

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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# 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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*Austin B. Williams, National Marine Fisheries Service Systematics Laboratory, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560.*

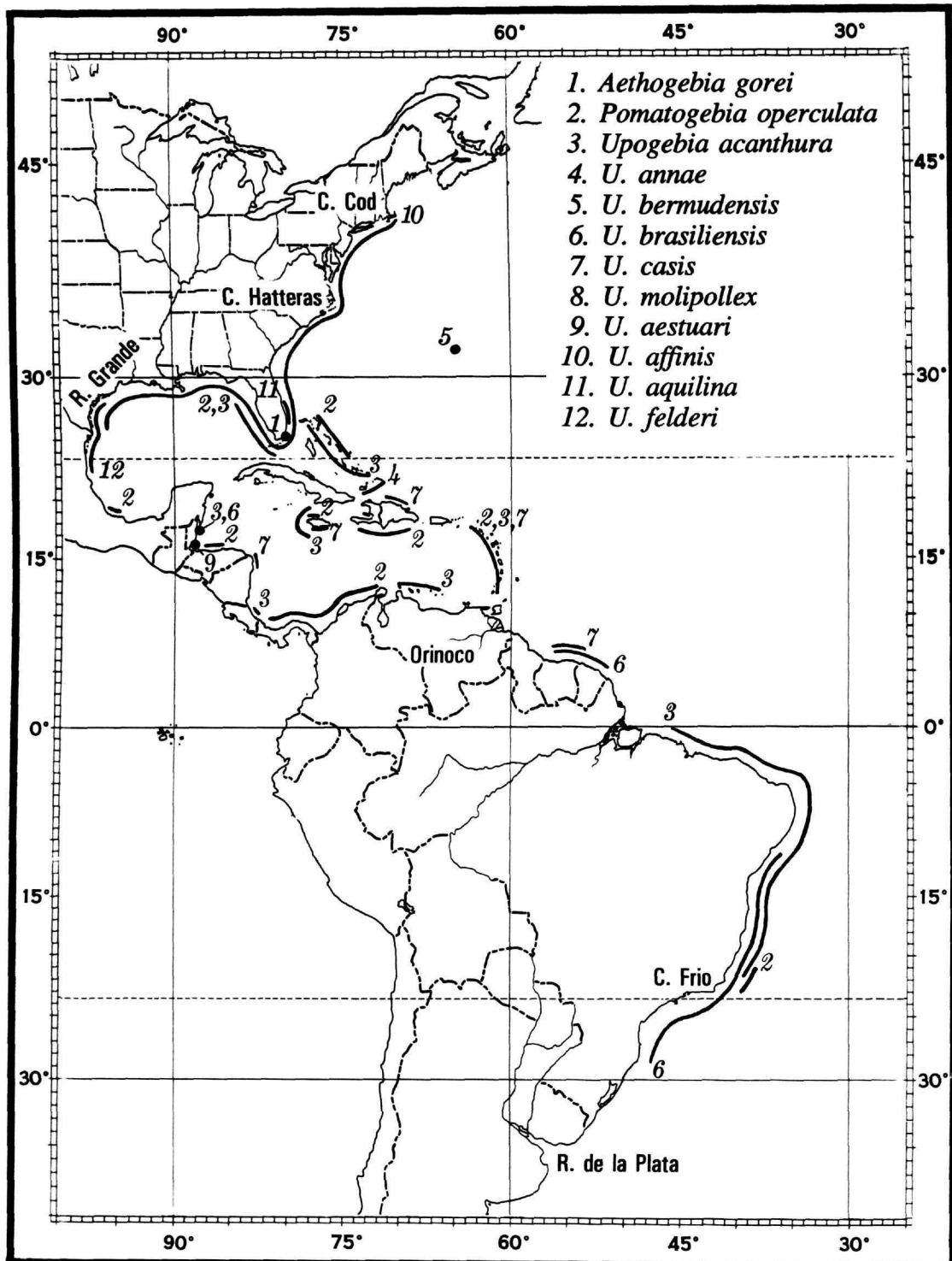


FIGURE 1.—Distributional ranges from Massachusetts, U.S.A., to southern Brazil of 12 western Atlantic species of Upogebiidae. Numbers for listed species are associated with appropriate range lines or restricted localities.



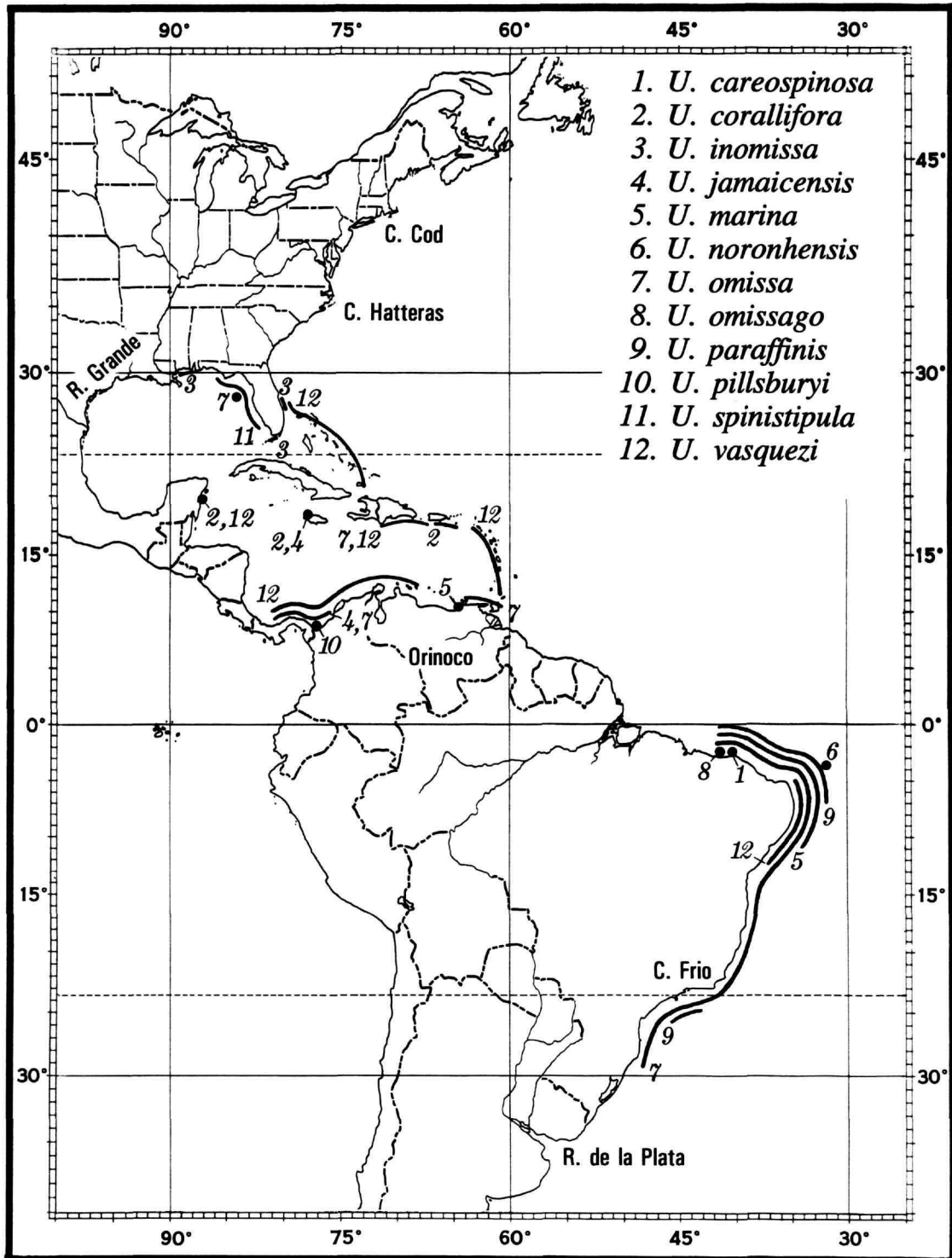


FIGURE 2.—Distributional ranges from Florida, U.S.A., to southern Brazil of 12 western Atlantic species of Upogebiidae. Numbers for listed species are associated with appropriate range lines or restricted localities.

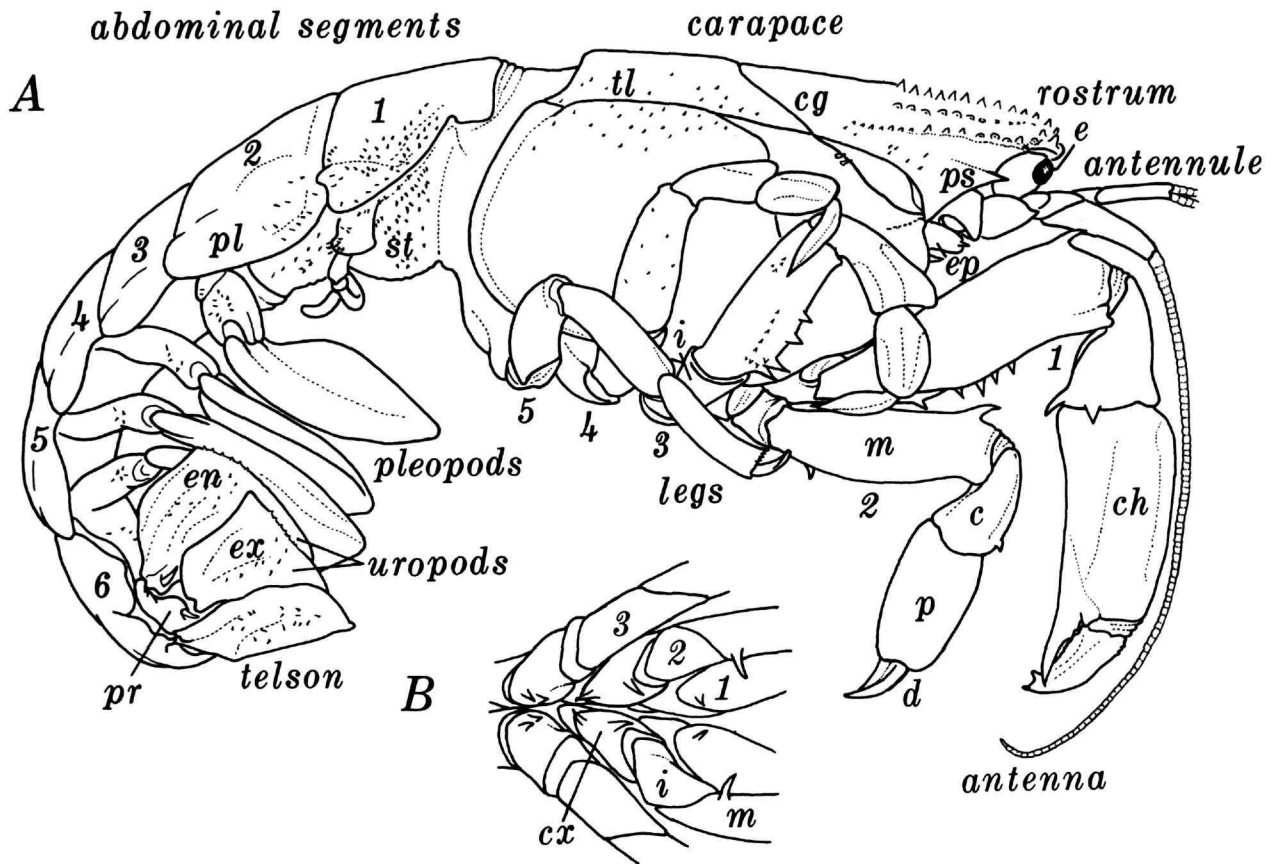


FIGURE 3.—Schematic drawing of upogebiid: A, animal in lateral view; B, coxa and associated articles of legs 1-3 in ventral view; c, carpus; cg, cervical groove; ch, cheliped; cx, coxa (sometimes spined); d, dactyl; e, eye; en, endopodite; ex, exopodite; i, ischium; m, merus (sometimes spined proximally); 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 upogebiid 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).

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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.	
	Lacking strong proximal spine on merus of second leg.
	<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
	Spine on merus of second leg absent or reduced to tubercle.
	<i>Upogebia annae</i> Thistle, A
	<i>Upogebia casis</i> , new species, A
	Strong proximal spine on merus of second leg.
	<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 coralliflora</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> Coêlho, 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
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.	
	<i>Aethogebia gorei</i> , new genus and species, A
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.	
	<i>Upogebia acanthura</i> (Coêlho), A
	<i>Upogebia ramphula</i> Williams, 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.	
	<i>Pomatogebia cocosia</i> Williams, P
	<i>Pomatogebia operculata</i> (Schmitt), A
	<i>Pomatogebia rugosa</i> (Lockington), P

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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

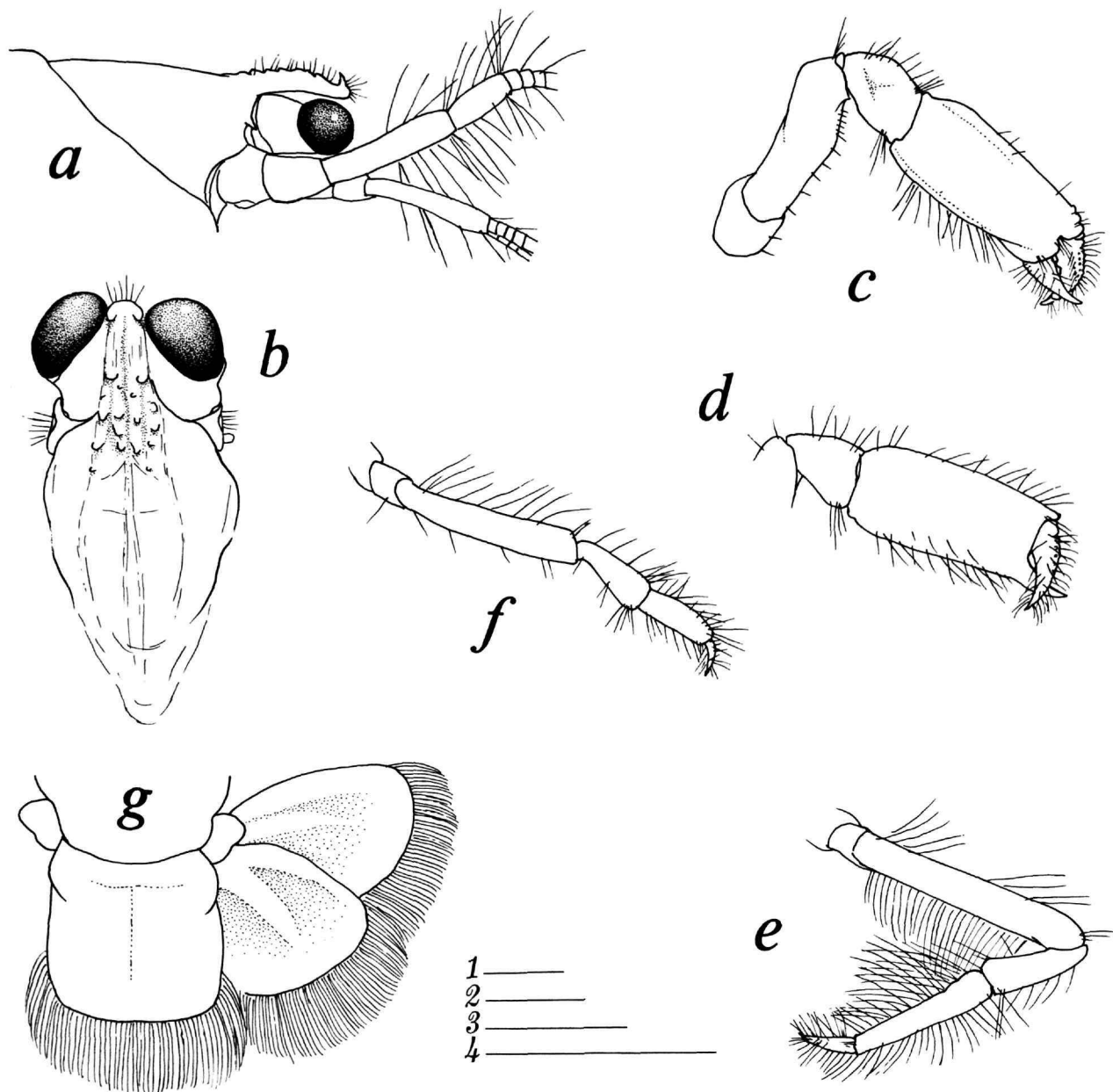


FIGURE 4.—*Aethogetia gorei*, new species, USNM 251425, ♂ holotype: *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e, f*, legs 2, 3; *g*, part of abdominal segment 6, telson, and uropods, dorsal. (Scales = 1 mm: 1 = *c-f*; 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 arthrobranchs 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 194?; 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.

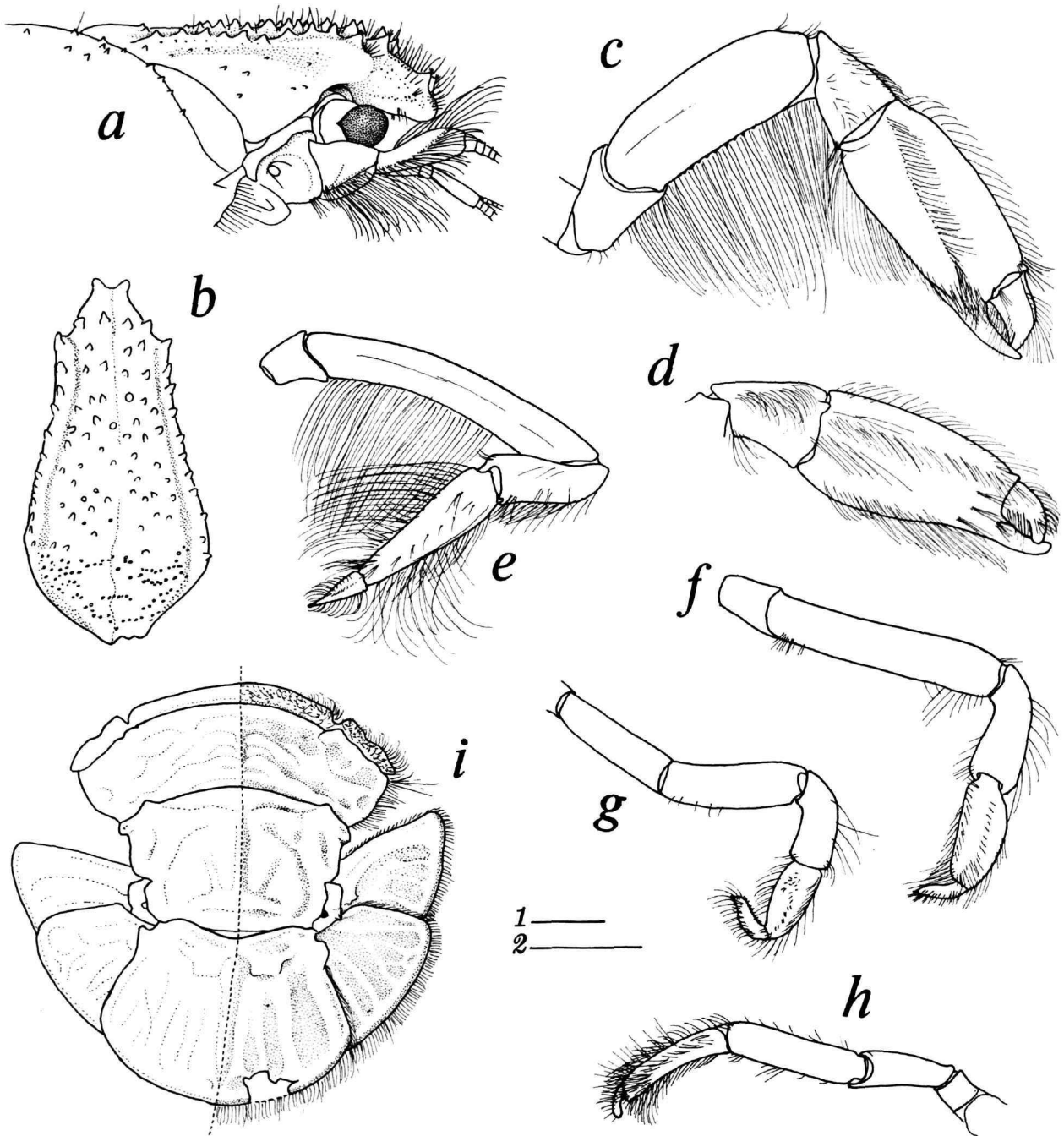


FIGURE 5.—*Pomatogebia operculata* (Schmitt), USNM 57952, ♀ paratype (*a, b, i* from Williams and Ngoc-Ho, 1991); *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e-h*, legs 2-5; *i*, abdominal segments 4 (part), 5, 6, telson, 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 CaCO<sub>3</sub> 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)

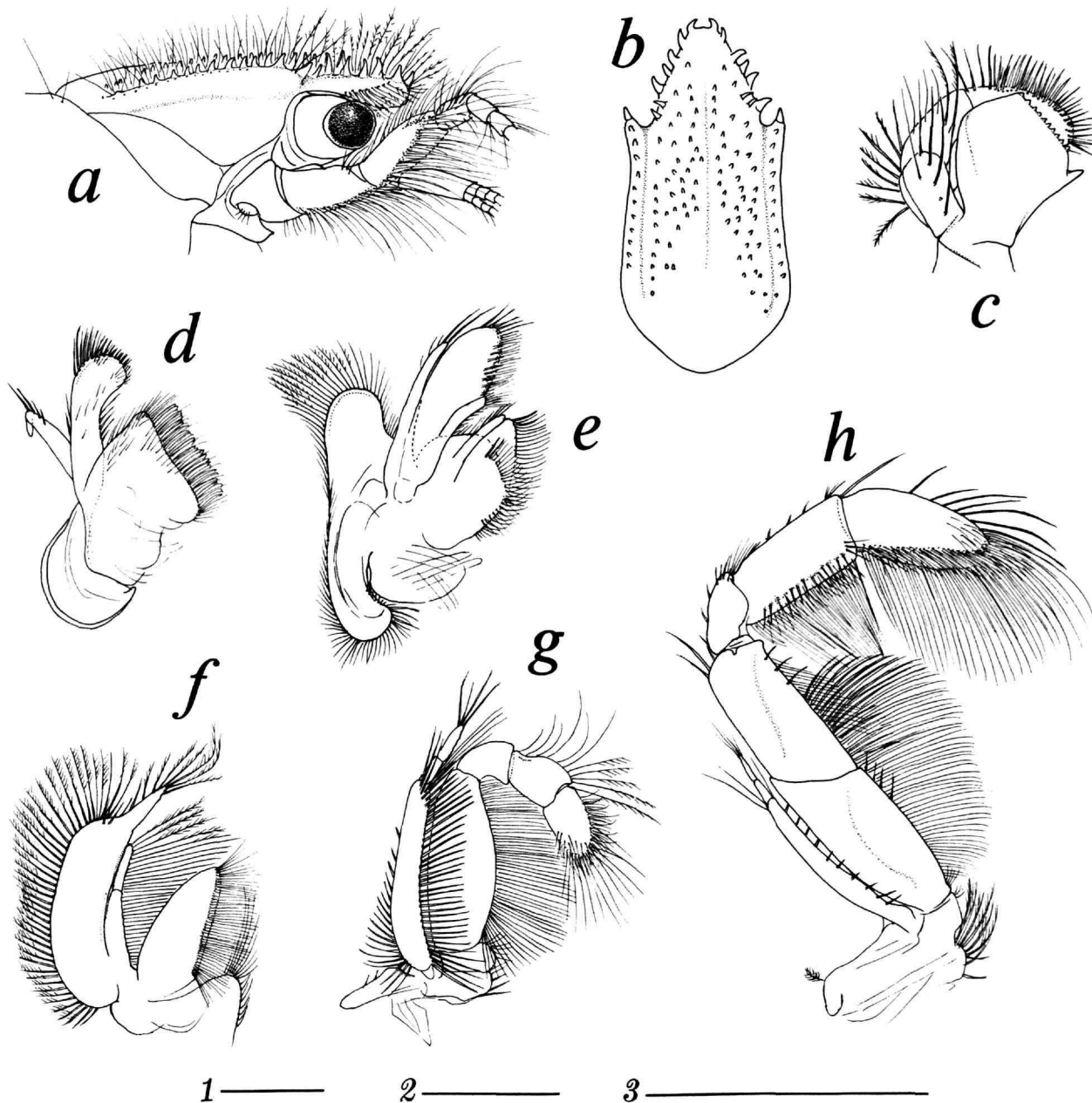


FIGURE 6.—*Upogebia acanthura* (Coêlho), USNM 233572, ♂ (from Williams, 1987): a, cephalic region, lateral; b, anterior carapace, dorsal; c, mandible; d, e, maxilla 1, 2; f-h, maxillipeds 1-3. (Scales = 1 mm: 1 = a, b; 2 = c; 3 = d-h.)

*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  $0.81 \times 0.94$  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



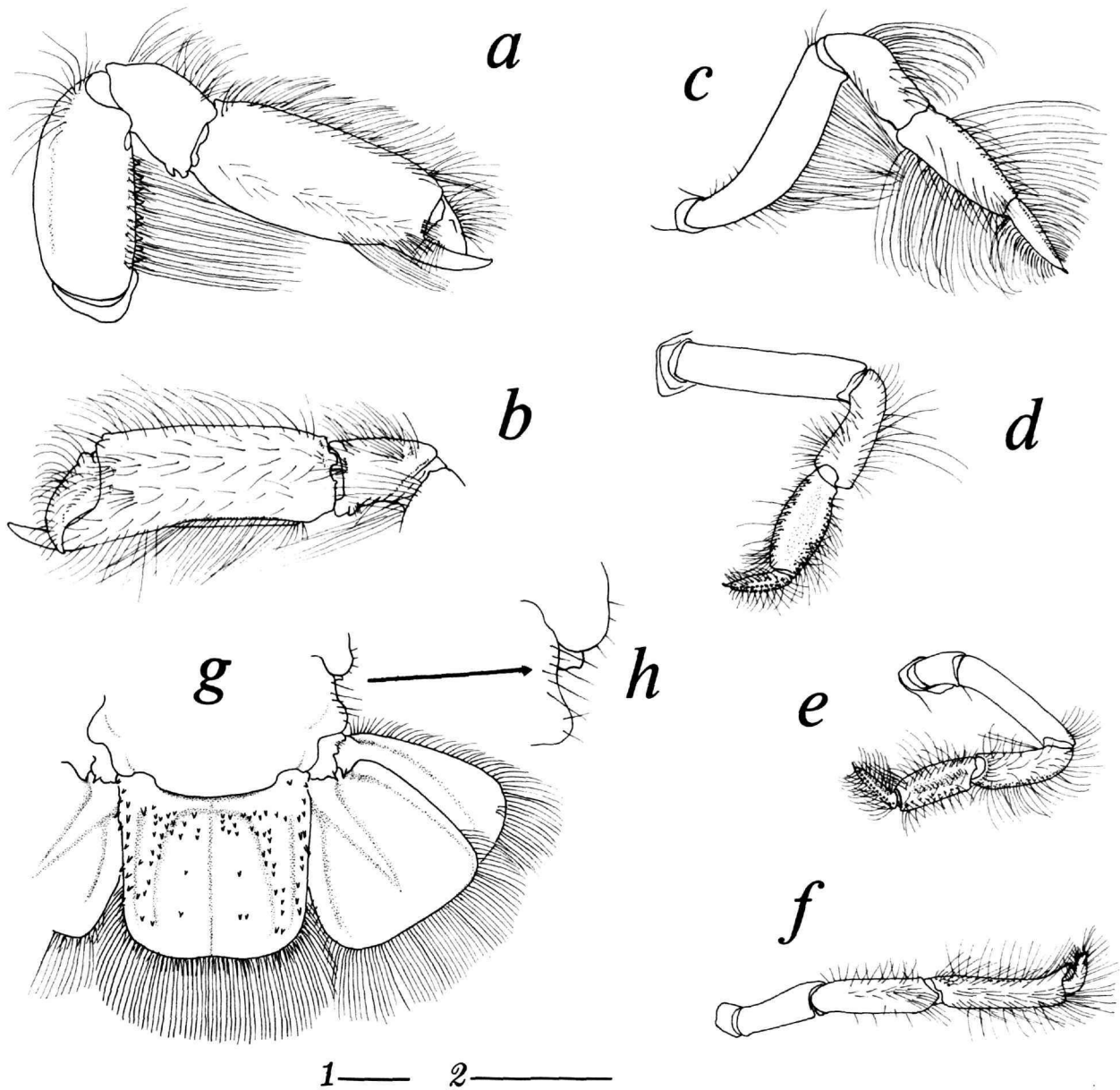


FIGURE 7.—*Upogebia acanthura* (Coelho), USNM 233572, ♂ (from Williams 1987): *a*, cheliped, right lateral; *b*, chela and carpus, right mesial; *c-e, f*, legs 2-5; *g*, parts of abdominal segment 6, telson, and uropods, dorsal; *h*, parts of lateral margin, segments 5, 6. (Scales = 1 mm: 1 = *a-g*;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

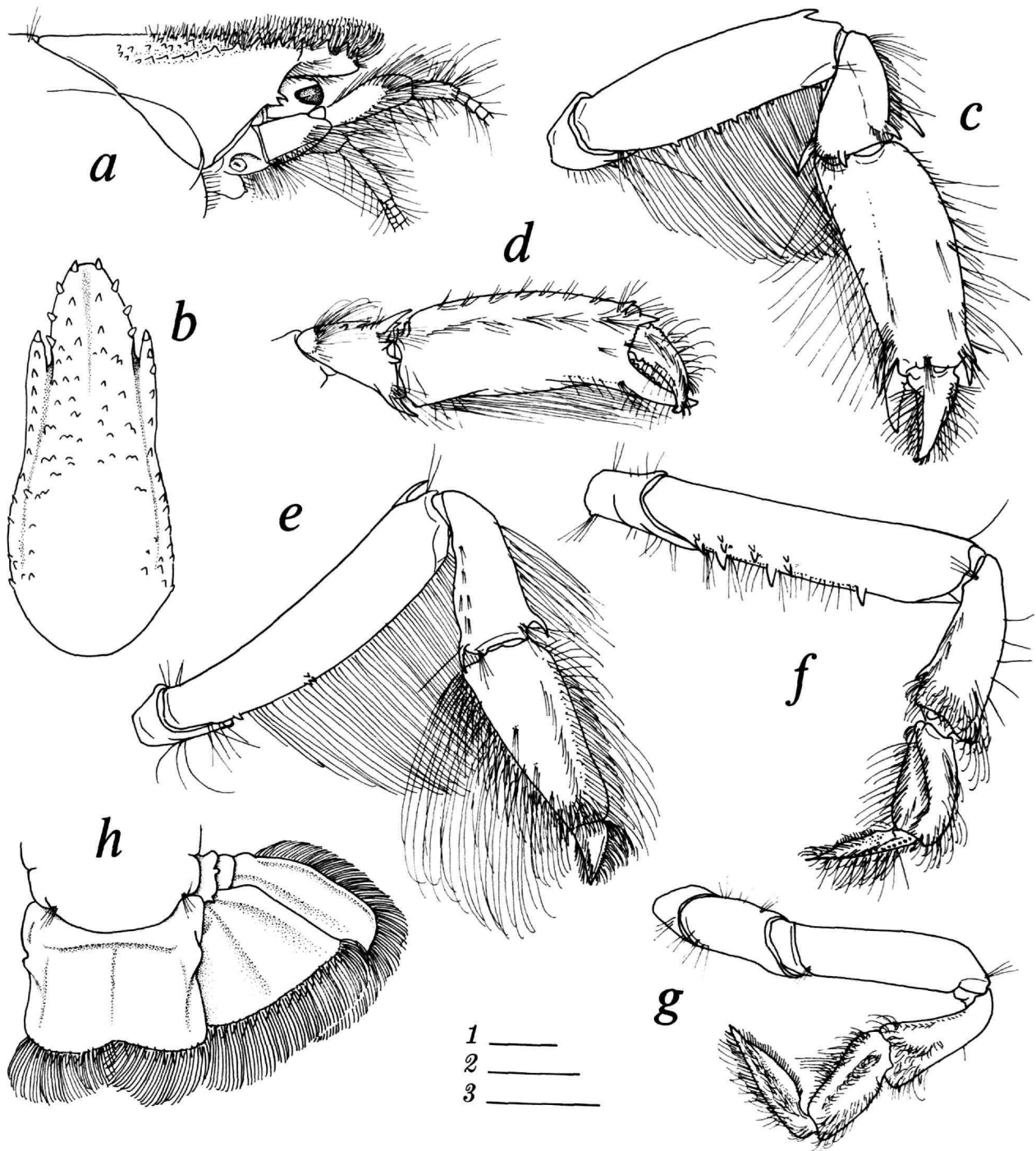


FIGURE 8.—*Upogebia annae* Thistle, USNM 138892, ♂ holotype: *a*, cephalic region, lateral; *b*, anterior carapace, dorsal; *c*, cheliped, right lateral; *d*, chela and carpus, left mesial; *e-g*, legs 2-4; *h*, parts of abdominal segment 6, telson, and uropods, dorsal. (Scales = 2 mm: 1 = *c,d*; 2 =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