft otter trawl, assorted inverts., 20 Jul 1969; USNM 57592 (Paratype), 1 ♀, Okra Reef, 16, Barbados, State Univ. of Iowa Barbados-Antigua Exped., 13 May 1918; USNM 213511, 1 ♂, 1 ♀ ovig., Barbados, P.J.B. Scott, 28 Jun 1981; USNM 251418, 1 ♂, SW of Grenada on shelf, 11°52.8'N, 61°53.3'W, 18 m, R/V *Pillsbury* sta 851, 10-ft otter trawl, sponges and coralline algae, 3 Jul 1969.

MEXICO: USLZ 3007, 1 ♀, Arrecife de Enmedio, E of Boca del Rio near Anton Lizardo, Veracruz, broken from dead coral ~2 m depth, USL Trop. Field Exped. IIB, 30 Dec 1977; USLZ 3008, 1 ♂, 1 ♀, same, broken from coral rock ~10 m depth, SCUBA, D.L. Felder, 30 Dec 1977.

HONDURAS: USNM 251419, 1 ♀ ovig., Gulf of Honduras, 16°02.1'N, 88°31.8'W, 26 m, R/V *Pillsbury* sta P-614, otter trawl, sponge, algae, coral, 19 Mar 1968; USNM 251420, 4 ♂, 3 ♀ (1 ovig.), chelae, near Cabo de Honduras, 15°59.2'N, 86°02'W-86°04.5'W, 35-37 m, R/V *Pillsbury* sta P-630, 40-ft trawl, rocks, coral, brachiopods, sponges, 21 Mar 1968.

PANAMA: SIO-C2880, 1 ♂, TEPE70-30, Agualargana Is., Holandes Cay, 9°35'54"N, 78°46'58"W, on coral, 0-18.2 m (60 ft), R/V *Alpha Helix*, SCUBA, Newman, Dana, Luke, 27 Sep 1970.

COLOMBIA: AMNH 14223, 1 ♂, 2 ♀, E end Gorgona Is., 4.5 m (2.5 fm), "Askoy" Exped. sta 89, sample 346, from masses of coral, J.C. Armstrong, 21 Apr 1941.

BRAZIL: MZUSP 8950, 2 ♀ ovig., Espírito Santo, 20°44'S, 40°03'W, N./Oc. *Almirante Saldanha* sta 1951, 10 Sep 1968.

DIAGNOSIS.—Postocular spine absent. Rostrum clearly exceeding eyestalks. Abdominal sternites unarmed; dorsal surface of tergites on AV and AVI ornamented with symmetrical pattern of rugae. T with distal margin wider than proximal margin, dorsal aspect bearing pattern of radiating longitudinal ribs. Cheliped with fixed finger nearly as long as dactyl; palm spineless mesially posterior to base of fixed finger; ischium spineless. P2 and P4 spineless.

DESCRIPTION.—Much of integument smooth and shiny, or iridescent. Rostrum deep and broadly subtriangular, extending either more or less straight forward or downturned, with subterminal paired spines near tip, central dorsal surface bearing tufts of setae but spineless; transverse row of 2-4 spines anterior to anterior spine on lateral ridge and continuous with field of spines over approximately $\frac{2}{3}$ of anterodorsal carapace; transverse row angling toward sides posteriorly, becoming tuberculate without setae posteriorly, gastric part posterior to this smooth; ornamented part flanked on each side by lateral furrow, and that in turn by lateral ridge bearing crest of about 4 strong acute spines on more or less arched anterior part, ridge then diverging posteriorly and bearing row of about 6-9 smaller almost uniform spines. Cervical groove deep and continuous, rather sharp shoulder lateral to it bearing irregular spines above and below level crossed by thalassinidean line, latter occasionally obscure and not obviously continuing to posterior margin of carapace as a line but as meandering tract. Postocular margin sinuous and spineless, one or more scattered small spines on lateral aspect of head below lateral ridge and anterior to thalassinidean line.

Abdomen broadly and smoothly arched dorsally on AI-IV, tergum of AIV with dense fringe of setae on posterior margin and transverse band across anterior $\frac{1}{2}$; pleura of AI narrowly rounded posterolaterally, those of AII-V broadly rounded, margins unspined; dense fine setae in tracts on pleura of AIII-IV, tuft on posterolateral corner of AII and anterolateral corner of AV; AVI irregularly rectangular, broader than long, its lateral margin scalloped anteriorly and fitted posteriorly for articulation with base of uropod; dorsal surface of AV and AVI ornamented with bold symmetrical pattern of meandering rugae.

Tail fan with exposed aspect generally concave. T with sides diverging posteriorly, stiffened with 6 primary radiating longitudinal ribs, laterals running length of margin; mesial pair forked or braided distally, submesial pair originating in raised eroded anterior region, flaring slightly, bearing 2-3 weak or

obsolescent spines and occasionally 1 or 2 remote spinules posteriorly, variably developed intercalary rib between mesial and lateral rib; U similar in structure. Entire tail fan with dense fringe of setae on distal margin and, together with AV and AVI, forming subcircular operculum when fully extended.

Eyestalk reaching to midlength or distal end of second article of antennular peduncle, fully exposed to lateral view; cornea more than $\frac{1}{2}$ as long as stalk, directed anterolaterally, tiny tubercle or spine at anteromesial emargination.

A1 peduncle reaching to base of terminal article of A2 peduncle, its proximal article broad basally, first 2 articles together about as long as strongly compressed distal article.

A2 peduncle with about $\frac{1}{3}$ its length extending beyond tip of rostrum; article 2 bearing no subdistal ventral spine; scale obsolete.

Mouthparts as figured for *P. rugosa* (Lockington), see Williams (1986:57); Mxp3 lacking epipod.

Epistomial projection in lateral view somewhat elongate, rounded terminally.

Chelipeds rather slender, articles spineless. Carpus trigonal, shallow longitudinal groove laterally, obsolescent spine at anterior end of dorsal crest; dense plumose setae in dorsal and dorsomesial tract. Palm oval in cross section, chl on female about 2.5 times chh, stouter in male, fingers more extended in female than in male; prominent setae in row of scattered sparse tufts on upper mesial surface, more dense along low lateral ridge, much longer in ventral tract; mesial and lateral condyles of dactyl fairly prominent. Fixed finger nearly as long as dactyl, rather stout and gently curved; few obsolescent teeth on proximal part of prehensile edge. Dactyl curved, setose, stouter than fixed finger, abruptly tapered to tip and hooking beyond tip of opposed finger when closed; dentate crest of small teeth on cutting edge along distal $\frac{2}{3}$ of length.

P2 spineless, slender, merus reaching to cover base of antenna; carpus elongate; propodus and dactyl tapering to acute tip. P3 and P4 similar, successively shorter, with propodus not tapered but dactyl slender, both these articles setose and bearing line of closely spaced granules laterally.

Two arthrobranches arranged in 2 biserial rows of divided (rod-like) lamellae on Mxp3 and P1-4.

MEASUREMENTS (in mm).—Holotype ♂, acl 4.5, abdomen and telson 14.5, length T 3.5 (from Schmitt, 1924); adult ♂, acl 5.0, cl 12.9, chl (worn fixed finger) 4.6, chh 2.6; adult ♀, same, 5.5, 9.0, 5.5, 2.3.

COLOR.—*Ovigerous Female*: Opaque, dull china white. Right chela orange distally, becoming lighter and much like Indian yellow with fine reddish specks toward middle; oblique fringe of setae white, top $\frac{1}{2}$ of carpus faintly yellow with dark specks; rest of leg white with faint suggestion of yellow; fingers darker, more reddish, approaching cadmium orange color. Second legs with dactyl and distal $\frac{1}{2}$ of propodus like chela, rest of leg white. Dorsal setae on anterior carapace speckled like Indian yellow but varying to lemon yellow. Eyes black or clove brown. Eggs opiment orange.

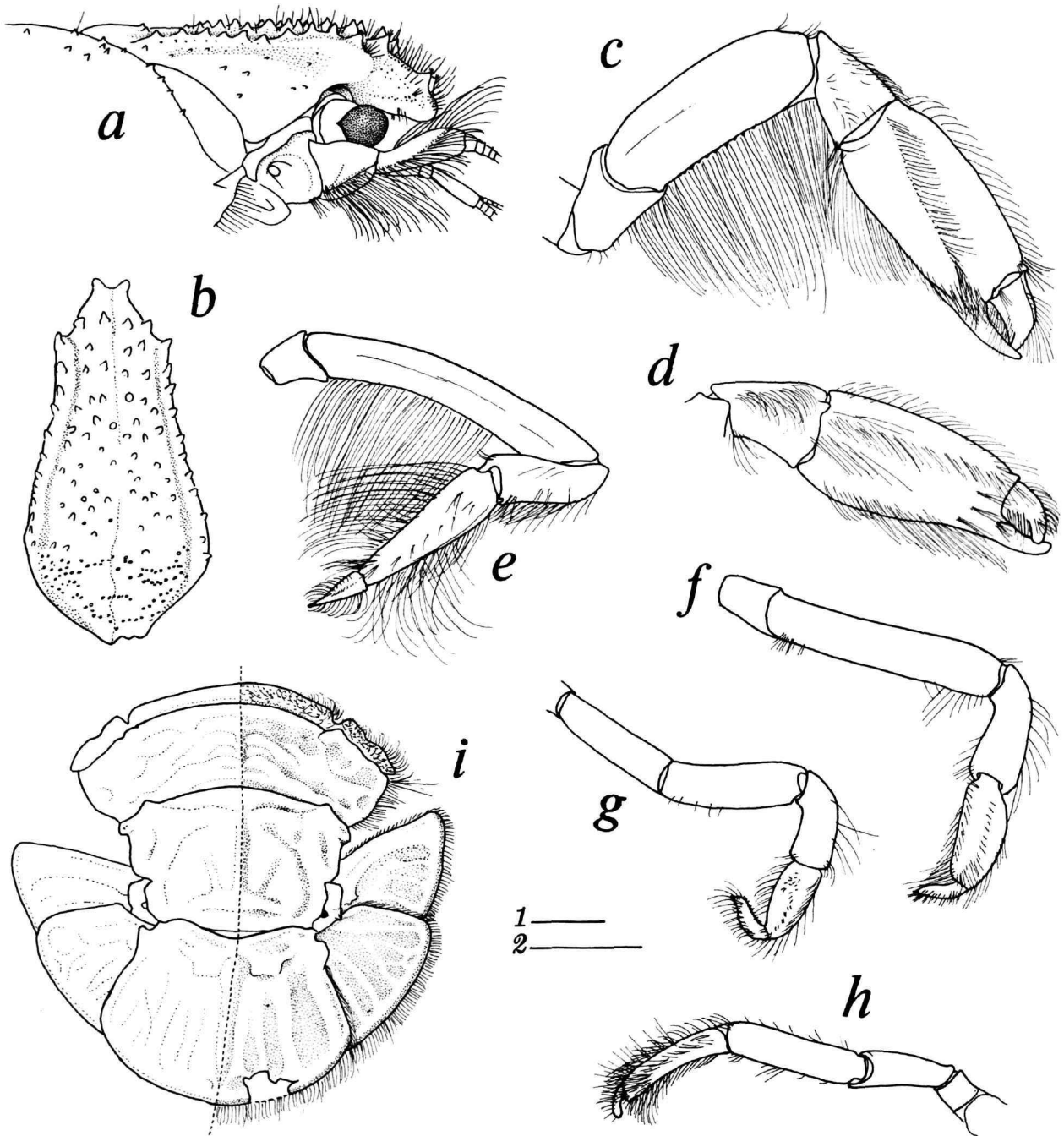


FIGURE 5.—*Pomatogebia operculata* (Schmitt), USNM 57952, ♀ paratype (*a, b, i* from Williams and Ngoc-Ho, 1991); *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e-h*, legs 2-5; *i*, abdominal segments 4 (part), 5, 6, telson, and uropods, dorsal. (Scales = 1 mm: 1 = *c-h*; 2 = *a, b, i*.)

Male: Abdomen and part of carapace with whitish sides having faint suggestion of pea green; opercular part of abdomen and legs almost plaster of Paris white. Chelae closely reticulated with orange ochraceous to orpiment orange, lower surface whitish; upper surface of carpi colored; fingers with less color than in female (from field notes of W.L. Schmitt, Dry Tortugas, Fla., 3 Aug 1930. The field notes are located in the Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution.).

TYPE LOCALITY.—Okra Reef, Barbados.

KNOWN RANGE.—Shelf off northwestern Florida through West Indies, Yucatan Peninsula, along shelf of Central and South America to State of Espírito Santo, Brazil; 1–56 m (Coêlho and Ramos, 1972:163).

HABITAT.—The species actively excavates its burrows in the calcium carbonate skeleton of massive corals (see Kleemann, 1984; Scott et al., 1988, for explanatory illustrations). Excavation is accomplished by means of probable secretory boring glands in the tail fan, second legs, and to a smaller extent in endopods of the pleopods, and by action of the chelipeds. The animals apparently soften walls of the burrow in hard CaCO₃ substrate by applying secretion from glands and then pick away loosened material with the chelae. Adkison et al. (1979) reported male-female pairs from colonies of *Madracis decactis* (Lyman) on the Florida Middle Grounds. Burrows are occupied by male-female pairs that often become entrapped and endure for several years; the animals line the burrows with mud, are able to turn freely in them, can close the burrow opening with the exactly fitting rugose caudal operculum, and feed by filtering.

REMARKS.—*Pomatogebia operculata* exhibits variation in the strength and pattern of rugosity on the caudal operculum formed by the last two abdominal segments and the tail fan. Some of the variations are pointed out in the description, although other variants, perhaps poorly preserved, show rugosity ill defined but never obsolescent.

Females may be ovigerous at smaller sizes than that of the mature specimen given in measurements above. Females generally have more slender chelae with relatively longer fingers than males (see also Adkison et al., 1979), although the largest females have worn fixed fingers and rather strongly curved dactyls.

Schmitt (1924) did not designate a repository for the type specimens of *Pomatogebia operculata*. The paratype female was cataloged in the USNM (see "Material Examined"), but the holotype male was not. Because the specimens upon which the description was based were collected by the Barbados-Antigua Expedition from the University of Iowa in 1918, and the description appeared in the University of Iowa Studies in Natural History, a search was made for the holotype by curators of the marine invertebrate collection at the University of Iowa Museum of Natural History (UIMNH). The specimen was not found there, and its status remains unknown. That collection

was developed by C.C. Nutting, partly in cooperation with the Smithsonian Institution, from which marine invertebrate materials were transferred to the UIMNH in the 1920s. During the search for the missing holotype, the present director of UIMNH, George Schrimper, suggested that all of the Nutting invertebrate collection be retransferred to the USNM inasmuch as the UIMNH was no longer involved in maintaining a marine invertebrate collection. The suggestion was adopted, and the transfer was made in autumn of 1990.

Genus *Upogebia* (Leach, 1814)

Upogebia (Leach, 1814:400).—Hemming, 1958:143, name no. 1034.—Sakai, 1982:8 [synonymy].—Williams, 1986:6.

DIAGNOSIS.—Flattened gastric region projecting into broadly triangular rostrum bearing dorsal spines; spines usually prominent and arranged in specifically distinct distributional patterns; about $\frac{2}{3}$ of flattened surface anterior to cervical groove, including rostrum, bearing pilose tufts, often emerging anterior to elements of armed field that change from spiny anteriorly to rugose and/or subspinose posteriorly where field angles toward sides and tapers to obsolescence; median dorsal furrow, often indistinct and obscured by setae, posterior to rostral tip; posterior gastric surface smooth; ornamented anterior part flanked on each side by posteriorly divergent well-developed furrow, and that in turn flanked by lateral ridge bearing crest of about 12 spines often grouped in 2 ranks, strongest in anterior part of crest projecting into lateral process, weaker posteriorly and grading into obsolescence. Orbital margin well defined, postorbital margin spineless, anterolateral margin with or without spines. Cervical groove deep and continuous, shoulder lateral to it often bearing spines or tubercles near intersection with thalassinidean line; latter always present in anterior region, sometimes absent or discontinuous in posterior region.

Abdomen broadly and smoothly arched dorsally; pleura of AI narrowly rounded posterolaterally, those of AII–V broadly rounded, with dense fine plumose setae on posterior margin of terga on AIII–IV and in tracts on AII–V; AVI subrectangular, wider than long, lateral margin sinuous, adapted for interlocking with base of extended uropodal lateral ramus, notch anterior to posterolateral lobe continuous with oblique groove and lunate dorsal impression.

T subrectangular, a little wider than long, broadest proximally, angle on anterolateral margin interlocking with groove on central rib of uropodal mesial ramus; posterior margin often shallowly concave and densely fringed with setae; transverse proximal ridge often prominent, adapted for abutting against posterior margin of AVI, and continuous with low lateral ridges at each side; median groove obsolescent.

A1 flagella unequal, lower thinner ramus somewhat longer than thicker upper ramus.

Two arthrobranchs arranged in biserial rows of undivided

(entire) lamellae on Mxp3 and P1-4.

U with spine or tubercle on protopod above base of mesial ramus; nearly straight distal margin of mesial ramus exceeded by curved margin of lateral ramus, both rami with dense fringe of setae and often with minute spines or granules distributed along distal margin; mesial ramus with low, median longitudi-

nal rib and less prominent lateral rib having shallowly concave margin except for rounded, proximal shoulder; lateral ramus with 3 ribs, mesial sturdiest one often bearing blunt spine proximally, intermediate rib longer, lateral rib least evident of all, slightly curved outward but shallowly concave proximally (adapted from Williams, 1986:6).

Key to Known Western Atlantic Species of *Upogebia*

1. Abdomen with lateral margin of AVI bearing small hooked anterolateral process; chelae with fingers nearly equal in length, prehensile edges finely and evenly toothed *U. acanthura* Coêlho
(West Florida Middle Grounds and Bahamas through Caribbean to Espírito Santo, Brazil)
Abdomen with lateral margin of AVI sinuous or somewhat lobed, but lacking hooked anterolateral process; chelae almost always with fingers unequal in length, prehensile edges not evenly toothed 2
2. Merus of leg 2 lacking proximal mesioventral spine, but proximal mesioventral tubercle rarely present in this position 3
Merus of leg 2 bearing proximal mesioventral spine 7
3. Rostrum bearing ventral spines *U. bermudensis*, new species
(Bermuda)
Rostrum lacking ventral spines 4
4. Dactyl of chela bearing tiny subterminal corneous spine on extensor surface (sometimes worn) 5
Dactyl of chela lacking tiny subterminal corneous spine on extensor surface . . 6
5. Merus of cheliped with subdistal dorsal spine clearly reaching beyond level of postorbital spine; palm of chela with dorsal ridges not evident, obsolete
. *U. annae* Thistle
(Great Inagua, Bahamas; Turks and Caicos Islands)
Merus of cheliped with subdistal dorsal spine reaching only to level of postorbital spine; palm of chela with dorsal ridges visible but obsolescent
. *U. casis*, new species
(Honduras, Jamaica, Dominican Republic, Lesser Antilles, Surinam)
6. Dactyl of chela with corneous tip, prehensile edge conspicuously toothed; fixed finger armed with row of small teeth on proximal prehensile edge
. *U. brasiliensis* Holthuis
(Belize, Surinam, Brazil from Bahia to Santa Catarina)
Dactyl of chela lacking corneous tip, prehensile edge inconspicuously toothed; fixed finger with prehensile edge broadened proximally into molar surface . . .
. *U. molipollex*, new species
(Puerto Rico)
7. Rostrum not bearing ventral spines 8
Rostrum usually bearing 1 or more ventral spines 20
8. Abdominal sternites variably armed with small spines, occasionally obsolescent; merus of legs 2 and 3 (P2-3) bearing 2 distodorsal spines, development on one or other of these legs occasionally not bilateral; merus of leg 4 (P4) with 1 or more ventral spines, occasionally also on ischium *U. omissa* Gomes Corrêa
(Greater Antilles, Panama to Santa Catarina, Brazil)
Abdominal sternites unarmed 9
9. Postocular (anterolateral) spines multiple, 4 or more *U. jamaicensis* Thistle
(Jamaica, Panama, Colombia)
Postocular (anterolateral) spine usually single, occasionally double 10

- 10. Antennular as well as antennal peduncles bearing ventral row of spines
 *U. spinistipula* Williams and Heard
 (Gulf of Mexico, West Florida platform)
 Antennal peduncle armed at most with tiny subdistal ventral spine on article 2 . .
 11
- 11. Palm of chela with spines on edge of ventral keel *U. affinis* (Say)
 (Massachusetts and southern Texas, U.S.A.)
 Palm of chela with no spines on edge of ventral keel, but may have few obsolescent
 spines on mesial aspect of ventral keel 12
- 12. Dorsal spines of rostrum inconspicuous, hidden in setae, subapical pair located well
 short of rostral tip; cheliped with only 2 spines on anteromesial margin of carpus
 *U. aestuari*, new species
 (Belize)
 Dorsal spines of rostrum readily visible, nested in setae but not hidden, dorsal pair
 near tip; cheliped with 3 spines on anteromesial margin of carpus 13
- 13. Palm of chela with lower mesial surface unspined 14
 Palm of chela with variously developed row of spines on lower mesial surface . .
 19
- 14. Fixed finger of chela as long as dactyl or nearly so; dactyl with tiny subdistal spine
 on extensor surface (sometimes worn or broken) 15
 Fixed finger of chela noticeably shorter than dactyl; dactyl without tiny subdistal
 spine on extensor surface 16
- 15. Dactyl of chela with calcareous tip enlarged and hooked like a "hawkbill"
 *U. aquilina*, new species
 (Southeastern Florida, U.S.A.)
 Dactyl of chela with calcareous tip not enlarged and hooked like a "hawkbill" . .
 *U. corallifora* Williams and Scott
 (Quintana Roo, Mexico; Jamaica; Puerto Rico; St. Croix)
- 16. Merus of leg 2 or 3 (P2 or P3) with single subdistal spine, at most 17
 Merus of leg 2 or 3 (P2 or P3) with 2 distodorsal spines 18
- 17. Palm of chela with dorsal and mesiodorsal ridges spineless . . *U. marina* Coêlho
 (Venezuela; Alagoas, Brazil)
 Palm of chela with dorsal ridge spineless, mesiodorsal ridge bearing many small
 tubercles *U. careospina*, new species
 (Ceará, Brazil)
- 18. Merus of leg 2 (P2) with 1 subdistal dorsal spine *U. omissago*, new species
 (Piauí, Brazil)
 Merus of leg 2 with 2 distodorsal spines *U. inomissa*, new species
 (Mississippi and southern Florida, U.S.A.)
- 19. Cheliped with anteromesial margin of carpus bearing weak to moderate spine near
 middle and 0–1 smaller spine between it and anterodorsal spine; ischium usually
 with 2, occasionally 0–1, strong ventral spine(s); coxa of cheliped and leg 2 (P2)
 with distomesial margin unarmed *U. noronhensis* Fausto-Filho
 (Fernando de Noronha, Brazil)
 Cheliped with anteromesial margin of carpus bearing moderate to strong spine near
 middle, and slightly smaller spine (rarely none) between it and anterodorsal spine;
 ischium usually with 1, occasionally 0–2, ventral spine(s); coxa of cheliped and
 leg 2 (P2) with spine on distomesial margin *U. vasquezi* Ngoc-Ho
 (Southeastern Florida, U.S.A.; Bahamas
 and West Indies; Belize to Bahia, Brazil)
- 20. Merus of leg 4 bearing 1 or more ventral spines *U. pillsbury*, new species
 (Panama)
 Merus of leg 4 spineless 21

21. Rostrum with ventral spines, terminal spine originating near anterodorsal margin, definitely projecting forward beyond tip, distinct from ventral series of spines, and tending to be buttressed; distal margin of urpods not bearing small spines or granules *U. paraffinis*, new species
(Ceará to São Paulo, Brazil)
Rostrum usually with ventral spines, terminal spine if present originating in anteroventral position, not buttressed, and seldom projecting beyond tip; distal margin of uropods bearing remotely spaced small granules 22
22. Crested ridge lateral to anterior gastric region with setae not obscuring spines; rostrum with or without ventral spines, terminal spine, if present, originating in anteroventral position, not buttressed, and seldom projecting beyond tip; spines on chelipeds moderate in size *U. affinis* (Say)
(Massachusetts to southern Texas, U.S.A.)
Crested ridge lateral to anterior gastric region with setae obscuring spines; rostrum with ventral spines, anteriormost spine definitely part of ventral series of spines, originating in anteroventral position and often projecting beyond tip; spines on chelipeds obviously strong and well developed *U. felderi*, new species
(Coast of central Texas, U.S.A., to state of Tamaulipas, Mexico)

Upogebia acanthura (Coelho, 1973)

FIGURES 6, 7

Upogebia (Calliadne) sp. A, Coelho and Ramos, 1972:163.

Cupogebia (calliadne) [sic] *acanthura* Coelho, 1973a:344.

Upogebia synagelas Williams, 1987:590, figs. 1-3.

Upogebia acanthura.—Coelho and Ramos-Porto, 1987:37.

Upogebia (Calliadne) acanthura.—Coelho and Rattacaso, 1988:386.

MATERIAL EXAMINED (including types of *U. synagelas*).—
U.S.A.: Florida Middle Grounds, coral reef, Gulf of Mexico: Sta 151, 28°32'20"N, 84°18'36"W: MESC 6183-4563, 1 juv., diver collected, 27.4 m, 5 Oct 1978; MESC 6183-4558, 1 juv., diver collected, 31.3-33 m, 17 Jan 1979; MESC 6183-4574, 5 juvs., 27.4 m, diver collected, 18 Jan 1979. Sta 481, 28°30'52"N, 84°18'59"W: MESC 6183-4589, 1 ♂, 29 m, diver collected, 6 Oct 1978; MESC 6183-4556, 2 juvs., 29 m, diver collected, 8 Oct 1978; MESC 6183-4580, 2 ♂ (juvs.), 29 m, diver collected, 8 Oct 1978; MESC 6183-4587, 1 juv., 29 m, diver collected, 8 Oct 1978; MESC 6183-4552, 1 juv. (tiny), 37.5 m, submersible, 8 Nov 1978. Sta 491, 28°27'18"N, 84°17'02"W: MESC 6183-4575, 1 ♂, 29 m, diver collected, 16 Oct 1978. Sta 482, 28°31'06"N, 84°18'55"W: MESC 6183-4578, 1 ♀ (juv.), 33.5 m, diver collected, 8 Jul 1979. Sta 2315, 28°34'05"N, 84°14'11"W: MESC 6183-10523, 1 juv., 38 m, Capetown dredge, 30 Aug 1977.

BAHAMAS: Grand Bahama Island, Freeport: MESC 6183-10524, 1 juv., 21-23 m, diver collected, Nov 1975; MESC 6183-10525, 1 ♂, 2 ♀ (1 ovig.), 1 frag., 21-23 m, diver collected, Nov 1975.

JAMAICA: RMNH, 1 ♀ ovig., 1 cephalothorax, E. Palisades, from sponge, 22.8-30.4 m, T.F. Goreau and F.M. Bayer, 20 Dec 1969. USNM 233572, 1 ♂, USNM 233573, 1 ♀, and USNM 233574, 1 ♂, 1 ♀, Discovery Bay, 18°28'N, 77°24'W, spur and groove reefs on Fore Reef, Long Term Survey site,

host sponge *Agelas sceptrum*, 27.4-35 m (90-115 ft), SCUBA, P.J.B. Scott, 3 Oct 1985; USNM 233575, 2 ♂, 2 ♀ (ovig., 1 with eyed eggs, 1 with variably hatched zoeae), Pear Tree Bottom, Discovery Bay, occurring as pairs in *A. sceptrum*, 22 m, J. Woodley, 25 Nov 1985; USNM 251245, 4 ♂, 7 ♀ (5 ovig.), Pedro Bank, S of Jamaica, 17°09'N, 78°57'W, from orange sponges, 26 m, R/V Pillsbury sta 1252, 10-ft otter trawl, 14 Jul 1970.

TURKS AND CAICOS ISLANDS: USNM 251721, 1 ♂, 1 ♀ ovig., 1 juv., fringing reef off Pine Cay, on yellow (slimy) sponge, 24-27 m, (80-90 ft), R. Heard, 14 Nov 1989.

LESSER ANTILLES: USNM 251248, 3 ♂, 3 ♀ ovig., W of Redonda, 16°59.8'N, 62°30.2'W, algae and sponges, 27-46 m, R/V Pillsbury sta 956, 5-ft Blake trawl, 19 Jul 1969; USNM 233576, 2 ♂, 1 ♀, "Nurse's Jetty, on Bank Reef," 1 km W Hometown, St. James, Barbados, 13°10.7'N, 59°38.9'W, host sponge *A. sceptrum*, 18.3 m (60 ft), H.M. Reiswig collection no. 76-8-9.1, SCUBA, 9 Aug 1976 (specimens in collection of Redpath Museum, McGill University cat. no. RMI 2727); USNM 233577, 1 ♂, 3 ♀ ovig., same; USNM 251249, 9 ♂, 15 ♀ (9 ovig.), NE of Grenada, 12°23.5'N, 61°21.6'W, 358-359 m, R/V Pillsbury sta 857, 5-ft Blake trawl, net full of sponges, 3 Jul 1969.

BELIZE: USNM 251246, 2 ♂, 2 ♀ (1 ovig. from which ~20 young hatched), SW of Carrie Bow Cay, patch reef, ~6 m, AC-CBC-124, O. McConnell, 23 Apr 1977.

COSTA RICA: USNM 251247, 1 ♀ ovig. E of Limón, 10°01.3'N, 82°50'W, R/V Pillsbury sta P-1319, IKMT at 25 m (bottom 677-730 m), 27 Jan 1971.

NETHERLANDS ANTILLES: RMNH, 10 ♂, 19 ♀ (16 ovig.), Pescadera Bay, Curaçao, Netherlands Antilles, reef buoy Caraibisch Marine Biologisch Institut, in sponge *Agelas clathrodes* (Schmidt), 24 m, W.F. Hoppe, 201b, 25 Feb 1985.

BRAZIL: Pará: MZUSP 8953, 1 ♀ (fragmentary paratype)

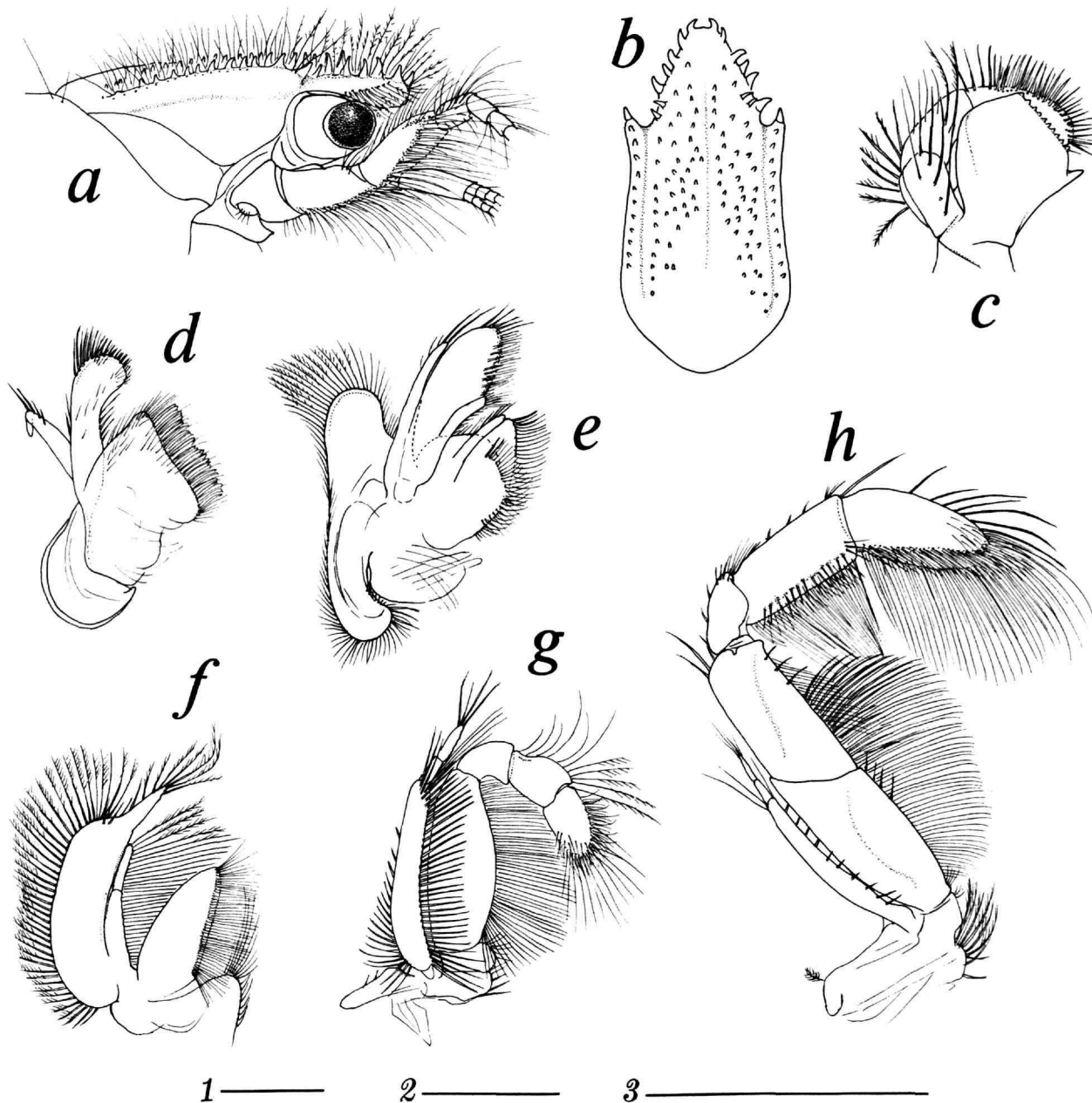


FIGURE 6.—*Upogebia acanthura* (Coêlho), USNM 233572, ♂ (from Williams, 1987): a, cephalic region, lateral; b, anterior carapace, dorsal; c, mandible; d, e, maxilla 1, 2; f-h, maxillipeds 1-3. (Scales = 1 mm: 1 = a, b; 2 = c; 3 = d-h.)

Almirante Saldanha Geomar sta 166, 02°15'N, 48°15'W, 68 m, Jul 1971 (the type locality). *Ceará*: USNM 138895, 1 ♂ (frag.), NW of Fortaleza, 02°39'S, 39°21'W, 40.2 m, R/V *Oregon* sta 4255, dredge, 13 Mar 1963.

Data for specimens examined by P.A. Coêlho are: Pernambuco, 08°32'18"S, 34°44'30"W, 54 m, Pesq. IV 05, 12 Jun 1971; Espírito Santo, Banco Jaseur, 20°32'S, 35°46'W, 70 m, A.S. 1946, 8 Sep 1968.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Postocular spine absent. Abdominal sternites unarmed; AVI bearing anterolateral process. T subrectangular. Carpus of cheliped with no spines on mesiodistal margin. Merus of P2–4 spineless.

DESCRIPTION.—Rostrum truncate-triangular to slightly ovate with sides bowed laterally in dorsal view, slightly broader at base than long, downcurved; tip exceeding eyestalks in normal position by about width of cornea; dorsal pair of erect, slender subapical spines followed on each side by 4–6 strong acute spines hooked slightly backward; posteriorly divergent lateral ridge bearing crest of 10–19 small, closely crowded spines, strongest on process lateral to rostrum and decreasing posteriorly, sometimes to tubercles. Shoulder lateral to cervical groove unarmed. Postocular spine absent.

Abdominal sternites unarmed; pleura of AI very poorly developed, of AII–V rather well developed and bearing plumose setae on margins from middle of segment AII to middle of AV, pilose tract extending dorsally to some extent near anterior and posterior margin of tergum on AIII, scattered setae elsewhere dorsally; AVI broader than long, sinuous flange-like lateral margin bearing slightly hooked anterolateral process and marked dorsally on each side with obsolescent, irregularly lunate furrow.

T as long as U, slightly wider than long, broadly convex posteriorly; median longitudinal furrow and broader submarginal furrow at each side; small acute spines irregularly placed along lateral margins as well as submarginally and irregularly on raised tracts, some spines clustered in twos and threes.

Eyestalk rather stout, clearly exceeded by rostrum; cornea large but narrower than base of eyestalk in lateral view and directed anterolaterally.

A1 peduncle with anteromesial spine on basal article well behind mesioventral angle, but not always present; article 2 rarely with ventral spine.

A2 peduncle sometimes with obsolescent mesioventral subdistal spine on article 2; scale obsolescent.

Mxp3 lacking epipod.

Extension of epistome spineless in lateral view.

Chelipeds moderately robust. Ischium usually spineless, rarely with 1, more rarely 2, small ventral spines or tubercles. Merus with row of 3–10 ventral spines randomly scattered or crowded centrally, subdistal dorsal spine or tubercle almost never present. Carpus rather short, usually with submarginal distodorsal spine on mesial aspect obscured by setae, and often small ventral spine distolaterally. Palm with greatest depth at about $\frac{1}{4}$ length; fingers elongate, nearly equal in length, gently curved toward each other and tapering to tips, sometimes crossed, opposed edges entire.

P2–5 with smooth, spineless articles.

Two arthrobranchs arranged in 2 biserial rows of divided (rod-like) lamellae on Mxp3 and P1–4.

Pleopods densely setose on margins, exopod far longer and broader than endopod.

U lateral ramus with convex distal margin, that of mesial ramus less so, distal spine on protopod lateral to articulation of mesial ramus; comparable acute spine proximally on prominent rib of lateral ramus; central and lateral ribs of mesial ramus variably bearing irregular row of about 8–10 small spines (often obsolescent on lateral rib), and sometimes scattered spines elsewhere on blade, lateral ramus usually bearing sparse obsolescent spines on distolateral, submarginal, and lateral ribs.

MEASUREMENTS (in mm).—♂, acl 3.6, cl 6.4, chl 4.4, chh 1.6; ♀ ovig., same, 4.2, 7.0, 4.5, 1.2; eggs approximately 0.81×0.94 in diameter.

COLOR.—Carapace of male with gastric region diffuse orange, spines and spine rows on this region and rostrum light orange; segments of abdomen each with orange band along posterior border; T with light orange on spines and around bases of spines. Chelipeds with dorsal surface of carpus and proximal $\frac{3}{4}$ of palm mottled orange on lighter background, distodorsal parts of palm and fingers dark orange or orange-red, finger tips white, merus with distodorsal streak of orange mesial to orange distodorsal spine. P2 with distodorsal margin light orange; joints of P2–5 light orange. Female bearing light yellow-orange eggs, eye pigment not developed. (Data taken from field notes and sketches by R.W. Heard for sponge-dwelling individuals collected at 33.5 m depth, Turks and Caicos Islands.)

KNOWN RANGE.—Northeastern Gulf of Mexico and Bahamas through Caribbean Sea and along coast of South America to Espírito Santo, Brazil; 6–70 m, rarely 358–359 m.

REMARKS.—When *Upogebia synagelas* was described, I was unaware of the identity of *U. acanthura* from its brief description, but now that I have seen a fragmentary paratype from the MZUSP and a drawing of the tail fan of the holotype, kindly provided by Dr. Coêlho, it is apparent that *U. synagelas* must be synonymized with *U. acanthura*. In Jamaica, the species lives commensally as male-female pairs in the agelasid sponge, *Agelas sceptrum* (Lamarck), and in *A. dispar* Duchassaing and Michelotti on the Florida Middle Grounds in the eastern Gulf of Mexico and the Bahama Islands (Williams, 1987).

Upogebia acanthura most closely resembles eastern Pacific *U. ramphula* (Williams, 1986:52) in structure of the rostrum, abdomen, eyes, mouthparts, and walking legs. There are differences in shape of the fingers (toothless in *U. acanthura*) and in shape of elements of the tail fan, which are spineless in *U. ramphula*. Nevertheless, the similarity is striking, as in many species pairs found on both sides of Central America. Although the exact habitat of *U. ramphula* is presently unknown, it may prove to be some species of sponge.

There is considerable variation in the amount of spination on the tail fan of *U. acanthura* and in other ornamentation of the body. Dr. Coêlho's drawing of the tail fan shows perhaps the most densely spined example I have seen, with all ribs on the uropods having at least some spines, but uropods of some individuals are nearly spineless. The specimen from Costa Rica

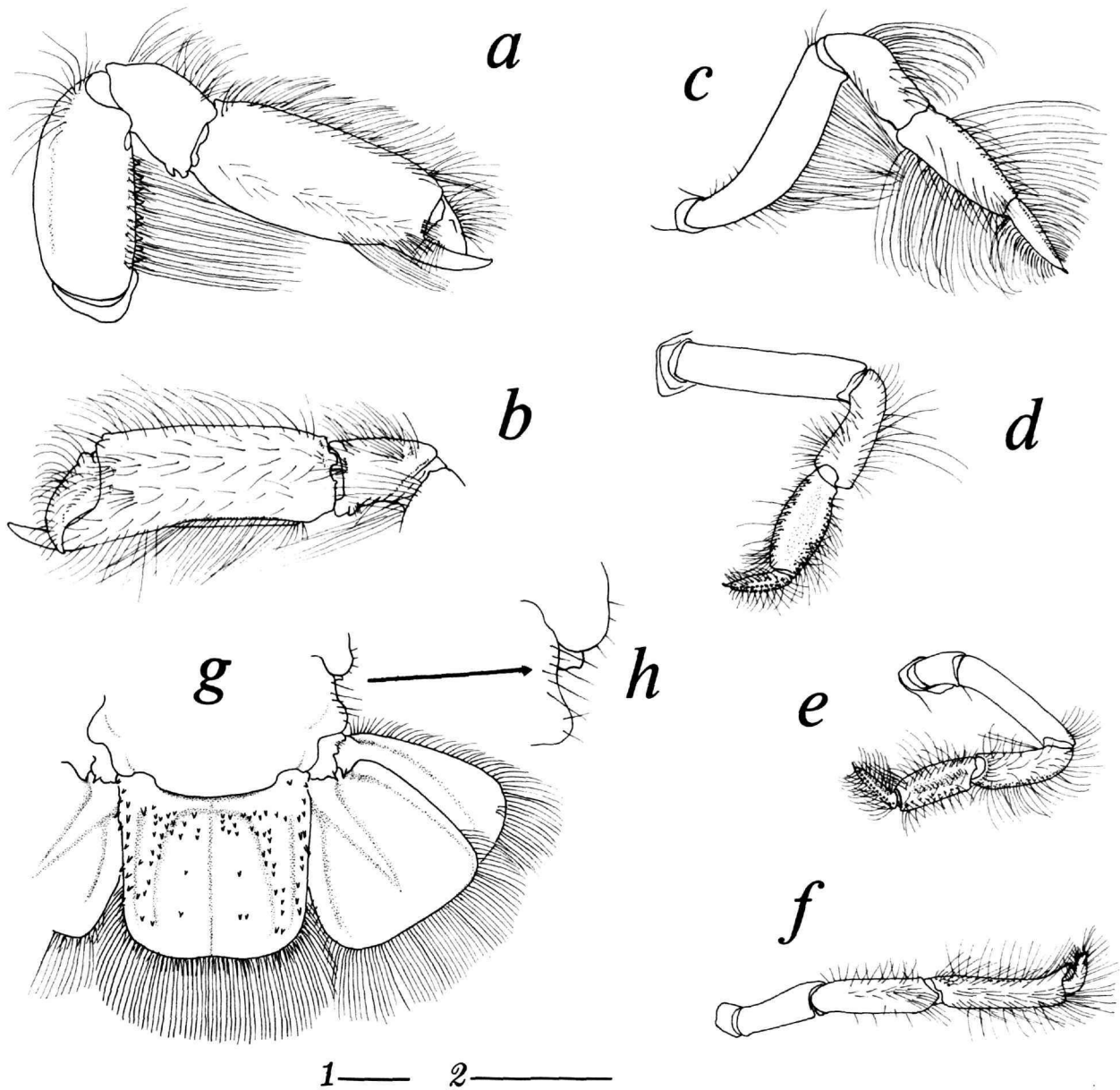


FIGURE 7.—*Upogebia acanthura* (Coelho), USNM 233572, ♂ (from Williams 1987): *a*, cheliped, right lateral; *b*, chela and carpus, right mesial; *c-e, f*, legs 2-5; *g*, parts of abdominal segment 6, telson, and uropods, dorsal; *h*, parts of lateral margin, segments 5, 6. (Scales = 1 mm: 1 = *a-g*; 2 = *h*.)

has relatively stronger spines on the telson than do other specimens examined. The merus of the cheliped usually lacks a dorsal subdistal spine or tubercle, but some specimens have this feature. Moreover, the carpus of P1 has a highly variable distodorsal spine on the mesial aspect that ranges from absent to acicular. Usually, this spine is rudimentary and obscured by

setae, as is the case in specimens described as *U. synagelas* (Williams, 1987). Williams also noted (1987:594) that chelae "of selected juveniles are noticeably stouter than those of adults. For example, in one juvenile with a carapace length of 2.56 mm the right chela has a palm length of 1.79 and a mid-palm height of 0.77; mid-palm height of the right chela in

[an adult ♂] is 0.35 the palm length, whereas in the above mentioned juvenile the relationship is 0.43. In still another juvenile the relationship is 0.53."

The newly emergent zoea I was illustrated by Williams (1987).

Upogebia annae Thistle, 1973

FIGURE 8

Upogebia annae Thistle, 1973:12-14, 17, fig. 5.

MATERIAL EXAMINED.—BAHAMAS: USNM 138892, ♀ (holotype), S of Great Inagua Island, 20°54'N, 73°36'W, 229 m, Oregon sta 5421, 25 May 1965; USNM 138893, 1 ♂ (paratype), same.

TURKS AND CAICOS ISLANDS: USNM 138894, 1 ♂ (paratype), S of Grand Turk Island, 19°55.5'N, 71°07'W, 183 m, Silver Bay sta 5158, 14 Oct 1963.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites unarmed; AVI with anterolateral lobe but lacking hooked anterolateral process. T subrectangular. P1 merus with subdistal dorsal spine reaching beyond level of postorbital spine, carpus with 2 moderate but subequal spines on anteromesial margin. P2 with proximal mesioventral spine on merus reduced to tubercle or absent; merus of P4 spineless.

DESCRIPTION.—Rostrum subtriangular, sides slightly convex, straight in lateral view, tip exceeding eyestalks by $\frac{1}{2}$ again their length; dorsal pair of strong subapical spines followed on each side by 3 strong spines; lateral ridge either slightly concave in dorsal view or parallel to median line in anterior $\frac{1}{2}$, then slightly divergent and bowed laterally in posterior $\frac{1}{2}$, bearing crest of about 13-15 spines, strongest on process lateral to rostrum and decreasing to tubercles posteriorly. Shoulder lateral to cervical groove smooth or sometimes bearing 1 or 2 tiny obsolescent tubercles below intersection with thalassinidean line; latter continuing to posterior margin of carapace. Postocular spine present, asymmetrically doubled in holotype.

Abdominal sternites unarmed, terga of AIII-IV with very few setae on posterior margin.

T subrectangular, slightly concave distally, prominent transverse proximal ridge confluent with lateral ridge at each side.

Eyestalk stout, cornea narrower than diameter of stalk, directed anterolaterally and with proximolateral margin tending to be subangular rather than rounded.

A1 peduncle reaching to about proximal $\frac{1}{4}$ of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article.

A2 peduncle with about $\frac{1}{2}$ its length extending beyond tip of rostrum; article 2 bearing tiny subdistal ventral spine; scale moderate, oval.

Mxp3 with epipod.

Epistomial projection rather broadly rounded in lateral view, bearing 1-2 tiny, often obsolescent apical spines.

Chelipeds with ventral margin of ischium bearing tiny spine or tubercle distally. Merus with single subdistal dorsal spine reaching beyond level of postocular spine, sometimes reaching level of lateral rostral spines; row of 4-7 variably sized and arranged spines on ventral margin. Carpus trigonal, shallow longitudinal groove laterally and moderate submarginal spine at anterior ventrolateral corner; mesiodorsal crest of 2-4 moderate to strong spines plus sometimes a granule behind prominent spine on anterior margin, and remotely behind this near proximodorsal corner 1-2 often small spines at base of faint ridge extending obliquely forward across dorsal side of article; 1-3 strong spines on anterodorsal margin mesial to articulation with propodus; 2 moderate subequal spines near middle of anteromesial margin. Chl about 3-4 times chh; female with obsolete dorsal ridge terminating anteriorly near stout subdistal spine mesial to it, mesiodorsal row of almost undiscernible low rounded spines becoming obsolete at about $\frac{2}{3}$ - $\frac{3}{4}$ length; variable distomarginal spine below lateral and mesial dactylar condyles, 2-5 much smaller spines ventral to mesial condyle on distal margin; lower mesial surface spineless except for 2 obsolescent rugae with associated setal tufts near base of fixed finger, and low transversely arcuate ridge near proximomesial corner. Fixed finger nearly as long as dactyl, slightly downcurved in middle and tapering to moderately slender tip, about 5-7 small teeth on proximal prehensile edge. Dactyl longitudinally ridged and setose; strong tooth at $\frac{1}{4}$ length of prehensile edge followed by crest bearing file of fine teeth becoming obsolete near tip, toothless section basally; curved extensor surface sometimes bearing 2 or more obsolescent tubercles proximally and worn or tiny subdistal tooth, comeous in holotype; male similar but palm with no dorsal spine rows, tubercles present on mesial surface near anteromesial spines of carpus.

Legs elongate and slender. P2 reaching about to distal $\frac{1}{4}$ of palm; carpus with slender, acute distodorsal spine and similar but smaller subdistal ventral spine; merus with slender subdistal dorsal spine, proximal mesioventral spine absent or reduced to tubercle, sometimes another tubercle or small spine at $\frac{1}{3}$ length; coxa with proximal ridge sometimes bearing cluster of about 3 tiny obsolescent spines. P3 with carpus sometimes bearing tiny subdistal ventral spine; merus with scattered ventral and ventrolateral spines tending to be clustered in proximal $\frac{1}{2}$; ischium unarmed, and coxa of female with flange-like low spine lateral to gonopore. P4 with merus and ischium unarmed.

U with tiny acute spine on protopod above base of mesial ramus; lateral ramus with mesial rib bearing at most a raised area.

MEASUREMENTS (in mm).—Holotype ♀, acl 7.4, cl 12.0, chl 9.0, chh 2.8; paratype ♂, same 8.1, 12.3, 11.8, 2.8.

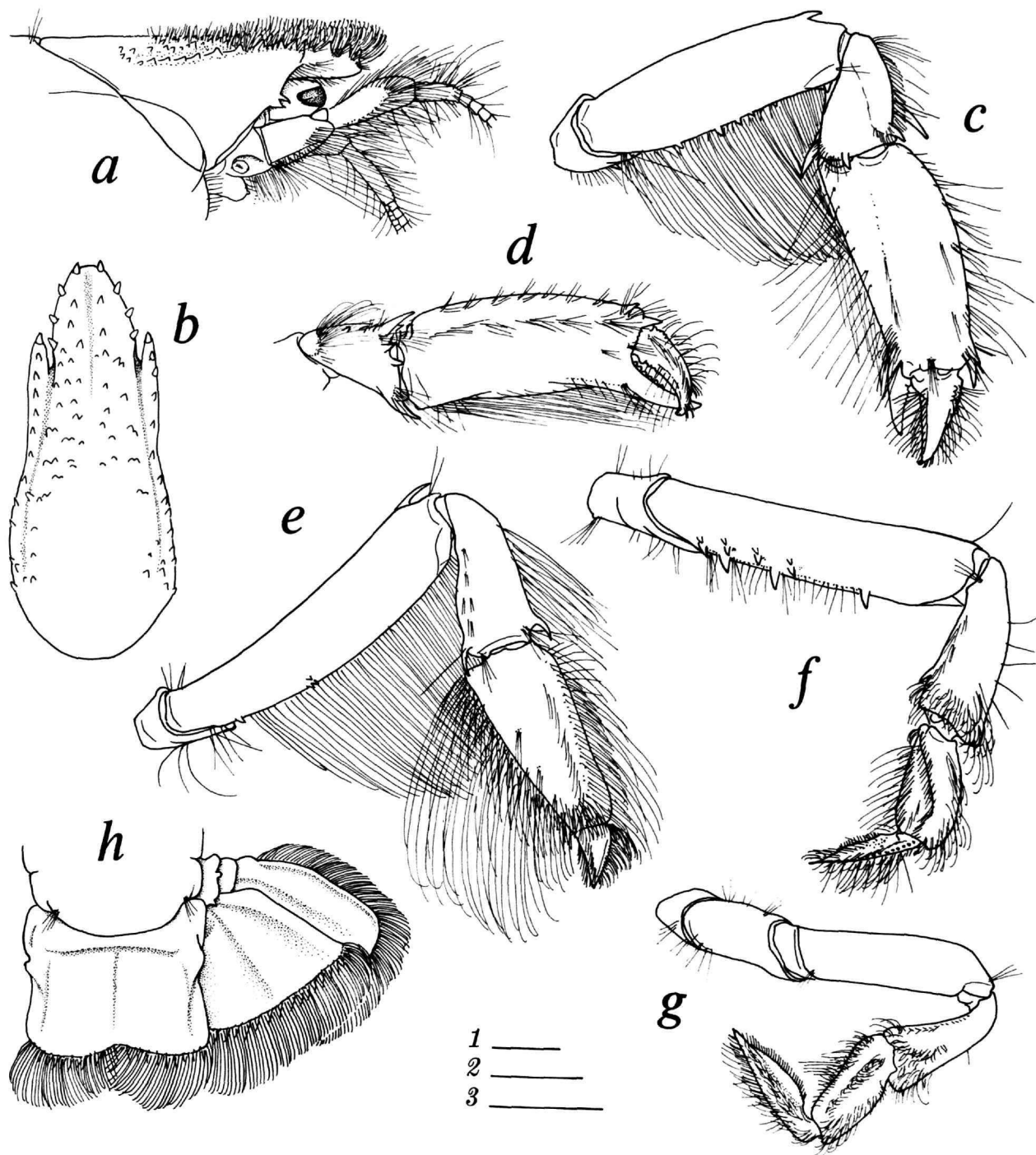


FIGURE 8.—*Upogebia annae* Thistle, USNM 138892, ♂ holotype: *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e-g*, legs 2-4; *h*, parts of abdominal segment 6, telson, and uropods, dorsal. (Scales = 2 mm: 1 = *c,d*; 2 = *a,e*; 3 = *b,f,g*.)

KNOWN RANGE.—Confined to the material examined.

REMARKS.—*Upogebia annae*, new species, is similar to *U. casis*, new species, described herein, differing from it chiefly in relative length of the legs and strength of spines on them, and in shape and ornamentation of the chelipeds; see remarks for that species. *Upogebia annae* shares with *U. corallifora* the presence of a tiny subterminal corneous spine on the extensor surface of the cheliped dactyl. The depth distribution of *U. annae* far exceeds that for *U. casis*.

Upogebia bermudensis, new species

FIGURE 9

MATERIAL EXAMINED.—BERMUDA: MCZ 12873, ♂ (holotype), Castle Harbor, Mowbray, 4 Oct 1902.

DIAGNOSIS.—Projections to either side of rostrum obsolete, lateral rostral ridge originating behind orbital margin in rather blunt spine. Postocular-antennal margin bearing 2–3 spines and additional tubercles. Abdominal sternites unarmed; AVI lacking hooked anterolateral spine. T subrectangular, distal margin concave. Merus of cheliped with row of spines on ventral margin; carpus with strong anterodorsal spine and strong spine on anteromesial margin; palm with row of strong dorsal spines and 3 strong spines on distal 1/2 of ventral margin. Merus of P2 lacking proximal mesioventral spine, but with 2 or 3 distal spines dorsally; carpus with 4 or 5 dorsal spines and 1 distoventral spine. Merus of P2 with 2 subdistal dorsal spines, merus of P3 spineless.

DESCRIPTION.—Rostrum lance-shape in dorsal outline, straight, bearing slight mid-dorsal ridge, median ventral keel bearing 3 strong spines curved anteroventrally, tip rounded, exceeding eyestalks by slightly more than once again their length; densely setose dorsally but sparsely spinose, continuous with setal tract extending at each side along dorsolateral aspect of cephalic region, but decreasing in density posteriorly to leave gastric region nearly smooth and glabrous; gastric region flanked on either side by shallow, slightly sinuous groove; each groove bounded in turn by lateral ridge originating behind orbital margin in rather blunt spine, terminating near cephalic groove, and bearing crest of few obsolescent spines and tubercles. Shoulder lateral to cervical groove acutely angled, bearing about 3–6 tiny spines below intersection with thalassinidean line; latter continued obscurely but uninterruptedly to posterior margin; gastroorbital region bearing few low spines and tubercles. Anterolateral margin bearing 2–3 postocular spines, and small spiniform tubercles near base of A2 peduncle.

Abdominal sternites unarmed.

T subrectangular, lateral margins converging somewhat posteriorly, posterior margin concave; obscure transverse proximal ridge confluent with slight lateral thickening at each side.

Eyestalk stout, horizontal, reaching nearly to midlength of

rostrum; prominent terminal cornea slightly ovate in lateral view, longer than stalk and greater in diameter.

A1 peduncle fully as long as A2 peduncle, its proximal 2 articles together slightly longer than terminal article; middle article with ventral spine; flagellum missing.

A2 peduncle with terminal article extending beyond tip of rostrum; penultimate article bearing strong subdistal ventral spine; minute scale rounded, flagellum missing.

Mxp3 apparently lacking epipod.

Epistomial projection rounded in lateral view, bearing tiny apical spine.

Chelipeds with merus reaching beyond level of major postorbital spine, bearing row of 5 small spines on ventral margin; 2 rather widely separated distal spines dorsally on left side, 3 on right. Carpus trigonal, dorsolateral surface more or less hollowed, obscurely rugose, punctate, and rather densely setose; lateral ridge bearing row of 6–7 anteriorly directed spines; strong anterodorsal spine preceded by 2 strong anteriorly curved spines on dorsal crest; anteromesial margin with single strong spine in middle. Palm somewhat compressed, chl about 2.6 times chh; lateral surface similar to that of unspined part of carpus, but setae very sparse, mesial surface covered with very fine short setae; dorsal and ventral surfaces bearing prominent plumose setae; strong dorsal ridge bearing row of 9–10 acute, widely separated, recumbent spines hidden in plumose setae and directed anteromesially; ventral keel bearing 3 strong acute spines on distal 1/2. Fixed finger strongly deflexed, hooked, much shorter than dactyl, drawn to acute tip, 2 acute hooked spines on proximal 1/2 of prehensile margin; dactyl much stouter than fixed finger and far overreaching it, longitudinally ridged proximal part opposing fixed finger rhomboid in cross section, longer distal part more or less triquetrous in cross section, all ridges bearing rows of thickly distributed long setae.

P2 reaching about to distal 1/4 of palm; propodus with small proximal spine on dorsal margin; carpus bearing row of 3–4 slender, widely spaced dorsal spines and nearly equal distoventral spine; merus with slender distal and subdistal spines on dorsal margin, lacking proximal mesioventral spine; coxa with spine on mesial margin. Coxa of P3 with spine lateral to apparently nonfunctional gonopore and 2 or 3 accessory spinules nearby. P4 with spineless merus. P5 missing.

Two arthrobranchs arranged in biserial rows of undivided entire lamellae on Mxp 3 and P1–4.

U with tiny acute spine on protopod above base of mesial ramus; rami overreaching T, lateral ramus suboval and longer than mesial ramus, subtriangular in outline.

MEASUREMENTS (in mm).—Holotype ♂, acl 1.6, cl 2.46, chl 1.92, chh 0.74.

KNOWN RANGE.—Confined to the type locality.

REMARKS.—Three thalassinidean species in the families Axiidae and Callianassidae have been reported from Bermuda (Markham and McDermott, 1981); now *Upogebia bermudensis* is the fourth member of the infraorder and the first upogebiid

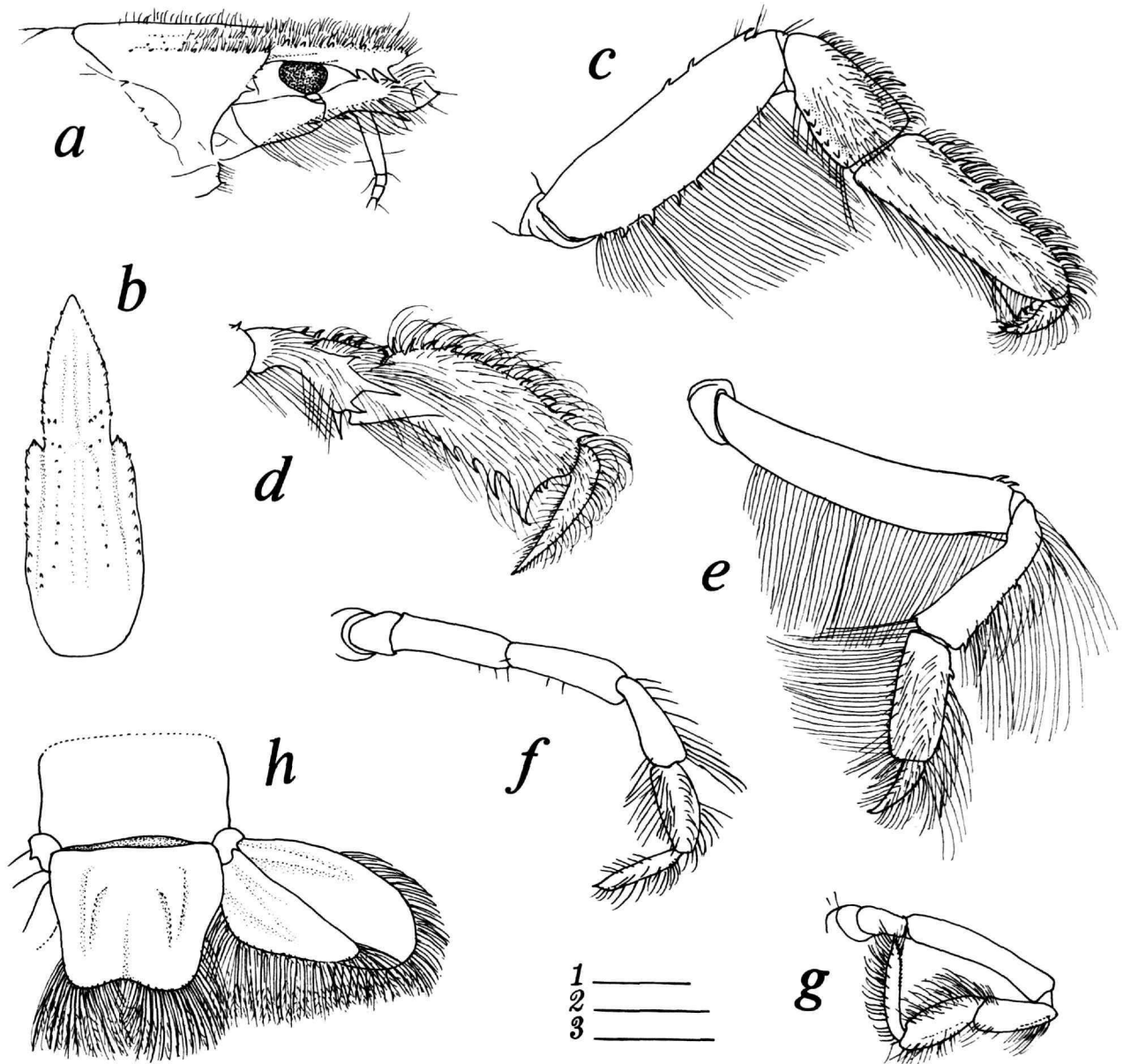


FIGURE 9.—*Upogebia bermudensis*, new species, MCZ 12873, ♂ holotype: *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e-g*, legs 2-4; *h*, parts of abdominal segment 6, telson, and uropods, dorsal. (Scales = 1 mm: 1 = *a,c-g*; 2 = *b*; 3 = *h*.)

known to occur there. The new species resembles *U. pillsbury*, new species, described herein from the Gulf of Darien in the southwestern Caribbean Sea, in general features of the carapace, the antennular and antennal peduncles, chelipeds, and telson overreached by uropods, but it is far less spiny. The merus of P2 lacks a proximoventral spine, whereas this spine is

present in *U. pillsbury*. There is also a tremendous difference in size, *U. bermudensis* being tiny by comparison with *U. pillsbury*, although *U. bermudensis* may be immature; the eyes, for example, are large in relation to body size, which may be a juvenile condition.

Mouthparts of the tiny unique holotype have not been

dissected because I hesitate to risk damaging it. Mxp3 apparently has no minute epipod, agreeing in this respect with *U. spinistipula*, which lacks this feature, and it is presumed that the other mouthparts probably fit the standard upogebian pattern as do mouthparts of that species and *U. pillsbury*. The branchial apparatus appears to fit the generic pattern. For other comparisons, see the "Remarks" for *U. pillsbury*.

ETYMOLOGY.—Named for the island of origin.

Upogebia brasiliensis Holthuis, 1956

FIGURE 10

Upogebia brasiliensis Holthuis, 1956:175, figs. 1, 2.—Gomes Corrêa, 1968:97–109, figs. 22–27, 32, 33 [comparisons].—Ngoc-Ho, 1979:147, 151–153, figs. 3a,b [comparisons, distrib., Georgetown, Guyana, not Esmeraldas, Ecuador].—Coêlho and Ramos-Porto, 1987:35 [key, distrib.].—Coêlho and Rattacaso, 1988:383 [N and S of Pernambuco but not within].

Upogebia (Upogebia) brasiliensis.—Coêlho, 1971:231 [habitat].

MATERIAL EXAMINED.—BELIZE: USNM 251424, 1 ♂ (juv.), halfway between Salt Creek and Colson Pt., 1 m, 33°C, 34 ppt, M.L. Jones, sta CB-40A, 16 May 1977.

SURINAM: USNM 251194, ♂ cephalothorax, 1 ♀ ovig., Clevia water side [5°52'N, 55°09'W], R.C. Gongryp.

FRENCH GUIANA: MNHNP Th-517, 1 ♂, 1 ♀, Golfe de Cayenne [mouth of Rivière de Cayenne], F. Geay.

BRAZIL: *Bahia*: MZUSP 8954, 1 ♂, Itaparica, 18 Aug 1970; USNM 251195, 1 ♀ ovig., Prado Praia do Torora, intertidal, M.L. Christoffersen, 12 Oct 1982. *Paraná*: MZUSP (unnumbered), 2 ♂, 8 ♀ (6 ovig.), Antonina, Ponta de Pita, under rocks with mud, R.D.D., 26 Feb 1970. *Santa Catarina*: USNM 152479, 2 ♂, 2 ♀ ovig., São Francisco (also labeled Rio de Janeiro), W.L. Schmitt, sta 47, 30 Oct 1925; USNM 251196, 22 ♀, Ponta da Cruz, São Francisco, littoral in soft granite, W.L. Schmitt, sta 45 and 46, 28 and 29 Oct 1925; USNM 251197, 78 ♂, same; USNM 251198, 76 ♀ ovig., same.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites unarmed; AVI with anterolateral lobe, but lacking hooked anterolateral spine. T subrectangular. Carpus of cheliped with 2 strong spines on anteromesial margin. Merus of P2 without proximal mesioventral spine, but with subdistal dorsal spine; merus of P4 spineless.

DESCRIPTION.—Rostrum triangular, broader at base than length of sides, usually straight in lateral view; tip usually exceeding eyestalks in male but often exceeded by eyestalks in mature female; dorsal pair of strong apical spines followed on each side by 2, rarely 3, spines of nearly equal size; posteriorly divergent lateral ridge bearing crest of about 12 rather blunt-tipped spines, spine on process lateral to rostrum followed first by 4–7 rather strong spines, remainder abruptly decreasing and diminishing almost to obsolescence posteriorly. Shoulder lateral to cervical groove almost never ornamented, very rarely bearing 1 or 2 obsolete tubercles or spines below

intersection with thalassinidean line, latter continuing to posterior margin. Postocular spine present, rarely doubled.

Abdominal sternites unarmed.

T bearing prominent transverse proximal ridge confluent with longitudinal ridge at each side.

Eyestalk stout, occasionally with small subterminal spine mesially or with minute tubercle on upper surface near cornea; cornea narrower than diameter of stalk, directed anterolaterally.

A1 peduncle reaching to about base of terminal article of A2 peduncle, its proximal 2 articles together about as long as terminal article.

A2 peduncle with about $\frac{1}{2}$ its length extending beyond tip of rostrum; articles spineless; scale moderate, oval, sometimes ending in minute point.

Mxp3 with small epipod.

Epistomial projection rather broad in lateral view, bearing 1 apical projection.

Chelipeds massive. Coxa unspined on mesiodistal margin. Ischium bearing 1 ventral spine or tubercle. Merus with row of 1–5 (rarely 6) short spines on ventral margin, subdistal dorsal spine (rarely doubled) reaching level of postocular spine. Carpus trigonal, shallow longitudinal groove laterally; 0–1 small spine at anterior ventrolateral corner, occasionally preceded by 1 or more smaller spines in male; mesiodorsal crest of 1–5 almost uniform small spines behind variably prominent spine on anterior margin, partly obscured by setae in proximal part of row, and 1–4 short spines obscured by setae on anterodorsal margin mesial to articulation with propodus; 1 moderately strong spine near middle of anteromesial margin, and often a smaller spine dorsal to it; very strong spine below at distoventral corner. Chl about 2.3–3.2 times chh; obsolescent spineless dorsal ridge terminating anteriorly near usually obsolescent subdistal spine (often missing) mesial to it; mesiodorsal row of small spines becoming obsolescent at about $\frac{1}{3}$ – $\frac{1}{2}$ (rarely $\frac{2}{3}$) length, spines in entire row irregular and often obsolescent; 1–2 distomarginal spines below lateral dactylar condyle and 1–4 below mesial one (spines often obsolescent); lower mesial palmar surface bearing transversely arcuate low ridge near proximomesial corner. Fixed finger usually almost as long as dactyl, slightly downcurved in middle and tapering to slender tip, 3–5 teeth on proximal prehensile edge (tip often broken off in preserved samples). Dactyl in male with corneous tip preceded on prehensile edge by subdistal tooth (often worn) and row of closely crowded moderate but irregular teeth increasing proximally to larger tooth in first $\frac{1}{4}$ of length, basal section toothless; corneous tip in female preceded on prehensile edge by strong subdistal tooth opposing tip of fixed finger, section proximal to this bearing about 4–7 closely set small teeth increasing proximally, then large tooth often standing alone at $\frac{1}{4}$ length, basal section toothless; curved extensor surface bearing about 3–4 small tubercles proximally, mesiodorsal surface bearing files of pearliform tubercles diminishing distally, 2 rows in adult male, 1 in adult female.

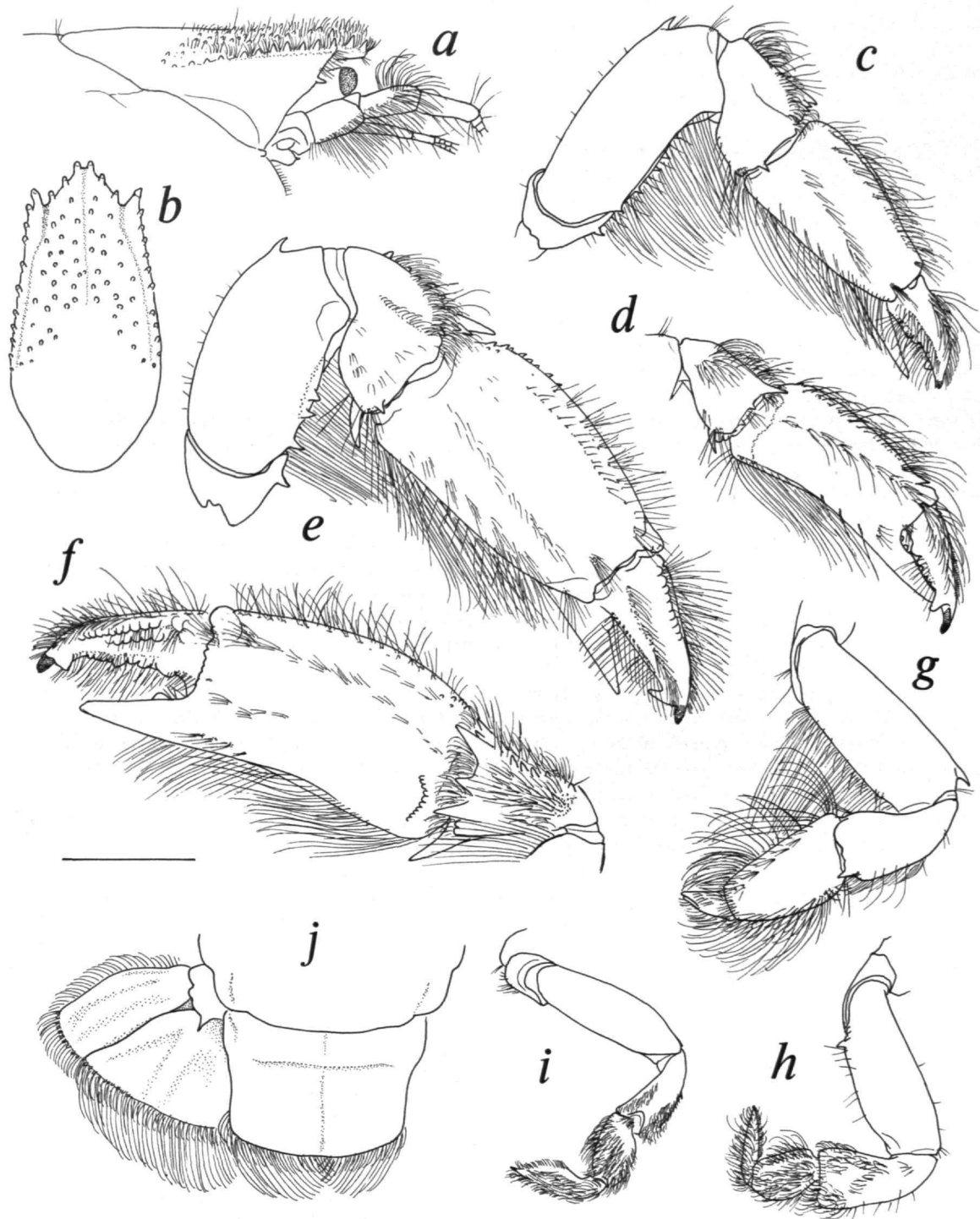


FIGURE 10.—*Upogebia brasiliensis* Holthuis (*a-d, g-j*, USNM 152479, ♀; *e, f*, USP 8954, ♂): *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e*, cheliped, right lateral; *f*, chela and carpus, left mesial; *g-i*, legs 2-4; *j*, parts of abdominal segment 6, telson, and uropods, dorsal. (Scale = 3 mm.)

P2 reaching about to distal $\frac{1}{4}$ of palm; carpus spineless; merus with 1 subdistal dorsal spine and no proximal mesioventral spine. Merus of P3 with cluster of small spines or tubercles ventrolaterally on proximal $\frac{1}{2}$, ischium spineless P4 with spineless merus.

U with acute spine on protopod above base of mesial ramus; mesial rib of lateral ramus usually unarmed, bearing at most an obsolescent tubercle proximally, distal margin of both rami bearing more or less evenly spaced granules.

MEASUREMENTS (in mm).—♂, acl 8.3, cl 11.5, chl 9.0, chh 4.0; ♀ ovig., same, 7.7, 10.8, 7.0, 2.6.

COLOR.—Abdomen of most individuals and eggs of ovigerous females bright orange; carapace and central $\frac{1}{3}$ of median dorsal abdomen slate gray, not so noticeable in field as in white plate some hours after collected, setae on forepart of carapace dirty cream buff; stomach showing, particularly on sides, between slate and indigo; telson mostly transparent; chelae with flush of buff pink or vinaceous pink; legs opaque white (from field notes by W.L. Schmitt, presumably pertaining to the most abundant of two species collected at sta 46, 28–30 Oct 1925, Purdy-Walter Rathbone Bacon Travelling Scholarship).

KNOWN RANGE.—Belize?, Surinam to Santa Catarina, Brazil. The small male from Belize seems to possess characters of the species, but it is from a locality far removed from the continuous distributional range of the species. I place it provisionally in *U. brasiliensis* until its identity can be confirmed by more material from the area.

REMARKS.—There is little doubt that *Upogebia brasiliensis* and *U. macroryae* Williams of the eastern Pacific tropical Panamic Province are geminate species. Williams (1986) pointed out that the main difference between the two is the presence in *U. macroryae* of a row of obsolescent tubercles on the shoulder paralleling the cervical groove below the thalassinidean line, and lack of these tubercles in *U. brasiliensis*. Now that a large series of the latter has been studied, this difference is emphasized, although within that series there is one ovigerous female among 76 that shows the tubercles developed and another has 3 spines on that shoulder. There are other sometimes subtle differences. *Upogebia brasiliensis* attains a larger size at maturity than does *U. macroryae*. The rostrum in *U. macroryae* is more downcurved than in *U. brasiliensis* and the subterminal pair of spines tends to be widely separated from the succeeding pair, whereas the marginal spines on the rostrum of *U. brasiliensis* are evenly distributed in most specimens, although a few, mainly males, resemble *U. macroryae* in reduced degree with respect to this character.

Upogebia brasiliensis is highly variable in other respects. The rostrum of mature females is short and often is exceeded by the eyes, whereas the eyes of *U. macroryae* rarely exceed the rostrum and usually fall far short of its tip in mature females. The cornea of *U. brasiliensis* varies in size from usually as broad as the eyestalk to approximately $\frac{1}{2}$ as broad. The postorbital spine may be asymmetrically doubled, and in an

ovigerous female from Surinam, USNM 251194, this spine is doubled on each side. Occasional doubling of the subdistal dorsal spine on the merus of the cheliped, even tripling of this spine on one ovigerous female from São Francisco, has been observed. The carpus of the cheliped usually bears a dorsal row of spines behind the prominent distodorsal spine in males, whereas females have few spines in this row, and often none at all; the spine on the anterior ventrolateral corner, usually lacking in females, is often strong in males and preceded by 1 or more spines; finally, the 2 spines on the distomesial carpal margin vary in size, usually short and often absent, but the upper and usually smaller of the pair may be doubled, and the lower larger one more rarely may be doubled also. I have not seen both of these spines doubled on the same individual (4 spines).

The palm of the chela in *U. brasiliensis* rarely has the dorsal obsolescent spineless ridge broken up into low spines, and there is considerable variation in the length of the mesiodorsal row of spines paralleling it. The mesial face of the palm in large individuals bears scattered tubercles, and the curved low ridge near the "heel" of the palm often bears 1–3 (very rarely 4) small short spines; rarer still, large males sometimes have 1–4 spines on the ventral heel of the palm near the aforementioned low mesial ridge. Although it is not a specific character, the distal part of the long slender fixed finger is often broken off in material examined, and there is an unusually high proportion of broken fixed fingers and dactyls that show the effects of wear after injury.

In his field notes, W.L. Schmitt recorded finding two specimens of *Upogebia* at Ponta da Cruz near São Francisco, Santa Catarina, sta 27, 7 Oct 1925, in soft granite. After field collecting at inland stations, he returned to this site "to get some pictures and found such a number and excellent chance to study [*Upogebia brasiliensis* except for 3 specimens of *U. omissa*, see under that species] that I have decided to spend a couple of days." He chopped open much soft rock, collected many specimens (see "Material Examined"), and gave a fairly concise summary of upogebioid biology as now understood. In one exposed triangular section of substrate, about a foot (30 cm) on a side, he took 4 pairs (8 specimens) in the upper 6 inches (15 cm). Ovigerous females seemed to be in burrows plugged except for small holes to allow water renewal; outside [above?] the plugs in each burrow was a male. The animals lodged themselves in flooded burrow pockets below the level of vent holes exposed by low tides. The burrows seemed to be occupied for life, for fouling growth around the holes was of long standing. Although exposed animals were good swimmers and quite active in the water, they surely did not leave burrows naturally [habitually?]; he thought they aerated the burrows with a swimming motion, but they could tolerate very stagnant water in which all crabs died. In the lowest part of burrow ramifications was usually a black plug enclosing remains or fragments of one or more dead individuals. The granite in which the animals worked was soft and friable, and Schmitt

wondered if the long finger was the primary digging organ [hence broken tips?]. Finally he asked, "Why do all *Upogebias* have numerous forward pointing spines on the rostrum and broad anterior carapace? Simplest thing in the world; when you try to pull them out of their burrows, they rise up on all 'fours' and push the spines against the top [side?] of the tunnel. You pull the animal to pieces before he comes loose. The harder you pull, the tighter the spines wedge. But if you find the tail sticking out of the burrow when you break it open, it pulls out very easily."

Upogebia casis, new species

FIGURE 11

Upogebia annae.—Scott, Reiswig, and Marcotte, 1988:483.

MATERIAL EXAMINED.—HONDURAS: USNM 251224, ♂ (holotype), 125 km ENE Cabo Gracias a Dios, 15°15'N, 81°51'W, alcyonarian patch reef with corals and scattered sponges, 18 m, R/V *Pillsbury* sta 1358, 10-ft otter trawl, 1 Feb 1971; USNM 251225, 1 ♀ (allotype), near Cabo de Honduras, 15°29.2'N, 86°02'W–86°04.2'W, rocks, corals, sponges, brachiopods, 35–37 m, R/V *Pillsbury* sta 630, 40-ft trawl, 22 Mar 1968.

JAMAICA: USNM 251226, 1 ♀ ovig., south coast, 17°44'N, 77°47'W, sand, *Halimeda*, inverts. including sponges, 27–29 m, R/V *Pillsbury* sta 1223, 6 Jul 1970; USNM 251227, 1 ♂, 1 ♀, Discovery Bay, forereef, sponge, 48.6 m, P.J.B. Scott, 30 Nov 1984.

DOMINICAN REPUBLIC: USNM 251228, 1 ♂, 20°00'N, 71°41'W, preserved with siliceous sponge, 38 m, R/V *Pillsbury* sta 1148, 5-ft Blake trawl, 15 Jan 1970.

LESSER ANTILLES: RMNH, 1 ♂, 1 ♀ ovig., NE Saba Bank, "Luymes" Saba Bank Exp. sta 124, 17°33'N, 63°22'W, rocky bottom, scattered corals, 24 m, divers, 12 Jun 1972; USNM 251229, 1 ♂ juv., S of Nevis, 17°10'N, 62°38.5'W, algae, corals, 27 m, R/V *Pillsbury* sta 959, 10-ft otter trawl, 19 Jul 1969; USNM 251230, 1 ♂, 1 ♀, NW Antigua on shelf, 17°15.5'N, 62°02.2'W, assorted inverts., 22 m, R/V *Pillsbury* sta 967, 10-ft otter trawl, 20 Jul 1969; USNM 251231, 1 ♂, SW of Dominica, 15°23.3'N, 61°14.1'W, with sponges, 73 m, R/V *Pillsbury* sta 928, 5-ft Blake trawl, 15 Jul 1969; USNM 251232, 1 ♀ ovig. (damaged), W coast Martinique, 14°53.8'N, 61°04.9'W, many inverts, 46 m, R/V *Pillsbury* sta 913, 10-ft otter trawl, 10 Jul 1969.

PANAMA: USNM 7777, 1 ♂, Caribbean Sea near Aspinwall (= Colón), 09°32'N, 79°54'30'W, broken shell, 62.2 m (34 fm), R/V *Albatross* sta 2146, large beam trawl, 2 Apr 1884.

SURINAM: USNM 251233, 1 ♀, 7°19'N, 56°51'W, sponges and inverts, 55–59 m, R/V *Pillsbury* sta 684, 10-ft try net, 14 Jul 1968; USNM 251234, 3 ♂, 1 ♀, 1 juv., same, in sponges, 50–59 m.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites

unarmed; AVI with anterolateral lobe but lacking hooked anterolateral spine. T subrectangular. Cheliped merus with subdistal dorsal spine reaching level of postorbital spine; carpus with 2 subequal spines on anterodistal margin. P2 with proximal mesioventral spine on merus reduced to tubercle or absent; merus of P4 spineless.

DESCRIPTION.—Rostrum subtriangular, narrow, straight or downturned, tip exceeding eyestalks by at least $\frac{3}{4}$ again their length; dorsal pair of strong subapical spines followed on each side by 3 strong spines, only about 2 spines mesial to lateral marginal spines, but many setae; lateral ridge parallel to median line in anterior $\frac{1}{2}$, then slightly divergent and bowed laterally in posterior $\frac{1}{2}$, bearing crest of about 12–14 spines, strongest on process lateral to rostrum and decreasing to tubercles posteriorly. Shoulder lateral to cervical groove bearing 1 or 2 barely perceptible tubercles below intersection with thalassinidean line; latter continuing to posterior margin of carapace. Postocular spine present, rarely doubled.

Abdominal sternites unarmed, terga III and IV with very few setae on posterior margin.

T subrectangular, prominent transverse proximal ridge confluent with broader lateral ridge at each side, distal margin with concavity very shallow.

Eyestalk stout, cornea narrower than diameter of stalk, directed anterolaterally, and with proximolateral margin tending to be subangular rather than rounded.

A1 peduncle reaching as far as midlength of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article.

A2 peduncle with less than $\frac{1}{2}$ its length extending beyond tip of rostrum; article 2 bearing tiny subdistal ventral spine; scale moderate, oval with subspinous tip.

Mxp3 bearing epipod.

Epistomial projection rather broadly rounded in lateral view, bearing 1 tiny or 2 subequal apical spines.

Chelipeds with coxa bearing tubercle or variable slender spine on distomesial margin. Ventral margin of ischium bearing tubercle or 1 acute spine distally. Merus with single subdistal dorsal spine reaching level of postocular spine or slightly beyond it; row of 4–8 variably sized and arranged spines on ventral margin. Carpus trigonal, shallow longitudinal groove laterally, with or without small submarginal spine at anterior ventrolateral corner often preceded by 1–3 well-separated obsolescent tubercles; mesiodorsal crest of 1–4 moderate to strong spines behind prominent spine on anterior margin, and sometimes behind these near proximodorsal corner 1–2 small spines at base of ridge extending obliquely across dorsal side of article; 1–3 moderate spines on anterodorsal margin mesial to articulation with propodus; 2 subequal spines near middle of anteromesial margin (and supernumerary small third spine on left carpus of holotype); strong spine at anteroventral corner. Chl about 3 times chh; dorsal ridge obsolescent, distodorsal submarginal spine mesial to it, mesiodorsal row of spines very low and rounded if present,

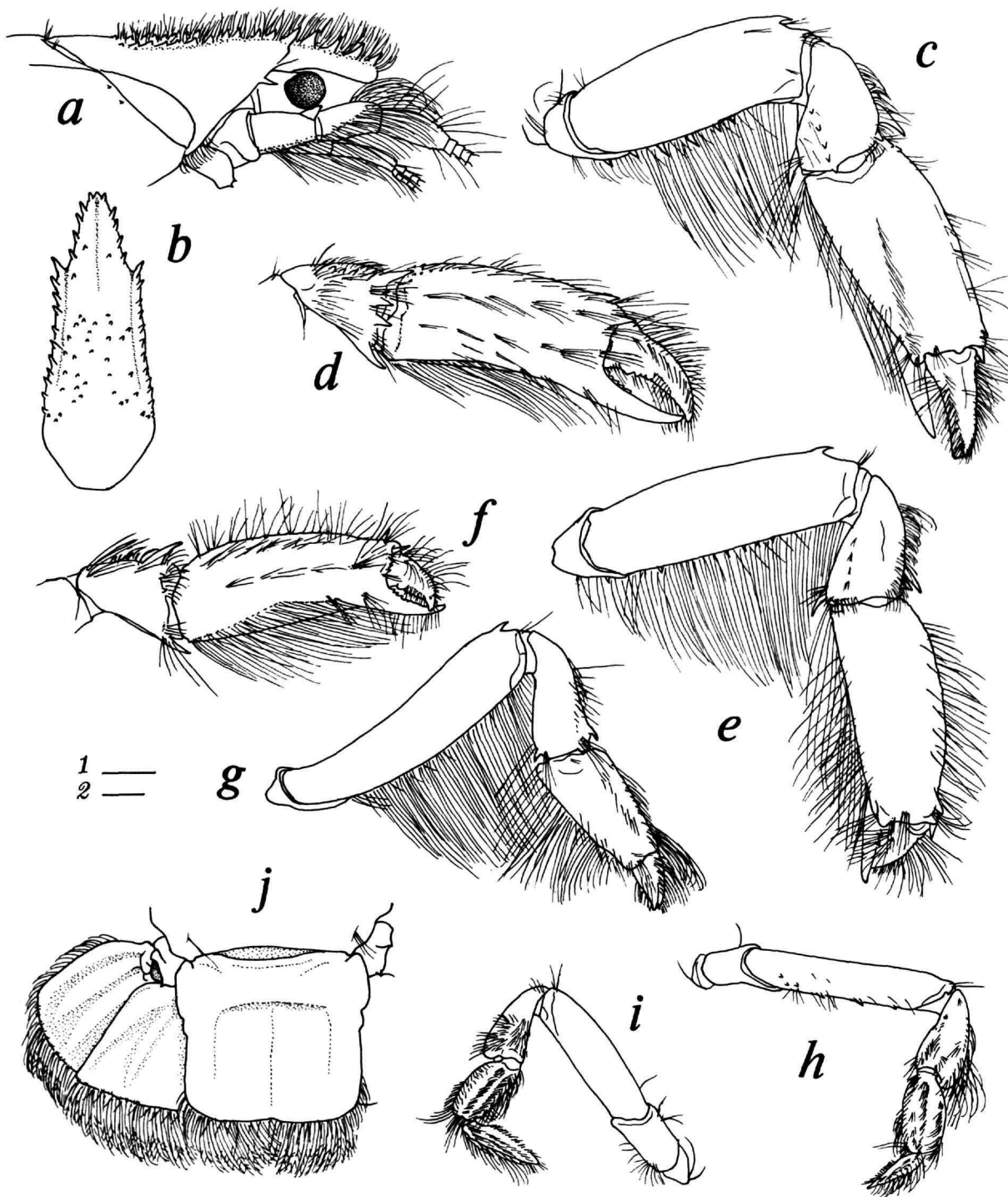


FIGURE 11.—*Upogebia casis*, new species (a-d, g-j, USNM 251224, ♂ holotype; e, f, USNM 251225, ♀ allotype): a, cephalic region, lateral; b, anterior carapace, dorsal; c, cheliped, right lateral, ♂; d, chela and carpus, left mesial, ♂; e, cheliped, right lateral, ♀; f, chela and carpus, left mesial, ♀; g, h (right), i (left), legs 2-4; j, parts of abdominal segment 6, telson, and uropods, dorsal. (Scales = 1 mm: 1 = a; 2 = b-j.)

becoming obsolescent at about $\frac{3}{4}$ length; variable distomarginal spine below lateral and mesial dactylar condyles, and 0–5 much smaller spines below it on distal margin of palm; mesial surface spineless except for widely scattered obsolescent rugae, each with associated setal tuft; few tubercles proximodorsally and low transversely arcuate ridge near proximomesial corner. Fixed finger nearly as long as dactyl but more slender, slightly downcurved in middle and tapering to moderately slender tip, about 5 small teeth on proximal prehensile edge. Dactyl longitudinally ridged and setose; moderate tooth at $\frac{1}{4}$ length of prehensile edge preceded by low crest bearing file of fine teeth becoming obsolete near corneous tip, basal section toothless; curved extensor surface sometimes bearing few obsolescent tubercles proximally and worn or tiny subdistal corneous tooth.

Legs elongate and slender. P2 reaching about to distal $\frac{1}{4}$ of palm; carpus with slender, acute distodorsal spine and similar but smaller subdistal ventral spine; merus with slender subdistal dorsal spine, proximal mesioventral spine asymmetrically absent or reduced to tubercle, and sometimes another tubercle or small spine at $\frac{1}{3}$ length; coxa with proximomesial ridge, sometimes bearing variable spine. P3 with merus bearing scattered ventral and ventrolateral spines tending to be clustered in proximal $\frac{1}{2}$; ischium unarmed and coxa of male without gonopore, female with flattened low spine lateral to gonopore. P4 with merus and ischium unarmed.

U with tiny acute spine on protopod above base of mesial ramus; lateral ramus with mesial rib bearing slightly raised area proximally.

MEASUREMENTS (in mm).—Holotype ♂, ac1 7.2, cl 10.8, chl 7.3, chh 2.4; allotype ♀, same, 6.4, 9.8, 6.4, 1.9; paratypes, Discovery Bay, ♂, same, 6.3, 9.5, 6.3, 1.8, ♀, same, 7.0, 6.7, 4.6, 1.3; Surinam, ♀, same, 8.2, 12.6, 9.1, 2.4.

HABITAT.—“Found excavating chambers in the sponge *Xestospongia* sp. which was living between the branches of a colony of *Madrasis formosa* at 50 m on the fore reef at Discovery Bay, Jamaica” (Scott et al., 1988:483, in account for *U. annae*).

KNOWN RANGE.—Confined to the material examined.

REMARKS.—*Upogebia casis*, new species, is similar to *U. annae*. *Upogebia casis* has a distodorsal spine on the merus of the cheliped that may reach slightly beyond the level of the postorbital spine, but never to the level of spines on the dorsal side of the carapace as in *U. annae*. Anteromesial spines on the cheliped carpus of *U. casis* are variable in number and strength of development, consisting usually of 1 or 2 small spines, but occasionally of 2 rather strong spines as in the holotype, and rarely 3 spines in this position. The merus of P2 has no proximal mesioventral spine in *U. annae* as is usually so in *U. casis*, but may be armed in this position with a tubercle or rarely with a small spine present on one side but not on the other. *Upogebia casis* in this respect thus bridges a great dichotomy among species of this genus in the western hemisphere, a group of species that lacks this spine, and a group that possesses it. The chelae of *U. annae* exhibit almost total suppression of

dorsal ridges, but the chelae of *U. casis* show rudimentary development of the spined mesiodorsal ridge so characteristic of many western Atlantic upogebioid species. Finally, all specimens of *U. casis* are from depths less than 74 m whereas *U. annae* is known from much greater depths, 183–229 m.

ETYMOLOGY.—From the Greek *kasis* (brother or sister).

Upogebia molipollex, new species

FIGURE 12

Upogebia (*Upogebia*) *affinis*.—Schmitt, 1935:196 [Puerto Rico specimen only, not fig. 58].

MATERIAL EXAMINED.—PUERTO RICO: AMNH 6820, ♀ (holotype), Guayanilla Harbor, 25 Jun 1915.

DIAGNOSIS.—Dorsal surface of rostrum bearing only marginal spines, projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites unarmed; AVI bearing slight anterolateral lobe but lacking hooked anterolateral spine. T subrectangular. Cheliped with subdistal dorsal spine of merus reaching beyond level of postorbital spine; carpus with small spine on anteromesial margin. Merus of P2 without proximal mesioventral spine, but with 1 subdistal dorsal spine; merus of P4 spineless.

DESCRIPTION.—Rostrum triangular, lateral margin longer than basal width; nearly straight in lateral view but angled slightly downward, tip exceeding eyestalks; dorsal pair of subapical spines followed on each side by 2 spines of equal size, spines separated by wide equal intervals on right side but third spine slightly more remote from others on left side; no other dorsal spines present. Posteriorly divergent lateral ridge bearing crest of about 10 spines, strongest on process lateral to rostrum and decreasing almost to obsolescence posteriorly; dorsal field of spines on anterior carapace irregular in size and arrangement, largest spines scattered in midlength of field. Shoulder lateral to cervical groove bearing 2 obsolescent granules below intersection with thalassinidean line, latter continuing strongly to posterior margin; area framed by cervical, postcervical, and antennal grooves bearing scattered obsolescent granules. Postocular spine present.

Abdominal sternites unarmed.

T bearing moderate transverse proximal ridge confluent with low longitudinal ridge to either side.

Eyestalk stout, deepest basally, almost horizontal in repose; prominent terminolateral cornea about as long as wide and nearly as wide as stalk.

A1 peduncle reaching about to base of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article.

A2 peduncle with almost $\frac{1}{3}$ its length extending beyond tip of rostrum; scale moderate, oval.

Mxp3 bearing epipod.

Epistomial projection rather broad in lateral view, bearing no apical projections.

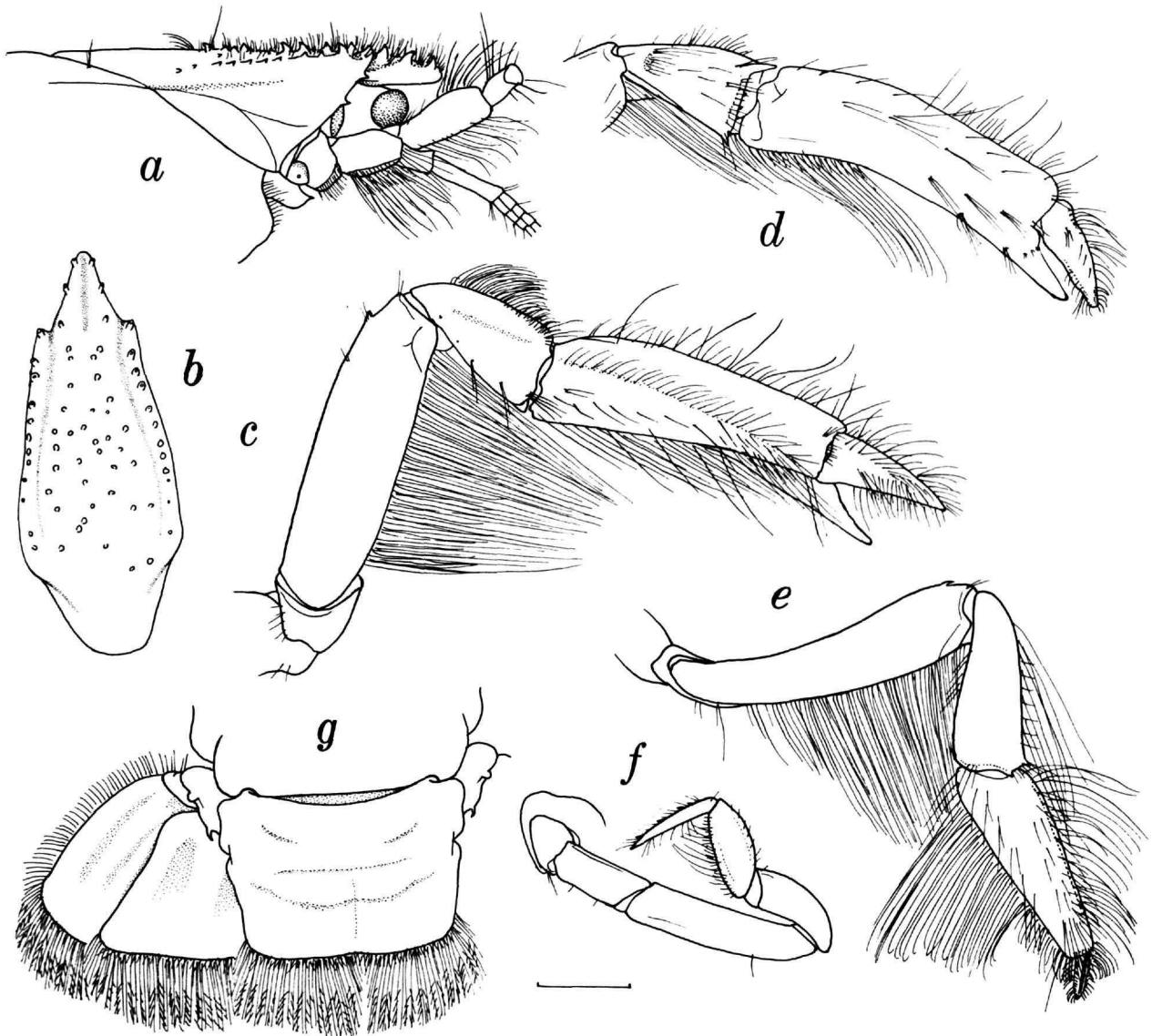


FIGURE 12.—*Upogebia molipollex*, new species, AMNH 6820, ♀ holotype: *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e, f*, legs 2, 4; *g*, parts of abdominal segment 6, telson, and uropods, dorsal. (Scale = 1 mm.)

Legs slender. Chelipeds subequal, right slightly stronger. Coxa and ventral margin of ischium spineless. Merus with single obsolescent subdistal dorsal spine beyond level of postocular spine. Carpus roughly trigonal, broad shallow longitudinal groove laterally, anterior ventrolateral corner spineless; mesiodorsal crest unarmed behind acute spine on anterior margin; 2 closely placed small spines on anterodorsal margin mesial to articulation with propodus; 1 small spine near

middle of anteromesial margin, and tiny spine below near distoventral corner. Chl about 3.7 times chh; spineless on dorsal ridge, lateral and mesial surfaces, and ventral keel, although latter with slight swelling at distal $\frac{1}{3}$ and near base of fixed finger; small spine near distal margin dorsal to left mesial dactylar condyle, margin below dactylar condyle unornamented; mesial surface bearing obsolescent obliquely transverse ridge near proximal margin. Fixed finger straight, shorter than

dactyl, stronger on right than on left side, prehensile edge with broad crushing surface proximally, then abruptly tapered to slender distal part bearing 0 (left)–3 (right) obsolescent teeth, tip rounded. Dactyl with prehensile edge bearing ill-defined row of small teeth and moderately developed swelling opposite base of fixed finger; mesial surface somewhat concave.

P2 reaching about to midlength of palm; carpus with small acute distodorsal and subdistal ventral spine; merus with slender subdistal dorsal spine but without proximal mesioventral spine; coxa unarmed. P3 missing. P4 with spineless merus.

U with acute small spine on protopod above base of mesial ramus; distal margin of both rami with few obsolescent granules.

MEASUREMENTS (in mm).—Holotype ♀, acl 4.2, cl 6.0, chl 3.7, chh 1.0.

KNOWN RANGE.—Known only from the type locality.

REMARKS.—There seem to be no species in the Western Hemisphere that closely resemble the unique holotype of *U. molipollex*. Distinctive characters worthy of special mention include the rostrum with marginal spines only, which resembles *U. aestuari*, new species, in this respect, the carapace with a suggestion of obsolescent granules on the region bounded by the cervical, postcervical, and antennal grooves, and the proximal broadened molar surfaces on prehensile edges of fingers of the chelae. The species resembles *U. annae* in having long slender legs, with the subdistal dorsal spine on the merus of P2 being situated at a level reaching beyond that of the postorbital spine. P3, often a bearer of distinctive characters in this genus, unfortunately is missing on both sides. The left chela is cracked at about the midlength of the palm and may be regenerated as it is smaller than the right chela.

ETYMOLOGY.—From the Latin *mola* (millstone), plus *pollex* (thumb), for the proximal grinding or molar surface on the fixed finger.

Upogebia aestuari, new species

FIGURE 13

MATERIAL EXAMINED.—BELIZE: USNM 251407, 1 ♀ ovig. (holotype), E of Commerce Bight pier, ~8–9 km S of Stann Creek (= Dangriga), transect of 75–80 m, from 1.5 m depth over brown mud above more compact black mud, grading through fine sand to coarser sand and fine gravel at shore, 30°C, 31 ppt, M.L. Jones, sta CB-41C, 17 May 1977.

DIAGNOSIS.—Projections to either side of rostrum ending in small acute spine. Postocular spine present. Abdominal sternites unarmed. T subrectangular. Carpus of cheliped with 2 strong spines on distomesial margin. Merus of P2 bearing strong proximal mesioventral spine and subdistal dorsal spine; merus of P3 with distodorsal spine and 3 strong ventral spines; merus of P4 spineless.

DESCRIPTION.—Rostrum triangular, lateral margin about as long as basal width, nearly straight but angled slightly

downward; tip exceeding eyestalks in normal position by less than width of cornea; dorsal marginal spines inconspicuous, hidden in setae, subapical pair located well short of rostral tip and followed on each side by 3 remote spines, no other dorsal spines present; median tract free of setae. Posteriorly divergent lateral ridge bearing crest of about 10 inconspicuous spines. Shoulder lateral to cervical groove bearing 1 well-developed spine on right side, 2 on left, below intersection with thalassinidean line. Postocular spine present.

Abdominal sternites unarmed.

T subrectangular, transverse proximal ridge confluent with inconspicuous lateral ridge at each side, convex distal margin with slight median indentation.

Eyestalk stout, slightly concave dorsally and convex ventrally in lateral view, almost horizontal in repose; prominent terminal cornea nearly as broad as diameter of stalk at midlength.

A1 peduncle reaching to midlength of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article.

A2 peduncle with about $\frac{1}{3}$ its length extending beyond tip of rostrum; article 2 bearing strong subdistal ventral spine; scale moderate, oval.

Mxp3 bearing epipod.

Epistomial projection rather narrowly rounded in lateral view, bearing small spine on anterodorsal aspect.

Chelipeds slender. Coxa unarmed. Ventral margin of ischium bearing 1 spine. Merus with row of 4 small spines on ventral margin, 1 near base and 3 remote from it but equidistant from each other; single subdistal dorsal spine reaching level of postocular spine. Carpus trigonal, shallow longitudinal groove laterally, obsolescent spine at anterior ventrolateral corner; mesiodorsal crest of 3 clearly visible spines behind prominent dorsal spine on anterior margin, and 3 short slender spines on anterodorsal margin mesial to articulation with propodus; strong spine near middle of anteromesial margin, slightly smaller spine dorsal to it, and strong slender spine at distoventral corner. Chl about 3.6 times chh; dorsal ridge spineless except for prominent, anteriorly curved acute spine at base, ridge terminating anteriorly near acute subdistal spine mesial to it; mesiodorsal ridge unspined but bearing few rounded bases of obsolescent tubercles in proximal $\frac{1}{2}$ of length; dactylar condyles each with acute spine below, spine strong on lateral side, weak on mesial side; mesial surface with row of setal tufts on upper $\frac{1}{2}$ paralleling mesiodorsal ridge, ventral keel bearing 2 or 3 obsolescent spines on mesial side near midlength, and low transversely arcuate ridge near proximomesial corner. Fixed finger only $\frac{1}{4}$ length of dactyl and more slender, its ventral margin at base continues the straight ventral margin of palm, but tip gently curved toward opposing dactyl, about 5 tiny rounded teeth crowded along proximal prehensile edge. Elongate dactyl longitudinally ridged, slightly curved, and bearing rows of dense setae; slender, acute corneous tip preceded on prehensile edge by long

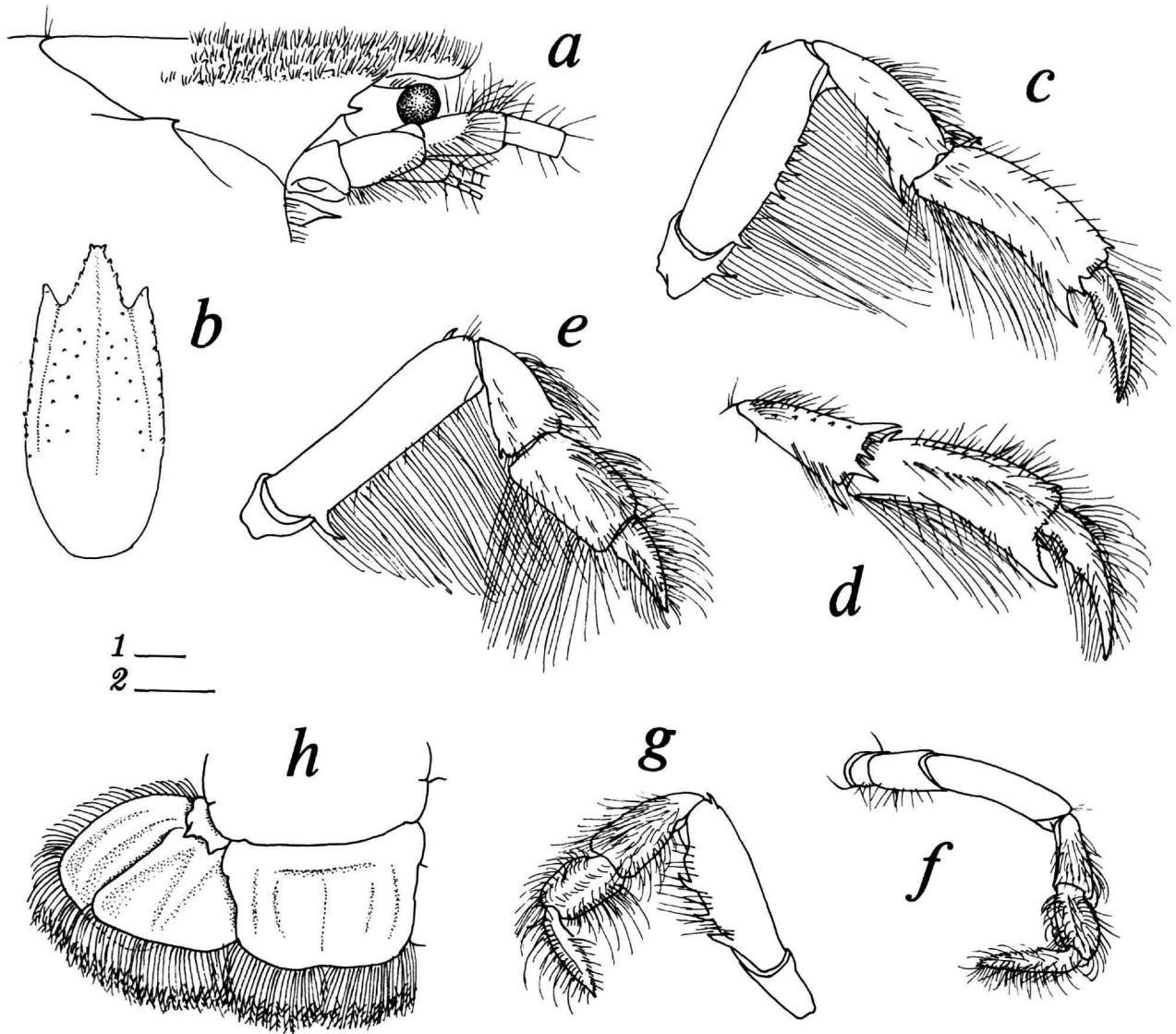


FIGURE 13.—*Upogebia aestuarii*, new species, USNM 251407, ♀ holotype: *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e-g*, legs 2-4; *h*, parts of abdominal segment 6, telson, and uropods, dorsal. (Scales = 1 mm: 1 = *a*; 2 = *b-h*.)

unarmed interval, then 2 low teeth approximating tip of fixed finger with their bases extended along longitudinal axis, distal tooth less than $\frac{1}{2}$ size of proximal tooth, and toothless section basally; curved extensor surface unornamented.

P2 reaching about to distal $\frac{1}{4}$ of palm; carpus with strong acute distodorsal spine, and smaller acute ventral spine; merus with slender subdistal dorsal spine and strong proximal mesioventral spine; coxa unarmed. P3 with merus bearing distodorsal spine and 3 strong spines on ventral margin. Merus

of P4 spineless.

U with blunt spine on protopod above base of mesial ramus; lateral ramus with mesial rib bearing obsolete spine proximally.

MEASUREMENTS (in mm).—Holotype ♀, acI 3.8, cl 6.0, chl 2.9, chh 0.8.

KNOWN RANGE.—Known only from the type locality.

REMARKS.—M.L. Jones collected this specimen somewhere along a 75–80 m transect mentioned in "Materials Examined." From the outer end to shore, the transect covered roughly four

kinds of bottom described in notes as "brown mud over more compact black mud at the outer ~1.5-m depth; from ~70 to 30 m offshore, fine gray sand over black compact mud, ~18 to 20 cm thick at ~1-m depth; from ~30 to 20 m offshore, gray soft mud (~40 to 50 cm thick) over firm bottom; from ~20 m to shore, fine sand with increasing amounts of coarse sand to fine gravel." This is far more habitat detail than is available for most of the collections available for study, but unfortunately the sector of the transect from which this specimen was taken remains unknown, although sta CB-41c indicates a position removed from the high-tide mark because M.L. Jones usually began digging at that level (a) and followed the tide out as it receded.

Although it bears reduced dorsal spines on the rostrum, but has acute spines on shoulders along the cervical groove, on the chelae, and second and third legs, *Upogebia aestuari*, new species, seems allied to the relatively spineless *U. marina* in general aspect, and it is near it in the key to Western Atlantic species of the genus. The almost subchelate condition and the suggestion of spines on the ventral keel of the palms, with well-developed anteromesial spines on the carpus of the chelipeds, are reminiscent of morphology found in *U. affinis* and *U. paraffinis*, although in far less accentuated form; however, lack of ventral spines on the rostrum places further distance between *U. aestuari* and these forms.

ETYMOLOGY.—The specific name from the Latin *aestuarium* (estuary), an adjective in the genitive case, referring to the habitat in which the holotype was found.

Upogebia affinis (Say, 1818)

FIGURE 14

Gebia affinis Say, 1818:241.—DeKay, 1844:22.—White, 1847:71 [Say's type, part of abdomen, telson, and left uropod].—Leidy, 1855:150 [New Jersey]; 1888:333 [list].—Smith, 1873:549 [list].—Verrill, 1873:368, pl. 2: fig. 7 [nat. hist.], 519 [food, summer flounder], 520 [food, windowpane], 530 [occurrence juv.].—Kingsley, 1878:327 [distrib.]; 1899:824 [key].—Rathbun, 1905:17 [habitat, New England].

Upogebia affinis.—Stebbing, 1893:185 [nat. hist.].—Fowler, 1912:361, pl. 108 [summary].—Hay and Shore, 1918:408, pl. 29: fig. 9 [nat. hist.].—Fish, 1925:158 [plankton].—Pearse, 1945:303 [ecol.]; 1952:235 [bopyrid].—Behre, 1950:21 [occurrence, Louisiana].—Deevey, 1960:41 [plankt. larv. occurrence].—Fingerman and Oguro, 1963:24 [chromatophores].—Dragovich and Kelly, 1964:80 [habitat].—McCloskey and Caldwell, 1965:114 [fungi in foregut].—Williams, 1965a:103, fig. 60 [nat. hist.]; 1965b:197 [host of *Leptalpheus*]; 1974b:16, figs. 44A, B [key]; 1984a:191, fig. 133 [nat. hist.]; 1986:10 [key, distrib.].—Gomes Corrêa, 1968:106 [tabular comparison], 107 [G part, figs. 16–21, 30, 31, not Brazilian material], 108 [key].—L.C. Thompson and Pritchard, 1969:114–129 [osmogreg.].—Rouse, 1970:140 [ovig. ♀, plankt. larv.].—Sikora et al., 1972:519 [food, *Urophycis* spp.].—Van Engel and Sandifer, 1972:157 [occurrence Va.].—Sandifer, 1973a:98–104, figs. 1–4 [larv. stages]; 1973b:243 [plankt. larv.].—Thistle, 1973:1–14 [passim], 23 [diagn. char., key].—Basan and Frey, 1977:55, 58 [creek banks].—Frey and Howard, 1975:283 [nat. hist.].—Dörge, 1977:401, 405, 415 [creek banks].—Williams and Wigley, 1977:9, 43 [distrib.].—Frey and Basan, 1981:117 [habitat].—Ngoc-Ho, 1981:241, 243–247, figs. 6–8 [larvae].—Aller et al.,

1983:571–604 [biochem., burrow water].—Chester et al., 1983:282 [estuarine distrib.].—Pemberton and Frey, 1985:241–257 [burrows].—Andrzejak, 1986:214 [plankt. postlarv. descr.].

Upogebia (Upogebia) affinis.—De Man, 1927:50, figs. 19–19g [part, not Barbados and Brazilian specimens]; 1928:22 [list, U.S.A. specimens only], 36 [nat. hist.], 39, 46 [key].—Schmitt, 1935:196, fig. 58 [but not description, see *U. mollipollex*, new species, herein].

MATERIAL EXAMINED.—U.S.A.: *Massachusetts*: USNM 2994, 3 ♀, Wellfleet, H.E. Webster, 1879; USNM 38262, 1 ♀, Martha's Vineyard Sound, U.S. Fish Comm., Verrill, Smith, Todd, 1871; USNM 13970, 4 ♂, 7 ♀, Head of Buzzards Bay, W. Nye, Jr., 17 Sep 1887. *Rhode Island*: USNM 104173, 3 ♀, Wickford, R.U. Gooding, 22 May 1959. *Connecticut*: USNM 31288, 2 ♂, Long Island Sound off Falkner Lt. and Madison, 28.3 m, U.S. Fish Comm., *Fish Hawk* sta 1701, dredge, 17 Sep 1892. *New Jersey*: MNHNP Th-1, 1 ♂, 1 ♀, from Yale [Peabody] Museum; USNM 251722, 1 ♂, Mullica River, transect from Oyster Bed Pt. to Deep Pt., RCB-75-007, Ichthyological Associates sta 1, 25-ft semi-balloon trawl, R.C.B., H.K.H., M.R.N., M.C.W., G.J.M., 21 Apr 1975; USNM 251397, frag. ♂ abdomen, Cape May Point, H.G. [Richards], #1286, 20 Mar 1932; USNM 64739, Maurice River Cove, 4.6 m, H.G. Richards, #415, 14 Apr 1930 [poor condition]. *Virginia*: USNM 58308, 1 juv. (♂?), off Thimble Light, Chesapeake Bay, 28 m, *Fish Hawk* sta 8898, 4 Dec 1920; USNM 41747, 2 ♂, 2 ♀ (1 ovig.), Virginia, H.E. Webster, Union College Collection; USNM 58293, 1 ♂ abdomen, Chesapeake Bay, 38°07'12"N, 76°13'30"W, 38 m, *Fish Hawk* sta 8388, 6 Dec 1915. *North Carolina*: USNM 66612, 4 ♂, 7 ♀ (ovig.), 1 cephalothorax, Gallant Point, Beaufort Harbor, mud flats, Schmitt and Shoemaker, 14 Sep 1928; USNM 251398, 1 ♂, Beaufort, W.H. Conn, Wesleyan Univ. Dept. Biol., Middletown, Conn., No. 667; USNM 67578, 1 ♀, Beaufort, Newport River canal, bopyrid in branchial chamber, trawl, S.F. Hildebrand, 6 Mar 1931; USNM 81910, 1 tiny juv., Beaufort, A.S. Pearse, 11 Aug 1941; USNM 251399, 20 ♀ and spare parts, Beaufort, A.S. Pearse, summer 1944; USNM 251400, 50 ♀ (ovig.) and spare parts, 24 ♂ and spare parts, 1 bopyrid, Beaufort, A.S. Pearse, summer 1944 [poorly preserv.]; ZMK 1 ♀ juv., Bogue Sound, 1/2–2/3 m, Mary E. Petersen, 1 Mar 1965. *South Carolina*: USNM 23278, 1 ♀, Parris Island, U.S. Fish Comm., *Fish Hawk*, 19 Jan [1891]; USNM 31289, 1 ♂, May River near Bluffton (Beaufort Co.), *Fish Hawk*, 17 Jan 1891; USNM 31290, 1 ♀, May River, *Fish Hawk*, 1891. *Georgia*: BMNH 124a, holotype [fragmentary, parts of abdomen and tail fan], Leach Collection, presented by Thomas Say; USLZ 3023, 2 ♀ (ovig.), Cabbage Island, Wassaw Sound, Chatham Co., intertidal in firm muddy sand, R.W. Heard, 4 Sep 1976; USLZ 3009, 11 ♂, Sapelo Island, 29°02'50"N, 90°09'46"W, BLM-WIN-MC, P2E, SOO#9, 13 Jan 1979; USNM 174414, 1 small ♂, off Georgia 31°13'N, 81°13'W, sta 0210-1-SA, 11 m, 21 Feb 1977; USNM 251421, 3 ♂, 5 ♀, St. Catherines Island, middle of North Beach, on surface, B. Winn and P. Small, 9 Oct 1990. *Florida*: FDNR

- EJ71418, 1 juv., St. Lucie Co., Hutchinson Island, E of F.P. & L. electrical generating plant, 27°21'23"N, 80°13'24"W, Shipke grab, R. Gallagher, M. Hollinger et al., 15 Sep 1971; FDNR EJ71125, 1 ♀ ovig., Gulf of Mexico, Monroe Co., Ten Thousand Islands, 2.9 naut. mi SW Rogers River, 25°26.7'N, 81°13.1'W, 2.7 m, R/V *Venus*, hydraulic clam dredge, W.C. Jaap and V.P. Williams, 6 Sep 1971; FDNR EJ74387, 1 ♀ ovig., Collier Co., inshore Marco Island, trough at Martinique Waterway entrance, 25°57'45"N, 81°42'51"W, 2.5 m, plug corer, C.M. Courtney, 5 Jul 1974; FDNR EJ71013, 1 ♂, 1 ♀ ovig., Manatee Co., Tampa Bay, Manatee River, 1/4 mi W Pt. Ogdeu, 27°30.7'N, 82°55'W, 1.5 m (5 ft), R/V *Venus*, hydraulic clam dredge, W.C. Jaap and T.A. Frakes, 18 Feb 1971; FDNR EJ67213, 1 ♂ (no legs), Gulf of Mexico, Hillsborough Co., 19 mi W Egmont Key, 27°37'N, 83°07'W, 18 m, R/V *Hernan Cortez*, Hourglass Cruise HC40, sta B, dredge, R. Presley, 2 Jun 1967; FDNR EJ78072, 1 ♂, Hillsborough Bay and Co., 2.5 mi S Hillsborough River mouth, east side of channel, 27°51'N, 82°26'W, 6 m, shrimp trawl, R.G. Taylor and D. Nickerson, 19 Feb 1978; FDNR EJ72032, 1 ♀, Pinellas Co., Old Tampa Bay, off Courtney Campbell Causeway, 2 mi W of Tampa public beach, 27°55'N, 82°38'W, shovel and seine, J.L. Simon, 1972; FDNR EJ71373, 1 ♂, same, Nov 1971; FDNR EJ68030, 1 ♀ ovig., Gulf of Mexico, Pinellas Co., Tampa Bay, NNW west end of Courtney Campbell Causeway, 27°57'N, 82°41.5'W, 1.8 m (6 ft), R/V *Venus* sta 3, hydraulic clam dredge, R.J. Stokes, 15 May 1968; FDNR EJ69271, 3 ♂, 6 ♀ (+ ♀ abdomen), Crystal River, offshore of power generating plant intake canal, Citrus Co., 28°56'N, 82°46'W, 3.3 m, screenwash (6-ft bag placed in sluiceway), R. Parrish, 20 Mar 1969; FDNR EJ69332, 1 ♀, Levy Co., Rum Key, 29°07'N, 83°04'W, 1.5 m (5 ft), R/V *Venus*, hydraulic clam dredge, M.F. Goodcharles, 14 Oct 1969; FDNR EJ70358, 17 ♂, 21 ♀ (2 ovig.), Franklin Co., bay side Alligator Point, shovel, 16 Oct 1970; St. Lucie Co., Indian River: HBOM 89:335, 1 ♂, Big Mud Creek, burrow in sandy mud bottom by A1A bridge, intertidal, by hand, R.H. Gore, 19 Sep 1972; HBOM 89:1172, 1 ♀, Jim Island, mud flat on oyster bar, intertidal, by hand, D. Putnam, 26 Jul 1974; HBOM 90:3098, 1 ♂ juv., Jim Island mud flats, intertidal in worm tubes, by hand, D.S.P., 7 Feb 1977; HBOM 89:3380, 1 ♀, Jim Island, intertidal, by hand, P.H., G.R.K., 23 Mar 1977; HBOM 89:6470, 1 ♀, Little Jim flat near Ft. Pierce Inlet, intertidal sand, seagrass, by hand, R.S. Fox et al., sta RF-88-2, 3 May 1988. USLZ 3500, 2 ♂, 5 ♀ (1 ovig., 4 fragmentary), Ft. Pierce, D.L. Felder, Aug 1989; USNM 251401, 2 juvs., St. Augustine, J.C. Pearson, 21 Jun 1935; USNM 251402, 1 juv., St. Augustine, J.C. Pearson, 8 Jul 1935; USNM 174415, 2 juvs. [near Flagler Beach], 29°27'N, 81°03'W, 20 m, sta 0886-2-7A, frags. (ID probable); USNM 251403, 4 ♂, 3 ♀, Indian River E of Little Jim Is. at marker No. 8 in channel N of Fort Pierce Inlet, 27°28.4'N, 80°18.6'W, muddy sand flat with some grass, yabby pump, R.B. Manning, sta FP-84-6, D.L. Felder, W.D. Lee, 11 Jul 1984; USNM 251183, 1 ♀, Indian River, on A1A causeway between Fort Pierce and Fort Pierce Beach, 27°27.7'N, 80°18.7'W, flat with some grass exposed at low tide, R.B. Manning, sta FP-86-2, D.L. Felder, W.D. Lee, 11 Aug 1986; USNM 251184, 1 juv., same, S of A1A bridge, W side of main channel, yabby pump, R.B. Manning, sta FP-86-5, D.L. Felder, W.D. Lee, 14 Aug 1986; USNM 251185, 1 ♀ ovig., same, sta FP-87-3, 2 Mar 1987; USNM 251186, 1 ♂, N side Fort Pierce Inlet, S side Coon Island, 27°28.2'N, 80°18.2'W, along shore, mud and hard packed sand, yabby pump, R.B. Manning, W.D. Lee, M. Schotte, C. King, sta FP-88-3, 21 Apr 1988; USNM 251187, 1 ♂, 2 ♀, Fort Pierce Inlet, across from Coast Guard Station on hard sand flat adjacent to *Spartina*, W.D. Lee and R.B. Manning, 15 Feb 1990; USNM 169918, 1 ♀ ovig., St. Lucie Co., Hutchinson Island, Big Mud Creek at Indian River, intertidal, seine, R.H. Gore, 27 Mar 1974; USNM 251188, 10 ♂, 15 ♀ (6 ovig.), Miami, R.B. Manning, 22 May 1988; USNM 251189, 1 ♂, 3 ♀ (2 ovig.), Key Biscayne, west side flats, yabby pump, R. Lemaire, 28 May 1988; USNM 77567, 1 ♂, 1 ♀ ovig., Sarasota Bay, W.E. Webster, Kingsley Collection #186; USNM 6461, 3 ♂, 2 ♀, Cedar Keys, in muddy sand between tides, H. Hemphill, Dec 1883; USNM 119331, 1 ♀, Wakulla Co., Panacea, Rock Landing Pier, surface, J. Rudloe, 10 Feb 1966; USNM 93721, 2 ♂, flats W Alligator Point [Alligator Harbor], hosts of types of *Phyllodurus robustus* Pearse 1952, H.J. Humm, 19 Jun 1952; USNM 251190, 1 ♀, A.M. Harrison, 2327, frag. [very poor condition]. *Alabama*: USLZ 3024, 1 ♂, Dauphin Island, Sea Lab jetties in muddy sand, Arthropod and Mollusk class, 11 Nov 1977. *Mississippi*: USNM 251191, 1 ♂, 1 ♀, Deer Island, extreme east end in mud and peat, M.W. Williams, sta M-14, 16 Nov 1943; USNM 251192, 1 ♂, Harrison Co., Biloxi, M.W. Williams, sta 14-11, 15 Dec 1943; USNM 251193, 2 ♂, 2 ♀ (1 ovig.), Little Deer Island, mouth of Biloxi Bay, intertidal, shovel, Jackson Invert. Zool. class, Gulf Coast Res. Lab., Jun 1983; USNM 87378, 1 ♀ ovig., Mississippi Gulf Coast, outlying islands and adjacent waters, J.F. Walker, sta 13, summer 1948; USNM 251723, 1 ♀, Hancock Co., St. Louis Bay, Bay St. Louis, L. Hubricht, 3 Mar 1963. *Louisiana*: USLZ 3012, 1 ♀, 021W500#6, Bay Marsh and Lease, Gulf of Mexico, 29°02'50"N, 90°09'46"W, BLM01-5245-800, 13 Jan 1979; USLZ 3013, 1 ♀, same but 02PE500#7; USLZ 3014, 1 ♀, same but 02PW2000#8; USLZ 3010, 1 juv., S of Miss. R. Delta, 28°34'09"N, 90°24'32"W, BLM-SM-MC, P4N2000#9, D. Felder, summer 1978; USLZ 44, 1 ♂, 29°22.5'N, 92°10.5'W, ARCNI44, 28 Jun 1968; USLZ 3105, 1 ♂, Freeport Sulfur Co., Terrebonne Parish, Caillou Island, 7.2 km (4.5 mi) NE western end of Timbalier Island, sta 5, 10-ft seine, LA, W.W. Forman, L.J. Kennain, 5 Feb 1980; USLZ 3011, 1 ♀ juv., Vermillion Bay, GIRI Dredging Project-sample IV-B, mud #3, 24 Aug 1976; USLZ 3015, 1 ♀ ovig., Chenier au Tigre, Vermillion Parish about 25 m from shore on Gulf of Mexico just E of freshwater Bayou, Ryan and L. Rogas, 13 Sep 1980; USNM 33104, 2 ♀, Chandeleur Islands, L.R. Cary; USNM 221337, 3 larvae (*U. affinis?*), Gulf of Mexico, 10 km SW Calcasieu River,

29°39'52"N, 93°26'34"W, 1 m, B. Andryszak, 4 Jun 1984. *Texas*: USLZ 3501, 1 ♂, 1 ♀ (juvs.), off Matagorda Island, 28°14'N, 96°29'W, 4/I HEV, BLM-STOCS study, 14 Feb 1976; USLZ 3022, 1 ♂ juv. (frag.), 7¹/₂ Fathom Reef, sediment sample, D.L. Felder, 24 Jun 1971; USLZ 3499, 1 ♂, 1 ♀, Causeway Blvd., S Padre Island and Port Isabel, landward side, D.L. Felder, Jul 1991; USNM 82076, 1 ♂, 1 ♀, Rockport, J.W. Hedgpeth, 29 Dec 1945; USNM 172304, 1 juv., SE Corpus Christi, 28°14'N, 96°29'W, 10 m, N. Rabalais, 11 Oct 1976.

DIAGNOSIS.—Rostrum bearing 0–8 ventral spines. Projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites unarmed. Carpus of cheliped with 2 strong spines on anteromesial margin. Merus of P2 with proximal mesioventral spine and 1 subdistal dorsal spine; merus of P3 with ventrolateral cluster of spines, that of P4 usually spineless.

DESCRIPTION.—Rostrum triangular, slightly downturned; median ventral keel bearing 1–8 (rarely 0) variably developed spines, but almost never ending in terminal projecting point; tip usually exceeding eyestalks in normal position by ¹/₃–¹/₂ their length, but sometimes barely so; dorsal pair of subapical spines followed on each side by 2 spines separated by slightly decreasing intervals; lateral ridge bearing crest of about 12 spines, strongest on process lateral to rostrum and decreasing almost to obsolescence posteriorly. Shoulder paralleling cervical groove bearing 1 spine, sometimes 2, below intersection with thalassinidean line, obsolescent tubercle occasionally above it. Postocular spine present.

Abdominal sternites unarmed.

T with well-developed median furrow, distal margin biarcuate; transverse proximal ridge confluent with lateral ridges unspined.

Eyestalk stout, deepest at about midlength, convex ventrally, concave dorsal side sometimes bearing 1–2 or more obsolescent tubercles in row; prominent terminal cornea narrower than diameter of stalk and directed ventrolaterally, sometimes triangular in lateral view, and occasionally with tiny mesiodistal spine on stalk above margin.

A1 peduncle reaching to about midlength of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article, proximal article with small distoventral spine or angle.

A2 peduncle with about ¹/₃ its length extending beyond tip of rostrum; article 1 bearing variable ventral spine, obsolete to strong and acute; article 2 bearing subdistal ventral spine; scale moderate, oval.

Mxp3 with epipod.

Epistomial projection rather broad in lateral view, bearing 1 spine at distodorsal corner.

Chelipeds with ventral margin of ischium bearing 1 spine. Merus with row of 4–5 spines on ventral margin, subdistal dorsal spine reaching level of postocular spine. Carpus trigonal, shallow longitudinal groove laterally, strong spine at anterior

ventrolateral corner preceded by 1–4 spines in row; mesiodorsal crest of almost uniform small spines leading to prominent spine on anterior margin, short dorsal spine near articulation with merus partly obscured by setae; 2–3 (rarely 4) strong spines on anterodorsal margin mesial to articulation with propodus; 1 strong spine near middle of anteromesial margin, nearly equal spine dorsal to it, and very strong spine at distoventral corner. Chl about 2 times chh; spineless dorsal ridge, with erect dorsal spine near its proximal end, mesiodorsal row of spines erect proximally and variably obsolescent near distal margin of palm; distal margin bearing row of obsolescent tubercles, reinforced distal margin below mesial dactylar condyle bearing spine and 3–4 small rounded spines below this in fully adult male, less well developed in immature male; lower mesial surface bearing scattered spines; ventral keel with row of 2–5 spines proximal to base of fixed finger, low transversely arcuate beaded ridge near proximomesial corner. Fixed finger shorter than dactyl, continuing contour of lower margin of palm, though bowed ventrally, and tapering to slender tip, 3–5 teeth on proximal prehensile edge. Dactyl of male with corneous tip preceded on prehensile edge by toothless interval, tooth at ²/₃ length opposing tip of fixed finger, then row of about 6 closely crowded small teeth increasing proximally to larger tooth in proximal ¹/₄ of length (sometimes only few large teeth in this row), and toothless section basally; arched extensor surface bearing rows of closely crowded beaded tubercles or spines separated by grooves and/or dense setae, largest tubercles erect proximally but becoming obsolescent distally, files of similar beaded granules on mesial and submesial surface; corneous tip in female preceded by slightly curved prehensile edge, strong tooth at ¹/₂ length opposing tip of fixed finger, proximal to this a section with obscure small teeth, then large tooth at ¹/₄ length, and toothless section basally; curved extensor surface bearing about 4 small tubercles proximally.

P2 reaching about to distal ¹/₄ of palm; carpus with distodorsal spine and tiny acute or obsolescent subdistal ventral spine; merus with slender subdistal dorsal spine and strong proximal mesioventral spine; coxa with 2 or more spines on mesial aspect, often acute, and posteromesial margin variously lobed. Merus of P3 with cluster of spines and spiniform granules ventrolaterally, and sometimes slender distodorsal spine; coxa with low spine lateral to gonopore, sometimes spine on distomesial margin, and rarely still another spine anterior to gonopore. P4 with merus usually spineless, rarely with 2 tiny lateral spines near ischium.

U not exceeding length of telson; spine on protopod above base of mesial ramus; mesial rib of lateral ramus often bearing blunt spine proximally; distal margin of rami bearing uniformly spaced small granules.

MEASUREMENTS (in mm).—♂, acl 12.8, cl 18.8, chl 10.8, chh 5.8; ♀ ovig., same, 10.8, 16.1, 7.7, 2.7.

COLOR.—Gray, blue, or yellowish gray dorsally, tinged with light blue medially on tail fan and on tergite V, interlaced with

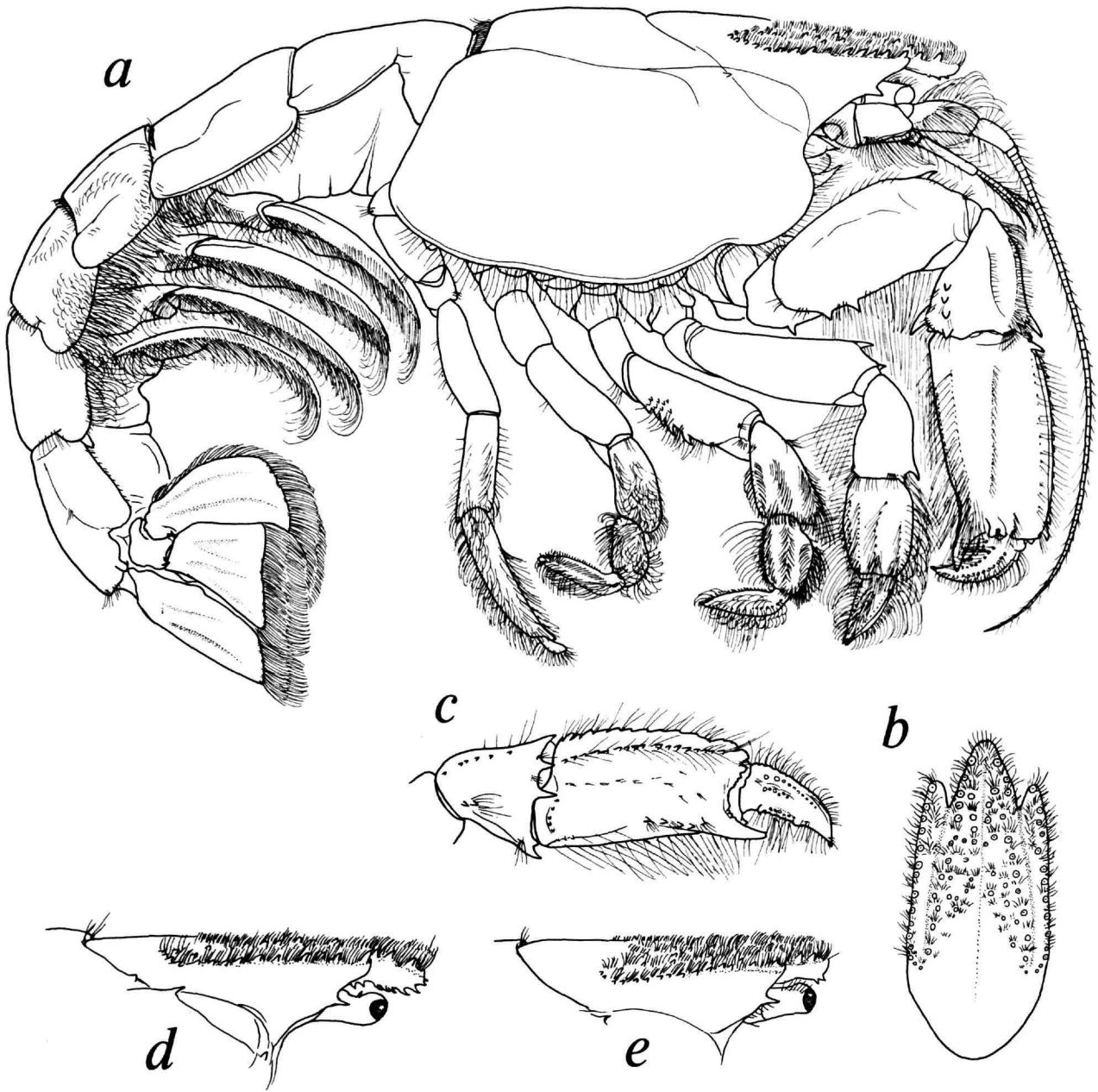


FIGURE 14.—*Upogebia affinis* (Say) (a-c, USNM 31289; d,e, USNM 251400): a, animal in lateral view; b, anterior carapace, dorsal; c, chela and carpus, left mesial; d,e, anterior carapace, lateral, ♂, ♀. (Scale = 1 mm.)

uniform light lines; an oblique blue spot on side of carapace at base of antenna extending posterodorsally; legs lighter on articles, but joints and dactyls of chelae lighter grayish white; underparts light. (From various authors as summarized in Williams 1984a, and color slide of specimen photographed on

overcast day at Ft. Pierce, Florida, by D.L. Felder, Aug 1986.)

KNOWN RANGE.—Massachusetts to southern Texas, U.S.A.

REMARKS.—Thomas Say (1818:243) noted that his specimen of *Gebia affinis* was “found on an oyster bar near the edge of the water at low tide, and appears to be rare.” Its length was

"two inches and a quarter" (= 57 mm). The holotype (White, 1847), now in the Natural History Museum (London) where it "was transferred to the spirit collection a few years ago" (R. Ingle, pers. com. 16 August 1989), is a fragmentary husk of the specimen that Say described, represented only by exoskeletal parts of the abdomen, telson, and left uropod. The specimen seems smaller than Say's measurements. Only structures that indicate generic placement of the specimen thus remain, and the sex is undeterminable. However, there can be little confusion concerning its identity as this is the only species of *Upogebia* that is known to occur in Georgia. The illustrated specimen, of size comparable to Say's type when originally described, is from South Carolina near the Georgia state line.

Upogebia affinis has long been thought to have a broad distribution in the western Atlantic, extending from Massachusetts, U.S.A., to south central Brazil. Several species, some undescribed until now, have been included within *U. affinis* in this broad sense. In the strict sense, the known range of this species extends only from Massachusetts to southern Texas, fitting a well-established biogeographic pattern for many species in the western North Atlantic (see Pérez Farfante, 1969; Williams, 1984a:6, 7, 1986:12; Briggs, 1987). Species formerly assigned to *U. affinis* that occur south and east of this range are herein identified otherwise.

Spination in *U. affinis*, *U. felderi*, and *U. paraffinis*, its Mexican and southern hemisphere counterparts described herein, is so similar that confusion of the three is understandable until their subtle differences become apparent. Chief among these are: (1) lack of a strong anteriorly projecting spine originating near the dorsal margin of the rostrum in *U. affinis*, but presence of such a spine, often extremely strong, in *U. paraffinis*; (2) stronger spines on the chelipeds of *U. felderi* and *U. paraffinis* than their counterparts in most individuals of *U. affinis*; (3) more strongly developed, but varied, spination on the coxa of P1-3 in *U. affinis* than in the other two species; and (4) presence of small granules or spines on the distal margin of U in *U. affinis* and *U. felderi*, but lack of these in *U. paraffinis*.

Strongly spined individuals of *U. affinis* are found throughout its range, but both *U. felderi* and *U. paraffinis* are especially strongly spined. There may be some tendency for development of stronger, more acute spination in warmer parts of the *U. affinis* range, as seems to occur in the widely distributed *Callinectes sapidus* Rathbun (Williams, 1974a:780, 781).

Fossilized burrows in limonitized oyster reef of the Late Pleistocene Biloxi Formation, Industrial Seaway Bridge, Gulfport, Mississippi, reported by Otvos (1982:21, 1985:25), have the Y shape characteristic of those constructed by *Upogebia* and are of a size that could accommodate *U. affinis*, but no fossilized mud shrimp remains have been associated with them.

Markham (1988:9, 14) revised the bopyrids, *Orthione furcata* (Richardson) and *Progebiophilus upogebiae* (Hay), that are known to infest *U. affinis* in Massachusetts and North Carolina, respectively.

Upogebia aquilina, new species

FIGURE 15

MATERIAL EXAMINED.—U.S.A.: *Florida*: USNM 251426, ♂ (holotype), Martin Co., Seminole Shores, intertidal, Worm Reef Survey, sta RHG-162-74, L.E.S., L.J.B., M.A.K, 15 Aug 1974, HBOM 89:2601; USNM 251427, ♀ ovig. (allotype), same; USNM 251428, 3 ♂, 2 ♀ (paratypes), same; HBOM 89:324, 1 ♂ (paratype), Palm Beach Co., Jupiter Inlet, broken from jetty rock, north side, 1.2 m (4 ft), R.H. Gore, 19 Sep 1972; HBOM 89:712, 1 ♂ (paratype), Palm Beach Co., Jupiter Inlet, south side by jetties (granite), SCUBA, R.G.G., G.R.S., 8 Mar 1973; HBOM 89:2207, 1 ♂ juv. (paratype), Martin Co., Seminole Shores, Hutchinson Island, worm reef, intertidal, by hand, sta RHG-162-74, L.E.S., L.J.B., M.G.R., 15 Aug 1974; HBOM 89:2651, 1 ♂ juv. (paratype), Martin Co., Indian River, Seminole Shores seawall at point of subdivisions, intertidal, hand and rotenone sta RHG-137-74, N.B., L.E.S., R.G.G, 20 Jul 1974.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites unarmed. T subrectangular. Carpus of chelipeds with small spine near middle of anteromesial margin, smaller or obsolescent spine dorsal to it usually present. Merus of P2 with proximal mesioventral spine, often a distodorsal spine, subdistal dorsal spine obsolescent; merus of P3 with 2-4 small ventral and ventrolateral spines; merus of P4 spineless.

DESCRIPTION.—Rostrum triangular, slightly downturned; lateral margin shorter than basal width; tip exceeding eyestalks by less than 1/2 width of cornea; dorsal pair of strong subapical spines followed on each side by 2 spines shorter in length, distance between subapical spines and second pair about twice that between second and third pair, median dorsal area spineless except for sparse spines at base; posteriorly divergent lateral ridge bearing crest of about 11-14 spines, strongest on process lateral to rostrum and decreasing posteriorly, but not to obsolescence. Shoulder lateral to cervical groove either unarmed or bearing 1-2 obsolescent tubercles below intersection with thalassinidean line. Postocular spine present.

Abdominal sternites unarmed.

T subrectangular, transverse proximal ridge confluent with inconspicuous longitudinal ridge at each side, posterior margin shallowly convex.

Eyestalk stout, inclined anterodorsally in repose, convex ventrally; prominent terminal cornea as broad as diameter of stalk in lateral view.

A1 peduncle reaching to level between base and midlength of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article.

A2 peduncle with about 1/2 its length extending beyond tip of rostrum; article 2 bearing tiny subdistal ventral spine; scale moderate, oval.

Mxp3 with epipod.

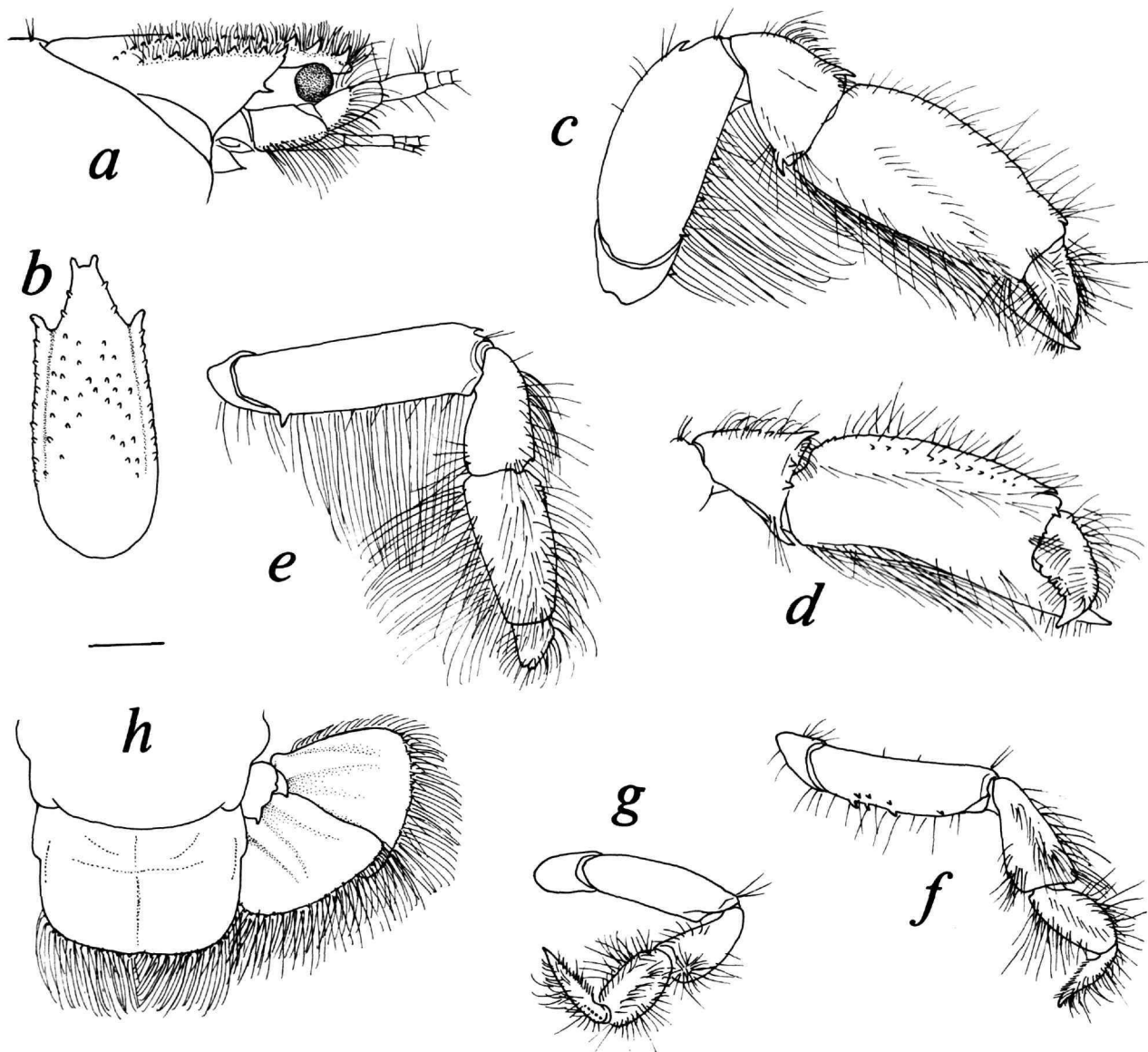


FIGURE 15.—*Upogebia aquilina*, new species, USNM 251426, ♂ holotype: *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e-g*, legs 2-4; *h*, parts of abdominal segment 6, telson, and uropods, dorsal. (Scale = 1 mm.)

Epistomial projection of adult rather broad in lateral view, bearing acuminate apical spine or 2 small slender spines.

Chelipeds with coxa bearing small spine on mesiodistal margin. Ischium bearing 1 spine on ventral margin. Merus with ventral margin bearing 5-6 small to moderate spines; single subdistal dorsal spine reaching level of postocular spine. Carpus trigonal, obsolescent longitudinal groove laterally, anterior ventrolateral corner usually bearing small stout spine

preceded by remote smaller spine, but sometimes spineless; prominent dorsal spine on anterior margin preceded by mesiodorsal crest of 5-6 almost uniform small spines, partly obscured by setae in many adults; 2-4 very small spines on anterodorsal margin mesial to articulation with propodus; adults with 1 small spine near middle of anteromesial margin, and smaller or obsolescent spine dorsal to it, but this margin sometimes unarmed; small slender spine at distoventral corner.

Chl about 2–3.5 times chh (depending on wear); lateral patch of long setae near base of fixed finger; spineless dorsal ridge terminating anteriorly near distal spine mesial to it; mesiodorsal row of forward-trending spines, usually about 14, becoming more widely spaced and obsolescent near anterior margin, fewer and obsolescent in juveniles and subadults; mesial surface bearing row of variously developed sparse low spines at level of lower $\frac{1}{3}$ (sometimes obsolete), low transverse arcuate ridge near proximomesial corner arising on sharp ventral keel, adult may have slightly rugose area mesiodorsally; lateral and mesial dactylar condyles usually bearing associated ventral spine, distomesial margin entire except for weak spine on lower $\frac{1}{2}$. Fixed finger slightly shorter than to as-long-as dactyl (noticeably shorter if worn) and more slender, slightly downcurved in middle and tapering to slender tip, 4–5 low teeth on proximal prehensile edge, distalmost sometimes clumped as a pair. Dactyl bearing longitudinal rows of setae; hawkbilled in lateral or mesial outline, tip strongly flexed, preceded on prehensile edge by crest of about 8–9 low rounded teeth, sometimes badly worn, ending in larger tooth proximally, toothless section at base short; tip often preceded on curved extensor surface by tiny subdistal corneous spine, and 2 rows of tiny tubercles proximally.

P2 reaching about to midlength of palm; carpus with small, occasionally obsolescent, distodorsal spine and stronger, acute, subdistal ventral spine; merus with obsolescent subdistal dorsal spine, often a distodorsal spine as well, and well-developed proximal mesioventral spine; coxa of adults with strong proximal spine mesially, but only a shoulder present in smaller individuals. P3 with 2–4 small ventral and ventrolateral spines. P4 with spineless merus and ischium.

U with acute spine on protopod above base of mesial ramus; both rami with dense fringe of setae and minute scattered spinules or granules on distal margin; lateral ramus with mesial rib bearing obsolescent spine.

MEASUREMENTS (in mm).—Holotype ♂, acl 4.5, cl 6.3, chl 4.8, chh 1.8; ♀ (allotype), same, 5.6, 7.8, 4.0 (worn), 1.9.

COLOR.—Body pale white, speckled red (field notes for HBOM 89:2601).

KNOWN RANGE.—Confined to material examined.

REMARKS.—*Upogebia aquilina* belongs to the large group of western Atlantic species in the genus that have a proximoventral spine developed on the merus of P2. The structure of the cheliped dactyl in *U. aquilina* resembles that of *U. corallifora* and *U. annae*, possessing a tiny subdistal corneous spine on the extensor surface that is subordinate to the overgrown noncorneous dactylar tip; the overgrowth is magnified in *U. aquilina*. Both *U. corallifora* and *U. aquilina* have a proximoventral spine on the merus of P2, whereas this spine is absent or obsolescent in *U. annae*. For other remarks, see accounts for the comparative species.

ETYMOLOGY.—From the Latin *aquilinus* -a -um (of or pertaining to an eagle), for the fancied resemblance of the hooked dactyl of the cheliped to the beak of an eagle.

Upogebia careospina, new species

FIGURE 16

MATERIAL EXAMINED.—BRAZIL: USNM 138899, ♀ (holotype), Ceará, N of Camocim, 02°31'S, 40°51'W, 27.5 m, Oregon sta 4247, 40-ft shrimp trawl, 12 Mar 1963; USNM 251244, ♀ ovig. (paratype), same.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites unarmed. T subrectangular. Carpus of cheliped with 2 spines on mesiodistal margin, palm without row of spines on mesioventral surface. Merus of P2 with proximal mesioventral spine and subdistal dorsal spine; merus of P4 spineless.

DESCRIPTION.—Rostrum triangular, lateral margin shorter than basal width; slightly downcurved in lateral view, tip exceeding eyestalks; dorsal pair of strong subapical spines followed on each side by 2–3 spines separated by nearly equally wide intervals, central dorsal area spineless and densely setose; posteriorly divergent lateral ridge bearing crest of about 13–15 moderate to small spines, strongest on process lateral to rostrum and decreasing almost to obsolescence posteriorly. Shoulder lateral to cervical groove unarmed below intersection with thalassinidean line, latter continuing strongly to posterior margin. Postocular spine present.

Abdominal sternites unarmed.

T bearing low transverse proximal ridge confluent with low longitudinal ridge to either side.

Eyestalk stout, deepest at about midlength, concave dorsally, convex ventrally, almost horizontal in repose; cornea prominent, oval, obliquely terminal, narrower than diameter of stalk.

A1 peduncle reaching about to base of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article.

A2 peduncle with almost $\frac{1}{3}$ its length extending beyond tip of rostrum; article 2 with dorsal margin raised into densely setose slight lobe at midlength and less setose submesial lobe; scale moderate, oval.

Mxp3 bearing epipod.

Epistomial projection rather broad in lateral view, bearing small apical projection.

Chelipeds with coxa bearing small spine on mesiodistal margin. Ventral margin of ischium bearing 1 spine. Merus with row of 4–7 relatively strong spines on ventral margin, number differing on right and left sides of both females examined; single subdistal dorsal spine reaching level of postocular spine. Carpus trigonal, shallow longitudinal groove laterally, anterior ventrolateral corner with or without obsolescent spine preceded by 0–2 obsolescent spines; mesiodorsal crest of 8 small spines behind prominent spine on anterior margin, and 1 or 2 obsolescent spines near articulation with merus, partly obscured by setae in proximal part of row; 4 variable spines obscured by dense setae on anterodorsal margin mesial to articulation with propodus; strong spine near middle of anteromesial margin, smaller similar spine dorsal to it, and very

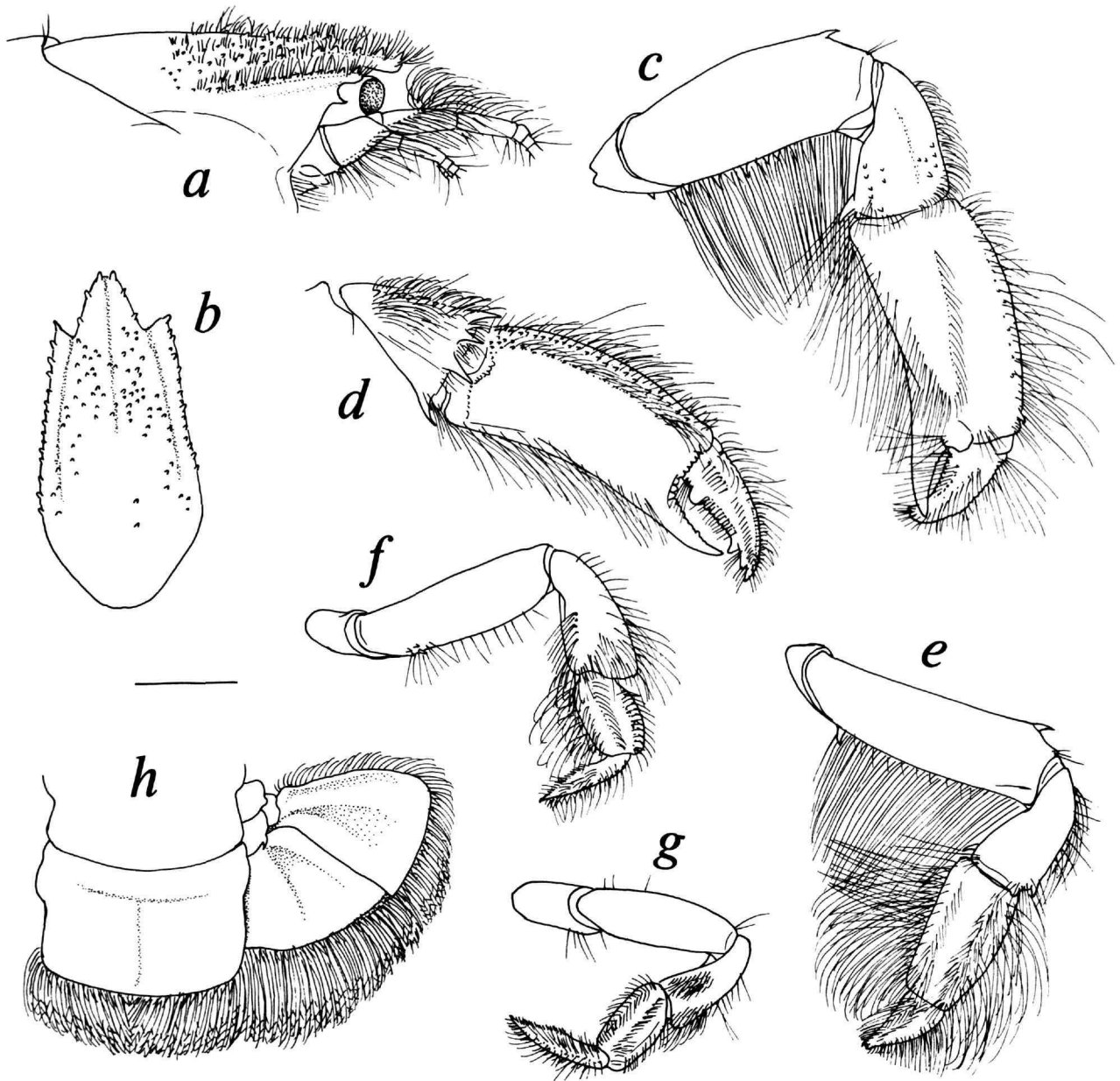


FIGURE 16.—*Upogebia careospina*, new species, USNM 138899, ♀ holotype: *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e-g*, legs 2-4; *h*, parts of abdominal segment 6, telson, and uropods, dorsal. (Scale = 1 mm.)

strong spine behind distoventral corner. Chl about 2.6-2.9 times chh; spineless dorsal ridge rather inconspicuous, partly obscured by setae, with stout spine mesial to it subdistally; mesiodorsal row of about 13-20 irregularly distributed small spines or spiniform tubercles, becoming obsolescent near distal

$\frac{2}{3}$ of palmar length and with tendency for development of scattered spines around proximal end of row; moderate spine and row of about 4 smaller rounded teeth below mesial dactylar condyle, single spine on margin below lateral condyle; mesial surface bearing longitudinal row of obsolescent ciliated

tubercles on upper $\frac{1}{2}$, lower $\frac{1}{2}$ unornamented; sinuous transverse granulatuberculate ridge surface near proximomesial margin intersecting rather sharp ventral keel. Fixed finger shorter than dactyl and more slender, continuing curve of lower margin of palm and tapering to slender tip, 5 irregular strong teeth on proximal prehensile edge. Dactyl with corneous tip preceded on prehensile edge by subdistal tooth, small tooth at base of much larger tooth opposing tip of fixed finger, and crowded row of 6–8 small teeth increasing proximad to much larger tooth near base, toothless section basally; mesial more or less concave surface bearing 2 rows of closely crowded periform tubercles, upper row running nearly length of finger, lower row only $\frac{1}{2}$ as long; curved extensor surface bearing 2 rows of small tubercles, strongest at base and diminishing to obsolescence distally, few scattered granules between rows at base.

P2 reaching about to midlength of palm; carpus with small acute distodorsal spine and similar subdistal ventral spine; merus with subdistal dorsal spine and strong proximal mesioventral spine; coxa with proximal spine, obsolescent in holotype but strong and doubled on right side in paratype. Merus of P3 with 2–3 ventral spines proximally; coxa with broad low spine lateral to gonopore. P4 with spineless merus.

U with acute short spine on protopod above base of mesial ramus; mesial rib of lateral ramus bearing tubercle proximally, distal margin of both rami bearing row of weak granules well-spaced apart.

MEASUREMENTS (in mm).—Holotype ♀, acl 8.6, cl 14.5, chl 5.7, chh 2.0; paratype ♀, same, 5.1, 7.3, 5.2, 2.0.

KNOWN RANGE.—Confined to the material examined.

REMARKS.—*Upogebia careospina* seems to resemble most closely *U. vasquezi*, but it differs in that the palms of the chelae have weaker dorsal spines and lack mesioventral spines. The carpus of the chelipeds is nearly featureless laterally. It is possible that this species could be interpreted as an extreme variant of *U. vasquezi*, but the dense setation and differences in spination clearly set it apart.

ETYMOLOGY.—From the Latin “careo,” to be without, want, be deprived of, and “spinata,” spines, for lack of a diagonal row of spines on the lower mesial surface of the chela.

Upogebia corallifora Williams and Scott, 1989

FIGURES 17, 18

Upogebia corallifora Williams and Scott, 1989:405, figs. 1, 2.

MATERIAL EXAMINED.—JAMAICA: USNM 230075, ♀ ovig. (holotype), Drunkenmans Cay, Port Royal, 3–4 m, area of dead *Siderastrea siderea* (Ellis and Solander, 1786), P.J.B. Scott, Oct 1986; USNM 230076, 2 ♂, 2 ♀ (1 ovig.) (paratypes), Drunkenmans Cay, Port Royal, ~2–4 m, P.J.B. Scott, 10 Oct 1986 (1 ♂ and 1 ♀ from this lot of specimens have been deposited in the National Museum of Canada); *Upogebia corallifora*? USNM 230077, 2 ♀ juvs., 2 juvs., Discovery Bay,

boring in Pleistocene CaCO₃ of an artificial reef, about 5 m depth, P.J.B. Scott, Oct 1986.

PUERTO RICO: USNM 251243, 1 ♂, 1 km E Cabo Rojo Light, in fine sand, 0.5 m, H. Austin, 15 Apr 1967.

VIRGIN ISLANDS OF THE UNITED STATES: *St. Croix* (all collected by M.L. Reaka project; in following list, excr. = experimental coral rubble sun dried and placed on reef): Teague Bay: USNM 251372, 1 juv., natural dead coral rubble on live patch reef in midlagoon, 3 m, PR-2, 19 Jun 1980; USNM 251373, 1 juv., natural dead coral rubble, base of live fore reef, 12 m, FR-6, 26 Feb 1981; 2 juvs., same habitat, PR-3, 4 Mar 1981; 3 ♂ juvs., same habitat, PR-4, 4 Mar 1981; 1 juv., same habitat, FR-10, 8 Mar 1981; USNM 251374, 1 ♀, natural dead coral rubble, live patch reef behind barrier reef, 3 m, PR-2, 17 Jun 1981; 2 ♀, same habitat, PR-7, 17 Jun 1981; 2 ♂, same habitat, PR-8, 17 Jun 1981; 2 ♀, same habitat, PR-10, 17 Jun 1981; 1 ♂ juv., natural dead coral rubble on live patch reef, midlagoon, 3 m, PR-1, 4 Mar 1981; USNM 251375, 1 ♂, 6 juvs., frags., excr. patch reef midlagoon, 3 m, PRcol3, wk3, 7 Jul 1981; USNM 251376, 4 juvs., excr. on patch reef in lagoon, ~3 m, PR-2, 11 Sep 1981; 1 juv., excr. back of bank barrier reef, 3 m, BR-3, 12 Sep 1981; 1 juv., excr. sea grass beds in lagoon, 4 m, SG4, 13 Sep 1981; 1 juv., excr. fore reef, 12 m, CST FR $\frac{1}{2}$ -5, 15 Sep 1981; 2 juvs., same habitat, FR FC 1, 15 Sep 1981; 3 juvs. frags., same habitat, FR-1, 16 Sep 1981; USNM 251377, 1 cephalothorax, excr. back of bank barrier reef, 3 m, AgSt Full 3A, 24 Jul 1982; USNM 251378, 1 juv., frags., same habitat, FR-9, 8 Mar 1981. Boiler Bay: USNM 251379, 1 ♂, 1 juv., natural dead coral rubble on live fringing reef with scattered seagrass, BBS-6, 7 Jun 1980; 6 juvs., same habitat, BBS-2, 20 Oct 1980; USNM 251380, 2 ♂, 4 ♀, frags., same habitat, BBS-1, 11 Feb 1981; USNM 251381, 1 ♂, 4+ juvs., excr. fringing reef, 3 m, BBST $\frac{1}{2}$ C2, 30 Apr 1981; USNM 251382, 2 ♂, 1 ♀, fringing reef, natural dead coral rubble and seagrass, 3 m, BBS-6, 18 Jun 1981; USNM 251383, 3 juvs., excr. fringing reef, 3 m, BBS col. 4, wk. 5, 19 Jul 1981; 2 ♀, 2 juvs., natural dead coral rubble, 2 m, AF-8, 30 Jul 1981; USNM 251384, 2 ♂, 4 juvs., same habitat, BBST $\frac{1}{2}$ C4, 9 Sep 1981; several juvs., natural dead coral rubble/sea grass on fringing reef, 3 m, BBS-4, 19 Aug 1980; USNM 251385, 1 juv., same habitat, BBST-1, 10 Sep 1981; 1 ♂ frag., excr. fringing reef, 3 m, BBST $\frac{1}{2}$ C5, 19 Sep 1981. Salt River Canyon: USNM 251386, 6 juvs., frags., excr. base of cinder block reef on sandy canyon floor, 20 m, MAV3, 12 Jan 1981; 1 juv., same habitat, MCIII-3, 12 Jan 1981; 2 cephalothoraxes (1 a ♀), same habitat, DC-1, 21 Jan 1981; USNM 251387, 1 ♀, 1 juv., natural dead coral rubble, back side bank barrier reef, 3 m, SCon-10, 30 Jun 1981; 2 ♂, 1 ♀, frags., natural dead coral rubble on live reef slope, 30–35 m, DCon-9, 27 Jun 1981; 3 ♂, 2 ♀ (1 ovig.), juvs., same habitat, SIV-2, 29 Jun 1981; 2 ♂, excr. on sand/sea grass floor, 3 m, SIII-4, 29 Jun 1981; 2 ♂, 5 ♀, frags., natural dead coral rubble, back side barrier reef, 3 m, SCon-1, 30 Jun 1981; 2 ♀, same habitat, SCon-4, 30 Jun 1981; 5 ♂, 4 ♀, 2 cephalothoraxes, same habitat, SCon-9, 30 Jun 1981; USNM

251388, 3 ♂, same habitat, DR-2c, 16 Jan 1982; USNM 251389, 3 ♂, 2 ♀, 1 juv., natural dead coral rubble back of barrier reef, 3 m, SCon-4, 18 Jan 1982; 1 ♂, 1 ♀, same habitat, SCon-3, 18 Jan 1982; 1 ♂, 1 ♀, same habitat, SCon-2, 18 Jan 1982; USNM 251392, 2 ♂, 1 ♀, natural coral rubble on reef slope, 20 m, SCon-4, 16 May 1982; USNM 251390, 1 ♀ ovig., 2 ♂ juvs., excr. sand/sea grass floor, 3–4 m, SAIV-1, 17 May 1982; 1 ♂, same habitat, SAV-3, 17 May 1982; USNM 251393, juv., excr. around cinder block experimental reef on sandy canyon floor, 20 m, MAIII-1, 20 May 1982; 1 juv., same habitat, MAIV-3, 20 May 1982; 1 ♀, same habitat, MAV-3, 20 May 1982; 4 ♂, 1 ♀ ovig., same habitat, MAII-6, 21 May 1982; USNM 251391, 3 juvs., excr. same habitat, 30–35 m, DAII-1, 22 May 1982; 1 ♂ juv., 1 ♀ juv., same habitat, DAIV-1, 22 May 1982; 1 ♂ juv., frags., same habitat, DAV-1, 22 May 1982; 1 ♂, 1 ♀, same habitat, DAV-6, 22 May 1982; 1 ♂, 1 ♀ ovig., excr. same habitat, DAII-6, 20 Aug 1982; USNM 251394, 1 juv., excr. placed on sandy canyon floor, 20 m, MCII-1, 23 May 1982; 1 ♂, 3 juvs. frags., same habitat, MCII-3, 23 May 1982; 1 juv., same habitat, MCIV-1, 23 May 1982; 1 postlarva, same habitat, MCIV-6, 23 May 1982; 1 ♀, same habitat, MCV-6, 23 May 1982; 1 ♂, 1 ♀ ovig., same habitat, MCV-1, 23 May 1982; USNM 251395, 1 juv., natural coral rubble, live reef slope, 20 m, MC-5, 25 May 1982.

MEXICO: *Quintana Roo*: USNM 251178, 1 ♂, Ascension Bay, along shore near Suliman Pt., rocks above high tide to tide pools below low tide level, Smithsonian-Bredin Caribbean Exped. IV, sta 85-60, Schmitt, Daiber, Bousfield, Rehder, 17 Apr 1960; USNM 251180, 1 ♂, N of Ascension Bay, 200–300 yds SW Suliman Pt., sand shallows, 0.6–1.5 m (2–5 ft), Smithsonian-Bredin Caribbean Exped. IV, sta 85-60, Bousfield, Daiber, Rehder, 17 Apr 1960.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites unarmed. T subrectangular. Carpus of cheliped in juveniles with no spines on anteromesial margin, adults with 0–1 or 2 small spines and rarely a row of obsolescent spines in this position. Merus of P2 bearing proximal mesioventral spine in adults, but no such spine in juveniles, and poorly developed subdistal dorsal spine; merus of P3 varying from spineless to bearing as many as 4 obsolescent ventral and ventrolateral spines; merus of P4 spineless.

DESCRIPTION.—Rostrum triangular, slightly downturned; lateral margin shorter than basal width in adults, but longer than this in juveniles; tip exceeding eyestalks by about $\frac{1}{2}$ width of cornea; dorsal pair of strong subapical spines followed on each side by 2 spines successively shorter in length, distance between subapical spines and second pair about twice that between second and third pair, median dorsal area spineless except for sparse spines at base; posteriorly divergent lateral ridge bearing crest of about 11–14 spines, strongest on process lateral to rostrum and decreasing to obsolescence posteriorly. Shoulder lateral to cervical groove usually unarmed but sometimes bearing obsolescent tubercle below intersection

with thalassinidean line. Postocular spine present.

Abdominal sternites unarmed.

T subrectangular, transverse proximal ridge confluent with inconspicuous longitudinal ridge at each side, shallow median concavity on distal margin.

Eyestalk stout, deepest at about midlength, straight to convex ventrally; prominent obliquely terminal cornea narrower than diameter of stalk in lateral view.

A1 peduncle reaching to about proximal $\frac{1}{4}$ of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article.

A2 peduncle with about $\frac{1}{2}$ its length extending beyond tip of rostrum; article 2 bearing tiny subdistal ventral spine; scale moderate, oval, sometimes with minute terminal spine.

Mxp3 bearing epipod.

Epistomial projection of adult rather broad in lateral view, bearing small apical spine; that of juvenile rather narrowly rounded in lateral view, unspined at tip.

Chelipeds with coxa usually unarmed, occasionally 1 slender spine on mesiodistal margin. Ventral margin of ischium unarmed or bearing 1 small or obsolescent spine. Merus with ventral margin often unarmed, but may bear 2–5 small to moderate spines; single subdistal dorsal spine reaching level of postocular spine. Carpus trigonal, shallow longitudinal groove laterally, anterior ventrolateral corner sometimes with slender spine, but often spineless; prominent dorsal spine on anterior margin preceded by mesiodorsal crest of almost uniform small spines partly obscured by setae in many adults, but these small spines often missing; 2–4 very small spines on anterodorsal margin mesial to articulation with propodus; adults with 1 small spine near middle of anteromesial margin, and obsolescent spine dorsal to it, sometimes both of these spines minutely doubled, but this margin usually unarmed in juveniles and subadults; small slender spine at distoventral corner. Acl about 3 times chh; lateral patch of long setae near base of fixed finger; spineless obsolescent dorsal ridge terminating anteriorly near distal spine mesial to it; mesiodorsal row of forward trending spines, usually about 8–11, becoming obsolescent near anterior margin, fewer and sometimes completely obsolescent in juveniles and subadults; mesial surface usually unarmed, row of variously developed setal tufts below mesiodorsal row of spines, low transverse arcuate ridge near proximomesial corner arising on sharp and occasionally granular ventral keel, large adult may have slightly rugose area mesiodorsally; lateral and mesial dactylar condyles usually without associated spines, distomesial margin entire except for weak spine or tubercles on lower $\frac{1}{2}$. Fixed finger slightly shorter than dactyl and more slender, slightly downcurved in middle and tapering to slender tip, 3–4 small teeth on proximal prehensile edge. Dactyl bearing longitudinal rows of setae, its curved extensor surface sometimes bearing about 3 small, proximal tubercles; elongate acute tip often preceded on extensor surface by tiny subdistal corneous spine; crest on prehensile edge bearing row of often irregular and poorly defined small teeth, ending in larger tooth

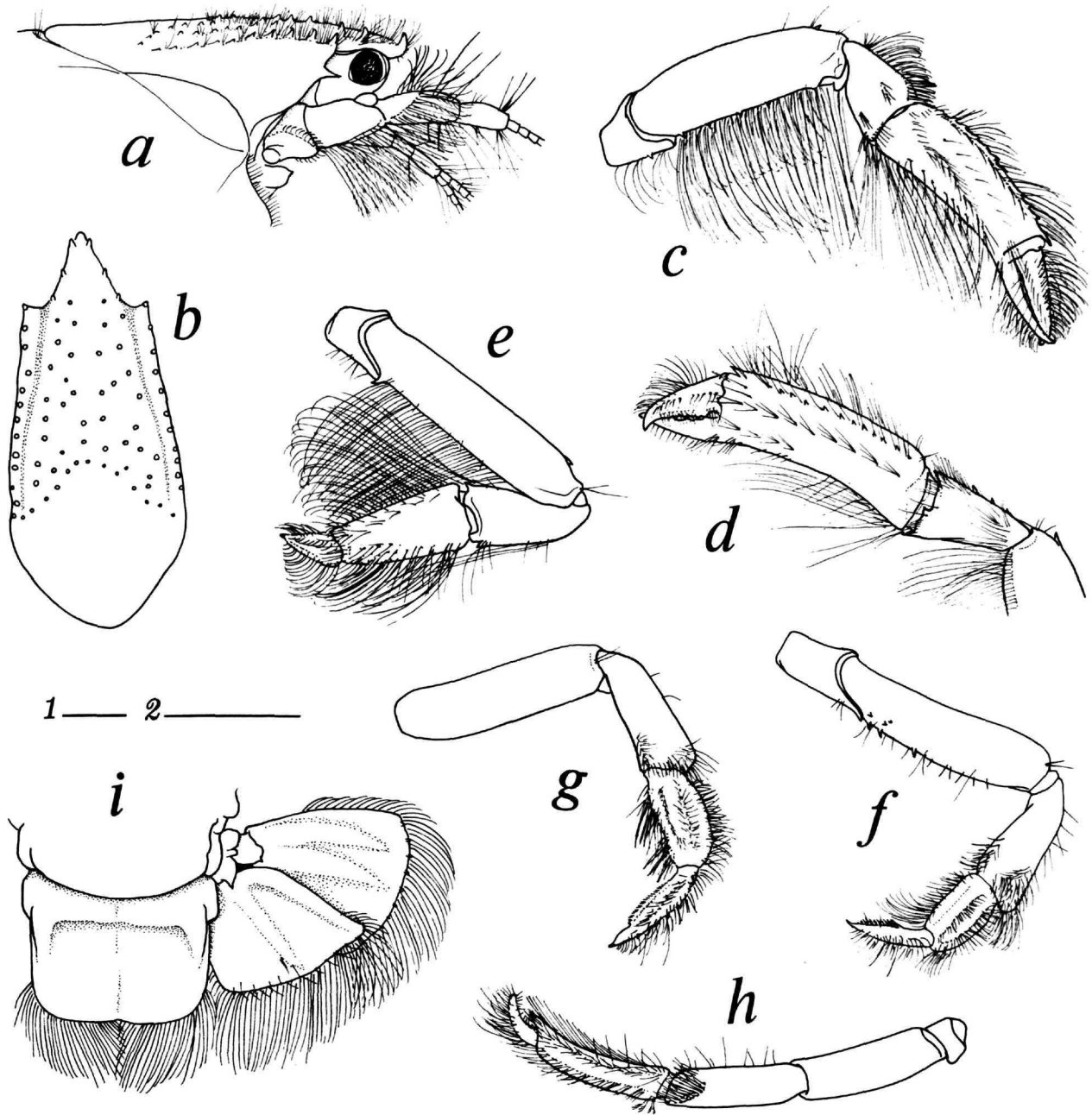


FIGURE 17.—*Upogebia corallifora* Williams and Scott (*a-d, h, i*, USNM 230075, ♀ holotype; *f, g* USNM 230076, paratypes (from Williams and Scott, 1989)): *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, right mesial; *e-h*, legs 2-5; *i*, parts of abdominal segment 6, telson, and uropods, dorsal. (Scales = 1 mm: 1 = *a-h*; 2 = *i*.)

proximally, toothless section at base short.

P2 reaching about to distal 1/4 of palm; carpus with obsolescent distodorsal spine and tiny, acute, subdistal ventral

spine; merus with obsolescent subdistal dorsal spine, moderate proximal mesioventral spine in adults, but none in juveniles; coxa often with strong proximal and smaller distal spine

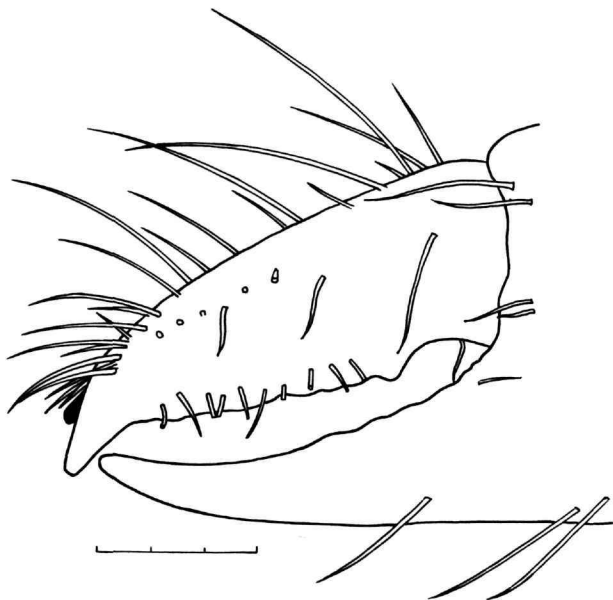


FIGURE 18.—*Upogebia corallifora* Williams and Scott, USNM 292393: Fingers of chela showing subterminal corneous (darkened) spine on extensor surface of dactyl. (Scale = 0.3 mm.)

mesially, but unarmed in smaller individuals. P3 with 1–5 obsolescent ventral and ventrolateral spines. P4 with spineless merus and ischium.

U with obsolescent spine on protopod above base of mesial ramus; both rami with dense fringe of setae and minute scattered spines or granules on distal margin; lateral ramus with mesial rib bearing obsolescent spine.

MEASUREMENTS (in mm).—Holotype ♀, acl 4.6, cl 7.3, chl 4.5, chh 1.2; ovigerous ♀, same, 3.3, 4.8, 3.2, 0.74; ♂, same, 3.8, 5.2, 3.3, 1.2.

COLOR.—Field notes describe the Puerto Rico specimen, USNM 251243, as white.

KNOWN RANGE AND HABITAT.—Known distribution of *U. corallifora* is limited to localities listed above, although Williams and Scott (1989) noted a specimen of what appeared to be this species that was collected from dead coral on the reef of Bellairs Research Institute, Barbados, in 1981. This specimen was lost and cannot now be verified. It is possible that the species is widely distributed in coral reef habitats of the Caribbean region (see Williams and Scott, 1989).

Williams and Scott (1989) noted that the Jamaican habitat of *U. corallifora* partly overlaps that of *P. operculata*. Both species inhabit dead coral skeletons there, but occurrence of the former is much restricted. It has not been found with boreholes opening from living corals, which are a common habitat for *P. operculata* (Scott et al., 1988). The abundant samples from St. Croix provided by M.L. Reaka amply demonstrate the

association of these two species with coral and coral rubble there, although actual presence in boreholes was not demonstrated in this sampling program.

REMARKS.—The dactyl of the cheliped in *Upogebia corallifora* has a calcareous tip that is often preceded on its extensor surface by a tiny subdistal corneous spine. Presence of this spine was not noticed when the species was first described (Williams and Scott, 1989) and only became apparent when the large series from St. Croix was studied, for the spine is often more evident in juveniles than in adults. The tip of this finger is analogous to that on other species in the genus (*U. brasiliensis*, for example) that have the dactyl ending in a prominent acute corneous tip preceded on the prehensile surface by an adjacent calcareous tooth, but in *U. corallifora* the corneous spine has overgrown the corneous dactylar tip to become the functional tip of the dactyl (Figure 18), thereby relegating the corneous tip to a subordinate reduced spine on the subdistal extensor surface of the finger. This secondarily reduced corneous spine is not always evident because it may be worn, obscured by a dense setal tuft, or lost by breakage of the dactyl tip.

Upogebia felderi, new species

FIGURE 19

MATERIAL EXAMINED.—U.S.A.: *Texas*: USLZ 3515, 1 ♂ (paratype), Calhoun Co., Port O'Connor, shoreline of bay, yabby pump, D. Felder and J. Staton, 3 Aug 1990.

Mexico: *Tamaulipas*: USLZ 3017, 2 ♂ (paratypes, 1 with ♀ bopyrid, *Progebiophilus upogebiae* (Hay) and attached ♂), Barra del Tordo, mouth of Río Carrizal, oyster covered beaches near grass beds, shallow water and intertidal, D.L. Felder, R. Tinin, N. Rabalais et al., USL 7FF III-B, 14 Jun 1978; USLZ 3018, 1 ♂ (paratype), same, on edges and just inshore of *Thalassia* bed, 0–0.5 m in estuary about 500 m from mouth, between village and dune line, yabby pump, photo voucher, 14 Jun 1978; USLZ 3019, 11 ♂, 7 ♀ (2 ovig., 1 bearing bopyrid, USNM 251431 and USNM 251433 taken from original number of specimens in lot, remainder are paratypes), same, inshore of grass beds, yabby pump, D.L. Felder and R. Tinnin, sta 6, 24 May 1982; USLZ 3020, 1 ♀ juv. (paratype), same, 12–15 m deep on rocky ledges among muddy dead bryozoans, D.L. Felder and N. Rabalais, 17 Aug 1979; USLZ 3021, 3 ♂, 2 ♀ (1 ovig.) (paratypes), same, D.L. Felder and N. Rabalais, 25 May 1982; USLZ 3498, 1 ♂, 4 ♀ ovig. (USNM 251430 and USNM 251432 taken from original number of specimens in lot, remainder are paratypes), Barra del Tordo, mangrove mud flat and beach shore near seagrass flats, yabby pump, 32 ppt, D.L. Felder and party, USL TFE 91-1, 31 Mar 1991; USNM 251430, 1 ♂ with oviducal openings (holotype), from USLZ 3498; USNM 251431, 1 ♀ ovig. (allotype), from USLZ 3019; USNM 251432, 1 ♂, 3 ♀ ovig. (paratypes), from USLZ 3498; USNM 251433, 3 ♂, 2 ♀ (paratypes), from USLZ 3019.

DIAGNOSIS.—Rostrum often with anteriorly projecting spine terminating ventral row of spines. Projections to either side of rostrum ending in moderate spine. Postocular spine present. Abdominal sternites unarmed. T subrectangular. Carpus of cheliped with 2 very strong spines below mesiodorsal spine on anteromesial margin. Merus of P2 with proximal mesioventral spine and 1 subdistal dorsal spine; merus of P3 with ventrolateral cluster of spines; merus of P4 spineless.

DESCRIPTION.—Rostrum triangular, slightly broader at base than long, slightly downturned; median ventral keel often bearing variably developed spines, anteriormost usually projecting forward, usually exceeding eyestalks in normal position by $1/3$ – $1/2$ their length; dorsal pair of subapical spines followed on each side by 2–4 often asymmetrically arranged spines; middorsal area spineless; posteriorly divergent lateral ridge bearing crest of about 12 spines, strongest in middle of row and decreasing in size posteriorly, anterior spines lateral to rostrum hidden in dense setae. Shoulder paralleling cervical groove bearing 1 or 2 spines below intersection with thalassinidean line. Postocular spine present.

Abdominal sternites unarmed.

T with distal margin slightly biarcuate and sometimes bearing obsolescent median spine; transverse proximal ridge confluent with lateral ridges unspined.

Eyestalk stout, deepest at about midlength, convex ventrally, almost straight dorsal side sometimes bearing 1 or 2 small spines, 1 or 2 spines on mesial basal flange; prominent terminal cornea narrower than diameter of stalk and directed ventrolaterally.

A1 peduncle reaching to beyond midlength of terminal article of A2 peduncle, its proximal 2 articles together about equal in length to terminal article, proximal article without small distoventral angle mesially.

A2 peduncle with about $1/3$ its length extending beyond tip of rostrum; article 1 either spineless ventrally, or bearing a spine; article 2 bearing strong subdistal ventral spine; scale moderate, oval.

Mxp3 bearing epipod.

Epistomial projection rather broad in lateral view, bearing 1 strong spine at distodorsal corner.

Chelipeds with coxa in male bearing small spine on mesiodistal margin. Ventral margin of ischium usually bearing 1 strong spine, occasionally 2, and sometimes asymmetrically 1 and 2 on either side. Merus with row of 4–6 strong spines on ventral margin, distal ones sometimes diminishing in length, subdistal dorsal spine reaching level of postocular spine. Carpus trigonal, shallow longitudinal groove laterally, strong spine at anterior ventrolateral corner preceded by 1–4 spines (sometimes worn or suppressed); mesiodorsal crest of 4–6 nearly uniform moderate spines leading to prominent spine on anterior margin, short strong dorsal spine or pair of unequal spines near articulation with merus partly obscured by setae; 2–3 (rarely 0) strong spines on anterodorsal margin mesial to articulation with propodus; strong spine near middle of

anteromesial margin, nearly equal or stronger spine dorsal to it, and very strong spine near distoventral corner. Chl about 1.9 times chh in male, about 2.5 times in female; spineless dorsal ridge, with erect dorsal spine or pair of spines near its proximal end; mesiodorsal row of strong spines, more erect proximally than distally and sometimes irregular in size and position, those on female variable in size and becoming diminished distally; strong spine below lateral dactylar condyle, reinforced distal margin below mesial dactylar condyle bearing spine and 3–4 rounded spines below it in fully adult male, less well developed in female and immature male; mesial palmar surface bearing arched upper row of obsolescent spines and well-developed setae, ventral keel bearing row of 3–4 spines proximal to base of fixed finger, low transversely arcuate beaded ridge near proximomesial corner. Fixed finger shorter than dactyl and more slender, continuing contour of lower margin of palm, though slightly bowed ventrally, and tapering to strong rounded tip in male, with slender acute tip in female, about 5 variable small teeth on proximal prehensile edge. Dactyl tip in male corneous, preceded on prehensile edge by tooth at $2/3$ length opposing tip of fixed finger, then crest of about 5 closely crowded rounded teeth ending proximally in larger tooth at proximal $1/4$ of length (sometimes only few large teeth in this row), and toothless section basally; arched extensor surface bearing central row of closely crowded beaded granules or spines, largest proximally and becoming obsolete distally, flanked on each side by longitudinal ridge, groove, and row of dense setae; files of beaded granules on mesial and submesial surfaces; corneous tip in female preceded by slightly curved

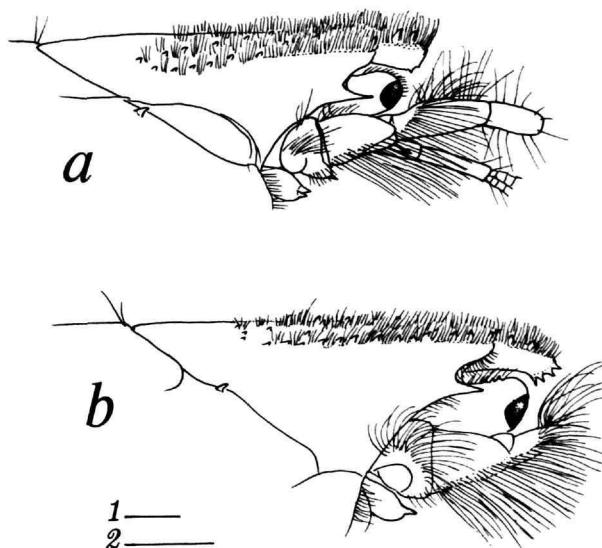


FIGURE 19.—*Upogebia felderi*, new species (a, USNM 251430, ♂ holotype; b, USNM 251431, ♀ allotype): a, b, cephalic region, lateral. (Scales = 2 mm; 1 = a; 2 = b.)

prehensile edge, strong tooth at $1/2$ length opposing tip of fixed finger, section proximal to this bearing variable small- to moderate-size teeth, occasionally a moderate tooth at $1/4$ length, and toothless section basally.

P2 reaching about to distal $1/4$ of palm; carpus with distodorsal spine and acute or obsolescent subdistal ventral spine; merus with slender subdistal dorsal spine and strong proximal mesioventral spine; coxa with 2 acute spines of variable strength on mesial aspect. Merus of P3 with cluster of spines and spiniform granules ventrolaterally on proximal $1/2$, and strong distodorsal spine; coxa with low spine lateral to gonopore and minute spine on distomesial margin. P4 usually with spineless merus, rarely with 2 tiny lateral spines near ischium.

U with small spine on protopod above base of mesial ramus; mesial rib of lateral ramus bearing an obsolete spine proximally; distal margin of rami bearing granules or minute spines.

MEASUREMENTS (in mm).—Holotype ♂, acl 8.6, cl 12.5, chl 7.4, chh 4.0; allotype ♀, same, 9.9, 14.4, 6.8, 2.7.

COLOR.—Light yellowish white dorsally on rostrum, spiny anterior gastric field, chelipeds, and second legs, but shadowy light gray band on distal part of cheliped merus; lighter yellowish white on branchiostegites and central anterior part of telson; darker yellowish on abdominal tergites I–II, and posterolateral parts of tergite VI; thoracic dorsum delimited by cephalic groove and lineae thalassinicae suffused with grayish, still darker gray with olive cast on central part of abdominal tergites III–V and anterior part of tergite VI; legs 4–5 with dorsally exposed articles moderate gray; uropods, sides, and distal part of telson gray. (From color transparency of specimen photographed at mouth of Río Carrizal, Barra del Tordo, Tamaulipas, Mexico, by D.L. Felder, May 1982.)

KNOWN RANGE.—Confined to the material examined. The Río Carrizal estuary was characterized by Rabalais et al. (1989).

REMARKS.—This species has general spination as strong as that of *U. paraffinis* and often has anteriorly projecting terminal spine(s) on the rostrum, but the principal terminal spine, if present, is unbuttressed and usually does not arise in a dorsal position. The rostrum is relatively shorter than in *U. paraffinis*. Anterior spines in the crest on the lateral ridge of the carapace are nestled in setae in *U. affinis*, *U. felderi*, and *U. paraffinis*, but density of the setae in *U. felderi* almost completely obscures these spines, whereas the spines are almost always easily visible in the other two species. As in *U. affinis*, the distal margins of the uropods bear granules or minute spines, more strongly expressed on the lateral than on the mesial ramus. The species thus has morphological characters of both *U. affinis* and *U. paraffinis*, but its color differs from that of its geographically closest neighbor, *U. affinis*. Specimens from the Caribbean region attributed to *U. affinis* now are found to be misidentified. Thousands of kilometers separate *U. felderi* in Texas and northeastern Mexico from the known range of *U. paraffinis*. *Upogebia felderi* and *U. affinis* differ in color, but the color of *U. paraffinis* is not a matter of record, so that

comparison cannot be made here.

ETYMOLOGY.—The specific name is a patronymic, in honor of D.L. Felder.

Upogebia inomissa, new species

FIGURE 20

MATERIAL EXAMINED.—U.S.A.: *Mississippi*: USNM 251396, 1 ♂ (holotype), Dog Keys Pass, W end of Horn Island, in shipworm tunnels in water logged wood, trawl, col. W.B. Sikora, 13 Jun 1991; USNM 251410, 1 ♀ (allotype), same; USNM 91255, 1 ♀ ovig. (paratype), Ocean Springs, col. J.F. Walker, Gulf Coast Research Lab., #10b, summer 1950. *Florida*: FDNR 7EJ83028, 1 ♀ (paratype, poor condition), Indian River Co., ~25.9 km (14 nautical mi), E Vero Beach, 27°40'N, 80°06'W, 27 m, R/V *Delaware II* sta 025, 8-ft scallop tumbler dredge, W. Lyons, D. Camp et al., 21 Apr 1983; HBOM 89:243, 1 ♂ (paratype), Vero Beach, Indian River Co., 274 m (300 yd) E of sand point, inside dead *Pleuroploca gigantea* shell on coquina, 3 m (10 ft) depth, R.P.M., R.G.G., 26 Jul 1972; HBOM 89:2567, 1 ♂ juv., 1 ♀ (paratypes), Martin Co., Seminole Shores, worm reef, intertidal by hand, L.E.S., L.B., R.G.G., G.R.K., sta RGH-138-74, 20 Jun 1974; HBOM 89:2650, 1 ♂ (paratype), St. Lucie Co., Jim Island, Ft. Pierce, in oyster clumps, intertidal, by hand, sta RGH-149-74, L.E.S., L.V.B., M.G.R., 17 Jul 1974; HBOM 89:3381, 1 ♀ (damaged paratype), St. Lucie Co., Jim Island, intertidal by hand, D. Putnam, P. Dudley, 7 Mar 1977; USNM 251411, 2 ♂, 1 ♀ (paratypes), Sawyer Key, Florida Bay side, carbonate sand bar, 0.5–1.0 m, R. and S. Heard, J. Thomas, 10 Apr 1986; USNM 251439, 1 ♀, St. Andrews Bay, from ship worm infested decomposing piece of wood at Panama City marina, 0.9 m (3 ft), water temp 23.9°C, 30 ppt, John M. Foster, 30 Oct 1992.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites unarmed. T subrectangular. Carpus of cheliped with 1 strong and 1 short spine on mesiodistal margin. Merus of P2 bearing 1 proximal mesioventral spine and 2 subdistal dorsal spines; merus of P3 with 1 subdistal dorsal spine; merus of P4 usually spineless.

DESCRIPTION.—Rostrum triangular, short, straight to slightly downcurved in lateral view; tip exceeding slightly upturned eyestalks; dorsal pair of strong subapical spines followed on each side by 2–3 often remote spines; posteriorly divergent lateral ridge bearing crest of 12 or more spines, strongest on process lateral to rostrum and decreasing posteriorly. Shoulder lateral to cervical groove bearing 1–3 tubercles below intersection with thalassinidean line, and sometimes another above this juncture. Postocular spine present.

Abdominal sternites usually unarmed, but some adults show varying development of spines.

T subrectangular, prominent transverse proximal ridge confluent with inconspicuous lateral ridge at each side.

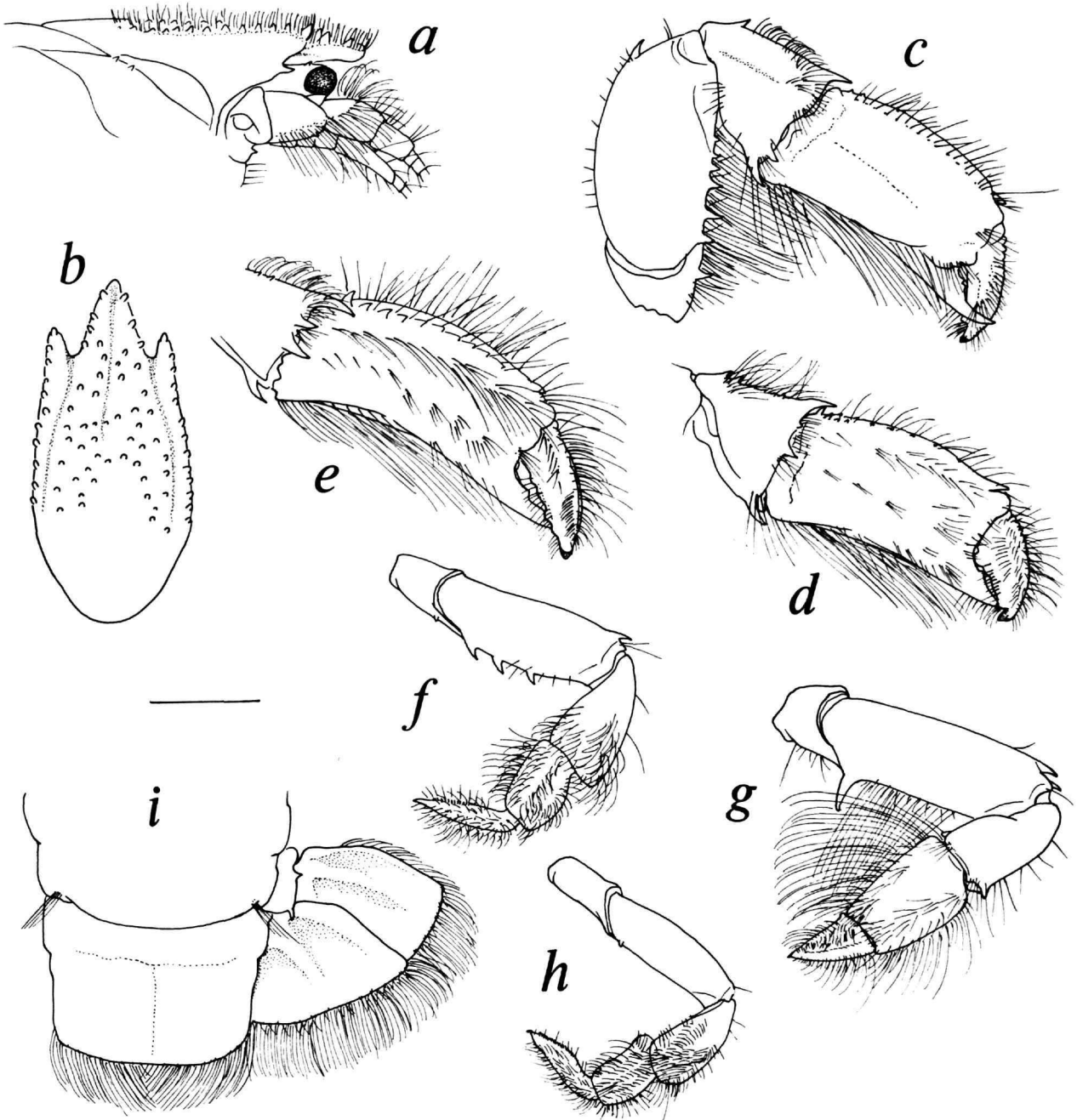


FIGURE 20.—*Upogebia inomissa*, new species (a-d, f-i, USNM 251396, ♂ holotype; e, USNM 251410, ♀ allotype): a, cephalic region, lateral; b, anterior carapace, dorsal; c, cheliped, right lateral, ♂; d, chela and carpus, left mesial, ♂; e, chela and carpus, left mesial, ♀; f-h, legs 2-4; i, parts of abdominal segment 6, telson, and uropods, dorsal. (Scale = 2 mm.)

Eyestalk stout, deepest at about midlength in lateral view, concave dorsally, convex ventrally, more or less obliquely erect in repose; prominent terminal cornea narrower than diameter of

stalk.

A1 peduncle reaching to about 1/2 length of terminal article of A2 peduncle, its proximal 2 articles together slightly longer

than terminal article.

A2 peduncle with about $\frac{1}{3}$ its length extending beyond tip of rostrum; article 2 bearing subdistal ventral spine; scale moderate, oval.

Mxp3 bearing epipod.

Epistomial projection rather broad in lateral view, bearing 2 small unequal apical spines.

Chelipeds with coxa bearing slender spine on mesiodistal margin. Ventral margin of ischium bearing 1 spine. Merus with row of 4–7 strong spines on ventral margin; single subdistal dorsal spine reaching level of postocular spine. Carpus trigonal, shallow longitudinal groove laterally, strong spine at anterior ventrolateral corner preceded by 1 spine or row of sparse spines; remote mesiodorsal crest of 3–6 small spines behind prominent dorsal spine on anterior margin partly obscured by setae, proximal spine more erect than others, and 2–4 short stout spines obscured by setae on anterodorsal margin mesial to articulation with propodus; 1 strong spine near middle of anteromesial margin, smaller spine (sometimes much smaller and corneous tipped) dorsal to it, and strong slender spine at distoventral corner. Chl about 2.5 times chh; spineless dorsal ridge terminating anteriorly near stout subdistal spine mesial to it; mesiodorsal row of small spines (sometimes obsolescent) beginning with more or less erect spines proximally and becoming obsolescent at about $\frac{2}{3}$ – $\frac{3}{4}$ length; poorly developed distomarginal spine below lateral and mesial dactylar condyles, 1–3 remote smaller spines ventral to mesial condyle on distal margin; lower mesial surface spineless but low transversely arcuate ridge near proximomesial corner. Fixed finger shorter than dactyl and more slender, slightly downcurved in middle and tapering to slender tip, 4–6 teeth on proximal prehensile edge, not as well developed in female as in male. Dactyl longitudinally ridged and setose; that of female with corneous tip preceded on prehensile edge by either an unarmed interval or 1 or 2 rather stout low spines, then more or less rectangular tooth-like crest increasing proximally to its greatest height, and toothless section basally; curved extensor surface bearing about 3–4 small tubercles proximally; that of male with corneous tip preceded on prehensile edge by strong tooth, then finely multidentate prehensile crest bracketed on each end by larger tooth, and toothless section basally; concave mesial aspect in both sexes bearing 2 unequal rows of tubercles, most numerous in upper row.

P2 reaching about to distal $\frac{1}{4}$ of palm; carpus with acute distodorsal spine and tiny, nearly equal subdistal ventral spine; merus dorsally bearing slender distal spine and larger subdistal spine, and strong proximal mesioventral spine; coxa with proximal and distal raised areas mesially but no spines. Merus of P3 with slender distodorsal spine, sometimes a larger subdistal spine located closer to it than analog on leg 2, strong ventral spines tending to cluster near ischio-meral articulation, and cluster of smaller spines or spiniform granules proximolaterally; ischium unarmed and coxa with low spine lateral to gonopore. P4 with merus usually unarmed, occasionally a

proximoventral spine, ischium unarmed.

U with acute spine on protopod above base of mesial ramus; lateral ramus with mesial rib bearing blunt spine proximally.

MEASUREMENTS (in mm).—Holotype ♂, acl 6.4, cl 9.3, chl 5.4, chh 2.3; allotype ♀, same, 7.9, 11.5, 6.3, 2.3.

COLOR.—Holotype ♂ (dorsal view): Branchiostegites, antennae, and displayed parts of folded legs milky white; broad dorsal tract running length of cephalothorax olive on setose field of anterior carapace and posterior cardiac region but bluish gray slate colored on gastric region; abdomen dorsally mottled bluish gray slate colored, but with middorsal row of darker polygonal designs, broad triangular patch on tergite 1, roughly trapezoidal patch on tergite 2, narrower but laterally disposed rectangular patch on tergites 3 and 4, and more elongate rectangular spot on tergite 5 and apparently on tergite 6, but full view of latter and tail fan as well as chelae not visible on photograph.

Allotype ♀ (oblique lateral view): General color pattern similar to that of male, but darker slate color on gastric region and pinkish salmon suffused with bluish gray in broad tract on cardiac region; abdomen similarly colored on tergites 1–3, but pleurae of these segments and segment 4 lighter with milky white margin, remainder of segments not visible; pleopods yellowish; oblique joint between ischium and merus of right cheliped slate blue. (From photograph taken by Walter B. Sikora shortly after formalin fixation.)

KNOWN RANGE.—Confined to material examined.

REMARKS.—*Upogebia inomissa*, new species, lacks sternal spines on the abdominal segments, so characteristic of *U. omissa*. *Upogebia inomissa* is similar to *U. omissa* in possessing 2 subdistal dorsal spines on the merus of P2, but unlike the latter almost always has only 1 such spine on the merus of P3, and it lacks spines on the merus of P4, whereas the merus of this leg in *U. omissa* almost always bears spines on the ventral margin. General spination of the carpus and palm of the cheliped of *U. inomissa* is much as in *U. omissa*, but the erect proximal spine in the mesiodorsal palmar row of *U. inomissa* is missing in *U. omissa*, and there are differences in the shape and spination of the fingers.

Upogebia inomissa is known only from the coast of Mississippi and southern peninsular Florida, but its geographic range may be broader than that now that possible confusion with *U. affinis* has been clarified.

ETYMOLOGY.—From the Latin prefix *in-* (not), plus *omissa*, the species that it resembles.

Upogebia jamaicensis Thistle, 1973

FIGURE 21

Upogebia jamaicensis Thistle, 1973:16, fig. 4.

MATERIAL EXAMINED.—JAMAICA: USNM 41748, ♂ (holotype), Montego Bay, salt water pond, E.A. Andrews, 24 Jun 1910; USNM 138896 ♀ (paratype), same; USNM 138897 ♀

(paratype), same; USNM 138898, 1 ♀, Montego Bay, brackish pond, C.B. Wilson, 2 Jul 1910; USNM 251222, 1 ♀, Montego Bay, brackish pond near sea beach, C.B. Wilson, 24 Jun 1910; USNM 251223, 2 ♀ ovig., Montego Bay, from brackish pond, C.B. Wilson, 29 Jun 1910.

PANAMA; USNM 251176, 5 ♂ (1 juv.), 3 ♀ (1 ovig.), Colon, small embayment 9.1 mi E Maria Chiquita on Portobello Road, 0–0.9 m (0–3 ft), sandy, mud, mangrove, ebb low tide, 31°C, 21 ppt, 0–23 m (75 ft) offshore, noxfish, Dawson and Dawson sta 1491, 3 Jul 1971; USNM 251177, 1 ♂, 3 ♀ (2 ovig.), 8 juvs., Colon, embayment at 9 mi E Maria Chiquita on Portobello Road, 0–0.9 m (0–3 ft), 0–15 m (50 ft) offshore, *Thalassia*, ebb tide, 27 ppt, chemfish, Dawson and Dawson sta 1493, 4 Jul 1971.

COLOMBIA: USNM 251422, 11 ♂, 6 ♀ (2 ovig., 1 juv.), Baru, mouth of Cienaga, Porto Nao, intertidal, yabby pump, R. Lemaitre, SOSC, 24 Jul 1988; USNM 251423, 1 ♂, 1 ♀, same; USNM 256062, 113 ♂, 69 ♀ (36 ovig.), same locality, very shallow mud flat inside lagoon near mouth, some sea grass (*Thalassia*), numerous burrow openings, yabby pump, R. Lemaitre, SOSC, sta B#6A, 18 Jul 1991; USNM 256061, 38 ♂, 41 ♀ (17 ovig.), same, sta B#6B, 19 Jul 1991; USNM 251182, 1 ♂, south coast of Bahía de Barbacoas, Caribbean coast, “Colombiana de Acuicultura” shrimp ponds 1 and 5, with shovel, S. Nates, 13 Dec 1991.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Postocular spines number 4–6. Row of acute spines on shoulder lateral to cervical groove. Abdominal sternites unarmed. T subrectangular. Carpus of cheliped with moderate spine on anteromesial margin. P2 with proximal mesioventral spine on merus; P3 with 2 dorsal spines on merus, distal and subdistal; merus of P4 spineless.

DESCRIPTION.—Rostrum triangular, slightly downturned, long, reaching level of articulation between penultimate and terminal articles of antennal peduncle in male, shorter in female, tip exceeding eyestalks; dorsal pair of strong subapical spines followed on each side, after moderate interval in male and much smaller space in female, by 3–6 spines nearly equal in length; about $\frac{3}{4}$ of carapace surface anterior to cervical groove bearing pilose tufts, each emerging anterior to elements of an armature changing from spiny anteriorly to subspiny posteriorly; divergent lateral ridge bearing crest of 12 spines, strongest on process lateral to rostrum and decreasing somewhat posteriorly. Adults and subadults with shoulder lateral to cervical groove bearing about 6–11 acute spines below intersection with thalassinidean line, smaller individuals with spines weak or undeveloped, 2–3 of larger spines near notch in anterior carapace margin (incisura clavicularis; see Holthuis, 1974:734, 737) with bases united. Postocular spines numbering 4–6. Clump of about 3 spines on lateral aspect of head below lateral ridge and anterior to thalassinidean line (gastroorbital region).

Abdominal sternites unarmed; AVI with lateral margin sinuous, widest at midlength, dorsal sulcus running obliquely

anterolaterad from notch anterior to posterolateral corner and usually becoming obsolete on dorsal surface; but sulcus becoming obsolescent in large adults and arcing toward anterolateral corner.

T subrectangular, a little wider than long.

Eyestalk stout, convex ventrally; cornea slightly narrower than diameter of stalk.

A1 peduncle reaching to about proximal $\frac{1}{4}$ of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article.

A2 peduncle with only terminal article extending beyond tip of rostrum in male, but penultimate article also extending beyond shorter rostrum of female; article 2 spineless; scale moderate, oval.

Mxp3 bearing epipod.

Epistomial projection acuminate in lateral view.

Chelipeds with ventral margin of coxa bearing a hooked spine; ischium bearing 2, rarely 3 slender spines. Merus with row of 5–6 strong acuminate spines on ventral margin, single subdistal dorsal spine reaching level of midpostocular row. Carpus trigonal, shallow longitudinal groove laterally; strong spine at anterior ventrolateral corner and 1 or more spines of variable strength preceding it; mesiodorsal crest of about 4–6 irregular spines behind prominent spine on anterior margin, partly obscured by setae in proximal part of row, and short oblique row of 3 or more spines diverging from proximal end onto dorsal surface in male, 2 moderate spines on anterodorsal margin mesial to articulation of propodus; stout spine near middle of anteromesial margin. Palm length including fixed finger about twice maximal height in male, about 2.7 times in female, lateral oblique row of setae ending anteriorly in patch of long setae near base of fixed finger; dorsal row of spines becoming smaller and more crowded anteriorly; male bearing parallel mesiodorsal row of smaller somewhat irregular spines becoming obsolescent distally, and remote spine on condyle of dactyl; anterolateral row of stout spines increasing to clump of stout spines near condyle of dactyl (much less developed in female); lower mesial surface spineless but bearing low transversely arcuate ridge proximally. Fixed finger of male much shorter than dactyl, stout, hooked, continuing from downcurved ventral edge of palm and tapering to slender tip, 4–6 or more crowded, evenly rounded small teeth on proximal prehensile edge; short triangular with slender apex in female, 4 teeth on proximal prehensile edge. Dactyl much longer than fixed finger, ribbed and bearing dense setae in rows; comeous tip preceded on distally toothless prehensile edge by strong tooth opposing tip of fixed finger at $\frac{1}{2}$ – $\frac{2}{3}$ length, with about 3–5 smaller rounded teeth proximal to this tooth and 1 similar tooth close by distally; curved extensor surface bearing about 3–6 small proximal tubercles.

P2 reaching about to distal $\frac{1}{4}$ of palm; carpus with obsolescent distodorsal spine and tiny, acute, subdistal ventral spine; merus with small subdistal dorsal spine and strong proximal mesioventral spine; coxa with strong proximal and

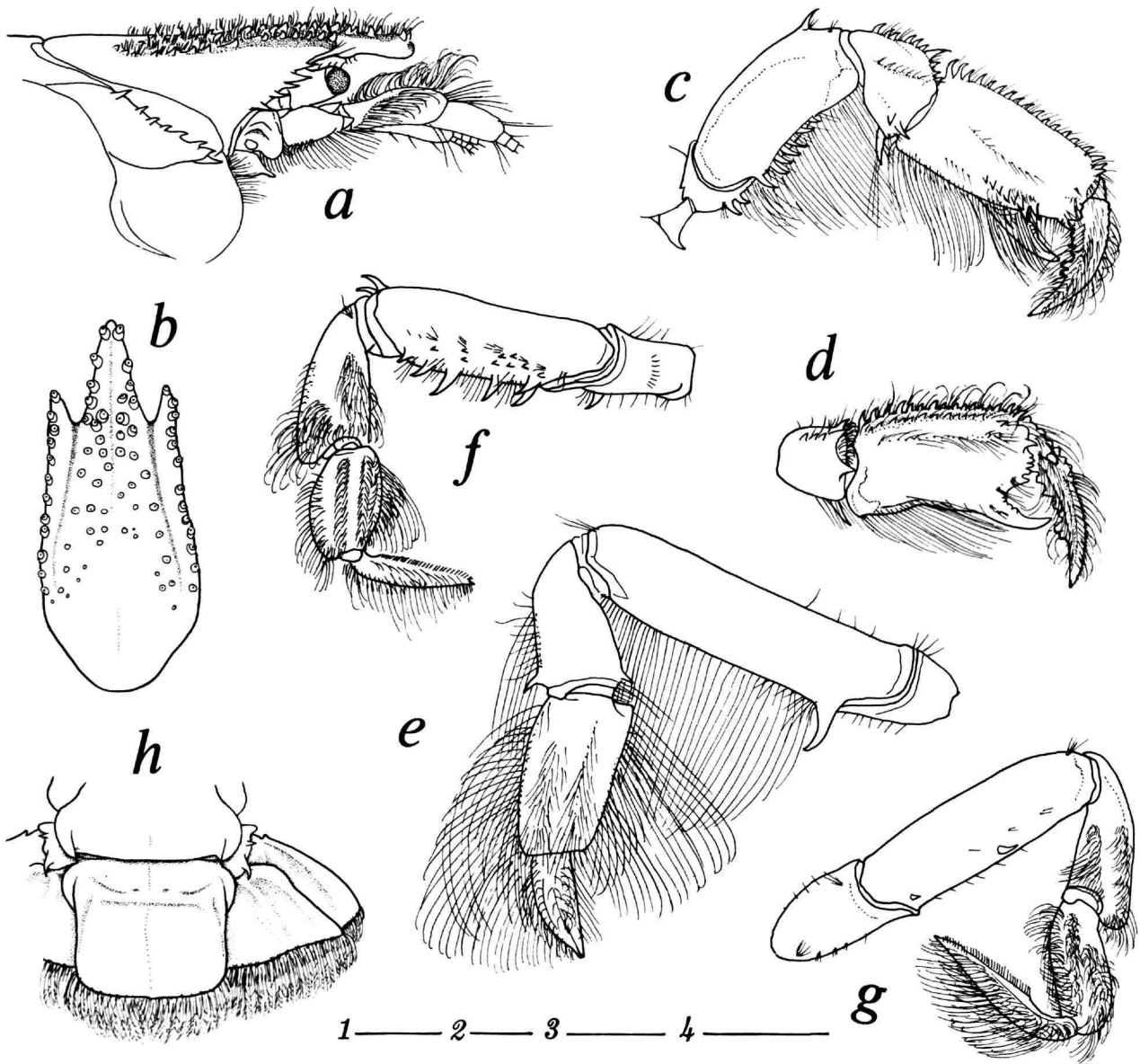


FIGURE 21.—*Upogebia jamaicensis* Thistle, USNM 41748, ♂ holotype: *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e-g*, legs 2-4; *h*, parts of abdominal segment 6, telson, and uropods, dorsal. (Scales = 2 mm: 1 = *a,b*; 2 = *c,d,h*; 3 = *e,f*; 4 = *g*.)

smaller distal spine posteromesially. Merus of P3 with distal and subdistal dorsal spines, row of slender ventral spines, and scattered smaller spines posterolaterally; ischium with dis-ventral spine, and mesial spine on coxa. P4 spineless.

U with acute spine on protopod above base of mesial ramus; mesial rib of lateral ramus bearing rounded eminence proximally.

MEASUREMENTS (in mm).—Holotype ♂, ac1 9.0, cl 15.0, chl 6.4, chh 3.8; paratype ♀, same, 7.9, 11.8, 5.1, 1.9.

KNOWN RANGE.—Confined to the material examined.

REMARKS.—Three specimens are known from Jamaica in addition to those studied by Thistle (1973). There, the species apparently is limited to a brackish seaside pond habitat. The Panama specimens are smaller than those from Colombia,

which in turn are smaller than those from Jamaica, but all conform to the type series in other respects than size.

Upogebia marina Coêlho, 1973

FIGURE 22

Upogebia (*Upogebia*) sp. C. Coêlho and Ramos, 1972:163.

Upogebia (*Upogebia*) *marina* Coêlho, 1973b:345.—Coêlho and Rattacaso, 1988:385.

Upogebia marina.—Coêlho and Ramos-Porto, 1987:36.

MATERIAL EXAMINED.—VENEZUELA: USNM 251405, 1 ♀, Turpialito, ~20 km E of central Cumaná, soft mud over shell mush, faint H₂S odor, inside pier, 24°C, 35 ppt, M.L. Jones, C-78-2, 17 Jan 1978; USNM 251406, 1 ♂, Laguna Grande on outer peninsula, opposite Cumaná, from coarse sand and rocks, 24°C, 35 ppt, M.L. Jones, C-78-3-1, 17 Jan 1978.

BRAZIL: Alagoas: MZUSP 8955, 1 ♀ (ovig.), 09°15'S, 35°14'W, Askaroa sta 21, 9 Sep 1965.

DIAGNOSIS.—Projections to either side of rostrum ending in small acute spine. Postocular spine present. Abdominal sternites unarmed. T subrectangular. Carpus of cheliped with 2 strong spines on distomesial margin. Merus of P2 bearing 1 proximal mesioventral spine and 1 subdistal dorsal spine; that of P3 and P4 spineless.

DESCRIPTION.—Rostrum triangular, slightly downcurved; tip exceeding eyestalks in normal position by about width of cornea; dorsal pair of strong subapical spines followed on each side by 3 remote spines; posteriorly divergent lateral ridge bearing crest of 12 or more spines, strongest on process lateral to rostrum and decreasing posteriorly. Shoulder lateral to cervical groove unarmed. Postocular spine present.

Abdominal sternites unarmed.

T subrectangular, transverse proximal ridge confluent with inconspicuous lateral ridge at each side.

Eyestalk stout, deepest at about midlength, slightly concave dorsally, noticeably convex ventrally, almost horizontal in repose; prominent terminal cornea narrower than diameter of stalk.

A1 peduncle reaching to base of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article.

A2 peduncle with about 1/3 its length extending beyond tip of rostrum; article 2 bearing obsolescent subdistal ventral spine; scale moderate, oval.

Mxp3 bearing epipod.

Epistomial projection broadly rounded in lateral view, bearing small spine on anterodorsal aspect.

Chelipeds slender. Coxa unarmed. Ventral margin of ischium bearing 1 spine. Merus with row of 2–5 small spines on ventral margin; single subdistal dorsal spine reaching level of postocular spine. Carpus trigonal, shallow longitudinal groove laterally, without spine at anterior ventrolateral corner; mesiodorsal crest of 8 small spines behind prominent dorsal

spine on anterior margin partly obscured by setae, and 2–3 short stout spines obscured by setae on anterodorsal margin mesial to articulation with propodus; strong spine near middle of anteromesial margin, slightly smaller spine dorsal to it, and strong slender spine at distoventral corner. Chl about 3 times chh; spineless dorsal and mesiodorsal ridges present; small distomarginal spine below lateral and mesial dactylar condyles, small spine on distal margin of palm ventral to mesial condyle; mesial surface unarmed, but low transversely arcuate ridge near proximomesial corner. Fixed finger much shorter than dactyl and more slender, slightly downcurved in middle and tapering to slender tip, 4–7 teeth on proximal prehensile edge. Dactyl longitudinally ridged and setose; corneous tip preceded on prehensile edge by unarmed interval and strong tooth closing against tip of fixed finger, then a more or less sinuous crenulate crest increasing to strong tooth at its proximal and greatest height, toothless section basally; curved extensor surface bearing about 2–3 small tubercles proximally.

P2 reaching to about distal 1/4 of palm; carpus with obsolescent distodorsal spine and subdistal ventral spine; merus with slender subdistal dorsal spine and strong proximal mesioventral spine; coxa unarmed. Ischium and merus of P3 and P4 spineless, except coxa of P3 with broad low spine lateral to gonopore.

U with blunt spine on protopod above base of mesial ramus; lateral ramus with mesial rib bearing obsolete spine proximally.

MEASUREMENTS (in mm).—Ovigerous ♀, acl 5.2, cl 7.2, chl 4.1, chh 1.3.

TYPE LOCALITY.—Station SALD 1730, 21 m depth in littoral of Piauí, Brazil.

KNOWN RANGE.—Venezuela, this paper, and Brazil from Piauí to Sergipe (Coêlho and Ramos-Porto, 1987, Coêlho and Rattacaso, 1988).

HABITAT.—Calcareous algae, reefs, sand, including estuaries (Coêlho and Ramos-Porto, 1987; Coêlho and Rattacaso, 1988).

REMARKS.—A Venezuela female, USNM 251405, has a left chela less than 1/2 the length of the right chela, one of two regenerated chelae observed in material examined for this paper.

Upogebia noronhensis Fausto-Filho, 1969

FIGURE 23

Gebia spinigera.—Pocock, 1890:515.

Upogebia noronhensis Fausto-Filho, 1969:1–7, 15 figs.; 1970:58.—Coêlho and Ramos, 1972:163.—Thistle, 1973:2, 12–14, 23 [key].—Williams, 1986:10 [key].—Coêlho and Ramos-Porto, 1987:36.—Coêlho and Rattacaso, 1988:383.

MATERIAL EXAMINED.—BRAZIL: *Fernando de Noronha*: LCMC 163, 3 ♀ (1 ovig.) (paratypes), Baía de Sueste, Fausto-Filho, 7 Aug 1968.

DIAGNOSIS.—Projections to either side of rostrum ending in spine. Postocular spine present. Abdominal sternites unarmed.

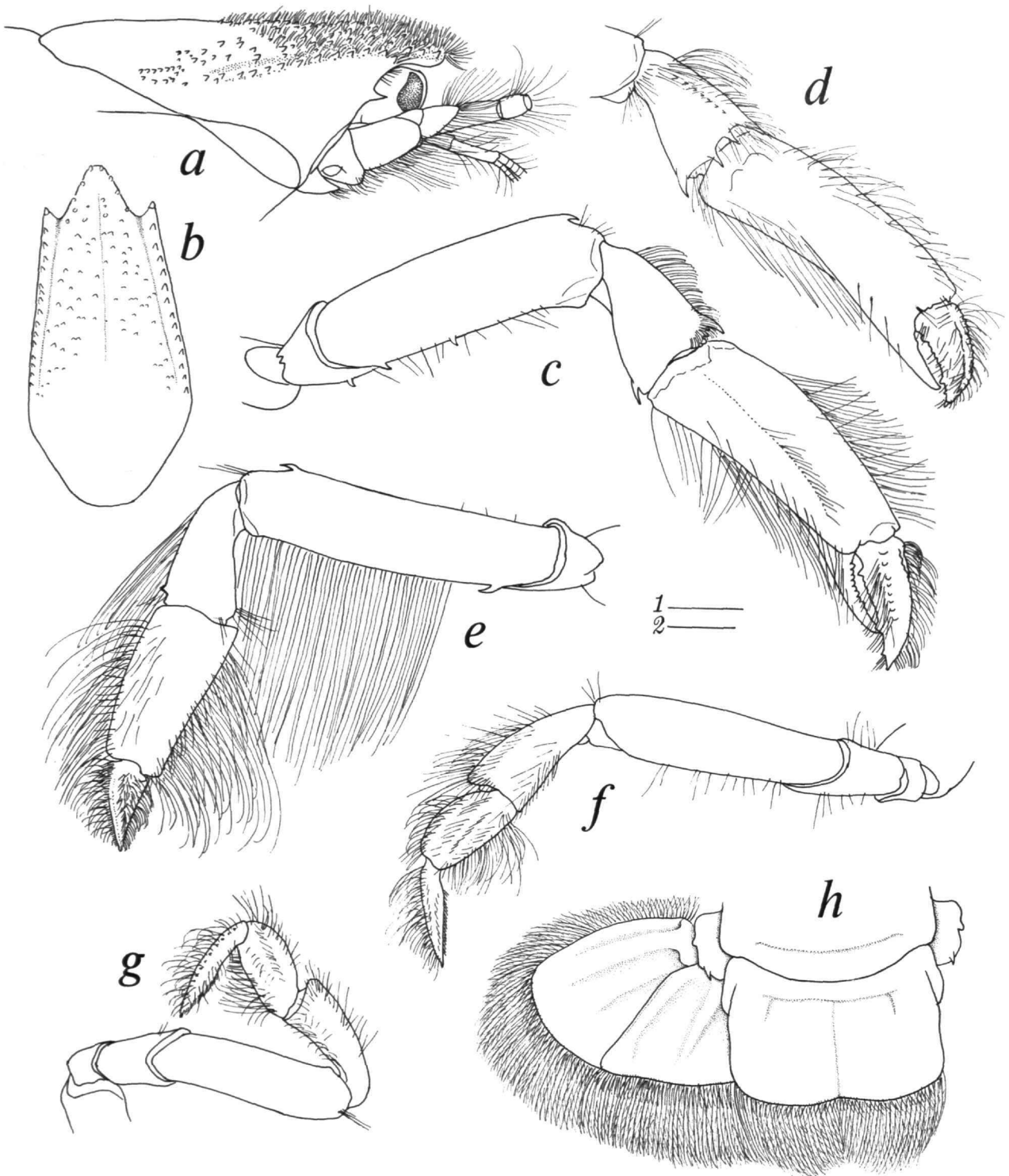


FIGURE 22.—*Upogebia marina* Coêlho, USP 8955, ♀ ovigerous: *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e-g*, legs 2-4; *h*, parts of abdominal segment 6, telson, and uropods, dorsal. (Scales = 1 mm: 1 = *a, d-g*; 2 = *b, c, h*.)

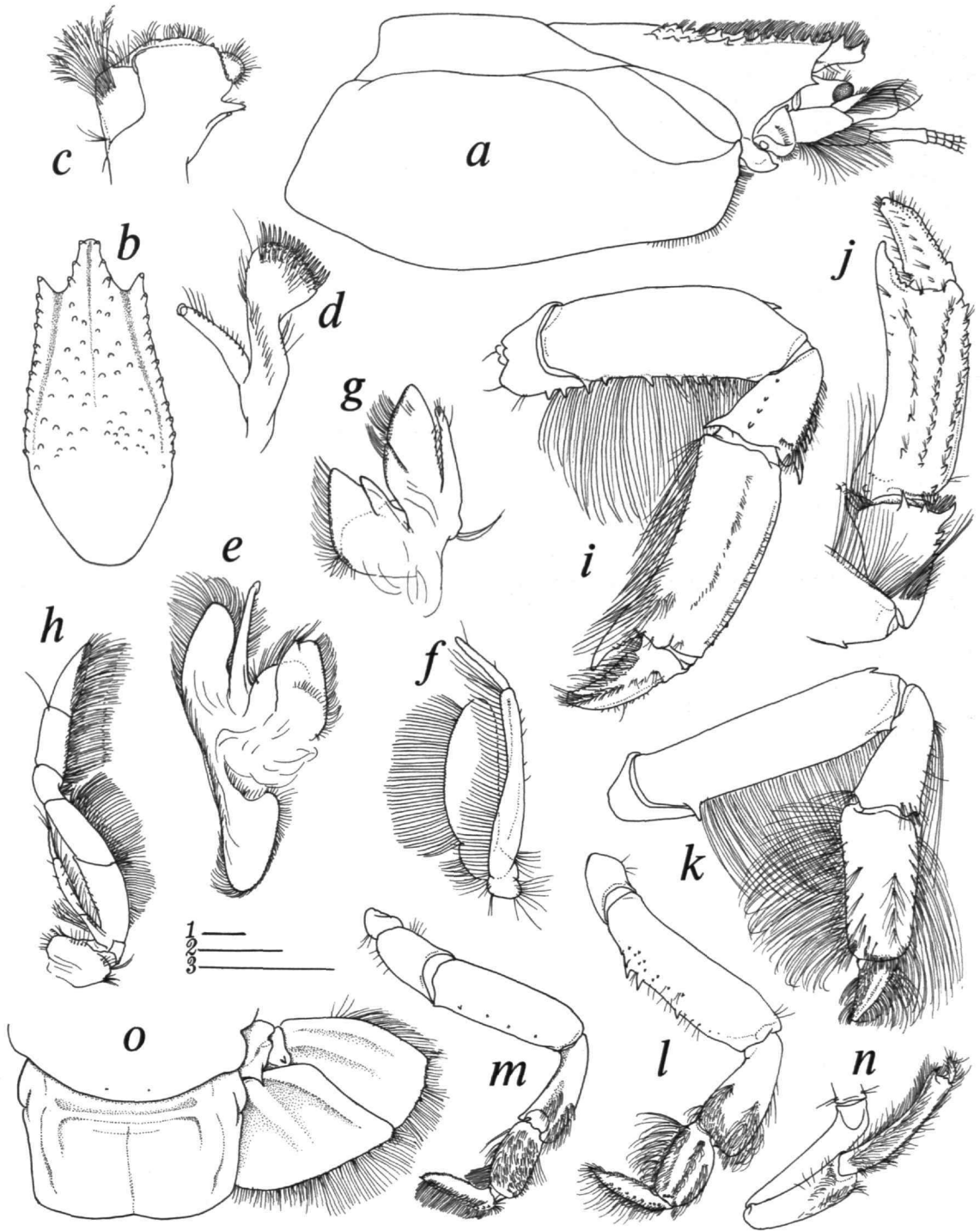


FIGURE 23.—*Upogebia noronhensis* Fausto-Filho (from 3 ♀ paratypes, No. 163, Laboratorio de Ciências do Mar, Universidade Federal do Ceará, Fortaleza, Brazil): a, carapace, lateral; b, anterior carapace, dorsal; c, mandible; d, 1st maxilla; e, 2nd maxilla; f, 1st maxilliped; g, 2nd maxilliped; h, 3rd maxilliped; i, cheliped, right lateral; j, chela and carpus, right mesial; k-n, legs 2-5; o, parts of abdominal segment 6, telson, and uropods, dorsal. (Scales = 1 mm: 1 = a, b, i-o; 2 = d-h; 3 = c.)

T subrectangular. Carpus of cheliped with strong spine on anteromesial margin. Merus of P2 bearing proximal mesioventral spine and subdistal dorsal spine; that of P3 with cluster of ventrolateral spines; that of P4 spineless.

DESCRIPTION.—Rostrum triangular, dorsal pair of strong subapical spines followed on each side by 2 remote spines; straight to very slightly downcurved in lateral view, tip exceeding eyestalks in normal position; posteriorly divergent lateral ridge bearing crest of 11–12 spines, strongest on process lateral to rostrum and decreasing posteriorly. Shoulder lateral to cervical groove usually unornamented, bearing at most 1 obsolescent tubercle below intersection with thalassinidean line. Postocular spine present.

Abdominal sternites unarmed.

T subrectangular, prominent transverse proximal ridge confluent with less conspicuous lateral ridge at each side.

Eyestalk stout, deepest anterior to midlength or with dorsal and ventral margins subparallel; prominent terminal cornea narrower than diameter of stalk.

A1 peduncle reaching to proximal part of terminal article of A2 peduncle, its proximal 2 articles together $\frac{1}{4}$ longer than terminal article.

A2 peduncle with about $\frac{1}{3}$ its length extending beyond tip of rostrum; article 2 bearing subdistal ventral spine; scale moderate, oval.

Mouthparts representative of species in genus *Upogebia* illustrated; Mxp3 bearing epipod.

Epistomial projection in lateral view rather broadly rounded distally, bearing 1 small apical spine.

Chelipeds with coxa bearing slender spine on mesiodistal margin. Ventral margin of ischium bearing 1–2 spines. Merus with row of 2–5 widely spaced spines on ventral margin; single subdistal dorsal spine reaching level of postocular spine. Carpus trigonal, shallow longitudinal groove laterally, small spine at anterior ventrolateral corner sometimes preceded by secondary smaller spine; mesiodorsal crest of 5–6 strong spines behind prominent dorsal spine on anterior margin partly obscured by setae, and 2–3 short spines obscured by setae on anterodorsal margin mesial to articulation with propodus; 1 strong spine near middle of anteromesial margin, and strong slender spine at distoventral corner. Chl about 2.8–3.8 times chh; spineless dorsal ridge terminating anteriorly near small subdistal spine mesial to it, mesiodorsal row of about 15 strong spines tending to be staggered in proximal $\frac{1}{2}$; ventral to this row and paralleling it, a row of smaller spines (~10), sometimes more closely spaced in proximal $\frac{1}{3}$ than in distal $\frac{2}{3}$; below this and more or less paralleling ventral margin of palm, a row of 4–6 strong spines, larger distally than proximally; variable distomarginal spine below lateral and mesial dactylar condyles, and ventral to mesial condyle 2–4 remote small spines on distal margin; ill-defined low transverse ridge near proximomesial corner. Fixed finger about $\frac{1}{2}$ length of dactyl and more slender, slightly downcurved in middle and tapering to slender tip, about 4 teeth on proximal prehensile edge. Dactyl longitudi-

nally ridged and setose; corneous tip preceded on prehensile edge by unarmed interval, then a more or less rectangular finely toothed crest increasing proximally to its greatest height in strong tooth, toothless section basally; curved extensor surface bearing about 2 small tubercles proximally. Cheliped of male more robust than that of female (see Fausto-Filho, 1969, figs. 1, 9, 10).

P2 reaching about to distal $\frac{1}{4}$ of palm; carpus with blunt distodorsal spine and obsolescent subdistal ventral spine; merus with slender subdistal dorsal spine and strong proximal mesioventral spine. Merus of P3 with 3–4 strong ventral spines on proximal $\frac{2}{3}$ of margin, and cluster of smaller spines or spiniform granules proximolaterally; ischium unarmed and coxa with low spine lateral to female gonopore. P4 with merus and ischium spineless.

U with acute spine on protopod above base of mesial ramus; lateral ramus with mesial rib bearing acute spine proximally.

MEASUREMENTS (in mm).—Paratype ♀, acl 9.0, cl 12.8, chl 8.8, chh 2.3; same, 14.1, 9.0, 8.2, 2.9.

KNOWN RANGE.—The species is endemic to Fernando de Noronha, Brazil.

HABITAT.—The species was found on the inner part of a cove on Fernando de Noronha at the limits of the infra and median littoral, below pebbles, in natural cracks, or in burrows excavated by the animals themselves. The small area collected, approximately 5 m², was influenced by fresh water draining from the reservoir of the island (Fausto-Filho, 1969).

REMARKS.—Both Pocock (1890) and Fausto-Filho (1969) inferred the relationships of *U. noronhensis* as near to *U. spinigera* of the eastern Pacific. However, now that more species have come to light, its relationships seem closer to *U. vasquezi*.

Eston et al. (1986), in a survey of benthic marine organisms of Fernando de Noronha that were collected from 25 × 25 cm quadrats taken along four transects of the rocky coasts from the supralittoral fringe to a depth of 30 m, reported no specimens of *U. noronhensis*. Although that study had a botanical emphasis, it would seem from sampling of this intensity on beach areas of the archipelago that *U. noronhensis* is not one of the coral boring species and that it probably is confined to substrates such as those sampled by Fausto-Filho.

Upogebia omissa Gomes Corrêa, 1968

FIGURE 24

Upogebia omissa Gomez Corrêa, 1968:98, figs. 1–15, 28, 29.—Fausto-Filho, 1970:58 [distrib.].—Coelho, 1970:56 [estuarine distrib.].—Coelho et al., 1970:508 [habitat].—Coelho and Ramos-Porto, 1987:35 [key], 36 [Brazilian distrib.].

Upogebia (Upogebia) sp. B, Coelho, 1971:231.—Coelho and Ramos, 1972:162.

Upogebia (Upogebia) omissa.—Coelho and Rattacaso, 1988:383.

MATERIAL EXAMINED.—U.S.A.: Florida: FDNR EJ68027, 1 ♂, Pinellas Co., S end of Dunedin wreckage drop

under limestone rocks, 28°00'02"N, 83°52'06"W, 8.5 m (28 ft), rotenone and dipnet, M.A. Moe, Jr., and T.F. Maloney, 15 May 1968.

DOMINICAN REPUBLIC: USNM 251235, 1 ♀, 2 cephalothoraxes, Playa de Monte Cristi, 19°52.3'N, 71°39.5'W, hard substrate along patio wall pounded by waves on seaward side of hotel, M.L. Jones, sta 26, 22 Feb 1969.

PUERTO RICO: USNM 251236, 1 ♂, Parguera, Lajas, West Maguey Id., Gooding and Humes, 6 Aug 1959.

PANAMA: USNM 251237, 1 ♂, Colon, Limon Bay, Fort Randolph near base of E jetty, 0–1.5 m, *Thalassia*, mud, some rock, low flood tide, 29°C, 30 ppt, ichthyocide, Panama Survey, C.E. Dawson 1650, M.L. Jones, Panama Survey sta 153-2, 3 Nov 1973; USNM 251238, 2 ♂, 1 ♀, Limon, Fort Randolph at base of E Jetty, 09°23.1'N, 79°53.46'W, sieving bare sand patch beyond *Thalassia*, ~1.5 m (5 ft) deep, Panama Survey sta 153-3, Jones and Dawson, 3 Nov 1973.

COLOMBIA: USNM 251181, 3 ♂, 8 ♀ (6 ovig.), south coast of Bahía de Barbacoas, Caribbean coast, "Colombiana de Acuicultura" shrimp ponds 1 and 5, with shovel, S. Nates, 13 Dec 1991.

VENEZUELA: USNM 251727, 1 ♂, Isla Margarita, La Isleta, on inner side of peninsula, thick sticky black mud overlain with about 5 mm oxidized layer, slight H₂S odor, M.L. Jones, sta 78-1-1, 13 Jan 1978; USNM 251728, 1 ♂, 2 ♀, 1 juv., Isla Margarita, <1 m, dark gray well-sorted sand and shell frags., H₂S odor, M.L. Jones, sta 78-1-2, 13 Jan 1978; USNM 251729, 1 ♀, Isla Margarita, Boca del Río, 50 m E Mangrove Island N of lab buildings, bare sand in *Thalassia* beds, M.L. Jones, sta M-12, 17 Feb 1977.

TRINIDAD: RMNH 14981, 1 ♂, 7 ♀ (1 ovig.), mouth of Diego Martin River, dug from mangrove detritus, one specimen with bopyrid parasite, H.O. von Hagen, 6 Jan 1966; USNM 7661, 2 ♂, 1 ♀, shore, R/V *Albatross*, no sta no. given, 30 Jan–2 Feb 1884; USNM 120489, 2 ♀ (1 ovig.), Coroni Swamp, Blue River mouth, holes in mud, P.R. Bacon, B.14, 4 Aug 1966.

BRAZIL: Ceará: MZUSP 8054, 1 ♀, Ponta do Trapia, Camocim, Paulo Young, 6 Aug 1982. *Rio Grande do Norte*: MZUSP (unnumbered), 2 ♂, 3 ♀ ovig., Natal, nursery of shrimp project, 27 Jan 1979. *Paraíba*: USNM 25793, 2 ♂, 5 ♀ (1 ovig.), Mamanguape stone reef, A.W. Greeley, Branner-Agassiz Expedition, 22–23 Jun 1899; USNM 25794, 1 ♂, *Rio Paraíba*, on mangroves, Branner-Agassiz Expedition, A.W. Greeley, 21 Jun 1899; USNM 25795, 1 ♀, Contello Bay, A.W. Greeley, Branner-Agassiz Exped., 27 Jun 1899; USNM 222054, 1 ♂, 1 ♀ (ovig.), João Pessoa, Ponta do Cabo Branco, intertidal, M.L. Christoffersen, 6 Oct 1969; USNM 222056, 1 ♀ (ovig.), Cebedelo, *Rio Paraíba do Norte* estuary, M.L. Christoffersen, 15 Feb 1980. *Bahia*: USNM 222053, 1 ♀, Prado Praia do Tororo, intertidal, M.L. Christoffersen, 12 Oct 1982; USNM 222058, 1 ♀ (ovig.), between Ponta Imbucuaba and Cumuruxtiba, corraline reef intertidal, M.L. Christoffersen,

J.S. Mourão, F.J. Mein, 4 Oct 1982. *Espírito Santo*: MZUSP 8615, 1 ♂, 1 ♀, Santa Cruz, H.R. Costa, 8 Jul 1970. *Rio de Janeiro*: MZUSP 8617, 2 ♀, Ilha da Marambaia, 1973; RMNH 28667, 1 ♂, 2 ♀, Septiba, H.R. da Costa, Apr 1958. *São Paulo*: RMNH 28664, 1 ♂, 2 ♀ ovig., São Francisco, taken at night from under stones, H.R. da Costa, Feb 1961; RMNH 28665, 6 ♂, 2 ♀, fragments, same, near Santos, under stones, H.R. da Costa, Jul 1961. *Paraná*: MZUSP (unnumbered), 2 ♂, 2 ♀ (1 ovig.), Isthmus of the Ilha de Canôbá, with *Phragmatopoma*, S.A. Rodrigues, 23 Mar 1978. *Santa Catarina*: RMNH 200A, 5 ♂ juvs., B.N. Basemente?, 10 Mar 1960; RMNH 206A, 1 ♀; USNM 251242, 1 ♂, 2 ♀, Ponta da Cruz, São Francisco, W.L. Schmitt, 29–31 Oct 1925; USNM 251408, 17 ♂, 25 ♀ (14 ovig.), São Francisco, W.L. Schmitt, sta 45–46, 28–29 Oct 1925.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites usually armed with ventral spines. T subrectangular. Carpus of cheliped usually with 2 strong spines on mesiodistal margin, sometimes with 1 strong spine and 1 smaller spine above it. P2 with proximal mesioventral spine and 1 or 2 distodorsal spines on merus; P3 with 1 or 2 distodorsal spines on merus; merus of P4 almost always with ventral spines.

DESCRIPTION.—Rostrum triangular; short, straight, or slightly downcurved, tip exceeding eyestalks in normal position; dorsal pair of strong subapical spines followed on each side by 2–3 spines and often separated from them by wide interval; posteriorly divergent lateral ridge bearing crest of 10–12 or more spines, strongest on process lateral to rostrum and diminishing posteriorly. Shoulder lateral to cervical groove bearing 1–4 spines, tubercles, or granules below intersection with thalassinidean line, and sometimes spine or granule above this juncture. Postocular spine present, occasionally doubled.

Abdominal sternites usually armed with ventral spines, tending to increase in prominence with age.

T with transverse proximal ridge continuous with inconspicuous lateral ridge at each side, transverse sector usually bearing single row of obsolescent granules.

Eyestalk stout, deepest at about midlength, concave dorsally, convex ventrally, obliquely erect in repose; prominent terminal cornea narrower than diameter of stalk.

A1 peduncle reaching to about proximal 1/4 of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article.

A2 peduncle with about 1/2 its length extending beyond tip of rostrum; article 2 bearing hooked subdistal ventral spine; scale oval, moderate in size.

Mxp3 bearing epipod.

Epistomial projection rather broad in lateral view, bearing 2 small apical spines, lower one occasionally obsolescent.

Chelipeds with coxa usually bearing slender spine on mesiodistal margin. Ventral margin of ischium bearing 2 unequal spines or single spine. Merus with row of 4–7 strong spines on ventral margin (occasionally spine at distal end of

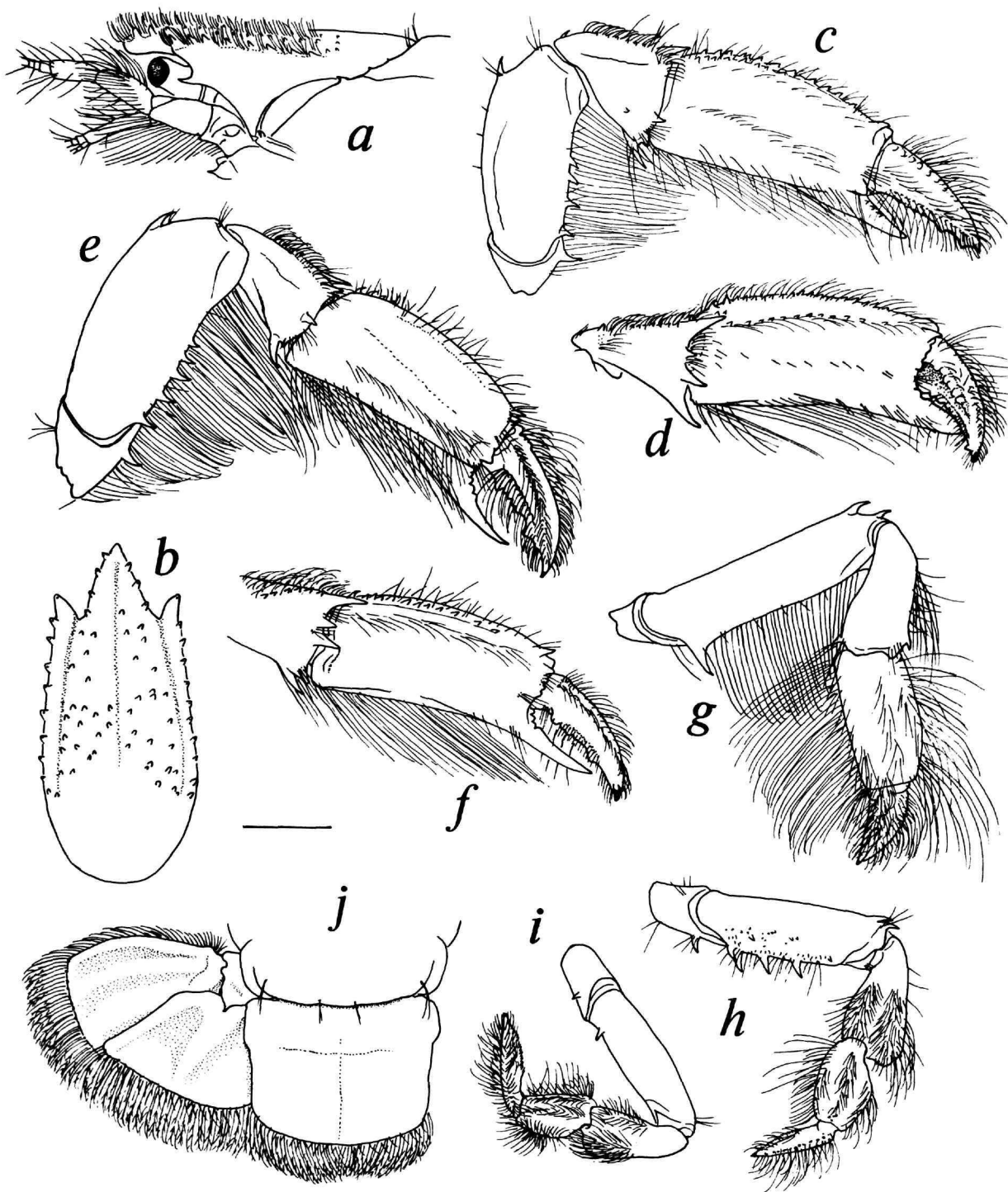


FIGURE 24.—*Upogebia omissa* Gomes Corrêa (a-d, g-j, USNM 25796, ♂; e, f, USNM 25795, ♀): a, cephalic region, lateral; b, anterior carapace, dorsal; c, cheliped, right lateral, ♂; d, chela and carpus, left mesial, ♂; e, cheliped, right lateral, ♀; f, chela and carpus, left mesial, ♀; g-i, legs 2-4; j, parts of abdominal segment 6, telson, and uropods, dorsal. (Scale = 2 mm.)

row reduced); single subdistal dorsal spine reaching level of postocular spine. Carpus trigonal, shallow longitudinal groove laterally, usually with strong spine at anterior ventrolateral corner preceded by 1 or more remote obsolescent spines; mesiodorsal crest of almost uniform small spines behind prominent spine on anterior margin, sometimes remote from it, and partly obscured by setae in proximal part of row, 3–4 short stout spines obscured by setae on anterodorsal margin mesial to articulation with propodus; 1 strong spine near middle of anteromesial margin, smaller spine dorsal to it, and very strong spine below at distoventral corner. Chl about 2.5–2.7 times chh in male, more slender in female; spineless dorsal ridge terminating anteriorly near stout subdistal spine mesial to it; mesiodorsal row of small spines, more erect proximally than distally, becoming obsolescent at about $\frac{2}{3}$ length; below this a row of obsolescent tubercles leading toward distomarginal spine below mesial dactylar condyle, margin below it bearing 1–3 small spines, row of small to obsolescent spines on lower mesial surface, low transversely arcuate ridge near proximomesial corner, and occasionally a tubercle near midlength on mesial side of ventral keel; lateral dactylar condyle with distomarginal spine below. Fixed finger shorter than dactyl and more slender, slightly downcurved in middle and tapering to slender tip, 3–6 teeth on proximal prehensile edge, sometimes clustered in 2 groups of 2 or 3 spines. Dactyl longitudinally ridged and setose; corneous tip in male preceded on prehensile edge (if not worn) by subdistal tooth, 2nd tooth at $\frac{3}{4}$ length often opposing tip of fixed finger, then crest of about 7 closely crowded small teeth increasing proximally to larger tooth at $\frac{1}{4}$ length, basal section toothless, concave mesial surface bearing 2 rows of pearliform tubercles in large male; corneous tip in female preceded by more or less straight prehensile edge, strong tooth at $\frac{2}{3}$ length opposing tip of fixed finger, section proximal to this with obscure small teeth, then large tooth at $\frac{1}{4}$ length, basal section toothless; curved extensor surface bearing 2–4 small tubercles proximally.

P2 reaching about to distal $\frac{1}{4}$ of palm; carpus with obsolescent distodorsal spine and tiny acute subdistal ventral spine; merus with 2 slender rather widely separated subdistal dorsal spines (distalmost rarely missing) and strong proximal mesioventral spine; coxa with variably expressed proximal spine and smaller distal spine mesially. Merus of P3 with 2 slender distodorsal spines, spine on distal margin smaller than subdistal one and occasionally missing, slender ventral spines on proximal $\frac{1}{2}$ and cluster of spines or spiniform granules ventrolaterally; ischium usually with single ventral spine but sometimes unarmed, coxa with spine lateral to gonopore. P4 usually with row of strong ventral spines on merus and ventral spine on ischium, but spines variable.

U with acute spine on protopod above base of mesial ramus; lateral ramus bearing blunter spine on mesial rib proximally; both rami with sharp granules along distal margin.

MEASUREMENTS (in mm).—♂, acl 7.9, cl 12.2, chl 9.0, chh 3.6; ♀, same, 7.7, 12.2, 6.4, 2.4.

TYPE LOCALITY.—Barra do Ceará, Fortaleza, Brazil.

KNOWN RANGE.—Confined to material examined.

HABITAT.—The species occurs from around the low tide mark to 9 m depths on reefs and in estuaries, generally under rocks (Coelho and Rattacaso, 1988).

REMARKS.—Clearly, there is considerable variation in the spinose ornamentation of this species. Spination on the abdominal sternites is distinctive, although partly suppressed in some individuals. The double distodorsal spines on the merus of P2 and P3 are fairly diagnostic, although some individuals have asymmetrical development of spine number; in one case the merus of these legs on a mature female bears 3 rather than 2 spines each. The merus of P4 usually is spined, but in some individuals it is spineless. Thistle's (1973) comment that there is no sexual dimorphism in the chelae must be modified, because there is some sexually dimorphic palm width and fixed-finger length. Males exhibit "false hermaphroditism," i.e., gonopores are present on the coxa of P3.

Some of the specimens from Trinidad have only 1 distodorsal spine on the merus of P2, and some of them exhibit absence of or extreme obsolescence of spines on the abdominal sternites. These variants, if compared with variants of *U. omissa* over a broad geographic range, appear to be from a population exhibiting provincial morphology. Much more complete sampling will be necessary before such levels of divergence from norms for the species can be evaluated critically.

Coelho and his associates studied a large series of this species, the most complete listing of which is in Coelho and Rattacaso (1988). They noted ovigerous females in all months of the year except March, July, and September; the material studied here does not alter this finding.

Lemos de Castro and Lima (1975) described a bopyrid isopod, *Parione tropica*, from specimens of *U. omissa* collected in Pernambuco, Brazil, and two other parasitized individuals have been observed (Coelho and Rattacaso, 1988).

Upogebia omissago, new species

FIGURE 25

MATERIAL EXAMINED.—BRAZIL: *Piauí*: USNM 222057, 1 ♀ (holotype), Luis Correia, Praia do Coqueiro, P.S. Young et al., 5 Aug 1982; USNM 251412, 1 ♂ (allotype), same; USNM 251413, 1 ♂, 2 ♀ (paratypes), same.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites unarmed. T subrectangular. Carpus of cheliped with 1 strong and 1 smaller spine on mesiodistal margin. Merus of P2 bearing 1 proximal mesioventral spine and 1 subdistal dorsal spine; merus of P3 with 1 distodorsal spine and rarely a subdistal spine in addition; merus of P4 spineless.

DESCRIPTION.—Rostrum triangular, short, straight to slightly downcurved in lateral view; tip exceeding slightly

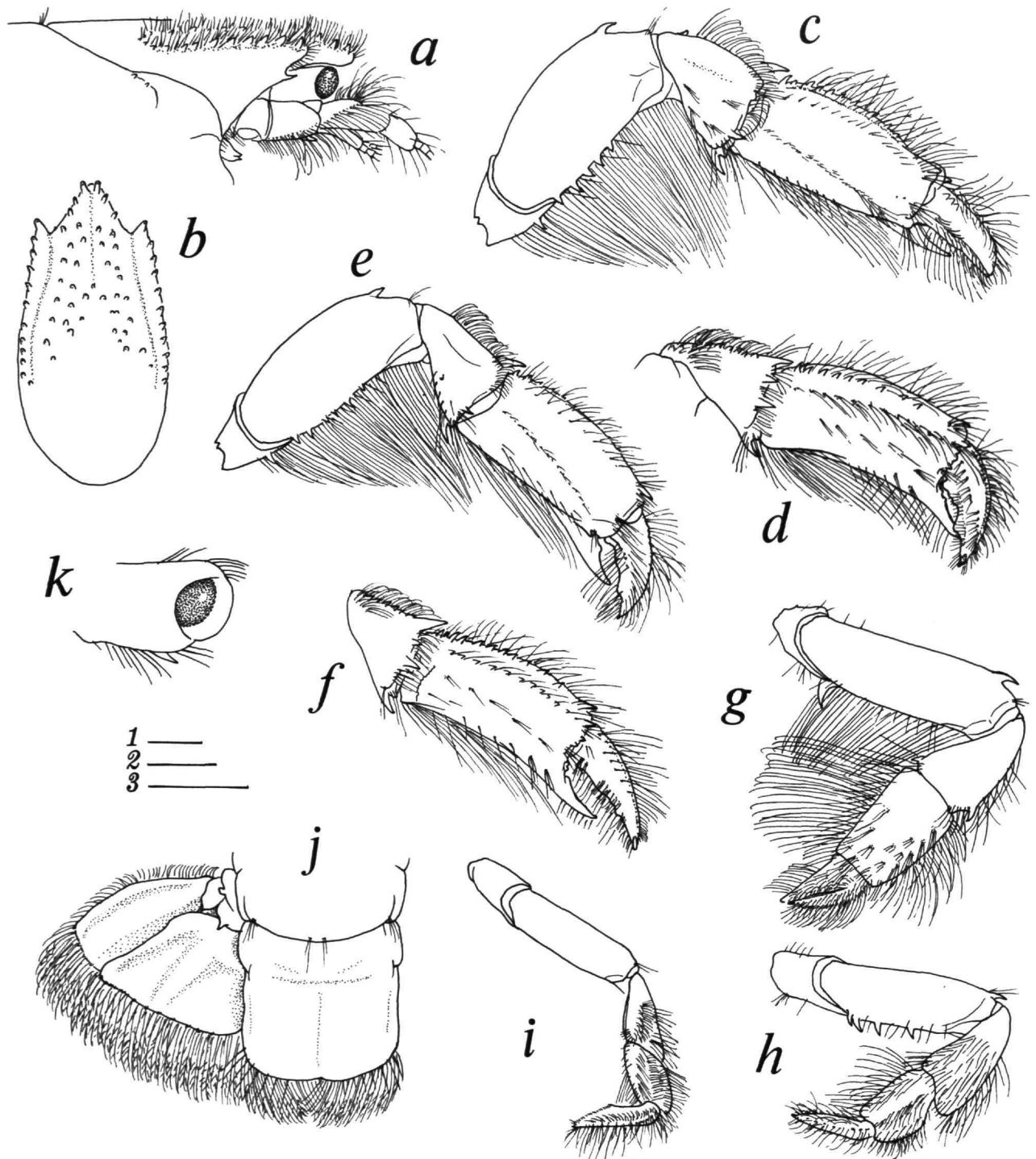


FIGURE 25.—*Upogebia omissago*, new species, *a-d, g, j, i*, USNM 222057, ♀ holotype; *e, f*, USNM 251412, ♂ allotype; *k*, USNM 225413, ♀ paratype): *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped right lateral, ♀; *d*, chela and carpus, left mesial, ♀; *e*, cheliped, right lateral, ♂; *f*, chela and carpus, left mesial, ♂; *g-i*, legs 2-4; *j*, parts of abdominal segment 6, telson, and uropods, dorsal; *k*, Right eyestalk showing ventral spine. (Scales = 1 mm: 1 = *a-d, g-i*; 2 = *e, f*; 3 = *k*.)

upturned eyestalks; dorsal pair of strong subapical spines followed on each side by 2–3 often remote spines; posteriorly divergent lateral ridge bearing crest of 11–13 spines, strongest on process lateral to rostrum and decreasing posteriorly. Shoulder lateral to cervical groove usually bearing 2 tubercles, sometimes 1 obsolescent tubercle, below intersection with thalassinidean line. Postocular spine present.

Abdominal sternites unarmed.

T subrectangular, prominent transverse proximal ridge confluent with inconspicuous lateral ridge at each side.

Eyestalk stout, more or less obliquely erect in repose, deepest at about midlength in lateral view, concave dorsally, convex ventral margin variably smooth or bearing 1–2 obsolescent spines, occasionally a single well-developed spine, prominent terminal cornea narrower than diameter of stalk.

A1 peduncle reaching to about $1/2$ length of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article.

A2 peduncle with about $1/3$ its length extending beyond tip of rostrum; article 2 bearing subdistal ventral spine; scale moderate, oval.

Mxp3 bearing epipod.

Epistomial projection rather broad in lateral view, bearing 2 small unequal apical spines.

Chelipeds with coxa bearing flattened, sometimes compound-tipped spine on mesiodistal margin. Ventral margin of ischium bearing 1 spine. Merus with row of 3–6 strong spines on ventral margin, number often bilaterally asymmetrical; subdistal dorsal spine (sometimes asymmetrically doubled) reaching level of postocular spine. Carpus trigonal, shallow longitudinal groove laterally, strong spine at anterior ventrolateral corner preceded by 1–3 much smaller spines; mesiodorsal crest of 5–6 small spines behind prominent dorsal spine on anterior margin partly obscured by setae, and 4–5 short stout spines obscured by setae on anterodorsal margin mesial to articulation with propodus; strong spine near middle of anteromesial margin, slightly smaller spine dorsal to it, and strong slender spine at distoventral corner. Chl about 2.5 times chh; spineless dorsal ridge terminating anteriorly near stout subdistal spine mesial to it; mesiodorsal row of 9–11 spines beginning with more or less erect spines proximally and becoming more or less obsolescent at about $2/3$ – $3/4$ length; poorly developed distomarginal spine below lateral and mesial dactylar condyles, 2–3 smaller spines ventral to mesial condyle on distal margin; mesial surface spineless, but longitudinal row of setal tufts paralleling mesiodorsal spines and sparser row below this, including 2–3 setal tufts above lower margin near base of fixed finger; low transversely arcuate ridge near proximomesial corner. Fixed finger shorter than dactyl, more slender, and tapering to slender tip, 3–4 teeth on proximal prehensile edge. Dactyl longitudinally ridged and setose; comeous tip in both male and female preceded on prehensile edge by unarmed interval, then strong tooth opposing tip of

fixed finger, preceded in turn by toothed crest increasing proximally to its greatest height in another strong tooth, and toothless section basally; curved extensor surface bearing about 2–3 small tubercles proximally; mesial aspect concave in both sexes.

P2 reaching about to distal $1/4$ of palm; carpus with acute distodorsal spine and tiny, nearly equal subdistal ventral spine; merus with well-developed subdistal dorsal spine and strong proximal mesioventral spine; coxa with variable blunt spine on proximomesial portion. Merus of P3 with slender distodorsal spine (additional nearly equal-size subdistal dorsal spine on right side in largest female paratype), 3–4 strong ventral spines and cluster of additional spines and spiniform tubercles proximolaterally near ischio-meral articulation; ischium unarmed and coxa with low spine lateral to gonopore. P4 with merus usually unarmed, occasionally a single proximoventral spine; ischium unarmed.

U with acute spine on protopod above base of mesial ramus; lateral ramus with mesial rib bearing blunt spine proximally.

MEASUREMENTS (in mm).—Holotype ♀, acl 6.1, cl 9.3, chl 4.8, chh 1.9; allotype ♂, same, 4.6, 6.5, 3.6, 1.4; largest paratype ♀, same, 7.7, 9.3, 4.8, 1.9.

KNOWN RANGE.—Confined to material examined.

REMARKS.—*Upogebia omisago* lacks sternal spines on the abdominal segments, a feature so characteristic of *U. omisssa*. *Upogebia omisago* differs from *U. omisssa* in possessing 1 subdistal dorsal spine on the merus of P2 and P3, but the largest female paratype atypically has 2 distodorsal spines on the merus of right P3. *Upogebia omisago* lacks spines on the merus of P4, whereas the merus of this leg in *U. omisssa* almost always bears spines on the ventral margin, and occasionally does in *U. inomisssa*. General spination of the carpus and palm of the cheliped of *U. omisago* is much as in *U. omisssa*, but spines of the mesiodorsal row are larger than in the latter; the pattern of spines on the fingers is the same in the two sexes of *U. omisago*, whereas males have stouter, more heavily toothed fingers in *U. omisssa*. The eyestalk of *U. omisago* tends to be spined ventrally, whereas it is unspined in both *U. omisssa* and *U. inomisssa*.

The geographic range of *Upogebia inomisssa* seems to be confined to the northern Gulf of Mexico and southern peninsular Florida, north of the much more widely distributed *U. omisssa*, which ranges from the Dominican Republic to southern Brazil. *Upogebia omisago* is known at present from a single locality in the Brazilian state of Piauí, well within the range of *U. omisssa*. At first, I tried to fit all three of these forms into a single taxonomic entity, the presumed parent species, *U. omisssa*, calling the two less-widely distributed forms mere variants of it. However, each of the two “variants” has a suite of characters that separates it from the fairly widespread sample set of *U. omisssa*; therefore, it seems best to regard each of the forms as specifically distinct.

ETYMOLOGY.—A Neo-Latin noun in apposition, derived from the Latin *omisssa* plus the suffix *-ago* (resembling).

Upogebia paraffinis, new species

FIGURE 26

Upogebia affinis.—Rathbun, 1900:151 [NE Brazil].—Williams, 1965a:103 [part, Brazilian distrib.]; 1974b:41 [same]; 1984a:191 [same]; 1986:12 [same].—Coelho, 1966:163, 168 [estuarine distrib.]; 1970:56 [same].—Gomes Corrêa, 1968:107 [Brazilian specimens, not figs. 16–21, 30, 31], 108 [key, part].—Coelho et al., 1970:508 [ecol., distrib.].—Thistle, 1973:1–14, 23 [part, Brazilian distrib.].—Williams and Wigley, 1977:9 [part, Brazilian distrib.].—Coelho and Ramos-Porto, 1987:33 [key, part], 36 [Brazilian distrib.].

Upogebia (Upogebia) affinis.—De Man, 1927:50 [part, Brazilian specimens]; 1928:22 [list, habitat, Brazilian specimens], 45, 46 [key appl. to Brazilian material].—Schmitt, 1935:196 [Brazilian distrib.].—Coelho and Ramos, 1972:163 [Brazilian distrib.].—Coelho and Rattacaso, 1988:383 [key, part], 384 [Brazilian distrib., ecol.].

MATERIAL EXAMINED.—BRAZIL: Ceará: MZUSP 8054, 1 ♂ (paratype), Ponta do Trapia, Camocim, Paulo Young, 6 Aug 1982. Paraíba: USNM 22055, 1 ♂, 1 ♀ (paratypes), Cabedelo, Rio Paraíba do Norte estuary, Ilha da Restinga, M.L. Christofferson, 13 May 1980. São Paulo: MZUSP 9103, 1 ♀, Praia do Codo, Saco da Ribera, Ubatuba, in *Halodule wrightii*, Jul 1986; MZUSP 8049, ♂ (holotype), 1 ♀ (allotype), Praia do Araçá, São Sebastião, S. Rodrigues, 10 Nov 1966; MZUSP (unnumbered), 1 ♂, 4 ♀ (2 ovig.) (paratypes), Praia do Araçá, São Sebastião, J.A. Peterson, 11 Nov 1966.

DIAGNOSIS.—Rostrum almost always with anteriorly projecting spine terminating ventral row of spines. Projections to either side of rostrum ending in strong spine. Postocular spine present. Abdominal sternites unarmed. T subrectangular. Carpus of cheliped with 2 very strong spines below mesiodorsal spine on mesiodistal margin. Merus of P2 with proximal mesioventral spine and 1 subdistal dorsal spine; merus of P3 with ventrolateral cluster of spines; merus of P4 spineless.

DESCRIPTION.—Rostrum triangular, slightly broader at base than long, slightly downturned; median ventral keel bearing 2–3 variably developed spines, anteriormost usually projecting strongly forward, usually exceeding eyestalks in normal position by $\frac{1}{3}$ – $\frac{1}{2}$ their length; dorsal pair of subapical spines followed on each side by 2–4 often asymmetrically arranged spines; middorsal area spineless; posteriorly divergent lateral ridge bearing crest of about 12 spines, strongest on process lateral to rostrum and decreasing almost to obsolescence posteriorly. Shoulder paralleling cervical groove bearing 1 spine below intersection with thalassinidean line. Postocular spine present.

Abdominal sternites unarmed.

T with well-developed median furrow, distal margin biarcuate; transverse proximal ridge confluent with lateral ridges unspined.

Eyestalk stout, deepest at about midlength, convex ventrally, almost straight dorsal side sometimes bearing 1 or 2 small spines and 1 or 2 tiny spines on basal flange; prominent terminal cornea narrower than diameter of stalk and directed ventrolaterally.

A1 peduncle reaching to about midlength of terminal article

of A2 peduncle, its proximal 2 articles together slightly longer than terminal article, proximal article with small distoventral angle mesially.

A2 peduncle with about $\frac{1}{3}$ its length extending beyond tip of rostrum; article 1 usually spineless ventrally, but sometimes bearing acute spine; article 2 bearing strong subdistal ventral spine; scale moderate, oval.

Mxp3 bearing epipod.

Epistomial projection rather broad in lateral view, bearing 1 strong spine at distodorsal corner.

Chelipeds with coxa in male bearing small spine on mesiodistal margin. Ventral margin of ischium usually bearing 1 strong spine, occasionally 2. Merus with row of 4–5 strong spines on ventral margin, distal ones sometimes diminishing in length, subdistal dorsal spine reaching level of postocular spine. Carpus trigonal, shallow longitudinal groove laterally, strong spine at anterior ventrolateral corner preceded by 1–3 spines (sometimes worn or suppressed); mesiodorsal crest of 5–7 almost uniform moderate spines leading to prominent spine on anterior margin, short strong dorsal spine or pair of unequal spines near articulation with merus partly obscured by setae; 2–3 strong spines on anterodorsal margin mesial to articulation with propodus; strong spine near middle of anteromesial margin, nearly equal spine dorsal to it, and very strong spine near distoventral corner. Ch1 about 1.8 times chh in male, about 2.5 times in female; spineless dorsal ridge with erect dorsal spine or pair of spines near its proximal end; mesiodorsal row of strong spines, more erect proximally than distally and sometimes irregular in size and position, those on female variable in size and becoming obsolescent distally; strong spine below lateral dactylar condyle, reinforced distal margin below mesial dactylar condyle bearing spine and 3–4 rounded spines below it in fully adult male, less well developed in female and immature male; mesial palmar surface bearing arched upper row of obsolescent spines, and male with irregular lower row of spines in proximal $\frac{1}{2}$ (obsolescent in female), ventral keel bearing row of 3–4 spines proximal to base of fixed finger, low transversely arcuate beaded ridge near proximomesial corner. Fixed finger shorter than dactyl and more slender, continuing contour of lower margin of palm, although slightly bowed ventrally, and tapering to strong rounded tip in male, slender acute tip in female, 3–7 small teeth on proximal prehensile edge. Dactyl tip in male (rarely corneous) preceded on prehensile edge by tooth at $\frac{2}{3}$ length opposing tip of fixed finger, then row of about 5 closely crowded ragged teeth ending proximally in larger tooth at proximal $\frac{1}{4}$ of length (sometimes only few large teeth in this row), and toothless section basally; arched extensor surface bearing rows of closely crowded beaded granules separated by grooves and/or dense setae, 1–2 dorsal spines or tubercles proximally but row becoming obsolescent distally, rows of similar beaded granules on mesial and submesial surfaces; corneous tip in female preceded by slightly curved prehensile edge, strong tooth at $\frac{1}{2}$ length opposing tip of fixed finger,

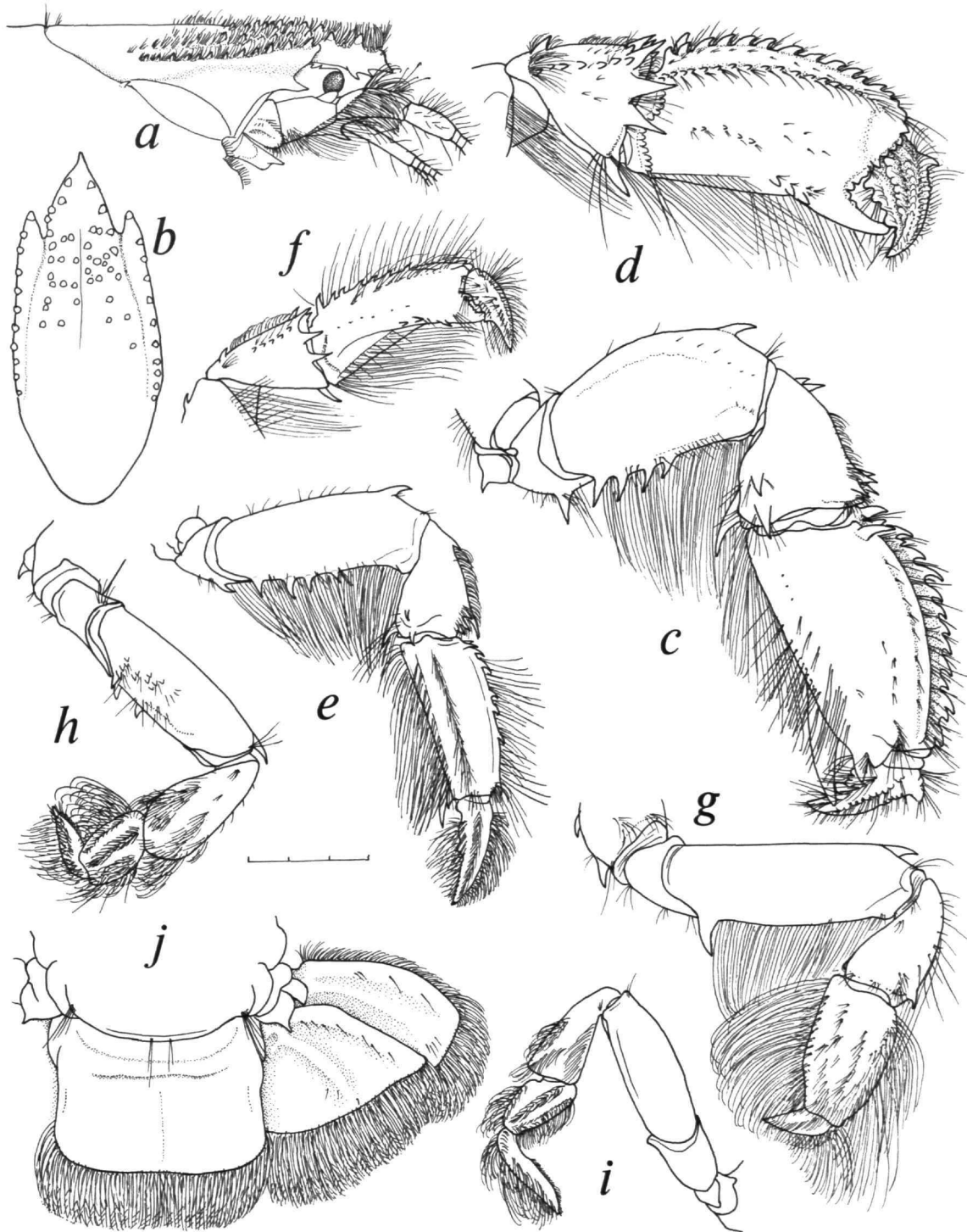


FIGURE 26.—*Upogebia paraffinis*, new species (USP 8049, *a-d, g-j*, ♂ holotype; *e, f*, ♀ allotype): *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral, ♂; *d*, chela and carpus, left mesial, ♂; *e*, cheliped, right lateral, ♀; *f*, chela and carpus, left mesial, ♀; *g-i*, legs 2-4; *j*, parts of abdominal segment 6, telson, and uropods, dorsal. (Scale = 3 mm.)

proximal to this a section with obscure small teeth, large tooth at $\frac{1}{4}$ length, and toothless section basally.

P2 reaching about to distal $\frac{1}{4}$ of palm; carpus with distodorsal spine and tiny acute or obsolescent subdistal ventral spine; merus with slender subdistal dorsal spine and strong proximal mesioventral spine; coxa with 2 acute spines of variable strength on mesial aspect. Merus of P3 with cluster of spines and spiniform granules ventrolaterally on proximal $\frac{1}{2}$, and strong distodorsal spine; coxa with low spine lateral to gonopore and minute spine on distomesial margin. P4 usually with spineless merus, rarely with 2 tiny lateral spines near ischium.

U with spine on protopod above base of mesial ramus; mesial rib of lateral ramus bearing an often blunt spine proximally; distal margin of rami bearing no granules.

MEASUREMENTS (in mm).—Holotype ♂, acl 8.2, cl 12.3, chl 6.9, chh 3.7.

KNOWN RANGE.—Known only from the material examined.

REMARKS.—*Upogebia affinis* has long been regarded as having a distribution ranging from the State of Massachusetts in the northeastern United States to Estado de São Paulo, Brazil (summarized in Williams, 1984b). Review of specimens from over this broad range shows that the pattern of spination is similar throughout, with variations, but the strength of spination is distributed individually or in distinct populations. The northern *U. affinis*, sensu stricto, generally is less strongly spined than the southern *U. paraffinis*. I regard these as two distinct species on the basis of spine strength alone. Aside from general spine development, which is difficult to quantify in keys for identification, the rostrum of *U. paraffinis* almost always has a prominent anteriorly directed terminal spine that is separated from the most anterior of the ventral rostral spines. Spines in this position, if present in *U. affinis*, are usually in an inferior position, not terminal. Moreover, presence or absence of granules on the distal margin of the uropods, a character usually relegated to secondary status, separates the two species; granules are present on *U. affinis*, but absent on *U. paraffinis*, the opposite of what one would expect on the basis of overall strength of ornamentation.

ETYMOLOGY.—From the Latin *par* (equal or like), plus *affinis*, for its nearest congener.

Upogebia pillsbury, new species

FIGURE 27

MATERIAL EXAMINED.—COLOMBIA: USNM 251435, 1 ♂ (holotype), Caribbean Sea off Cabo Tiburon, 08°41'N, 77°13'W, 57 m, R/V *Pillsbury* sta 412, 40-ft otter trawl, 18 Jul 1966; USNM 251436, 1 ♀ ovig. (allotype), same; USNM 251437, 5 ♂, 7 ♀ (4 ovig.) (paratypes), same.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Multiple spines and tubercles on postocular margin. Abdominal sternites unarmed. T subrectangular. Merus of cheliped with row of spines on both dorsal and ventral

margins; carpus with erect mesiodistal dorsal spine and 1 strong spine on mesiodistal margin. Merus of P2 lacking proximal mesioventral spine, but with 2 or 3 distodorsal spines, carpus with 4 or 5 dorsal spines and 1 distoventral spine. Merus of P3 with row of spines on dorsal and ventral margins; merus of P4 with cluster of ventrolateral spines and 1 dorsal spine or tubercle.

DESCRIPTION.—Rostrum linguiform, straight in lateral view, long, tip exceeding eyestalks by interval equal to their length; oblique ridge at either side of minutely granulate, rounded tip bearing 2–3 strong, erect spines curved slightly backward; median ventral keel bearing 5–6 spines curved anteroventrally. Pilose-armed field on anterior carapace arranged in row of about 10 short spines to either side of median furrow on rostrum and anterior gastric region, partly obscured by long setae, with row diverging posterolaterally on gastric region and continuing with 7–8 spines on edge of broad furrow lateral to it; gastric region with scattered small spines mesial to lateral row, but posterior region glabrous. Lateral ridge extended into process lateral to rostrum bearing crest of 8 spines on anterior $\frac{1}{2}$, and behind interruption at level of gastric region, 8 more spines on posterior divergent part. Shoulder lateral to cervical groove bearing about 4 spines above intersection with thalassinidean line, and 8–9 spines below this juncture; thalassinidean line continuing uninterrupted to posterior margin; gastroorbital region of carapace armed with 4 or 5 sharp spines and additional obsolescent spines; scattered spines variably developed above and below thalassinidean line between cervical and postcervical grooves, on anterior part of branchiostegite, and along ridge below hepatic groove. One or 2 postocular spines present, and other smaller variable spines on postocular margin.

Abdominal sternites unarmed.

T subrectangular, posterior margin shallowly biarcuate; slightly granular transverse proximal ridge, followed by cluster of obsolescent granules, confluent with lateral ridge at each side, bearing 1 or 2 small or obsolescent spines on anterior part and scattered obsolete spines or tubercles posteriorly; lateral margin bearing variably obsolescent granules or spines.

Eyestalk stout, horizontal, reaching midlength of rostrum; slight ventral angle in line with base of cornea and with obsolescent angle on dorsal margin, prominent terminal cornea narrower than diameter of stalk.

A1 peduncle reaching to about $\frac{1}{2}$ length of terminal article of A2 peduncle, its proximal 2 articles together slightly longer than terminal article; basal article bearing distoventral spine, middle article sometimes with ventral spine.

A2 peduncle with terminal article extending beyond tip of rostrum; article 2 bearing slender, curved, subdistal ventral spine and 2 smaller dorsal spines; third article with 2 slender curved ventral spines; moderate scale bearing anterolateral spine.

Mxp3 bearing epipod.

Epistomial projection rather broad in lateral view, bearing

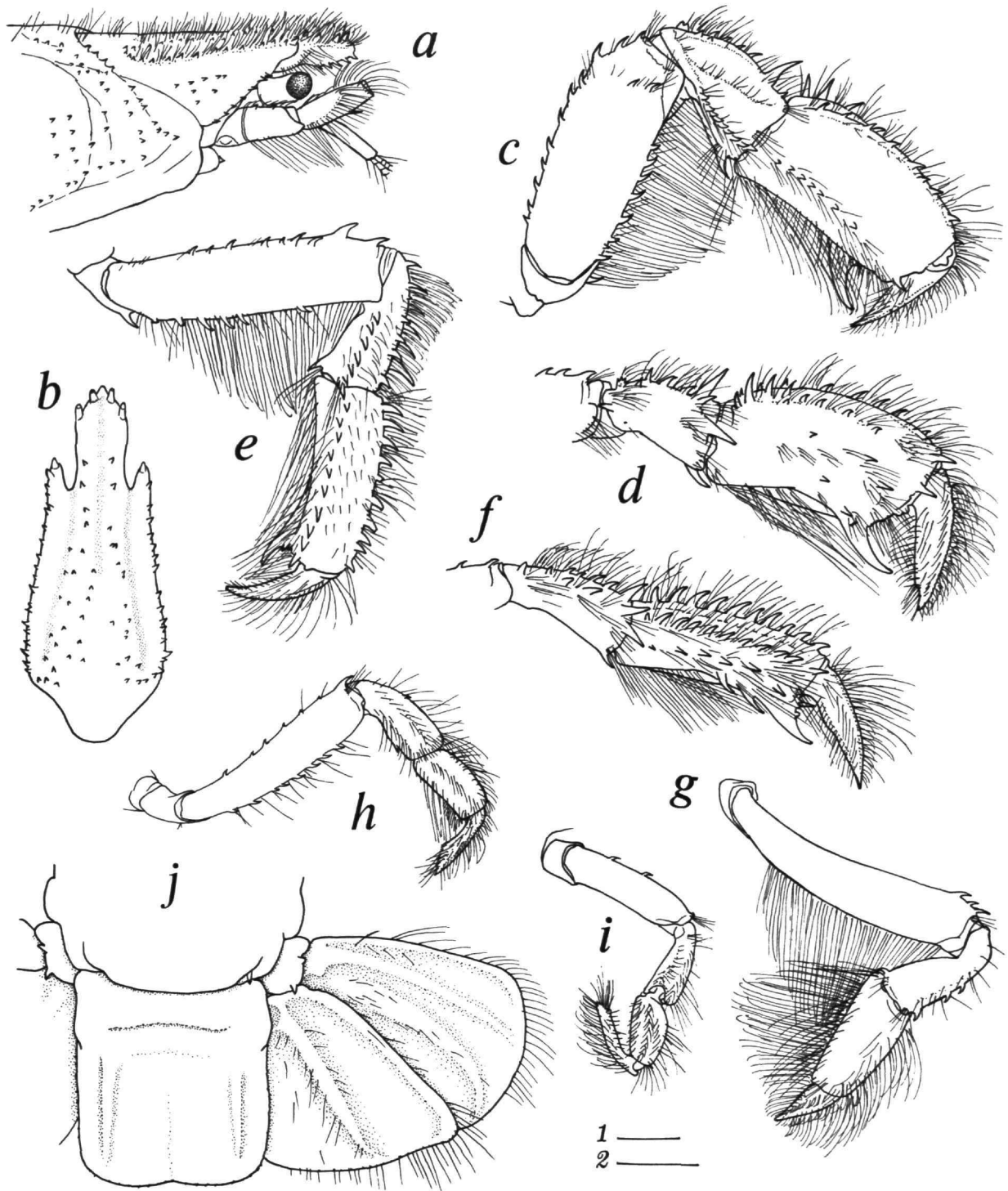


FIGURE 27.—*Upogebia pillsburyi*, new species (a-d, g-j, USNM 251435, ♂ holotype; e, f, USNM 251436, ♀ allotype): a, cephalic region, lateral; b, anterior carapace, dorsal; c, cheliped, right lateral, ♂; d, chela and carpus, left mesial, ♂; e, cheliped, right lateral, ♀; f, chela and carpus, mesial, ♀; g-i, legs 2-4; j, parts of abdominal segment 6, telson, and uropods, dorsal. (Scales = 2 mm: 1 = a,c,d, g-i; 2 = b,e,f,j.)

prominent apical spine.

Chelipeds much more massive in male than in female. Basis bearing mesial angle. Ventral margin of ischium bearing 1 spine. Merus with row of about 10 strong spines on ventral margin; about 10–12 less-erect spines on dorsal margin, except for distal 3 or 4 stronger spines reaching well beyond level of major postocular spines; an oblique row of spines leading from dorsal margin to lateral merocarpal condyle. Carpus trigonal, shallow longitudinal groove laterally, strong spine at anterior ventrolateral corner preceded by variable row of spines; mesiodorsal crest of 4–6 spines running from mesial merocarpal condyle to base of erect dorsal spine on anterior margin, short stout spine on anterodorsal margin mesial to articulation with propodus; strong spine on anteromesial margin and strong slender spine near distoventral corner. Chl about 2.5 times chh; dorsal row of 7–10 spines paralleled by mesiodorsal row of 8–10 spines more or less erect, strong proximally but becoming smaller or sometimes obsolescent distally, field of 4–8 or more scattered spines on mesiodistal surface below this; distomarginal spine below lateral and mesial dactylar condyles, extremely strong spine on distal margin ventral to mesial condyle, then row of about 10 smaller spines leading to hooked fixed finger shorter than dactyl and ending in slender tip. Dactyl hollowed on flexor surface but longitudinally ridged on extensor surface and setose, tip corneous.

P2 reaching about to distal $\frac{1}{4}$ of palm; carpus with 3–5 acute distodorsal spines and nearly equal subdistal ventral spine; merus with 2–3 slender distal spines on dorsal margin; coxa with proximal and distal raised areas mesially but no spines. Merus of P3 with 7–8 spines on ventral margin and 5–6 spines on dorsal margin, distal spines strongest; carpus with 0–2 tiny dorsal spines and ventral spine. Merus of P4 bearing 2–6 obsolescent ventrolateral spines or tubercles and 1 similar spine on middle of dorsal margin.

Two arthrobranchs arranged in 2 biserial rows of divided (rod-like) lamellae on Mxp3 and P1–4.

U with moderately acute spine on protopod above base of mesial ramus; lateral ramus with mesial rib bearing similar spine proximally; both rami exceeding telson.

MEASUREMENTS (in mm).—Holotype ♂, acI 9.2, cl 15.0, chl 6.4, chh 3.1; allotype ♀, same, 7.2, 11.3, 5.5, 1.7.

KNOWN RANGE.—Confined to material examined.

REMARKS.—*Upogebia pillsbury*, new species, one of the most distinctive species among western Atlantic members of the genus, seems to have a number of characters shared with other species. The linguiform rostrum with ventral spines bears some resemblance to that of *U. bermudensis* and to species of the Indo-Pacific genus *Gebiacantha* Ngoc-Ho, 1989a, although western Atlantic species with rostra more typical of *Upogebia* also have ventral spines (*U. spinistipula*, *U. affinis*, *U. felderi*, and *U. paraffinis*). Numerous spines on the anterolateral margin and along the cervical groove give it some resemblance to *U. jamaicensis*, although it is spinier than that species. The legs are long, longer than in *U. annae* and *U. casis*, and spinier

than any other species in the region. The uropods of *U. pillsbury*, *U. spinistipula*, and *U. bermudensis* overreach the telson, but the former two have a well-developed proximoventral spine on the merus of P2, whereas the latter lacks it. The arthrobranchs of *U. pillsbury* are arranged in two biserial rows of divided (rod-like) lamellae on Mxp3 and P1–4, whereas those of *U. bermudensis* appear to be arranged in biserial rows of undivided lamellae, and those of *U. spinistipula* seem intermediate between these types, being undivided but somewhat rod-like rather than flattened lamellae. The species thus exhibits a complex of specializations.

ETYMOLOGY.—The species name, from the University of Miami R/V *Pillsbury* whose cruises produced many collections of Upogebiidae, is treated as a noun in apposition.

Upogebia spinistipula Williams and Heard, 1991

FIGURES 28, 29

Upogebia spinistipula Williams and Heard, 1991:49, figs. 2, 3.

MATERIAL EXAMINED.—U.S.A.: Florida: FDNR EJ67315, 1 ♀, Gulf of Mexico, Hillsborough Co., 65 mi W Egmont Key, 27°37'N, 83°58'W, 55 m, R/V *Hernan Cortez* Hourglass Cruise HC43, sta D, dredge, R. Presley, 1 Sep 1967; USNM 239251, ♂ (holotype), MAFLA sta 2211, 27°56'29.5"N, 83°52'59.5"W, coarse sand, 43 m, Nov 1977; USNM 239252, ♀ (allotype), same, Jul 1976; USNM 239260, 11 ♂, 7 ♀ (2 ovig.), 1 juv. (paratypes), same, Jul 1975 (4 ♂ and 2 ♀ ovig. transferred to GCRL); USNM 239261, 2 ♂, 2 ♀ ovig., 2 other frags. (paratypes), same, Jul 1976; USNM 239262, 1 ♀ ovig. (paratype), same, Feb 1978; USNM 239265, detached legs, MAFLA sta 2211, 9 Aug 1977 and Feb 1978; USNM 239253, 3 ♀ ovig and 1 probable ♂ (paratypes), MAFLA sta 2528, 29°54'58.6"N, 86°04'58.5"W, coarse sand, 37 m, Feb 1977; 1 ♂ cephalothorax, same, Sep 1977; 2 ♀ (1 ovig.) (paratypes), same, Feb 1978; USNM 239254, 3 ♀ (1 frag.) (paratypes), MAFLA sta 2531, 29°47'58.9"N, 86°09'28.9"W; coarse sand, 45 m, 7 Feb 1976; 1 juv., same, Nov 1977; USNM 239255, 1 tiny cephalothorax, MAFLA sta 2532, 29°46'N, 86°12.5'W, coarse sand, 52 m, Jul 1976; USNM 239256, 1 ♀ ovig. (paratype), MAFLA sta 2533, 29°42'59.9"N, 85°15'28.6"W, coarse sand, 67 m, 26 Sep 1975; 1 tiny juv. (paratype), same, 8 Feb 1976; USNM 239257, 1 ♂ (paratype), MAFLA sta 2534, 29°40'N, 86°17'W, coarse sand, 73 m, Jul 1976; USNM 239258, 1 juv. (paratype), MAFLA sta 2419, 29°46'59.8"N, 84°05'00.2"W, medium fine sand, 10 m, Sep 1977; USNM 239259, 1 ♂ (paratype), MAFLA sta 2313, 28°23'59.3"N, 85°15'03.0"W, clayey, sandy silt, 177 m, 20 Jan 1976; USNM 239263, 4 juvs. (2 frags.) (paratypes), MAFLA sta 2748, 27°37.2'N, 83°53.5'W, coarse sand, 50 m, Jul 1976; 1 ♂, 2 ♀ (paratypes), same, Nov 1977; 1 juv. frags. (paratype), same, Feb 1978; USNM 239264, 1 postlarva (paratype), MAFLA sta 2959, 25°40'N, 83°05'W, silty, very fine sand, 60 m, 9 Aug 1977.

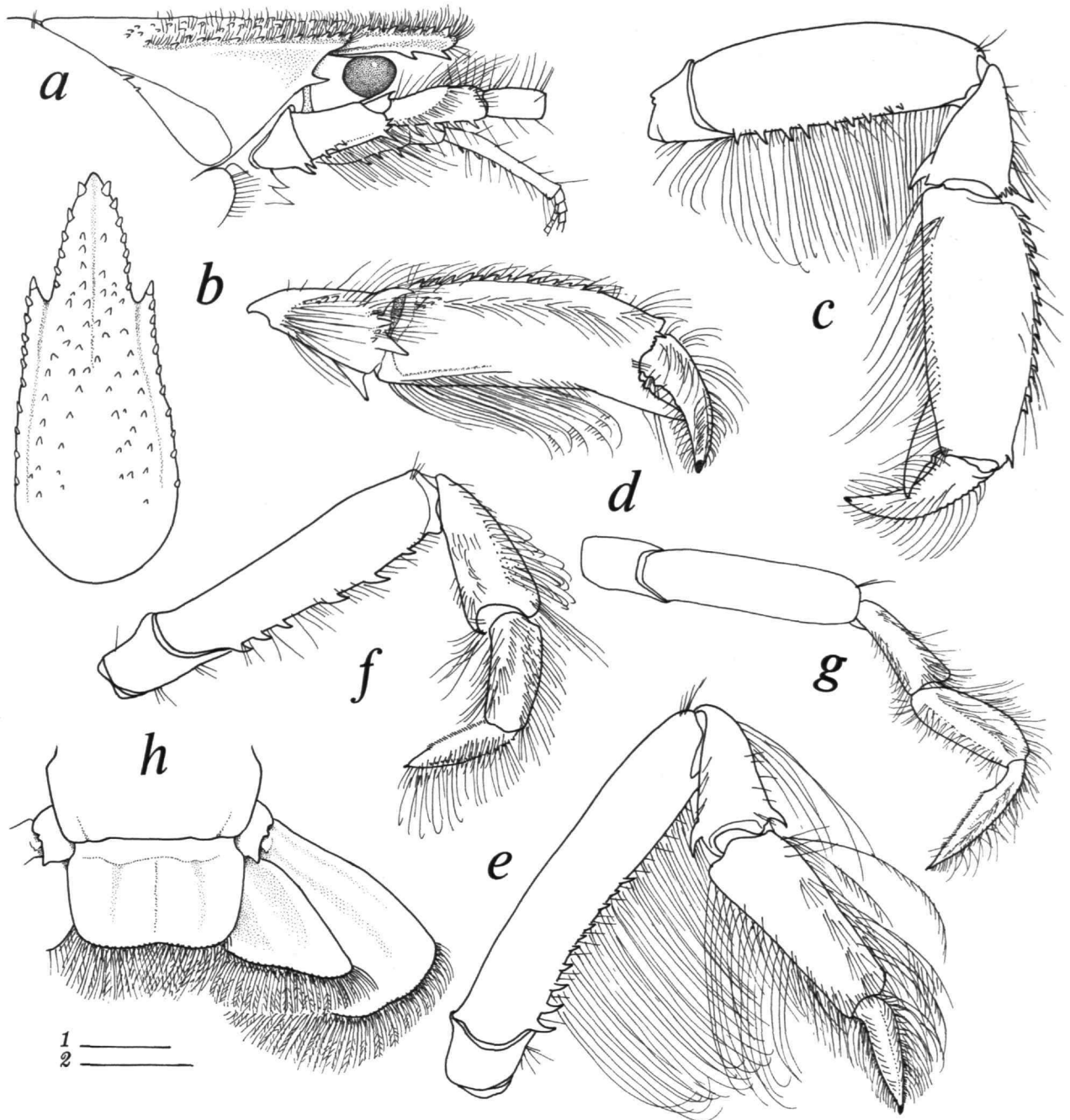


FIGURE 28.—*Upogebia spinistipula* Williams and Heard, USNM 239251, ♂ holotype (from Williams and Heard, 1991): a, cephalic region, lateral; b, anterior carapace, dorsal; c, cheliped, right lateral; d, chela and carpus, left mesial; e-g, legs 2-4; h, parts of abdominal segment 6, telson, and uropods, dorsal. (Scales = 1 mm: 1 = a,c,h; 2 = b, d-g.)

DIAGNOSIS.—Rostrum elongate subtriangular, bearing subapical pair of strong spines followed on each side by 5-7

strong spines. Projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites

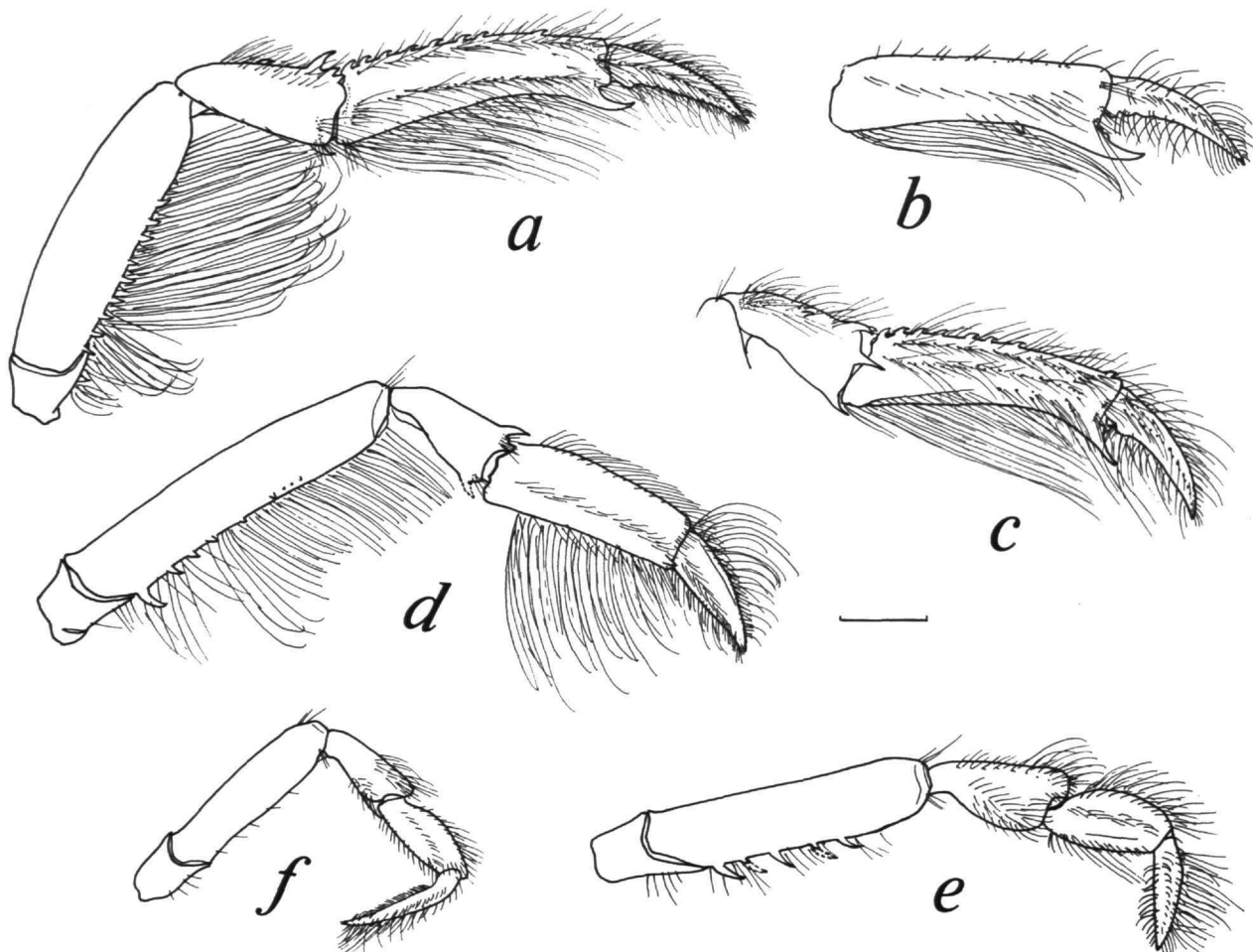


FIGURE 29.—*Upogebia spinistipula* Williams and Heard, USNM 239260, ♀ paratype: a, cheliped, right lateral; b, right chela rotated slightly to show ventral spine on palm; c, chela and carpus, left mesial; d-f, legs 2-4. (Scale 1 mm.)

unarmed. T subrectangular, posterior margin with slight concavity. A1 and A2 peduncles each bearing irregular row of ventral spines. Merus of cheliped lacking subdistal dorsal spine, carpus with 2 very small subequal spines on anteromesial margin. Merus of P2 with proximal mesioventral spine; merus of P4 spineless.

DESCRIPTION.—Rostrum subtriangular, narrow, straight in lateral view, tip exceeding eyestalks by distance at least $\frac{3}{4}$ their length; dorsal pair of strong, subapical spines followed on each lateral margin by 5-7 strong spines, ventral midline bearing 2-3 subapical ventral spines; dorsal surface bearing spiniform tubercles arranged more or less parallel to each lateral margin and confluent with field of similar spines on anterior $\frac{2}{3}$ of cephalic region; posteriorly divergent lateral ridge bearing crest

of about 8-10 spines, strongest on lateral rostral process and decreasing to obsolescence posteriorly. Shoulder flanking cervical groove bearing 1 or 2 spines below intersection with thalassinidean line; latter continued to posterior margin of carapace with slight interruption. Postocular spine present.

Abdominal sternites unarmed, tergites glabrous, very few setae on margin of pleura III-V.

T subrectangular, obsolescent transverse anterior ridge confluent with broader lateral ridge at each side, posterior margin with shallow concavity.

Eyestalk stout, concave dorsally, convex ventrally in lateral view; cornea as broad as distal diameter of stalk, directed anteriorly and laterally.

A1 peduncle reaching slightly beyond terminal article of A2

peduncle, its proximal 2 articles together slightly shorter than terminal article; uneven row of spines on ventral margin of articles 1, 2, and proximal $\frac{1}{2}$ of 3.

A2 peduncle with more than $\frac{1}{3}$ its length (terminal and distal part of penultimate article) extending beyond tip of rostrum, row of spines on ventrolateral margin of articles 1 and proximal part of 2, ventromesial spines on article 2 continued as ventral row on article 3; scale moderate, triangular, tapered to acute terminal spine; flagellum reaching beyond branchiostegite.

Mxp3 without epipod.

Epistomial projection subquadrate in lateral view, bearing 2 strong spines on anterodorsal corner.

Chelipeds with coxa bearing slender anteriorly hooked spine on posteromesial margin. Ventral margin of ischium spineless. Merus lacking subdistal dorsal spine, row of 9–11 slender variably sized and arranged spines or tubercles on ventral margin. Carpus trigonal, shallow longitudinal groove laterally, lacking submarginal spine at anterior ventrolateral corner; mesiodorsal crest of 3 moderate to strong spines behind prominent spine on anterior margin, 3 moderate spines on anterodorsal margin mesial to articulation with propodus; strong spine near middle of anteromesial margin and occasionally 1 or 2 smaller spines on margin above it, male sometimes with tubercles on proximomesial surface near anteromesial spines. Chl about 2.4 times chh in male, 5.5 times that in female; male with obsolescent dorsal ridge, mesiodorsal row of forwardly bent or hooked spines paralleling this, and on proximomesial margin beneath overhanging prominent anterodorsal spine of carpus an S-shape row of spiniform tubercles; distomarginal spine below mesial dactylar condyle, 1–3 smaller spines ventral to this on distal margin; female with lower mesial surface usually spineless, but male often with spine on ventral margin of palm about $\frac{2}{3}$ distance from proximal margin; low ridge running obliquely anteriorly from heel of palm to become obsolescent at midlength. Fixed finger short, slender, slightly downcurved in middle and tapering to slender tip, 2–5 obsolescent teeth on proximal prehensile edge. Dactyl far overreaching fixed finger, setose; toothless tip corneous.

P2–5 elongate and slender. P2 reaching about to distal $\frac{1}{4}$ of palm; carpus with slender, acute distodorsal spine and similar but smaller subdistal ventral spine; merus without subdistal dorsal spine, proximal mesioventral spine succeeded distally by 5–7 spines diminishing in size along row; coxa with strong proximomesial spine. P3 with merus bearing ventral row of 5–9 spines; ischium unarmed; coxa of female with flange-like low spine lateral to gonopore. P4 with merus and ischium unarmed.

Two arthrobranchs arranged in 2 biserial rows of undivided (entire but rather rod-like) lamellae on Mxp3 and P1–4.

U with ovate lateral ramus far overreaching subtriangular mesial ramus, tiny acute spine on protopod above base of mesial ramus.

MEASUREMENTS (in mm).—Holotype ♂, acl 6.8, cl 10.9, chl

7.7, chh 2.8; allotype ♀, same, 4.0, 6.8, 2.8, 0.77.

KNOWN RANGE.—Discovered in box core samples taken on the continental shelf of the northeastern Gulf of Mexico. The collections were part of a Minerals Management Service sponsored study referred to as the Mississippi-Alabama-Florida (MAFLA) Outer Continental Shelf Study. Specimens first came from 11 of the 87 MAFLA stations distributed in 9 transects that were sampled for benthic infauna. The species has been taken at stations scattered from southeast of Panama City, Florida, to west of Cape Romano in water depths ranging from 10 to 177 m.

REMARKS.—*Upogebia spinistipula* has an essentially retangular telson, being morphologically similar in this respect to the majority of upogebiid species in the western hemisphere, but it is overreached by the uropodal exopod. The species also differs from western Atlantic congeners in other respects. The spiny antennular and antennal peduncles, for which the species is named, are shared by no other known representatives in the region, but these articles are spined in the recently erected *Gebiacantha* Ngoc-Ho, 1989a, which contains several species from the Indo-West Pacific region. *Gebiacantha acutispina* (de Saint Laurent and Ngoc-Ho, 1979) and *G. reunionensis* Ngoc-Ho, 1989a are perhaps closest to *U. spinistipula* with respect to these structures. The relatively smooth chelipeds of *U. spinistipula*, however, are devoid of the strong ventral spines characteristic of all *Gebiacantha* species.

The long slender rostrum of *U. spinistipula* bears some resemblance to that of *U. lepta* Williams, 1986, from the eastern Pacific, but the dorsal surface of the rostrum of the former bears small spines in addition to those along the rostral margin, whereas the dorsal surface, except for the margin, is spineless in *U. lepta*. *Upogebia spinistipula*, therefore, seems to stand apart in a number of respects from other species in the family.

Upogebia vasquezi Ngoc-Ho, 1989

FIGURES 30, 31

Upogebia affinis.—Schmitt, 1936:375 [inferred occurrence].

Upogebia vasquezi Ngoc-Ho, 1989b:866, figs. 1, 2.—Markham et al., 1990:424 [distribution].

MATERIAL EXAMINED.—U.S.A.: Florida: USNM 251200, 1 ♀, St. Lucie Co., Ft. Pierce, Indian River, N side Fort Pierce Inlet, S side Coon Island, 27°28.2'N, 80°18.2'W, muddy, hard packed sand along shore, yabby pump, R.B. Manning FP-85-7, M.L. Reaka, W.D. Lee, H. Reichardt, 14 Aug 1985; USNM 251201, 1 ♀, same, R.B. Manning FP-88-3, W.D. Lee, M. Schotte, C. King, 21 Apr 1988; USNM 251240, 1 ♀, Indian River, Fort Pierce Inlet, 27°27'42"N, 080°18'42"W, on sandy flats with seagrass, exposed at low tide, yabby pump, R.B. Manning FP-89-4, R. Brown, W.D. Lee, 1.2 m (4 ft), 11 Aug 1989; USNM 251668, 2 ♂, Broward Co., John U. Lloyd State Park Beach Restoration Project, C. Messing, sta II-BA, Feb

1990; USNM 251429, 1 ♂, 1 ♀ ovig., Long Key, Dry Tortugas, sandy mud flat of seining beach, intertidal, taken with dipnet after explosion of dynamite charge, W.L. Schmitt, 16 Aug 1930.

BAHAMAS: USNM 251202, 3 ♂, 1 ♀ (ovig.), San Salvador, Pigeon Creek, mound at mouth of *Callianassa* burrow, H.A. Curran, Jun 1985.

TURKS AND CAICOS ISLANDS: USNM 251203, 1 ♂, 1 ♀ ovig., Pine Key, "Walk Cay," 1 m, yabby pump, R. Heard, 9 Apr 1988; USNM 251204, 4 ♂, 7 ♀ (3 ovig.), same, 14 Apr 1988; USNM 251205, 11 ♂, 11 ♀ (3 ovig.), same, 17 Apr 1988; USNM 251206, 1 ♂, 1 ♀ ovig., flats on S shore of Pine Cay near human shelter, 3 m, 1500, R. Heard, J.M., 15 Apr 1989 (1 ♂, 2 ♀ returned to R. Heard); USNM 251207, 8 ♂, 8 ♀ (6 ovig.), Pine Cay, south beach east Bonefish Cove, 50–100 m, 1 with bopyrid, R. Heard, 4 May 1990 (9 ♂, 9 ♀ returned to R. Heard); USNM 251208, 9 ♂, 10 ♀ (1 ovig.), Bonefish Cove, R. Heard, 13 May 1990 (10 ♂, 10 ♀ returned to R. Heard).

DOMINICAN REPUBLIC: AMNH 8771, 1 ♂, 3 ♀ (2 ovig.), El Cayo, sta 201, 6 Aug 1933.

LESSER ANTILLES: *St. Croix* (all collected by M.L. Reaka project; in following list, excr. = experimental coral rubble sun dried and placed on reef): Teague Bay: USNM 251366, 2 juvs., excr. placed on sand-sea grass floor of lagoon behind bank barrier reef, 3–4 m, DFRF-5A, 18 Sep 1981. Boiler Bay: USNM 251367, 1 ♀, naturally occurring dead coral rubble/beach rock, intertidal, BBI-1, 15 Oct 1980; USNM 251368, 1 ♀, 1 cephalothorax, 2 juvs., natural dead coral rubble on fringing reef with scattered sea grass, 3 m, BBS-4, 19 Aug 1980; 4 juvs., same habitat, BBS-2, 20 Oct 1980; 4 ♂, 2 ♀, frags., same habitat, BBS-1, 11 Feb 1981; juvs., same habitat, BBS col4 wk5, 19 Jul 1981. Salt River Canyon: USNM 251369, 2 juvs., excr. base cinder block artificial reef on sandy canyon floor, 20 m, MAV-3, 12 Jan 1981; USNM 251370, 1 ♂, 1 ♀ ovig., juvs. frags., excr. base cinder block artificial reef on sand/sea grass floor, 3 m, SIV-4, 29 Jun 1981; USNM 251371, 2 ♂, 1 ♀, 1 juv., natural dead coral rubble on back side of bank barrier reef, 3 m, SCon-9, 30 Jun 1981; 2 ♂, same habitat, SCon-4, 30 Jun 1981; 1 ♂, same habitat, SCon-4, 18 Jan 1982; 1 ♂, 1 ♀, excr. base cinder block artificial reef on sand/sea grass bottom back of bank barrier reef, 3–4 m, SAII-6, 17 May 1982; 2 ♂ juvs., 1 ♀ ovig., same habitat, SAIV-1, 17 May 1982. *Barbuda*: USNM 251215, 1 ♀, reefs off Martello Tower, S coast, Smithsonian-Bredin Exped., R/V *Freelance* sta 92-56, Nicholson, Schmitt, and Chace, 17 Apr 1956. *Antigua*: USNM 251724, 4 ♀, Tank Bay, English Harbor, Smithsonian-Bredin Exped., R/V *Freelance* sta 74-56, seine hauls on mud bottom, under rocks, oyster bar and along beach, Schmitt, Chace, Nicholson, Jackson, 3 Apr 1956; USNM 251216, 1 ♂, 2 ♀, beach N of Black's Point, Falmouth Harbor, cracked from rocks and coral, Smithsonian-Bredin Exped., R/V *Freelance* sta 110-59, 30 Apr 1959. *Martinique*: USNM 251217, 8 ♂, 4 ♀, 20 juvs., 14°25.2'N, 60°53.8'W, rocky shore, 0–2 m, R/V *Pillsbury* sta P-896, Pronoxfish, 8 Jul 1969. *Bar-*

bados: USNM 57951, 1 ♀ ovig., Pelican, Is., Univ. Iowa Barbados-Antigua Exped., shallows, 14 May 1918; USNM 68950, 1 ♀, same. *Tobago*: USNM 251218, 2 ♂, E of Pigeon Point, plankton tow and sponge in *Thalassia* beds near mangrove swamp, Smithsonian-Bredin Exped., R/V *Freelance* sta 30-59, W.L. Schmitt, 10 Apr 1959; USNM 251219, 2 ♂, Charlottesville, Pirate's Bay, E side Man of War Bay, sheltered cove, 1.5–3 m (5–10 ft), hand net in poison sta, Blum, Nizinski, Williams, Howe, Munro, and Schotte, 5 Sep 1990; USNM 251434, 1 ♀, Petit Trou, lagoon, sand-gravel bottom, patches of turtle grass, with *Callianassa*, 1–1.5 m, yabby pump, R.W. Heard, sta 9, 2 Apr 1992; USNM 251438, 1 ♂, 1 ♀, 2 juvs., Milford Bay near Pigeon Point, 11°09'N, 60°50'W, sand beach behind reef, dead coral rock washings, 1 m, R.W. Heard, sta 5, 7 Apr 1992.

MEXICO: *Quintana Roo*: USNM 251250, 1 ♀ ovig., Puerto Morelos, in old battery case S of old pier, 3 m, J.C. Markham, 520.4939010, 13 Sep 1986; USNM 251179, 1 ♂, 2 ♀, N of Ascension Bay, 200–300 yds SW of Suliman Pt. sand shallows, 0.6–1.5 m (2–5 ft), Smithsonian-Bredin Caribbean Exped. IV, R/V *Freelance*, sta 87-60, Bousfield, Daiber, Rehder, 17 Apr 1960.

PANAMA: USNM 251209, 4 ♂, Canal Zone, Galeta Island, 09°24.4'N, 79°52.35'W, ocean-side reef flat with tide pools, rock, and lithified algae, poison, 15 cm, hand, NMNH-STRI Panama Survey sta 2-3, R.B. Manning, J. Rosewater, C.A. Child, 17 Apr 1971; USNM 251210, 1 ♂, 1 ♀, 1 cephalothorax, Galeta Island, reef and shore near STRI lab, assoc. with *Thalassia*, sand, marl, mangrove, algae, Panama Survey sta 60-4, D.L. Pawson, J. Del Rosario, R. Brown, J. Rosewater, 9 Nov 1971; USNM 251239, 1 ♂, Colon, Galeta Island, reef flat across surge channel from STRI Lab., shore, *Thalassia*, algae, flood tide, 24.3°C, 33 ppt, 0–1 m, sta 1546, ichthyocide, Dawson et al., 29 Apr 1972; USNM 251211, 7 ♂, 4 ♀ (1 ovig.), San Blas, Isla Pico Feo, 09°33'07"N, 78°58'33"W, N shore, mud, sand, some rocks, algae, low flood tide, 0–0.8 m, 38°C, 35 ppt, C.E. Dawson and party, sta 1610, 7 Apr 1973; USNM 251725, 124 ♂, 27 ♀ (8 ovig.; 1 ♂, 4 ♀ with bopyrids), San Blas, Isla Pico Feo, N shore, 09°33'07"N, 78°58'33"W, mud, sand, some rock, algae, etc., flood tide, 0–0.75 m, 30.5°C, 29.7 ppt, C.E. Dawson and party, sta 1592, ichthyocide, 8 Nov 1972; USNM 251726, 58 ♂, 28 ♀ (5 ovig.), San Blas, Isla Mira, 09°32'58"N, 78°54'14"W, *Thalassia*, mangrove, sand, some rock, low flood tide, 0–1 m, C.E. Dawson and party, sta 1593, ichthyocide, 9 Nov 1972.

COLUMBIA: USNM 138900, 2 ♂, 2 ♀, Caribbean Sea, A.J. Provenzano, received 8 Apr 1964.

NETHERLANDS ANTILLES: RMNH 28670, 25 ♂, 30 ♀ (5 ovig.), fragments, Curaçao Bay just NW of Piscadera Bay, in burrows made in layer of oil washed ashore on beach, oil covered with sand, inside of burrows covered with thin film of sand, L.B. Holthuis no. 1088, 2 Feb 1957; RMNH 30966, 18 ♂, 17 ♀ (5 ovig.), Lac Bonaire, mouth at northern point of peninsula, in brown seaweed and algae, sand, L.B. Holthuis no.

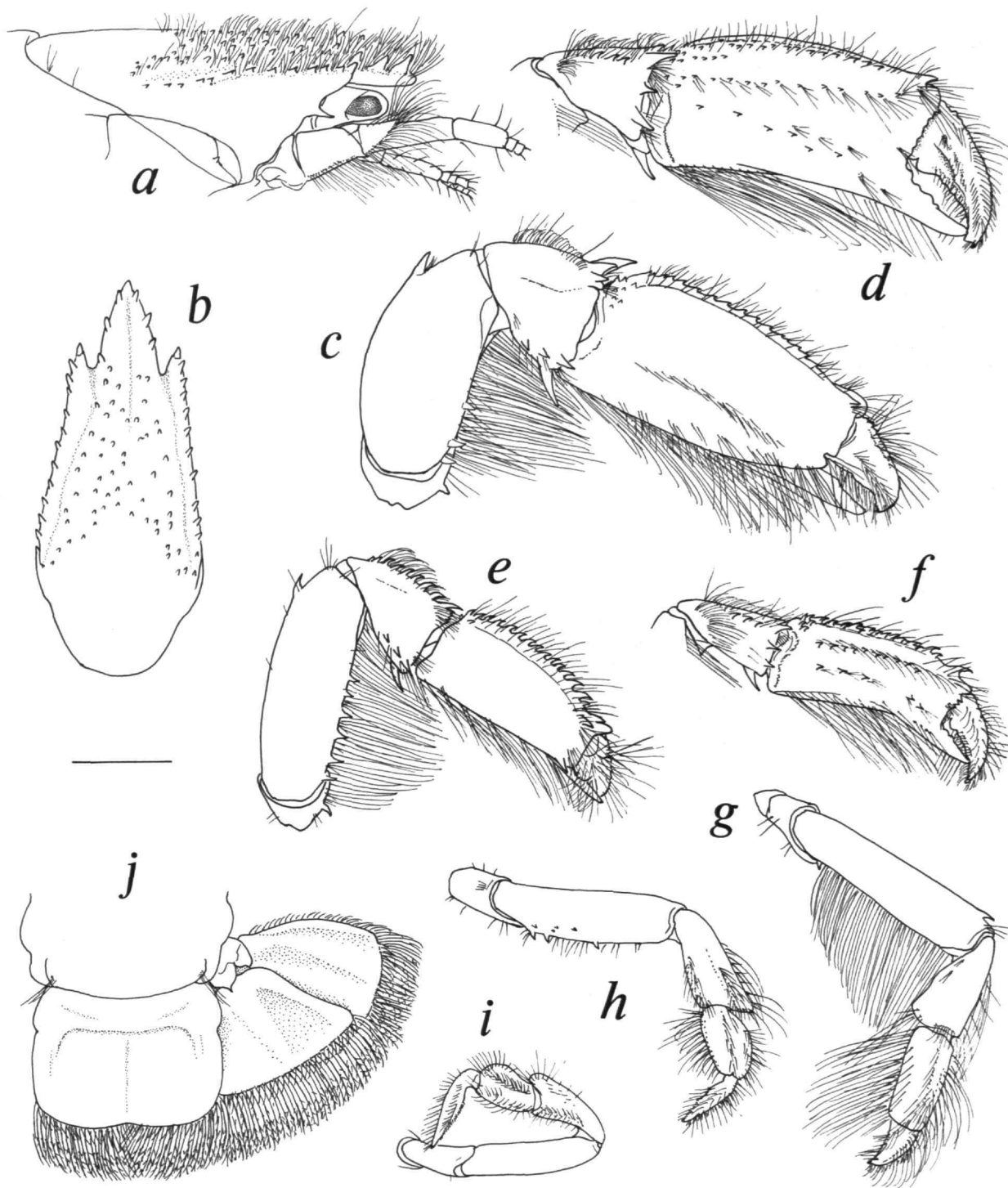


FIGURE 30.—*Upogebia vasquezii* Ngoc-Ho (a-d, g-j, USNM 251202, ♂, e, f, ♀): a, cephalic region, lateral; b, anterior carapace, dorsal; c, cheliped, right lateral, ♂; d, chela and carpus, left mesial, ♂; e, cheliped, right lateral, ♀; f, chela and carpus, left mesial, ♀; g-i (left), legs 2-4; j, parts of abdominal segment 6, telson, and uropods, dorsal. (Scale = 2 mm.)

1138, 6 Mar 1957; USNM 251212, 1 ♂, Aruba, Klein Lagoon, R. Lemaitre, 1 m, yabby pump, 6 Jan 1987; USNM 251213, 2 ♂, 2 ♀, same, 10 Jan 1987, 1.5 m; USNM 251214, 5 ♂, 3 ♀ (2 ovig.), same, west end of Commandeurs Bay, R. Lemaitre, 0.5 m, yabby pump [Jan 1987]; USNM 67423, 1 ♂, Bonaire, Lac, northern lagoon, seived out of sand with *Halimeda*, ~12 m, don. P. Hummelinck, 12 Oct 1933.

BRAZIL: *Natal:* USNM 251241, 1 ♂, 2 ♀, Natal, Stanford Exped., F. Baker, 1911. *Paraíba:* USNM 251220, 3 ♀ (1 ovig.), João Pessoa, Ponta do Cabo Branco, intertidal, M.L. Christoffersen, 4 Oct 1979. *Bahia:* USNM 251221, 1 ♂, 4 ♀ (3 ovig.), between Ponta Imbucuaba and Cumuruxitiba, coral-line reef, intertidal, M.L. Christoffersen, J.S. Mourão, J.F. Mein, 14 Oct 1982.

DIAGNOSIS.—Projections to either side of rostrum ending in acute spine. Postocular spine present. Abdominal sternites unarmed; T subrectangular. Carpus of cheliped with 2 spines on mesiodistal margin, palm with row of spines on mesiodistal surface. Merus of P2 with proximal mesioventral spine and 1 subdistal dorsal spine; merus of P4 without ventral spines.

DESCRIPTION.—Rostrum triangular, lateral margin longer than basal width, nearly straight in lateral view, tip exceeding eyestalks; dorsal pair of strong subapical spines followed on each side by 2 well-separated spines, median dorsal area spineless; posteriorly divergent lateral ridge bearing crest of about 12–14 spines, strongest on process lateral to rostrum and decreasing almost to obsolescence posteriorly. Shoulder lateral to cervical groove usually unarmed but sometimes bearing obsolescent granule below intersection with thalassinidean line, latter continuing strongly to posterior margin. Postocular spine present.

Abdominal sternites unarmed.

T bearing moderate transverse proximal ridge confluent with low longitudinal ridge to either side.

Eyestalk stout, deepest at about midlength, concave dorsally, convex ventrally, almost horizontal in repose; prominent oval, obliquely terminal cornea narrower than diameter of stalk and longer than deep.

A1 peduncle reaching about to base of terminal article of A2 peduncle (beyond midlength of terminal article in small male), its proximal 2 articles together slightly longer than terminal article.

A2 peduncle with almost $\frac{1}{3}$ its length extending beyond tip of rostrum; article 2 bearing tiny hooked subdistal ventral spine; scale moderate, oval.

Mxp3 bearing epipod.

Epistomial projection rather broad in lateral view, bearing 1 or 2 small apical projections.

Chelipeds with coxa bearing slender spine on mesiodistal margin. Ventral margin of ischium bearing 1 spine. Merus with row of 2–7 moderate to strong spines on ventral margin, decreasing in size distally; single subdistal dorsal spine reaching level of postocular spine. Carpus trigonal, shallow

longitudinal groove laterally, moderate spine at anterior ventrolateral corner preceded by 1–5 or more spines in adult, but spines at this site variable and sometimes obsolete; mesiodorsal crest of almost uniform small spines behind prominent spine on anterior margin, partly obscured by setae in proximal part of row, and 2–4 variable spines often obscured by setae on anterodorsal margin mesial to articulation with propodus; strong spine near middle of distomesial margin, slightly smaller spine dorsal to it, and very strong spine behind distoventral corner. Chl about 2.5–2.7 times chh; spineless dorsal ridge terminating anteriorly near stout subdistal spine mesial to it; mesiodorsal row of forward trending spines, usually about 12–15 and well developed, fewer in juveniles, but occasionally increased in number by intercalation of small supernumerary spines between “normal-size” spines, entire series becoming reduced in size but increased in number to as many as 25 in some individuals, spines becoming obsolescent near anterior margin, occasionally with few scattered spiniform granules or small spines near proximal end; below this another row of smaller spines on upper mesial surface; diagonal longitudinal row or tract of spines on mesioventral surface, strongest distally; variable spine and row of small rounded teeth or marginal tubercles on margin below mesial dactylar condyle; sinuous transverse granular ridge on mesial surface near proximal margin arising on rather sharp and occasionally granular ventral keel. Fixed finger shorter than dactyl and more slender, continuing curve of lower margin of palm or slightly more downcurved, and tapering to usually slender tip (sometimes worn and rounded), 3–4 irregular strong teeth on proximal prehensile edge. Dactyl with corneous tip in mature male preceded on prehensile edge by subdistal tooth, an interval, then row of ill-defined closely crowded small teeth increasing somewhat proximally to larger tooth near base, and toothless section basally; mesial more or less concave surface bearing 2 rows of closely crowded periform tubercles, upper row running nearly length of finger, lower row only $\frac{1}{2}$ as long; corneous tip in female preceded by more or less straight prehensile edge, sometimes strong tooth at $\frac{2}{3}$ length opposing tip of fixed finger, section proximal to this bearing obscure small teeth, then large tooth near base and toothless section basally; curved and slightly twisted extensor surface bearing 2 rows of small crowded tubercles diminishing to obsolescence distally, and, between these rows in mature individuals, 1 or 2 additional short proximal rows of granules.

P2 reaching about to midlength of palm; carpus with small acute distodorsal spine and smaller acute subdistal ventral spine; merus with subdistal dorsal spine and proximal mesioventral spine, sometimes obscure or worn; coxa with strong acute proximal and smaller mesial spine, both occasionally worn. Merus of P3 with row of ventral spines and scattered ventrolateral spines or spiniform granules on proximal $\frac{1}{2}$; coxa with mesial spine, broad and lateral to gonopore in female. P4 with spineless merus.

U with acute slender spine on protopod above base of mesial



FIGURE 31.—View of exposed tidal flat at low tide in Pigeon Creek, San Salvador, Bahamas, showing mounds cast up around mouths of callianassid burrows. Mounds are secondarily burrowed by *Upogebia vasquezi*. (Photo by H.H. Curran and E. Kotler, 1956.)

ramus; mesial rib of lateral ramus bearing tubercle proximally, distal margin of both rami bearing row of granules well-spaced apart.

MEASUREMENTS (in mm).—♂, acl 6.4, cl 8.8, chl 7.0, chh 2.8; ♂, same, 6.0, 8.3, 4.6, 1.5; ♂, same, 5.1, 7.4, 5.3, 2.3.

COLOR.—*Ovigerous female* (found dead after dynamite blast on tidal flat): Suffused with poppy red throughout. Anterior part of body, dorsum of carapace, and, to much lesser degree, branchial regions tinged with maize yellow, first abdominal segment same; alimentary tract maize yellow, giving abdomen a faint trace of this color; posterior 1/2 of abdominal segments II–V and all of epimeral regions red spotted; almost all of last abdominal segment same except 2 translucent white semicircular areas and 2 posterior spots with red dots; anterior central 1/2 of telson more or less red spotted, posterior and more lateral parts clear, quite transparent. Uropods clear transparent, except anterior margin and midriff red spotted, but ribs translucent white, and accessory rib of outer ramus between midrib and outer margin without red spots. Chelipeds with 2 double lines of small red dots on either margin of narrow flat upper surface of propodus, outer face of carpus, about base of white upper anterior carpal spine, on upper margin of merus, and on flat dorsal triangular area at junction with carpus. Other legs semiopaque translucent white (from field notes of W.L. Schmitt, 16 Aug 1930).

Living Male: Carapace anterior to cervical groove cinereous; abdominal segments with poppy red spots in all but clear

areas, but overlaid in some places by china blue, tints of this blue also on carapace; right cheliped and left chela without red spots seen on female described above; second legs with anterior part of meri red spotted; cornea of eyes black to clove brown (from field notes of W.L. Schmitt, 16 Aug 1930).

KNOWN RANGE.—Southeastern Florida and the Bahamas through the West Indies and Panama to northeastern Brazil.

REMARKS.—*Upogebia vasquezi* sometimes has been mistaken for *U. affinis* sensu lato, from which it differs in several respects. Chief among these is lack of spines on the ventral side of the rostrum and on the ventral keel of the chelae. Among the most distinguishing characters is the number of spines in the dorsal row on the chelae, which varies from 12–14 strong and forward trending to as many as 25 more or less erect small spines. Some individuals have both large and small spines in this row arrayed in varying numbers, in which cases the small spines are intercalated between the large ones. Strength of the spines does not appear to be associated with size, sex, or geography, small numerous spines being found on some large males and few coarse spines on still immature individuals. Another distinguishing character is a diagonally longitudinal row or tract of spines on the mesioventral surface of the palm. These spines vary from strong and acuminate to obsolescent, apparently bearing little or no relationship to sex or geography, and from as few as 2 in juveniles to as many as 7 in adults, grading in strength from small proximally to large distally. The

carpus of the cheliped in adults and many juveniles has a well-developed spine on the ventrolateral margin preceded by 1–5 or more smaller spines, but in some small individuals these spines may not be present at all.

Upogebia vasquezi first came to my attention in a collection of specimens taken from firm areas in coalesced sediment (pelloidal Ca_2CO_3 sand) cast up by a callianassid sp. around burrows in the intertidal flat of hypersaline Pigeon Creek, San Salvador (normally 42–44 ppt, tidal range about 70 cm) (Figure 30) that were sent to me for identification (H.A. Curran, Dept. Geology, Smith College, Northampton, Mass., pers. com. 15 Aug 1986). There the burrows of *U. vasquezi* almost always are inhabited by male : female pairs (examined examples of the latter often being ovigerous) and are basically Y-shape, as characteristic for *Upogebia* (see Dworschak, 1983), although the pattern is variously compounded by side branches or duplicate branches.

The disproportionate number of males and females in two large lots of specimens from Panama (USNM 251725, 124 ♂ : 27 ♀, and 251726, 58 ♂ : 28 ♀), among which almost all of the small individuals lack pleopods on the first abdominal segment (the male form), suggests protandry in this species.

The species appears to be widely distributed in nearshore habitats of the Caribbean region.

Upogebia incertae sedis

MATERIAL EXAMINED.—MEXICO: USNM 251409, Arrowsmith Bank E of Yucatan, 21°05'N, 86°23'W, burrows from burrow system of unknown species of *Upogebia* in coral rock (dry), 146–265 m, R/V Pillsbury sta 581, 10-ft otter trawl, 22 May 1967, labeled "puis va *Upogebia petalura*."

Phylogenetic Considerations

Two regions of the body provide primary bases for differentiating subgroups within the family Upogebiidae and for comparing it to other families within the Thalassinidea. These are the conformation of the anterior carapace and the posterior abdomen, which are variously modified to a burrowing mode of life. The dorsally flattened, spiny, setose surface of the anterior carapace, so characteristic of the upogebiids in a multitude of variations, seems to be adapted for anchoring the animal within its burrow and perhaps serves as a means of filtration or channelization of respiratory water currents, especially among species that burrow within sediment. The caudal complex of abdominal segment VI, telson, and uropods takes the general form of a tail fan characteristic of many long-tailed decapod crustaceans that used it for retrograde swimming by cupped contraction of the flexible abdomen; but the tail fan would seem rarely to function this way in burrowers, and it shows specializations in species that are known to be borers in stony coral or that live in the canals of sponges.

Features of these regions of the body, as enumerated in the following list, have long been used to distinguish species, subgenera, and genera, but character bases for the latter have become compromised as alleged gaps between them have been closed by the growing number of recognized species.

1. Rostrum triangular in dorsal view (primitive) or strap-like in shape (advanced). Almost all species of Upogebiidae have a rostrum that is basically triangular in dorsal outline. Rarely is the rostrum nearly parallel sided, hence strap-like in outline, perhaps being thus narrowed to provide room for the eyes. The latter condition is known in only one small species among those in the western hemisphere.

2. Dorsal spines and setae on rostrum confluent with flattened field of spines and setae on gastric region (advanced). This is a common feature of the family, but some species lack spines and/or setae on the rostrum and gastric region, and related thalassinideans lack this combination feature (primitive).

3. Lateral groove flanking armed gastric field, present in majority of upogebiids, that itself is flanked laterally by a crest armed dorsally with spines and ending in an anterior projection flanking the base of the rostrum (advanced). The lateral groove perhaps acts as a filtering channel for respiratory water currents. Some forms living commensally in sponges or corals lack this feature or exhibit it in reduced form.

4. The rostrum usually bears no ventral spines, but in some species, such as, *Upogebia affinis*, there are from 0 to 8 ventral spines, with spinelessness or few weak spines being the predominant state. However, a few species have well-developed ventral rostral spines whose shape and arrangement are almost diagnostic. This is a multistate character.

5. The cervical groove is emphasized by a shoulder that parallels it lateroventrally. This shoulder is usually spineless, although there are often tubercles just below its juncture with the thalassinidean line, and in a few species the shoulder bears a row of spines.

6. The anterolateral margin bears from 0 to 1 to several spines. The genus *Calliadne*, considered a subgenus by some authors, was characterized as having the spineless condition. One spine in a postorbital position is by far the commonest condition, and multiple spines are found in a few species. Both 5 and 6 are multistate characters that often track together.

7. The linea thalassinica is variously developed in the Thalassinidea. It seems to be universally present in the Upogebiidae and Callianassidae, which are specialized burrowing forms, but it is not present in some other families of the group. Absence of the linea thalassinica may be the primitive condition, but there is no certainty about this.

8. Appendix masculina present on the male second pleopod (primitive) or absent. Loss of this appendix seems to be universal in the Upogebiidae, but it is present in Axiidae and Callianassidae.

9. Tail fan normal (primitive) or opercular (advanced). This structure in most upogebiids consists of a telson and uropods

articulated with abdominal segment VI to form a caudal swimming fan, but in some coral boring species this complex is modified into an operculum with an eroded and rugose surface that serves as a plug that can be inserted into the burrow opening.

10. The normal tail fan is arranged around a telson that is (a) subtriangular, tapering to a broadly truncate tip, (b) roughly rectangular, having a posterior margin slightly narrower than the anterior margin and straight or barely biconvex, or (c) noticeably concave in posterior margin. The latter condition has been used as one of the defining characters of the genus *Gebiacantha*.

11. The normal tail fan has uropodal lateral rami that are equal in length to the mesial rami and the telson (primitive), but in some species the lateral rami are noticeably longer than the mesial rami or telson (advanced).

12. Abdominal segment VI is adapted in all Upogebiidae to interlock with the protopodite of the extended uropod. The

usual state of this lateral margin is sinuous (primitive), but in some species the anterolateral sinuosity is drawn into a hooked process, and in still others the margin is drawn into a lateral process (advanced).

13. There is sketchy evidence that species commensal in sponges have few or moderate numbers of large eggs, hence abbreviated larval development, whereas the usual condition among noncommensal burrowers is many small eggs (primitive), with extended larval development in plankton. Data are insufficient to categorize species in these putative groups at present.

14. *Calliadne* originally was described as having fingers of the chelipeds equal in length. They are, but many species having fingers of equal length do not fit other presumed descriptors for this genus. Rather, these equal fingers may have distinctive tooth patterns that correlate with large egg size. Data are insufficient at present to categorize species having these features.

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