

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.

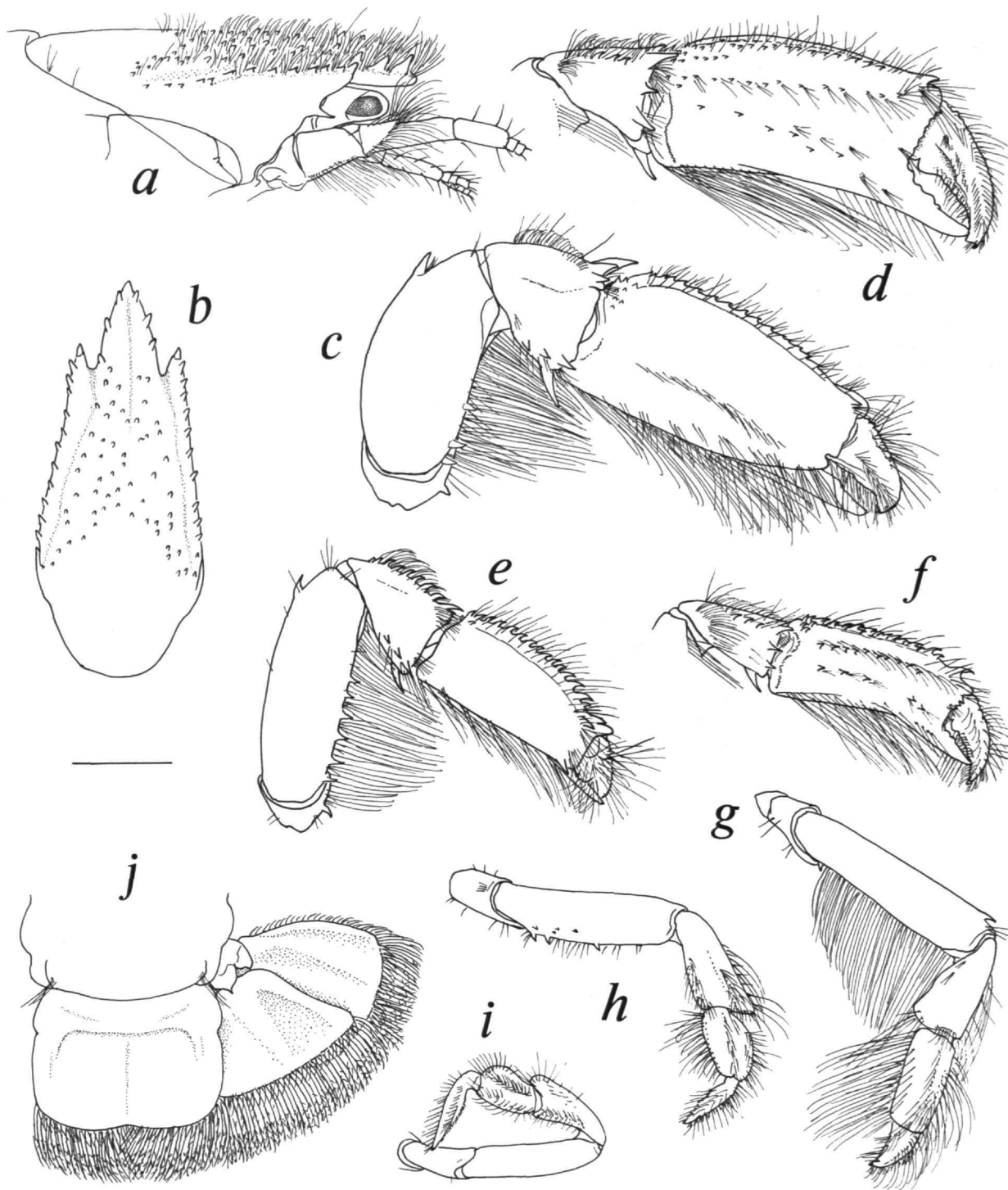


FIGURE 30.—*Upogebia vasquezii* Ngoc-Ho (a-d, g-j, USNM 251202, ♂, e, f, ♀): a, cephalic region, lateral; b, anterior carapace, dorsal; c, cheliped, right lateral, ♂; d, chela and carpus, left mesial, ♂; e, cheliped, right lateral, ♀; f, chela and carpus, left mesial, ♀; g-i (left), legs 2-4; j, parts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

Literature Cited

- Adkison, D.L., T.S. Hopkins, and J.K. Shaw
1979. Notes on *Upogebia operculata* (Crustacea: Decapoda) from the Northeastern Gulf of Mexico. *Association of Southeastern Biologists Bulletin*, 26(2):83. [Abstract 251.]
- Aller, R.C., J.Y. Yingst, and W.J. Ullman
1983. Comparative Biogeochemistry of Water in Intertidal *Onuphis* (Polychaeta) and *Upogebia* (Crustacea) Burrows: Temporal Patterns and Causes. *Journal of Marine Research*, 41(3):571-604.
- Andryszak, B.L.
1986. *Upogebia affinis* (Say): Its Postlarval Stage Described from Louisiana Plankton, with a Comparison to Postlarvae of Other Species within the Genus and Notes on Its Distribution. *Journal of Crustacean Biology*, 6(2):214-226.
- Balss, H.
1924. Westindische Decapoden. *Zoologischer Anzeiger*, 61(7/8):177-182, 5 figures.
- Basan, P.B., and R.W. Frey
1977. Actual-Palaeontology and Neoinchology of Salt Marshes near Sapelo Island, Georgia. In R.P. Crimes and J.C. Harper, editors, Trace Fossils, 2. *Geological Journal*, special issue, 9:41-70.
- Behre, E.H.
1950. Annotated List of the Fauna of the Grand Isle Region, 1928-1946. *Occasional Papers of the Marine Laboratory, Louisiana State University*, 6:1-66.
- Borradaile, L.A.
1903. On the Classification of the Thalassinidea. *Annals and Magazine of Natural History*, series 7, 12:534-551, 638.
- Briggs, J.C.
1974. *Marine Zoogeography*. ix + 475 pages. New York: McGraw-Hill Book Co.
1987. Chapter 3: The Caribbean connection. In *Biogeography and Plate Tectonics*, pages 33-44. Amsterdam: Elsevier.
- Chester, A.J., R.L. Ferguson, and G.W. Thayer
1983. Environmental Gradients and Benthic Macroinvertebrate Distributions in a Shallow North Carolina Estuary. *Bulletin of Marine Science*, 33(2):282-295.
- Coelho, P.A.
1966. Distribuição dos Crustáceos decápodos na área de Barra das Jangadas. *Trabalhos Instituto de Biologia Marítima e Oceanografia, Universidade do Recife*, 5/6(for 1963-64):159-173.
1970. Estuários e lagunas do nordeste. In J. Vasconcelos Sobrinho, *As regiões naturais do nordeste, o meio e a civilização*, pages 49-60. Recife: Conselho do Desenvolvimento de Pernambuco, 1970 [1971].
1971. A distribuição dos Crustáceos decápodos reptantes do norte do Brasil. *Trabalhos Instituto Oceanográfico, Universidade Federal de Recife*, 9/11(for 1967-69):223-238.
1973a. Descrição preliminar de *Cupogebia (calliadne)* [sic] *acanthura*, n. sp., do Brasil (Crustacea, Decapoda, Callianassidae). *Ciência e Cultura (São Paulo)*, 25(6):344.
1973b. Descrição preliminar de *Upogebia (Upogebia) marina*, n. sp., do nordeste do Brasil (Crustacea, Decapoda, Callianassidae). *Ciência e Cultura (São Paulo)*, 25(6):345.
- Coelho, P.A., M.L. Koenig, and M. de A. Ramos
1970. A macrofauna benthica dos estuários de Pernambuco e da Paraíba. In F.M. Leccia, editor, *Actas IV Congresso Latinoamericana de Zoología, Caracas, 10-16 Noviembre 1968*, 2:497-528.
- Coelho, P.A., and M. de A. Ramos
1972. A constituição e a distribuição da fauna de decápodos do litoraleste da América do Sul entre as latitudes de 5°N e 39°S. *Trabalhos Oceanográficos de Universidade Federal de Pernambuco, Recife*, 13:133-236.
- Coelho, P.A., and M. Ramos-Porto
1987. Sinopse dos Crustáceos decápodos Brasileiros (Famílias Callianassidae, Callianideidae, Upogebiidae, Parapaguridae, Paguridae, Diogenidae). *Trabalhos Oceanográficos da Universidade Federal de Pernambuco, Recife*, 19(for 1985-86):27-53.
- Coelho, P.A., and M.C.A. Rattacaso
1988. Revisão das espécies de *Upogebia* encontradas em Pernambuco, Brasil (Crustacea, Decapoda, Thalassinidea). *Revista Brasileira de Zoologia*, 5(3):381-392.
- Deevey, G.B.
1960. The Zooplankton of the Surface Waters of the Delaware Bay Region. *Bulletin of the Bingham Oceanographic Collection*, 17(2):5-53.
- DeKay, J.E.
1844. Chapter 6: Crustacea. In *Zoology of New-York, or the New-York Fauna; Comprising Detailed Descriptions of All the Animals Hitherto Observed Within the State of New-York, with Brief Notices of Those Occasionally Found Near Its Borders, and Accompanied by Appropriate Illustrations*, pages 1-70, plates 1-13. Albany: Carrol and Cook.
- De Man, J.G.
1927. A Contribution to the Knowledge of Twenty-one Species of the Genus *Upogebia* Leach. *Capita Zoologica*, 2(5):1-56, 6 plates.
1928. The Decapoda of the Siboga Expedition, Part 7: The Thalassinidae and Callianassidae Collected by the Siboga Expedition with Some Remarks on the Laomediidae. *Siboga-Expeditie, Monographie*, 39a⁶:1-187, 20 plates.
- Dörjes, J.
1977. Marine Macrobenthic Communities of the Sapelo Island, Georgia Region. In B.C. Coull, editor, *Ecology of Marine Benthos. Belle W. Baruch Library in Marine Science*, 6:339-421. Columbia: University of South Carolina Press.
- Dragovich, A.J., and J.A. Kelly, Jr.
1964. Ecological Observations of Macro-Invertebrates in Tampa Bay, Florida. *Bulletin of Marine Science of the Gulf and Caribbean*, 14(1):74-102.
- Dworschak, P.C.
1983. The Biology of *Upogebia pusilla* (Petagna) (Decapoda, Thalassinidea), I: The Burrows. *Marine Biology*, 4(1):19-43.
- Ellis, J., and D. Solander
1786. The Natural History of Many Curious and Uncommon Zoophytes, Collected from Various Parts of the Globe by the Late John Ellis ... Systematically Arranged and Described by the Late Daniel Solander. ...Pages i-xii + 1-208, plates 1-63. London: Benj. White & Son; and P. Elmsly.
- Eston, V.R. de, A.E. Migotto, E.C. de Oliveira Filho, S. de A. Rodrigues, and J.C. de Freitas
1986. Vertical Distribution of Benthic Marine Organisms on Rocky Coasts of the Fernando de Noronha Archipelago (Brazil). *Boletim do Instituto Oceanográfico, São Paulo*, 34:37-53.
- Fausto-Filho, J.
1969. *Upogebia noronhensis*, nova espécie de Crustáceo do Brasil (Crustacea, Decapoda, Callianassidae). *Arquivos de Ciências do Mar*, 9(1):1-7.
1970. Quarta contribuição ao inventário dos Crustáceos decápodos marinhos do nordeste Brasileiro. *Arquivos de Ciências do Mar*, 10(1):55-60.

- Fingerman, M., and C. Oguro
1963. Chromatophore Control and Neurosecretion in the Mud Shrimp, *Upogebia affinis*. *Biological Bulletin, Woods Hole*, 124(1):24-30.
- Fish, C.J.
1925. Seasonal Distribution of the Plankton of the Woods Hole Region. *Bulletin of the United States Bureau of Fisheries*, 41:91-179, 81 graphs.
- Fowler, H.W.
1912. The Crustacea of New Jersey. *Annual Report of the New Jersey State Museum*, 2:29-650, 150 plates.
- Frey, R.W., and P.B. Basan
1981. Taphonomy of Relict Holocene Salt Marsh Deposits, Cabretta Island, Georgia. *Senckenbergiana Maritima*, 13(4/6):111-155.
- Frey, R.W., and J.D. Howard
1975. Endobenthic Adaptations of Juvenile Thalassinidean Shrimp. *Bulletin of the Geological Society of Denmark*, 24:283-297.
- Gomes Corrêa, M.M.
1968. Sobre as espécies de "Upogebia" Leach do litoral brasileiro, com descrição de uma espécie nova (Decapoda, Callinassidae). *Revista Brasileira de Biologia*, 28(2):97-109.
- Hay, W.P., and C.A. Shore
1918. The Decapod Crustaceans of Beaufort, N.C., and the Surrounding Region. *Bulletin of the United States Bureau of Fisheries*, 35(for 1915 and 1916):369-475, plates 25-39.
- Hemming, F., editor
1958. *Official List of Generic Names in Zoology, First Installment: Names 1-1274*. Pages xxxvi + 200. London: International Trust for Zoological Nomenclature.
- Holthuis, L.B.
1956. Three Species of Crustacea Decapoda Macrura from Southern Brazil, Including a New Species of *Upogebia*. *Zoologische Mededelingen, Leiden*, 34(11):173-181.
1974. Lobsters of the Superfamily Nephropidea of the Atlantic Ocean (Crustacea: Decapoda). *Bulletin of Marine Science*, 24(4):723-884.
- Kingsley, J.S.
1878. List of Decapod Crustacea of the Atlantic Coast, Whose Range Embraces Fort Macon. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 30:316-328 [published 9 Nov 1878], 329-330 [published 7 Jan 1879].
1899. Synopses of North-American Invertebrates, IV: Astacoid and Thalassinoid Crustacea. *American Naturalist*, 33(394):819-824.
- Kleemann, K.
1984. Lebensspuren von *Upogebia operculata* (Crustacea, Decapoda) in karibischen Steinkorallen (Madreporaria, Anthozoa). *Beiträge zur Paläontologie von Österreich, Institut für Paläontologie der Universität Wien*, 11:35-57, 5 plates.
- Leach, W.E.
1814. Crustaceology. In *Edinburgh Encyclopaedia*, second edition, 7:383-437, plate 221. New York: Samuel Whiting and John L. Tiffany.
- Leidy, J.
1855. Article XI: Contributions Towards a Knowledge of the Marine Invertebrate Fauna of the Coasts of Rhode Island and New Jersey. *Journal of the Academy of Natural Sciences of Philadelphia*, series 2, 3:135-152, plates 10, 11.
1888. Remarks on the Fauna of Beach Haven, New Jersey. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 40:329-333.
- Lemos de Castro, A., and I.M.B. Lima
1975. Crustaceos isópodos epicarídeos do Brasil, VII: Descrição de uma espécie nova de *Parione* Richardson. *Atas da Sociedade de Biologia do Rio de Janeiro*, 17(3):101-103.
- Markham, J.C.
1988. Descriptions and Revisions of Some Species of Isopoda Bopyridae of the North Western Atlantic Ocean. *Zoologische Verhandlungen, Leiden*, 246:1-63.
- Markham, J.C., F.E. Donath-Hernández, J.L. Villalobos-Hiriart, and A.C. Díaz-Barriga
1990. Notes on the Shallow-water Marine Crustacea of the Caribbean Coast of Quintana Roo, Mexico. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoológica*, 61(3):405-446.
- Markham, J.C., and J.J. McDermott
1981. A Tabulation of the Crustacea Decapoda of Bermuda. *Proceedings of the Biological Society of Washington*, 93(4):1266-1276.
- McCloskey, L.R., and S.P. Caldwell
1965. *Enteromyces callianassae* Lichtwardt (Trichomycetes, Eccrinales) in the Mud Shrimp *Upogebia affinis* [sic] (Say). *Journal of the Elisha Mitchell Scientific Society*, 81(2):114-117.
- Ngoc-Ho, N.
1979. A Taxonomic Study of Six Species of *Upogebia* Leach (Crustacea, Decapoda, Thalassinidea) in the Collections of the British Museum (Natural History), London. *Bulletin of the British Museum (Natural History), Zoology*, 35(2):147-161.
1981. A Taxonomic Study of the Larvae of Four Thalassinid Species (Decapoda, Thalassinidea) from the Gulf of Mexico. *Bulletin of the British Museum (Natural History), Zoology*, 40(5):237-273.
1989a. Sur le genre *Gebiacantha* gen. nov., avec la description de cinq espèces nouvelles (Crustacea, Thalassinidea, Upogebiidae). *Bulletin du Muséum National d'Histoire Naturelle, Paris, section A, series 4*, 11(1):117-145.
1989b. Description de trois espèces nouvelles de la famille des Upogebiidae (Crustacea, Thalassinidea). *Bulletin du Muséum National d'Histoire Naturelle, Paris, section A, series 4*, 11(4):865-878.
1991. Sur quelques Callianassidae et Upogebiidae de Nouvelle-Calédonie (Crustacea, Thalassinidea). In B. Richer de Forges, editor, *Le benthos des fonds meubles des lagons de Nouvelle Calédonie*, 1:1-11. Paris: ORSTOM Editions.
- Otvos, E.G.
1982. *Guidebook, New Orleans Geological Society 1982 Field Trip, Coastal Geology of Mississippi, Alabama and Adjacent Louisiana Areas*. 66 pages, folded map. New Orleans: The New Orleans Geological Society.
1985. *Guidebook, Coastal Evolution Louisiana to Northwest Florida, American Association of Petroleum Geologists Annual Meeting, New Orleans, Field Trip, March 27-29, 1985*. 91 pages. New Orleans: The New Orleans Geological Society.
- Pearse, A.S.
1945. Ecology of *Upogebia affinis* (Say). *Ecology*, 26(3):303-305.
1952. Parasitic Crustaceans from Alligator Harbor, Florida. *The Quarterly Journal of the Florida Academy of Sciences*, 15(4):187-243.
- Pemberton, S.G., and R.W. Frey
1985. The *Glossifungites* Ichnofacies: Modern Examples from the Georgia Coast, U.S.A. In H.A. Curran, editor, *Biogenic Structures: Their Use in Interpreting Depositional Environments*. *Society of Economic Paleontologists and Mineralogists, Tulsa, Oklahoma*, special publication, 35:237-259.
- Pérez Farfante, I.
1969. Western Atlantic Shrimps of the Genus *Penaeus*. *Fishery Bulletin, United States Fish and Wildlife Service*, 67(3):i-x + 461-591.
- Pocock, R.I.
1890. Crustacea. In N.H. Ridley, *Notes on the Zoology of Fernando Noronha*. *Journal of the Linnean Society of London, Zoology*, 20:506-526, plate 30.
- Poore, G.C.B., and D.J.G. Griffin
1979. The Thalassinidea (Crustacea: Decapoda) of Australia. *Records of the Australian Museum*, 32(6):217-321.
- Rabalais, S.C., W.M. Pulich, Jr., N.N. Rabalais, D.L. Felder, R.K. Tinnen, and R.D. Kalke
1989. A Biological and Physiological Characterization of the Rio Carrizal

- Estuary, Tamaulipas, Mexico. *Contributions in Marine Science*, 31:25-37.
- Rathbun, M.J.
 1900. Results of the Branner-Agassiz Expedition to Brazil, I: The Decapod and Stomatopod Crustacea. *Proceedings of the Washington Academy of Sciences*, 2:133-156, plate 8.
 1905. Fauna of New England, 5: List of the Crustacea. *Occasional Papers of the Boston Society of Natural History*, 7:1-117.
- Rouse, W.L.
 1970. Littoral Crustacea from Southwest Florida. *Quarterly Journal of the Florida Academy of Sciences*, 32(2)(for 1969):127-152.
- Saint Laurent, M. de, and P. Le Loeuff
 1979. Crustacés Decapodes Thalassinidea, I: Upogebiidae et Callianassidae. In Résultats Scientifiques des Campagnes de la *Calypso*, Fasc. 11, Campagnes de la *Calypso* au large des côtes Atlantiques Africaines (1956 et 1959) (suite), no. 22. *Annals de l'Institut Oceanographique*, 55(11):29-101.
- Saint Laurent, M. de, and N. Ngoc-Ho
 1979. Description de deux espèces nouvelles du genre *Upogebia* Leach, 1814 (Decapoda, Upogebiidae). *Crustaceana*, 37(1):57-70.
- Sakai, K.
 1982. Revision of Upogebiidae (Decapoda, Thalassinidea) in the Indo-West Pacific Region. *Researches on Crustacea, The Carcinological Society of Japan*, special number, 1:1-106, 20 text-figures, plates A-G.
- Sakai, K., and H. Mukai
 1991. Two Species of *Upogebia* from Tokushima, Japan, with a Description of a New Species, *Upogebia trispinosa* (Crustacea: Decapoda: Thalassinidea). *Zoologische Mededelingen*, 65:317-325.
- Sandifer, P.A.
 1973a. Larvae of the Burrowing Shrimp, *Upogebia affinis*, (Crustacea, Decapoda, Upogebiidae) from Virginia Plankton. *Chesapeake Science*, 14(2):98-104.
 1973b. Distribution and Abundance of Decapod Crustacean Larvae in the York River Estuary and Adjacent Lower Chesapeake Bay, Virginia, 1968-1969. *Chesapeake Science*, 14(4):235-257.
- Say, T.
 1818. An Account of the Crustacea of the United States. *Journal of the Academy of Natural Sciences of Philadelphia*, 1(2):235-253, 313-319, 374-401, 423-444, 445-458, plate 4.
- Schmitt, W.L.
 1924. Report on the Macrura, Anomura and Stomatopoda Collected by the Barbados-Antigua Expedition from the University of Iowa in 1918. *University of Iowa Studies in Natural History*, 10(4):65-99, plates 1-5.
 1935. Crustacea Macrura and Anomura of Porto Rico and the Virgin Islands. *Scientific Survey of Porto Rico and the Virgin Islands, New York Academy of Sciences*, 15(2):125-227.
 1936. Macruran and Anomuran Crustacea from Bonaire, Curaçao and Aruba. *Zoologische Ergebnisse einer Reise nach Bonaire, Curaçao und Aruba im Jahre 1930*, 16:363-378, plates 11-13.
- Scott, P.J.B., H.M. Reiswig, and B.M. Marcotte
 1988. Ecology, Functional Morphology, Behaviour, and Feeding in Coral- and Sponge-boring Species of *Upogebia* (Crustacea: Decapoda: Thalassinidea). *Canadian Journal of Zoology*, 66(2):483-495.
- Sikora, W.B., R.W. Heard, and M.D. Dahlberg
 1972. The Occurrence and Food Habits of Two Species of Hake, *Urophycis regius* and *U. floridanus* in Georgia Estuaries. *Transactions of the American Fisheries Society*, 101(3):513-525.
- Smith, S.I.
 1873. Crustacea. In S.F. Baird, *Report of Commissioner of Fish and Fisheries, on the Condition of the Sea-fisheries of the South Coast of New England in 1871 and 1872*, pages 545-567, 573-580. Washington, D.C.: U.S. Government Printing Office.
- Stebbing, T.R.R.
 1893. A History of Crustacea; Recent Malacostraca. *The International Scientific Series*, 74: xvii + 466 pages, plates i-xix. New York: D. Appleton and Company.
- Swinbanks, D.D., and J.W. Murray
 1981. Biosedimentological Zonation of Boundary Bay Tidal Flats, Fraser River Delta, British Columbia. *Sedimentology*, 28(2):201-237.
- Thistle, D.
 1973. A Taxonomic Comparison of the American *Upogebia* (Decapoda, Thalassinidea), Including Two New Species from the Caribbean. *Breviora*, 408:1-23.
- Thompson, L.C., and A.W. Pritchard
 1969. Osmoregulatory Capacities of *Callianassa* and *Upogebia* (Crustacea: Thalassinidea). *Biological Bulletin, Woods Hole*, 136(1):114-129.
- Thompson, R.K., and A.W. Pritchard
 1969. Respiratory Adaptations of Two Burrowing Crustaceans, *Callianassa californiensis* and *Upogebia pugettensis* (Decapoda, Thalassinidea). *Biological Bulletin, Woods Hole*, 136(2):274-287.
- Van Engel, W.A., and P.A. Sandifer
 1972. Order Decapoda. In M.L. Wass, editor, *A Check List of the Biota of Lower Chesapeake Bay, Virginia Institute of Marine Science, Special Scientific Report*, 65:155-164.
- Verrill, A.E.
 1873. Report upon the Invertebrate Animals of Vineyard Sound and Adjacent Waters, with an Account of the Physical Features of the Region. In S.F. Baird, *Report of Commissioner of Fish and Fisheries on the Condition of the Sea-fisheries of the South Coast of New England in 1871 and 1872*, 1:295-778, plates 1-38. Washington, D.C.: U.S. Government Printing Office. [Reprinted 1874.]
- White, A.
 1847. *List of the Specimens of Crustacea in the Collection of the British Museum*. viii + 143 pages. London: Printed by Order of the Trustees.
- Williams, A.B.
 1965a. Marine Decapod Crustaceans of the Carolinas. *Fishery Bulletin, United States*, 65(1): xi + 1-298. Washington, D.C.: United States Fish and Wildlife Service.
 1965b. A New Genus and Species of Snapping Shrimp (Decapoda, Alpheidae) from the Southeastern United States. *Crustaceana*, 9(2):192-198.
 1974a. The Swimming Crabs of the Genus *Callinectes* (Decapoda: Portunidae). *Fishery Bulletin, United States*, 72(3):685-798. Washington, D.C.: United States Fish and Wildlife Service.
 1974b. Marine Flora and Fauna of the Northeastern United States, Crustacea: Decapoda. *National Oceanic and Atmospheric Administration Technical Report, National Marine Fisheries Service Circular*, 389:1-50.
 1984a. *Shrimps, Lobsters, and Crabs of the Atlantic Coast of the Eastern United States, Maine to Florida*. xviii + 550 pages. Washington, D.C.: Smithsonian Institution Press.
 1984b. The Mud Crab *Panopeus herbstii*, s.l., Partition into Six Species (Decapoda: Xanthidae). *Fishery Bulletin, United States*, 81(4)(for 1983):863-882. Washington, D.C.: United States Fish and Wildlife Service.
 1986. Mud Shrimps, *Upogebia*, from the Eastern Pacific (Thalassinidea: Upogebiidae). *Memoirs of the San Diego Society of Natural History*, 14:1-60
 1987. *Upogebia synagelas*, New Species, a Commensal Mud Shrimp from Sponges in the Western Central Atlantic (Decapoda: Upogebiidae). *Proceedings of the Biological Society of Washington*, 100(3):590-595.
- Williams, A.B., and D.L. Felder
 1986. Analysis of Stone Crabs: *Menippe mercenaria* (Say), Restricted, and a Previously Unrecognized Species Described (Decapoda: Xanthi-

- dae). *Proceedings of the Biological Society of Washington*, 99(3):517-543.
- Williams, A.B., and R.W. Heard
1991. *Upogebia spinistipula*, a New Burrowing Shrimp from the Florida Shelf, Northeastern Gulf of Mexico (Decapoda: Upogebiidae). *Proceedings of the Biological Society of Washington*, 104(1):49-54.
- Williams, A.B., and N. Ngoc-Ho
1990. *Pomatogebia*, a New Genus of Thalassinidean Shrimps from Western Hemisphere Tropics (Crustacea, Upogebiidae). *Proceedings of the Biological Society of Washington*, 103(3):614-616.
- Williams, A.B., and P.J.B. Scott
1989. *Upogebia corallifora*, a New Species of Coral-boring Shrimp from the West Indies (Decapoda: Upogebiidae). *Proceedings of the Biological Society of Washington*, 102(2):405-410.
- Williams, A.B., and R.L. Wigley
1977. Distribution of Decapod Crustacea Off Northeastern United States Based on Specimens at the Northeast Fisheries Center, Woods Hole, Massachusetts. *National Oceanic and Atmospheric Administration Technical Report, National Marine Fisheries Service Circular*, 407: iv + 44 pages.

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